United States
Environmental Protection
Agency

Office of Emergency and
Remedial Response
Washington, DC 20460

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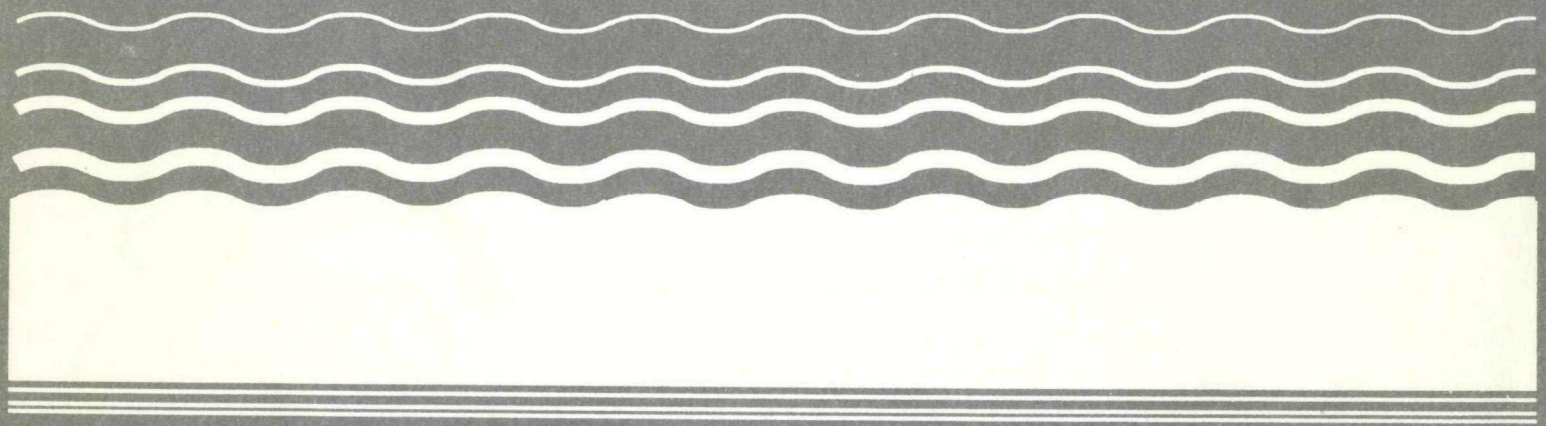
Superfund

EPA

Summary of Treatment Technology Effectiveness for Contaminated Soil



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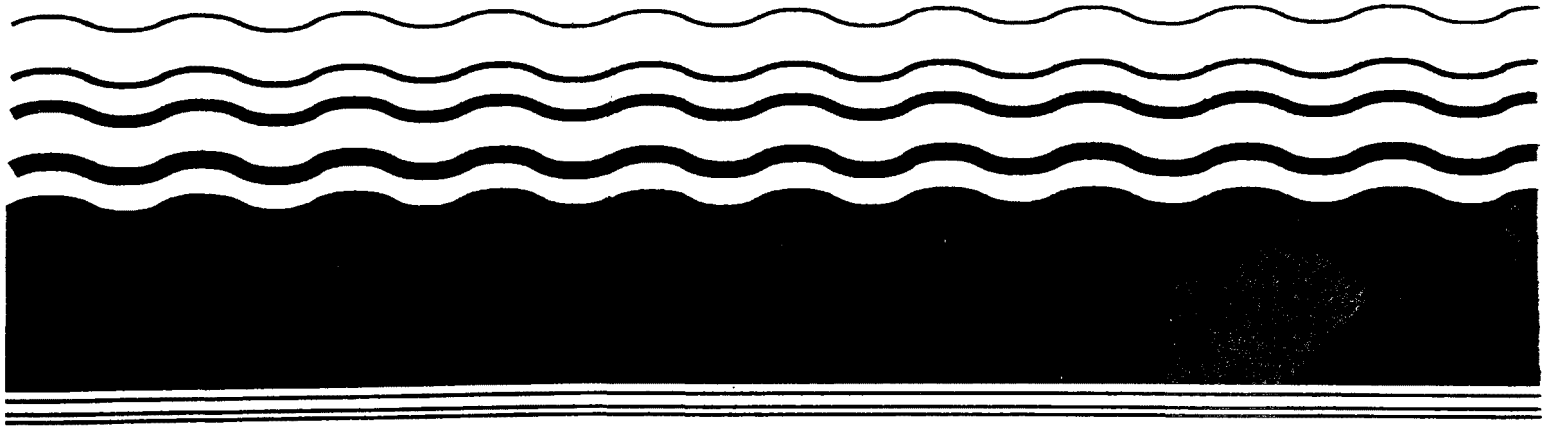

DISCLAIMER

This report has been reviewed in accordance with the U.S. Environmental Protection Agency's peer and administrative review policies and approved for presentation and publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

FOREWORD

The Environmental Protection Agency is committed to a broad use of treatment technologies for the management of Superfund waste. The 1990 National Contingency Plan (NCP) clearly states EPA's preference for the selection of more treatment remedies to comply with the CERCLA preference for remedies that employ treatment as a principal element. A further reinforcement of the importance of treatment is that, in the Revised NCP, the two criteria of "long-term effectiveness and permanence" and "reduction of toxicity, mobility, or volume through treatment" are given the most weight in the balancing process during Superfund remedy selection.

The Revised NCP expresses a preference for treatment in response actions, and in fact during FY 1990, 73% of the Superfund sites involved treatment as part of the selected remedies in the Records of Decision. However, Superfund experience with treatment technologies for soils is somewhat limited. Relatively few soil treatment technologies are considered to be fully developed and available for common use. In order to meet the goals contained in the 1986 Superfund amendments, which formed the basis for the Revised NCP, the Agency must rely on technologies that are currently innovative and require site-specific treatability testing before they are readily available for use.

This document represents a substantial effort conducted by OERR for several years to compile and analyze numerous treatment data on contaminated soil from reports which were obtained from EPA Regional offices, the Departments of Defense and Energy, and treatment vendors. Results were presented as received, without independent validation, to facilitate timely technology transfer. The document was technically reviewed by EPA Risk Reduction Engineering Laboratory staff prior to publication.

Associated with this document is a unique soil treatment data base which is presented as an appendix to the document. Together the document and quantitative data base have a number of potential applications, including screening treatment technologies for specific wastes, evaluating relative effectiveness of various technologies on similar contaminants, and targeting technologies for treatability studies, as well as providing data for the development of treatment standards for contaminated soil and debris.

We hope this document will be useful to EPA project managers, other Federal and State project managers, and contractors, all of whom are challenged to remediate hazardous waste sites in this country. Additional copies of the report may be obtained at no charge from EPA's Center for Environmental Research Information, 26 West Martin Luther King Drive, Cincinnati, Ohio, 45268, using the EPA document number found on the report's front cover. Once this supply is exhausted, copies can be purchased from the National Technical Information Service, Ravensworth Bldg., Springfield, VA, 22161, (703) 487-4600. Reference copies will be available at EPA libraries in their Hazardous Waste Collection.

Henry L. Longest, II, Director
Office of Emergency and
Remedial Response

ABSTRACT

To comply with the Superfund Amendments and Reauthorization Act (SARA) of 1986, the U.S. Environmental Protection Agency (U.S. EPA) began to reevaluate past disposal practices for contaminated soils from Superfund sites. SARA required that U.S. EPA give preference to alternatives that use treatment as a principal element for these and all Superfund wastes. In addition, the 1984 Hazardous and Solid Waste Amendments (HSWA) to RCRA prohibit continued land disposal of untreated hazardous wastes and require U.S. EPA to develop treatment standards that must be met before disposal of contaminated soil from Superfund sites is allowed.

The U.S. EPA Office of Emergency and Remedial Response (OERR) contracted CDM Federal Programs Corporation (FPC) to assist the Agency in fulfilling these obligations. An extensive soil treatment data collection effort was conducted throughout 1987 and 1988. The results from several hundred previously conducted studies were collected and reviewed. All applicable soil treatment information was carefully extracted and loaded into a series of relational data bases developed specifically for this application. The quantitative data were subjected to a limited mathematical analysis to determine the effectiveness of six categories of treatment technologies on eleven contaminant treatability groups. The qualitative information was valuable in documenting the unique characteristics of various contaminant-soil matrices and their treatability. The U.S. EPA is using the results of both the quantitative and qualitative analyses to prepare Superfund program guidance. This report summarizes the results of this study and presents the recommendations developed for the treatment of contaminated soils.

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EXECUTIVE SUMMARY

APPROACH AND CONCLUSIONS

Background

The Comprehensive Environmental Response Compensation and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, mandated that the U.S. Environmental Protection Agency (U.S. EPA) identify, investigate, and remediate abandoned hazardous waste sites in this country. Many of these sites contain large quantities of contaminated soil. In the past, the less contaminated soils were often capped, while the hot spots were often excavated and landfilled in permitted disposal facilities.

Under SARA, U.S. EPA is required to reevaluate past disposal practices and to give preference to alternatives that use treatment as a principal element. SARA requires U.S. EPA to select remedies which are protective of human health and the environment, and which comply with "applicable or relevant and appropriate requirements" of the state and federal governments. The Resource Conservation and Recovery Act (RCRA) of 1976 and its 1984 Hazardous and Solid Waste Amendments (HSWA) are two major laws that may be applicable to Superfund wastes. HSWA prohibits continued land disposal of untreated hazardous wastes and requires U.S. EPA to develop treatment standards that must be met before disposal is allowed. After the standards or land disposal restrictions (LDRs) become effective, wastes that are not treated to those standards will be banned from land disposal.

The LDRs for contaminated soils could have a major impact on the Superfund program. These disposal restrictions will assist U.S. EPA in ensuring that remedies involving treatment are incorporated into remedial actions. For this reason, the U.S. EPA Office of Emergency and Remedial Response (OERR) led an intensive effort to compile existing soil treatment data and to evaluate the effectiveness of the available technologies. This report summarizes the qualitative and quantitative information collected, which exemplifies the current status of soil treatment technologies. The Technology Screening Guide for Treatment of CERCLA Soils and Sludges (U.S. EPA, September 1988) provides additional qualitative information on technologies which may be suitable for the management of soils and sludges containing CERCLA wastes.

Purpose And Scope

The U.S. EPA OERR contracted CDM Federal Programs Corporation (FPC) to collect and evaluate the available information on soil treatment technologies. FPC performed a comprehensive study to meet two goals: (1) to support the development of RCRA treatment standards for contaminated soils from Superfund sites and (2) to assist in technology transfer. This study focused on treatment methods for excavated soils, because these soils would trigger the LDRs during subsequent placement; therefore, in-situ treatment applications were not included in the scope. The soil treatment data collected for this project were evaluated and screened, and preliminary conclusions were drawn regarding the effectiveness of the various technologies surveyed on commonly occurring classes of contaminants and soils.

These conclusions are based upon the data that were compiled as a result of the 1987 and 1988 data collection effort. This body of information will be broadened and updated as additional soil treatment data become available from CERCLA response actions, Superfund Innovative Technology Evaluation (SITE) program demonstrations, and RCRA corrective actions. To facilitate timely technology transfer, the currently available information is presented as received, without independent validation. Due to the developmental status of some of the technologies and applications, the reproducibility of the results cannot be ensured. However, based upon this information, a reader who has a thorough knowledge of specific waste site conditions can select treatment technology categories which warrant further site-specific investigation.

Data Collection And Analysis

During the data collection effort, nearly 550 documents were obtained from various sources. The sources included U.S. EPA Superfund removal and remedial activities, U.S. EPA Office of Research and Development (OR&D) tests, Department of Defense and Department of Energy studies, state programs, private party studies, and vendor demonstrations. Abstracts of many of these documents are included in the Superfund Treatability Clearinghouse Abstracts (U.S. EPA, March 1989). Documents that dealt with in-situ or liquid treatment applications, or did not contain test results from treatability studies (approximately 480 documents), were eliminated from further quantitative analysis. However, the documents which reported some quantitative or pertinent qualitative information on the treatment of excavated soils were reviewed and the pertinent facts were incorporated into this summary.

Sixty-eight studies contained analytical data on soil treatment applications and formed the quantitative basis for this report. These 68 studies reported the results of laboratory, pilot, and full scale treatment studies of thermal destruction, dechlorination, bioremediation, low temperature thermal desorption, chemical extraction and soil washing, and immobilization technologies treating contaminated soils. All applicable quantitative and qualitative data were entered into a data base system developed for this project. Because insufficient treatment data were available on some individual contaminants, data from similar contaminants were classified among eleven treatability groups. These groups are listed below. A more detailed breakdown is provided in Appendix A.

- (W01) non-polar halogenated aromatics, excluding PCBs, dioxins, furans, and their precursors
- (W02) PCBs, halogenated dioxins, furans, and their precursors
- (W03) halogenated phenols, creosols, amines, thiols, and other polar aromatics
- (W04) halogenated aliphatic compounds
- (W05) halogenated cyclic aliphatics, ethers, esters, and ketones
- (W06) nitrated aromatic and aliphatic compounds
- (W07) heterocyclics and simple non-halogenated aromatics
- (W08) polynuclear aromatics and heterocyclics
- (W09) other polar non-halogenated organic compounds
- (W10) non-volatile metals
- (W11) volatile metals

The many discrete treatment technologies were classified into the following six technology groups:

- thermal destruction
- dechlorination
- bioremediation
- low temperature thermal desorption
- chemical extraction and soil washing
- immobilization

Data Limitations

Many treatment technologies for contaminated soil are still under development. For this reason, the data collected for this study were sometimes highly variable; however, the data were sufficient to develop preliminary conclusions regarding the effectiveness of various treatment technologies on common types of contaminants.

Each of the studies reviewed for this project was conducted for a different purpose in response to different requirements. As a result, the soil treatment data base has several limitations which are noted as follows:

- Treatment data were unavailable for some contaminants.
- Some treatment technologies were only tested at laboratory/bench or pilot scales, thereby limiting the applicability of data to full scale treatments.
- The untreated and treated soils from a particular test were sometimes analyzed using different analytical procedures; a removal efficiency could not be calculated for these tests.
- The degradation products from waste destruction technologies were seldom identified or quantified, preventing a complete evaluation of the technologies' effectiveness.
- Some treatment technologies transfer contaminants from one medium to another -- these cross media impacts were not always quantified.
- Different analytical protocols were used to generate treatment data for different tests. These various protocols may not yield comparable results.
- The reporting of significant figures was inconsistent, limiting the ability to statistically evaluate and compare the data.
- Quality assurance/quality control (QA/QC) procedures used for field sampling and laboratory analysis were inconsistently reported, and few studies were independently validated or reviewed, limiting the reliability of the data.

Because many of these treatment technologies are still under development, the effectiveness of the technologies on variable waste concentrations, combinations of contaminants, and different soil characteristics is only partially documented. Because the average removal efficiencies presented herein are based on highly variable data and are subject to a great deal of uncertainty, removal efficiency should be one of several criteria used for selecting technologies for further evaluation. In addition, the screening process and limitations of the data base may have introduced biases into the data. These factors may affect the statistical significance of the data.

Considerations Of Soil Treatment

The complex nature of solid waste matrices, such as contaminated soil from a Superfund site, severely complicates the treatment process. Soil is a non-homogeneous medium and the proportion of clay, organic matter, sand, debris, and other constituents can affect the distribution and treatability of contaminants. In addition, the distribution of contaminants often is very non-homogeneous and is dependent on patterns of contaminant deposition and transport. Collectively, these conditions make the treatment of contaminated soil a technical challenge. Discussions of some important considerations relevant to the selection of soil treatment processes follow.

The magnitudes of the untreated contaminant concentration and the desired treatment goal are important factors in technology selection. Some processes are designed to treat wastes with high levels of contamination, while others are only effective below certain threshold levels. Treatment processes can also provide widely varying treatment levels with some processes producing residues in the part per billion range, while others result in part per million range residues.

A critical element in solids treatment is materials handling. Waste transfer throughout the treatment system is particularly important for solids and viscous sludges where traditional conveyance methods are frequently ineffective. Slugs of material or debris tend to jam treatment equipment, resulting in breakage, downtime, and the potential for uncontrolled releases to the environment. Materials handling equipment should be tested on the waste as part of any treatability testing program. Experiments should be conducted on an untreated waste as well as on any intermediate mixtures exhibiting changes in viscosity, particle size, density, etc.

Preprocessing of waste to maximize homogeneity of the waste characteristics is important to successful treatment technology operation. Any treatment technology will operate most efficiently and cost effectively when it is designed and utilized to treat a homogeneous waste with a narrow range of physical/chemical characteristics. Preprocessing is important to the waste treatment system, because the effectiveness of some technologies is directly affected by the conditions of the contaminated soil. If contaminant types and concentrations, waste viscosity, particle size, BTU content, moisture content, acidity, alkalinity, etc. vary widely, control of the system can be difficult and costly. Many of these waste characteristics can be modified and improved with appropriate preprocessing.

Materials handling and preprocessing technologies with potential application for soil are currently in use in industries such as construction, agriculture, and mining. The use of such technologies should be considered during all soil remediation activities. Preprocessing techniques should also be incorporated in treatability testing programs. The results of such tests will better define the range of waste characteristics which the actual treatment technology will have to address.

General Conclusions

Contaminated soils can be treated through three basic mechanisms: (1) destruction of the contaminants through chemical alteration to a less toxic compound; e.g., thermal destruction, dechlorination, and bioremediation; (2) transfer of the contaminants to another waste stream for subsequent treatment; e.g., low temperature thermal desorption and chemical extraction and soil washing; and (3) permanent bonding of the contaminants within a stabilized matrix preventing future leaching; e.g., immobilization.

The two technologies that have been widely demonstrated on soils to date are thermal destruction for organic contaminants and immobilization for inorganic contaminants. While these two technologies may be highly effective in treating particular classes of wastes, neither provides an ideal solution to complex mixtures of organic and inorganic wastes which are common at Superfund sites. The inherent difficulty in treating a waste in a soil matrix, where waste conveyance and mixing are in themselves complicated unit operations, contributes to the need to find special solutions. Other issues, such as landfill capacity and cost, cross media impacts, and natural resource conservation also support the need to develop and use alternative treatment technologies for contaminated soil.

This report has been prepared with the goal of presenting information on a number of treatment options that are applicable to excavated soils. As stated previously, in situ soil techniques, such as some types of bioremediation, soil vapor extraction, immobilization, and combined ground water and vadose zone soil treatment were beyond the scope of this project. In situ techniques should also be considered when researching remediation measures for a contaminated soil problem.

The analytical data base system developed for this project was subjected to a series of screens by the U.S. EPA Office of Emergency and Remedial Response. The screens were intended to eliminate

data which were from the application of an inappropriate technology to a waste; from a test which appeared to be inadequately designed or operated; or from a study which used inappropriate analytical procedures.

After an in-depth review of the data remaining after screening, recommendations were developed regarding the effectiveness of the six technology groups on each of the treatability groups. For destruction and physical transfer technologies applied to organics, the removal efficiency was analyzed. This evaluation factor was replaced by the reduction in mobility for immobilization for organics and inorganics, and for chemical extraction and soil washing of inorganics. In Figure 1, "Predicted Treatment Effectiveness for Contaminated Soil," summary information is provided by treatability group and by technology. For each treatability group, the effectiveness of various technologies is evaluated using the following ratings:

- *Demonstrated Effectiveness* - A significant percentage of the data (20%) is from pilot and full scale operations, the average removal efficiency for all the data exceeds 90%, and there are at least ten data pairs.
- *Potential Effectiveness* - The average removal efficiency for all the data exceeds 70%.
- *No Expected Effectiveness* - The average removal efficiency for all of the data is less than 70%, and no interference is expected to this process as a result of this group.
- *No Expected Effectiveness* - Potential adverse effects to the environment or to the treatment process may occur.

In some cases, data that met these requirements were judged to be more or less effective than the data imply, based upon additional qualitative information. If the compounds within a treatability group were so variable that a range of conclusions could be drawn for a particular technology, two symbols were used. These cases are discussed in the report.

Abbreviated conclusions for each of the six technology categories follow. The referenced removal efficiencies represent averages from the available data. The removal efficiencies were calculated using the following formula:

$$\frac{\text{Untreated Concentration} - \text{Treated Concentration}}{\text{Untreated Concentration}} \times 100 = \text{Percent Removal Efficiency*}$$

*(Percent Mobility Reduction for Immobilization of Organics and Inorganics and Chemical Extractions and Soil Washing of Inorganics)

This differs from the measure of destruction and removal efficiency (DRE) commonly used for incineration, which measures the effluent concentration in the stack gas rather than the concentration in the treated ash. For immobilization technologies, this factor represents the reduction in mobility from the stabilized matrix as opposed to the actual destruction of the contaminants. The untreated and treated soil concentrations were measured in the leachate from the application of an extraction protocol from untreated and treated wastes, rather than in terms of total constituent analysis. The treated soil concentrations were not adjusted upward to account for the dilution effected by the addition of large quantities of stabilizing agents. The reduction in mobility also applies to the chemical extraction and soil washing data for inorganic treatability groups.

FIGURE 1

TECHNOLOGY / TREATABILITY GROUP	THERMAL DESTRUCTION	DECHLORINATION	BIOREMEDIATION [4]	LOW TEMPERATURE THERMAL DESORPTION	CHEMICAL EXTRACTION AND SOIL WASHING	IMMOBILIZATION [4]
NON-POLAR HALOGENATED AROMATICS (W01)	●	◒	◒ [3]	● ◒ [3]	◒	◒ [2]
PCBs, HALOGENATED DIOXINS, FURANS, AND THEIR PRECURSORS (W02)	●	◒	◒	○ [1]	◒	◒ [1]
HALOGENATED PHENOLS, CRESOLS, AMINES, THIOLS, AND OTHER POLAR AROMATICS (W03)	● [3]	◒	◒	◒	◒	◒ [3]
HALOGENATED ALIPHATIC COMPOUNDS (W04)	●	◒ [2]	◒ [2,3]	●	◒	◒ [2]
HALOGENATED CYCLIC ALIPHATICS, ETHERS, ESTERS, AND KETONES (W05)	●	◒ [1]	◒ [1]	○ [1]	◒ [1]	◒ [1]
NITRATED COMPOUNDS (W06)	●	○ [1]	◒	○ [1]	◒	◒ [1]
HETEROCYCLICS AND SIMPLE NON-HALOGENATED AROMATICS (W07)	●	○ [2,3]	◒ [2,3]	●	◒	◒ [2]
POLYNUCLEAR AROMATICS (W08)	●	○ [2,3]	◒	◒ [3]	◒	◒
OTHER POLAR NON-HALOGENATED ORGANIC COMPOUNDS (W09)	●	○ [2,3]	◒ [2,3]	◒	◒	◒ [2]
NON-VOLATILE METALS (W10)	○ [1]	○ [1]	○ X [1]	○ [1]	◒	● [3]
VOLATILE METALS (W11)	X [1]	○ [1]	○ X [1]	○ [1]	◒	● [3]

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● Demonstrated Effectiveness
◒ Potential Effectiveness
○ No Expected Effectiveness (no expected interference to process)
X No Expected Effectiveness (potential adverse effects to environment or process)

1 Data were not available for this treatability group. Conclusions are drawn from data for compounds with similar physical and chemical characteristics.
2 High removal efficiencies implied by the data may be due to volatilization or soil washing.
3 The predicted effectiveness may be different than the data imply, due to limitations in the test conditions.
4 These technologies may have limited applicability to high levels of organics.

Figure 1. Predicted Treatment Effectiveness for Contaminated Soil

TECHNOLOGY CONCLUSIONS

Thermal Destruction

Thermal destruction uses high temperatures to incinerate and destroy hazardous wastes, usually by converting the contaminants to carbon dioxide, water, and other combustion products in the presence of oxygen. Some technologies require a two-stage system with a secondary combustion chamber, while other technologies effect combustion in a single stage. Thermal destruction is a proven technology which can effectively and rapidly treat all organic compounds. It consistently achieves the best overall results for these contaminants, usually accomplishing well over 99% removal. Thermal destruction technologies are equally effective on halogenated, non-halogenated, aliphatic, aromatic, and polynuclear compounds, based on an analysis of contaminant concentrations in the ash. However, incineration of nitrated compounds may generate large quantities of nitrous oxides.

Rotary kiln incineration is most common for soils, probably due to the relative simplicity and abundant availability of the equipment. Feed systems can be altered to accommodate large diameter particles, and residence times can be increased to ensure that all the contaminants have been treated. Depending on the capacity of the unit, rotary kilns can also process large volumes of wastes. Several new technologies have recently been applied to soils. Circulating and fluidized bed combustion units are effective on small particle sizes. Larger particles may be too heavy for entrainment, which is the key to heat transfer and thus combustion in these units. This problem may not be significant however, because the majority of contaminants tend to be adsorbed to smaller clay and fine sand-sized particles.

Some infrared incinerators offer increased control of temperature and residence time. These units also can be run in a pyrolytic (absence of oxygen) mode. Pyrolytic technologies are being tested on wastes containing metals, because recent treatment studies suggest that, in the absence of oxygen, metals may be charred into the ash (U.S. EPA, December 1988). The theory behind this mechanism is still under investigation.

Thermal destruction has not been widely demonstrated as an effective technology for treating soils contaminated with metals. High concentrations of volatile metal compounds present a significant emissions problem, which cannot be effectively contained by conventional scrubbers or electrostatic precipitators due to the small particle size of metal-containing particulates. Baghouse filters, while more effective, also result in significant increases in operating and maintenance costs. Non-volatile metals tend to remain in the soil when exposed to thermal destruction; however, they may slag and foul the equipment, increasing the frequency of costly maintenance. If detrimental effects such as volatile metal emissions to the atmosphere or non-volatile metal slagging can be prevented, thermal destruction followed by immobilization of the ash residue are effective technologies for mixed organic and inorganic wastes.

Dechlorination

Dechlorination is a destruction process that uses a chemical reaction to replace chlorine atoms in chlorinated aromatic molecules with an ether or hydroxyl group. This converts the more toxic compounds into less toxic, more water-soluble products. The transformation of contaminants within the soil produces compounds that are more readily removed from the soil and subsequently treated. Field and laboratory tests have identified several types of solutions that can dechlorinate PCBs, dioxins, furans, and other aromatic compounds. Based upon the limited data available from a laboratory study, dechlorination may also have potential applications to other halogenated compounds including straight-chain aliphatics. Although no data were available for halogenated cyclic aliphatics, it is expected that dechlorination will be effective on these compounds as well.

The data in the data base indicate that PCBs, halogenated dioxins, furans, and pentachlorophenols may be treated by dechlorination to approximately 80% removal. More recent data indicate that removal efficiencies may approach 99.9% (des Rosiers, 1989). The degradation products have not been identified, but treated soils have been tested for bioaccumulation, mutagenicity, and acute toxicity, and there is no evidence that the degradation products are toxic (des Rosiers, 1989). Because the dechlorination process is operated at elevated temperatures (100°C or greater), wastes containing mixtures of halogenated and non-halogenated volatile compounds appear to experience destruction of both types of compounds. In reality, the non-halogenated compounds probably have been volatilized or extracted by the dechlorinating solvent.

The toxicity of the original waste is reduced or eliminated by stripping chlorine atoms. Resulting by-products should be identified and may require subsequent treatment to achieve protective levels of the remaining contaminants. The soils must be slurried with the dechlorinating solution to maximize contact and enable the chemical reactions to occur. Excessive amounts of humus and reactive clays with high cation exchange capacities will limit the effectiveness of dechlorination, because of the types of soil-contaminant bonds formed and their relative strengths. The presence of moisture at four to ten percent or greater tends to hinder the completion of the reaction (des Rosiers, October 1988; U.S. EPA, April 1984). However, excess moisture can be removed prior to treatment by evaporation, distillation, or other techniques. High concentrations of reactive metals, under very alkaline conditions, hinder the dechlorination process. To date, no full scale soil treatment programs have been undertaken using dechlorination.

Bioremediation

Bioremediation is a destruction process that uses soil microorganisms to chemically degrade organic contaminants. These microorganisms include bacteria, fungi, and yeasts. Biodegradation of hazardous wastes can occur as both an intracellular and an extracellular activity. When intracellular, the hazardous organic compound is used as an energy source by the cell. When extracellular, the waste is broken down as a result of exposure to enzymes that are produced by the cell in the process of metabolizing other substances such as glucose or cellulose. In the latter case, the enzymes are excreted outside the cell membrane, where they come into contact with the waste material and trigger the breakdown reaction. Both intracellular and extracellular biodegradation can occur in the presence or in the absence of oxygen. In the presence of oxygen (aerobic), bacteria, fungi, and yeasts biodegrade organics to carbon dioxide, water, and cell protein. In the absence of oxygen (anaerobic), they biodegrade the waste, generating methane, carbon dioxide, and cell protein.

Bioremediation has successfully treated many non-halogenated compounds, but it is less successful with halogenated compounds. The data base indicates that non-halogenated aromatics, heterocyclics, and other polar compounds have exhibited removal efficiencies in excess of 99%. Halogenated aliphatic compounds were also successfully treated; however, the average of over 99% removal from the available data may be a result of volatilization in addition to bioremediation. Volatilization may also account for some of the removal of semivolatile compounds. As expected, the data base 2indicates that the more complex halogenated and nitrated compounds exhibited lower removal efficiencies, ranging from approximately 50% to 87%. In addition, poly-halogenated compounds may be toxic to many microorganisms; however, recent research indicates that various species of white rot fungi are capable of degrading these halogenated compounds. Metal salts also present a problem, because high concentrations may be inhibitory or toxic to many microorganisms.

Low Temperature Thermal Desorption

Low temperature thermal desorption is a physical transfer process that uses air, heat, and/or mechanical agitation to volatilize contaminants into a gas stream, where the contaminants are then subjected to further treatment. Like other physical transfer processes, low temperature thermal desorption moves the contaminants into a medium which is easier to treat than soil. This is a

relatively new technology, based upon a simple mass transfer concept, and manyapplications are under development. This technology is most effective on the more volatile organic compounds, and it is limited in its ability to volatilize metals (with the exception of mercury) and semi-volatile organic compounds.

A low temperature thermal desorption unit operates more effectively at higher temperatures and increased residence times. For highly contaminated soils, a larger volume of air flowing through the unit also enhances treatment performance. The degree of volatility of the compound rather than type of substituted group is the limiting factor. Removal efficiencies, ranging from approximately 65% for polynuclear aromatics to 99% for non-polar halogenated aromatics, have been demonstrated by these units at bench, pilot, and full scales.

In comparison to thermal destruction units, this technology is in a developmental phase. Capital and operating costs for low temperature units are significantly less than corresponding costs for thermal destruction units. For highly volatile contaminants, the low temperature units provide equivalent performance; however, the data base indicates that as the volatility of the contaminants decreases, so does the effectiveness. A potential advantage of the low temperature unit over thermal destruction is the ability of the former to effectively and safely treat wastes containing mixtures of organics and inorganics. When coupled with subsequent treatment of the gas stream and immobilization of the solids in a treatment train, this technology offers a possible solution to the problem of wastes containing organics and high concentrations of inorganics.

Chemical Extraction And Soil Washing

Chemical extraction and soil washing are physical transfer processes in which contaminants are disassociated from the soil, becoming dissolved or suspended in a liquid solvent. This liquid waste stream then undergoes subsequent treatment to remove the contaminants and the solvent is recycled, if possible. Soil washing uses water as the solvent to separate the clay particles, which contain the majority of the contaminants, from the sand fraction. Chemical extraction processes use a solvent which separates the contaminants from the soil particles and dissolves the contaminant in the solvent. If the selection of the solvent is optimized, with the addition of surfactants or chelating agents, chemical extraction and soil washing can successfully treat many organic and inorganic contaminants, particularly those which are more soluble in the solvent of choice.

For the same contaminants, the data base indicates that chemical extraction and soil washing are more effective on sandy soils than on soils high in clay. The differences between the treatability of sand and clay are (1) the contaminant to soil bond may be within the clay particles, but on the outer surface of the sand particles and (2) clays have proportionally more surface area than sands, which translates to potentially greater contaminant adsorption on clays.

Soil washing is best suited for sites where nearly all the contaminants are adsorbed on the clay fraction. Soil washing then physically separates the contaminated clay from any relatively clean sand fractions, reducing the volume of waste requiring further treatment. The chemical extraction process involves breaking the bond between the contaminant and the soil particle in order to establish a bond between the contaminant and the solvent.

Much of the data in the data base is from soil washing, a form of aqueous chemical extraction that has been successfully demonstrated in several laboratory and pilot scale tests, and in three full scale units in the Netherlands. The majority of the available data on organic compounds indicates removal efficiencies of approximately 90% to 99%, with lower values of approximately 71% to 82% for some of the less volatile and less water soluble aromatic compounds. The reported effectiveness could be due in part to volatilization for compounds with higher vapor pressures.

In addition to effectiveness on some organics, the chemical extraction process, with optimized solvent selection, has demonstrated reductions in mobility of 85% to 89% for volatile and non-volatile metals,

respectively. The majority of the available data for chemical extraction is from laboratory studies, where the soil was sorted by hand into relatively small-sized clumps. The results achieved under these ideal conditions may not be reproducible under full scale conditions, where larger clumps of soil will be treated.

The chemical extraction process has some limitations. It is often difficult to select a solvent that is effective on both organic and inorganic contaminants. While surfactants are most effective on organics, they are not as effective as chelating agents on inorganics. The fine clay particles, which may remain contaminated due to their high cation exchange capacities, are very difficult to separate from the solvent. The clay particles may require immobilization prior to disposal, while the spent solvents are often toxic and may also require treatment.

Immobilization

Immobilization processes reduce the mobility of contaminants by stabilizing or solidifying them within the soil matrix, without causing significant contaminant destruction or transfer to another medium. Volatile organics may volatilize during treatment, and an emission control system may be required. Contaminant leaching can be significantly retarded by selecting optimal formulations and proportions of stabilizing agents.

The most common processes add portland cement and/or lime pozzolan materials (such as flyash) to the waste. In portland cement systems, hydration products from silicate compounds and water are generated, resulting in the formation of a calcium silicate hydrate gel. The gel swells and interlocking silicate fibrils are formed which surround the contaminant ions. After setting and curing, a rigid mass exists that is resistant to leaching. The lime/pozzolan processes use finely divided non-crystalline silica (flyash) and the calcium in lime to produce a cementitious solid. The contaminants are entrapped within this concrete mixture. In addition to the commonly used portland cement and lime/pozzolan materials, many vendors have developed proprietary agents which are claimed to have increased effectiveness. These proprietary formulations were not evaluated in detail during this study. Immobilization has successfully reduced the mobility of metal compounds; and recent research with organophilic clays, by the U.S. EPA Risk Reduction Engineering Laboratory, indicates that this technology may be applicable to some organic contaminants as well (Gibbons & Soundararajan, 1988).

For the immobilization processes, contaminant concentrations are typically measured in terms of EP Toxicity, Toxicity Characteristic Leaching Procedure (TCLP), or similar extraction protocols performed on the untreated and treated soils. Immobilization can accomplish reductions in mobility of 81% to 93% for metals. Reductions in mobility for organics range from 61% to 99%; immobilization appears to be most effective on polynuclear aromatics and halogenated aliphatics. This reported mobility reduction does not reflect an increase in the treated soil leachate concentration to account for the dilution effected by the addition of large quantities of stabilizing agents. The effectiveness of this technology in immobilizing organic compounds is being investigated. Some organic mobility reductions may actually be removals as a direct result of volatilization during the exothermic mixing process and throughout the curing period. However, the data available indicate that significant bonding takes place between some organic contaminants and certain organophilic species in the binding matrix. For example, current research efforts attempt to quantify this bond energy through the use of Differential Scanning Calorimetry, and only preliminary results are available at this time (Gibbons & Soundararajan, 1988).

SUMMARY

The complex nature of contaminated soils presents a significant challenge in terms of successful waste treatment and minimization of undesirable cross media impacts. The effectiveness of available soil treatment technologies can vary widely due to the unique characteristics of contaminated soils. Key factors affecting technology selection and effectiveness include the following:

- Materials handling and preprocessing techniques may be necessary to homogenize the contaminant concentrations and particle sizes before feeding the waste into a particular technology.

- Initial contaminant concentrations and soil characteristics may limit the ability of a technology to treat the waste. Waste concentrations must be characterized before and during remediation.

- Treatment goals vary depending on the level of acceptable risk. These goals affect the selection process, with some technologies, such as thermal destruction, capable of removing contaminants down to the part per billion range while others achieve treatment goals in the part per million range.

- Mixtures of organic and inorganic contaminants may preclude the use of some treatment processes due to the potential for undesirable cross media impacts. An acceptable solution may involve the use of several treatment technologies in a treatment train.

All of these factors must be considered when predicting the effectiveness of treatment technologies for contaminated soils. The results summarized in this report should only be used to select treatment technologies for further site-specific evaluation. In addition, treatment technologies which were beyond the scope of this study, such as in-situ treatment and combined treatment of soil and ground water, should also be considered.

When determining the applicability of technologies to a soil waste, treatment test results from a series of actual site samples representative of the variety of site conditions should be evaluated. In terms of treatment technology effectiveness, the entire treatment train configuration should be considered, including materials handling and preprocessing; destruction, contaminant transfer, or immobilization; and effluent, emission, or residue treatment technologies. Where possible, the results of previous treatability studies and successful treatment applications should be consulted to aid in the prediction of treatment system effectiveness. However, in every case, there can be no substitute for the information provided by well operated pilot scale treatability studies on a series of waste samples that are representative of the variety of conditions found at the site.

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GLOSSARY

ARAR	Applicable or Relevant and Appropriate Requirement
CAS	Chemical Abstracts Service
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act (1980)
DRE	Destruction and Removal Efficiency
HSWA	Hazardous and Solid Waste Amendments (1984)
LDR	Land Disposal Restrictions
OERR	Office of Emergency and Remedial Response (USEPA)
OR&D	Office of Research and Development (USEPA)
OSW	Office of Solid Waste (USEPA)
QA	Quality Assurance
QC	Quality Control
RCRA	Resource Conservation and Recovery Act (1976)
SARA	Superfund Amendments and Reauthorization Act (1986)
SITE	Superfund Innovative Technology Evaluation

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SECTION 1
OVERVIEW

1.1 INTRODUCTION

Background

The Comprehensive Environmental Response Compensation and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, mandated that the U.S. Environmental Protection Agency (U.S. EPA) identify, investigate, and remediate abandoned hazardous waste sites in this country. Many of these sites contain large quantities of contaminated soil. In the past, the less contaminated soils were often capped, while the hot spots were excavated and landfilled in permitted disposal facilities.

Under SARA, U.S. EPA is required to re-evaluate past disposal practices and to give preference to alternatives that use treatment as a principal element. SARA requires the U.S. EPA to select remedies which are protective of human health and the environment, and which comply with "applicable or relevant and appropriate requirements" (ARAR's) of the state and federal governments. The Resource Conservation and Recovery Act (RCRA) of 1976 and its 1984 Hazardous and Solid Waste Amendments (HSWA) are two major laws that may be applicable to Superfund wastes. HSWA prohibits continued land disposal of untreated hazardous wastes and requires U.S. EPA to develop treatment standards that must be met before disposal is allowed. After the standards or land disposal restrictions (LDRs) become effective, wastes that are not treated in accordance with those standards will be banned from land disposal.

The LDRs for contaminated soils could have a major impact on the Superfund program. These disposal standards will assist the U.S. EPA in ensuring that remedies involving treatment are incorporated into remedial actions. For this reason, the U.S. EPA Office of Emergency and Remedial Response (OERR) led an intensive effort to compile existing soil treatment data and to evaluate the effectiveness of the available technologies. This report summarizes the information collected for the U.S. EPA. This information exemplifies the current status of soil treatment technologies and was used to develop program guidance.

Scope of Work

The U.S. EPA Office of Emergency and Remedial Response (OERR) contracted CDM Federal Programs Corporation (FPC) to support the Superfund program by collecting and evaluating the available information on soil treatment technologies. The purpose of the assignment was to support the development of treatment standards for contaminated soils from Superfund sites as well as to provide technology transfer to the Superfund program. This report presents the results of the data collection effort and identifies the treatment technologies that have been tested on contaminated soils. This assignment focused on treatment methods for excavated soils, because these soils would trigger the LDRs during subsequent placement. As a result, in-situ treatment applications were not included in the scope of this assignment. Although data were sought on the treatment of contaminated debris, minimal information was available; therefore, debris was excluded from the scope as well.

This summary report includes the data that were available to the research team during their 1987 and 1988 data collection effort. The information is presented as received, without independent validation, to facilitate timely technology transfer. Due to the developmental status of some of the technologies and applications, the reproducibility of the results cannot be ensured. These limitations notwithstanding, the data were

evaluated and screened, and were used to develop preliminary conclusions regarding the effectiveness of the various technologies on commonly occurring classes of contaminants and soils.

The available data and preliminary conclusions presented in this summary report will assist hazardous waste management personnel and U.S. EPA project managers in selecting soil treatment technologies for site-specific evaluation. This body of information will continue to be broadened and updated as more information becomes available from CERCLA response actions, Superfund Innovative Technology Evaluation (SITE) program demonstrations, and RCRA corrective actions. Additional information on treatment technologies is available from the Superfund Treatability Clearinghouse Abstracts (U.S. EPA, March 1989), and from the Technology Screening Guide for Treatment of CERCLA Soils and Sludges (U.S. EPA, September 1988). The information contained in this summary report and in the studies referenced herein provide preliminary answers to the following questions.

1) What soil treatment technologies are potentially applicable to a given set of site conditions?

2) What previous treatment studies, referenced in this document, have been conducted on similar contaminants? Who are the contacts for those studies?

3) What special characteristics of the soil itself could affect treatment effectiveness?

4) What additional analyses should be conducted on soil samples to better predict the effectiveness of treatment technologies?

5) What potential materials handling issues could limit the operation of a treatment system?

6) Which soil characteristics could be modified through preprocessing to improve treatment performance?

7) What are the emissions, effluents, and residues from various treatment technologies, and what potential cross media impacts should be considered?

1.2 ORGANIZATION AND USE OF THIS REPORT

Organization

This document has been organized into the following sections, which present the project results and conclusions:

Section 1 discusses the scope of the project, the organization and use of the report, the data collection and analysis effort, the data screening rationale, the organization of the treatment data, the limitations of the data, and special considerations of soil treatment. A methodology is presented for using this document to select technologies for further site-specific investigation.

Section 2 identifies the eleven treatability groups and treatment recommendations for each group.

Section 3 discusses the six technology groups, including principles of operation, waste characteristics, and design and operating parameters that affect performance.

Appendices A through I present supporting documentation. To evaluate a technology for a waste site, knowledge of both the general characteristics of the soil itself and the individual contaminant concentrations is required. Based upon these data, a site-specific evaluation of a technology or a treatment train approach can be conducted.

Methodology to Use This Report

A methodology for using this report to select treatment technologies for further investigation at a hazardous waste site is recommended below.

STEP 1. Determine which treatability groups are present on the site. Section 2 describes the treatability groups. Appendix A lists the individual compounds within each treatability group and the Chemical Abstracts Service (CAS) codes.

STEP 2. Determine which treatment technologies have been applied to those treatability groups. Section 2 describes the types of treatment technologies for which data are available in each treatability group. Appendix B lists the technology groups and treatment technologies considered in this study.

STEP 3. Determine which of these treatment technologies have been most effective on the types of waste found at the site. Section 3 describes the six technology groups in more detail and summarizes results and conclusions for each treatability group. Appendix C explains how the available analytical data from previous treatment studies were evaluated and screened to develop these conclusions. Appendices D through G tabulate data on the effectiveness of these technologies in terms of treated soil concentrations and removal efficiencies achieved (reduction in mobility for immobilization and chemical extraction and soil washing of inorganics). These reports are sorted first by treatability group, then by technology group, and finally by removal efficiency (or reduction in mobility).

The most effective performance data may be found in Appendices D through F. Appendices D and F present treatment results for organic contaminants, while Appendix E presents inorganic results. These analytical data are summarized in Sections 2 and 3 of this report. The remainder of the available data, reflecting technology and treatability group combinations that are not the most effective or have not been widely tested, are found in Appendix G. These data are particularly valuable in the evaluation of sites with mixed organic and inorganic contamination, where a treatment train may be the most effective approach. These data also provide preliminary results from new and emerging applications of treatment technologies to complex soil contamination problems.

STEP 4. Determine the intent and applicability of the study which produced the data of interest. Appendix H presents short summaries of those studies containing the analytical data that have been evaluated in detail in this report. Results of the bench, pilot, or full scale tests are presented briefly and the contaminant names and CAS codes are listed. The summaries in Appendix H are presented in order by the Document Library Number, to enable the reader to go from the data tables in Appendices D through G to the summary of the document which produced the data of interest. The source documents themselves may be accessed through the Hazardous Waste Collection in the U.S. EPA libraries, by referring to the Document Library Number in the bibliography.

It is recommended that applicable document summaries be reviewed first, followed by thorough evaluations of the documents themselves. This historical data should then be supplemented with site-specific treatability studies. In this way, new studies can begin where the previous studies ended, building upon the previous work to further establish the effectiveness of treatment technologies on complicated environmental problems.

STEP 5. Once potential treatment technologies have been selected, review other studies evaluating these technologies to determine the limitations and capabilities of the technology. Appendix I is a bibliography of the nearly 550 documents that were reviewed as part of this study. The bibliography also includes documents that did not contribute analytical data to the data base, but that may be very useful in a qualitative sense. For example, some of the documents are proposed work plans that contain detailed design information, and many of the literature reviews contain information on the potential applicability of various treatment technologies.

The bibliography is sorted first by technology group and then by individual treatment technology, to facilitate the identification of those documents that contain further information on a particular technology. A recommended contact is listed in the bibliography for this purpose. All efforts have been made to maintain current contact information for each document.

Example: Here is an example of how to use this document to identify treatment technologies which may be applicable to a wood treatment site. Wood Treatments, Inc. (WTI) used oils containing pentachlorophenol (PCP) and creosote to preserve and treat wood. For a brief period, copper, chromium, and arsenic were also used to treat wood at WTI. Sludge in a lagoon at the facility is contaminated with pentachlorophenol, cresols, polynuclear aromatic hydrocarbons (PAHs), constituents of the oils,

and low concentrations of metals. Low concentrations of benzene and toluene, which were used to clean equipment, are also present in the lagoon.

STEP 1. The following Treatability Groups are present in the sludge:

- W03 includes the pentachlorophenol and cresols
- W07 includes the benzene and toluene
- W08 includes the polynuclear aromatic hydrocarbons
- W10 includes copper and chromium
- W11 includes arsenic

STEP 2. The following treatment technologies have been applied to these Treatability Groups:

- thermal destruction
- dechlorination
- bioremediation
- low temperature thermal desorption
- chemical extraction and soil washing
- immobilization

STEP 3. The following treatment technologies have been most effective on the types of waste at WTI:

- Thermal destruction has been demonstrated to be effective on all the organic contaminants. It is ineffective on the metals. High concentrations of volatile metals may create an emissions problem, but the metal concentrations at WTI may not be high enough to cause any problems.

- Dechlorination is potentially effective on the PCP and cresols, but it is ineffective on the other, non-chlorinated compounds; although the more volatile non-halogenated organics may appear to be destroyed, they have in fact been volatilized instead.

- Bioremediation has been demonstrated to be effective on benzene, toluene, and PAHs, and it is potentially effective on PCP and cresols. Although bioremediation is not effective on metals, which are sometimes toxic to the microorganisms, the low concentrations of metals at WTI may prove not to adversely affect this treatment process.

- Low temperature thermal desorption has been demonstrated to be effective on benzene and toluene. It is potentially effective on PCP and cresols. It is not effective on the PAHs or metals.

- Chemical extraction and soil washing have been demonstrated to be effective on benzene and toluene, and are potentially effective on the other contaminants.

- Immobilization has been demonstrated to be effective on metals, and it is potentially effective on PCP, cresols, and possibly PAHs. However, emissions of benzene and toluene, two volatile organics, would have to be controlled. High concentrations of oils may adversely affect this treatment process.

In summary, bioremediation and thermal destruction may effectively treat the organic contaminants. Immobilization may effectively reduce the mobility of the metals and possibly some of the organics. Chemical extraction and soil washing may also be effective. Dechlorination and low temperature thermal desorption would be effective only on PCP, and benzene and toluene, respectively. A treatment train may be required to remediate all the contaminants at WTI.

STEP 4. The following documents describe thermal destruction, bioremediation, chemical extraction and soil washing, and immobilization for these types of wastes. Summaries of these documents are presented in Appendix H. Corresponding document numbers can be found on the bottom right-hand corner of each page of Appendix H.

- Thermal Destruction: FDBP-1, EUZH-1, EURE-1, FCQC-1, EUZM-1, EXPC-1, EZZB-1, EZYN-1

- Bioremediation: EWGC-1, EZZA-1, EWFZ-1, EWQX-1

- Chemical Extraction and Soil Washing: EUQW-1, EUTT-3, EVAR-1, EUTT-2, FCQC-1

- Immobilization: FHMH-1, FCAK-1, EUXT-1, FAAP-1, FCAK-2, EURY-1, FCAK-3, EUXT-1

STEP 5. Additional studies are listed in the Bibliography (Appendix I) regarding remediation

of wood treatment sites, materials handling problems for sludges, and other documents. Some examples of these documents are listed below. These documents should be discussed with the contacts listed in the Bibliography.

- CLMS: Remedial Investigation of the Coleman Evans Wood Preserving Site.
- FBTR: The SRS/EIF Oily Sludge Fixation Process.
- FHYK: Treatment Demonstration Report of Creosote Contaminated Soils.
- EUXR: On Site Incineration Testing of Shirco Infrared Systems Portable Pilot Test Unit at the International Paper Company Wood Treatment Plant.

This information suggests that bioremediation may effectively treat the organic contaminants. Chemical extraction and soil washing followed by treatment of the liquid may effectively treat both the organic and inorganic contaminants. Thermal destruction would effectively treat the organic contaminants, but might be very expensive, particularly if high concentrations of metals are present. Dechlorination and low temperature thermal desorption would treat only a few of the organic contaminants. Immobilization may be needed to reduce the mobility of the solid residues generated by these other technologies. Treatability studies should be undertaken to evaluate bioremediation, chemical extraction and soil washing, and possibly immobilization. Because the waste is a relatively homogeneous sludge, different remedies will probably not be needed for any hot spots. However, materials handling issues should be addressed when selecting a remedy.

1.3 DATA COLLECTION AND ANALYSIS

During the data collection effort, nearly 550 documents were obtained from various sources. These included U.S. EPA Superfund removal and remedial activities; U.S. EPA Office of Research and Development (OR&D) tests; Department of Defense and Department of Energy studies; state programs; private party studies; and vendor demonstrations. Any available document that contained information on the treatment of contaminated soil was collected in order to compile as complete a data base as possible. These documents represent a compilation of the best available information, which will be expanded as more data become available from CERCLA response actions, SITE demonstrations, and RCRA corrective actions. Many of the documents dealt with in-situ soil treatment, or the treatment of liquids rather than excavated soils. Many other documents were proposals or literature reviews, or dealt primarily with site characterization. Those documents that did not contain test results were eliminated from further quantitative analysis; however, applicable qualitative information was retained and used to develop this report.

Sixty-eight studies contained analytical data from the results of laboratory, pilot, and full scale testing of thermal destruction, dechlorination, bioremediation, low temperature thermal desorption, chemical extraction and soil washing, and immobilization technologies treating contaminated soils. Because insufficient treatment data were available on individual contaminants, data from contaminants with similar physical and chemical structures, and hence similar treatability characteristics, were classified among eleven treatability groups. Treatment technologies were classified into six technology groups. All applicable quantitative and qualitative soil treatment data were entered into a data base developed for this assignment.

The data were then subjected to multiple screens. These screens were intended to eliminate data derived from: (1) the application of an inappropriate technology to a particular waste; (2) a test that appeared to be inadequately designed or operated; (3) a study that used inappropriate analytical procedures, such as total waste analysis results to evaluate immobilization; or (4) less successful test runs that were used to optimize treatment conditions.

Data which passed through the screens are presented in Appendices D, E, and F. Appendix D presents total constituent analysis data for the nine organic treatability groups. Appendix E includes extraction protocol data for the two inorganic contaminant groups for chemical extraction and soil washing and immobilization technologies. Appendix F presents extraction protocol results for six of the nine organic contaminant groups for immobilization technologies. Additional data that were eliminated from

quantitative analysis, because they are not representative of the "best" performance, are referenced where appropriate, and have been included in Appendix G. The rationale for the data screens is discussed in more detail in Section 1.4 and in Appendix C.

1.4 DATA SCREENING

The available data were examined to identify the "best" or most successful treatment results. These screens are described in detail in Appendix C. Some data points were screened from the data base because, based upon the study descriptions, they appeared to be from inadequately designed or operated technology applications. These data points may have been generated during unsuccessful test runs designed to optimize equipment performance. Other individual data points and some entire treatment studies were screened from the data base, because they were reported using inappropriate analytical protocols. If untreated and treated soil concentrations could not be matched, or if the calculated removal efficiency was less than or equal to zero, the data were also removed from consideration.

Results from treatment technologies that are considered to be ineffective on the contaminant being measured, such as thermal destruction of metals, were also screened from the data base. Much of this data was generated during the treatment of mixed organic and inorganic wastes. These data provide valuable insights into the behavior of multiple contaminants treated by a variety of technologies, similar to a treatment train approach.

The data which passed through the screens are summarized in Sections 2 and 3, and are presented in detail in Appendices D, E, and F. The data which did not pass through these screens are presented in Appendix G. These data, while not indicative of the best performance, provide useful qualitative information in this rapidly developing field, and are referenced in this report, where applicable.

The rationale for screening out certain treatment data is described below.

- *Treatment of Inorganic Wastes* - Thermal destruction technologies were not considered to be effective or environmentally sound technologies for the treatment of inorganic wastes; therefore, these data were not considered in this analysis. Data for inorganic compounds treated by dechlorination, bioremediation, and low temperature thermal desorption, technologies targeted for the treatment of organic compounds, were also screened from the data base. Data from research using these technologies on mixed organic and inorganic wastes were screened from the data base and are included in Appendix G.

- *Total Constituent Analysis Data for Immobilization Technologies* - Immobilization treatments retard the leaching of individual waste constituents. The effectiveness of such technologies should be assessed by the concentrations in the leachate from the treated and untreated wastes. Concentrations in the leachate are measured using an extraction procedure and cannot be obtained from total constituent analysis results. Accordingly, only immobilization data sets containing leachate concentration data from untreated and treated wastes were considered. Data sets containing total constituent analysis concentrations were screened from the data base and appear in Appendix G. Some samples of soils which were treated by immobilization underwent both total constituent analysis and leachate extraction procedures. While the total constituent analyses were screened from the data base, leachate extraction data for these samples were retained.

  Leachate Extraction Data for Destruction Technologies - Data sets for the treatment of organic compounds, where the contaminants were removed and destroyed, were required to be reported in terms of total constituent analysis of the untreated and treated soils. Therefore, leachate extraction procedure data were not considered. When available, the extraction procedure results have been included in Appendix G. Some samples of soils, which were treated by destruction technologies, underwent both total constituent analysis and leachate extraction procedures. While the leachate extraction data were screened from the data base, the total constituent analysis data from these samples were retained.

- *Laboratory Precision and Accuracy* - Precision in this report is defined as the agreement among analytical results from similar wastes that underwent similar treatment under similar conditions. Accuracy is the nearness of the mean to the true value. Data that clearly indicated poor laboratory precision or accuracy were not considered.

- *Detection Limits and Negative Removal Efficiencies* - In instances where treated waste concentrations were reported as zero or less than an unspecified detection limit (not detected), common analytical detection limits were substituted so that removal efficiencies or reductions in mobility could be calculated. Data were not considered where the detection limit resulted in a removal efficiency less than or equal to zero (where the reported treated soil concentration was greater than or equal to the reported untreated soil concentration). Also, due to the uncertainty involved in establishing some detection limits, data were not considered for compounds for which detection limits could not be estimated.

1.5 ORGANIZATION OF TREATMENT DATA

The treatment data collected were classified by the contaminants present and the treatment technology employed. Due to a lack of sufficient treatment data on a contaminant-specific basis, the data were sorted into categories of contaminants with similar physical and/or chemical properties, referred to as treatability groups. Contaminants were sorted among eleven treatability groups. The various treatment technologies were sorted among six technology groups. Lists of the treatability groups and technology groups follow. Examples of individual contaminants and treatment technologies are provided in Appendices A and B.

Treatability Groups

- Non-polar halogenated aromatic compounds excluding PCBs, dioxins, furans, and their precursors (W01)
- PCBs, halogenated dioxins, furans, and their precursors (W02)
- Halogenated phenols, cresols, amines, thiols, and other polar aromatics (W03)
- Halogenated aliphatic compounds (W04)
- Halogenated cyclic aliphatics, ethers, esters, and ketones (W05)
- Nitrated aromatic and aliphatic compounds (W06)
- Heterocyclics and simple non-halogenated aromatics (W07)
- Polynuclear aromatics and heterocyclics (W08)
- Other polar non-halogenated organic compounds (W09)
- Non-volatile metals (W10)
- Volatile metals (W11)

Technology Groups

- Thermal Destruction (Incineration)
- Dechlorination (Dehalogenation)
- Bioremediation
- Low Temperature Thermal Desorption
- Chemical Extraction and Soil Washing
- Immobilization

1.6 DATA LIMITATIONS

Contaminated soil treatment techniques are still largely under development, and limited data are available at this time. Each study that generated data referenced in this report was conducted for a different purpose in response to different requirements. The data referenced in this report came predominantly from laboratory studies performed at bench scale, using beakers as reaction vessels, or from pilot scale studies, using down-sized equipment. Limited information exists from full scale treatments performed at actual sites. Therefore, this evaluation of the effectiveness of the technologies has several limitations, which are noted below.

- *Scale-up Uncertainties* - The prediction of scale up achievable by various technologies, based on small-scale results, is not a straight forward task. At times, high removal efficiencies can be accomplished under ideal small scale conditions using a hand-sorted waste feed and tightly controlled and maintained operating conditions. It may be impossible to reproduce these removal efficiencies on a larger automated scale. Therefore, actual full scale technology effectiveness may be lower than the results indicated from bench scale testing.

- *Incomplete Reports* - The types of reports collected range from detailed printouts of all data generated, to very brief reports or letters summarizing the information into a few data points. Thus, the relative importance of the data reported could not be determined consistently.

- *Incomplete Waste Stream Analysis* - Waste streams were not consistently measured to determine the fate of the contaminants and their intermediate and final degradation products in emissions, effluents, or residues. Often, the study was designed to demonstrate that a certain concentration could be achieved in a certain regulated emission stream. For example, in instances where incinerator stack gas was measured, while the incinerator ash was not analyzed, the data was not added to the data base. This variability in waste stream measurement also resulted in a lack of information regarding undesirable cross media impacts.

- *Incomplete Contaminant Analysis* - A full range of contaminants was seldom quantified. Often, the studies reported analyses for certain target compounds only. This may have been due in part to the high cost associated with analyzing samples. Unfortunately, this approach resulted in a lack of information for many compounds, and a "not analyzed" cannot be assumed to mean "not detected." This lack of data was especially significant in the case of bioremediation, where often the initial compound was not detected in the treated residue, yet no attempt was made to analyze for any biodegradation products.

- *Incomplete Reporting of QA/QC Procedures* - Detailed laboratory quality assurance and quality control procedures (QA/QC) were rarely reported, and there is no assurance that they were consistently applied within the study. For example, some documents did not indicate which analytical methods were used. Many documents did not address whether the analytical results of laboratory blanks or spiked samples met acceptable QA/QC criteria. In addition, many documents did not indicate whether any field or wash blank or duplicate samples were collected, whether any chain-of-custody records were maintained, or what decontamination procedures were used. This lack of information raised questions about the quality of the data.

- *Lack of Independent Validation* - There were few cases, if any, in which a third party reviewed and validated the data generated for quality assurance purposes. Independent verification is an important element in the acceptance of any data.

- *Varied Analytical Protocols* - Because each treatment study was conducted in response to unique requirements, a variety of analytical protocols was reported among the many tests. These different protocols do not yield comparable results. In addition, the untreated and treated soils from a particular test were not always analyzed using consistent procedures, thereby invalidating the calculation of a removal efficiency or reduction in mobility.

- *Significant Figures* - The number of reported significant figures varied from one study to the next, and the majority of the studies reported at least two significant figures. Therefore, the values presented in Sections 2 and 3 of this report are limited to two significant figures. While Appendices D through G present seven digits, they are only statistically valid to two significant figures.

- *Statistical Significance* - The available data exhibit wide variations in untreated soil characteristics, process operating conditions, and hence treatment system performance. For this reason, the calculation of average untreated and treated soil concentrations and process removal efficiencies for one group may not statistically be significantly different from those of another group. Caution is advised when referring to these values. Preferably, each treatment technology should be evaluated separately when drawing conclusions about the effectiveness of a particular technology on a particular contaminant.

1.7 SPECIAL CONSIDERATIONS OF SOIL TREATMENT

The majority of the treatment data summarized and discussed in this report were from the treatment of contaminated soils. The balance of the data was from the treatment of sludges. No data were available from the treatment of debris.

Therefore, this report focuses on the treatment of contaminated soils only and does not address contaminated debris. However, some of the technologies described in this report for soil treatment may also be modified to treat debris.

A major purpose of this assignment was to document the difficulties encountered when treating contaminated soils and, therefore, to substantiate the necessity of different treatment standards for these wastes. The available treatment data exhibited large variations in effectiveness, due to many factors that are unique to the soil itself. Knowledge of these considerations is important to understand and predict the effectiveness of treatment technologies on contaminated soils.

The complex nature of a solid waste matrix, such as contaminated soil from a Superfund site, severely complicates the treatment process. The contamination may have been non-uniformly deposited over time, which resulted in hot spots and areas of very low concentration. In addition, large volumes of soil may be contaminated with a mixture of compounds. The complex bonding forces that are exhibited by various soil fractions, particularly clays and organic matter, can be difficult to counteract and can affect the treatability of contaminated soil. To further complicate these circumstances, the age of many of these sites has allowed significant opportunity for environmental weathering to occur, allowing many contaminants to migrate through the soil matrix. Collectively, these conditions, coupled with the frequent existence of debris such as rocks, tree stumps, metallic objects, and discarded appliances, make the treatment of contaminated soil a technical challenge. Discussions of some of the important considerations relevant to the selection of soil treatment processes follow.

Soil Type

The type of soil that is contaminated can determine the effectiveness of the treatment process. The particle size, or soil texture, correlates strongly with the mineralogy. Sand-sized and silt-sized particles tend to be composed of relatively inert silica oxides and similar minerals, whereas clay-sized particles tend to consist of clay minerals. Clay minerals generally consist of planar sheets of silica and aluminum oxides interlayered with cations. The cations are held within the sheets by ionic bonds, Van der Waals forces, or similar bonds. Under the appropriate conditions, the cations can be replaced relatively easily by other ions with similar size and charge. Thus, clay minerals have a relatively high cation exchange capacity.

The particle size affects treatability in two ways. First, because the potential reaction sites are primarily limited to the surface of the particle, the surface-to-volume ratio has a major impact on the nature and rate of reactions between the particle and the contaminant. Therefore, larger sand-sized particles are less reactive than smaller clay-sized particles, particularly since reactions may occur between the sheets of clay minerals. Second, the cation exchange capacity has a major impact on the reactions that can occur. The high cation exchange capacity of clay minerals enables them to be more reactive with many contaminants than the minerals characteristic of sand-sized particles. Organic matter, which also has a high cation exchange capacity, is also more reactive than sand-sized particles. Thus, the relatively large surface area and the high cation exchange capacity make clays and organic matter more difficult to treat than sands and silts.

Some technologies, such as chemical extraction and soil washing, use the differences in cation exchange capacity and surface area as the basis for soil treatment. Surface soils generally contain both sand and clay particles. The majority of the contamination may be adsorbed on the clays. Washing the soil to separate clays and sand may produce a large volume of relatively clean sandy soil and a small concentrated volume of clay and contaminants, depending on the type of soil.

Contaminant Concentrations

The magnitudes of the untreated contaminant concentration and the desired treatment goal are important factors in technology selection. Some processes are designed to treat wastes with very high levels of contamination, while others are only effective below certain threshold levels. Treatment processes also provide widely varying effluents, with some processes effective in the part per billion range, while others result in part per million range residues. A technology such as thermal destruction is an appropriate method

of treating very concentrated levels of organic contamination, resulting in very low levels of residual contamination in the ash. If, however, the untreated soil contains relatively low levels of volatile organics, the use of an incinerator would be very costly in terms of energy consumption. A low temperature thermal desorption or biological unit would probably be as effective at a much lower cost.

Materials Handling

Materials handling, or waste transfer throughout the treatment system, is a major consideration for soils and viscous sludges, because traditional conveyance methods are frequently ineffective. Fugitive emissions of volatiles may be a problem while the soil is being excavated, stockpiled, and transported to the treatment unit. Slugs of material or debris tend to jam treatment equipment, resulting in breakage, downtime, and the potential for uncontrolled releases to the environment. Materials handling equipment should be tested on the waste as part of any treatability testing program. Experiments should be conducted on the untreated waste as well as on any intermediate mixtures exhibiting changes in viscosity, particle size, density, etc.

Preprocessing

Preprocessing is vital to the success of the waste treatment system, because the effectiveness of some technologies is directly correlated to the conditions of the contaminated soil. Preprocessing of waste to increase the homogeneity of the waste is important because any treatment technology will operate most efficiently and cost effectively when it is designed and utilized to treat a homogeneous waste with a narrow range of physical and chemical characteristics. If contaminant types and concentrations, waste viscosity, particle size, BTU content, moisture content, acidity, alkalinity, etc. vary widely, control of the system can be very difficult and costly to maintain.

Moisture content is an example of a waste characteristic that affects different technologies in different ways. For example, dechlorination is adversely affected by a high water content, while chemical extraction and soil washing frequently employ a water-based solvent to dissolve or disperse contaminants. For thermal destruction and low temperature thermal desorption, the presence of moisture increases the energy required to destroy or volatilize the contaminants. Many treatment operations can benefit from moisture addition or reduction, which is a relatively simple unit operation.

Material size is another waste characteristic that can be altered during preprocessing to improve treatment performance. With smaller clumps of soil, the contaminant within the soil is more accessible to the driving force that governs the treatment process. Residence times and operating temperatures can be reduced, thereby reducing treatment system costs and improving throughput. Conveying the contaminated soil through the treatment train is also most effective when the soil particles are relatively small. There is less likelihood of jamming the equipment and causing costly maintenance and downtime.

Materials handling and preprocessing technologies with potential applications for soil are currently in use in areas such as the construction, agricultural, and mining industries. The use of such technologies should be seriously considered during all soil remediation activities. Preprocessing techniques should also be incorporated in treatability testing programs. The results of such tests will better define the range of waste characteristics which the primary treatment technology will have to address.

Waste Mixtures

The treatment of soils contaminated with a mixture of organic and inorganic contaminants, such as those commonly encountered at Superfund sites, presents additional challenges. For example, bioremediation of soils contaminated with organic compounds and high concentrations of metals may be difficult because the metals may be toxic to the microorganisms. Thermal destruction of soils contaminated with volatile organic compounds and volatile metals will effectively destroy the organic contaminants, but it may also volatilize the metals. Air pollution control systems utilizing state-of-the-art equipment may not be successful in trapping volatile metal emissions. If these systems are not effective, the risk of metal emissions to the atmosphere will be very high. To avoid this serious cross media impact, an alternative treatment train approach could include low temperature thermal desorption to

volatilize the organics with their subsequent destruction or entrapment in the gas stream treatment system. The volatile metals remaining in the soil residue could then be immobilized.

Basic Treatment Mechanisms

Given effective materials handling and preprocessing equipment, waste treatment can be accomplished through the following three basic mechanisms: destruction of soil contaminants, physical transfer of contaminants to another medium for subsequent treatment, or immobilization of contaminants. The mixtures of organic and inorganic contaminants, which often are present in Superfund site soils, may preclude the use of some treatment processes due to potential undesirable cross media impacts, such as uncontrolled particulate emissions from an incinerator scrubber system. An acceptable solution may involve the use of several treatment mechanisms in a treatment train to treat mixed organic and inorganic waste.

1.8 SUMMARY

The complex nature of contaminated soil presents a unique challenge in terms of successful waste treatment and minimization of undesirable cross media impacts. When determining the applicability of technologies to a soil waste, treatment test results from a series of actual site samples, representative of the variety of site conditions, should be evaluated. In terms of treatment technology effectiveness, the entire treatment train configuration should be considered, including materials handling and preprocessing; contaminant destruction, physical transfer, or immobilization; and effluent, emission, or residue treatment technologies. Where possible, the results of previous studies and successful treatment applications should be consulted to aid in the prediction of treatment system effectiveness.

The remaining chapters of this report focus on assessing the relative effectiveness of various treatment technologies upon the full range of contaminants encountered at Superfund sites. While qualitative conclusions are discussed at length in Sections 2 and 3, the quantitative results, which formed the bases for those conclusions, are presented in the Appendices. When referring to the analytical data in Appendices D through G, it is important to also refer to the corresponding treatability study summaries presented in Appendix H to better understand each particular treatment study. The information summarized in this report and presented in detail in the many source documents will be very valuable to hazardous waste professionals when they consider specific contaminated soil problems. However, the maximum degree of confidence can be obtained from well operated pilot scale treatability studies, which test a series of waste samples representative of the variety of conditions found at each site.

REFERENCES

1. U.S. Environmental Protection Agency. March 1989. Superfund Treatability Clearinghouse Abstracts. Prepared by CDM Federal Programs Corporation for the Office of Emergency and Remedial Response. EPA/540/2-89/001.

2. U.S. Environmental Protection Agency. September 1988. Technology Screening Guide for Treatment of CERCLA Soils and Sludges. Prepared by Camp Dresser and Mckee Inc. and Versar Inc. for the the Office of Emergency and Remedial Response. EPA/540/2-88/004.

SECTION 2

TREATABILITY GROUP DESCRIPTIONS AND TREATMENT RECOMMENDATIONS

2.1 INTRODUCTION

This section discusses the available soil treatment data in terms of the following eleven treatability groups:

- non-polar halogenated aromatics, excluding PCBs, dioxins, furans, and their precursors (W01)
- PCBs, halogenated dioxins, furans, and their precursors (W02)
- halogenated phenols, cresols, amines, thiols, and other polar aromatics (W03)
- halogenated aliphatic compounds (W04)
- halogenated cyclic aliphatics, ethers, esters, and ketones (W05)
- nitrated aromatic and aliphatic compounds (W06)
- heterocyclics and simple non-halogenated aromatics (W07)
- polynuclear aromatics and heterocyclics (W08)
- other polar non-halogenated organic compounds (W09)
- non-volatile metals (W10)
- volatile metals (W11)

Examples of the compounds in each of these groups are found in Appendix A. If data were available for an individual compound, that compound is designated with an asterisk in Appendix A.

After an in-depth review of the data remaining after screening, a prediction was made of the treatment effectiveness of the six technology groups on each of the treatability groups. For destruction and physical transfer technologies applied to organics, the removal efficiency was analyzed. This evaluation factor was replaced by the reduction in mobility for immobilization and for chemical extraction and soil washing of inorganics. An overall summary of the predicted treatment effectiveness is presented in Figure 2-1 using the following ratings:

- *Demonstrated Effectiveness* - A significant percentage of the data, 20%, are from pilot or full scale operations, the average removal efficiency for all of the data exceeds 90%, and there are at least ten data pairs.

- *Potential Effectiveness* - The average removal efficiency for all of the data exceeds 70%.

- *No Expected Effectiveness* - The average removal efficiency for all of the data is less than 70%, and no interference is expected to this process as a result of this group.

- *No Expected Effectiveness* - Potential adverse effects to the environment or to the treatment process may occur. For example, high concentrations of metals may interfere with biological treatment.

In several instances, the data base implied that a technology would be more or less effective than the quantitative data for the technology appeared to support. In these cases, engineering judgment was used to predict the effectiveness of the technology. This judgment was based on data for compounds with similar physical and chemical characteristics, an understanding of the treatment technology's capabilities and characteristics, and a careful evaluation of the data and the limitations of the test runs involved. The conclusions from the data base were modified in the following instances:

- Bioremediation of non-polar halogenated aromatics (W01) generated an average removal efficiency of 53%. However, the untreated soil concentration was very low,

TECHNOLOGY / TREATABILITY GROUP	THERMAL DESTRUCTION	DECHLORINATION	BIOREMEDIATION [4]	LOW TEMPERATURE THERMAL DESORPTION	CHEMICAL EXTRACTION AND SOIL WASHING	IMMOBILIZATION [4]
NON-POLAR HALOGENATED AROMATICS (W01)	●	◒	◒ [3]	● ◒	◒	◒
PCBs, HALOGENATED DIOXINS, FURANS, AND THEIR PRECURSORS (W02)	●	◒	◒ [3]	◒ [1]	◒	◒ [1]
HALOGENATED PHENOLS, CRESOLS, AMINES, THIOLS, AND OTHER POLAR AROMATICS (W03)	● [3]	◒	◒	◒	◒	◒ [3]
HALOGENATED ALIPHATIC COMPOUNDS (W04)	●	◒ [2]	◒ [2]	●	◒	◒ [2]
HALOGENATED CYCLIC ALIPHATICS, ETHERS, ESTERS, AND KETONES (W05)	●	◒ [1]	◒ [1]	○ [1]	◒ [1]	◒ [1]
NITRATED COMPOUNDS (W06)	●	○ [1]	◒	○ [1]	◒	◒ [1]
HETEROCYCLICS AND SIMPLE NON-HALOGENATED AROMATICS (W07)	●	○ [2]	◒ [2]	●	◒	◒ [2]
POLYNUCLEAR AROMATICS (W08)	●	○ [2]	◒	○	◒	◒
OTHER POLAR NON-HALOGENATED ORGANIC COMPOUNDS (W09)	●	○ [2]	◒ [2]	◒	◒	◒ [2]
NON-VOLATILE METALS (W10)	○ [1]	○ [1]	○ X [1]	○ [1]	◒	● [3]
VOLATILE METALS (W11)	X [1]	○ [1]	○ X [1]	○ [1]	◒	●

8/20/90

● Demonstrated Effectiveness
◒ Potential Effectiveness
○ No Expected Effectiveness (no expected interference to process)
X No Expected Effectiveness (potential adverse effects to environment or process)

1 Data were not available for this treatability group. Conclusions are drawn from data for compounds with similar physical and chemical characteristics.
2 High removal efficiencies implied by the data may be due to volatilization or soil washing.
3 The predicted effectiveness may be different than the data imply, due to limitations in the test conditions.
4 These technologies may have limited applicability to high levels of organics.

Figure 2-1. Predicted Treatment Effectiveness for Contaminated Soil

averaging 2.9 ppm, and treatment of more heavily contaminated soils generally yields higher removal efficiencies. Data for compounds with similar physical and chemical characteristics suggest that bioremediation is more effective than 53% removal efficiency. Therefore, bioremediation was predicted to be potentially effective on these compounds.

- Low temperature thermal desorption has been demonstrated to be effective on some of the more volatile compounds among the non-polar halogenated aromatics (W01), particularly chlorobenzene and 1,2-dichlorobenzene. It is not expected that this technology will perform as well on the less volatile pesticides that are also contained in this treatability group such as DDE and DDT. For this reason, both the demonstrated effectiveness and potential effectiveness designations have been indicated.

- Nearly all of the data in the data base on thermal destruction of halogenated phenols, cresols, amines, thiols, and other polar aromatics (W03) were generated by bench scale tests. Only 8% of the data were from pilot and full scale tests. However, the average removal efficiency was 96%, comparable to that for compounds with similar physical and chemical characteristics. Therefore, thermal destruction was predicted to have demonstrated effectiveness on these contaminants.

- Immobilization of halogenated phenols, cresols, amines, thiols, and other polar aromatics (W03) generated an average reduction in mobility of 61%. This average was based only on four data pairs for pentachlorophenol. Data for compounds with similar physical and chemical characteristics suggest that immobilization is more effective than 61% reduction in mobility. Therefore, immobilization was predicted to be potentially effective on these contaminants.

- Bioremediation of halogenated aliphatics (W04), heterocyclics and simple non-halogenated aromatics (W07), and other polar non-halogenated organics (W09) generated average removal efficiencies of >99%. However, several of these studies found that these compounds may have volatilized during treatment. Data for compounds with similar physical and chemical characteristics suggest that bioremediation of these compounds is not as effective as >99%. Therefore, bioremediation was predicted to be potentially effective on these compounds.

- Dechlorination of some non-halogenated compounds (W07, W08, and W09) generated average removal efficiencies of 91% to 99%. Because these compounds are non-halogenated, these removal efficiencies could not be due to dechlorination. These removal efficiencies appeared to be caused by volatilization at the elevated temperatures used in dechlorination processes, or by the dechlorination process acting as a soil washing process. Therefore, dechlorination was predicted to have no effect on all non-halogenated compounds. However, these anomalies should be considered and may be useful in developing a treatment process or treatment train for mixtures of halogenated and non-halogenated wastes.

- Low temperature thermal desorption is not generally effective for the majority of polynuclear aromatic compounds (W08), as the average of the data in the data base indicates. However two of the more volatile compounds in this group, particularly anthracene and acenaphthene, were treated by this technology with removal efficiencies ranging from 72% to 99% in a series of bench scale tests documented in the data base. Considering the range of results for different polynuclear compounds, both the potential effectiveness and the no expected effectiveness designations have been indicated.

- Immobilization of non-volatile metals (W10) has been well demonstrated historically. The 24 pairs of untreated and treated soil data in the data base have an average reduction in mobility of only 81%. This unexpectedly low average is due to two tests (5 data pairs) on low levels of chromium (1 ppm or less) which had very poor results (10% - 40% reduction in mobility). These data pairs lowered the average of the other 19 successful data pairs, which had reductions in mobility ranging from 85% to >99%. If the 5 uncharacteristic data pairs are disregarded, the remaining data support the prediction that immobilization has demonstrated effectiveness on non-volatile metals.

- Immobilization of volatile metals (W11) has been well demonstrated historically. The data in the data base are limited to bench scale results. Based upon the average reduction in mobility of these results, 93%, and other qualitative knowledge, it is predicted that immobilization will demonstrate effectiveness on volatile metals at pilot and full scale as well.

In all other instances, the conclusions presented in Figure 2-1 were developed from the criteria described previously.

Figure 2-2 summarizes the volume of data upon which the conclusions in Figure 2-1 are based. Figure 2-2 lists the number of data pairs available and identifies the percentage of these data pairs which are from bench-, pilot-, and full-scale treatability tests. Figure 2-2 indicates that nearly all of the conclusions in Figure 2-1 are based on more than ten data pairs.

The treatability groups were taken from the "Proposed Guidance Manual; Interim Guidance for Treatment of Contaminated Soil at CERCLA and RCRA Corrective Action Sites," which was prepared for the Office of Solid Waste (U.S. EPA, June 1988). Consistent information has been compiled for each treatability group regarding the amount of treatment data available, the effectiveness of the various treatment technologies, and general observations. Quantitative conclusions for each treatability group regarding each technology are presented in Figures 2-3 through 2-13. For each treatability group, these figures summarize the following information by technology group:

- number of untreated and treated data pairs available
- percent of data from bench, pilot, and full scale operations
- average untreated and treated soil concentrations
- average removal efficiency or reduction in mobility for immobilization and chemical extraction and soil washing of inorganics
- general observations

For the organic data from thermal destruction, dechlorination, bioremediation, low temperature thermal desorption, and chemical extraction and soil washing, the untreated and treated soil contaminant concentrations were measured using the total constituent analysis methodology.

For the organic and inorganic data from immobilization technologies and for the inorganic data from chemical extraction and soil washing, the untreated and treated soil concentrations were measured in terms of extraction protocol leachate rather than by the total constituent analysis methodology.

This study calculated the effectiveness of all technologies using the formula:

$$\frac{\text{Untreated Concentration} - \text{Treated Concentration}}{\text{Untreated Concentration}} \times 100 = \text{Percent Removal Efficiency}^{*}$$

* (Percent Mobility Reduction for Immobilization of Organics and Inorgenes and Chemical Extractions and Soil Washing of Inorganics)

This differs from the commonly used measure of destruction and removal efficiency (DRE) for incineration, which measures the concentration in the stack gas rather than in the ash.

The average untreated and treated soil concentrations in Figures 2-3 through 2-13 were calculated from the untreated or treated soil data available for that technology group and treatability group, regardless of scale or individual contaminant. For each pair of untreated and treated concentration values, a percent removal efficiency was calculated. The average removal efficiencies presented in Figures 2-3 through 2-13 were then calculated by averaging the individual removal efficiencies. The effectiveness of the treatment technology on that treatability group is more accurately characterized by calculating the average removal efficiency for a treatability group from the individual removal efficiencies, rather than from a removal efficiency calculation using the average untreated and the average treated concentrations. The same rationale was used regarding the average reduction in mobility for immobilization data and for inorganic chemical extraction and soil washing data.

The data and averages summarized in Figures 2-3 through 2-13 are not to be interpreted as the actual treatment standards for contaminated soils subject to the RCRA land disposal restrictions (LDRs). The actual treatment standards for contaminated soils are being

TECHNOLOGY / TREATABILITY GROUP	THERMAL DESTRUCTION	DECHLORINATION	BIOREMEDIATION	LOW TEMPERATURE THERMAL DESORPTION	CHEMICAL EXTRACTION AND SOIL WASHING	IMMOBILIZATION
NON-POLAR HALOGENATED AROMATICS (W01)	32 data pairs from 6 B 94 P 0 F	8 data pairs from 100 B 0 P 0 F	66 data pairs from 95 B 5 P 0 F	29 data pairs from 48 B 4 P 48 F	20 data pairs from 100 B 0 P 0 F	4 data pairs from 100 B 0 P 0 F
PCBs, HALOGENATED DIOXINS, FURANS, AND THEIR PRECURSORS (W02)	161 data pairs from 3 B 83 P 14 F	31 data pairs from 97 B 3 P 0 F	1 data pairs from 0 B 100 P 0 F	0 data pairs from 0 B 0 P 0 F	22 data pairs from 82 B 4 P 14 F	0 data pairs from 0 B 0 P 0 F
HALOGENATED PHENOLS, CRESOLS, AMINES, THIOLS, AND OTHER POLAR AROMATICS (W03)	61 data pairs from 92 B 2 P 6 F	8 data pairs from 100 B 0 P 0 F	3 data pairs from 100 B 0 P 0 F	14 data pairs from 100 B 0 P 0 F	20 data pairs from 100 B 0 P 0 F	4 data pairs from 100 B 0 P 0 F
HALOGENATED ALIPHATIC COMPOUNDS (W04)	92 data pairs from 21 B 79 P 0 F	16 data pairs from 100 B 0 P 0 F	27 data pairs from 0 B 100 P 0 F	132 data pairs from 27 B 50 P 23 F	40 data pairs from 100 B 0 P 0 F	9 data pairs from 100 B 0 P 0 F
HALOGENATED CYCLIC ALIPHATICS, ETHERS, ESTERS, AND KETONES (W05)	118 data pairs from 67 B 33 P 0 F	0 data pairs from 0 B 0 P 0 F	0 data pairs from 0 B 0 P 0 F	0 data pairs from 0 B 0 P 0 F	0 data pairs from 0 B 0 P 0 F	0 data pairs from 0 B 0 P 0 F
NITRATED COMPOUNDS (W06)	142 data pairs from 73 B 27 P 0 F	0 data pairs from 0 B 0 P 0 F	22 data pairs from 0 B 100 P 0 F	0 data pairs from 0 B 0 P 0 F	3 data pairs from 100 B 0 P 0 F	0 data pairs from 0 B 0 P 0 F
HETEROCYCLICS AND SIMPLE NON-HALOGENATED AROMATICS (W07)	42 data pairs from 7 B 88 P 5 F	24 data pairs from 100 B 0 P 0 F	54 data pairs from 0 B 100 P 0 F	111 data pairs from 37 B 39 P 24 F	55 data pairs from 98 B 0 P 2 F	12 data pairs from 100 B 0 P 0 F
POLYNUCLEAR AROMATICS (W08)	24 data pairs from 33 B 59 P 8 F	5 data pairs from 100 B 0 P 0 F	37 data pairs from 19 B 81 P 0 F	52 data pairs from 27 B 60 P 13 F	24 data pairs from 71 B 0 P 29 F	2 data pairs from 100 B 0 P 0 F
OTHER POLAR NON-HALOGENATED ORGANIC COMPOUNDS (W09)	34 data pairs from 35 B 65 P 0 F	16 data pairs from 100 B 0 P 0 F	22 data pairs from 0 B 100 P 0 F	34 data pairs from 82 B 6 P 12 F	58 data pairs from 95 B 0 P 5 F	7 data pairs from 100 B 0 P 0 F
NON-VOLATILE METALS (W10)	0 data pairs from 0 B 0 P 0 F	0 data pairs from 0 B 0 P 0 F	0 data pairs from 0 B 0 P 0 F	0 data pairs from 0 B 0 P 0 F	34 data pairs from 100 B 0 P 0 F	24 data pairs from 67 B 33 P 0 F
VOLATILE METALS (W11)	0 data pairs from 0 B 0 P 0 F	0 data pairs from 0 B 0 P 0 F	0 data pairs from 0 B 0 P 0 F	0 data pairs from 0 B 0 P 0 F	54 data pairs from 100 B 0 P 0 F	33 data pairs from 100 B 0 P 0 F

B, P, and F represent the percent of data pairs derived from Bench, Pilot and Full scale tests, respectively.

Figure 2-2. Number and Type of Data Pairs Used to Predict The Treatment Effectiveness for Contaminated Soil

developed by the U.S. EPA Office of Solid Waste (OSW) and are not the same as the averages presented in these figures.

2.2 NON-POLAR HALOGENATED AROMATIC COMPOUNDS EXCLUDING PCBS, FURANS, DIOXINS, AND THEIR PRECURSORS (W01)

Halogenated aromatic compounds (e.g., chlorobenzene, dichlorobenzene), which contain chlorine or bromine, exhibit different reactivities than their aliphatic counterparts. Generally, the compounds in this group exhibit low water solubilities, making them difficult to treat by aqueous processes unless additives (i.e., surfactants) are used. They are more resistant to biodegradation and require higher temperatures in incineration processes than their non-halogenated counterparts. For all non-incineration processes including dechlorination, brominated and chlorinated compounds behave similarly. For incineration processes, the major difference is that brominated compounds release hydrogen bromide and bromine, which inhibit flame propagation processes and can cause severe corrosion of exposed metal parts and refractory materials.

The effectiveness of soil treatment technologies on this group of contaminants is summarized in Figure 2-3. This group of compounds can be treated by thermal destruction. Low temperature thermal desorption and chemical extraction and soil washing may effectively treat many of the members of this group, but the treatment efficiency will be influenced by the operating conditions. Though the only data available to analyze treatment efficiency were for chlorobenzene, dechlorination may effectively treat the compounds in this group. This treatability group is more resistant to biological degradation than its non-halogenated counterparts, but bioremediation may still be a treatment option to consider. PCBs, furans, dioxins and their precursors are excluded from this group because current regulations mandate more stringent treatment wastes containing these contaminants. These compounds are evaluated in treatability group W02.

2.3 PCBS, HALOGENATED DIOXINS, FURANS, AND THEIR PRECURSORS (W02)

As explained in Section 2.2, more stringent regulations cover the destruction of PCBs, halogenated dioxins, and furans. Furthermore, wastes containing chlorinated phenolic compounds (e.g., halogenated phenoxyacetic acid derivatives) may contain halogenated furans and dioxins as impurities. Because of the more toxic nature and the more stringent treatment requirements for these wastes, they are classified as a separate group.

The effectiveness of soil treatment technologies on this group of contaminants is summarized in Figure 2-4. The treatment specified by existing U.S. EPA regulations for this group is thermal destruction. In addition, dechlorination and chemical extraction and soil washing have been shown to be potentially effective in some cases. Ongoing research indicates that some biological processes show potential application to this treatability group. Immobilization processes have been used to immobilize PCBs and these data are presented in Appendices F and G.

2.4 HALOGENATED PHENOLS, CRESOLS, AMINES, THIOLS, AND OTHER POLAR AROMATICS (W03)

This group of compounds includes halogenated phenols, halogenated alkyl-substituted phenols, halogenated cresols, halogenated amines, and halogenated alkyl-substituted thiols (e.g., chlorophenol, methoxychlor). As a group, these compounds are more water soluble than non-polar halogenated aromatics. This property can result in better treatment efficiency with chemical extraction and soil washing. Thermal destruction and dechlorination have successfully treated this group. Low temperature thermal desorption, immobilization, and biological processes also have the potential to be effective on these compounds. The effectiveness of soil treatment technologies on this group of contaminants is summarized in Figure 2-5.

Due to the presence of halogens, nitrogen, and sulfur, thermal destruction of these compounds produces large amounts of acid gases. These acid gases can result in serious cross media

TREATMENT TECHNOLOGY	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % REMOVALS	GENERAL OBSERVATIONS
THERMAL DESTRUCTION	32 PAIRS 6 % BENCH 94 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 590 TREATED 0.024 AVERAGE REMOVAL EFFICIENCY >99 %	• This technology works very well at optimum operating conditions on a variety of initial concentrations. • Brominated compounds will inhibit flame propagation. • High levels of acid gases produced in the presence of oxygen will attack the refractory walls and exposed metal surfaces.
DECHLORINATION	8 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 190 TREATED 1.6 AVERAGE REMOVAL EFFICIENCY 98 %	• Data were for chlorobenzene only. These data suggest that this technology is potentially effective in certain situations.
BIOREMEDIATION	66 PAIRS 95 % BENCH 5 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 2.9 TREATED 0.79 AVERAGE REMOVAL EFFICIENCY 53 %	• This technology is not effective for all contaminants in this class; however, there is potential for effectiveness for low initial concentrations with further development. • The presence of these contaminants at low concentrations is not expected to interfere with the treatment of applicable wastes. • The effectiveness of this technology may be different than the data imply, because the initial concentrations in these tests were so low.
LOW TEMPERATURE THERMAL DESORPTION	29 PAIRS 48 % BENCH 4 % PILOT 48 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 130 TREATED 0.07 AVERAGE REMOVAL EFFICIENCY 99 %	• Although this technology was not expected to perform well on this treatability group, the data from studies which utilized higher operating temperatures and longer residence times indicate that many of the compounds in this group may be treated by this technology with potential effectiveness. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled. • This technology has demonstrated effectiveness on some of the more volatile contaminants in this group, and it is potentially effective on the remaining contaminants.
CHEMICAL EXTRACTION AND SOIL WASHING	20 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 170 TREATED 0.30 AVERAGE REMOVAL EFFICIENCY >99 %	• This technology is potentially effective on these contaminants but all data are from bench scale. • Surfactants may adhere to the soil and reduce soil permeability. • Possible volatile emission losses may occur during treatment.
IMMOBILIZATION	4 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 3.1 TREATED 0.65 AVERAGE MOBILITY REDUCTION 83 %	• Data were for chlorobenzene only. • These data suggest that this technology is potentially effective in certain situations, particularly where the initial concentration is low. • The treatment mechanism for the more volatile compounds may be volatilization as opposed to immobilization. Air pollution control systems may be necessary to minimize cross media impacts from these volatile emissions. • It is not recommended that this technology be selected if this is the only treatability group present.

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Figure 2-3. Final Conclusions by Treatability Group
Non-Polar Halogenated Aromatics (W01)

TREATMENT TECHNOLOGY	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % REMOVALS	GENERAL OBSERVATIONS
THERMAL DESTRUCTION	161 PAIRS 3 % BENCH 83 % PILOT 14 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 1,100 TREATED 0.055 AVERAGE REMOVAL EFFICIENCY >99 %	• This technology works very well at optimum operating conditions on a variety of initial concentrations. • High levels of acid gases produced in the presence of oxygen will attack the refractory walls and exposed metal surfaces.
DECHLORINATION	31 PAIRS 97 % BENCH 3 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 180 TREATED 1.6 AVERAGE REMOVAL EFFICIENCY 83 %	• This technology is potentially effective, especially for sandy soils. • Data on sludges show better removal due to more uniform distribution of contaminants and better reagent contact. • Lower initial concentrations give lower removal efficiencies. • Moisture content over 4 to 7% deactivates the NaPEG reagent. • Particle size and soil matrix affect reagent penetration and process effectiveness. • Recent data indicate that greater than 99% of PCBs and furans can be destroyed (des Rosiers, 1988).
BIOREMEDIATION	1 PAIRS 0 % BENCH 100 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 2,000 TREATED 0.12 AVERAGE REMOVAL EFFICIENCY >99 %	• The lone data pair is PCBs. • Ongoing research suggests that this technology may be potentially effective for this group.
LOW TEMPERATURE THERMAL DESORPTION	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• No data were available. • The physical and/or chemical characteristics of the constituents of this treatability group suggest that this technology would not be effective. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled.
CHEMICAL EXTRACTION AND SOIL WASHING	22 PAIRS 82 % BENCH 4 % PILOT 14 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 9,900 TREATED 4,000 AVERAGE REMOVAL EFFICIENCY 71 %	• This technology is potentially effective on these contaminants with further development. • Some of the available data for this treatability group were based on very high initial concentrations; however consideration should be given to the ability of the technology to treat high initial concentrations. • The presence of oil in the matrix enhances removal. • The removal efficiency decreases as the percent of clays and clayey silts increases. • Surfactants may adhere to the soil and reduce soil permeability.
IMMOBILIZATION	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE MOBILITY REDUCTION 0 %	• Incomplete quantitative data were available to evaluate treatment effectiveness. These quantitative data and additional qualitative information suggest that this technology is potentially effective in certain situations, particularly where the initial concentration is low. • It is not recommended that this technology be selected if this is the only treatability group present.

Figure 2-4. Final Conclusions by Treatability Group
PCBs, Halogenated Dioxins, Furans, and Their Precursors (W02)

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TREATMENT TECHNOLOGY	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % REMOVALS	GENERAL OBSERVATIONS
THERMAL DESTRUCTION	81 PAIRS 92 % BENCH 2 % PILOT 6 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 550 TREATED 0.70 AVERAGE REMOVAL EFFICIENCY 96 %	• This technology works well at optimum operating conditions on a variety of initial concentrations. • Oxides of nitrogen and sulfur can create potential serious cross media impacts if not removed from gas emissions. • High concentrations of acid gases produced in the presence of oxygen will attack the refractory walls and exposed metal surfaces.
DECHLORINATION	8 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 98 TREATED 2.4 AVERAGE REMOVAL EFFICIENCY 96 %	• Data were for pentachlorophenol only. These data suggest that this technology is potentially effective in certain situations. • Recent data indicate that greater than 99% of contaminants can be destroyed (des Rosiers, 1988).
BIOREMEDIATION	3 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 83 TREATED 17 AVERAGE REMOVAL EFFICIENCY 74 %	• This technology is potentially effective for low initial concentrations. • Bioremediation requires uniformly mixed media with small particle sizes. • Toxic compounds such as cyanides, arsenic, heavy metals, and some organics adversely affect the treatment. • Preprocessing includes mixing and nutrient and organism addition. • Bioremediation is a slow process. • Bioremediation has low costs relative to other technologies.
LOW TEMPERATURE THERMAL DESORPTION	14 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 260 TREATED 67 AVERAGE REMOVAL EFFICIENCY 72 %	• Although the data suggest that this technology is not as effective with this treatability group, the technology, if operated at higher temperatures and residence times, may successfully treat many of the compounds in this group. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled.
CHEMICAL EXTRACTION AND SOIL WASHING	20 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 87 TREATED 18 AVERAGE REMOVAL EFFICIENCY 72 %	• Data were from pentachlorophenol only. • This technology is potentially effective on these contaminants, especially for treating sandy soils. • Surfactants may adhere to the soil and reduce soil permeability.
IMMOBILIZATION	4 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 2.5 TREATED 1.1 AVERAGE MOBILITY REDUCTION 61 %	• Data were from pentachlorophenol only. These data suggest that this technology is potentially effective in certain situations, particularly where the initial concentration is low. • The effectiveness of this technology on these contaminants may be different than the data imply, due to limitations in the test conditions. • It is not recommended that this technology be selected if this is the only treatability group present.

Figure 2-5. Final Conclusions by Treatability Group
Halogenated Phenols, Cresols, Amines, and Thiols (W03)

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impacts as well as serious damage to both metal and refractory components in the treatment equipment.

2.5 HALOGENATED ALIPHATIC COMPOUNDS (W04)

This group of compounds includes all brominated, chlorinated, and fluorinated alkanes, alkenes, and acetylenes. These include industrial halogenated solvents such as carbon tetrachloride, trichloroethylene, perchloroethylene, and the dichloroethane and trichloroethane compounds.

The effectiveness of soil treatment technologies on this group of contaminants is summarized in Figure 2-6. The high volatility of this class renders it very susceptible to treatment by low temperature thermal desorption. In addition, thermal destruction, biological processes, and chemical extraction and soil washing have successfully treated this group. However, in some instances, volatilization of the compounds in this group has been misinterpreted to be actual destruction during the treatment process. If wastes containing such volatile compounds are immobilized, volatile emissions may need to be captured and treated. Dechlorination may effectively treat this group. However, acetylene is one of the final products of the dechlorination of halogenated aliphatics. In the presence of certain heavy metals such as silver and copper, acetylene may form explosive metal acetylides.

2.6 HALOGENATED CYCLIC ALIPHATICS, ETHERS, ESTERS, AND KETONES (W05)

This group is comprised of a wide variety of halogenated polar cyclic aliphatic compounds which are primarily used as pesticides or pesticide precursors. This group includes halogenated ethers, carboxylic acids, aldehydes, and ketones. These compounds are generally less volatile but more water soluble than halogenated aliphatic compounds.

The effectiveness of soil treatment technologies on this group of contaminants is summarized in Figure 2-7. The only data available to evaluate this treatability group were for thermal destruction processes. Though no data were available to analyze treatment efficiency, chemical extraction and soil washing, bioremediation, and dechlorination theoretically may effectively treat this group. Treatment effectiveness must be confirmed by treatability studies.

2.7 NITRATED AROMATIC AND ALIPHATIC COMPOUNDS (W06)

The physical/chemical characteristics of this class of compounds generally are dominated by the presence of one or more nitro groups ($-NO_2$). The class includes both nitrated aromatic and aliphatic compounds. These compounds are primarily used as explosives or intermediates in the production of explosives. Smaller amounts of some of these chemicals are also used to manufacture precursors for organic dyes and pigments. Because most of these compounds are explosive, extreme caution is required when treating them, especially in high concentrations.

The effectiveness of soil treatment technologies on this group of contaminants is summarized in Figure 2-8. Thermal destruction of high concentrations of these compounds may also result in the release of nitrous gases. A nitrous oxide burner should be used in thermal destruction processes to control these emissions. Thermal destruction processes have successfully treated this group with biological processes showing potential effectiveness as well. Limited data suggest that chemical extraction and soil washing may also have potential effectiveness on this group.

2.8 HETEROCYCLICS AND SIMPLE NON-HALOGENATED AROMATICS (W07)

This group includes simple non-polar aromatic solvents such as benzene, toluene, ethyl benzene, styrene, and xylenes. It also includes the heterocyclic compounds from Appendix VIII of 40 CFR 261 which are primarily pyridine and a few alkyl substituted pyridine derivatives. For a number of chemical reactions, pyridine and benzene behave similarly. The major difference (excluding their physical molecular structures and molecular weights) is that substituted pyridines are more water soluble than their benzene analogues.

The effectiveness of soil treatment technologies on this group of contaminants is summarized in Figure 2-9. The compounds in this group are very volatile, making treatment by low temperature thermal desorption very efficient. In

TREATMENT TECHNOLOGY	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % REMOVALS	GENERAL OBSERVATIONS
THERMAL DESTRUCTION	92 PAIRS 21 % BENCH 79 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 41 TREATED 0.016 AVERAGE REMOVAL EFFICIENCY >99 %	• This technology works well at optimum operating conditions on a variety of initial concentrations. • If this is the only treatability group present, low temperature thermal desorption may be more cost effective. • High levels of acid gases produced in the presence of oxygen will attack the refractory walls and exposed metal surfaces.
DECHLORINATION	16 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 330 TREATED 0.44 AVERAGE REMOVAL EFFICIENCY 98 %	• These data suggest that this technology is potentially effective in certain situations. • Some halogenated aliphatics react with the APEG reagents to form explosive compounds, especially in the presence of heavy metals. The potential for this to occur should be evaluated in the laboratory before dechlorination treatment is selected. • The high removal efficiency may be the result of volatilization or the APEG process acting as a soil washing process.
BIOREMEDIATION	27 PAIRS 0 % BENCH 100 % PILOT 4 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 23 TREATED 0.027 AVERAGE REMOVAL EFFICIENCY >99 %	• This technology is potentially effective for low initial concentrations. • Bioremediation requires uniformly mixed media with small particle sizes. • Toxic compounds such as cyanides, arsenic, heavy metals, and some organics adversely affect the treatment. • Preprocessing includes mixing and nutrient and organism addition. • Bioremediation is a slow process. • Bioremediation has low costs relative to other technologies. • Removal may actually represent volatilization during preprocessing and treatment.
LOW TEMPERATURE THERMAL DESORPTION	132 PAIRS 27 % BENCH 50 % PILOT 23 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 590 TREATED 18 AVERAGE REMOVAL EFFICIENCY 94 %	• This technology works well on this treatability group. • Removal efficiencies are not as high with soils having extremely elevated concentrations. A longer residence time may remedy this situation. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled.
CHEMICAL EXTRACTION AND SOIL WASHING	40 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 290 TREATED 0.22 AVERAGE REMOVAL EFFICIENCY >99 %	• This technology is potentially effective on these contaminants, but all data are from bench scale. • This technology may be more applicable to sandy soils. • Surfactants may adhere to the soil and reduce soil permeability. • Volatile emissions may occur during treatment.
IMMOBILIZATION	9 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 11 TREATED 0.24 AVERAGE MOBILITY REDUCTION 88 %	• Though these data suggest that this technology is potentially effective in certain situations, particularly where the initial concentration is low, the reductions in mobility may be due to volatilization of the volatile compounds during treatment. • Air pollution control systems may be necessary to minimize cross media impacts from these volatile emissions. • It is not recommended that this technology be selected if this is the only treatability group present.

Figure 2-6. Final Conclusions by Treatability Group
Halogenated Aliphatic Compounds (W04)

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TREATMENT TECHNOLOGY	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % REMOVALS	GENERAL OBSERVATIONS
THERMAL DESTRUCTION	118 PAIRS 67 % BENCH 33 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 790 TREATED 17 AVERAGE REMOVAL EFFICIENCY 99 %	• This technology works well at optimum operating conditions on a variety of initial concentrations.
DECHLORINATION	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• Data were not available for this treatability group. Data for compounds with similar physical and chemical characteristics suggest that this technology is potentially effective in certain situations. Treatability studies will be needed to confirm the technology's effectiveness.
BIOREMEDIATION	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• Data were not available for this treatability group. Data for compounds with similar physical and chemical characteristics suggest that this technology may be potentially effective in certain situations with low initial concentrations.
LOW TEMPERATURE THERMAL DESORPTION	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• No data were available for this treatability group. • The physical and/or chemical characteristics of the constituents of this treatability group suggest that this technology would <u>not</u> be effective. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled.
CHEMICAL EXTRACTION AND SOIL WASHING	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• Data were not available for this treatability group. Data for compounds with similar physical and chemical characteristics suggest that this technology is potentially effective in certain situations. • Surfactants may adhere to the soil and reduce soil permeability.
IMMOBILIZATION	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE MOBILITY REDUCTION 0 %	• Data were not available for this treatability group. Data for compounds with similar physical and chemical characteristics suggest that this technology is potentially effective in certain situations, particularly where the initial concentration is low. • It is not recommended that this technology be selected if this is the only treatability group present.

Figure 2-7. Final Conclusions by Treatability Group
Halogenated Cyclic Aliphatics, Ethers, Esters, and Ketones (W05)

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TREATMENT TECHNOLOGY	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % REMOVALS	GENERAL OBSERVATIONS
THERMAL DESTRUCTION	142 PAIRS 73 % BENCH 27 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 98,000 TREATED 200 AVERAGE REMOVAL EFFICIENCY 99 %	• This technology works well at optimum operating conditions on a variety of initial concentrations. • High amounts of nitrous gases may be released into the atmosphere if not controlled by a nitrous oxide burner.
DECHLORINATION	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• Data were not available available for this treatability group. • The physical and/or chemical characteristics of the constituents of this treatability group indicate that this technology would not be effective.
BIOREMEDIATION	22 PAIRS 0 % BENCH 100 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 13,000 TREATED 82 AVERAGE REMOVAL EFFICIENCY 82 %	• This technology is potentially effective on these contaminants, especially at low concentrations. • Some of the available data for this treatability group were based on very high initial concentrations; however consideration should be given to the ability of the technology to treat high initial concentrations. • Bioremediation requires uniformly mixed media with small particle sizes. • Toxic compounds such as cyanides, arsenic, heavy metals, and some organics adversely affect the treatment. • Preprocessing includes mixing and nutrient and organism addition. • Bioremediation is a slow process. • Bioremediation has low costs relative to other technologies.
LOW TEMPERATURE THERMAL DESORPTION	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• No data were available for this treatability group. • The physical and/or chemical characteristics of the constituents of this treatability group indicate that this technology would not be effective. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled.
CHEMICAL EXTRACTION AND SOIL WASHING	3 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 6,900 TREATED 4.7 AVERAGE REMOVAL EFFICIENCY >99 %	• This technology is potentially effective on these contaminants. However, data are limited and testing was conducted at bench scale.
IMMOBILIZATION	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE MOBILITY REDUCTION 0 %	• Data were not available for this treatability group. Data for compounds with similar physical and chemical characteristics suggest that this technology is potentially effective in certain situations, particularly where the initial concentrations are low.

Figure 2-8. Final Conclusions by Treatability Group
Nitrated Aromatic and Aliphatic Compounds (W06)

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TREATMENT TECHNOLOGY	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % REMOVALS	GENERAL OBSERVATIONS
THERMAL DESTRUCTION	42 PAIRS 7 % BENCH 88 % PILOT 5 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 740 TREATED 0.077 AVERAGE REMOVAL EFFICIENCY >99 %	• This technology works very well at optimum operating conditions on a variety of initial concentrations. • Low temperature thermal desorption may be more cost effective.
DECHLORINATION	24 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 2,200 TREATED 23 AVERAGE REMOVAL EFFICIENCY 99 %	• The physical and/or chemical characteristics of the constituents of this treatability group suggest that this technology would not be effective. • The high removal efficiency may be the result of volatilization or the APEG process acting as a soil washing process.
BIOREMEDIATION	54 PAIRS 0 % BENCH 100 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 220 TREATED 0.025 AVERAGE REMOVAL EFFICIENCY >99 %	• This technology is potentially effective for low initial concentrations. • The high removal indicated by the data may actually represent volatilization during preprocessing and treatment. • Bioremediation requires uniformly mixed media with small particle sizes. • Toxic compounds such as cyanides, arsenic, heavy metals, and some organic compounds adversely affect treatment. • Preprocessing includes mixing and nutrient and organism addition. • Bioremediation is a slow process. • Bioremediation has low costs relative to other technologies.
LOW TEMPERATURE THERMAL DESORPTION	111 PAIRS 37 % BENCH 39 % PILOT 24 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 920 TREATED 1.7 AVERAGE REMOVAL EFFICIENCY 96 %	• This technology works well on this treatability group. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled.
CHEMICAL EXTRACTION AND SOIL WASHING	55 PAIRS 98 % BENCH 0 % PILOT 2 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 1,700 TREATED 3.8 AVERAGE REMOVAL EFFICIENCY >99 %	• This technology is potentially effective on these contaminants but nearly all data are from bench scale. • Volatile emissions may occur during treatment. • Surfactants may adhere to the soil and reduce soil permeability.
IMMOBILIZATION	12 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 23 TREATED 5.8 AVERAGE MOBILITY REDUCTION 73 %	• Though these data suggest that this technology is potentially effective in certain situations, particularly where the initial concentration is low, the reductions in mobility may be due to the volatilization of volatile organic compounds during treatment. • Air pollution control systems may be necessary to minimize cross media impacts from these volatile emissions. • It is not recommended that this technology be selected if this is the only treatability group present.

Figure 2-9. Final Conclusions by Treatability Group
Heterocyclics and Simple Non-Halogenated Aromatics (W07)

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addition, thermal destruction, biological processes, and chemical extraction and soil washing have successfully treated this group. In some cases, volatilization of the compounds in this group may have been misinterpreted to be actual destruction during the treatment process. This probably accounts for the apparent effectiveness of dechlorination on these non-halogenated contaminants. If wastes containing such volatile compounds are immobilized, volatile emissions may need to be captured and treated. Other technologies which were beyond the scope of this report, such as in-situ vapor extraction, may also be effective.

2.9 POLYNUCLEAR AROMATICS AND HETEROCYCLICS (W08)

This group contains compounds with two or more fused aromatic rings. It also includes compounds containing heterocyclic rings. These compounds all have low aqueous solubilities and relatively high boiling points.

The effectiveness of soil treatment technologies on this group of contaminants is summarized in Figure 2-10. This treatability group can be successfully treated by thermal destruction. Biological processes and chemical extraction and soil washing have demonstrated potential effectiveness on this group in some cases. Some compounds in this group may be treated by low temperature thermal desorption. However, the data suggest that this technology is not generally effective for this group. Because these compounds exhibit very low water solubilities, immobilization may be effective in specific instances.

The apparent effectiveness of dechlorination on this treatability group is probably the result of volatilization of a single compound.

2.10 OTHER POLAR NON-HALOGENATED ORGANIC COMPOUNDS (W09)

This broad grouping contains the non-halogenated polar organic compounds including:

- Non-halogenated phenols, phenylethers, and cresols
- Aromatic and aliphatic alcohols
- Aromatic and aliphatic aldehydes and ketones
- Aromatic and aliphatic nitriles and isocyanates
- Sulfonic acids, sulfones, and thiols
- Phosphate esters, carboxylic acid esters, and sulfate esters
- Amines, substituted hydrazines, and nitrosamines

As a whole, these compounds are non-halogenated and contain one or more polar groups. They are all, to varying degrees, water soluble.

The effectiveness of soil treatment technologies on this group of contaminants is summarized in Figure 2-11. They can be treated effectively by thermal destruction and biological processes and in some cases by chemical extraction and soil washing. Potential effectiveness is indicated by low temperature thermal desorption. The apparent effectiveness of dechlorination on this treatability group may be the result of volatilization or a soil washing effect. Immobilization of the semi-volatile compounds in this class may be effective.

2.11 NON-VOLATILE METALS (W10)

The toxic metal compounds listed in Appendix VIII of 40 CFR 261 can be divided into two classes: those containing volatile metal salts and those containing non-volatile metal salts. Non-volatile metal compounds are defined as those not possessing significant vapor pressures below 1000°C. The non-volatile metals include copper, nickel, beryllium, chromium, and barium.

The effectiveness of soil treatment technologies on this group of contaminants is summarized in Figure 2-12. This group of metals can be treated by immobilization and by chemical extraction and soil washing. If the concentration of one or more metals in a waste is high, a recovery technology may be considered as well.

2.12 VOLATILE METALS (W11)

Volatile metals are defined as those possessing significant vapor pressures below 1000°C. Volatile metals include compounds of lead, zinc, cadmium, and mercury. It is necessary to distinguish between volatile and non-volatile metallic compounds, because in thermal destruction treatment technologies, volatile metal constituents form gaseous metal oxides and metal chlorides, generating very fine particulates in the emissions. The effectiveness of soil treatment technologies on this group of contaminants is summarized in Figure 2-13.

TREATMENT TECHNOLOGY	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % REMOVALS	GENERAL OBSERVATIONS
THERMAL DESTRUCTION	24 PAIRS 33 % BENCH 59 % PILOT 8 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 1,200 TREATED 0.32 AVERAGE REMOVAL EFFICIENCY >99 %	• This technology works very well at optimum operating conditions on a variety of initial concentrations.
DECHLORINATION	5 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 3,600 TREATED 180 AVERAGE REMOVAL EFFICIENCY 91 %	• The physical and/or chemical characteristics of the constituents of this treatability group suggest that this technology would not be effective. • The high removal efficiency may be the result of volatilization or the APEG process acting as a soil washing process.
BIOREMEDIATION	37 PAIRS 19 % BENCH 81 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 120 TREATED 3.8 AVERAGE REMOVAL EFFICIENCY 87 %	• This technology is potentially effective for low initial concentrations. • Bioremediation requires uniformly mixed media with small particle sizes. • Toxic compounds such as cyanides, arsenic, heavy metals, and some organic compounds adversely affect treatment. • Preprocessing includes mixing and nutrient and organism addition. • Bioremediation is a slow process. • Bioremediation has low costs relative to other technologies.
LOW TEMPERATURE THERMAL DESORPTION	52 PAIRS 27 % BENCH 60 % PILOT 13 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 1,400 TREATED 130 AVERAGE REMOVAL EFFICIENCY 65 %	• This technology is not generally effective as a treatment for this group, but individual compounds may be treated effectively at higher operating temperatures and longer residence times. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled.
CHEMICAL EXTRACTION AND SOIL WASHING	24 PAIRS 71 % BENCH 0 % PILOT 29 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 1,600 TREATED 380 AVERAGE REMOVAL EFFICIENCY 82 %	• This technology is potentially effective on these contaminants with further development. • Some of the available data for this treatability group were based on very high initial concentrations; however, consideration should be given to the ability of the technology to treat high initial concentrations. • Surfactants may adhere to the soil and reduce soil permeability.
IMMOBILIZATION	2 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 3.0 TREATED 0.03 AVERAGE MOBILITY REDUCTION 99 %	• These limited data suggest that this technology is potentially effective in certain situations, particularly where the initial concentration is low.

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Figure 2-10. Final Conclusions by Treatability Group Polynuclear Aromatics and Heterocyclics (W08)

TREATMENT TECHNOLOGY	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % REMOVALS	GENERAL OBSERVATIONS
THERMAL DESTRUCTION	34 PAIRS 35 % BENCH 65 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) / AVERAGE REMOVAL EFFICIENCY UNTREATED 690 / 98 % TREATED 0.28	• This technology works well at optimum operating conditions on a variety of initial concentrations.
DECHLORINATION	16 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) / AVERAGE REMOVAL EFFICIENCY UNTREATED 1,700 / 96 % TREATED 30	• The physical and/or chemical characteristics of the constituents of this treatability group suggest that this technology would not be effective. • The high removal efficiency may be the result of volatilization or the APEG process acting as a soil washing process.
BIOREMEDIATION	22 PAIRS 0 % BENCH 100 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) / AVERAGE REMOVAL EFFICIENCY UNTREATED 64 / >99 % TREATED 0.32	• This technology is potentially effective for low initial concentrations. • Bioremediation requires uniformly mixed media with small particle sizes. • Toxic compounds such as cyanides, arsenic, heavy metals, and some organic compounds adversely affect treatment. • Preprocessing includes mixing and nutrient and organism addition. • Bioremediation is a slow process. • Bioremediation has low costs relative to other technologies. • Removal may actually represent volatilization during preprocessing and treatment.
LOW TEMPERATURE THERMAL DESORPTION	34 PAIRS 82 % BENCH 6 % PILOT 12 % FULL	AVERAGE CONCENTRATIONS (ppm) / AVERAGE REMOVAL EFFICIENCY UNTREATED 1,900 / 82 % TREATED 170	• This technology is potentially effective on some contaminants in this group. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled.
CHEMICAL EXTRACTION AND SOIL WASHING	58 PAIRS 95 % BENCH 0 % PILOT 5 % FULL	AVERAGE CONCENTRATIONS (ppm) / AVERAGE REMOVAL EFFICIENCY UNTREATED 70,000 / 91 % TREATED 15,000	• This technology is potentially effective on these contaminants. • Some of the available data for this treatability group were based on very high initial concentrations; however, consideration should be given to the ability of the technology to treat high initial concentrations. • Treatment effectiveness should be evaluated on a case-by-case basis. • Surfactants may adhere to the soil and reduce soil permeability. • Volatile emissions may occur during treatment.
IMMOBILIZATION	7 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) / AVERAGE MOBILITY REDUCTION UNTREATED 20 / 77 % TREATED 5.6	• These limited data suggest that this technology is potentially effective in certain situations, particularly where the initial concentration is low. • The treatment mechanism for the more volatile compounds may be volatilization as opposed to immobilization. Air pollution control systems may be necessary to minimize cross media impacts from these volatile emissions. • It is not recommended that this technology be selected if this is the only treatability group present.

Figure 2-11. Final Conclusions by Treatability Group
Other Polar Non-Halogenated Organic Compounds (W09)

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TREATMENT TECHNOLOGY	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % REMOVALS	GENERAL OBSERVATIONS
THERMAL DESTRUCTION	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• The physical and/or chemical characteristics of the constituents of this treatability group indicate that this technology would not be effective. • Pyrolysis and infrared thermal destruction of wastes with metal concentrations over 500 ppm may possibly reduce the mobility of these metals by binding the metals into the solid residue.
DECHLORINATION	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• The physical and/or chemical characteristics of the constituents of this treatability group suggest that this technology would not be effective.
BIOREMEDIATION	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• High concentrations of heavy metals may adversely affect particular organisms. • The physical and/or chemical characteristics of the constituents of this treatability group suggest that the technology would not be effective.
LOW TEMPERATURE THERMAL DESORPTION	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• The physical and/or chemical characteristics of the constituents of this treatability group indicate that this technology would not be effective. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled.
CHEMICAL EXTRACTION AND SOIL WASHING	34 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 34 TREATED 1.1 AVERAGE REMOVAL EFFICIENCY 89 %	• This technology is potentially effective on these contaminants. • Water and H_2SO_4 at a pH of 1.0 and a 3:1 molar ratio of EDTA at a pH of 12.0 can both achieve good levels of extraction. • Iron (1-2%) may cause solvent regeneration problems.
IMMOBILIZATION	24 PAIRS 67 % BENCH 33 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 28 TREATED 0.34 AVERAGE MOBILITY REDUCTION 81 %	• This technology works well on these contaminants. • High levels of oil and grease may interfere with the process. • Soluble salts of Mg, Sb, Zn, Cu, and Pb may interfere with the pozzolan reaction. • High levels of sulfates may interfere with the process. • Pretreatment may be required to increase pH.

Figure 2-12. Final Conclusions by Treatability Group
Non-Volatile Metals (W10)

8/20/90

TREATMENT TECHNOLOGY	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % REMOVALS	GENERAL OBSERVATIONS
THERMAL DESTRUCTION	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• This technology is not recommended if the waste contains high concentrations of volatile metals, due to potential volatilization of these metals with subsequent cross media impacts. • Pyrolysis and infrared thermal destruction may reduce the mobility of these metals by binding the metals into the solid residue.
DECHLORINATION	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• The physical and/or chemical characteristics of the constituents of this treatability group suggest that this technology would not be effective.
BIOREMEDIATION	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• High concentrations of heavy metals may adversely affect particular organisms. • The physical and/or chemical characteristics of the constituents of this treatability group suggest that the technology would not be effective.
LOW TEMPERATURE THERMAL DESORPTION	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• The physical and/or chemical characteristics of the constituents of this treatability group indicate that this technology would not be effective. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled.
CHEMICAL EXTRACTION AND SOIL WASHING	54 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 71 TREATED 10 AVERAGE REMOVAL EFFICIENCY 85 %	• This technology is potentially effective on these contaminants, especially for sandy soils. • Silty and clayey soils are not as effectively treated. • Arsenic may be difficult to extract due to low solubility.
IMMOBILIZATION	33 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 610 TREATED 1.4 AVERAGE MOBILITY REDUCTION 93 %	• Based on the pilot scale data this technology works well on these contaminants. Some bench scale data was not representative of optimum conditions. • High levels of oil and grease may interfere with the process. • Soluble salts of Mg, Sb, Zn, Cu, and Pb may interfere with the pozzolan reaction. • High levels of sulfates may interfere with the process. • Pretreatment may be required to increase pH.

Figure 2-13. Final Conclusions by Treatability Group
Volatile Metals (W11)

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Because it is technically difficult and costly to treat the emissions effectively, it is not recommended to incinerate wastes containing high concentrations of these metals. Volatile metals can be treated by immobilization and by chemical extraction and soil washing. For high concentrations of these metals, a recovery technology may also be considered as a treatment option. The relatively high volatility of metallic and organic forms of mercury is of particular concern when selecting a treatment technology. Effective emission control during both pretreatment and actual treatment may be necessary. Otherwise, potentially serious impacts to both human health and the environment may occur.

REFERENCES

1. U.S. Environmental Protection Agency. June 7, 1988. Proposed Guidance Manual; Interim Guidance for Treatment of Contaminated Soil at CERCLA and RCRA Corrective Action Sites. Prepared by Versar Inc. for the Office of Solid Waste.

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SECTION 3

TECHNOLOGY DESCRIPTIONS AND CONCLUSIONS

This section discusses the available soil treatment data in terms of the six technology groups. These six groups are:

- thermal destruction
- dechlorination
- bioremediation
- low temperature thermal desorption
- chemical extraction and soil washing
- immobilization

Consistent information has been compiled for each technology category, including summary figures presenting conclusions in a format similar to Figures 2-3 through 2-13 in Section 2. The explanation of the calculations in Figures 2-3 through 2-13 also applies to Figures 3-2, 3-4, 3-7, 3-9, 3-12, and 3-14 in this section. Each figure is preceded by a short report that presents subsections on Description and Applicability, Basic Principles of Operation, Waste Characteristics Affecting Performance, and Design and Operating Parameters Affecting Performance. The text is supplemented with process diagrams, Figures 3-1, 3-3, 3-5, 3-6, 3-8, 3-10, 3-11, and 3-13.

With the exception of rotary kiln incineration and some cement and lime/pozzolan immobilization processes, all of the technologies described in the following section are considered to be innovative technologies for the treatment of contaminated soil. In most cases, the specific technologies are already developed, it is the application of these technologies to the treatment of contaminated soil that is new. Continued development and testing by the waste treatment community is expected to identify additional treatment technologies and to improve the performance and versatility of the technologies presently in use.

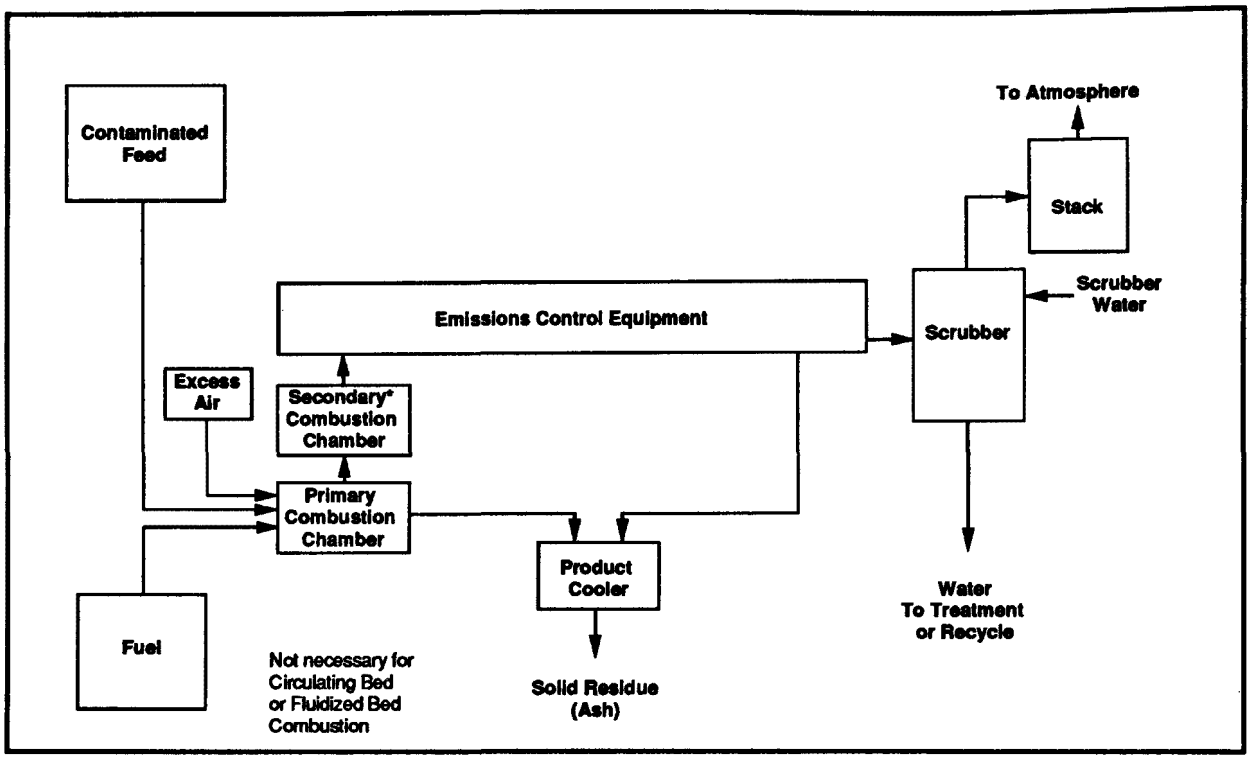
3.1 THERMAL DESTRUCTION

Description and Applicability

Thermal destruction is a controlled destruction process that uses high temperatures to destroy hazardous wastes usually through conversion to carbon dioxide, water, and other combustion products in the presence of oxygen. "The specific products of thermal destruction [combustion] vary depending on the types of wastes that are burned [and destruction operating parameters]. Most thermal destruction units consist of a waste feed system, an air or oxygen-fed burner system, a combustion chamber, a combustion monitoring system, and equipment for air pollution treatment and control and ash removal" (U.S. EPA, November 1986). These elements are applied somewhat differently in the various types of thermal destruction or combustion units. Figure 3-1 is a schematic flow diagram of this technology. A discussion of these applications follows and it also includes those technologies which do not use a burner or combustion chamber.

The thermal destruction system usually operates in two steps or chambers. The organic contaminants are first desorbed from the soil and combustion is partially initiated in the primary combustion chamber. Complete destruction of the organic contaminants then occurs in the secondary combustion chamber. Proper operation is particularly essential when incinerating halogenated compounds and PCBs, to avoid forming products of incomplete combustion.

Thermal destruction does not destroy volatile metals such as lead and mercury or non-volatile metals such as iron and chromium. Incinerating wastes with high concentrations of volatile



(Adapted from U.S. EPA, December 1986.)

Figure 3-1. Thermal Destruction Flow Diagram

metals has the potential to adversely affect human health and the environment. In the high temperature environment of hazardous waste incinerators, in the presence of oxygen, practically all metals form metal oxides which enter the gas stream. Some of these metal oxide particulates are too small to be removed by conventional air pollution control technology, such as scrubbers or electrostatic precipitators. Baghouse dust collectors usually remove these small particulates, but the air emissions must first be cooled to below 200°C, adding additional expense. For these reasons, conventional air pollution control systems may not be able to trap these contaminants and they can potentially be subsequently released into the environment.

Metals which do not form particulates will be concentrated in the treated soil. Metals may also produce a slag which coats equipment and hampers effective operation. Some thermal destruction technologies, such as infrared incineration and pyrolysis, may fuse the metals into the ash residue, reducing the ability of the metals to leach out of the residue.

As the data base demonstrates, thermal destruction is very effective in treating organic contaminants. The effectiveness of this treatment technology on soil contaminants is summarized in Figure 3-2. The effectiveness of thermal destruction for the treatment of contaminated soil wastes was measured by the removal efficiency in the solid phase using an equation involving treated and untreated soil concentrations, as previously defined in Section 2.1. This equation is significantly different from the conventional method of destruction and removal efficiency (DRE) analysis, which uses untreated soil concentrations and effluent gas concentrations. The removal efficiency calculated from the solid phase was used because it gave a better indication of the quantity of contamination remaining in the treated residue.

The data base indicates that a removal efficiency of greater than 98% was achieved for each organic treatability group except for halogenated phenols, cresols, amines, thiols, and other polar aromatic compounds (W03).

TREATABILITY GROUP	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % REMOVALS	GENERAL OBSERVATIONS
NON-POLAR HALOGENATED AROMATICS (W01)	32 PAIRS 6 % BENCH 94 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 590 TREATED 0.024 AVERAGE REMOVAL EFFICIENCY >99 %	• This technology works very well at optimum operating conditions on a variety of initial concentrations. • Brominated compounds will inhibit flame propagation. • High levels of acid gases produced in the presence of oxygen will attack the refractory walls and exposed metal surfaces.
PCBs, HALOGENATED DIOXINS, FURANS, AND THEIR PRECUSORS (W02)	161 PAIRS 3 % BENCH 83 % PILOT 14 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 1,100 TREATED 0.055 AVERAGE REMOVAL EFFICIENCY >99 %	• This technology works very well at optimum operating conditions on a variety of initial concentrations. • High levels of acid gases produced in the presence of oxygen will attack the refractory walls and exposed metal surfaces.
HALOGENATED PHENOLS, CRESOLS, AMINES, THIOLS, AND OTHER POLAR AROMATICS (W03)	81 PAIRS 92 % BENCH 2 % PILOT 6 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 550 TREATED 0.70 AVERAGE REMOVAL EFFICIENCY 98 %	• This technology works well at optimum operating conditions on a variety of initial concentrations. • Oxides of nitrogen and sulfur can create potential serious cross media impacts if not removed from gas emissions. • High concentrations of acid gases produced in the presence of oxygen will attack the refractory walls and exposed metal surfaces.
HALOGENATED ALIPHATIC COMPOUNDS (W04)	92 PAIRS 21 % BENCH 79 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 41 TREATED 0.016 AVERAGE REMOVAL EFFICIENCY >99 %	• This technology works well at optimum operating conditions on a variety of initial concentrations. • If this is the only treatability group present, low temperature thermal desorption may be more cost effective. • High levels of acid gases produced in the presence of oxygen will attack the refractory walls and exposed metal surfaces.
HALOGENATED CYCLIC ALIPHATICS, ETHERS, ESTERS, AND KETONES (W05)	118 PAIRS 67 % BENCH 33 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 790 TREATED 17 AVERAGE REMOVAL EFFICIENCY 99 %	• This technology works well at optimum operating conditions on a variety of initial concentrations.
NITRATED COMPOUNDS (W06)	142 PAIRS 73 % BENCH 27 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 98,000 TREATED 200 AVERAGE REMOVAL EFFICIENCY 99 %	• This technology works well at optimum operating conditions on a variety of initial concentrations. • High amounts of nitrous gases may be released into the atmosphere if not controlled by a nitrous oxide burner.

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Figure 3-2. Final Conclusions by Treatment Technology — Thermal Destruction

TREATABILITY GROUP	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (PPM) AND % REMOVALS	GENERAL OBSERVATIONS
HETEROCYCLICS AND SIMPLE NON-HALOGENATED AROMATICS (W07)	42 PAIRS 7 % BENCH 88 % PILOT 5 % FULL	AVERAGE CONCENTRATIONS (ppm) / AVERAGE REMOVAL EFFICIENCY UNTREATED 740 / >99 % TREATED 0.077	• This technology works very well at optimum operating conditions on a variety of initial concentrations. • Low temperature thermal desorption may be more cost effective.
POLYNUCLEAR AROMATICS (W08)	24 PAIRS 33 % BENCH 59 % PILOT 8 % FULL	AVERAGE CONCENTRATIONS (ppm) / AVERAGE REMOVAL EFFICIENCY UNTREATED 1,200 / >99 % TREATED 0.32	• This technology works very well at optimum operating conditions on a variety of initial concentrations.
OTHER POLAR NON-HALOGENATED ORGANIC COMPOUNDS (W09)	34 PAIRS 35 % BENCH 65 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) / AVERAGE REMOVAL EFFICIENCY UNTREATED 690 / 98 % TREATED 0.28	• This technology works well at optimum operating conditions on a variety of initial concentrations.
NON-VOLATILE METALS (W10)	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) / AVERAGE REMOVAL EFFICIENCY UNTREATED 0 / 0 % TREATED 0	• The physical and/or chemical characteristics of the constituents of this treatability group indicate that this technology would <u>not</u> be effective. • Pyrolysis and infrared thermal destruction of wastes with metal concentrations over 500 ppm may possibly reduce the mobility of these metals by binding the metals into the solid residue.
VOLATILE METALS (W11)	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) / AVERAGE REMOVAL EFFICIENCY UNTREATED 0 / 0 % TREATED 0	• This technology is not recommended if the waste contains high concentrations of volatile metals, due to potential volatilization of these metals with subsequent cross media impacts. • Pyrolysis and infrared thermal destruction may reduce the mobility of these metals by binding the metals into the solid residue.

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Figure 3-2 Final Conclusions by Treatment Technology — Thermal Destruction (Cont.)

Although only a 96% removal efficiency was achieved for these compounds, the average treated soil concentration was very low at 0.70 ppm. This concentration is close to the analytical detection limit for these compounds. Therefore, very little relative difference can be detected between the untreated and treated soil concentrations. This makes higher removal efficiencies difficult to measure. In light of this limitation in the sensitivity of the analytical protocol and instrumentation, it can be concluded that thermal destruction has been demonstrated to be very effective on these contaminants as well.

Basic Principles of Operation

There are several types of thermal destruction units. Some of these units are capable of treating both liquid and solid wastes, while others can treat only liquid or solid waste. Most thermal destruction processes follow a similar basic flow scheme. Wastes are fed into the primary chamber where desorption and partial destruction of the organic contaminants occur. The ash residue is then removed from the unit for disposal and the gaseous products pass through the unit to a secondary chamber (afterburner). In the secondary chamber, carbon monoxide and other products of incomplete combustion (PICs) are further oxidized. The gas stream then passes through an air emissions control device, such as a cyclone separator, which removes particulates, then on to a scrubber system, and finally out through the stack. The principal differences between the various types of thermal units involve the operation of the primary chamber. The following is a discussion of several different types of processes.

Rotary Kiln - "Rotary kiln systems are capable of incinerating solid, liquid, and gaseous hazardous wastes either separately or simultaneously. Because of their versatility, rotary kilns have been used for treatment in large commercial facilities. A rotary kiln is a slowly rotating, refractory-lined cylinder that is mounted at a slight incline from the horizontal. Solid wastes enter at the high end of the kiln. Rotation of the kiln exposes the solids to the heat, vaporizes the contaminants, and allows them to combust by mixing with air at high temperatures. The rotation then causes the ash to move to the lower end of the kiln where it can be removed. Rotary kiln systems usually have a secondary combustion chamber or afterburner located downstream from the kiln to ensure more complete combustion of the volatilized components of solid wastes" (U.S. EPA, November 1986). Temperatures in the kiln can vary from 800°C to as high as 1200°C (Kristensen, 1985). Gas residence time in the afterburner can range from 1 to 3 seconds at temperatures from 1200°C to 1400°C.

Fluidized Bed - "A fluidized bed (combustion unit) consists of a column containing inert particles, such as sand, which is referred to as the bed. Air driven by a blower enters the bottom to fluidize the bed. Air passage through the bed promotes rapid and uniform mixing of the injected waste material within the fluidized bed. The bed has an extremely high heat capacity (approximately three times that of flue gas at the same temperature), thereby providing a large heat reservoir. The injected waste reaches ignition temperature quickly and transfers the heat of combustion back to the bed" (U.S. EPA, November 1986). In the primary reaction zone, average gas temperatures are 800°C to 900°C with a gas residence time of 1/2 second. The gas residence time in the secondary chamber varies from 2 to 5 seconds at temperatures from 900°C to 950°C (Rasmussen, C-E Environmental, February 1989). "Continued bed agitation by the fluidizing air allows larger particles to remain suspended in the combustion zone." (U.S. EPA, November 1986). Fluidized bed combustion units can handle a variety of solid and liquid wastes. However, wastes with a high ash content can foul the bed. Wastes containing chlorine or sulfur may require the addition of lime or sodium carbonate to absorb acid gases. Another limitation is that low melting point constituents may melt, become sticky, and defluidize the bed.

Circulating Bed - The circulating bed combustion unit is a continuous process similar to the fluidized bed combustion unit. The circulating bed unit can also handle solid and liquid wastes. Air is driven into the bottom of the combustion chamber to promote rapid mixing and provide a high heat exchange between the particles. Flue gases and treated particles pass through the top of the combustion chamber. The flue gases are quenched and filtered of any particulates which may remain. The particles that pass through the top of the combustion chamber are initially separated from the flue gases by a cyclone filter. These filtered particles are mixed with fresh feed soil and fed back into the bottom of the

combustion chamber. Ash is removed from the bottom of the combustion chamber. By using high turbulence and recirculating some of the waste, more complete combustion can occur. This results in lower quantities of process emissions and lower operating temperatures, which may reduce operating costs. Circulating bed combustors operate at temperatures between 800°C and 900°C with gas residence times of 2 to 3 seconds. Solid residence times are usually from 2 to 3 minutes (H. Diot, Ogden Environmental Services, February 1989). Due to the high efficiency of combustion in the recirculating system, no secondary destruction chamber is required. Therefore, the flue gas is simply quenched, sent through a dust filter, and emitted through a stack.

Infrared - Infrared incineration is a relatively new process that has been tested at a number of sites. Material to be processed is fed into a metering conveyer located at the feed end of the furnace. The primary chamber consists of a rectangular cross section "box" fabricated from carbon steel, lined with layers of lightweight ceramic fiber blankets mounted on stainless steel studs, and retained with ceramic fasteners. The material to be processed is conveyed through the furnace on a woven wire belt, which is supported on high-temperature alloy rollers. In the primary chamber, the wastes are passed under a series of transversely-mounted heating elements. These elements, which provide the infrared energy, are silicon carbide glow rods with external electrical connections at both ends. When the processed material reaches the discharge end of the furnace, it drops off the belt through a chute and into an enclosed hopper. The exhaust gases pass into the secondary chamber. The secondary chamber is similar in construction to the primary chamber and also uses ceramic fiber blanket insulation. An auxillary fuel fired burner is used to ignite combustible gases present in the exhaust and burn them at a predetermined temperature. This process can also operate at a variety of atmospheres, including oxidizing, reducing, or starved air mode. When the infrared incinerator is run in a starved air mode, it destroys the wastes in a pyrolytic manner (U.S. EPA, November 1985). The primary desorption chamber operates at temperatures of 500°C to 800°C with a sample retention time of 10 to 45 minutes. The secondary combustion chamber operates at 1200°C and a gas residence time of 2 to 30 seconds (des Rosiers, U.S. EPA, May 1987).

Pyrolysis - Pyrolysis units, also called controlled air or starved air incinerators, are another major technology used for hazardous waste thermal destruction. These are batch treatment systems that slowly volatilize or distill off the organics at relatively low temperatures. Pyrolysis treatment is a two-stage combustion process. The waste is ram-fed into the first stage, or primary chamber, and burned at roughly 50 to 80 percent of the stoichiometric air requirements at 500°C to 700°C. This starved air condition is created by a low air flow rate. This causes most of the volatile fraction to be destroyed pyrolytically, with the required heat provided by the oxidation of the carbonaceous fraction in the waste. The solid or sample residence times are usually long (minutes) and depend upon the type of sample. The resultant smoke and pyrolysis products consist primarily of volatile hydrocarbons and carbon monoxide, along with products of combustion. The combination of low temperatures and low air flow in the primary chamber yields a gas stream that is relatively low in metals and particulates. The gas stream from the primary chamber passes to the second stage or secondary chamber operated at 1200°C with a gas residence time of a few seconds (I. Licis, U.S. EPA, February 1989). Here additional air is injected to complete the combustion, which can occur either spontaneously or through the addition of supplementary fuels. It is this two-stage process that generally allows low stack emissions. The primary chamber combustion reactions and turbulent velocities are maintained at low levels by the starved air conditions so that particulate entrainment and carryover are minimized (U.S. EPA, November 1986). This technology is especially useful when treating wastes containing both metals and organics. The volatile organics are released in the primary chamber and destroyed in the secondary chamber. At the relatively low primary combustion temperatures and low excess air, the metals usually become bound in the char residue and do not overload the secondary combustion system. The main drawback to pyrolytic systems is the low throughput of waste, since a high residence time is required to ensure complete volatilization of organics.

Wet Air Oxidation and Aqueous Thermal Decomposition - Thermal destruction processes that do not use an open flame include wet air oxidation and aqueous thermal decomposition. Both processes incorporate the waste into anaqueous solution and elevate the temperature

and pressure. In low temperature wet air oxidation, temperatures range from 200°C to 300°C with residence times of 1 hour or more. Wet air oxidation, above the critical temperature of water, operating at 600°C and 3400 psi to 3700 psi (Super Critical Water Oxidation), has demonstrated the destruction of PCBs and RCRA wastes and requires less than a minute's residence time (Killilea, Modar Inc., February 1989). By this action, the contaminants are decomposed into simple organic compounds by the aqueous thermal decomposition process while wet air oxidation uses these conditions to dissolve more oxygen into solution, thereby oxidizing the contaminants (USATHAMA, January 1985). Data are available for the aqueous thermal decomposition of explosives, but data are limited for wet air oxidation.

Waste Characteristics Affecting Performance

The contaminant content coupled with the physical and chemical waste properties of the matrix must be considered to determine which thermal destruction process is most appropriate for treatment. These considerations include the actual compounds present in the waste, their concentrations, and the combustion temperature of the contaminant.

The combustion temperature of a contaminant defines the minimum operating temperature of a thermal destruction unit. The specific compounds and concentration ranges present in the waste can also affect treatment performance. Alkali metal salts, particularly sodium and potassium sulfate, and elevated levels of organic phosphorous compounds cause refractory attack and slagging at high temperatures. High halogen concentrations in the presence of oxygen and moisture in the gas stream, form acids which are extremely corrosive and attack refractory metals and metallic pollution control devices. Elevated chlorine concentrations decrease the heating value of the waste and increase the emission of HCl. Volatile metals produce emissions that are difficult to remove with conventional air pollution control equipment. Thermal destruction is not useful for wastes containing non-volatile metals because these inorganics are not destroyed and remain in the ash residue. At high temperatures (>1375°C), these metals may slag, and the generation of oxides of nitrogen can increase significantly.

Heterogeneity of the waste matrix and debris content are two other factors that greatly affect the treatment performance. A thermal destruction process is selected and optimized based on an expected contaminant concentration. However, a non-homogeneous waste such as a Superfund soil, often contains "hot spots" or high contaminant concentrations localized in the matrix. A thermal destruction unit may not be capable of handling the surges created by this phenomenon. As a result, there may be heavy particulate carryover into the afterburner or the particulate removal systems. Stack emissions may rise above acceptable limits. Debris that enters the thermal destruction unit may cause these same results by "occluding" (shielding) the waste from treatment. Debris such as drums, polyurethane bags, and other materials may also interfere with the process by lowering the operating temperature or by slagging and fouling the equipment.

Preprocessing can compensate for the effects of heterogeneity and debris content. Preprocessing may include screening and mixing as well as crushing to provide a consistent particulate size and homogeneity more suitable for treatment. Although extensive preprocessing will appear to increase capital and O&M costs, the tests performed have demonstrated the economic advantage of these preliminary operations compared to the costs of operating the primary process over a broader range of conditions. The extensive equipment repair and replacement costs and the ripple effects caused by equipment downtime, experienced at some hazardous waste sites to date, strongly support the use of extensive preprocessing of the soil wastes.

Other waste properties that affect treatment performance include moisture content, heating value, and special properties such as explosive content. The moisture content affects treatment performance by decreasing the heating value of a waste. Therefore, more energy has to be added to the process. The heating value is defined by the amount of energy released when a waste is oxidized. Some of this energy is used to fire subsequent waste as it enters the combustion chamber. Thus, once combustion is started in the chamber, enough energy must be added to the unit to make up the difference between the energy released during combustion (heat of combustion) and the energy needed to

maintain the operating temperature. Explosives also present a problem because a waste containing high explosive concentrations may produce excessive heat or even explosions during incineration.

Design and Operating Parameters Affecting Performance

The design and operating parameters that affect treatment performance include temperature, residence time, turbulence (degree of mixing), quantity of excess oxygen, and air handling design.
These are defined as follows:

Temperature - The optimum operating temperature must be high enough to maintain combustion. Thus, it must remain above the contaminant ignition temperature. The temperature must also be high enough for complete combustion of the waste components to occur. Because some intermediate products are more stable than the initial products, the temperature must also be high enough to combust these products. This is often accomplished in a two-phase system consisting of primary and secondary combustion chambers. The maximum temperature must also be controlled. Combustion chamber temperatures should not reach the point at which ash turns into a molten agglomerate.

Residence Time - The residence time also affects the degree of combustion. For cost-effective operation, the residence time must be minimized, but maintained long enough to ensure complete combustion. This time is a significant factor affecting system capacity, throughput, and cost.

Turbulence (Degree of Mixing) - The most difficult variable to quantify is the degree of mixing. Sufficient mixing (or turbulence), with temperature and residence time, is necessary to effectively ensure that the entire matrix is efficiently treated by the process.

Quantity of Excess Oxygen - The quantity of oxygen that is theoretically required to complete combustion is the stoichiometric requirement. Because no process is 100% efficient, excess oxygen, usually as air, must be provided beyond the stoichiometric amount to ensure complete combustion. Otherwise, undesirable products of incomplete combustion are formed, such as carbon monoxide. The amount of air introduced into the combustion chambers must also be closely monitored to ensure that the presence of too much air does not lower the temperature or "choke" the combustion process.

Air Handling Design - Air handling for thermal destruction includes the particulates catch and scrubber design. Each component must be designed not only to remove particulates and gases, but also to handle surges in the process. Careful attention should be given to air handling design to ensure adequate emissions treatment prior to release of the final product gases to the atmosphere. The further treatment and disposal requirements of the particulates catch and effluent scrubber water must also be considered.

Ash Generation and Disposal

The incineration of soils generates large amounts of ash and residue. Ash characteristics will depend on the type of thermal destruction process. Very little information is available in the literature on the type of ash generated by different incineration technologies.

When treating soils by incineration, the characteristics of the treated soil will provide important information on the ultimate disposal of the ash. Bench scale tests should be performed to determine the characteristics of the ash that may be generated during full scale treatment tests. A muffle furnace could be used to generate ash that would be similar in heavy metals content to the ash produced by some full scale systems. Attempts should be made to simulate full scale incineration temperatures in the laboratory. However, a muffle furnace may not be accurate to simulate high temperatures and short residence times in some afterburners (U.S. EPA, September 1988). Sample quantities should be large enough to allow for subsequent total waste constituent, EP Toxicity, and TCLP testing. Information gained from testing ash and treated soils will be very useful during feasibility study preparation, since test results will reveal whether delisting of the waste is possible. If the ash still meets hazardous waste criteria and requires further treatment, the costs of the incineration alternative can increase substantially.

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3.2 DECHLORINATION

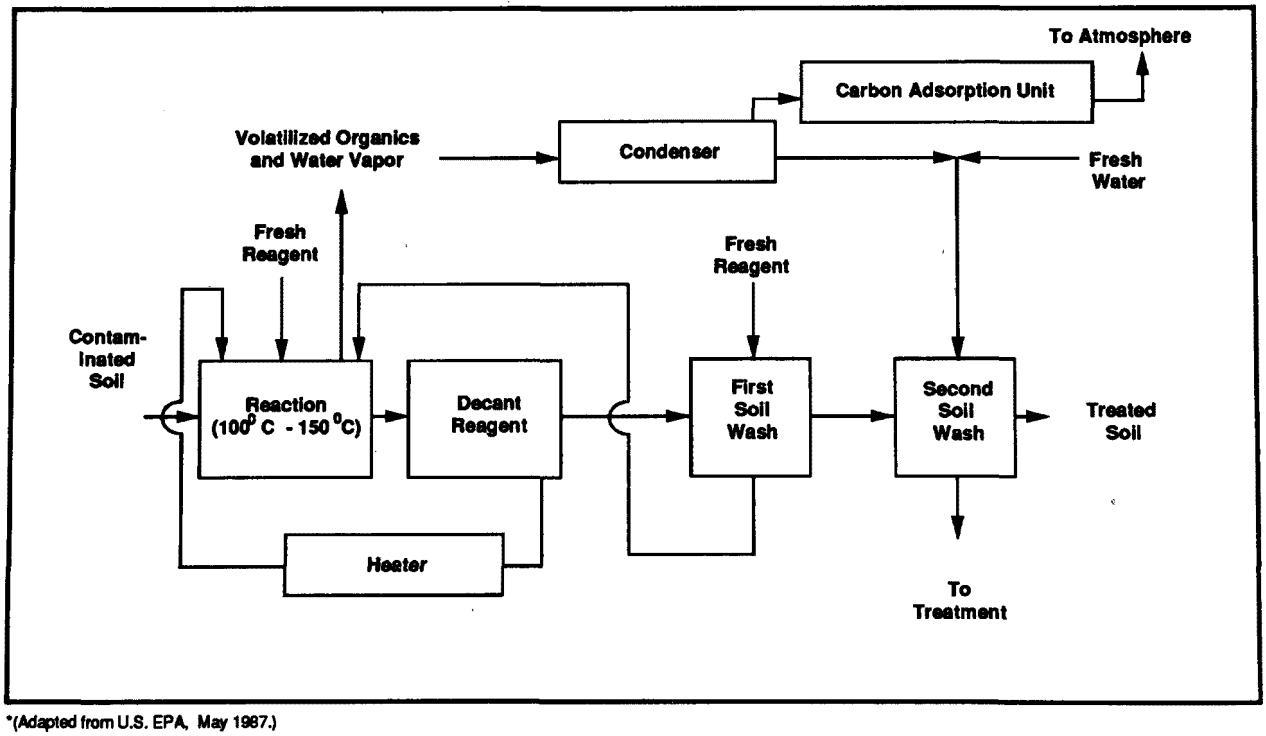
Description and Applicability

Dechlorination is a destruction process which uses a chemical reaction to remove the chlorine atoms in chlorinated molecules. This converts the more toxic compounds into less toxic, more water soluble products. This transformation of contaminants within the soil results in compounds that are more readily removed from the soil and subsequently treated (Rogers, July 1987). Figure 3-3 is a schematic flow diagram of this technology.

Field and laboratory tests have identified several types of solutions which can dechlorinate PCBs, dioxins, and furans. These solutions include potassium polyethylene glycolate (KPEG), sodium polyethylene glycolate (NaPEG), and methoxypolyethylene glycolate (MPEG). These processes are generally classified as alkali polyethylene glycolate (APEG). Another type of dechlorination treatment, referred to as the Sea Marconi's CDP-process, uses high molecular weight polyethylene glycolates (1500 to 6000) in combination with potassium carbonate and inorganic peroxide (i.e., sodium peroxide). This process has been proven to destroy 2,3,7,8-tetrachlorodibenzo-p-dioxin in solvents and soils as well as on hard surfaces (U.S. EPA, October 1986).

Halogenated aromatic compounds are dechlorinated by a nucleophilic substitution reaction in which a chlorine atom is replaced by an ether or hydroxyl group. Chlorinated aliphatic compounds are dechlorinated by an elimination reaction and the formation of a double or triple carbon-carbon bond (Morrison and Boyd, 1973).

The toxicity of the original waste is reduced by removal of chlorine atoms. Treatability studies should identify resulting byproducts; these by-products may require subsequent treatment to destroy all remaining contaminants. Bioassay tests revealed that neither tetrachlorobenzene nor APEG reaction by-products accumulated in fathead minnows, caused cell mutations, or caused immediate harm to fish or mammals (des Rosiers, U.S. EPA, July 1987; des Rosiers,



*(Adapted from U.S. EPA, May 1987.)

Figure 3-3. Dechlorination Flow Diagram

U.S. EPA, 1989). The water solubleby-products are expected to biodegrade to CO_2 and water (des Rosiers, U.S. EPA, February 1989). Earlier studies indicated that not all of the chlorines were removed by the process (Rogers and Peterson, 1985). However, recent data indicate that essentially all of the chlorine can be removed by the process (des Rosiers, U.S. EPA, 1989).

The contaminated soils must be slurried with the solution to maximize contact and enable the chemical reactions to occur. The presence of moisture at 4% to 10% (U.S. EPA, April 1984; des Rosiers, U.S. EPA, October 1988), or high concentrations of reactive metals such as aluminum or transition metals, hinders the dechlorination process. To date, no full scale soil treatment programs have been undertaken using dechlorina-tion. However, two mobile systems are being employed and are anticipated to be in full operation in 1989. Additionally, a mobile APEG process was used to treat liquid chlorinated hazardous wastes at a Superfund site. A removal efficiency of greater than 99% was obtained for oils contaminated with dioxins and polychlorinated phenols (des Rosiers, U.S. EPA, 1989).

Equipment for the dechlorination process consists of a reagent drum, drum pumps, a reaction vessel, a carbon filter drum, a heater, and a condenser. In addition, several soil wash/rinse units and a carbon adsorption unit may also be required.

The effectiveness of this treatment technology on soil contaminants is summarized in Figure 3-4. The dechlorination process has been shown to successfully treat PCBs, dioxins, and furans in bench scale treatability studies. Removal efficiencies of up to 95% (W02) have been achieved by these studies with an average removal efficiency of 83% from the available data. These results came predominantly from bench scale studies; however, no full scale data are available to support these findings at this time. Therefore, due to the uncertainties concerning successful scale-up, it is predicted that dechlorination is potentially effective on this technology group.

Dechlorination may also be potentially effective in treating halogenated aliphatic (W04) and nonpolar halogenated organic compounds (W01). However, the degradation products from the APEG treatment of halogenated aliphatic compounds include acetylene (Rogers, U.S. EPA, June 1988; Morrison and Boyd, 1973). Acetylene is an extremely volatile and potentially explosive compound which may also form acetylides. Several of these metal acetylides, particularly those of copper and silver, are very unstable and can explode upon drying (Morrison and Boyd, 1973).

No data were available for halogenated cyclic alipatics, ethers, esters, and ketones (W05). However, data for compounds with similar physical and chemical characteristics suggest that dechlorination is potentially effective on these compounds.

The limited available data suggest that the APEG solutions may also be potentially effective on other halogenated polar aromatic compounds (W03). Wastes contaminated with non-halogenated organic compounds and inorganic compounds cannot be treated by dechlorination, because of the absence of chlorine in these treatability groups. It is possible that contaminants in these treatability groups may volatilize into the air stream or transfer into the reagent during treatment of halogenated compounds. Dechlorination may be used as part of a treatment train to treat waste mixtures which contain halogenated and non-halogenated organic compounds and inorganic compounds.

The presence of reactive metals (e.g., aluminum) under alkaline conditions may be deleterious to the dechlorination process. If these contaminants are present in the waste matrix, a suitable pretreatment may be necessary to remove them prior to the dechlorination treatment (U.S. EPA, September 1988).

Dechlorination of some non-halogenated compounds (W07, W08, and W09) generated average removal efficiencies ranging from 91% to 99%. Because these compounds are non-halogenated, these removal efficiencies could not be due to dechlorination. These removal efficiencies appeared to be caused by volatilization at the elevated temperatures used in dechlorination processes, or by the dechlorination process acting as a soil washing process. Therefore, dechlorination was predicted to be ineffective on all non-halogenated compounds. However, these anomalies should be considered and may be

TREATABILITY GROUP	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % REMOVALS	GENERAL OBSERVATIONS
NON-POLAR HALOGENATED AROMATICS (W01)	8 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 190 TREATED 1.6 AVERAGE REMOVAL EFFICIENCY 98 %	• Data were for chlorobenzene only. These data suggest that this technology is potentially effective in certain situations.
PCBs, HALOGENATED DIOXINS, FURANS, AND THEIR PRECURSORS (W02)	31 PAIRS 97 % BENCH 3 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 180 TREATED 1.6 AVERAGE REMOVAL EFFICIENCY 83 %	• This technology is potentially effective, especially for sandy soils. • Data on sludges show better removal due to more uniform distribution of contaminants and better reagent contact. • Lower initial concentrations give lower removal efficiencies. • Moisture content over 4 to 7% deactivates the NaPEG reagent. • Particle size and soil matrix affect reagent penetration and process effectiveness. • Recent data indicate that greater than 99% of PCBs and furans can be destroyed (des Rosiers, 1988).
HALOGENATED PHENOLS, CRESOLS, AMINES, THIOLS, AND OTHER POLAR AROMATICS (W03)	8 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 98 TREATED 2.4 AVERAGE REMOVAL EFFICIENCY 96 %	• Data were for pentachlorophenol only. These data suggest that this technology is potentially effective in certain situations. • Recent data indicate that greater than 99% of contaminants can be destroyed (des Rosiers, 1988).
HALOGENATED ALIPHATIC COMPOUNDS (W04)	16 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 330 TREATED 0.44 AVERAGE REMOVAL EFFICIENCY 98 %	• These data suggest that this technology is potentially effective in certain situations. • Some halogenated aliphatics react with the APEG reagents to form explosive compounds, especially in the presence of heavy metals. The potential for this to occur should be evaluated in the laboratory before dechlorination treatment is selected. • The high removal efficiency may be the result of volatilization or the APEG process acting as a soil washing process.
HALOGENATED CYCLIC ALIPHATICS, ETHERS, ESTERS, AND KETONES (W05)	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• Data were not available for this treatability group. Data for compounds with similar physical and chemical characteristics suggest that this technology is potentially effective in certain situations. Treatability studies will be needed to confirm the technology's effectiveness.
NITRATED COMPOUNDS (W06)	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• Data were not available available for this treatability group. • The physical and/or chemical characteristics of the constituents of this treatability group indicate that this technology would not be effective.

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Figure 3-4. Final Conclusions by Treatment Technology — Dechlorination

TREATABILITY GROUP	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % REMOVALS	GENERAL OBSERVATIONS
HETEROCYCLICS AND SIMPLE NON-HALOGENATED AROMATICS (W07)	24 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 2,200 TREATED 23 AVERAGE REMOVAL EFFICIENCY 99 %	• The physical and/or chemical characteristics of the constituents of this treatability group suggest that this technology would not be effective. • The high removal efficiency may be the result of volatilization or the APEG process acting as a soil washing process.
POLYNUCLEAR AROMATICS (W08)	5 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 3,600 TREATED 180 AVERAGE REMOVAL EFFICIENCY 91 %	• The physical and/or chemical characteristics of the constituents of this treatability group suggest that this technology would not be effective. • The high removal efficiency may be the result of volatilization or the APEG process acting as a soil washing process.
OTHER POLAR NON-HALOGENATED ORGANIC COMPOUNDS (W09)	16 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 1,700 TREATED 30 AVERAGE REMOVAL EFFICIENCY 96 %	• The physical and/or chemical characteristics of the constituents of this treatability group suggest that this technology would not be effective. • The high removal efficiency may be the result of volatilization or the APEG process acting as a soil washing process.
NON-VOLATILE METALS (W10)	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• The physical and/or chemical characteristics of the constituents of this treatability group suggest that this technology would not be effective.
VOLATILE METALS (W11)	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• The physical and/or chemical characteristics of the constituents of this treatability group suggest that this technology would not be effective.

Figure 3-4. Final Conclusions by Treatment Technology — Dechlorination (Cont.)

8/21/90

useful in developing a treatment process or treatment train for mixed wastes.

Basic Principles of Operation

In the batch dechlorination process, the contaminated soil is placed into the reaction drum where it is slurried with the dechlorination reagent which has been preheated. Water vapor from the reaction drum is processed through a condenser and a carbon filter drum prior to discharge. Vigorous mixing and increasing the temperature and reaction time will ensure complete destruction of the contaminants.

Finally, the soil is washed to remove excess reagent from the soil matrix. The soil washing/rinsing is usually performed twice, but the rinsing may be conducted even more often to ensure that no reagent remains in the soil. By-products from the process (usually metal chlorides and biphenyl compounds) may be treated using activated carbon (after pH adjustment), ion exchange, bioremediation, or immobilization.

Waste Characteristics Affecting Performance

Water vapor and moisture in the soil can deactivate APEG reagents. Care must be taken since the dechlorinating agents are very hygroscopic and can absorb water from the air. When sodium polyethylene glycolate is used, a moisture content of 4% to 10% in the soil matrix can deactivate the dechlorination process (U.S. EPA, April 1984; des Rosiers, U.S. EPA, October 1988). Preheating the soil matrix before dechlorination to remove moisture content may considerably improve the process efficiency. Heating the reagents enhances the rate of dechlorination (Rogers and Peterson, September 1985).

Dechlorination as a chemical destruction process is affected by the permeability of the soil matrix. Particle size distribution and clay content can significantly affect the ability of the dechlorination reagents to penetrate the contaminated soil matrix (U.S. EPA, May 1987). However, dioxins have a tendency to chemisorb or bond with the soil particles (des Rosiers, U.S. EPA, February 1989). This characteristic, when coupled with non-uniform distribution of the contaminant throughout the soil matrix, reduces the effectiveness of dioxin destruction by the dechlorination reagents.

Organic contaminants in the soil matrix may be adsorbed on the surface or absorbed within the soil particles, in the micropores of the soil, or even wrapped up in the helical humic structures present in some soils. Extraction of dioxin from the micropores of the soil matrix can be expected to occur more slowly than extraction from the surface of the soil particles. The rate of reaction for the dechlorination process is notably higher for liquids than for soils. This is consistent with available data which reveal better removal of dioxins from sludges than from soils. In addition, the appropriateness of dechlorination for mixed wastes (especially those containing halogenated aliphatics) should be evaluated in the laboratory, because an explosion hazard may be present when dechlorinating these compounds.

Design and Operating Parameters Affecting Performance

The design and operating parameters which influence the effectiveness of the dechlorination process are soil moisture and type, degree of mixing, reaction time, PEG:soil:contaminant ratio, pH control, temperature, and solvent and PEG recoveries. These parameters are summarized as follows:

1. *Soil moisture and type* - Water bound in the soil deactivates the alkali polyethylene glycolate reagent. The soil should be dried before reagent is added. The type of soil will also affect the amount of time necessary to treat contaminated soils with the APEG reagents. Contaminants can be bound tightly to certain soils, hence reaction times and temperatures may have to be varied to effectively remove the contaminants.

2. *Degree of mixing* - The degree of mixing between the soil and the polyethylene glycolate (APEG solution) is a critical factor. The degree of mixing needs to be thorough to ensure that the contaminant in the soil makes intimate contact with the dechlorination reagent. Creating a slurry may improve removal efficiencies.

3. *Reaction time* - Reaction time between the contaminant and the dechlorination reagent must be sufficient to ensure that all

possible reactions occur. This must be determined experimentally depending on the type and amount of solvent and physical and chemical characteristics of the soil.

4. *APEG:soil:contaminant ratio* - This ratio is dependent on the type of APEG, the initial contaminant concentration, the solvent used (usually dimethyl sulfoxide), and the soil type. As a general rule, two and a half times more APEG reagent than the maximum number of chlorine atoms on contaminant molecules is required to effectively dechlorinate (des Rosiers, U.S. EPA, February 1989).

5. *pH control* - The pH is extremely important to the operation of the process. It has been reported that the pH should be raised above 12 before adding APEG reagent. *Continuous monitoring to ensure that the pH is maintained in the proper range during the treatment process is recommended.

6. *Temperature* - The optimum temperature range for dechlorination varies depending on the compounds present. Typically, the reaction is run at about 100°C, but dechlorination of some compounds may require temperatures up to 150°C.

7. *Solvent and APEG recoveries* - The degree of recovery of solvent following the dechlorination treatment is important to the overall economics of the process. Recovery of APEG reagents by distillation is typically only about 50%, while washing is significantly more successful, yielding 94% to 99% recovery of the reagent.

*Contaminated soils containing organic esters, such as n-butyl esters of 2,4,-D and 2,4,5-T, must be pretreated with potassium hydroxide to a pH above 12 prior to adding APEG reagent to avoid wasting the special dechlorinating reagent.

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3.3 BIOREMEDIATION

Bioremediation is a destruction process which uses soil microorganisms to chemically degrade organic contaminants. The microorganisms can include bacteria, fungi, and yeasts (Cheremisinoff, 1986). Biodegradation can occur in the presence or in the absence of oxygen. In the presence of oxygen (aerobic), bacteria, fungi, and yeasts biodegrade organics to carbon dioxide, water, and cell protein. In the absence of oxygen (anaerobic), they biodegrade the waste to generate methane, carbon dioxide, and cell protein (U.S. EPA, November 1986). Two typical bioremediation processes which can be applied to soils are composting, depicted in Figure 3-5, and activated sludge, depicted in Figure 3-6.

The effectiveness of this treatment technology on soil contaminants is summarized in Figure 3-7. The data base suggests that halogenated aliphatic compounds (W04) and the polar non-halogenated organic compounds (W09) are successfully treated biologically with average removal efficiencies in excess of 99%. However, it is unclear from the data base if these results represent actual destruction or if the contaminants from the biomass/waste mixture volatilized as a result of handling or heating the contaminated soil during treatment. In one study, the results indicated that volatilization was the removal mechanism, not biodegradation (U.S. EPA, June 1987). In another study, measurements indicated that trichloroethylene volatilized from a compost within several hours (USATHAMA, May 1986). If volatile emissions can be controlled, then biological treatment may be potentially effective on these wastes.

The data base indicates that biological treatment of nitrated compounds (W06) and polynuclear aromatic compounds (W08) has been achieved, with average removal efficiencies of 82% and 87%, respectively, in pilot scale studies. Therefore, biological treatment is predicted to be potentially effective on these groups of contaminants also.

Bioremediation is more successful with non-halogenated compounds than with halogenated compounds. The data base indicates that non-halogenated aromatics (W01) and heterocyclics (W07), have exhibited average removal efficiencies of 99%. Halogenated aliphatic compounds were also successfully treated; however, the average of 99% removal from the available data may be a result of volatilization in addition to bioremediation. As expected, the data base indicates that the more complex halogenated compounds (W01 and W03) exhibited lower removal efficiencies, ranging from 53% to 74%. In addition, poly-halogenated compounds may be toxic to many microorganisms; however, recent research indicates that various species of white rot fungi are capable of degrading these halogenated compounds. Bioremediation is predicted to be potentially effective on halogenated compounds.

One data pair for PCBs (W02) from a pilot study yielded a removal efficiency of 99%, suggesting that bioremediation may be able to treat soils containing PCBs. However, one data pair does not provide sufficient support to conclude that bioremediation is effective for this treatability group. No data were available in the data base on bioremediation of dioxins, furans, or their precursors. A decision to biologically treat these contaminants must be made on a case-by-case basis and confirmed with treatability studies. Ongoing research may develop biological processes to treat these halogenated wastes. Bioremediation of these compounds may be feasible, especially if the overall concentrations are low.

No data were available in the data base to evaluate the effectiveness of biologically treating halogenated cyclic aliphatics, ethers, esters, and ketones (W05). Data for compounds with similar physical and chemical characteristics imply that bioremediation may potentially be effective on these wastes.

Biological processes are not suitable for the treatment of wastes with high levels of metals (W10 and W11). The metal contaminants are not destroyed by the organisms and high levels of metals in the waste may be toxic to the organisms, thereby reducing the effectiveness of this process on the organic portion of the waste. Metal salts also present a problem, because high concentrations may be inhibitory or toxic to many microorganisms.

Basic Principles of Operation

There are two categories of bioremediation, anaerobic and aerobic. While anaerobic biological processes have been shown to be effective in treating complex organic wastes that generally cannot be treated aerobically (e.g.,

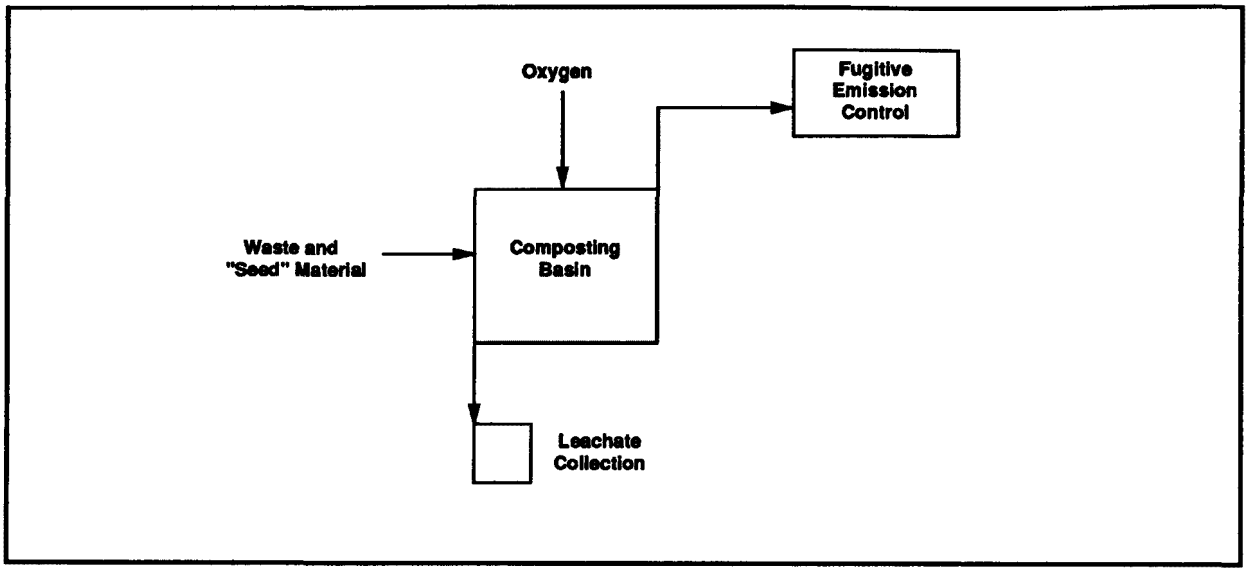
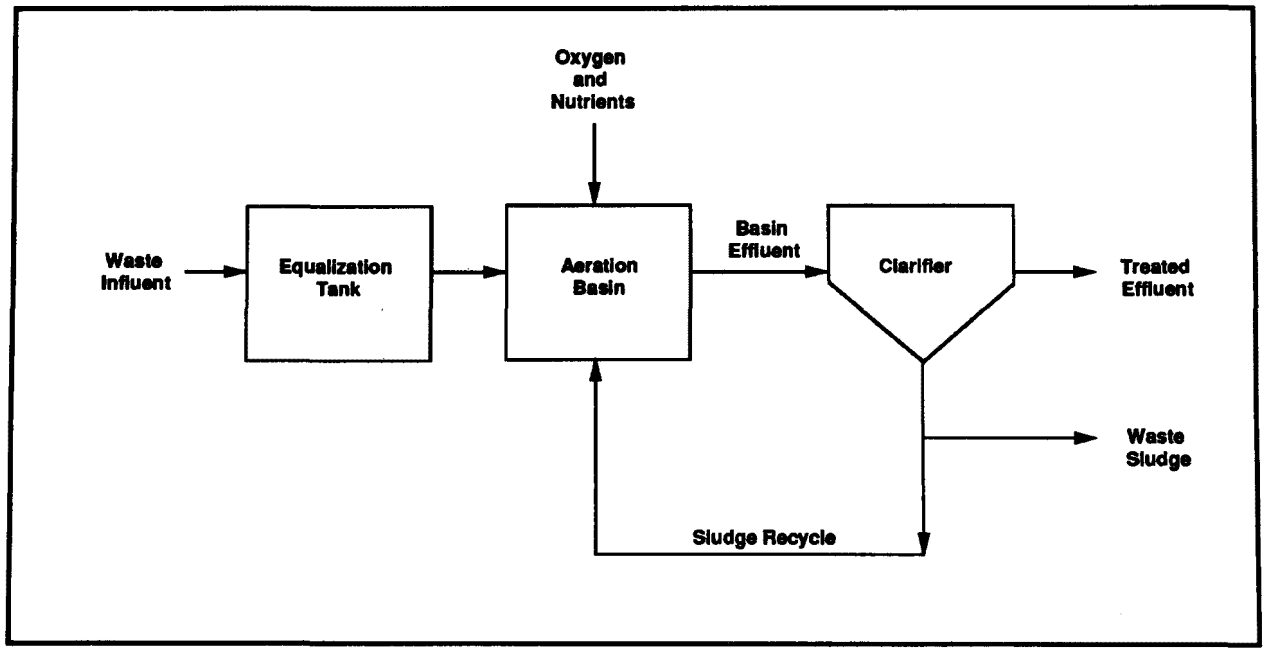


Figure 3-5. Composting Flow Diagram



*(Modified from U.S. EPA, November 1986.)

Figure 3-6. Activated Sludge Flow Diagram

TREATABILITY GROUP	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % REMOVALS	GENERAL OBSERVATIONS
NON-POLAR HALOGENATED AROMATICS (W01)	66 PAIRS 95 % BENCH 5 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 2.9 TREATED 0.79 AVERAGE REMOVAL EFFICIENCY 53 %	• This technology is not effective for all contaminants in this class; however, there is potential for effectiveness for low initial concentrations with further development. • The presence of these contaminants at low concentrations is not expected to interfere with the treatment of applicable wastes. • The effectiveness of this technology may be different than the data imply, because the initial concentrations in these tests were so low.
PCBs, HALOGENATED DIOXINS, FURANS, AND THEIR PRECURSORS (W02)	1 PAIRS 0 % BENCH 100 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 2,000 TREATED 0.12 AVERAGE REMOVAL EFFICIENCY 99 %	• The lone data pair is PCBs. • Ongoing research suggests that this technology may be potentially effective for this group.
HALOGENATED PHENOLS, CRESOLS, AMINES, THIOLS, AND OTHER POLAR AROMATICS (W03)	3 PAIRS 0 % BENCH 100 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 83 TREATED 17 AVERAGE REMOVAL EFFICIENCY 74 %	• This technology is potentially effective for low initial concentrations. • Bioremediation requires uniformly mixed media with small particle sizes. • Toxic compounds such as cyanides, arsenic, heavy metals, and some organics adversely affect the treatment. • Preprocessing includes mixing and nutrient and organism addition. • Bioremediation is a slow process. • Bioremediation has low costs relative to other technologies.
HALOGENATED ALIPHATIC COMPOUNDS (W04)	27 PAIRS 0 % BENCH 100 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 23 TREATED 0.027 AVERAGE REMOVAL EFFICIENCY >99 %	• This technology is potentially effective for low initial concentrations. • Bioremediation requires uniformly mixed media with small particle sizes. • Toxic compounds such as cyanides, arsenic, heavy metals, and some organics adversely affect the treatment. • Preprocessing includes mixing and nutrient and organism addition. • Bioremediation is a slow process. • Bioremediation has low costs relative to other technologies. • Removal may actually represent volatilization during preprocessing and treatment.
HALOGENATED CYCLIC ALIPHATICS, ETHERS, ESTERS, AND KETONES (W05)	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• Data were not available for this treatability group. Data for compounds with similar physical and chemical characteristics suggest that this technology may be potentially effective in certain situations with low initial concentrations.
NITRATED COMPOUNDS (W06)	22 PAIRS 0 % BENCH 100 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 13,000 TREATED 1,400 AVERAGE REMOVAL EFFICIENCY 82 %	• This technology is potentially effective on these contaminants, especially at low concentrations. • Some of the available data for this treatability group were based on very high initial concentrations; however consideration should be given to the ability of the technology to treat high initial concentrations. • Bioremediation requires uniformly mixed media with small particle sizes. • Toxic compounds such as cyanides, arsenic, heavy metals, and some organics adversely affect the treatment. • Preprocessing includes mixing and nutrient and organism addition. • Bioremediation is a slow process. • Bioremediation has low costs relative to other technologies.

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Figure 3-7 Final Conclusions by Treatment Technology — Bioremediation

TREATABILITY GROUP	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % REMOVALS	GENERAL OBSERVATIONS
HETEROCYCLICS AND SIMPLE NON-HALOGENATED AROMATICS (W07)	54 PAIRS 0 % BENCH 100 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 220 TREATED 0.025 AVERAGE REMOVAL EFFICIENCY >99 %	• This technology is potentially effective for low initial concentrations. • The high removal indicated by the data may actually represent volatilization during preprocessing and treatment. • Bioremediation requires uniformly mixed media with small particle sizes. • Toxic compounds such as cyanides, arsenic, heavy metals, and some organic compounds adversely affect treatment. • Preprocessing includes mixing and nutrient and organism addition. • Bioremediation is a slow process. • Bioremediation has low costs relative to other technologies.
POLYNUCLEAR AROMATICS (W08)	37 PAIRS 19 % BENCH 81 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 120 TREATED 3.8 AVERAGE REMOVAL EFFICIENCY 87 %	• This technology is potentially effective for low initial concentrations. • Bioremediation requires uniformly mixed media with small particle sizes. • Toxic compounds such as cyanides, arsenic, heavy metals, and some organic compounds adversely affect treatment. • Preprocessing includes mixing and nutrient and organism addition. • Bioremediation is a slow process. • Bioremediation has low costs relative to other technologies.
OTHER POLAR NON-HALOGENATED ORGANIC COMPOUNDS (W09)	22 PAIRS 0 % BENCH 100 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 64 TREATED 0.32 AVERAGE REMOVAL EFFICIENCY >99 %	• This technology is potentially effective for low initial concentrations. • Bioremediation requires uniformly mixed media with small particle sizes. • Toxic compounds such as cyanides, arsenic, heavy metals, and some organic compounds adversely affect treatment. • Preprocessing includes mixing and nutrient and organism addition. • Bioremediation is a slow process. • Bioremediation has low costs relative to other technologies. • Removal may actually represent volatilization during preprocessing and treatment.
NON-VOLATILE METALS (W10)	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• High concentrations of heavy metals may adversely affect particular organisms. • The physical and/or chemical characteristics of the constituents of this treatability group suggest that the technology would not be effective.
VOLATILE METALS (W11)	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• High concentrations of heavy metals may adversely affect particular organisms. • The physical and/or chemical characteristics of the constituents of this treatability group suggest that the technology would not be effective.

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Figure 3-7. Final Conclusions by Treatment Technology — Bioremediation (Cont.)

organochlorine pesticides), only limited data on these anaerobic processes were available. Therefore, aerobic biological treatment will be the focus of this discussion.

Aerobic processes use organisms (bacteria, yeasts, fungi) which require oxygen (either air or oxygen-containing compounds) for biodegradation of organic contaminants. Additional nutrients in the form of nitrogen and phosphorous are also needed (U.S. EPA, November 1986). Nitrogen and phosphorous must be added at a carbon to nitrogen to phosphorous ratio of 50 to 2 to 1 to optimize biodegradation (U.S. EPA, June 1987). The organisms degrade the organic waste and obtain energy for cell metabolism and cell growth. A fraction of the waste is also oxidized to by-products such as nitrates, sulfates, water, and carbon dioxide. Intermediate degradation by-products must be identified and evaluated for their mutagenicity and carcinogenicity (Louisiana Department of Environmental Quality, 1986). A biomass of organisms, consisting mainly of cell protein, entrained constituents of the waste, partially degraded constituents, and intermediate biodegradation products, is formed during the treatment process. This final treated residue must be disposed. If this residue is classified as a hazardous waste, other treatment technologies will need to be employed prior to disposal (U.S. EPA, November 1986).

Several types of aerobic bioremediation have been used to treat contaminated soils, liquids, and sludges. Some of these processes have been adapted from the activated sewage sludge treatment of sanitary wastewater. Figures 3-5 and 3-6 are schematic flow diagrams of composting and activated sludge bioremediation, respectively. These and other types of bioremediation which have been used to treat sludges and soils are described below.

Landfarming has been used by the petroleum refining industry for some time. Oily wastes are spread over a large area of soil to evaporate the water and biodegrade the organics. These landfarming sites may be used for years, and any metals in the wastes accumulate in the soil (Lorenzen, et al, December 1986). Because operating parameters are difficult to control, landfarming is less effective than other bioremediation techniques. Some of the contaminants infiltrate into the soil, and may affect subsurface soils or ground water. Several newer technologies have been developed that avoid the problems associated with landfarming. Composting has been used to treat nonhazardous wastes for many years, and this technology is now being used for industrial and hazardous wastes. In composting these wastes, the waste is first mixed with organic bulking amendments such as wood chips, straw, or manure to enhance the nutrient supply available to microorganisms, and to make the physical characteristics of the soil more suitable. Microorganisms may be added as part of the organic amendments, or the wastes may be seeded with microorganisms. The resulting mixture is placed into lined containers which may include aeration, temperature control, and leachate collection equipment. Air emission containment and control may be required as well (USATHAMA, May 1986).

Many bioremediation technologies slurry the waste and treat it in bioreactors. Contaminated soil or sludge is slurried with water in a mixing tank or lagoon. These mixers are often aerators, which keep the solids slurried with the water, and add oxygen for microorganisms. Emulsifiers may be added and pH may be adjusted to increase the solubility of the organics. Nutrients may be added as well. As with other forms of bioremediation, air emissions may need to be controlled. After several weeks or months, the contaminant concentrations are reduced to acceptable levels. The solid residue is then separated from the liquids. The liquids may be recycled to the next batch, or discharged to a wastewater treatment plant or surface water (U.S. EPA, November 1986).

Microorganisms

Many sources of microorganisms may be used. Indigenous microorganisms naturally present in the waste may be suitable if the appropriate nutrients are added. Indigenous microorganisms may also be enriched in the laboratory. This is done by collecting microorganisms from the site and gradually feeding them increasing concentrations of the waste under optimum conditions. This builds up the microorganism's tolerance and ability to digest the contaminants. Alternatively, seed microorganisms from agricultural waste or sludge from a sewage treatment plant may be used. In the future, specialized microorganisms may be created by genetic engineering, to clean up particularly toxic contaminants.

Biodegradation of wastes can occur as both an extracellular as well as an intracellular activity. When intra cellular, the organic compound is used as an energy (food) source by the cell (Bopp, 1986 and Biological Sciences Branch, 1987). When extra cellular, the waste is broken down as a result of exposure to enzymes that are produced by the cell in the process of metabolizing other substances, such as glucose (Bumpus, 1987 and 1986). In the latter case, the enzymes are secreted outside the cell membrane, where they come into contact with the waste material and trigger the breakdown action.

Both intracellular and extracellular biodegradation may occur at the same time, by different microorganisms. Alternatively some microorganisms may have both intracellular and extracellular enzyme activity. The characteristics of biodegradation using intracellular and extracellular processes are slightly different, as explained below.

Microorganisms which degrade contaminants intracellularly are absorbing the contaminants into the cell to use as food. High concentrations of contaminants may be toxic to these microorganisms. However, if the concentrations are nontoxic, or if the microorganism is acclimated to the contaminant, the contaminant may degrade relatively rapidly. As the concentration of the contaminant decreases, the food supply for these microorganisms decreases, and the microorganisms begin to die. The rate of degradation of the contaminants decreases, and eventually the contaminant concentrations stabilize. Thus, intracellular biodegradation may not be able to decrease the contaminant concentration as low as concentrations attainable by extracellular biodegradation.

Microorganisms which degrade contaminants extracellularly may be digesting the contaminants to use as food, or may be degrading the contaminants as an unintended by-product of another activity. For example, the enzymes secreted by a fungus to digest cellulose may degrade other compounds as well. Contaminants may be less toxic to these microorganisms, because the compounds are not absorbed into the cell. Extracellular biodegradation may be slower than intracellular biodegradation, because the organism is not benefiting from the process. However, the organism is less affected by the decrease in contaminant concentration, and the rate of contaminant degradation remains relatively constant. Thus, extracellular biodegradation may be able to decrease the contaminant concentration to very low levels.

Waste Characteristics Affecting Performance

Bioremediation systems require that the contaminated soil or sludge be sufficiently and homogeneously mixed to ensure optimum contact with the seed organisms. Another important factor is the level at which a contaminant can be toxic to the organisms in the biomass. Cyanides, certain heavy metals such as arsenic and cadmium, and some products of biodegradation can be toxic at high levels.

The presence of larger particles (>2 cm), especially rocks and debris, does not present serious operating problems for composting. Treatment efficiency may be improved, however, by employing pretreatment methods, to reduce oversized materials and to create a more homogeneous waste matrix. The smaller particles will increase the efficiency of the treatment because of better contact between organisms and contaminants (USATHAMA, September 1982). Activated sludge must have a small and fairly uniform particle distribution which can be slurried and maintained in suspension throughout the process.

For the successful application of bioremediation to soils and sludges, the soil or sludge must be compatible with the physical-chemical and nutritional needs of the organisms. Toxic effects on the organisms must be considered. Treatment process modifications and/or waste pretreatment may also be required to provide the proper environment necessary for maintaining an active population of organisms (U.S. EPA, November 1986).

Design and Operating Parameters Affecting Performance

Many parameters affect the performance of bioremediation systems including equalization basins or areas, nutrients, aeration/oxygen supply, waste-biomass contact time, microorganism growth phase, temperature, pH control, and selection of microorganisms. The ways in which these parameters are controlled are specific to the type of bioremediation process employed (U.S. EPA, November 1986).

The following outlines several important parameters for bioremediation:

Equalization - Equalization homogenizes the feed material to minimize variations in the contaminant load and matrix. This is important because biological treatment is sensitive to variations in untreated flow rate and organic loadings. Sudden changes in these parameters can cause process upsets, toxic effects, or reduced dissolved oxygen levels, all of which will result in diminished treatment efficiency. Sufficient equalization time should be provided to yield a relatively constant loading to the treatment system (U.S. EPA, November 1986).

Nutrients - Nutrient addition is important when controlling the growth of organisms, particularly because insufficient nutrients will result in poor biological growth with poor removal of organic compounds. The principal inorganic nutrients required are nitrogen and phosphorus. The total amount of nutrients required will depend on the net mass of organisms produced. In addition to the major nutrients, trace amounts of potassium, calcium, sulfur, magnesium, iron, and manganese are required for optimum biological growth (U.S. EPA, November 1986).

Aeration/Oxygen Supply - An adequate supply of oxygen is critical to maintain an environment in which aerobic organisms can grow and metabolize the organic material. The oxygen can be provided as atmospheric oxygen or in the form of oxygen-supplying compounds (e.g., peroxides). In bioreactors, the dissolved oxygen concentration in the aeration basin should be maintained close to the saturation level at all times (U.S. EPA, November 1986). In composts, diffusion of oxygen will vary according to the physical and chemical characteristics of the compost. If the supply of oxygen does not keep pace with the needs of the organisms, the oxygen will become a limiting factor. Mechanical aeration, mixing, or the addition of oxygen-containing compounds are effective solutions for this problem (U.S. EPA, June 1987).

Waste/Bio Mass Contact Time - For a specified amount of organic contaminant biodegradation of organic contaminants to be achieved, a sufficient amount of contact between the waste and the organisms must occur. The amount of contact required is a function of the concentration of organic contaminants in the waste. The way in which this contact is achieved varies with the type of biological treatment system used. In bioreactors, contact is maintained by constant mixing and aeration of the biomass/waste mixture. In composting, waste is neither added nor removed, so contact is more difficult to maintain. Contact can be controlled by allowing the contaminants to remain in the compost for the maximum amount of time possible or by blending portions of older composted material with new compost and waste feed.

Microorganism Growth Phase - This parameter can only be controlled in the activated sludge process where biomass (sludge) wasting and recycling are practiced (U.S. EPA, November 1986). In composting and bioreactors, as the concentrations of organisms and waste by-products increase and the concentrations of contaminants are reduced, the population of organisms will plateau and then begin to decrease.

Temperature - Biological growth can occur under a wide range of temperatures, although the majority of the species are active between 20°C and 35°C. The rate of biochemical reactions in cells increases with temperature up to a maximum, above which the rate of activity declines as enzyme denaturation occurs and organisms either die off or become less active. The temperature in bioreactors can be controlled effectively. Composts are more susceptible to temperature variations than are activated sludge systems. This is primarily due to the build-up of heat within the compost as biodegradation occurs and to the large surface area available for heat transfer to and from the atmosphere (U.S. EPA, November 1986). Weather changes can also cause problems in controlling the temperature of the compost. Mechanical aeration can be used as a means to control the temperature of the compost, with increases in aeration resulting in decreases in temperature. The estimation of the critical operating temperature is an important design factor.

pH Control - In general, neutral or slightly alkaline pH levels favor biological growth. The optimum range for most organisms found in biological treatment systems is between 6.0 and 8.0 (U.S. EPA, November 1986). However, fungi often require lower pH levels, usually 4.5 or lower (U.S. EPA, July 1986-January 1987). Treatment effectiveness is generally insensitive to changes within this range; however, pH levels outside of this range can lower treatment performance. The pH of the feed should be monitored and adjusted during pretreatment, in the aeration basin of bioreactors, and during the feed preparation for composts (U.S. EPA, November 1986).

Selection of Microorganisms - The nature and quantities of the toxic constituents in a waste affect the biodegradability of the waste. Organisms differ substantially in their tolerance to toxins and in their ability to degrade compounds at differing concentrations. In all biological treatment systems, the organisms naturally undergo a selection process in which the organisms capable of efficient biodegradation under the given circumstances increase their numbers and other organisms are killed or washed out. Recently, biological additives have been developed that are essentially freeze-dried cultures of special organisms. These cultures can be added to the biological treatment system to enhance and maintain the population of specific organisms (U.S. EPA, November 1986).

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3.4 LOW TEMPERATURE THERMAL DESORPTION

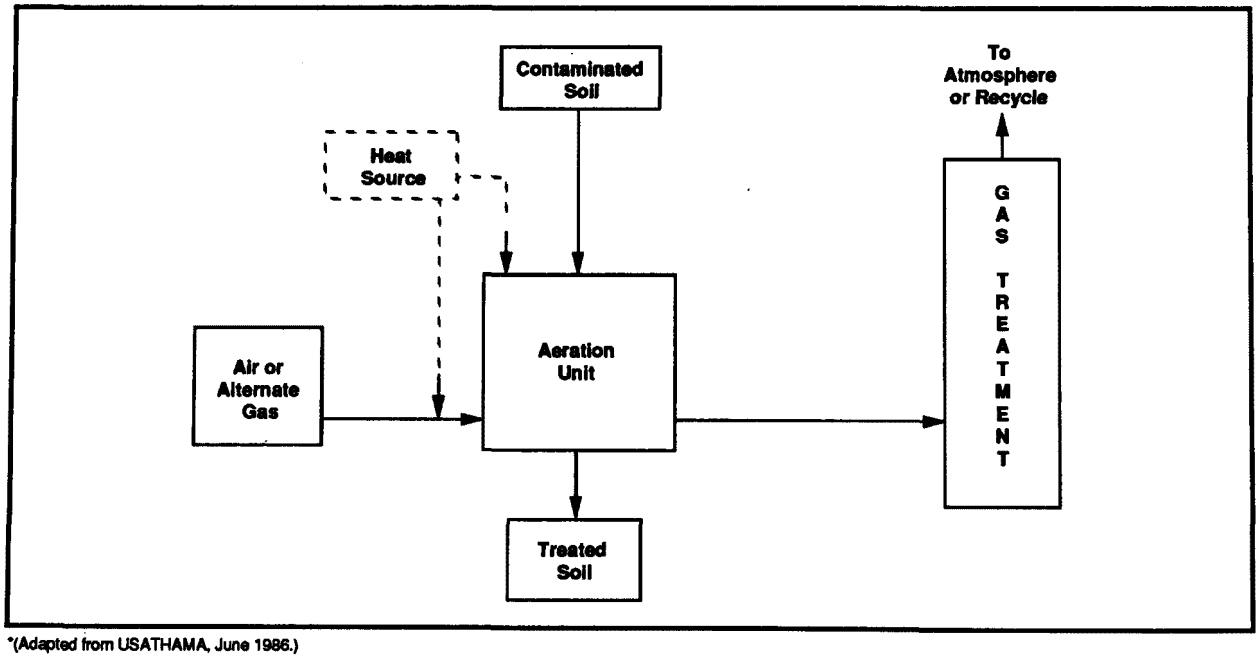
Description and Applicability

Low temperature thermal desorption is the physical process of using ambient air, heat, and/or mechanical agitation to volatilize contaminants from a soil into a gas stream for further treatment. The equipment used in low temperature thermal desorption includes an aeration unit, gas stream handling equipment, soil handling equipment, and appropriate monitoring systems. Figure 3-8 is a schematic flow diagram of this technology.

The effectiveness of this treatment technology on soil contaminants is summarized in Figure 3-9. Low temperature thermal desorption data are limited.

The process is most effective on volatile organic compounds.

Data for the other halogenated aromatic (W01 and W03) and aliphatic compounds (W04) and the volatile non-halogenated organic compounds (W07) indicate that these compounds can be successfully treated by this technology. Although some polynuclear aromatic compounds (W08) may be effectively treated under optimum operating conditions, such as elevated temperatures, low temperature thermal desorption is not generally as successful as destruction technologies, because removal efficiencies average only 65%. Polar non-halogenated organic compounds (W09) represent a broad range of physical/ chemical characteristics. The effectiveness of low temperature thermal desorption on this treatability group should be evaluated on a compound-specific basis.



*(Adapted from USATHAMA, June 1986.)

Figure 3-8. Low Temperature Thermal Desorption Flow Diagram

TREATABILITY GROUP	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % REMOVALS	GENERAL OBSERVATIONS
NON-POLAR HALOGENATED AROMATICS (W01)	29 PAIRS 48 % BENCH 4 % PILOT 48 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 130 TREATED 0.07 AVERAGE REMOVAL EFFICIENCY 99 %	• Although this technology was not expected to perform well on this treatability group, the data from studies which utilized higher operating temperatures and longer residence times indicate that many of the compounds in this group may be treated by this technology with potential effectiveness. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled. • This technology has demonstrated effectiveness on some of the more volatile contaminants in this group, and it is potentially effective on the remaining contaminants.
PCBs, HALOGENATED DIOXINS, FURANS, AND THEIR PRECUSORS (W02)	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• No data were available. • The physical and/or chemical characteristics of the constituents of this treatability group suggest that this technology would not be effective. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled.
HALOGENATED PHENOLS, CRESOLS, AMINES, THIOLS, AND OTHER POLAR AROMATICS (W03)	14 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 260 TREATED 67 AVERAGE REMOVAL EFFICIENCY 72 %	• Although the data suggest that this technology is not as effective with this treatability group, the technology, if operated at higher temperatures and residence times, may successfully treat many of the compounds in this group. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled.
HALOGENATED ALIPHATIC COMPOUNDS (W04)	132 PAIRS 27 % BENCH 50 % PILOT 23 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 590 TREATED 18 AVERAGE REMOVAL EFFICIENCY 94 %	• This technology works well on this treatability group. • Removal efficiencies are not as high with soils having extremely elevated concentrations. A longer residence time may remedy this situation. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled.
HALOGENATED CYCLIC ALIPHATICS, ETHERS, ESTERS, AND KETONES (W05)	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• No data were available for this treatability group. • The physical and/or chemical characteristics of the constituents of this treatability group suggest that this technology would not be effective. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled.
NITRATED COMPOUNDS (W06)	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• No data were available for this treatability group. • The physical and/or chemical characteristics of the constituents of this treatability group indicate that this technology would not be effective. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled.

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Figure 3-9 Final Conclusions by Treatment Technology — Low Temperature Thermal Desorption

TREATABILITY GROUP	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % REMOVALS	GENERAL OBSERVATIONS
HETEROCYCLICS AND SIMPLE NON-HALOGENATED AROMATICS (W07)	111 PAIRS 37 % BENCH 39 % PILOT 24 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 920 TREATED 1.7 AVERAGE REMOVAL EFFICIENCY 96 %	• This technology works well on this treatability group. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled.
POLYNUCLEAR AROMATICS (W08)	52 PAIRS 27 % BENCH 60 % PILOT 13 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 1,400 TREATED 130 AVERAGE REMOVAL EFFICIENCY 65 %	• This technology is not generally effective as a treatment for this group, but individual compounds may be treated effectively at higher operating temperatures and longer residence times. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled.
OTHER POLAR NON-HALOGENATED ORGANIC COMPOUNDS (W09)	34 PAIRS 82 % BENCH 6 % PILOT 12 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 1,900 TREATED 170 AVERAGE REMOVAL EFFICIENCY 82 %	• This technology is potentially effective on some contaminants in this group. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled.
NON-VOLATILE METALS (W10)	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• The physical and/or chemical characteristics of the constituents of this treatability group indicate that this technology would not be effective. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled.
VOLATILE METALS (W11)	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• The physical and/or chemical characteristics of the constituents of this treatability group indicate that this technology would not be effective. • This technology is not recommended for the treatment of waste mixtures which contain high concentrations of metallic and/or organic forms of mercury, unless emissions are controlled.

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Figure 3-9. Final Conclusions by Treatment Technology — Low Temperature Thermal Desorption (Cont.)

No data are available for PCBs, dioxins, furans, and their precursors (W02); halogenated cyclic aliphatics, ethers, esters, and ketones (W05); or nitrated compounds (W06). It is not expected that this technology would be effective on any of these three treatability groups.

The data base indicates that metals (W10 and W11) are not effectively treated by low temperature thermal desorption, because of the low vapor pressures of most metals at the normal operating temperatures of desorption units. Mercury is an exception to this generalization. Because of its relatively high vapor pressure of 0.0012 mm of Hg at 20°C, mercury can be expected to volatilize under the operating conditions of some low temperature thermal desorption units. Unfortunately, mercury is not easily removed from gas streams by conventional post-treatment systems. Therefore, waste mixtures that contain metallic and/or organic forms of mercury should not be treated by this technology, unless the mercury emissions can be controlled.

Due to its effectiveness in treating volatile organics, low temperature thermal desorption could be used in combination with one or more other technologies (in a treatment train) to treat soils containing mixtures of organic and inorganic compounds. For example, if a waste contains volatile metals and volatile organics, low temperature thermal desorption followed by immobilization may be an effective treatment train scenario to consider.

Basic Principles of Operation

The basic principle of operation for this technology is to provide a driving force to aid in the volatilization of the contaminants from a soil matrix to the gas stream with subsequent treatment of the gas stream (see Figure 3-8). Thus, low temperature thermal desorption is actually a physical process that uses mass transfer as its method of treatment. Unlike incineration, it does not rely on combustion or an open flame to oxidize or chemically destroy the contaminants. A low temperature thermal desorption unit can be operated at ambient temperature, or the unit itself or the inlet gas stream can be heated by electricity or a fossil fuel. If a fossil fuel is chosen, it must be clean burning and it should not produce volatile organic emissions.

Most units incorporate mechanical agitation during treatment to facilitate the effectiveness of the process. The inlet gas stream is used to purge the unit of volatile organics as they are released from the soil. When air is used, it is usually sent to an afterburner for subsequent treatment. Nitrogen can be used to provide a non-oxidizing atmosphere. This gas can then be filtered, recovered, and recycled back to the process (U.S. EPA, December 1987).

A low temperature thermal desorption unit may be operated as either a batch or a continuous process. The batch process involves putting a volume of soil into the unit at a fixed bed height. Air is then circulated through the unit. The air either enters the unit just above the bed or through a perforated plate just below the bed. In contrast, the continuous process transports the soil through the unit by a conveyer belt or by a screw conveyer, which also provides agitation during treatment. The inlet air stream may then pass through the unit in a countercurrent direction, which provides maximum removal.

Waste Characteristics Affecting Performance

The physical properties of the waste, such as moisture content, heating value, debris content, and soil composition, may have significant effects on the treatment performance. High moisture content usually causes the waste to exhibit a low heating value, thus, the overall process requires more energy. Also, the moisture content of the treated soil provides an indication of volatile organic removal. The greatest removal usually occurs during the evaporation of moisture from the soil. The soil composition (e.g., silt content, clay content) can also affect the treatment process in varying degrees. Very little information exists that can quantify these variables. As previously stated, this technology performs best for the treatment of volatile organics, or for those contaminants that have a high volatility or high vapor pressure and tend to bind less to the matrix.

According to available data, some of the more successful tests incorporated extensive preprocessing of the inlet soil. This preprocessing included removing rocks and debris from the waste matrix, mixing the waste to create a more homogeneous feed, and screening and crushing the waste matrix to achieve a smaller

particle size. Air emission monitoring must also be conducted to control fugitive emissions during preprocessing. Although no tests directly correlated preprocessing to technology performance, it is believed that these measures did improve treatment effectiveness.

Design and Operating Parameters Affecting Performance

Design and operating parameters that affect treatment performance include air handling, temperature, feed control, degree of mixing, residence time, and bed height and are described as follows:

Air handling - Inlet and outlet air streams must be monitored for contaminant concentration, moisture content, temperature, flow rate, and pressure (USATHAMA, January 1987). All of these factors have a direct bearing on treatment performance. By measuring the effluent contaminant concentration, a removal efficiency can be determined. Based on this measurement, process changes can be implemented. If necessary, untreated soil concentration should also be monitored for fugitive emissions that may occur during preprocessing and feeding. Temperature, flow rate, and pressure combine to affect the amount of each contaminant that can be saturated in the purge gas and removed. This effect is also determined by the physical characteristics of the contaminants, such as the solubility of the contaminant in water. Attempts at correlating air inlet moisture to removal efficiency for a given temperature have also been conducted (USATHAMA, June 1986). As previously mentioned, the outlet gas handling system may involve either a gas recovery system or an afterburner and emissions control system. The type of purge gas used is dependent on the scale and economics of the operation.

Temperature - The optimum operating temperature is dependent on several factors. First, the temperature must be high enough to volatilize the contaminants without reaching the ignition temperature. Second, the temperature combined with bed height, residence time, and degree of mixing must also be able to affect the entire matrix. Finally, the optimum operating temperature is waste specific and is also affected by soil moisture, soil composition, and nature of the contaminants. The operating temperatures used are lower than those on incinerators, and sometimes the process is run at room temperature using only aeration as a driving force for mass transfer.

If low temperature thermal desorption is used in a treatment train, and the waste includes volatile metals such as mercury, the operating temperature must be kept well below the volatilization point of these elements so that they remain in the soil for further treatment. Attention should be given to the location of the temperature measurement device when monitoring the system. The bed temperature may fluctuate from one location in the unit to another and at different depths in the soil, especially if there is no mechanical agitation during treatment. Thus, the temperature must be carefully monitored to provide sufficient energy to volatilize the contaminants while keeping them below the ignition temperature. Inlet air or gases are often heated to maintain a constant temperature in the low temperature thermal desorption unit.

Feed control - This is an often overlooked design parameter. It is usually assumed that any low temperature thermal desorption unit will properly feed the contaminated soil or sludge whether in a batch or continuous process. However, in a realistic situation, the contaminated matrix may contain debris and particles of different sizes. A feed system must be properly designed to handle these variations without clogging and to remove debris or large particles that may damage other machinery. The system must also be designed to monitor and handle variations in contaminant concentration. The feed control system is one area that determines total system capacity.

Degree of mixing - This design parameter is difficult to define or quantify. Several variables that help determine whether there is a proper degree of mixing are residence time, tempera- ture, bed height, and mechanical agitation. These factors combine to ensure that the treatment is properly affecting as much of the matrix as possible.

Residence time - For a given temperature, the residence time will determine the system capacity. By controlling the residence time, the system will be better able to adapt to

changes in the waste characteristics such as contaminant concentration, moisture content, and heterogeneity.

Bed height - The bed height should be regulated to ensure that the entire matrix is properly treated during batch processing. This is why it is advantageous to use mechanical agitation or screw conveying during treatment. These measures will help ensure that all of the matrix is treated, while using a minimum residence time.

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3.5 CHEMICAL EXTRACTION AND SOIL WASHING

Description and Applicability

Chemical extraction and soil washing are physical transfer processes in which contaminants are washed from the soil, becoming dissolved or suspended in a liquid chemical. This liquid waste stream then undergoes subsequent treatment to remove the contaminants, and the solvent is recycled, if possible. Soil washing processes generally use water as the solvent to separate the clay particles, which contain the majority of the contaminants, from the coarser soil fractions. Chemical extraction processes generally use a solvent that separates the contaminants from the soil particles and dissolves the contaminant in the solvent. Numerous combinations of soil washing, chemical extraction, and other treatment technologies are available. Figures 3-10 and 3-11 are schematic flow diagrams of chemical extraction and soil washing,

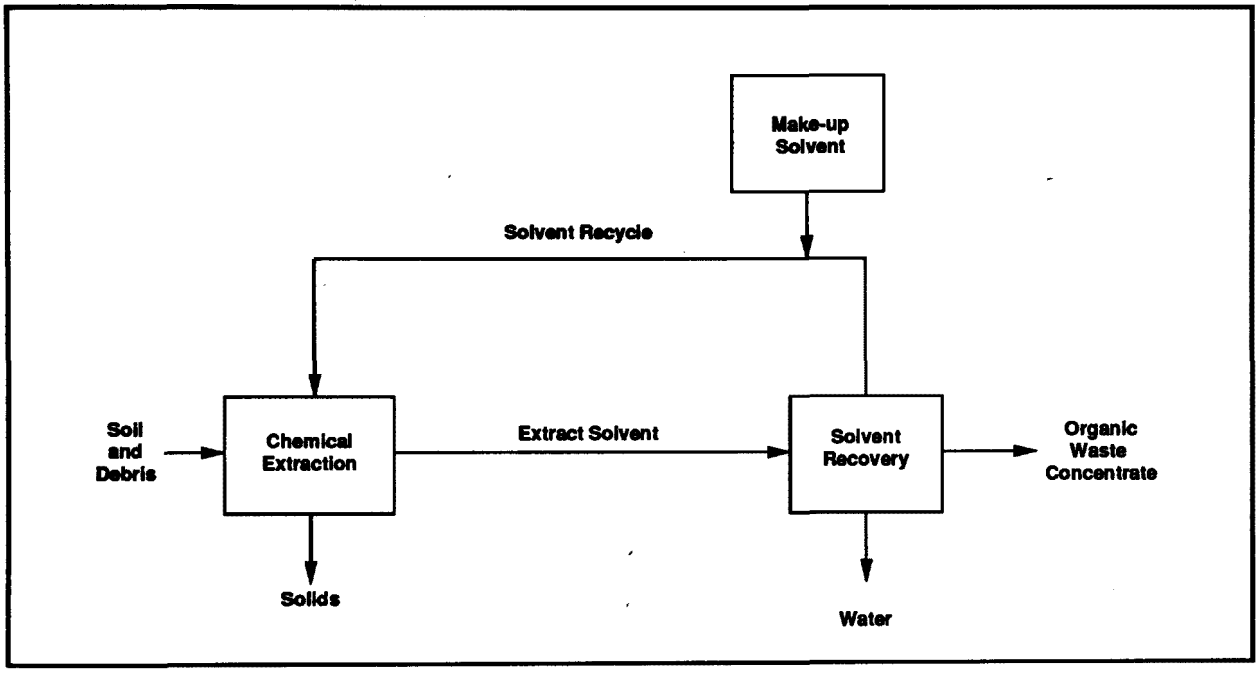

Figure 3-10. Chemical Extraction Flow Diagram

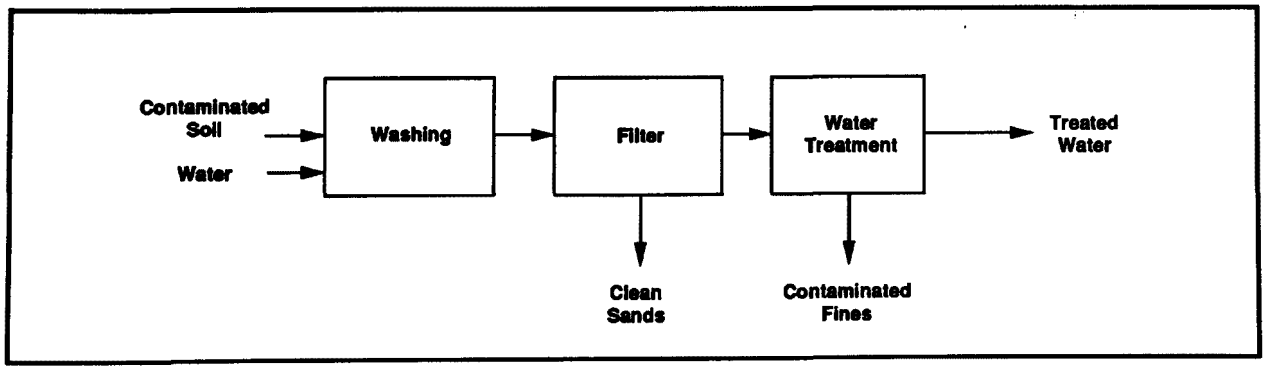

Figure 3-11. Soil Washing Flow Diagram

respectively. If the selection of the solvent is optimized with the addition of surfactants or chelating agents, chemical extraction and soil washing can successfully treat many organic and inorganic contaminants, particularly those that are more soluble in the solvent of choice.

The difference between the treatability of sand and clay is best explained by the location of the contaminant-soil bond and the different surface to volume ratios. Clays are much smaller than sand particles and have a plate-like rather than a massive structure. In clays, the bonding takes place between the layers of the clay mineral, and the contaminants are therefore less accessible to the solvent. For sands, the bonding takes place on the outside of the mineral; therefore, the contaminants are readily available for removal by the solvent. The small plate-like structure of clays also provides clays with a much higher surface to volume ratio than sands. Thus, clays have much more surface area that can adsorb contaminants.

Chemical extraction and soil washing are therefore best suited for sandy and sandy loam soils that are low in humus and clay content. The basic mechanism at work in the chemical extraction process includes breaking the bond between the contaminant and the soil particle to establish a bond between the contaminant and the solvent. For the same contaminants, chemical extraction exhibits a distinctly improved effectiveness on larger sand particles than on smaller clay particles. Soil washing is best suited for sites where nearly all the contaminants are adsorbed on the clay particles. Soil washing then physically separates the contaminated clay from the relatively clean sand fractions. This reduces the volume of waste requiring further treatment.

Chemical extraction and soil washing have been successfully demonstrated through a number of bench and pilot scale studies; however, only three full scale units are currently in operation. These units are located in the Netherlands (Soczo, et al, undated; FPC, August 1987). The equipment required to operate a chemical extraction system includes pretreatment screens, a water-knife unit, counter-current extractors, scrubbers, filter presses, an activated carbon column, and solvent regeneration/reuse units.

The effectiveness of these treatment technologies on soil contaminants is summarized in Figure 3-12. Chemical extraction and soil washing appear to offer the best treatment on halogenated aromatics (W01) except for PCBs and dioxins (W02), halogenated aliphatics (W04), nitrated compounds (W06), and heterocyclic and non-halogenated aromatic compounds (W07). For these compound groups a removal efficiency of greater than or equal to 99% was achieved by the available data. These data must be viewed with caution because the results may be due to some of these contaminants having volatilized during treatment. In addition, these data were entirely from bench scale testing. Because of the uncertainties associated with the success of scale up, this technology was predicted to be potentially effective on these compounds.

The removal efficiencies of the other organic compounds ranged from 72% for halogenated polar aromatics (W03) to 82% for polynuclear aromatics (W08) to 91% for other polar non-halogenated organics (W09). Some of these compounds have strong contaminant soil binding abilities due to surface dipolar characteristics which may account for the lower effectiveness on some contaminants. The majority of these data were from bench scale applications as well. Therefore, chemical extraction was predicted to be only potentially effective on these contaminants.

Bench scale studies for PCB-contaminated sediments (W02) achieved more than 99% removal. However, one study conducted on manufactured organic and inorganic soils achieved only 35% to 50% removal of PCBs. In addition, the extraction of PCBs was found to be more efficient for sediments containing oil than for those containing little or no oil (U.S. EPA, May 1987). Chemical extraction on dioxin/furan-contaminated soils can be expected to achieve removal efficiencies comparable to those for PCBs, because of their similar chemical structures. Available data from a bench scale treatability study on dioxins (excluding PCBs and herbicides) report an average removal of 91%.

Although no data were available for halogenated cyclic aliphatics, ethers, esters, and ketones (W05), the physical and chemical characteristics of these contaminants suggest that they can potentially be treated by chemical extraction or soil washing. This judgment is, in part, based on the higher water solubilities of this group.

TREATABILITY GROUP	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % REMOVALS	GENERAL OBSERVATIONS
NON-POLAR HALOGENATED AROMATICS (W01)	20 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 170 TREATED 0.30 AVERAGE REMOVAL EFFICIENCY >99 %	• This technology is potentially effective on these contaminants but all data are from bench scale. • Surfactants may adhere to the soil and reduce soil permeability. • Possible volatile emission losses may occur during treatment.
PCBs, HALOGENATED DIOXINS, FURANS, AND THEIR PRECURSORS (W02)	22 PAIRS 82 % BENCH 4 % PILOT 14 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 9,900 TREATED 4,000 AVERAGE REMOVAL EFFICIENCY 71 %	• This technology is potentially effective on these contaminants with further development. • Some of the available data for this treatability group were based on very high initial concentrations; however consideration should be given to the ability of the technology to treat high initial concentrations. • The presence of oil in the matrix enhances removal. • The removal efficiency decreases as the percent of clays and clayey silts increases. • Surfactants may adhere to the soil and reduce soil permeability.
HALOGENATED PHENOLS, CRESOLS, AMINES, THIOLS, AND OTHER POLAR AROMATICS (W03)	20 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 87 TREATED 18 AVERAGE REMOVAL EFFICIENCY 72 %	• Data were from pentachlorophenol only. • *This technology is potentially effective on these contaminants, especially for treating sandy soils.* • Surfactants may adhere to the soil and reduce soil permeability.
HALOGENATED ALIPHATIC COMPOUNDS (W04)	40 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 290 TREATED 0.22 AVERAGE REMOVAL EFFICIENCY >99 %	• This technology is potentially effective on these contaminants, but all data are from bench scale. • This technology may be more applicable to sandy soils. • Surfactants may adhere to the soil and reduce soil permeability. • Volatile emissions may occur during treatment.
HALOGENATED CYCLIC ALIPHATICS, ETHERS, ESTERS, AND KETONES (W05)	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE REMOVAL EFFICIENCY 0 %	• *Data were not available for this treatability group. Data for compounds with similar physical and chemical characteristics suggest that this technology is potentially effective in certain situations.* • Surfactants may adhere to the soil and reduce soil permeability.
NITRATED COMPOUNDS (W06)	3 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 6,900 TREATED 4.7 AVERAGE REMOVAL EFFICIENCY >99 %	• This technology is potentially effective on these contaminants. However, data are limited and testing was conducted at bench scale.

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Figure 3-12. Final Conclusions by Treatment Technology — Chemical Extraction and Soil Washing

TREATABILITY GROUP	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % REMOVALS	GENERAL OBSERVATIONS
HETEROCYCLICS AND SIMPLE NON-HALOGENATED AROMATICS (W07)	55 PAIRS 98 % BENCH 0 % PILOT 2 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 1,700 TREATED 3.8 AVERAGE REMOVAL EFFICIENCY >99 %	• This technology is potentially effective on these contaminants but nearly all data are from bench scale. • Volatile emissions may occur during treatment. • Surfactants may adhere to the soil and reduce soil permeability.
POLYNUCLEAR AROMATICS (W08)	24 PAIRS 71 % BENCH 0 % PILOT 29 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 1,600 TREATED 380 AVERAGE REMOVAL EFFICIENCY 82 %	• This technology is potentially effective on these contaminants with further development. • Some of the available data for this treatability group were based on very high initial concentrations; however, consideration should be given to the ability of the technology to treat high initial concentrations. • Surfactants may adhere to the soil and reduce soil permeability.
OTHER POLAR NON-HALOGENATED ORGANIC COMPOUNDS (W09)	58 PAIRS 95 % BENCH 0 % PILOT 5 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 70,000 TREATED 15,000 AVERAGE REMOVAL EFFICIENCY 91 %	• This technology is potentially effective on these contaminants. • Some of the available data for this treatability group were based on very high initial concentrations; however, consideration should be given to the ability of the technology to treat high initial concentrations. • Treatment effectiveness should be evaluated on a case-by-case basis. • Surfactants may adhere to the soil and reduce soil permeability. • Volatile emissions may occur during treatment.
NON-VOLATILE METALS (W10)	34 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 34 TREATED 1.1 AVERAGE MOBILITY REDUCTION 89 %	• This technology is potentially effective on these contaminants. • Water and H_2SO_4 at a pH of 1.0 and a 3:1 molar ratio of EDTA at a pH of 12.0 can both achieve good levels of extraction. • Iron (1-2%) may cause solvent regeneration problems.
VOLATILE METALS (W11)	54 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 71 TREATED 10 AVERAGE MOBILITY REDUCTION 85 %	• This technology is potentially effective on these contaminants, especially for sandy soils. • Silty and clayey soils are not as effectively treated. • Arsenic may be difficult to extract due to low solubility.

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Figure 3-12. Final Conclusions by Treatment Technology — Chemical Extraction and Soil Washing (Cont.)

Data for volatile metals further demonstrate better reductions in mobility (85% to 99%) for sandy soil matrices as compared to 65% to 75% reductions in mobility for silty soils. The reductions in mobility for non-volatile metals ranged from 41% to 99%. However, either the use of sulfuric acid as an extraction solvent at a pH of 1.0 or the use of ethylenediaminetetracetic acid (EDTA) as a chelating Figure 3-12 agent at a pH of 12.0 yields consistently high reductions in mobility. Metals having low water solubilities (e.g., arsenic) may be difficult to remove from the soil by extraction. Finally, the presence of iron (1% to 2%) in a contaminated soil may hinder regeneration and/or reuse of the solvent (U.S. EPA, December 1985).

Basic Principles of Operation

Two principal removal mechanisms are used in extractive cleaning:

- The contaminants are dissolved in the extracting agent with or without the assistance of a chemical reaction (e.g., chelation) preceding or acting simultaneously with the extraction.

- The contaminants are dispersed in the extraction phase in the form of particles (suspended or colloidal) with or without the assistance of a surfactant and prior mechanical treatment. The subsequent separation between the contaminated clay particles and the relatively clean sand particles in the resulting slurry is dependent on differences in particle size, settling velocity, surface properties, or a combination of these characteristics.

A general process scheme for chemical extraction/soil washing involves the following steps:

1. "The soil to be cleaned is pretreated to remove large objects such as pieces of wood, vegetation, concrete, stones, drums, etc., while hard clods of soil are reduced in size. The sieved residue may be cleaned separately.

2. The pretreated soil is mixed intensively with an extracting agent. The primary purpose of this step is to transfer the contaminants to the extraction fluid, either as particles or as a solute.

3. The soil and the extracting agent are separated. The contaminants, the smaller soil particles (clay and silt particles), and the soluble components in the soil are generally carried off with the extraction agent.

4. The soil undergoes subsequent washing with clean extracting agent and/or water to remove as much of the remaining extraction fluid as possible.

5. The larger particles carried off with the extraction phase are separated and, if required, these particles undergo a subsequent washing with clean extracting agent.

6. The contaminated fine grained material and the soluble components are separated from the extraction fluid, whereupon part of the fluid is re-used after the addition of chemicals, if required." (Assink, November 1985).

The chemical extraction/soil washing process results in the transfer of contaminants from the soil matrix to the wash medium. The contaminants may still be adsorbed on the clays suspended in the wash medium. The wash medium then undergoes further treatment before final disposal or regeneration. A large number of physical, chemical, and biological purification methods, including coagulation, flocculation, sedimentation, an aerobic and aerobic biological treatment, and immobilization, are available to clean the contaminated aqueous extracting agents (Assink, 1985).

Waste Characteristics Affecting Performance

Chemical extraction is recommended for soils that contain less than 30% fine (<63um) and/or humus particles. Sand particles (>50mm to 80mm) are fairly easy to clean because of their relatively high settling velocities and smaller specific surface areas for adsorption. On the other hand, humus-like components and silt and clay particles readily form a relatively stable suspension with the extraction liquid, making it almost impossible to separate the soil particles from the contaminated particles. Hence, this technology is more applicable to sandy waste matrices.

In addition, the smaller particles produce a larger quantity of sludge, thereby increasing treatment costs. Moreover, size distribution analysis on metals (e.g., lead) reveals that larger quantities of contaminant are associated with the finer particles. As mentioned, soils with low humus content, and consequently low (less than 0.12%) total organic carbon (TOC), are easier to treat than high TOC soils (up to 2% to 4%), due to the strong affinity between the contaminants and the organic material (U.S. EPA, December 1985).

A recommended treatment train involves treatment of the medium and coarse soil particles by chemical extraction, and treatment of the remaining fines either by biological or immobilization processes. Soils containing complex mixtures of contaminants (e.g., metals and organics) are not recommended for treatment using chemical extraction due to the difficulty in formulating a suitable extraction fluid. In addition, variations in the concentrations of the contaminants in the waste matrix may also require frequent reformulation of the extraction mixture. For example, low concentrations of contaminants in the waste matrix will generally require a weaker reagent mixture than will high concentrations of the same contaminants. This phenomenon can be avoided if suitable pretreatment is applied to create a more homogeneous waste feed material.

The use of surfactants to remove organics reduces soil permeability, as the surfactant adheres to the soil particles and decreases the effective porosity of the soil matrix. Mechanical treatment following chemical extraction or soil washing, such as tilling, may be employed in an attempt to recreate soil porosity if the treated soil will be placed back on the site. Similarly, other solvents may also undergo reactions with the soil matrix that may reduce contaminant mobility. This also may adversely affect the extraction process efficiency.

Design and Operating Parameters Affecting Performance

Temperature, pH control, reaction time, extracting agent concentration, solution-soil ratio, and number of rinses are the primary variables affecting removal efficiencies in chemical extraction (U.S. EPA, October 1987) and are discussed as follows:

Temperature - Elevated temperatures may reduce the required reaction times; however, they may also volatilize a significant amount of the organics. If needed, VOC emissions can be treated in the field with an activated carbon air filtration system. Temperature has little effect on chelation of metals, with the exception of chromium III, where an elevated temperature may be necessary for rapid chelation. Ambient temperature (70°F to 80°F) has been accepted as the standard operating temperature.

pH control - pH is one of the most critical parameters. Both metal cations and chelating agents are influenced by hydrogen ions; therefore, any change in pH affects the equilibrium of the system. Metals are most effectively chelated at pH levels ranging from 8.0 to 12.0. With respect to organic contaminants, pH is a useful variable for improving the mobility of the contaminant into solution. Available data demonstrate that a pH of 9.6 accomplished the best removals for organic compounds. A pH of 12.0 was demonstrated as the optimum pH for metal chelation in a recent OR&D study on organics and metals removal (U.S. EPA, October 1987). However, in some instances, the combination of water and sulfuric acid at a pH of 1.0 achieved good metals removal. A 3:1 molar ratio of EDTA at a pH of 12.0 has also achieved good metals removal. The optimum pH for metals removal needs to be determined by the actual metals present and their concentrations in the waste.

Reaction time - Reaction time, which determines the actual contact time between the extractant and the contaminated soil and, in effect, the time for transfer of contaminants, may affect the treatment performance considerably. Bench tests analyzing the wash solvent at various reaction times show that a 15-minute contact time is sufficient to effect a near complete transfer of metal contaminants. Organics, on the other hand, have been reported to take one to three hours depending on other conditions (U.S. EPA, October 1987).

Extractant concentration - The concentration of the extractant for the chemical extraction and soil washing processes depends on the type of extractant used. The choice of a

particular wash solvent is based upon a number of factors including purification efficiency, safety, toxicity, and regeneration and treatment capability. Moreover, a number of chemical additives aimed at improving the extraction efficiency may be considered. For example, acids may be added to dissolve heavy metals; or, particularly in the case of clay and humus soils, the addition of bases may help to disperse contaminants in the extraction phase (Assink, 1985).

A literature search on organics removal (U.S. EPA, October 1987) indicated an optimum range of surfactant concentrations between 1% and 10%; however, concentrations over 1.5% were reported to result in materials handling problems. Surfactant concentrations of 0.1% are reported to be optimal (R. Traver, U.S. EPA, September 23, 1988). EDTA is considered to be the most acceptable chelating agent for metals, as it chelates a variety of metals over a broad pH range, is completely miscible with water, will not chelate univalent metal ions, and is readily available. Based on the manufacturer's calculations, a modest ratio of 1:1 to 3:1 EDTA to total metal ions present in the contaminated soil should chelate all of the metals present (with the possible exception of arsenic), depending on the pH of the wash solution.

Solution:soil (ratio) - The solution to soil ratio should be kept to a minimum to facilitate dewatering and to minimize the production of wastewater. However, based on the available literature, solution to soil ratios below 10:1 may not allow adequate soil-solution contact.

Number of rinses - Following contact with the wash solution, the soil should be rinsed with either clean solution or plain water to enhance removal of solubilized contaminants; excessive rinsing, however, will generate additional wastewater. According to the literature, a minimum of two rinses is necessary (U.S. EPA, May 1987).

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3.6 IMMOBILIZATION

Description and Applicability

Immobilization refers to a broad class of treatment processes that physically or chemically reduce the mobility of hazardous constituents in a waste. Figure 3-13 is a schematic flow diagram of this technology. Other terms that are sometimes used synonymously with immobilization include stabilization, solidification, and encapsulation (U.S. EPA, undated). These terms are defined below:

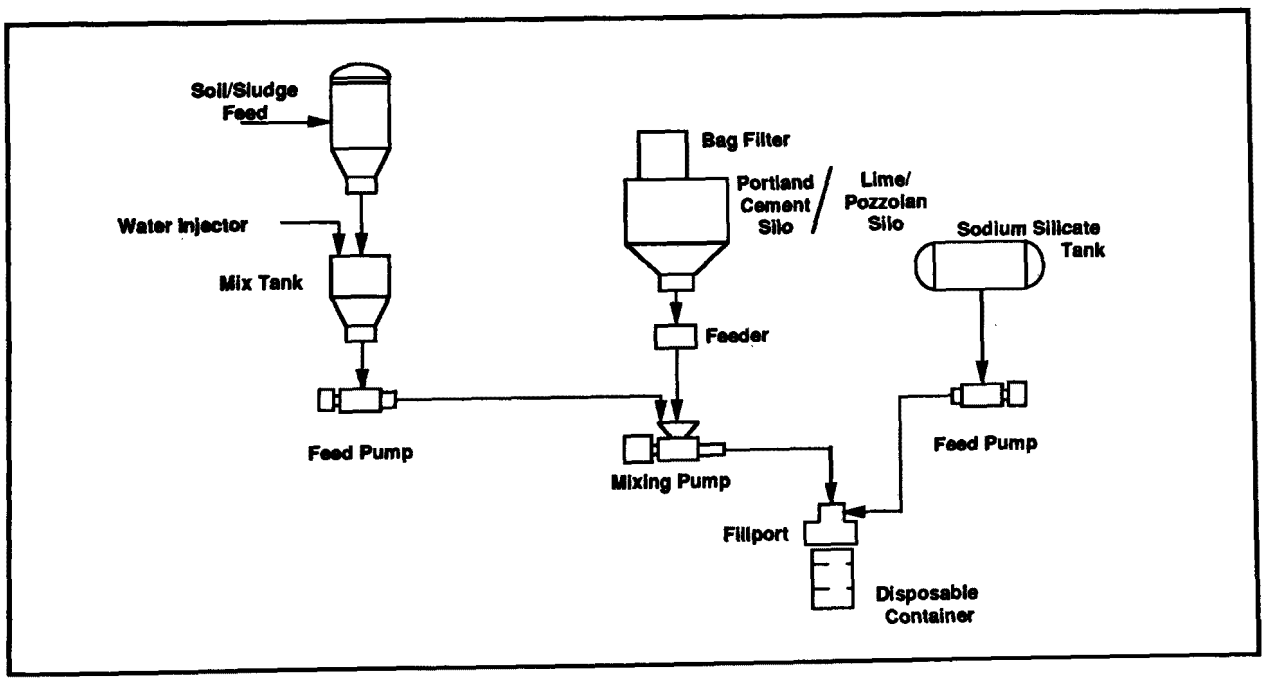
Stabilization - A process by which a waste is converted to a more chemically stable form. The term entails the use of a chemical reaction to transform the toxic component to a new non-toxic compound or substance.

Solidification - A process in which materials are added to a liquid or semiliquid waste to produce a solid. It may or may not involve a chemical bonding between the toxic contaminant and the additive.

Encapsulation - A process involving the complete coating or enclosure of a toxic particle or waste agglomerate with a new substance, e.g., the additive or binder. Microencapsulation is the encapsulation of individual particles. Macroencapsulation is the encapsulation of an agglomeration of waste particles or microencapsulated materials (U.S. EPA, undated; ASTM, undated).

Since the goal of immobilization is to reduce the mobility of hazardous constituents, the effectiveness of immobilization is evaluated by a leaching test or extraction procedure on the treated residue and not by a total constituent analysis of the waste. Therefore, the reference to the removal efficiency for immobilization actually reflects the reduction in the mobility of the contaminants that remain in the treated residue.

The immobilization treatment system typically consists of a materials feed system, a reaction tank equipped with mixing equipment, and an area for curing (U.S. EPA, 52 Federal Register 29991). The effectiveness of immobilization depends on the type and amount of binder (additives) used. The greater the amount of binder used, the higher the cost of treating the waste.



*(Adapted from U.S. EPA, 1985.)

Figure 3-13. Immobilization Flow Diagram

The effectiveness of this treatment technology on soil contaminants is summarized in Figure 3-14. According to the data base, the immobilization technology was successfully applied to the treatment of volatile metals and non-volatile metals at bench, pilot, and full scales. Studies on these treatability groups report average reductions in mobility in the leachate of 93% and 81%, respectively. In the case of the non-volatile metals, elimination of 5 of the 24 available data pairs, which had untreated soil leachate concentrations of 1 ppm or less, significantly raises the average reduction in mobility. This revised analysis was the source of the prediction that this technology had demonstrated effectiveness on these contaminants.

Data on the immobilization of organic contaminants are presented in Appendix F. The immobilization of organic contaminants may be effective in some cases (Gibbons, July 1988). The data base indicates that immobilization can reduce the mobility of various organics in the leachate. The data on polynuclear aromatics (W08) was the most successful, indicating an average reduction in mobility of 99%; however all of the data are from bench scale testing. Immobilization of halogenated phenols, cresols, amines, thiols, and other polar aromatics was the least successful, with an average reduction in mobility of 61%. However, this average was based only on four data pairs for pentachlorophenol. Data for compounds with similar physical and chemical characteristics suggest that immobilization is more effective than 61% reduction in mobility. Therefore, immobilization was predicted to be potentially effective on these contaminants.

Bench scale results from non-polar halogenated aromatics (W01), halogenated aliphatics (W04), heterocyclics and simple non-halogenated aromatics (W07), and other polar non-halogenated organics (W09) all indicated the potential effectiveness of immobilization. However volatilization is a likely cross media impact from this technology which should be anticipated and treated appropriately.

No immobilization data were available for PCBs and similar compounds (W02), halogenated cyclic aliphatics (W05), or nitrated compounds (W06). Data for compounds with similar physical and chemical characteristics suggest that immobilization may be potentially effective, particularly where the initial concentrations are low.

Basic Principles of Operation

"The basic principle of [immobilization] is the binding of constituents of concern into a solid that is resistant to leaching. The mechanism by which this occurs depends upon the type of [immobilization] process. Two of the most common are lime/pozzolan-based processes and portland cement-based processes." (U.S. EPA, 52 FR 29991).

"In portland cement systems, the waste is mixed with anhydrous cement powder, water, and frequently, pozzolanic additives. The cement powder consists of a mixture of powdered oxides of calcium, silica, aluminum, and iron produced by kiln burning materials rich in calcium and silica at high temperatures. The major mechanism of [immobilization] in this system is the formation of hydration products from silicate compounds and water. A calcium silicate hydrate gel is formed. This gel swells and forms the cement matrix which is composed of interlocking silicate fibrils. At the same time, constituents present in the waste slurry, (e.g., hydroxides of calcium and various heavy metals), form the interstices of the concrete matrix. Metal ions also become incorporated into the crystal structure of the cement matrix itself. A rigid mass results from the interlocking fibrils and other components during setting and curing." (U.S. EPA, 52 FR 29991).

"The lime/pozzolan processes use the finely divided, noncrystalline silica in pozzolanic material (e.g., fly ash) and the calcium in lime to produce a concrete-like solid of calcium silicate and alumino hydrates. The waste containment is achieved by entrapping the waste in this pozzolan concrete matrix. In actual operation, the waste, water, and a selected pozzolanic material are mixed to a pasty consistency. Hydrated lime is blended into the mixture and the resulting moist material is packed or compressed into a mold and cured over a sufficient time interval." (U.S. EPA, 52 FR 29991).

TREATABILITY GROUP	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % AVG. MOBILITY REDUCTION	GENERAL OBSERVATIONS
NON-POLAR HALOGENATED AROMATICS (W01)	4 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 3.1 TREATED 0.65 AVERAGE MOBILITY REDUCTION 83 %	• Data were for chlorobenzene only. • These data suggest that this technology is potentially effective in certain situations, particularly where the initial concentration is low. • The treatment mechanism for the more volatile compounds may be volatilization as opposed to immobilization. Air pollution control systems may be necessary to minimize cross media impacts from these volatile emissions. • It is not recommended that this technology be selected if this is the only treatability group present.
PCBs, HALOGENATED DIOXINS, FURANS, AND THEIR PRECUSORS (W02)	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE MOBILITY REDUCTION 0 %	• Incomplete quantitative data were available to evaluate treatment effectiveness. These quantitative data and additional qualitative information suggest that this technology is potentially effective in certain situations, particularly where the initial concentration is low. • It is not recommended that this technology be selected if this is the only treatability group present.
HALOGENATED PHENOLS, CRESOLS, AMINES, THIOLS, AND OTHER POLAR AROMATICS (W03)	4 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 2.5 TREATED 1.1 AVERAGE MOBILITY REDUCTION 61 %	• Data were from pentachlorophenol only. These data suggest that this technology is potentially effective in certain situations, particularly where the initial concentration is low, the effectiveness of this technology on these contaminants may be different than the data imply, due to limitations in the test conditions. • It is not recommended that this technology be selected if this is the only treatability group present.
HALOGENATED ALIPHATIC COMPOUNDS (W04)	9 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 11 TREATED 0.24 AVERAGE MOBILITY REDUCTION 88 %	• Though these data suggest that this technology is potentially effective in certain situations, particularly where the initial concentration is low the reductions in mobility may be due to volatilization of the volatile compounds during treatment. • Air pollution control systems may be necessary to minimize cross media impacts from these volatile emissions. • It is not recommended that this technology be selected if this is the only treatability group present.
HALOGENATED CYCLIC ALIPHATICS, ETHERS, ESTERS, AND KETONES (W05)	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE MOBILITY REDUCTION 0 %	• Data were not available for this treatability group. Data for compounds with similar physical and chemical characteristics suggest that this technology is potentially effective in certain situations, particularly where the initial concentration is low. • It is not recommended that this technology be selected if this is the only treatability group present.
NITRATED COMPOUNDS (W06)	0 PAIRS 0 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 0 TREATED 0 AVERAGE MOBILITY REDUCTION 0 %	• Data were not available for this treatability group. Data for compounds with similar physical and chemical characteristics suggest that this technology is potentially effective in certain situations, particularly where the initial concentrations are low.

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Figure 3-14. Final Conclusions by Treatment Technology — Immobilization

TREATABILITY GROUP	NUMBER AND SCALE OF AVAILABLE DATA	AVERAGE CONCENTRATIONS (ppm) AND % AVG. MOBILITY REDUCTION	GENERAL OBSERVATIONS
HETEROCYCLICS AND SIMPLE NON-HALOGENATED AROMATICS (W07)	12 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 23 TREATED 5.8 AVERAGE MOBILITY REDUCTION 73 %	• Though these data suggest that this technology is potentially effective in certain situations, particularly where the initial concentration is low, the reductions in mobility may be due to the volatilization of volatile organic compounds during treatment. • Air pollution control systems may be necessary to minimize cross media impacts from these volatile emissions. • It is not recommended that this technology be selected if this is the only treatability group present.
POLYNUCLEAR AROMATICS (W08)	2 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 3.0 TREATED 0.03 AVERAGE MOBILITY REDUCTION 99 %	• These limited data suggest that this technology is potentially effective in certain situations, particularly where the initial concentration is low.
OTHER POLAR NON-HALOGENATED ORGANIC COMPOUNDS (W09)	7 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 20 TREATED 5.6 AVERAGE MOBILITY REDUCTION 77 %	• These limited data suggest that this technology is potentially effective in certain situations, particularly where the initial concentration is low. • The treatment mechanism for the more volatile compounds may be volatilization as opposed to immobilization. Air pollution control systems may be necessary to minimize cross media impacts from these volatile emissions. • It is not recommended that this technology be selected if this is the only treatability group present.
NON-VOLATILE METALS (W10)	24 PAIRS 67 % BENCH 33 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 28 TREATED 0.34 AVERAGE MOBILITY REDUCTION 81 %	• This technology works well on these contaminants. • High levels of oil and grease may interfere with the process. • Soluble salts of Mg, Sb, Zn, Cu, and Pb may interfere with the pozzolan reaction. • High levels of sulfates may interfere with the process. • Pretreatment may be required to increase pH.
VOLATILE METALS (W11)	33 PAIRS 100 % BENCH 0 % PILOT 0 % FULL	AVERAGE CONCENTRATIONS (ppm) UNTREATED 610 TREATED 1.4 AVERAGE MOBILITY REDUCTION 93 %	• Based on the pilot scale data this technology works well on these contaminants. Some bench scale data was not representative of optimum conditions. • High levels of oil and grease may interfere with the process. • Soluble salts of Mg, Sb, Zn, Cu, and Pb may interfere with the pozzolan reaction. • High levels of sulfates may interfere with the process. • Pretreatment may be required to increase pH.

8/21/90

Figure 3-14. Final Conclusions by Treatment Technology — Immobilization (Cont.)

Waste Characteristics Affecting Performance

"The level of performance for stabilization processes is measured by the amount of constituents that can be leached from the stabilized material. There are two techniques currently recognized by the U.S. EPA as measures of leachability. The first is the Extraction Procedure (EP) Toxicity Test (40 CFR 261); the second is the Toxicity Characteristic Leaching Procedure (TCLP)." (U.S. EPA, 52 FR 29991).

"In the lime/pozzolan system, oil, grease, and very fine insoluble materials (i.e., 74 x 10^{-6} meter particle size) can weaken bonding between waste particles and cement by coating the particles." (U.S. EPA, 52 FR 29991). The acidic pH of the medium can render the cement or lime/pozzolan system inadequate by neutralizing the alkaline conditions required for the reactions. The particle shape may interfere with the setting of the cement or lime/pozzolan system. Excessively "flat" waste particles may cause the mixture to maintain a fluidized consistency and may impede curing and setting of the material (U.S. EPA, 1985). High moisture content may also negatively affect the process by causing the free liquid to separate, which results in an increase of leaching potential in the lime/pozzolan or cement system. "The presence of certain inorganic compounds (e.g., sodium borate and calcium sulfate) will also interfere with the cementitious reactions, prolonging setting and curing time and weakening bond strength. Soluble salts of copper, lead, manganese, tin, and zinc may cause large variations in setting and curing time and reduce the dimensional stability of the cured matrix, thereby increasing leachability potential." (U.S. EPA, 52 FR 29991). Inorganic salts (e.g., barium carbonate) when present in the waste matrix can increase the amounts of metals, particularly chromium, that are capable of leaching out of the solidified mass (AFESC, December 1983).

Extreme temperatures below 4°C and above 30°C may also prolong the curing rate. Heating the waste slurry can also dramatically affect the results. By increasing the temperature of the waste slurry (to greater than 100°C), the leaching potential also increases (AFESC, December 1983). In addition, a large flux in the temperature during the curing period can also interfere with the immobilization process (U.S. EPA, 1985). "The presence of certain organic compounds may likewise interfere." (U.S. EPA, 52 FR 29991).

In portland cement systems, large amounts of sulfates and sodium salts of arsenate, phosphate, iodate, and sulfides will impede setting, causing swelling and spalling of the stabilized product (USATHAMA, December 1980).

Other physical/chemical characteristics that may influence the performance of the immobilization process include the bulk to dry ratio of the soil, the wet/dry durability, the freeze/thaw durability, and the long term durability or the effect of weathering processes on the immobilized waste. In addition, the final waste volume can vary between 1.5 and 3 times its original volume, but generally the volume increase is about twice the original volume of the waste (ORNL, 1986). Even factors not directly associated with the technology can influence the performance of the immobilization process. These factors include geographical location, as it influences weather conditions and their subsequent impact on the process and economic considerations.

Design and Operating Parameters Affecting Performance

The primary design and operating parameters affect-ing the performance of the immobilization techology are selection of immobilizing agents and other additives, ratio of waste stabilizing agents to other additives, mixing cure conditions, pH control, ion exchange potential, and oil content of the waste (U.S. EPA, 52 FR 29991 and U.S. EPA, 1985).

1. *Selection of immobilizing agents and other additives* - "The type of immobilizing agent selected and the use of additives will determine the bonding and structure of the immobilized waste solid and, therefore, have an effect on how well waste constituents are incorporated into the solid. Immobilizing agents and other additives must be carefully selected based on the chemical and physical characteristics of the waste to be immobilized. For example, the amount of sulfates in a waste will come into consideration when choosing a lime/pozzolan over portland cement-based system. Lime/ pozzolan or a special low alumina, sulfate-resistant cement would be the [immobilizing] agent of choice, as it would

prevent swelling and spalling in the stabilized product. Waste-solidifying formulations in immobilization processes vary widely, and a variety of materials may be used in conjunction with the [immobilizing] agent to change performance characteristics. These include soluble silicates, hydrated silica gels, clays, emulsifiers, surfactants, carbon, and zeolites. In portland cement systems, soluble silicates will reduce the interference from metal ions in the waste. Emulsifiers and surfactants will allow the incorporation of immiscible organic liquids. Carbon, silicates, and zeolites will adsorb toxic constituents and be encapsulated within the [immobilized] solid crystal lattice matrix." (U.S. EPA, 52 FR 2991).

2. *Ratio of waste [immobilizing] agents and other additives* - "The amount of [immobilizing] agents and other additives is a critical parameter in that [immobilizing] materials are necessary in the mixture to bind the waste constituents of concern properly, thereby making them less susceptible to leaching. The appropriate ratios of amounts of waste to [immobilizing] agents and other additives are established after evaluating the waste and the selected [immobilization] formulation. This may be done by setting up a series of experiments that allow separate leachate and strength testing of different mix ratios. Once established, the ratios are maintained by monitoring the volume and/or weight of the waste and the [immobilizing] agents and other additives through the use of feed systems." (U.S. EPA, 52 FR 29991).

3. *Mixing* - "The conditions of mixing include the type and duration of mixing. Mixing is necessary to ensure adequate distribution of the waste and the [immobilizing] agents, thereby resulting in uniform bonding. Insufficient mixing could result in some of the waste constituents of concern not being bound in the solid and thus being susceptible to leaching." (U.S. EPA, 52 FR 29991).

4. *Cure conditions* - "The conditions of cure include the duration of curing and the ambient curing conditions (temperature and humidity). The duration of curing is a critical parameter to ensure that the waste particles have had sufficient time in which to form astable solid. The time necessary for complete [immobilization] to occur depends upon the waste type and the treatment process used. The performance of the[immobilized] waste (i.e., the levels ofconstituents in the leachate) will be highly dependent upon whether complete [immobiliza-tion] has occurred. Curing conditions such as ambient temperature and humidity affect the rate of curing and, therefore, could affect the strength of the [immobilized] solid." (U.S. EPA, 52 FR 29991).

5. *pH Control* - "It is important that the pH of all cementitious processes be greater than 10.0. This ensures that enough lime is present to initiate and continue the cementitious reactions. At a pH below 10.0, the cementitious reactions virtually cease. Additionally, if there is not substantial excess alkalinity, the initial process mechanisms of calcium alumino-sulfate generation may give a false set because components present in the system will adsorb or react with the lime or hydroxide present. This may reduce the pH to below 10.0, thereby stopping the cementitious reactions. Thus, the practitioner must make certain that enough lime or hydroxide is available to not only react to form the cementitious bonds, but also to act as a buffer to keep the pH greater than 10.0." (U.S. EPA, 1985).

6. *Ion exchange potential* - "Ion exchange potential is important because it helps keep metal ions unavailable for leaching as in an alkaline environment. The ion exchange works in exactly the same manner as commercial ion exchange resins or natural zeolites." (U.S. EPA, 1985).

7. *Oil content of the waste* - "Oil contaminated wastes seem to have limited effect on the cementitious matrix. It appears that hydrocarbon oils can be added to the mix at up to 30% to 40% by weight without stopping the cement reaction. The best results apparently occur in high solids content mixes, where the oil most likely is adsorbed on the surfaces of the additives, but enough surface area remains to permit the reactions to proceed." (U.S. EPA, 1985).

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APPENDIX A

CONTAMINANTS ARRANGED BY WASTE TREATABILITY GROUPS

This appendix presents a list of specific contaminants in each Treatability Group. The asterisks appearing beside certain contaminants indicate which contaminants have data in Appendices D, E, and F and were used to develop the quantitative conclusions in this report. Data for the remaining contaminants are in Appendix G.

Most, but not all of the contaminants in Appendix A are defined as hazardous substances. Chemical Abstracts Services (CAS) codes are given for each contaminant. When a CAS code could not be identified, a code was assigned.

APPENDIX A

Best Demonstrated Available Technology
for W01 - HALOGENATED NON-POLAR AROMATIC COMPOUNDS

	Contaminant Name	CAS Number
	1,2,4,5-TETRACHLOROBENZENE	95-94-3
	1,2,4-TRICHLOROBENZENE	120-82-1
*	1,2-DICHLOROBENZENE	95-50-1
	1,3-DICHLOROBENZENE	541-73-1
	1,4-DICHLOROBENZENE	106-46-7
	2-CHLORONAPHTHALENE	91-58-7
*	4,4'-DDD	72-54-8
*	4,4'-DDE	72-55-9
*	4,4'-DDT	50-29-3
	BENZYL CHLORIDE	100-44-7
*	CHLOROBENZENE	108-90-7
	CHLOROBENZILATE	570-15-6
	HEXACHLOROBENZENE	118-74-1
	PENTACHLOROBENZENE	608-93-5
*	TOTAL CHLOROBENZENES	T108-90-7
*	TOTAL TRICHLOROBENZENES	TOT-TCB

* - Data are available on these contaminants in Attachments D, E, and F.

APPENDIX A

Best Demonstrated Available Technology
for W02 - DIOXINS/FURANS/PCBS & THEIR PRECURSORS

	Contaminant Name	CAS Number
*	1,2,3,4-TETRACHLORODIBENZO-P-DIOXIN	30746-58-8
*	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	1746-01-6
*	2,3,7,8-TETRACHLORODIBENZOFURAN	F1746-01-6
*	2,4,5-TRICHLOROPHENOXYACETIC ACID	93-76-5
	2,4,5-TRICHLOROPHENOXYPROPIONIC ACID	93-72-1
*	2,4-DICHLOROPHENOXYACETIC ACID (2,4-D)	94-75-7
	DECACHLOROBIPHENYLS	JPCB
*	DICHLOROBIPHENYLS	BPCB
	HEPTACHLOROBIPHENYLS	GPCB
*	HEPTACHLORODIBENZODIOXINS	HEPCDD
*	HEPTACHLORODIBENZOFURANS	HEPCDF
*	HEXACHLOROBIPHENYLS	FPCB
*	HEXACHLORODIBENZODIOXINS	HEXCDD
*	HEXACHLORODIBENZOFURANS	HEXCDF
*	MONOCHLOROBIPHENYL	APCB
	NONACHLOROBIPHENYLS	IPCB
	OCTACHLOROBIPHENYLS	HPCB
*	OCTACHLORODIBENZODIOXINS	OCDD
*	OCTACHLORODIBENZOFURANS	OCDF
*	PCB-1016	12674-11-2
	PCB-1221	11104-28-2
	PCB-1232	11141-16-5
	PCB-1242	53469-21-9
*	PCB-1248	12672-29-6
	PCB-1254	11097-69-1
*	PCB-1260	11096-82-5
*	PENTACHLOROBIPHENYLS	EPCB
*	PENTACHLORODIBENZODIOXINS	PCDD
*	PENTACHLORODIBENZOFURANS	PCDF
*	TETRACHLOROBIPHENYLS	DPCB
*	TETRACHLORODIBENZODIOXINS	TCDD
*	TETRACHLORODIBENZOFURANS	TCDF
*	TOTAL DIOXINS AND FURANS	TOT-DF
	TOTAL FURANS	TOT-FUR
*	TOTAL PCB'S	1336-36-3
*	TRICHLOROBIPHENYLS	CPCB

* - Data are available on these contaminants in Attachments D, E, and F.

APPENDIX A

Best Demonstrated Available Technology
for W03 - HAL PHENOLS, CRESOLS, ETHERS, & THIOLS

	Contaminant Name	CAS Number
	2,3,4,6-TETRACHLOROPHENOL	58-90-2
*	2,4,5-TRICHLOROPHENOL	95-95-4
*	2,4,6-TRICHLOROPHENOL	88-06-2
*	2,4-DICHLOROPHENOL	120-83-2
	2,6-DICHLOROPHENOL	87-65-0
	2-CHLOROPHENOL	95-57-8
	3,3'-DICHLOROBENZIDINE	91-94-1
*	3,4-DICHLOROPHENOL	34DCP
	4-BROMOPHENYL PHENYL ETHER	101-55-3
	4-CHLORO-3-METHYLPHENOL	59-50-7
	4-CHLOROANILINE	106-47-8
	4-CHLOROPHENYL PHENYL ETHER	7005-72-3
	METHOXYCHLOR	72-43-5
	P-CHLOROBENZENESULFONIC ACID	PCBSA
*	P-CHLOROPHENYLMETHYL SULFIDE	CPMS
*	P-CHLOROPHENYLMETHYL SULFONE	CPMSO2
*	P-CHLOROPHENYLMETHYL SULFOXIDE	CPMSO
*	PENTACHLOROPHENOL	87-86-5
*	SUPONA	470-90-6

* - Data are available on these contaminants in Attachments D, E, and F.

APPENDIX A

Best Demonstrated Available Technology
for W04 - HALOGENATED ALIPHATIC COMPOUNDS

	Contaminant Name	CAS Number
	1,1,1,2-TETRACHLOROETHANE	630-20-6
*	1,1,1-TRICHLOROETHANE	71-55-6
*	1,1,2,2-TETRACHLOROETHANE	79-34-5
	1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	76-13-1
*	1,1,2-TRICHLOROETHANE	79-00-5
*	1,1-DICHLOROETHANE	75-34-3
*	1,1-DICHLOROETHENE	75-35-4
*	1,2-DIBROMO-3-CHLOROPROPANE	96-12-8
*	1,2-DICHLOROETHANE	107-06-2
*	1,2-DICHLOROPROPANE	78-87-5
	2-CHLORO-1,3-BUTADIENE	126-99-8
	BROMODICHLOROMETHANE	75-27-4
	BROMOFORM	75-25-2
	BROMOMETHANE (METHYL BROMIDE)	74-83-9
*	CARBON TETRACHLORIDE	56-23-5
	CHLOROETHANE	75-00-3
*	CHLOROFORM	67-66-3
	CHLOROMETHANE (METHYL CHLORIDE)	74-87-3
	CIS-1,2-DICHLOROETHENE	156-59-2
	CIS-1,3-DICHLOROPROPENE	10061-01-5
	DIBROMOCHLOROMETHANE	124-48-1
	DICHLORODIFLUOROMETHANE	75-71-8
	ETHYLENE DIBROMIDE	106-93-4
	HEXACHLOROBUTADIENE	87-68-3
	HEXACHLOROETHANE	67-72-1
*	METHYLENE CHLORIDE (DICHLOROMETHANE)	75-09-2
	PENTACHLOROETHANE	76-01-7
*	TETRACHLOROETHENE	127-18-4
*	TRANS-1,2-DICHLOROETHENE	156-60-5
	TRANS-1,3-DICHLOROPROPENE	10061-02-6
*	TRICHLOROETHENE	79-01-6
	TRICHLOROFLUOROMETHANE	75-69-4
*	VINYL CHLORIDE	75-01-4

* - Data are available on these contaminants in Attachments D, E, and F.

APPENDIX A

Best Demonstrated Available Technology
for W05 - HAL CYC ALIPHATICS/ETHERS/ESTERS/KETONES

	Contaminant Name	CAS Number
	2-CHLOROETHYL VINYL ETHER	110-75-8
	3-CHLOROPROPIONITRILE	542-76-7
*	ALDRIN	309-00-2
*	ALPHA-BHC	319-84-6
*	BETA-BHC	319-85-7
	BIS(2-CHLOROETHOXY) METHANE	111-91-1
	BIS(2-CHLOROETHYL) ETHER	111-44-4
	BIS(2-CHLOROISOPROPYL) ETHER	39638-32-9
*	CHLORDANE	57-74-9
	CHLOROMETHYL METHYL ETHER	542-88-1
*	DELTA-BHC	319-86-8
*	DIELDRIN	60-57-1
*	ENDOSULFAN I	959-98-8
*	ENDOSULFAN II	33213-65-9
*	ENDOSULFAN SULFATE	1031-07-8
*	ENDRIN	72-20-8
*	ENDRIN ALDEHYDE	7421-93-4
	ENDRIN KETONE	53494-70-5
	EPICHLOROHYDRIN	106-89-8
*	GAMMA-BHC (LINDANE)	58-89-9
*	HEPTACHLOR	76-44-8
*	HEPTACHLOR EPOXIDE	1024-57-3
	HEXACHLOROCYCLOPENTADIENE	77-47-4
	HEXACHLORONORBORNADIENE	3389-71-7
*	ISODRIN	465-73-6
	OCTACHLOROCYCLOPENTENE	706-78-5
	TOXAPHENE	8001-35-2

* - Data are available on these contaminants in Attachments D, E, and F.

APPENDIX A

Best Demonstrated Available Technology
for W06 - NITRATED AROMATIC & ALIPHATIC COMPOUNDS

	Contaminant Name	CAS Number
*	1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE	121-82-4
	2,4-DINITROPHENOL	51-28-5
	2,4-DINITROTOLUENE	121-14-2
	2,6-DINITROTOLUENE	606-20-2
*	2-AMINO-4,6-DINITROTOLUENE	T99-55-8
	2-METHYL-4,6-DINITROPHENOL	534-52-1
	2-NITROANILINE	88-74-4
	2-NITROPHENOL	88-75-5
	3-NITROANILINE	99-09-2
	4-NITROANILINE	100-01-6
	4-NITROPHENOL	100-02-7
*	DINITROBENZENE	25154-54-5
	ETHYL PARATHION	56-38-2
*	HMX	135-HMX
	METHYL PARATHION	298-00-0
	NITROBENZENE	98-95-3
*	NITROCELLULOSE	9004-70-0
	PENTACHLORONITROBENZENE	82-68-8
*	TRINITROBENZENE	99-35-4
*	TRINITROPHENLYMETHYLNITRAMINE (TETRYL)	479-45-8
*	TRINITROTOLUENE (TN)	118-96-7

* - Data are available on these contaminants in Attachments D, E, and F.

APPENDIX A

Best Demonstrated Available Technology
for W07 - HETEROCYCLICS & SIMPLE NON-HAL AROMATICS

	Contaminant Name	CAS Number
	1-ETHYL-2-METHYL-BENZENE	611-14-3
	ALKYL BENZENE	ABC
*	AROMATIC HYDROCARBONS	TOT-AR
*	BENZENE	71-43-2
*	BENZENE, TOLUENE, ETHYLBENZENE, XYLENES	BTEX
*	ETHYLBENZENE	100-41-4
	ISOPROPYLBENZENE	98-82-8
*	M-XYLENE	108-38-3
*	O&P XYLENE	95-47-6
	O-XYLENE	97-47-6
	P-XYLENE	106-42-3
	PYRIDINE	110-86-1
*	STYRENE	100-42-5
*	TOLUENE	108-88-3
*	XYLENES (TOTAL)	1330-20-7

* - Data are available on these contaminants in Attachments D, E, and F.

APPENDIX A

Best Demonstrated Available Technology
for W08 - POLYNUCLEAR AROMATICS

	Contaminant Name	CAS Number
*	1-METHYLNAPHTHALENE	90-12-0
*	2-METHYLNAPHTHALENE	91-57-6
*	ACENAPHTHENE	83-32-9
*	ACENAPHTHYLENE	208-96-8
*	ANTHRACENE	120-12-7
	BENZO(A)ANTHRACENE	56-55-3
	BENZO(A)PYRENE	50-32-8
*	BENZO(B)FLUORANTHENE	205-99-2
	BENZO(G,H,I)PERYLENE	191-24-2
*	BENZO(K)FLUORANTHENE	207-08-9
	BIPHENYL	92-52-4
	CHRYSENE	218-01-9
	DIBENZO(A,H)ANTHRACENE	53-70-3
*	DIBENZOFURAN	132-64-9
*	FLUORANTHENE	206-44-0
*	FLUORENE	86-73-7
	INDENO(1,2,3-CD)PYRENE	193-39-5
*	NAPHTHALENE	91-20-3
*	PHENANTHRENE	85-01-8
*	PYRENE	129-00-0
*	TOTAL POLYCYCLIC AROMATIC HYDROCARBONS	TOT-PAH

* - Data are available on these contaminants in Attachments D, E, and F.

APPENDIX A

Best Demonstrated Available Technology
for W09 - OTHER POLAR ORGANIC COMPOUNDS

	Contaminant Name	CAS Number
	1,2-BENZENEDICARBOXYLIC ACID	117-82-8
	1,2-DIPHENYLHYDRAZINE	122-66-7
	1,4 DIOXANE	123-91-1
	1-PROPANOL	71-23-8
	2,4-DIMETHYLPHENOL	105-67-9
*	2-BUTANONE	78-93-3
	2-ETHOXYETHANOL	110-80-5
	2-HEPTANONE	110-43-0
	2-HEXANONE	591-78-6
	2-METHYLPHENOL	95-48-7
	3-METHYL PHENOL	108-39-4
	4-HYDROXY-4-METHYL-2-PENTANONE	123-42-2
	4-METHYL-2-PENTANONE	108-10-1
	4-METHYL-3-PENTEN-2-ONE	141-79-7
	4-METHYL-4-PENTEN-2-ONE	3744-02-3
	4-METHYLPHENOL	106-44-5
	5-METHYL-2-HEXANONE	110-12-3
*	ACETONE	67-64-1
	ACETONITRILE	75-05-8
	ACETOPHENONE	98-86-2
	ACROLEIN	107-02-8
	ACRYLONITRILE	107-37-1
	ALLYL ALCOHOL	107-18-6
	ANILINE	62-53-3
	BENZIDINE	92-87-5
	BENZOIC ACID	65-85-0
	BENZOIC ACID, DIHYDROXY	T119-36-8
	BENZYL ALCOHOL	100-51-6
*	BIS(2-ETHYLHEXYL) PHTHALATE	117-81-7
*	BUTYLBENZYL PHTHALATE	85-68-7
*	CARBON DISULFIDE	75-15-0
	CRESOLS	1319-77-3
	CYCLOHEXANONE	108-94-1
*	DI-N-BUTYL PHTHALATE	84-74-2
*	DI-N-OCTYL PHTHALATE	117-84-0
	DIETHYL PHTHALATE	84-66-2
	DIMETHOXYETHANE	110-71-4
	DIMETHYL PHTHALATE	131-11-3
	DIPHENYLAMINE	122-39-4
	ETHANOL,2-ETHOXY ACETATE	111-15-9
	ETHOXYETHYLENE	109-92-2

* - Data are available on these contaminants in Attachments D, E, and F.

APPENDIX A

Best Demonstrated Available Technology
for W09 - OTHER POLAR ORGANIC COMPOUNDS

	Contaminant Name	CAS Number
	ETHYL ACETATE	141-78-6
	ETHYLENE OXIDE	75-21-8
	HEXADECANOIC ACID	57-10-3
	HEXANEDIOIC ACID, DIOCTYL ESTER	123-79-5
	ISOBUTANOL	78-83-1
*	ISOPHORONE	78-59-1
	METHANOL	67-56-1
	METHYL METHACRYLATE	80-62-6
	N-NITROSODI-N-PROPYLAMINE	621-64-7
	N-NITROSODIMETHYLAMINE	62-75-9
	N-NITROSODIPHENYLAMINE	86-30-6
	ORGANIC CYANIDE	C57-12-5
*	PHENOL	108-95-2
	PROPANOIC ACID,2-METHYL	74381-40-1
	TRIETHYLAMINE	121-44-8
	VINYL ACETATE	108-05-4

* - Data are available on these contaminants in Attachments D, E, and F.

APPENDIX A

Best Demonstrated Available Technology
for W10 - NON-VOLATILE METALS

	Contaminant Name	CAS Number
	ALUMINUM	7429-90-5
	BARIUM	7440-39-3
	BERYLLIUM	7440-41-7
	CALCIUM	7440-70-2
*	CHROMIUM	7440-47-3
	CHROMIUM (HEXAVALENT)	18540-29-9
	COBALT	7440-48-4
*	COPPER	7440-50-8
	IRON	7439-89-6
	LITHIUM	7439-93-2
	MAGNESIUM	7439-95-4
	MANGANESE	7439-96-5
	MOLYBDENUM	7439-98-7
*	NICKEL	7440-02-0
	POTASSIUM	7440-09-7
	SODIUM	7440-23-5
	STRONTIUM	7440-24-6
	VANADIUM	7440-62-2

* - Data are available on these contaminants in Attachments D, E, and F.

APPENDIX A

Best Demonstrated Available Technology
for W11 - VOLATILE METALS

	Contaminant Name	CAS Number
	ANTIMONY	7440-36-0
*	ARSENIC	7440-38-2
*	CADMIUM	7440-43-9
*	LEAD	7439-92-1
	MERCURY	7439-97-6
	SELENIUM	7782-49-2
	SILVER	7440-22-4
	THALLIUM	7440-28-0
	TIN	7440-31-5
	TITANIUM	7440-32-6
*	ZINC	7440-66-6

* - Data are available on these contaminants in Attachments D, E, and F.

APPENDIX A

Best Demonstrated Available Technology
for W12 - OTHER INORGANICS

Contaminant Name	CAS Number
AMMONIA AS NITROGEN	N7664-41-7
ASBESTOS (FIBROUS)	01332-21-4
BORON	7440-42-8
CARBON MONOXIDE	XCOX
CHEMICAL OXYGEN DEMAND	COD
CHLORIDE	CHLORIDE
CYANIDE	57-12-5
DESTRUCTION REMOVAL EFFICIENCY	XDRE-%
FLUORIDE	16984-48-8
HCl EMMISSIONS KG/HR	X7647-01-0
HYDRAZINE	302-01-2
HYDROCYANIC ACID	74-90-8
NITRATE AS N	NO3
OXIDES OF NITROGEN	XNOX
PARTICULATE EMISSIONS G/DSCF	XPART-A
PARTICULATE EMISSIONS MG/DSCM	XPART
pH	XPH
PHOSPHATE	PO4
PHOSPHORUS	7723-14-0
SILICON	7440-21-3
SULFATE	SULFATE
SULFIDE	A57-12-5
THALLIUM SULFATE	10031-59-1
URANIUM	7440-61-1
YITRIUM	10361-92-9

* - Data are available on these contaminants in Attachments D, E, and F.

APPENDIX A

Best Demonstrated Available Technology
for W13 - OTHER ORGANICS

Contaminant Name	CAS Number
% REMOVAL TOTAL VOLATILE ORGANICS	XRET-VOC
1-METHYLPHENANTHRENE	1-MP
1-PENTENE-3-OL	616-25-1
2 METHYL PROPANE	75-28-5
2(3H)FURANONE,DIHYDRO	96-48-0
2(5H)-FURANONE, 5,5-DIMETHYL	20019-64-1
2,3,4 TRIMETHYL HEXANE	921-47-1
2,3-DIMETHYL HEPTANE	3074-71-3
2,4-DIMETHYL HEPTANE	2213-23-2
2,5-DIMETHYL HEPTANE	2216-30-0
2,6,10,14 TETRAMETHYL HEXADECANE	638-36-8
2,6,10,14 TETRAMETHYL PENTADECANE	1921-70-6
2-CHLOROETHANOL PHOSPHATE	115-96-8
3 HEXON-2-ONE-5-METHYL	5166-53-0
3,3-DIMETHYL HEXANE	563-16-6
3,5-DIMETHYL HEPTANE	926-82-9
3-METHYL OCTANE	2216-33-3
4 PENTIN 2-ONE	13891-87-7
4-METHYL OCTANE	2216-34-4
4-PENTEN-2-ONE	1389-18-7
4H-1,2,4 TRIAZALE, 4 METHYL	1057-00-8
7,12-DIMETHYLBENZ (A) ANTHRACENE	57-97-6
9,9'-DICHLOROFLUORENE	C86-73-7
ALK20	ALK20
ALKANE (19.71)	ALK19
ALKANE (25.02)	ALK25
ALKANE (27.81)	ALK27
AZULENE,7-ETHYL-1,4-DEMETHYL	1529-05-5
BENZAMIDE,2-HYDROXY-N-PHENYL	87-17-2
C10 AROMATIC (9.7-11.5)	C10AR97
C7 ALIPHATIC (20.68)	C7AL
C9 AROMATIC (37.54)	C9AR37
C9 AROMATIC (7.6-9.0)	C9AR76
CAPTAN	133-06-2
CARBAZOLE (9-AZAFLUORENE)	A86-73-7
CHLOROPHENESIC ACID	CPEA
CHLOROPHENIC ACID	CPA
CRUDE OIL	CRUDE
DECENE	19699-18-0
DIAZINON	333-41-5
DIBENZ (A,H) ACRIDINE	226-36-8

* - Data are available on these contaminants in Attachments D, E, and F.

APPENDIX A

Best Demonstrated Available Technology
for W13 - OTHER ORGANICS

Contaminant Name	CAS Number
DICYCLOPENTADIENE	77-73-6
DIESEL FUEL, OIL, PETROL	DIESEL
DIMETHYL TEREPHTHALATE	A131-11-3
DIMETHYLNAPHTHALENE	DMN
EICOSANE	112-95-8
GLYPHOSATE	GLY
HEPTADECANE	629-78-7
HEPTANE	142-82-5
HEXADECANE	544-76-3
HEXANE	110-54-3
MALATHION	121-75-5
METHYLCYCLOPENTANE	96-37-7
MINERAL OIL	8020-83-5
NONANE	111-84-2
OCTADECANE	593-45-3
OIL AND GREASE	TOT-OIL
OTHER VOLATILE ORGANIC COMPOUNDS	OTH-VOC
PENTADECANE	629-62-9
PENTANE	109-66-0
PHENOLIC COMPOUNDS	PHEN
PHORATE	298-02-2
PRONAMIDE	23950-58-5
TETRACOSANE HEXAMETHYL	111-01-3
TOTAL EXTRACTABLE HYDROCARBONS	TEH
TOTAL HYDROCARBONS	THC
TOTAL ORGANIC CARBON	TOC
TOTAL ORGANIC HALOGENS	TOX
TOTAL PETROLEUM HYDROCARBONS	TOT-PETROL
TOTAL VOLATILE ORGANICS	TOT-VOC
TRIMETHYLNAPHTHALENE	TMN

* - Data are available on these contaminants in Attachments D, E, and F.

APPENDIX B

TREATMENT TECHNOLOGY GROUPS AND INDIVIDUAL TREATMENT PROCESSES

Thermal Destruction

*Rotary Kiln
*Fluidized Bed
*Circulating Bed
*Infrared
*Pyrolysis
Wet Air Oxidation
*Aqueous Thermal Decomposition
*Critical Water Oxidation
UV Photolysis

Dechlorination

*APEG Dechlorination
*KPEG Dechlorination
*MPEG Dechlorination
NaPEG Dechlorination

Biological

Activated Sludge
*Composting

Low Temperature Thermal Desorption

*Low Temperature Thermal Desorption

Chemical Extraction and Soil Washing

*Chemical Extraction
*Soil Washing

Immobilization

*Solidification
*Stabilization
Fixation

*Technologies with analytical data in Appendices D, E, and F.

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APPENDIX C

DATA SCREENS AND MODIFICATIONS

The analytical data contained in the contaminated soil data base were evaluated through two series of screens in order to eliminate data that were not representative of well designed and well operated systems. This section describes the various data screens that were applied and presents the rationale for each. All rejected data have been retained in subsections of the data base and are available for further evaluation. Data which passed through both series of screens are presented in Appendices D, E, and F. Data which passed through the primary screens but not the secondary screens are retained in Appendix G.

The initial screens were very general in nature, representing a quality control check on the data base. Data were removed from consideration for four basic reasons:

- Unmatched untreated data or treated data were not considered further. This included unreported untreated or treated values or unmatched analytical protocols.

- If the calculated removal efficiency was less than or equal to zero, corresponding untreated and treated data were disregarded. This phenomenon either indicated problems with the technology effectiveness or with the analytical protocols. Sometimes, the negative result was unavoidable. This was the case for the non-volatile organic data from low temperature thermal desorption process where the non-volatiles were not volatilized, but the waste was reduced in volume, thereby resulting in a concentration increase with no mass increase.

- The EP Toxicity and TCLP protocols were the only extraction protocols included in the data base, because only data from these tests have been used to develop other LDR guidelines.

- If the treatment data resulted from a series of tests on the same waste material, the data from the tests with the highest removal efficiencies were retained and all other test data were screened from the data base. In this way, only the most successful performance results were considered. These data were often generated by a series of test runs designed to determine the best operating conditions.

The secondary screens were more specific with respect to treatment technologies and contaminants treated. Descriptions of these screens follow:

- Specific data pairs were screened because the technology was not appropriate for the contaminant group. An example is the low temperature thermal desorption data for inorganics.

- Only extraction analyses were used to evaluate the effectiveness of the immobilization technology. All total constituent analyses for wastes treated with immobilization were screened from the data base.

- Non-detected effluent values were substituted with common detection limits. These detection limits are presented at the end of this appendix. If the addition of the detection limits resulted in a negative removal efficiency, the data were screened from the data base.

- All total constituent analysis data for metals were eliminated from further consideration. Because metals can not be destroyed, but are instead immobilized or removed, only extraction protocols are an effective measurement of the success of the treatment technology. Appendix G contains the total constituent analysis data for metals, which shows how effectively the treatment process removed metals from the waste.

- All data for the destruction of metals were screened and eliminated from further consideration because metals cannot be destroyed. This screen affects data from thermal destruction, bioremediation, and dechlorination technologies.

- Nine contaminants were not detected (ND) in the treated soils and no substitute detection limits

were available. Therefore, when the treated soil concentration of these contaminants was ND, these data pairs were screened from the data base:

Ethoxyethylene 109-92-2
Hexane 110-54-3
Dimethoxyethane 110-71-4
Heptane 142-82-5
Alkyl Benzene ABC
Molybdenum 7439-82-4
RDX 121-82-4
HMX 133-GHMX
Tetryl 479-45-8

The secondary screens further refined the data base, identifying the "best" performance data for each treatability group. The data that passed through both the initial and secondary screens appear in Appendices D, E, and F. The data that passed through the initial but not the secondary screens appear in Appendix G. While the data in Appendix G are not indicative of the "best" performance, they provide valuable information regarding the treatment of mixtures of organic and inorganic wastes. In these cases, an approach must be sought which optimizes the treatment of each contaminant in the mixed waste, without creating undesirable cross media impacts. Often treatment trains are the best solutions to such problems.

Detection Limits Substituted for Non-Detected Values

During the process of extracting data for incorporation into the soil treatment data base, a number of reports which were evaluated reported the treated soil concentrations as not detected (ND). In order to provide non zero treated soil concentration values and thus more realistic removal efficiencies, common analytical detection limits were substituted for the treated soil concentrations for a number of compounds. These substituted detection limits follow:

Contaminant CAS Code

Compound and CAS Code
Detection Limit (ppm)

1. acenaphthene 0.33
   83-32-9
2. 2-amino-4,6-dinitrotoluene 1
   T99-55-8
3. arsenic 0.01
   7440-38-2
4. barium 0.2
   7440-39-3
5. benzene 0.005
   71-43-2
6. carbon tetrachloride 0.005
   56-23-5
7. 1,1-dichloroethane 0.005
   75-34-3
8. 1,2-dichloroethane 0.005
   107-06-2
9. 1,1-dichloroethene 0.005
   75-35-4
10. dinitrobenzene 0.5
    25154-54-5
11. di-n-octyl phthalate 0.33
    117-84-0
12. nickel 0.04
    7440-02-0
13. silver 0.01
    7440-22-4
14. 2,3,7,8-tetrachlorodibenzo-p-dioxin 0.00017
    1746-01-6
15. tetrachloroethene 0.005
    127-18-4
16. toluene 0.005
    108-88-3
17. trans-1,2-dichloroethene 0.005
    156-60-5
18. trichloroethene 0.005
    79-01-6
19. trinitrobenzene 1
    99-35-4
20. trinitrotoluene (TNT) 1
    118-96-7
21. xylenes (total) 0.005
    1330-20-7

APPENDIX D

TOTAL CONSTITUENT ANALYSIS
WASTE TREATMENT RESULTS FOR ORGANICS

This Appendix tabulates the data used to develop the conclusions in the report for treatment of organic contaminants by thermal destruction, dechlorination, bioremediation, low temperature thermal desorption, and chemical extraction and soil washing technologies. Data used to develop the conclusions on the immobilization of organics are presented in Appendix F. The untreated and treated concentrations in the wastes are reported, as well as the corresponding removal efficiencies. The data are sorted by treatability group, technology group, and contaminant. Not all treatability groups have data for all technology groups.

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W01 HALOGENATED NON-POLAR AROMATIC COMPOUNDS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.964706	3.40000		0.12000		INCINERATION	CHLOROBENZENE	SOIL	B	980-TS1-RT-FDBP-1	21
2	0.846666	3.00000		0.46000		INCINERATION	CHLOROBENZENE	SOIL	B	980-TS1-RT-FDBP-1	20
	SOIL = 2 data points			SLUDGE (SLUD) = 0 data points							
1	0.999990	200.60000	E1	0.00200	ND	ROTARY KILN	4,4'-DDT	SOIL	P	980-TS1-RT-EZUY-1	1
2	0.999989	181.36600	E1	0.00200	ND	ROTARY KILN	4,4'-DDD	SOIL	P	980-TS1-RT-EZUY-1	1
3	0.999986	360.00000		0.00500	ND	ROTARY KILN	CHLOROBENZENE	SOIL	P	ORD-TS1-RT-EUZM-1	3
4	0.999985	340.00000		0.00500	ND	ROTARY KILN	CHLOROBENZENE	SOIL	P	ORD-TS1-RT-EUZM-1	1
5	0.999985	129.60000	E1	0.00200	ND	ROTARY KILN	4,4'-DDT	SOIL	P	980-TS1-RT-EZUY-1	1
6	0.999983	117.84600	E1	0.00200	ND	ROTARY KILN	4,4'-DDD	SOIL	P	980-TS1-RT-EZUY-1	1
7	0.999982	111.66500	E1	0.00200	ND	ROTARY KILN	4,4'-DDD	SOIL	P	980-TS1-RT-EZUY-1	1
8	0.999979	240.00000		0.00500	ND	ROTARY KILN	CHLOROBENZENE	SOIL	P	ORD-TS1-RT-EUZM-1	2
9	0.999933	29.67000		0.00200	ND	ROTARY KILN	4,4'-DDT	SOIL	P	980-TS1-RT-EZUY-1	1
10	0.999872	7.83500		0.00100	ND	ROTARY KILN	4,4'-DDE	SOIL	P	980-TS1-RT-EZUY-1	1
11	0.999838	6.19400		0.00100	ND	ROTARY KILN	4,4'-DDE	SOIL	P	980-TS1-RT-EZUY-1	1
12	0.999833	30.00000		0.00500	ND	ROTARY KILN	CHLOROBENZENE	SOIL	P	ORD-TS1-RT-EUZM-1	6
13	0.999803	5.07100		0.00100	ND	ROTARY KILN	4,4'-DDE	SOIL	P	980-TS1-RT-EZUY-1	1
14	0.999773	22.00000		0.00500	ND	ROTARY KILN	CHLOROBENZENE	SOIL	P	ORD-TS1-RT-EUZM-1	4
15	0.999275	6.90000		0.00500	ND	ROTARY KILN	CHLOROBENZENE	SOIL	P	ORD-TS1-RT-EUZM-1	5
	SOIL = 15 data points			SLUDGE (SLUD) = 0 data points							
1	0.999995	16600.00000	J	0.08000	J	INFRARED	CHLOROBENZENE	SOIL	P	980-TS1-RT-FCNU-1	1
2	0.999981	242.00000	E3	0.00470		INFRARED	TOTAL CHLOROBENZENES	SOIL	P	980-TS1-RT-EWQD-1	3
3	0.999979	58.00000		0.00120		INFRARED	TOTAL CHLOROBENZENES	SOIL	P	980-TS1-RT-EWQD-1	1
4	0.999943	169.00000	E2	0.00960		INFRARED	TOTAL CHLOROBENZENES	SOIL	P	980-TS1-RT-EWQD-1	2
5	0.999885	40.00000		0.00460		INFRARED	TOTAL CHLOROBENZENES	SOIL	P	980-TS1-RT-EWQD-1	5
6	0.999839	31.00000		0.00500	ND	INFRARED	CHLOROBENZENE	SOIL	P	980-TS1-RT-EZZB-1	1
7	0.999839	31.00000		0.00500	ND	INFRARED	CHLOROBENZENE	SOIL	P	980-TS1-RT-EZZB-1	2
8	0.999515	33.00000		0.01600		INFRARED	TOTAL CHLOROBENZENES	SOIL	P	980-TS1-RT-EWQD-1	4
9	0.998936	4.70000		0.00500	ND	INFRARED	CHLOROBENZENE	SOIL	P	980-TS1-RT-EZZB-1	7
10	0.998936	4.70000		0.00500	ND	INFRARED	CHLOROBENZENE	SOIL	P	980-TS1-RT-EZZB-1	8
11	0.997222	1.80000		0.00500	ND	INFRARED	CHLOROBENZENE	SOIL	P	980-TS1-RT-EZZB-1	5
12	0.997222	1.80000		0.00500	ND	INFRARED	CHLOROBENZENE	SOIL	P	980-TS1-RT-EZZB-1	6
	SOIL = 12 data points			SLUDGE (SLUD) = 0 data points							

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W01 HALOGENATED NON-POLAR AROMATIC COMPOUNDS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999843	2.10000		0.00033	ND	CIRCULATING BED COMB	TOTAL TRICHLOROBENZENES	SOIL	P	980-TS1-RT-EUXM-1	3
2	0.999816	1.80000		0.00033	ND	CIRCULATING BED COMB	TOTAL TRICHLOROBENZENES	SOIL	P	980-TS1-RT-EUXM-1	1
3	0.999746	1.30000		0.00033	ND	CIRCULATING BED COMB	TOTAL TRICHLOROBENZENES	SOIL	P	980-TS1-RT-EUXM-1	5

SOIL = 3 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W01 HALOGENATED NON-POLAR AROMATIC COMPOUNDS
Technology Group: DECHLORINATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999970	387.00000		0.01020		DECHLORINATION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUTV-1	4
2	0.999690	345.00000		0.10600		DECHLORINATION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUTV-1	1
3	0.996220	4.26000		0.01610		DECHLORINATION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUTV-1	2
4	0.990470	387.00000		3.69000		DECHLORINATION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUTV-1	8
5	0.976810	345.00000		8.00000		DECHLORINATION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUTV-1	5
6	0.976640	13.10000		0.30600		DECHLORINATION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUTV-1	3
7	0.965730	4.26000		0.14600		DECHLORINATION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUTV-1	6
8	0.965110	13.10000		0.45700		DECHLORINATION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUTV-1	7

SOIL = 8 data points SLUDGE (SLUD) = 0 data points

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W01 HALOGENATED NON-POLAR AROMATIC COMPOUNDS
Technology Group: BIOREMEDIATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999724	18.10000		0.00500	ND	AEROBIC	CHLOROBENZENE	SOIL	P	980-TS1-RT-EZZA-1	2
2	0.999669	18.10000		0.00600	ND	AEROBIC	CHLOROBENZENE	SOIL	P	980-TS1-RT-EZZA-1	2
3	0.999669	18.10000		0.00600	ND	AEROBIC	CHLOROBENZENE	SOIL	P	980-TS1-RT-EZZA-1	2
4	0.913808	6.82200		0.58800		AEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	1
5	0.829790	0.23500		0.04000		AEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	13
6	0.771430	0.87500		0.20000		AEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	8
7	0.768250	6.82200		1.58100		AEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	1
8	0.752418	6.82200		1.68900		AEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	2
9	0.746110	0.77200		0.19600		AEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	11
10	0.731897	6.82200		1.82900		AEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	2
11	0.730280	0.87500		0.23600		AEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	7
12	0.716510	4.68800		1.32900		AEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	7
13	0.695590	0.77200		0.23500		AEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	11
14	0.678612	1.75800		0.56500		AEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	3
15	0.677460	0.77200		0.24900		AEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	1
16	0.648490	6.82200		2.39800		AEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	12
17	0.646189	1.75800		0.62200		AEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	4
18	0.638300	0.23500		0.08500		AEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	3
19	0.638300	0.23500		0.08500		AEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	13
20	0.629053	4.68800		1.73900		AEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	7
21	0.586924	6.82200		2.81800		AEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	12
22	0.571780	0.40400		0.17300		AEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	9
23	0.544400	0.25900		0.11800		AEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	15
24	0.534129	4.68800		2.18400		AEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	8
25	0.519909	1.75800		0.84400		AEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	3
26	0.505790	0.25900		0.12800		AEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	16
27	0.494820	0.77200		0.39000		AEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	1
28	0.484641	1.75800		0.90600		AEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	13
29	0.464529	3.80600		2.03800		AEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	9
30	0.440000	0.87500		0.49000		AEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	7
31	0.400990	0.40400		0.24200		AEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	9
32	0.380977	3.80600		2.35600		AEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	9
33	0.340309	1.09900		0.72500		AEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	5
34	0.339430	0.87500		0.57800		AEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	8
35	0.306380	0.23500		0.16300		AEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	4
36	0.289249	4.68800		3.33200		AEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	8
37	0.283894	1.09900		0.78700		AEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	16
38	0.253128	1.75800		1.31300		AEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	13
39	0.240930	0.77200		0.58600		AEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	12
40	0.230570	0.77200		0.59400		AEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	2
41	0.170210	0.23500		0.19500		AEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	3

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W01 HALOGENATED NON-POLAR AROMATIC COMPOUNDS
Technology Group: BIOREMEDIATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
42	0.129208	1.09900		0.95700		AEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	5
43	0.069498	0.25900		0.24100		AEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	5
44	0.034749	0.25900		0.25000		AEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	5
	SOIL = 44 data points			SLUDGE (SLUD) = 0 data points							
1	0.892407	6.82200		0.73400		ANAEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	17
2	0.886690	6.82200		0.77300		ANAEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	18
3	0.819950	0.77200		0.13900		ANAEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	17
4	0.800058	6.82200		1.36400		ANAEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	18
5	0.759954	1.75800		0.42200		ANAEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	20
6	0.720210	0.77200		0.21600		ANAEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	18
7	0.719659	1.40900		0.39500		ANAEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	24
8	0.714691	1.40900		0.40200		ANAEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	24
9	0.685230	0.77200		0.24300		ANAEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	17
10	0.674061	1.75800		0.57300		ANAEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	20
11	0.656428	1.75800		0.60400		ANAEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	19
12	0.600135	1.48300		0.59300		ANAEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	25
13	0.490446	1.09900		0.56000		ANAEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	22
14	0.464210	1.41100		0.75600		ANAEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	23
15	0.294928	6.82200		4.81000		ANAEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	17
16	0.214740	1.09900		0.86300		ANAEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	22
17	0.192852	1.48300		1.19700		ANAEROBIC	4,4'-DDT	SOIL	B	980-TS1-RT-EZUU-1	26
18	0.121760	0.77200		0.67800		ANAEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	18
19	0.069498	0.25900		0.24100		ANAEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	21
20	0.030888	0.25900		0.25100		ANAEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	21
21	0.021276	0.23500		0.23000		ANAEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	19
22	0.018633	0.16100		0.15800		ANAEROBIC	4,4'-DDE	SOIL	B	980-TS1-RT-EZUU-1	23
	SOIL = 22 data points			SLUDGE (SLUD) = 0 data points							

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W01 HALOGENATED NON-POLAR AROMATIC COMPOUNDS
Technology Group: LOW TEMPERATURE THERMAL DESORPTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999991	322.00000		0.00300		LOW TEMP DESORPTION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	2
2	0.999985	322.00000		0.00500	ND	LOW TEMP DESORPTION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	1
3	0.999985	322.00000		0.00500	ND	LOW TEMP DESORPTION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	3
4	0.999985	322.00000		0.00500		LOW TEMP DESORPTION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	9
5	0.999985	322.00000		0.00500		LOW TEMP DESORPTION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	10
6	0.999957	322.00000		0.01400		LOW TEMP DESORPTION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	8
7	0.999938	320.00000		0.02000	ND	LOW TEMP DESORPTION	1,2-DICHLOROBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
8	0.999933	300.00000		0.02000	ND	LOW TEMP DESORPTION	1,2-DICHLOROBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
9	0.999839	322.00000		0.05200		LOW TEMP DESORPTION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	6
10	0.999817	322.00000		0.05900		LOW TEMP DESORPTION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	5
11	0.999798	322.00000		0.06500		LOW TEMP DESORPTION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	4
12	0.999535	43.00000		0.02000	ND	LOW TEMP DESORPTION	1,2-DICHLOROBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
13	0.999394	6.60000		0.00400		LOW TEMP DESORPTION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	14
14	0.999394	6.60000		0.00400		LOW TEMP DESORPTION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	15
15	0.999394	6.60000		0.00400		LOW TEMP DESORPTION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	16
16	0.999394	33.00000		0.02000	ND	LOW TEMP DESORPTION	1,2-DICHLOROBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
17	0.999355	31.00000		0.02000	ND	LOW TEMP DESORPTION	1,2-DICHLOROBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
18	0.999091	6.60000		0.00600		LOW TEMP DESORPTION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	13
19	0.999091	22.00000		0.02000	ND	LOW TEMP DESORPTION	1,2-DICHLOROBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
20	0.998750	16.00000		0.02000	ND	LOW TEMP DESORPTION	1,2-DICHLOROBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
21	0.998667	15.00000		0.02000	ND	LOW TEMP DESORPTION	1,2-DICHLOROBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
22	0.998667	15.00000		0.02000	ND	LOW TEMP DESORPTION	1,2-DICHLOROBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
23	0.998667	15.00000		0.02000	ND	LOW TEMP DESORPTION	1,2-DICHLOROBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
24	0.997424	6.60000		0.01700		LOW TEMP DESORPTION	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	17
25	0.997368	7.60000		0.02000	ND	LOW TEMP DESORPTION	1,2-DICHLOROBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
26	0.980000	50.00000		1.00000	ND	LOW TEMP DESORPTION	1,2-DICHLOROBENZENE	SOIL	P	980-TS1-RT-FCSF-1	1
27	0.882353	1.70000		0.20000	ND	LOW TEMP DESORPTION	1,2-DICHLOROBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
28	0.866666	1.50000		0.20000	ND	LOW TEMP DESORPTION	1,2-DICHLOROBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
29	0.866666	1.50000		0.20000	ND	LOW TEMP DESORPTION	1,2-DICHLOROBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1

SOIL = 29 data points SLUDGE (SLUD) = 0 data points

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W01 HALOGENATED NON-POLAR AROMATIC COMPOUNDS
Technology Group: CHEMICAL EXTRACTION AND SOIL WASHING

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999964	330.00000		0.01200		SOIL WASHING	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	49
2	0.999939	330.00000		0.02000		SOIL WASHING	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	43
3	0.999911	316.00000		0.02800		SOIL WASHING	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	1
4	0.999846	13.00000		0.00200		SOIL WASHING	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	19
5	0.999846	13.00000		0.00200		SOIL WASHING	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	25
6	0.999808	13.00000		0.00250		SOIL WASHING	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	13
7	0.999770	330.00000		0.07600		SOIL WASHING	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	55
8	0.999692	13.00000		0.00400		SOIL WASHING	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	26
9	0.999538	13.00000		0.00600		SOIL WASHING	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	20
10	0.999273	11.00000		0.00800		SOIL WASHING	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	31
11	0.999114	316.00000		0.28000		SOIL WASHING	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	2
12	0.999051	316.00000		0.30000		SOIL WASHING	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	7
13	0.999000	13.00000		0.01300		SOIL WASHING	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	14
14	0.999000	11.00000		0.01100		SOIL WASHING	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	37
15	0.997152	330.00000		0.94000		SOIL WASHING	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	56
16	0.996835	316.00000		1.00000		SOIL WASHING	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	8
17	0.995758	330.00000		1.40000		SOIL WASHING	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	50
18	0.995455	330.00000		1.50000		SOIL WASHING	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	44
19	0.985000	11.00000		0.16500		SOIL WASHING	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	32
20	0.979091	11.00000		0.23000		SOIL WASHING	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	38

SOIL = 20 data points SLUDGE (SLUD) = 0 data points

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W02 DIOXINS/FURANS/PCBS & THEIR PRECURSORS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999166	3.60000		0.00300	ND	INCINERATION	PCB-1260	SOIL	B	980-TS1-RT-EZYN-1	1
2	0.998733	1.50000		0.00190	ND	INCINERATION	PCB-1016	SOIL	B	980-TS1-RT-EZYN-1	1
3	0.998620	2.90000		0.00400	ND	INCINERATION	PCB-1260	SOIL	B	980-TS1-RT-EZYN-1	1
4	0.998000	1.50000		0.00300	ND	INCINERATION	PCB-1016	SOIL	B	980-TS1-RT-EZYN-1	1
	SOIL = 4 data points			SLUDGE (SLUD) = 0 data points							
1	0.999998	840.00000	E1	0.00200	ND	ROTARY KILN	2,4,5-TRICHLOROPHENOXYACETIC ACID	SOIL	F	980-TS1-RT-EUZH-1	5
2	0.999996	510.00000	E1	0.00200	ND	ROTARY KILN	2,4,5-TRICHLOROPHENOXYACETIC ACID	SOIL	F	980-TS1-RT-EUZH-1	2
3	0.999994	3300.00000	E2	0.02000	ND	ROTARY KILN	2,4-DICHLOROPHENOXYACETIC ACID (2,4-D)	SOIL	F	980-TS1-RT-EUZH-1	2
4	0.999991	220.00000	E1	0.00200	ND	ROTARY KILN	2,4,5-TRICHLOROPHENOXYACETIC ACID	SOIL	F	980-TS1-RT-EUZH-1	3
5	0.999980	100.00000	E1	0.00200	ND	ROTARY KILN	2,4,5-TRICHLOROPHENOXYACETIC ACID	SOIL	F	980-TS1-RT-EUZH-1	1
6	0.999957	47.00000		0.00200	ND	ROTARY KILN	2,4,5-TRICHLOROPHENOXYACETIC ACID	SOIL	F	980-TS1-RT-EUZH-1	4
7	0.999950	400.00000	E1	0.02000	ND	ROTARY KILN	2,4-DICHLOROPHENOXYACETIC ACID (2,4-D)	SOIL	F	980-TS1-RT-EUZH-1	5
8	0.999833	120.00000	E1	0.02000	ND	ROTARY KILN	2,4-DICHLOROPHENOXYACETIC ACID (2,4-D)	SOIL	F	980-TS1-RT-EUZH-1	3
9	0.999643	56.00000		0.02000	ND	ROTARY KILN	2,4-DICHLOROPHENOXYACETIC ACID (2,4-D)	SOIL	F	980-TS1-RT-EUZH-1	1
10	0.999130	23.00000		0.02000	ND	ROTARY KILN	2,4-DICHLOROPHENOXYACETIC ACID (2,4-D)	SOIL	F	980-TS1-RT-EUZH-1	4
11	0.997200	0.06060		0.00017	ND	ROTARY KILN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	F	980-TS1-RT-EUZH-1	5
12	0.996800	0.05420		0.00017	ND	ROTARY KILN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	F	980-TS1-RT-EUZH-1	2
13	0.996300	0.04580		0.00017	ND	ROTARY KILN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	F	980-TS1-RT-EUZH-1	4
14	0.995500	0.03800		0.00017	ND	ROTARY KILN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	F	980-TS1-RT-EUZH-1	3
15	0.994700	0.03210		0.00017	ND	ROTARY KILN	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	F	980-TS1-RT-EUZH-1	1
16	0.991000	0.00120		0.00001		ROTARY KILN	2,3,7,8-TETRACHLORODIBENZO FURAN	SOIL	F	980-TS1-RT-EUZH-1	5
17	0.991000	0.00120		0.00001		ROTARY KILN	OCTACHLORODIBENZODIOXINS	SOIL	F	980-TS1-RT-EUZH-1	5

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W02 DIOXINS/FURANS/PCBS & THEIR PRECURSORS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
18	0.980000	0.00049		0.00001		ROTARY KILN	2,3,7,8-TETRACHLORODIBENZO FURAN	SOIL	F	980-TS1-RT-EUZH-1	2
19	0.980000	0.00066		0.00001		ROTARY KILN	2,3,7,8-TETRACHLORODIBENZO FURAN	SOIL	F	980-TS1-RT-EUZH-1	4
20	0.970000	0.00072		0.00002		ROTARY KILN	OCTACHLORODIBENZODIOXINS	SOIL	F	980-TS1-RT-EUZH-1	3
21	0.970000	0.00080		0.00002		ROTARY KILN	OCTACHLORODIBENZODIOXINS	SOIL	F	980-TS1-RT-EUZH-1	4
22	0.960000	0.00058		0.00002		ROTARY KILN	2,3,7,8-TETRACHLORODIBENZO FURAN	SOIL	F	980-TS1-RT-EUZH-1	3
23	0.750000	0.00045		0.00011	ND	ROTARY KILN	2,3,7,8-TETRACHLORODIBENZO FURAN	SOIL	F	980-TS1-RT-EUZH-1	1
	SOIL = 23 data points			SLUDGE (SLUD) = 0 data points							
1	1.000000	740.00000		0.00040	ND	INFRARED	DICHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	2
2	1.000000	770.00000		0.00040	ND	INFRARED	DICHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	4
3	1.000000	1060.00000		0.00040	ND	INFRARED	TRICHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	2
4	1.000000	1000.00000		0.00040	ND	INFRARED	TRICHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	3
5	1.000000	1200.00000		0.00040	ND	INFRARED	TRICHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	4
6	0.999999	650.00000		0.00040	ND	INFRARED	DICHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	3
7	0.999999	770.00000		0.00080	ND	INFRARED	TETRACHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	2
8	0.999999	710.00000		0.00080	ND	INFRARED	TETRACHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	3
9	0.999999	790.00000		0.00080	ND	INFRARED	TETRACHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	4
10	0.999998	5.66000		0.00001		INFRARED	OCTACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	4
11	0.999998	4.70000		0.00001		INFRARED	OCTACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	5
12	0.999998	200.00000		0.00040	ND	INFRARED	TRICHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	5
13	0.999997	3.15100		0.00001		INFRARED	OCTACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	3
14	0.999997	9.50000	J	0.00003	J	INFRARED	OCTACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-FCNU-1	1
15	0.999996	5.94000		0.00002		INFRARED	OCTACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	4
16	0.999996	5.16000		0.00002		INFRARED	OCTACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	5
17	0.999996	48.00000		0.00020	ND	INFRARED	MONOCHLOROBIPHENYL	SOIL	P	980-TS1-RT-EZZC-1	2
18	0.999996	50.00000		0.00020	ND	INFRARED	MONOCHLOROBIPHENYL	SOIL	P	980-TS1-RT-EZZC-1	4
19	0.999996	110.00000		0.00040	ND	INFRARED	TETRACHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	5
20	0.999995	170.00000		0.00080	ND	INFRARED	PENTACHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	2
21	0.999995	160.00000		0.00080	ND	INFRARED	PENTACHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	3
22	0.999995	160.00000		0.00080	ND	INFRARED	PENTACHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	4
23	0.999994	71.00000		0.00040	ND	INFRARED	DICHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	5
24	0.999993	7.45800		0.00005		INFRARED	OCTACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	3
25	0.999993	30.00000		0.00020	ND	INFRARED	MONOCHLOROBIPHENYL	SOIL	P	980-TS1-RT-EZZC-1	3
26	0.999989	35.00000		0.00040	ND	INFRARED	TRICHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	1
27	0.999979	7.30000	J	0.00015	J	INFRARED	OCTACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-FCNU-1	1

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W02 DIOXINS/FURANS/PCBS & THEIR PRECURSORS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
28	0.999974	2.30100		0.00006		INFRARED	OCTACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	2
29	0.999973	30.00000		0.00080	ND	INFRARED	TETRACHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	1
30	0.999970	0.35800		0.00001		INFRARED	OCTACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	2
31	0.999964	11.00000		0.00040	ND	INFRARED	DICHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	1
32	0.999960	0.28000		0.00001		INFRARED	HEPTACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	4
33	0.999960	0.23800		0.00001		INFRARED	HEPTACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	5
34	0.999947	15.00000		0.00080	ND	INFRARED	PENTACHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	5
35	0.999941	3.40000		0.00020	ND	INFRARED	MONOCHLOROBIPHENYL	SOIL	P	980-TS1-RT-EZZC-1	5
36	0.999940	0.34000		0.00002		INFRARED	HEPTACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	2
37	0.999930	0.29200		0.00002		INFRARED	HEPTACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	3
38	0.999920	0.12100		0.00001		INFRARED	HEXACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	2
39	0.999910	0.11500		0.00001	ND	INFRARED	HEXACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	3
40	0.999900	0.10600		0.00001		INFRARED	HEPTACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	5
41	0.999880	0.17400		0.00002		INFRARED	HEPTACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	3
42	0.999852	5.40000		0.00080	ND	INFRARED	HEXACHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	3
43	0.999840	0.31500	J	0.00005	J	INFRARED	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-FCNU-1	1
44	0.999820	0.22700		0.00004	ND	INFRARED	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-EUTR-1	1
45	0.999810	0.15600		0.00003	ND	INFRARED	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-EUTR-1	2
46	0.999810	0.10900		0.00002		INFRARED	HEXACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	4
47	0.999800	0.05000		0.00001	ND	INFRARED	HEPTACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	1
48	0.999800	0.09800		0.00002		INFRARED	HEPTACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	2
49	0.999800	0.09000		0.00002		INFRARED	HEXACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	5
50	0.999760	0.12800		0.00003		INFRARED	HEPTACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	4
51	0.999700	0.08000		0.00002		INFRARED	HEXACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	5
52	0.999700	0.03530		0.00001	ND	INFRARED	OCTACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	1
53	0.999700	0.03600		0.00001	ND	INFRARED	PENTACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	3
54	0.999700	0.04100		0.00001	ND	INFRARED	PENTACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	4
55	0.999700	0.03300		0.00001	ND	INFRARED	TETRACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	3
56	0.999700	0.04200		0.00001	ND	INFRARED	TETRACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	4
57	0.999700	0.03800		0.00001	ND	INFRARED	TETRACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	5
58	0.999636	1100.00000		0.40000	ND	INFRARED	TRICHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	6
59	0.999600	0.05800		0.00002		INFRARED	HEXACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	2
60	0.999600	0.20200		0.00008		INFRARED	OCTACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	1
61	0.999600	0.02700		0.00001	ND	INFRARED	PENTACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	5
62	0.999530	0.12900		0.00006		INFRARED	HEXACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	4
63	0.999460	740.00000		0.40000	ND	INFRARED	DICHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	6
64	0.999400	0.01700		0.00001	ND	INFRARED	HEXACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	1
65	0.999400	0.05400		0.00003		INFRARED	HEXACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	3

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W02 DIOXINS/FURANS/PCBS & THEIR PRECURSORS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
66	0.999400	0.01800		0.00001	ND	INFRARED	PENTACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	2
67	0.999400	0.05300		0.00003		INFRARED	PENTACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	2
68	0.999300	0.01460		0.00001	ND	INFRARED	HEPTACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	1
69	0.999012	810.00000		0.80000	ND	INFRARED	TETRACHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	6
70	0.999000	0.00940		0.00001	ND	INFRARED	HEXACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	1
71	0.998660	0.60000		0.00080	ND	INFRARED	PENTACHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	1
72	0.998600	0.04900		0.00007		INFRARED	TETRACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	5
73	0.998500	0.03400		0.00005		INFRARED	PENTACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	5
74	0.998500	0.03300		0.00005		INFRARED	TETRACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	3
75	0.998300	0.01200		0.00002		INFRARED	TETRACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	2
76	0.998000	0.00630		0.00001	ND	INFRARED	OCTACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-FREV-1	1
77	0.998000	0.00670		0.00001	ND	INFRARED	TETRACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	1
78	0.998000	0.00600		0.00001	ND	INFRARED	TETRACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	2
79	0.998000	0.06700		0.00013		INFRARED	TETRACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	4
80	0.997500	0.04400		0.00011		INFRARED	PENTACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	4
81	0.997000	0.00400		0.00001	ND	INFRARED	PENTACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EWQD-1	1
82	0.997000	0.00310		0.00001	ND	INFRARED	PENTACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	1
83	0.995500	0.03800		0.00017	ND	INFRARED	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-EWQD-1	4
84	0.995000	0.03400		0.00017	ND	INFRARED	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-EWQD-1	5
85	0.995000	160.00000		0.80000	ND	INFRARED	PENTACHLOROBIPHENYLS	SOIL	P	980-TS1-RT-EZZC-1	6
86	0.992900	0.02400		0.00017	ND	INFRARED	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-EWQD-1	3
87	0.992593	27.00000		0.20000	ND	INFRARED	MONOCHLOROBIPHENYL	SOIL	P	980-TS1-RT-EZZC-1	6
88	0.987000	0.00400		0.00005		INFRARED	PENTACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EWQD-1	3
89	0.974000	0.00670		0.00017	ND	INFRARED	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-EWQD-1	1
90	0.961000	0.00440		0.00017	ND	INFRARED	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-EWQD-1	2
91	0.825000	0.00120		0.00021		INFRARED	OCTACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-FREV-1	1
	SOIL = 91 data points			SLUDGE (SLUD) = 0 data points							
1	0.919355	62.00000		5.00000		CRITICAL WATER OXIDA	TOTAL PCB'S	SLUD	B	980-TS1-RT-FBZZ-2	1
	SOIL = 0 data points			SLUDGE (SLUD) = 1 data points							
1	1.000000	3000.00000		0.00050		PYROLYSIS	PCB-1260	SOIL	P	980-TS1-RT-EXPD-1	1

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W02 DIOXINS/FURANS/PCBS & THEIR PRECURSORS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
2	1.000000	3000.00000		0.00050	ND	PYROLYSIS	PCB-1260	SOIL	P	980-TS1-RT-EXPD-1	2
3	1.000000	3000.00000		0.00060		PYROLYSIS	PCB-1260	SOIL	P	980-TS1-RT-EXPD-1	3
4	1.000000	3000.00000		0.00100		PYROLYSIS	PCB-1260	SOIL	P	980-TS1-RT-EXPD-1	4
5	1.000000	3000.00000		0.00050		PYROLYSIS	TOTAL PCB'S	SOIL	P	980-TS1-RT-FCFR-4	2
6	0.999830	0.24000		0.00004		PYROLYSIS	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-FCSS-1	1
7	0.999640	0.11100		0.00004	ND	PYROLYSIS	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-EURE-1	1
8	0.999640	0.11300		0.00004	ND	PYROLYSIS	TETRACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EURE-1	1
9	0.999400	0.01880		0.00001	ND	PYROLYSIS	PENTACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EURE-1	1
10	0.999200	0.01270		0.00001	ND	PYROLYSIS	TETRACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EURE-1	1
11	0.998600	0.07900	J	0.00011	ND	PYROLYSIS	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-FCFR-4	1
12	0.996000	0.00270		0.00001	ND	PYROLYSIS	2,3,7,8-TETRACHLORODIBENZOFURAN	SOIL	P	980-TS1-RT-EURE-1	1
13	0.990000	0.00320		0.00003	ND	PYROLYSIS	PENTACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EURE-1	1
14	0.982000	0.00110		0.00002	ND	PYROLYSIS	HEXACHLORODIBENZODIOXINS	SOIL	P	980-TS1-RT-EURE-1	1
15	0.980000	0.00065		0.00001	ND	PYROLYSIS	HEXACHLORODIBENZOFURANS	SOIL	P	980-TS1-RT-EURE-1	1

SOIL = 15 data points SLUDGE (SLUD) = 0 data points

1	1.000000	11000.00000	E3	0.00349		CIRCULATING BED COMB	PCB-1260	SOIL	P	980-TS1-RT-EUXM-1	1
2	1.000000	12000.00000		0.00530		CIRCULATING BED COMB	PCB-1260	SOIL	P	980-TS1-RT-EUXM-1	5
3	1.000000	11000.00000		0.00350		CIRCULATING BED COMB	TOTAL PCB'S	SOIL	P	980-TS1-RT-EWHC-1	1
4	1.000000	9800.00000		0.00320		CIRCULATING BED COMB	TOTAL PCB'S	SOIL	P	980-TS1-RT-EWHC-1	3
5	1.000000	11000.00000		0.00350		CIRCULATING BED COMB	TOTAL PCB'S	SOIL	P	980-TS1-RT-FCFR-3	1
6	0.999999	12000.00000		0.00990		CIRCULATING BED COMB	TOTAL PCB'S	SOIL	P	980-TS1-RT-EWHC-1	2
7	0.999997	12000.00000	E3	0.03327		CIRCULATING BED COMB	PCB-1260	SOIL	P	980-TS1-RT-EUXM-1	2
8	0.999997	12000.00000		0.03300		CIRCULATING BED COMB	TOTAL PCB'S	SOIL	P	980-TS1-RT-EWHC-1	2
9	0.999997	12000.00000		0.03300		CIRCULATING BED COMB	TOTAL PCB'S	SOIL	P	980-TS1-RT-FCFR-3	2
10	0.999994	11000.00000		0.06600		CIRCULATING BED COMB	TOTAL PCB'S	SOIL	P	980-TS1-RT-EWHC-1	1
11	0.999981	9800.00000		0.18590		CIRCULATING BED COMB	PCB-1260	SOIL	P	980-TS1-RT-EUXM-1	3
12	0.999981	9800.00000		0.18600		CIRCULATING BED COMB	TOTAL PCB'S	SOIL	P	980-TS1-RT-EWHC-1	3
13	0.999981	9800.00000		0.18600		CIRCULATING BED COMB	TOTAL PCB'S	SOIL	P	980-TS1-RT-FCFR-3	3
14	0.996438	20.00000		0.07125		CIRCULATING BED COMB	PCB-1248	SOIL	P	980-TS1-RT-EUXM-1	6
15	0.993302	47.00000		0.31480		CIRCULATING BED COMB	PCB-1260	SOIL	P	980-TS1-RT-EUXM-1	7

SOIL = 15 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W02 DIOXINS/FURANS/PCBS & THEIR PRECURSORS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999370	0.27200		0.00017	ND	THERMAL DESOP/UV PHO	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-EWGE-1	2
2	0.999360	0.26600		0.00017	ND	THERMAL DESOP/UV PHO	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-EWGE-1	4
3	0.999340	0.26000		0.00017	ND	THERMAL DESOP/UV PHO	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-EWGE-1	1
4	0.999280	0.23600		0.00017	ND	THERMAL DESOP/UV PHO	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-EWGE-1	3
5	0.998200	0.27200		0.00049	ND	THERMAL DESOP/UV PHO	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-FCSS-2	4
6	0.997850	0.23300		0.00050		THERMAL DESOP/UV PHO	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-EWGE-1	5
7	0.997810	0.24200		0.00053	ND	THERMAL DESOP/UV PHO	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-FCSS-2	3
8	0.996620	0.24900		0.00084	ND	THERMAL DESOP/UV PHO	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-FCSS-2	2
9	0.996580	0.24900		0.00085	ND	THERMAL DESOP/UV PHO	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-FCSS-2	2
10	0.996440	0.25600		0.00091		THERMAL DESOP/UV PHO	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-FCSS-2	5
11	0.994390	0.23200		0.00130	ND	THERMAL DESOP/UV PHO	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-FCSS-2	1
12	0.992150	0.24200		0.00190	ND	THERMAL DESOP/UV PHO	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	P	980-TS1-RT-FCSS-2	3

SOIL = 12 data points SLUDGE (SLUD) = 0 data points

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W02 DIOXINS/FURANS/PCBS & THEIR PRECURSORS
Technology Group: DECHLORINATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999660	2900.00000		1.00000	ND	DECHLORINATION	TOTAL PCB'S	SOIL	B	980-TS1-RT-FDBA-1	1
2	0.999500	2.00000		0.00100	ND	DECHLORINATION	1,2,3,4-TETRACHLORODIBENZO-P-DIOXIN	SOIL	B	980-TS1-RT-FCLC-2	3
3	0.999500	2.00000		0.00100	ND	DECHLORINATION	1,2,3,4-TETRACHLORODIBENZO-P-DIOXIN	SOIL	B	980-TS1-RT-FCLC-2	4
4	0.999500	2.00000		0.00100	ND	DECHLORINATION	1,2,3,4-TETRACHLORODIBENZO-P-DIOXIN	SOIL	B	980-TS1-RT-FCLC-2	5
5	0.999500	2.00000		0.00100	ND	DECHLORINATION	1,2,3,4-TETRACHLORODIBENZO-P-DIOXIN	SOIL	B	980-TS1-RT-FCLC-2	6
6	0.999500	2.00000		0.00100	ND	DECHLORINATION	1,2,3,4-TETRACHLORODIBENZO-P-DIOXIN	SOIL	B	980-TS1-RT-FCLC-2	7
7	0.999250	2.00000		0.00150	ND	DECHLORINATION	1,2,3,4-TETRACHLORODIBENZO-P-DIOXIN	SOIL	B	980-TS1-RT-FCLC-2	8
8	0.998720	1800.00000		2.30000		DECHLORINATION	TOTAL PCB'S	SOIL	B	980-TS1-RT-FBZZ-1	1
9	0.992500	2.00000		0.01500		DECHLORINATION	1,2,3,4-TETRACHLORODIBENZO-P-DIOXIN	SOIL	B	980-TS1-RT-FCLC-2	9
10	0.990345	116.00000		1.12000		DECHLORINATION	TOTAL PCB'S	SOIL	B	980-TS1-RT-FCLC-1	6
11	0.990000	0.15000		0.00150		DECHLORINATION	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	B	980-TS1-RT-FCFR-6	1
12	0.988500	2.00000		0.02300		DECHLORINATION	1,2,3,4-TETRACHLORODIBENZO-P-DIOXIN	SOIL	B	980-TS1-RT-FCLC-2	10
13	0.982000	2.00000		0.03600		DECHLORINATION	1,2,3,4-TETRACHLORODIBENZO-P-DIOXIN	SOIL	B	980-TS1-RT-FCLC-2	11
14	0.979828	116.00000		2.34000		DECHLORINATION	TOTAL PCB'S	SOIL	B	980-TS1-RT-FCLC-1	4
15	0.978723	47.00000		1.00000	ND	DECHLORINATION	TOTAL PCB'S	SOIL	P	980-TS1-RT-EUZD-1	1
16	0.969940	0.35600		0.01070		DECHLORINATION	TOTAL DIOXINS AND FURANS	SLUD	B	980-TS1-RT-FCLC-2	2
17	0.964138	116.00000		4.16000		DECHLORINATION	TOTAL PCB'S	SOIL	B	980-TS1-RT-FCLC-1	5
18	0.959655	116.00000		4.68000		DECHLORINATION	TOTAL PCB'S	SOIL	B	980-TS1-RT-FCLC-1	2
19	0.945455	77.00000		4.20000		DECHLORINATION	TOTAL PCB'S	SOIL	B	980-TS1-RT-FCLC-1	8
20	0.940862	116.00000		6.86000		DECHLORINATION	TOTAL PCB'S	SOIL	B	980-TS1-RT-FCLC-1	3
21	0.940179	112.00000		6.70000		DECHLORINATION	TOTAL PCB'S	SOIL	B	980-TS1-RT-FCLC-1	9
22	0.937069	116.00000		7.30000		DECHLORINATION	TOTAL PCB'S	SOIL	B	980-TS1-RT-FCLC-1	1
23	0.912987	77.00000		6.70000		DECHLORINATION	TOTAL PCB'S	SOIL	B	980-TS1-RT-FCLC-1	7
24	0.757790	0.15400		0.03730		DECHLORINATION	TOTAL DIOXINS AND FURANS	SLUD	B	980-TS1-RT-FCLC-2	1
25	0.510000	0.03300		0.01617		DECHLORINATION	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	B	980-TS1-RT-FCFR-6	4
26	0.460000	0.02800		0.01512		DECHLORINATION	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	B	980-TS1-RT-FCFR-6	3
27	0.450000	0.02800		0.01540		DECHLORINATION	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	SOIL	B	980-TS1-RT-FCFR-6	6
28	0.430000	0.03300		0.01881		DECHLORINATION	2,3,7,8-TETRACHLORODIBENZO	SOIL	B	980-TS1-RT-FCFR-6	5

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W02 DIOXINS/FURANS/PCBS & THEIR PRECURSORS
Technology Group: DECHLORINATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
29	0.328200	0.06550		0.04400		DECHLORINATION	2,3,7,8-TETRACHLORODIBENZO -P-DIOXIN	SOIL	B	980-TS1-RT-EUTY-1	1
30	0.250000	0.03300		0.02475		DECHLORINATION	2,3,7,8-TETRACHLORODIBENZO -P-DIOXIN	SOIL	B	980-TS1-RT-FCFR-6	2
31	0.167700	0.07690		0.06400		DECHLORINATION	2,3,7,8-TETRACHLORODIBENZO -P-DIOXIN	SOIL	B	980-TS1-RT-EUTY-1	1

SOIL = 29 data points SLUDGE (SLUD) = 2 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W02 DIOXINS/FURANS/PCBS & THEIR PRECURSORS
Technology Group: BIOREMEDIATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999940	2000.00000		0.12000		AEROBIC	TOTAL PCB'S	SLUD	P	980-TS1-RT-FCQP-1	1

SOIL = 0 data points SLUDGE (SLUD) = 1 data points

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W02 DIOXINS/FURANS/PCBS & THEIR PRECURSORS
Technology Group: CHEMICAL EXTRACTION AND SOIL WASHING

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.971680	0.67100		0.01900		SOIL WASHING	2,3,7,8-TETRACHLORODIBENZO -P-DIOXIN	SOIL	B	980-TS1-RT-FRET-1	8
2	0.968700	0.67100		0.02100		SOIL WASHING	2,3,7,8-TETRACHLORODIBENZO -P-DIOXIN	SOIL	B	980-TS1-RT-FRET-1	7
3	0.950000	300.00000		15.00000		SOIL WASHING	TOTAL PCB'S	SOIL	P	980-TS1-RT-EZUJ-1	1
4	0.941430	0.68300		0.04000		SOIL WASHING	TOTAL PCB'S	SOIL	F	980-TS1-RT-EVAR-1	2
5	0.926970	0.67100		0.04900		SOIL WASHING	2,3,7,8-TETRACHLORODIBENZO -P-DIOXIN	SOIL	B	980-TS1-RT-FRET-1	5
6	0.923990	0.67100		0.05100		SOIL WASHING	2,3,7,8-TETRACHLORODIBENZO -P-DIOXIN	SOIL	B	980-TS1-RT-FRET-1	6
7	0.889710	0.67100		0.07400		SOIL WASHING	2,3,7,8-TETRACHLORODIBENZO -P-DIOXIN	SOIL	B	980-TS1-RT-FRET-1	2
8	0.884956	11.30000		1.30000		SOIL WASHING	TOTAL PCB'S	SOIL	F	980-TS1-RT-EVAR-1	3
9	0.876300	0.67100		0.08300		SOIL WASHING	2,3,7,8-TETRACHLORODIBENZO -P-DIOXIN	SOIL	B	980-TS1-RT-FRET-1	3
10	0.867360	0.67100		0.08900		SOIL WASHING	2,3,7,8-TETRACHLORODIBENZO -P-DIOXIN	SOIL	B	980-TS1-RT-FRET-1	4
11	0.843750	3.20000		0.50000		SOIL WASHING	TOTAL PCB'S	SOIL	F	980-TS1-RT-EVAR-1	1
12	0.683000	100.00000		31.70000		SOIL WASHING	TOTAL PCB'S	SOIL	B	980-TS1-RT-EUZU-1	1
13	0.484380	25600.00000		13200.00000		SOIL WASHING	TOTAL PCB'S	SOIL	B	980-TS1-RT-EUZE-1	34
14	0.373330	3000.00000		1880.00000		SOIL WASHING	TOTAL PCB'S	SOIL	B	980-TS1-RT-EUZE-1	30
15	0.238280	25600.00000		19500.00000		SOIL WASHING	TOTAL PCB'S	SOIL	B	980-TS1-RT-EUZE-1	33
16	0.207030	25600.00000		20300.00000		SOIL WASHING	TOTAL PCB'S	SOIL	B	980-TS1-RT-EUZE-1	32
17	0.206670	3000.00000		2380.00000		SOIL WASHING	TOTAL PCB'S	SOIL	B	980-TS1-RT-EUZE-1	29
18	0.113330	3000.00000		2660.00000		SOIL WASHING	TOTAL PCB'S	SOIL	B	980-TS1-RT-EUZE-1	31

SOIL = 18 data points SLUDGE (SLUD) = 0 data points

1	0.999670	33641.00000		11.00000		CHEMICAL EXTRACTION	PCB-1260	SOIL	B	980-TS1-RT-EWGX-1	1
2	0.999450	32508.00000		18.00000		CHEMICAL EXTRACTION	PCB-1260	SOIL	B	980-TS1-RT-EWGX-1	1
3	0.997840	32914.00000		71.00000		CHEMICAL EXTRACTION	PCB-1260	SOIL	B	980-TS1-RT-EWGX-1	1
4	0.163380	33021.00000		27626.00000		CHEMICAL EXTRACTION	PCB-1260	SOIL	B	980-TS1-RT-EWGX-1	1

SOIL = 4 data points SLUDGE (SLUD) = 0 data points

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W03 HAL PHENOLS, CRESOLS, ETHERS, & THIOLS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999982	2700.00000		0.05000		INCINERATION	P-CHLOROPHENYLMETHYL SULFIDE	SOIL	B	980-TS1-RT-FDBP-1	18
2	0.999981	2600.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFIDE	SOIL	B	980-TS1-RT-FDBP-1	17
3	0.999978	2300.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFIDE	SOIL	B	980-TS1-RT-FDBP-1	5
4	0.999977	2600.00000		0.06000		INCINERATION	P-CHLOROPHENYLMETHYL SULFIDE	SOIL	B	980-TS1-RT-FDBP-1	19
5	0.999976	2100.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFIDE	SOIL	B	980-TS1-RT-FDBP-1	6
6	0.999976	2100.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFIDE	SOIL	B	980-TS1-RT-FDBP-1	7
7	0.999976	2100.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFIDE	SOIL	B	980-TS1-RT-FDBP-1	8
8	0.999976	2100.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFIDE	SOIL	B	980-TS1-RT-FDBP-1	10
9	0.999976	2100.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFIDE	SOIL	B	980-TS1-RT-FDBP-1	16
10	0.999975	2000.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFIDE	SOIL	B	980-TS1-RT-FDBP-1	11
11	0.999972	1800.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFIDE	SOIL	B	980-TS1-RT-FDBP-1	3
12	0.999969	1600.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFIDE	SOIL	B	980-TS1-RT-FDBP-1	12
13	0.999967	1500.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFIDE	SOIL	B	980-TS1-RT-FDBP-1	4
14	0.999960	2000.00000		0.08000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFIDE	SOIL	B	980-TS1-RT-FDBP-1	1
15	0.999958	1900.00000		0.08000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFIDE	SOIL	B	980-TS1-RT-FDBP-1	2
16	0.999943	1400.00000		0.08000		INCINERATION	P-CHLOROPHENYLMETHYL SULFIDE	SOIL	B	980-TS1-RT-FDBP-1	9
17	0.999861	360.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFONE	SOIL	B	980-TS1-RT-FDBP-1	4
18	0.999861	360.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFONE	SOIL	B	980-TS1-RT-FDBP-1	18
19	0.999849	330.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFONE	SOIL	B	980-TS1-RT-FDBP-1	16
20	0.999849	330.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFONE	SOIL	B	980-TS1-RT-FDBP-1	17
21	0.999826	460.00000		0.08000	ND	INCINERATION	P-CHLOROPHENYLMETHYL	SOIL	B	980-TS1-RT-FDBP-1	2

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W03 HAL PHENOLS, CRESOLS, ETHERS, & THIOLS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
22	0.999821	280.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFONE	SOIL	B	980-TS1-RT-FDBP-1	19
23	0.999750	200.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFONE	SOIL	B	980-TS1-RT-FDBP-1	5
24	0.999750	200.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFONE	SOIL	B	980-TS1-RT-FDBP-1	6
25	0.999737	190.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFONE	SOIL	B	980-TS1-RT-FDBP-1	12
26	0.999706	170.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFONE	SOIL	B	980-TS1-RT-FDBP-1	7
27	0.999688	160.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFONE	SOIL	B	980-TS1-RT-FDBP-1	8
28	0.999677	310.00000		0.10000		INCINERATION	P-CHLOROPHENYLMETHYL SULFONE	SOIL	B	980-TS1-RT-FDBP-1	13
29	0.999667	150.00000		0.05000		INCINERATION	P-CHLOROPHENYLMETHYL SULFONE	SOIL	B	980-TS1-RT-FDBP-1	9
30	0.999546	110.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFOXIDE	SOIL	B	980-TS1-RT-FDBP-1	18
31	0.999500	100.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFOXIDE	SOIL	B	980-TS1-RT-FDBP-1	15
32	0.999500	100.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFOXIDE	SOIL	B	980-TS1-RT-FDBP-1	16
33	0.999495	99.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFOXIDE	SOIL	B	980-TS1-RT-FDBP-1	17
34	0.999490	490.00000		0.25000		INCINERATION	P-CHLOROPHENYLMETHYL SULFONE	SOIL	B	980-TS1-RT-FDBP-1	1
35	0.999474	95.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFOXIDE	SOIL	B	980-TS1-RT-FDBP-1	4
36	0.999451	91.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFOXIDE	SOIL	B	980-TS1-RT-FDBP-1	19
37	0.999429	140.00000		0.08000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFOXIDE	SOIL	B	980-TS1-RT-FDBP-1	2
38	0.999405	84.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFOXIDE	SOIL	B	980-TS1-RT-FDBP-1	13
39	0.999353	1700.00000		1.10000		INCINERATION	P-CHLOROPHENYLMETHYL SULFIDE	SOIL	B	980-TS1-RT-FDBP-1	13
40	0.999333	120.00000		0.08000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFOXIDE	SOIL	B	980-TS1-RT-FDBP-1	1
41	0.999239	460.00000		0.35000		INCINERATION	P-CHLOROPHENYLMETHYL SULFONE	SOIL	B	980-TS1-RT-FDBP-1	3

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W03 HAL PHENOLS, CRESOLS, ETHERS, & THIOLS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
42	0.999123	57.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFOXIDE	SOIL	B	980-TS1-RT-FDBP-1	6
43	0.999057	53.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFOXIDE	SOIL	B	980-TS1-RT-FDBP-1	10
44	0.999057	53.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFOXIDE	SOIL	B	980-TS1-RT-FDBP-1	11
45	0.999020	51.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFOXIDE	SOIL	B	980-TS1-RT-FDBP-1	5
46	0.998936	47.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFOXIDE	SOIL	B	980-TS1-RT-FDBP-1	8
47	0.998913	46.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFOXIDE	SOIL	B	980-TS1-RT-FDBP-1	12
48	0.998723	47.00000		0.06000		INCINERATION	P-CHLOROPHENYLMETHYL SULFOXIDE	SOIL	B	980-TS1-RT-FDBP-1	7
49	0.998529	34.00000		0.05000	ND	INCINERATION	SUPONA	SOIL	B	980-TS1-RT-FDBP-1	19
50	0.998387	31.00000		0.05000	ND	INCINERATION	P-CHLOROPHENYLMETHYL SULFOXIDE	SOIL	B	980-TS1-RT-FDBP-1	9
51	0.998077	26.00000		0.05000	ND	INCINERATION	SUPONA	SOIL	B	980-TS1-RT-FDBP-1	18
52	0.997727	22.00000		0.05000	ND	INCINERATION	SUPONA	SOIL	B	980-TS1-RT-FDBP-1	8
53	0.997727	22.00000		0.05000	ND	INCINERATION	SUPONA	SOIL	B	980-TS1-RT-FDBP-1	17
54	0.997619	21.00000		0.05000	ND	INCINERATION	SUPONA	SOIL	B	980-TS1-RT-FDBP-1	16
55	0.997500	20.00000		0.05000	ND	INCINERATION	SUPONA	SOIL	B	980-TS1-RT-FDBP-1	13
56	0.997368	19.00000		0.05000	ND	INCINERATION	SUPONA	SOIL	B	980-TS1-RT-FDBP-1	5
57	0.997368	19.00000		0.05000	ND	INCINERATION	SUPONA	SOIL	B	980-TS1-RT-FDBP-1	6
58	0.997059	17.00000		0.05000	ND	INCINERATION	SUPONA	SOIL	B	980-TS1-RT-FDBP-1	10
59	0.996875	16.00000		0.05000	ND	INCINERATION	SUPONA	SOIL	B	980-TS1-RT-FDBP-1	11
60	0.996667	15.00000		0.05000	ND	INCINERATION	SUPONA	SOIL	B	980-TS1-RT-FDBP-1	3
61	0.996667	15.00000		0.05000	ND	INCINERATION	SUPONA	SOIL	B	980-TS1-RT-FDBP-1	7
62	0.996520	250.00000		0.87000		INCINERATION	P-CHLOROPHENYLMETHYL SULFONE	SOIL	B	980-TS1-RT-FDBP-1	11
63	0.996154	13.00000		0.05000	ND	INCINERATION	SUPONA	SOIL	B	980-TS1-RT-FDBP-1	4
64	0.995455	11.00000		0.05000	ND	INCINERATION	SUPONA	SOIL	B	980-TS1-RT-FDBP-1	12
65	0.994286	14.00000		0.08000	ND	INCINERATION	SUPONA	SOIL	B	980-TS1-RT-FDBP-1	2
66	0.994118	17.00000		0.10000		INCINERATION	SUPONA	SOIL	B	980-TS1-RT-FDBP-1	15
67	0.993846	13.00000		0.08000	ND	INCINERATION	SUPONA	SOIL	B	980-TS1-RT-FDBP-1	1
68	0.993590	7.80000		0.05000	ND	INCINERATION	SUPONA	SOIL	B	980-TS1-RT-FDBP-1	9
69	0.992286	350.00000		2.70000		INCINERATION	P-CHLOROPHENYLMETHYL SULFONE	SOIL	B	980-TS1-RT-FDBP-1	15
70	0.992273	2200.00000		17.00000		INCINERATION	P-CHLOROPHENYLMETHYL SULFIDE	SOIL	B	980-TS1-RT-FDBP-1	15
71	0.985185	270.00000		4.00000		INCINERATION	P-CHLOROPHENYLMETHYL	SOIL	B	980-TS1-RT-FDBP-1	10

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W03 HAL PHENOLS, CRESOLS, ETHERS, & THIOLS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
72	0.974546	110.00000		2.80000		INCINERATION	SULFONE P-CHLOROPHENYLMETHYL	SOIL	B	980-TS1-RT-FDBP-1	3
73	0.222222	18.00000		14.00000		INCINERATION	SULFOXIDE SUPONA	SOIL	B	980-TS1-RT-FDBP-1	14
	SOIL =	73	data points		SLUDGE (SLUD) =	0	data points				
1	0.997460	630.00000		1.60000	ND	ROTARY KILN	PENTACHLOROPHENOL	SOIL	P	ORD-TS1-RT-EUZM-1	2
2	0.818182	8.80000		1.60000	ND	ROTARY KILN	2,4,5-TRICHLOROPHENOL	SOIL	F	980-TS1-RT-EUZH-1	4
3	0.719298	5.70000		1.60000	ND	ROTARY KILN	2,4,5-TRICHLOROPHENOL	SOIL	F	980-TS1-RT-EUZH-1	5
4	0.567567	3.70000		1.60000	ND	ROTARY KILN	2,4,5-TRICHLOROPHENOL	SOIL	F	980-TS1-RT-EUZH-1	2
5	0.555555	3.60000		1.60000	ND	ROTARY KILN	2,4,5-TRICHLOROPHENOL	SOIL	F	980-TS1-RT-EUZH-1	3
6	0.108110	0.37000		0.33000	ND	ROTARY KILN	3,4-DICHLOROPHENOL	SOIL	F	980-TS1-RT-EUZH-1	5
	SOIL =	6	data points		SLUDGE (SLUD) =	0	data points				
1	0.981818	55.00000		1.00000	ND	PYROLYSIS	2,4,6-TRICHLOROPHENOL	SOIL	P	980-TS1-RT-EURE-1	1
2	0.900000	10.00000		1.00000	ND	PYROLYSIS	2,4-DICHLOROPHENOL	SOIL	P	980-TS1-RT-EURE-1	1
	SOIL =	2	data points		SLUDGE (SLUD) =	0	data points				

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W03 HAL PHENOLS, CRESOLS, ETHERS, & THIOLS
Technology Group: DECHLORINATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.996350	61.59000		0.22500		DECHLORINATION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUTV-1	3
2	0.990360	61.59000		0.59400		DECHLORINATION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUTV-1	7
3	0.980500	242.67000		4.73200		DECHLORINATION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUTV-1	1
4	0.976660	242.67000		5.66500		DECHLORINATION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUTV-1	5
5	0.957180	85.00900		3.64000		DECHLORINATION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUTV-1	4
6	0.954180	85.00900		3.89500		DECHLORINATION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUTV-1	8
7	0.945340	3.97000		0.21700		DECHLORINATION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUTV-1	6
8	0.918390	3.97000		0.32400		DECHLORINATION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUTV-1	2

SOIL = 8 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W03 HAL PHENOLS, CRESOLS, ETHERS, & THIOLS
Technology Group: BIOREMEDIATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.845865	133.00000		20.50000		BIOREMEDIATION	PENTACHLOROPHENOL	SOIL	P	980-TS1-RT-EWGC-1	3
2	0.837500	80.00000		13.00000		BIOREMEDIATION	PENTACHLOROPHENOL	SOIL	P	980-TS1-RT-EWGC-1	2
3	0.550000	36.00000		16.20000		BIOREMEDIATION	PENTACHLOROPHENOL	SOIL	P	980-TS1-RT-EWGC-1	1

SOIL = 3 data points SLUDGE (SLUD) = 0 data points

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W03 HAL PHENOLS, CRESOLS, ETHERS, & THIOLS
Technology Group: LOW TEMPERATURE THERMAL DESORPTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999475	381.00000		0.20000		LOW TEMP DESORPTION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EZYQ-1	8
2	0.994751	381.00000		2.00000		LOW TEMP DESORPTION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EZYQ-1	10
3	0.971129	381.00000		11.00000	ND	LOW TEMP DESORPTION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EZYQ-1	9
4	0.895013	381.00000		40.00000		LOW TEMP DESORPTION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EZYQ-1	3
5	0.842520	381.00000		60.00000		LOW TEMP DESORPTION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EZYQ-1	1
6	0.803150	381.00000		75.00000		LOW TEMP DESORPTION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EZYQ-1	2
7	0.717241	29.00000		8.20000	ND	LOW TEMP DESORPTION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EZYQ-1	14
8	0.675862	29.00000		9.40000	ND	LOW TEMP DESORPTION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EZYQ-1	15
9	0.672414	29.00000		9.50000	ND	LOW TEMP DESORPTION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EZYQ-1	17
10	0.662069	29.00000		9.80000	ND	LOW TEMP DESORPTION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EZYQ-1	13
11	0.655172	29.00000		10.00000	ND	LOW TEMP DESORPTION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EZYQ-1	16
12	0.475066	381.00000		200.00000		LOW TEMP DESORPTION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EZYQ-1	4
13	0.396326	381.00000		230.00000		LOW TEMP DESORPTION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EZYQ-1	5
14	0.278215	381.00000		275.00000		LOW TEMP DESORPTION	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EZYQ-1	6

SOIL = 14 data points SLUDGE (SLUD) = 0 data points

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W03 HAL PHENOLS, CRESOLS, ETHERS, & THIOLS
Technology Group: CHEMICAL EXTRACTION AND SOIL WASHING

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.981890	254.00000		4.60000		SOIL WASHING	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUQW-1	8
2	0.966929	254.00000		8.40000		SOIL WASHING	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUQW-1	7
3	0.897638	254.00000		26.00000		SOIL WASHING	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUQW-1	2
4	0.895625	80.00000		8.35000		SOIL WASHING	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUQW-1	49
5	0.888636	22.00000		2.45000		SOIL WASHING	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUQW-1	25
6	0.876667	30.00000		3.70000		SOIL WASHING	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUQW-1	37
7	0.768182	22.00000		5.10000		SOIL WASHING	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUQW-1	20
8	0.742126	254.00000		65.50000		SOIL WASHING	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUQW-1	1
9	0.718750	80.00000		22.50000		SOIL WASHING	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUQW-1	50
10	0.712500	80.00000		23.00000		SOIL WASHING	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUQW-1	43
11	0.700000	30.00000		9.00000		SOIL WASHING	PENTACHLOROPHENOL	SOIL	B	980-TS1-RT-EUZU-1	1
12	0.693333	30.00000		9.20000		SOIL WASHING	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUQW-1	31
13	0.690909	22.00000		6.80000		SOIL WASHING	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUQW-1	14
14	0.647727	22.00000		7.75000		SOIL WASHING	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUQW-1	26
15	0.577273	22.00000		9.30000	J	SOIL WASHING	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUQW-1	13
16	0.577273	22.00000		9.30000	J	SOIL WASHING	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUQW-1	19
17	0.555000	30.00000		13.35000		SOIL WASHING	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUQW-1	38
18	0.520000	80.00000		38.40000		SOIL WASHING	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUQW-1	55
19	0.512500	80.00000		39.00000		SOIL WASHING	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUQW-1	44
20	0.481250	80.00000		41.50000		SOIL WASHING	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-EUQW-1	56

SOIL = 20 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W04 HALOGENATED ALIPHATIC COMPOUNDS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999898	49.00000		0.00500	ND	INCINERATION	1,2-DIBROMO-3-CHLOROPROPANE	SOIL	B	980-TS1-RT-FDBP-1	19
2	0.999896	48.00000		0.00500	ND	INCINERATION	1,2-DIBROMO-3-CHLOROPROPANE	SOIL	B	980-TS1-RT-FDBP-1	18
3	0.999881	42.00000		0.00500	ND	INCINERATION	1,2-DIBROMO-3-CHLOROPROPANE	SOIL	B	980-TS1-RT-FDBP-1	17
4	0.999861	36.00000		0.00500	ND	INCINERATION	1,2-DIBROMO-3-CHLOROPROPANE	SOIL	B	980-TS1-RT-FDBP-1	5
5	0.999857	35.00000		0.00500	ND	INCINERATION	1,2-DIBROMO-3-CHLOROPROPANE	SOIL	B	980-TS1-RT-FDBP-1	3
6	0.999849	33.00000		0.00500	ND	INCINERATION	1,2-DIBROMO-3-CHLOROPROPANE	SOIL	B	980-TS1-RT-FDBP-1	4
7	0.999839	31.00000		0.00500	ND	INCINERATION	1,2-DIBROMO-3-CHLOROPROPANE	SOIL	B	980-TS1-RT-FDBP-1	6
8	0.999828	29.00000		0.00500	ND	INCINERATION	1,2-DIBROMO-3-CHLOROPROPANE	SOIL	B	980-TS1-RT-FDBP-1	8
9	0.999821	28.00000		0.00500	ND	INCINERATION	1,2-DIBROMO-3-CHLOROPROPANE	SOIL	B	980-TS1-RT-FDBP-1	7
10	0.999805	41.00000		0.00800	ND	INCINERATION	1,2-DIBROMO-3-CHLOROPROPANE	SOIL	B	980-TS1-RT-FDBP-1	1
11	0.999783	23.00000		0.00500	ND	INCINERATION	1,2-DIBROMO-3-CHLOROPROPANE	SOIL	B	980-TS1-RT-FDBP-1	10
12	0.999773	22.00000		0.00500	ND	INCINERATION	1,2-DIBROMO-3-CHLOROPROPANE	SOIL	B	980-TS1-RT-FDBP-1	11
13	0.999750	20.00000		0.00500	ND	INCINERATION	1,2-DIBROMO-3-CHLOROPROPANE	SOIL	B	980-TS1-RT-FDBP-1	13
14	0.999706	17.00000		0.00500	ND	INCINERATION	1,2-DIBROMO-3-CHLOROPROPANE	SOIL	B	980-TS1-RT-FDBP-1	15
15	0.999667	15.00000		0.00500	ND	INCINERATION	1,2-DIBROMO-3-CHLOROPROPANE	SOIL	B	980-TS1-RT-FDBP-1	12
16	0.999615	13.00000		0.00500	ND	INCINERATION	1,2-DIBROMO-3-CHLOROPROPANE	SOIL	B	980-TS1-RT-FDBP-1	9
17	0.999583	12.00000		0.00500	ND	INCINERATION	1,2-DIBROMO-3-CHLOROPROPANE	SOIL	B	980-TS1-RT-FDBP-1	16
18	0.999574	47.00000		0.02000		INCINERATION	1,2-DIBROMO-3-CHLOROPROPANE	SOIL	B	980-TS1-RT-FDBP-1	2
19	0.960833	24.00000		0.94000		INCINERATION	1,2-DIBROMO-3-CHLOROPROPANE	SOIL	B	980-TS1-RT-FDBP-1	14

SOIL = 19 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W04 HALOGENATED ALIPHATIC COMPOUNDS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999989	450.00000		0.00500	ND	ROTARY KILN	1,2-DICHLOROETHANE	SOIL	P	ORD-TS1-RT-EUZM-1	1
2	0.999986	350.00000		0.00500	ND	ROTARY KILN	TETRACHLOROETHENE	SOIL	P	ORD-TS1-RT-EUZM-1	3
3	0.999985	340.00000		0.00500	ND	ROTARY KILN	1,2-DICHLOROETHANE	SOIL	P	ORD-TS1-RT-EUZM-1	3
4	0.999981	260.00000		0.00500	ND	ROTARY KILN	TETRACHLOROETHENE	SOIL	P	ORD-TS1-RT-EUZM-1	2
5	0.999964	140.00000		0.00500	ND	ROTARY KILN	1,2-DICHLOROETHANE	SOIL	P	ORD-TS1-RT-EUZM-1	2
6	0.999927	68.00000		0.00500	ND	ROTARY KILN	CARBON TETRACHLORIDE	SOIL	P	980-TS1-RT-EXPC-1	1
7	0.999915	59.00000		0.00500	ND	ROTARY KILN	1,1-DICHLOROETHANE	SOIL	P	980-TS1-RT-EXPC-1	4
8	0.999912	57.00000		0.00500	ND	ROTARY KILN	CARBON TETRACHLORIDE	SOIL	P	980-TS1-RT-EXPC-1	4
9	0.999861	36.00000		0.00500	ND	ROTARY KILN	TETRACHLOROETHENE	SOIL	P	ORD-TS1-RT-EUZM-1	6
10	0.999828	29.00000		0.00500	ND	ROTARY KILN	TETRACHLOROETHENE	SOIL	P	ORD-TS1-RT-EUZM-1	4
11	0.999762	21.00000		0.00500	ND	ROTARY KILN	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EXPC-1	1
12	0.999667	15.00000		0.00500	ND	ROTARY KILN	1,1-DICHLOROETHENE	SOIL	P	980-TS1-RT-EXPC-1	4
13	0.999643	28.00000		0.01000		ROTARY KILN	1,2-DICHLOROETHANE	SOIL	P	ORD-TS1-RT-EUZM-1	6
14	0.999615	13.00000		0.00500	ND	ROTARY KILN	1,2-DICHLOROETHANE	SOIL	P	ORD-TS1-RT-EUZM-1	4
15	0.999412	8.50000		0.00500	ND	ROTARY KILN	TETRACHLOROETHENE	SOIL	P	ORD-TS1-RT-EUZM-1	5
16	0.999000	5.00000		0.00500	ND	ROTARY KILN	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EXPC-1	4
17	0.998936	4.70000		0.00500	ND	ROTARY KILN	1,1-DICHLOROETHENE	SOIL	P	980-TS1-RT-EXPC-1	1
18	0.998750	4.00000		0.00500	ND	ROTARY KILN	1,2-DICHLOROPROPANE	SOIL	P	980-TS1-RT-EXPC-1	1
19	0.998571	3.50000		0.00500		ROTARY KILN	1,2-DICHLOROETHANE	SOIL	P	ORD-TS1-RT-EUZM-1	5

SOIL = 19 data points SLUDGE (SLUD) = 0 data points

1	0.999961	128.00000		0.00500	ND	INFRARED	CARBON TETRACHLORIDE	SOIL	P	980-TS1-RT-EZZB-1	1
2	0.999961	128.00000		0.00500	ND	INFRARED	CARBON TETRACHLORIDE	SOIL	P	980-TS1-RT-EZZB-1	2
3	0.999953	106.00000		0.00500	ND	INFRARED	1,2-DICHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	7
4	0.999953	106.00000		0.00500	ND	INFRARED	1,2-DICHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	8
5	0.999942	86.00000		0.00500	ND	INFRARED	1,2-DICHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	1
6	0.999942	86.00000		0.00500	ND	INFRARED	1,2-DICHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	2
7	0.999884	43.00000		0.00500	ND	INFRARED	CHLOROFORM	SOIL	P	980-TS1-RT-EZZB-1	1
8	0.999884	43.00000		0.00500	ND	INFRARED	CHLOROFORM	SOIL	P	980-TS1-RT-EZZB-1	2
9	0.999875	40.00000		0.00500	ND	INFRARED	CARBON TETRACHLORIDE	SOIL	P	980-TS1-RT-EZZB-1	5
10	0.999875	40.00000		0.00500	ND	INFRARED	CARBON TETRACHLORIDE	SOIL	P	980-TS1-RT-EZZB-1	6
11	0.999872	39.00000		0.00500	ND	INFRARED	1,1,2,2-TETRACHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	1
12	0.999872	39.00000		0.00500	ND	INFRARED	1,1,2,2-TETRACHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	2
13	0.999853	34.00000		0.00500	ND	INFRARED	CARBON TETRACHLORIDE	SOIL	P	980-TS1-RT-EZZB-1	3
14	0.999853	34.00000		0.00500	ND	INFRARED	CARBON TETRACHLORIDE	SOIL	P	980-TS1-RT-EZZB-1	4
15	0.999849	33.00000		0.00500	ND	INFRARED	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EZZB-1	2
16	0.999844	32.00000		0.00500	ND	INFRARED	1,2-DICHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	5
17	0.999844	32.00000		0.00500	ND	INFRARED	1,2-DICHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	6

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W04 HALOGENATED ALIPHATIC COMPOUNDS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
18	0.999839	31.00000		0.00500	ND	INFRARED	1,1-DICHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	1
19	0.999839	31.00000		0.00500	ND	INFRARED	1,1-DICHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	2
20	0.999821	28.00000		0.00500	ND	INFRARED	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EZZB-1	1
21	0.999821	28.00000		0.00500	ND	INFRARED	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EZZB-1	2
22	0.999688	16.00000		0.00500	ND	INFRARED	1,1-DICHLOROETHENE	SOIL	P	980-TS1-RT-EZZB-1	1
23	0.999688	16.00000		0.00500	ND	INFRARED	1,1-DICHLOROETHENE	SOIL	P	980-TS1-RT-EZZB-1	2
24	0.999397	8.30000		0.00500	ND	INFRARED	1,2-DICHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	3
25	0.999397	8.30000		0.00500	ND	INFRARED	1,2-DICHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	4
26	0.999350	7.70000		0.00500	ND	INFRARED	1,1,2,2-TETRACHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	7
27	0.999350	7.70000		0.00500	ND	INFRARED	1,1,2,2-TETRACHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	8
28	0.998750	4.00000		0.00500	ND	INFRARED	CARBON TETRACHLORIDE	SOIL	P	980-TS1-RT-EZZB-1	7
29	0.998750	4.00000		0.00500	ND	INFRARED	CARBON TETRACHLORIDE	SOIL	P	980-TS1-RT-EZZB-1	8
30	0.998606	33.00000		0.04600	ND	INFRARED	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EZZB-1	1
31	0.998276	2.90000		0.00500	ND	INFRARED	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EZZB-1	7
32	0.998276	2.90000		0.00500	ND	INFRARED	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EZZB-1	8
33	0.997826	2.30000		0.00500	ND	INFRARED	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EZZB-1	5
34	0.997826	2.30000		0.00500	ND	INFRARED	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EZZB-1	6
35	0.997826	2.30000		0.00500	ND	INFRARED	1,1,2,2-TETRACHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	5
36	0.997826	2.30000		0.00500	ND	INFRARED	1,1,2,2-TETRACHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	6
37	0.997222	1.80000		0.00500	ND	INFRARED	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EZZB-1	5
38	0.997222	1.80000		0.00500	ND	INFRARED	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EZZB-1	6
39	0.996875	1.60000		0.00500	ND	INFRARED	1,1-DICHLOROETHENE	SOIL	P	980-TS1-RT-EZZB-1	5
40	0.996875	1.60000		0.00500	ND	INFRARED	1,1-DICHLOROETHENE	SOIL	P	980-TS1-RT-EZZB-1	6
41	0.996666	1.50000		0.00500	ND	INFRARED	CHLOROFORM	SOIL	P	980-TS1-RT-EZZB-1	5
42	0.996666	1.50000		0.00500	ND	INFRARED	CHLOROFORM	SOIL	P	980-TS1-RT-EZZB-1	6
43	0.996666	1.50000		0.00500	ND	INFRARED	1,1,1-TRICHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	2
44	0.996666	3.00000		0.01000	ND	INFRARED	VINYL CHLORIDE	SOIL	P	980-TS1-RT-EZZB-1	1
45	0.996666	3.00000		0.01000	ND	INFRARED	VINYL CHLORIDE	SOIL	P	980-TS1-RT-EZZB-1	2
46	0.994560	0.92000		0.00500	ND	INFRARED	1,1-DICHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	5
47	0.994560	0.92000		0.00500	ND	INFRARED	1,1-DICHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	6
48	0.992310	0.65000		0.00500	ND	INFRARED	1,1-DICHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	7
49	0.992310	0.65000		0.00500	ND	INFRARED	1,1-DICHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	8
50	0.991380	0.58000		0.00500	ND	INFRARED	CHLOROFORM	SOIL	P	980-TS1-RT-EZZB-1	7
51	0.991380	0.58000		0.00500	ND	INFRARED	CHLOROFORM	SOIL	P	980-TS1-RT-EZZB-1	8
52	0.990000	0.50000		0.00500	ND	INFRARED	1,1-DICHLOROETHENE	SOIL	P	980-TS1-RT-EZZB-1	7
53	0.990000	0.50000		0.00500	ND	INFRARED	1,1-DICHLOROETHENE	SOIL	P	980-TS1-RT-EZZB-1	8
54	0.977333	1.50000		0.03400	ND	INFRARED	1,1,1-TRICHLOROETHANE	SOIL	P	980-TS1-RT-EZZB-1	1

SOIL = 54 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W04 HALOGENATED ALIPHATIC COMPOUNDS
Technology Group: DECHLORINATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	1.000000	584.00000		0.00180	ND	DECHLORINATION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUTV-1	1
2	0.999980	151.00000		0.00300	ND	DECHLORINATION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUTV-1	4
3	0.999880	1265.00000		0.15600		DECHLORINATION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUTV-1	4
4	0.999860	584.00000		0.08450	ND	DECHLORINATION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUTV-1	5
5	0.999760	585.00000		0.14000		DECHLORINATION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUTV-1	1
6	0.999750	27.20000		0.00680		DECHLORINATION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUTV-1	3
7	0.999450	23.50000		0.01290		DECHLORINATION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUTV-1	2
8	0.998830	585.00000		0.68400		DECHLORINATION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUTV-1	5
9	0.998540	1265.00000		1.85000		DECHLORINATION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUTV-1	8
10	0.997380	151.00000		0.39500	ND	DECHLORINATION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUTV-1	8
11	0.996980	6.63000		0.02000	ND	DECHLORINATION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUTV-1	7
12	0.980390	6.63000		0.13000		DECHLORINATION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUTV-1	3
13	0.953310	27.20000		1.27000		DECHLORINATION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUTV-1	7
14	0.917100	0.19300		0.01600		DECHLORINATION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUTV-1	2
15	0.905960	23.50000		2.21000		DECHLORINATION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUTV-1	6
16	0.864250	0.19300		0.02620	ND	DECHLORINATION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUTV-1	6

SOIL = 16 data points SLUDGE (SLUD) = 0 data points

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W04 HALOGENATED ALIPHATIC COMPOUNDS
Technology Group: BIOREMEDIATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999927	68.77500		0.00500	ND	AEROBIC	1,1-DICHLOROETHANE	SOIL	P	980-TS1-RT-EZZA-1	2
2	0.999927	68.77500		0.00500	ND	AEROBIC	1,1-DICHLOROETHANE	SOIL	P	980-TS1-RT-EZZA-1	2
3	0.999898	68.77500		0.00700	ND	AEROBIC	1,1-DICHLOROETHANE	SOIL	P	980-TS1-RT-EZZA-1	2
4	0.999754	36.63000		0.00900	ND	AEROBIC	1,1,2-TRICHLOROETHANE	SOIL	P	980-TS1-RT-EZZA-1	4
5	0.999610	51.25000		0.02000	ND	AEROBIC	1,1,2-TRICHLOROETHANE	SOIL	P	980-TS1-RT-EZZA-1	2
6	0.999391	16.42500		0.01000		AEROBIC	METHYLENE CHLORIDE (DICHLOROMETHANE)	SOIL	P	980-TS1-RT-EZZA-1	2
7	0.999338	7.55000		0.00500		AEROBIC	1,1-DICHLOROETHANE	SOIL	P	980-TS1-RT-EZZA-1	3
8	0.999298	51.25000		0.03600		AEROBIC	1,1,2-TRICHLOROETHANE	SOIL	P	980-TS1-RT-EZZA-1	2
9	0.999269	16.42500		0.01200		AEROBIC	METHYLENE CHLORIDE (DICHLOROMETHANE)	SOIL	P	980-TS1-RT-EZZA-1	2
10	0.999269	16.42500		0.01200		AEROBIC	METHYLENE CHLORIDE (DICHLOROMETHANE)	SOIL	P	980-TS1-RT-EZZA-1	2
11	0.999205	7.55000		0.00600	ND	AEROBIC	1,1-DICHLOROETHANE	SOIL	P	980-TS1-RT-EZZA-1	3
12	0.999205	7.55000		0.00600		AEROBIC	1,1-DICHLOROETHANE	SOIL	P	980-TS1-RT-EZZA-1	3
13	0.999126	36.63000		0.03200		AEROBIC	1,1,2-TRICHLOROETHANE	SOIL	P	980-TS1-RT-EZZA-1	4
14	0.998930	4.67500		0.00500		AEROBIC	1,1,2,2-TETRACHLOROETHANE	SOIL	P	980-TS1-RT-EZZA-1	1
15	0.998716	4.67500		0.00600		AEROBIC	1,1,2,2-TETRACHLOROETHANE	SOIL	P	980-TS1-RT-EZZA-1	1
16	0.998576	51.25000		0.07300		AEROBIC	1,1,2-TRICHLOROETHANE	SOIL	P	980-TS1-RT-EZZA-1	2
17	0.998526	36.63000		0.05400		AEROBIC	1,1,2-TRICHLOROETHANE	SOIL	P	980-TS1-RT-EZZA-1	4
18	0.997527	14.15000		0.03500		AEROBIC	1,1,2-TRICHLOROETHANE	SOIL	P	980-TS1-RT-EZZA-1	1
19	0.996770	4.02500		0.01300		AEROBIC	METHYLENE CHLORIDE (DICHLOROMETHANE)	SOIL	P	980-TS1-RT-EZZA-1	1
20	0.996346	3.55800		0.01300		AEROBIC	METHYLENE CHLORIDE (DICHLOROMETHANE)	SOIL	P	980-TS1-RT-EZZA-1	3
21	0.996273	4.02500		0.01500		AEROBIC	METHYLENE CHLORIDE (DICHLOROMETHANE)	SOIL	P	980-TS1-RT-EZZA-1	1
22	0.995722	4.67500		0.02000		AEROBIC	1,1,2,2-TETRACHLOROETHANE	SOIL	P	980-TS1-RT-EZZA-1	1
23	0.994941	3.55800		0.01800		AEROBIC	METHYLENE CHLORIDE (DICHLOROMETHANE)	SOIL	P	980-TS1-RT-EZZA-1	3
24	0.994276	14.15000		0.08100		AEROBIC	1,1,2-TRICHLOROETHANE	SOIL	P	980-TS1-RT-EZZA-1	1
25	0.993540	4.02500		0.02600		AEROBIC	METHYLENE CHLORIDE (DICHLOROMETHANE)	SOIL	P	980-TS1-RT-EZZA-1	1
26	0.992973	3.55800		0.02500		AEROBIC	METHYLENE CHLORIDE (DICHLOROMETHANE)	SOIL	P	980-TS1-RT-EZZA-1	3
27	0.988198	14.15000		0.16700		AEROBIC	1,1,2-TRICHLOROETHANE	SOIL	P	980-TS1-RT-EZZA-1	1

SOIL = 27 data points SLUDGE (SLUD) = 0 data points

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W04 HALOGENATED ALIPHATIC COMPOUNDS
Technology Group: LOW TEMPERATURE THERMAL DESORPTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	1.000000	1500.00000		0.00500	ND	LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	16
2	0.999995	950.00000		0.00500	ND	LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	5
3	0.999988	423.00000		0.00500	ND	LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EZYQ-1	1
4	0.999988	423.00000		0.00500	ND	LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EZYQ-1	2
5	0.999988	423.00000		0.00500	ND	LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EZYQ-1	3
6	0.999988	423.00000		0.00500		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EZYQ-1	9
7	0.999988	423.00000		0.00500		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EZYQ-1	10
8	0.999987	304.00000		0.00400		LOW TEMP DESORPTION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EZYQ-1	2
9	0.999985	330.00000		0.00500	ND	LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	5
10	0.999984	304.00000		0.00500	ND	LOW TEMP DESORPTION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EZYQ-1	1
11	0.999984	304.00000		0.00500	ND	LOW TEMP DESORPTION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EZYQ-1	3
12	0.999984	304.00000		0.00500		LOW TEMP DESORPTION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EZYQ-1	10
13	0.999980	304.00000		0.00600		LOW TEMP DESORPTION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EZYQ-1	5
14	0.999980	3300.00000		0.07900		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	18
15	0.999980	1000.00000		0.02000	ND	LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
16	0.999978	1000.00000		0.02200		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	18
17	0.999976	210.00000		0.00500	ND	LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	17
18	0.999976	210.00000		0.00500	ND	LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	16
19	0.999974	304.00000		0.00800		LOW TEMP DESORPTION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EZYQ-1	6
20	0.999967	304.00000		0.01000		LOW TEMP DESORPTION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EZYQ-1	4
21	0.999967	150.00000		0.00500	ND	LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	16
22	0.999965	423.00000		0.01500		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EZYQ-1	8
23	0.999957	423.00000		0.01800		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EZYQ-1	6
24	0.999950	423.00000		0.02100		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EZYQ-1	5
25	0.999946	423.00000		0.02300		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EZYQ-1	4
26	0.999939	650.00000		0.04000		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
27	0.999936	314.00000		0.02000	ND	LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
28	0.999918	61.00000		0.00500	ND	LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	14
29	0.999905	304.00000		0.02900		LOW TEMP DESORPTION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EZYQ-1	9
30	0.999892	304.00000		0.03300	ND	LOW TEMP DESORPTION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EZYQ-1	8
31	0.999867	150.00000		0.02000	ND	LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
32	0.999857	140.00000		0.02000	ND	LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
33	0.999833	120.00000		0.02000	ND	LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
34	0.999830	2400.00000		0.42000		LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	18
35	0.999810	210.00000		0.04000		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
36	0.999698	430.00000		0.13000		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	28
37	0.999640	19000.00000		6.90000		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	5
38	0.999565	115.00000		0.05000	ND	LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	P	980-TS1-RT-FCSF-1	1
39	0.999500	40.00000		0.02000	ND	LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
40	0.999412	34.00000		0.02000	ND	LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
41	0.999350	7.70000		0.00500	ND	LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	17

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W04 HALOGENATED ALIPHATIC COMPOUNDS
Technology Group: LOW TEMPERATURE THERMAL DESORPTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
42	0.999091	4.40000		0.00400		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EZYQ-1	16
43	0.999070	1500.00000		1.40000		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	10
44	0.999000	20.00000		0.02000	ND	LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
45	0.998947	19.00000		0.02000	ND	LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
46	0.998947	19.00000		0.02000	ND	LOW TEMP DESORPTION	1,1,1-TRICHLOROETHANE	SOIL	F	980-TS1-RT-EXPE-1	1
47	0.998863	4.40000		0.00500		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EZYQ-1	14
48	0.998636	4.40000		0.00600		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EZYQ-1	15
49	0.998615	1300.00000		1.80000		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	10
50	0.998182	4.40000		0.00800		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EZYQ-1	13
51	0.997954	4.40000		0.00900		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EZYQ-1	17
52	0.997750	120.00000		0.27000		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	27
53	0.997727	8.80000		0.02000	ND	LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
54	0.997674	8.60000		0.02000	ND	LOW TEMP DESORPTION	1,1,1-TRICHLOROETHANE	SOIL	F	980-TS1-RT-EXPE-1	1
55	0.997468	7.90000		0.02000	ND	LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
56	0.997368	19.00000		0.05000	ND	LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-FCSF-1	1
57	0.997260	7.30000		0.02000	ND	LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
58	0.997237	760.00000		2.10000		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	11
59	0.996829	410.00000		1.30000		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	11
60	0.996721	6.10000		0.02000	ND	LOW TEMP DESORPTION	1,1-DICHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
61	0.996666	6.00000		0.02000	ND	LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
62	0.996563	320.00000		1.10000		LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	15
63	0.996154	1.30000		0.00500		LOW TEMP DESORPTION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EZYQ-1	16
64	0.996110	1800.00000		7.00000		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	15
65	0.995384	1.30000		0.00600		LOW TEMP DESORPTION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EZYQ-1	17
66	0.995349	4.30000		0.02000	ND	LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
67	0.994820	11000.00000		57.00000		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	6
68	0.994786	140.00000		0.73000		LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	10
69	0.994615	1.30000		0.00700		LOW TEMP DESORPTION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EZYQ-1	15
70	0.994444	3.60000		0.02000	ND	LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
71	0.993846	1.30000		0.00800		LOW TEMP DESORPTION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EZYQ-1	14
72	0.993240	0.74000		0.00500	ND	LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	20
73	0.993103	2.90000		0.02000	ND	LOW TEMP DESORPTION	1,1,1-TRICHLOROETHANE	SOIL	F	980-TS1-RT-EXPE-1	1
74	0.992592	2.70000		0.02000	ND	LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
75	0.992500	28.00000		0.21000		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	14
76	0.991148	61.00000		0.54000		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	13
77	0.990952	210.00000		1.90000		LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	6
78	0.990910	0.55000		0.00500	ND	LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	1
79	0.990769	1.30000		0.01200		LOW TEMP DESORPTION	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EZYQ-1	13
80	0.990714	1.40000		0.01300		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	3
81	0.990375	80.00000		0.77000		LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	14
82	0.989455	55.00000		0.58000		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	13

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W04 HALOGENATED ALIPHATIC COMPOUNDS
Technology Group: LOW TEMPERATURE THERMAL DESORPTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
83	0.989365	63.00000		0.67000		LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	2
84	0.989149	47.00000		0.51000		LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	13
85	0.988400	2500.00000		29.00000		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	15
86	0.988205	3.90000		0.04600		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	3
87	0.987500	0.40000		0.00500	ND	LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	20
88	0.986567	6.70000		0.09000		LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	28
89	0.985714	70.00000		1.00000		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	6
90	0.982192	73.00000		1.30000		LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	11
91	0.981818	1.10000		0.02000	ND	LOW TEMP DESORPTION	1,1,1-TRICHLOROETHANE	SOIL	F	980-TS1-RT-EXPE-1	1
92	0.977390	2300.00000		52.00000		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	26
93	0.977108	83.00000		1.90000		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	27
94	0.976190	0.21000		0.00500	ND	LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	1
95	0.975000	1600.00000		40.00000		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	2
96	0.968085	470.00000		15.00000		LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	9
97	0.957447	47.00000		2.00000		LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	12
98	0.956140	57.00000		2.50000		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	B	980-TS1-RT-FCMK-1	3
99	0.950000	0.40000		0.02000	ND	LOW TEMP DESORPTION	1,1,1-TRICHLOROETHANE	SOIL	F	980-TS1-RT-EXPE-1	1
100	0.946067	890.00000		48.00000		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	26
101	0.945455	220.00000		12.00000		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	12
102	0.942424	495.00000	E1	28.50000		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	B	980-TS1-RT-FCMK-1	4
103	0.935000	0.07700		0.00500	ND	LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	3
104	0.934409	930.00000		61.00000		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	9
105	0.926761	1420.00000	E2	104.00000	E1	LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	B	980-TS1-RT-FCMK-1	4
106	0.925920	0.54000		0.04000		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
107	0.916981	265.00000	E1	22.00000		LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	B	980-TS1-RT-FCMK-1	4
108	0.890000	30.00000		3.30000		LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	26
109	0.882609	230.00000		27.00000		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	12
110	0.857140	0.14000		0.02000	ND	LOW TEMP DESORPTION	1,1,1-TRICHLOROETHANE	SOIL	F	980-TS1-RT-EXPE-1	1
111	0.850850	5900.00000		880.00000		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	8
112	0.846150	0.13000		0.02000	ND	LOW TEMP DESORPTION	1,1,1-TRICHLOROETHANE	SOIL	F	980-TS1-RT-EXPE-1	1
113	0.843700	0.03200		0.00500	ND	LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	1
114	0.838700	0.03100		0.00500	ND	LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	4
115	0.833300	0.03000		0.00500	ND	LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	21
116	0.828600	0.07000		0.01200		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	21
117	0.818180	0.11000		0.02000	ND	LOW TEMP DESORPTION	1,1-DICHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
118	0.816327	98.00000		18.00000		LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	B	980-TS1-RT-FCMK-1	3
119	0.794440	0.18000		0.03700		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	4
120	0.792680	0.41000		0.08500		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	7
121	0.786670	1500.00000		320.00000		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	2
122	0.777800	0.09000		0.02000	ND	LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	F	980-TS1-RT-EXPE-1	1
123	0.750000	0.02000		0.00500	ND	LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	21

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W04 HALOGENATED ALIPHATIC COMPOUNDS
Technology Group: LOW TEMPERATURE THERMAL DESORPTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
124	0.720000	125.00000	E1	35.00000		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	B	980-TS1-RT-FCMK-1	3
125	0.684200	0.01900	J	0.00600	J	LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	B	980-TS1-RT-FCMK-1	1
126	0.666600	0.03300	J	0.01100	J	LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	B	980-TS1-RT-FCMK-1	1
127	0.663265	98.00000		33.00000		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	9
128	0.634920	0.63000		0.23000		LOW TEMP DESORPTION	TRICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	7
129	0.569893	930.00000		400.00000		LOW TEMP DESORPTION	TETRACHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	8
130	0.500000	0.04000		0.02000	ND	LOW TEMP DESORPTION	1,1,1-TRICHLOROETHANE	SOIL	F	980-TS1-RT-EXPE-1	1
131	0.433330	0.30000		0.17000		LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	7
132	0.272727	220.00000		160.00000		LOW TEMP DESORPTION	TRANS-1,2-DICHLOROETHENE	SOIL	P	980-TS1-RT-EUQS-1	8

SOIL = 132 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W04 HALOGENATED ALIPHATIC COMPOUNDS
Technology Group: CHEMICAL EXTRACTION AND SOIL WASHING

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999996	490.00000		0.00200		SOIL WASHING	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUQW-1	49
2	0.999993	902.00000		0.00600		SOIL WASHING	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUQW-1	49
3	0.999991	902.00000		0.00800		SOIL WASHING	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUQW-1	43
4	0.999978	408.00000		0.00900		SOIL WASHING	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUQW-1	1
5	0.999947	902.00000		0.04800		SOIL WASHING	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUQW-1	55
6	0.999944	354.00000		0.02000		SOIL WASHING	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUQW-1	1
7	0.999943	490.00000		0.02800		SOIL WASHING	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUQW-1	43
8	0.999900	20.00000		0.00200		SOIL WASHING	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUQW-1	31
9	0.999857	7.00000		0.00100		SOIL WASHING	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUQW-1	14
10	0.999842	19.00000		0.00300		SOIL WASHING	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUQW-1	14
11	0.999796	490.00000		0.10000		SOIL WASHING	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUQW-1	55
12	0.999790	19.00000		0.00400		SOIL WASHING	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUQW-1	20
13	0.999737	19.00000		0.00500	J	SOIL WASHING	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUQW-1	13
14	0.999737	19.00000		0.00500	J	SOIL WASHING	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUQW-1	19
15	0.999737	19.00000		0.00500	J	SOIL WASHING	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUQW-1	25
16	0.999701	408.00000		0.12200		SOIL WASHING	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUQW-1	2
17	0.999700	20.00000		0.00600		SOIL WASHING	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUQW-1	37
18	0.999684	19.00000		0.00600	J	SOIL WASHING	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUQW-1	26
19	0.999600	5.00000		0.00200		SOIL WASHING	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUQW-1	31
20	0.999600	5.00000		0.00200		SOIL WASHING	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUQW-1	37
21	0.999588	354.00000		0.14600		SOIL WASHING	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUQW-1	7
22	0.999571	7.00000		0.00300		SOIL WASHING	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUQW-1	20
23	0.999515	408.00000		0.19800		SOIL WASHING	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUQW-1	7
24	0.999486	354.00000		0.18200		SOIL WASHING	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUQW-1	2
25	0.999428	7.00000		0.00400		SOIL WASHING	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUQW-1	26
26	0.999388	490.00000		0.30000		SOIL WASHING	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUQW-1	56
27	0.999286	7.00000		0.00500	J	SOIL WASHING	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUQW-1	13
28	0.999286	7.00000		0.00500	J	SOIL WASHING	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUQW-1	19
29	0.999286	7.00000		0.00500	J	SOIL WASHING	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUQW-1	25
30	0.999204	490.00000		0.39000		SOIL WASHING	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUQW-1	44
31	0.999096	354.00000		0.32000		SOIL WASHING	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUQW-1	8
32	0.998781	902.00000		1.10000		SOIL WASHING	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUQW-1	56
33	0.998408	490.00000		0.78000		SOIL WASHING	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUQW-1	50
34	0.998393	902.00000		1.45000		SOIL WASHING	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUQW-1	50
35	0.998015	408.00000		0.81000		SOIL WASHING	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUQW-1	8
36	0.997450	902.00000		2.30000		SOIL WASHING	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUQW-1	44
37	0.995200	5.00000		0.02400		SOIL WASHING	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUQW-1	32
38	0.993200	5.00000		0.03400		SOIL WASHING	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-EUQW-1	38
39	0.992000	20.00000		0.16000		SOIL WASHING	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUQW-1	32
40	0.988500	20.00000		0.23000		SOIL WASHING	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-EUQW-1	38

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W04 HALOGENATED ALIPHATIC COMPOUNDS
Technology Group: CHEMICAL EXTRACTION AND SOIL WASHING

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num

SOIL = 40 data points SLUDGE (SLUD) = 0 data points

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W05 HAL CYC ALIPHATICS/ETHERS/ESTERS/KETONES
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999994	1600.00000		0.01000	ND	INCINERATION	DIELDRIN	SOIL	B	980-TS1-RT-FDBP-1	5
2	0.999994	1800.00000		0.01000	ND	INCINERATION	DIELDRIN	SOIL	B	980-TS1-RT-FDBP-1	6
3	0.999994	1800.00000		0.01000	ND	INCINERATION	DIELDRIN	SOIL	B	980-TS1-RT-FDBP-1	8
4	0.999993	2800.00000		0.02000	ND	INCINERATION	DIELDRIN	SOIL	B	980-TS1-RT-FDBP-1	19
5	0.999992	3900.00000		0.03000	ND	INCINERATION	ALDRIN	SOIL	B	980-TS1-RT-FDBP-1	18
6	0.999992	3700.00000		0.03000	ND	INCINERATION	ALDRIN	SOIL	B	980-TS1-RT-FDBP-1	19
7	0.999989	1800.00000		0.02000	ND	INCINERATION	DIELDRIN	SOIL	B	980-TS1-RT-FDBP-1	18
8	0.999988	2400.00000		0.03000	ND	INCINERATION	ALDRIN	SOIL	B	980-TS1-RT-FDBP-1	5
9	0.999987	2300.00000		0.03000		INCINERATION	ALDRIN	SOIL	B	980-TS1-RT-FDBP-1	6
10	0.999987	3700.00000		0.05000		INCINERATION	ALDRIN	SOIL	B	980-TS1-RT-FDBP-1	11
11	0.999987	2300.00000		0.03000	ND	INCINERATION	ALDRIN	SOIL	B	980-TS1-RT-FDBP-1	12
12	0.999983	1800.00000		0.03000		INCINERATION	DIELDRIN	SOIL	B	980-TS1-RT-FDBP-1	11
13	0.999982	1700.00000		0.03000	ND	INCINERATION	ALDRIN	SOIL	B	980-TS1-RT-FDBP-1	4
14	0.999982	1100.00000		0.02000	ND	INCINERATION	DIELDRIN	SOIL	B	980-TS1-RT-FDBP-1	12
15	0.999981	3600.00000		0.07000		INCINERATION	ALDRIN	SOIL	B	980-TS1-RT-FDBP-1	13
16	0.999980	1500.00000		0.03000		INCINERATION	DIELDRIN	SOIL	B	980-TS1-RT-FDBP-1	3
17	0.999978	2300.00000		0.05000		INCINERATION	ALDRIN	SOIL	B	980-TS1-RT-FDBP-1	8
18	0.999977	2200.00000		0.05000	ND	INCINERATION	ALDRIN	SOIL	B	980-TS1-RT-FDBP-1	1
19	0.999975	1600.00000		0.04000		INCINERATION	DIELDRIN	SOIL	B	980-TS1-RT-FDBP-1	13
20	0.999962	2100.00000		0.08000	ND	INCINERATION	ALDRIN	SOIL	B	980-TS1-RT-FDBP-1	2
21	0.999962	2100.00000		0.08000		INCINERATION	ALDRIN	SOIL	B	980-TS1-RT-FDBP-1	3
22	0.999960	1500.00000		0.06000		INCINERATION	DIELDRIN	SOIL	B	980-TS1-RT-FDBP-1	16
23	0.999960	250.00000		0.01000	ND	INCINERATION	ISODRIN	SOIL	B	980-TS1-RT-FDBP-1	3
24	0.999955	220.00000		0.01000	ND	INCINERATION	ISODRIN	SOIL	B	980-TS1-RT-FDBP-1	13
25	0.999952	210.00000		0.01000	ND	INCINERATION	ISODRIN	SOIL	B	980-TS1-RT-FDBP-1	18
26	0.999950	1600.00000		0.08000	ND	INCINERATION	DIELDRIN	SOIL	B	980-TS1-RT-FDBP-1	2
27	0.999950	200.00000		0.01000	ND	INCINERATION	ISODRIN	SOIL	B	980-TS1-RT-FDBP-1	4
28	0.999947	190.00000		0.01000	ND	INCINERATION	ISODRIN	SOIL	B	980-TS1-RT-FDBP-1	17
29	0.999944	180.00000		0.01000	ND	INCINERATION	ISODRIN	SOIL	B	980-TS1-RT-FDBP-1	11
30	0.999944	180.00000		0.01000	ND	INCINERATION	ISODRIN	SOIL	B	980-TS1-RT-FDBP-1	16
31	0.999944	180.00000		0.01000	ND	INCINERATION	ISODRIN	SOIL	B	980-TS1-RT-FDBP-1	19
32	0.999943	350.00000		0.02000	ND	INCINERATION	ENDRIN	SOIL	B	980-TS1-RT-FDBP-1	2
33	0.999929	1400.00000		0.10000		INCINERATION	DIELDRIN	SOIL	B	980-TS1-RT-FDBP-1	7
34	0.999923	130.00000		0.01000	ND	INCINERATION	ISODRIN	SOIL	B	980-TS1-RT-FDBP-1	8
35	0.999919	3100.00000		0.25000		INCINERATION	ALDRIN	SOIL	B	980-TS1-RT-FDBP-1	16
36	0.999918	610.00000		0.05000	ND	INCINERATION	ENDRIN	SOIL	B	980-TS1-RT-FDBP-1	19
37	0.999917	1800.00000		0.15000		INCINERATION	DIELDRIN	SOIL	B	980-TS1-RT-FDBP-1	1
38	0.999909	110.00000		0.01000	ND	INCINERATION	ISODRIN	SOIL	B	980-TS1-RT-FDBP-1	12
39	0.999905	1900.00000		0.18000		INCINERATION	ALDRIN	SOIL	B	980-TS1-RT-FDBP-1	7
40	0.999900	1000.00000		0.10000		INCINERATION	DIELDRIN	SOIL	B	980-TS1-RT-FDBP-1	9
41	0.999900	500.00000		0.05000	ND	INCINERATION	ENDRIN	SOIL	B	980-TS1-RT-FDBP-1	18

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W05 HAL CYC ALIPHATICS/ETHERS/ESTERS/KETONES
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
42	0.999900	100.00000		0.01000	ND	INCINERATION	ISODRIN	SOIL	B	980-TS1-RT-FDBP-1	7
43	0.999888	89.00000		0.01000	ND	INCINERATION	ISODRIN	SOIL	B	980-TS1-RT-FDBP-1	9
44	0.999884	430.00000		0.05000	ND	INCINERATION	ENDRIN	SOIL	B	980-TS1-RT-FDBP-1	8
45	0.999875	400.00000		0.05000	ND	INCINERATION	ENDRIN	SOIL	B	980-TS1-RT-FDBP-1	17
46	0.999872	390.00000		0.05000	ND	INCINERATION	ENDRIN	SOIL	B	980-TS1-RT-FDBP-1	13
47	0.999865	1700.00000		0.23000		INCINERATION	ALDRIN	SOIL	B	980-TS1-RT-FDBP-1	9
48	0.999865	370.00000		0.05000	ND	INCINERATION	ENDRIN	SOIL	B	980-TS1-RT-FDBP-1	16
49	0.999849	330.00000		0.05000	ND	INCINERATION	ENDRIN	SOIL	B	980-TS1-RT-FDBP-1	6
50	0.999844	320.00000		0.05000	ND	INCINERATION	ENDRIN	SOIL	B	980-TS1-RT-FDBP-1	11
51	0.999839	310.00000		0.05000	ND	INCINERATION	ENDRIN	SOIL	B	980-TS1-RT-FDBP-1	5
52	0.999833	1200.00000		0.20000		INCINERATION	DIELDRIN	SOIL	B	980-TS1-RT-FDBP-1	4
53	0.999833	300.00000		0.05000	ND	INCINERATION	ENDRIN	SOIL	B	980-TS1-RT-FDBP-1	10
54	0.999833	300.00000		0.05000	ND	INCINERATION	ISODRIN	SOIL	B	980-TS1-RT-FDBP-1	2
55	0.999815	270.00000		0.05000	ND	INCINERATION	ENDRIN	SOIL	B	980-TS1-RT-FDBP-1	3
56	0.999808	260.00000		0.05000	ND	INCINERATION	ENDRIN	SOIL	B	980-TS1-RT-FDBP-1	7
57	0.999792	240.00000		0.05000	ND	INCINERATION	ENDRIN	SOIL	B	980-TS1-RT-FDBP-1	4
58	0.999790	190.00000		0.04000		INCINERATION	ISODRIN	SOIL	B	980-TS1-RT-FDBP-1	10
59	0.999769	3500.00000		0.81000		INCINERATION	ALDRIN	SOIL	B	980-TS1-RT-FDBP-1	17
60	0.999750	200.00000		0.05000	ND	INCINERATION	ENDRIN	SOIL	B	980-TS1-RT-FDBP-1	12
61	0.999742	310.00000		0.08000	ND	INCINERATION	ENDRIN	SOIL	B	980-TS1-RT-FDBP-1	1
62	0.999706	170.00000		0.05000	ND	INCINERATION	ENDRIN	SOIL	B	980-TS1-RT-FDBP-1	9
63	0.999667	240.00000		0.08000	ND	INCINERATION	ISODRIN	SOIL	B	980-TS1-RT-FDBP-1	1
64	0.999615	130.00000		0.05000	ND	INCINERATION	ISODRIN	SOIL	B	980-TS1-RT-FDBP-1	6
65	0.999546	110.00000		0.05000	ND	INCINERATION	ISODRIN	SOIL	B	980-TS1-RT-FDBP-1	5
66	0.999419	1600.00000		0.93000		INCINERATION	DIELDRIN	SOIL	B	980-TS1-RT-FDBP-1	17
67	0.999280	0.14000		0.00010	ND	INCINERATION	GAMMA-BHC (LINDANE)	SOIL	B	980-TS1-RT-EZYN-1	1
68	0.999230	0.13000		0.00010	ND	INCINERATION	GAMMA-BHC (LINDANE)	SOIL	B	980-TS1-RT-EZYN-1	1
69	0.999167	3600.00000		3.00000		INCINERATION	ALDRIN	SOIL	B	980-TS1-RT-FDBP-1	10
70	0.999026	390.00000		0.38000		INCINERATION	ENDRIN	SOIL	B	980-TS1-RT-FDBP-1	15
71	0.998500	180.00000		0.27000		INCINERATION	ISODRIN	SOIL	B	980-TS1-RT-FDBP-1	15
72	0.998444	1800.00000		2.80000		INCINERATION	DIELDRIN	SOIL	B	980-TS1-RT-FDBP-1	10
73	0.995152	3300.00000		16.00000		INCINERATION	ALDRIN	SOIL	B	980-TS1-RT-FDBP-1	15
74	0.993867	1500.00000		9.20000		INCINERATION	DIELDRIN	SOIL	B	980-TS1-RT-FDBP-1	15
75	0.970300	0.06400		0.00190	ND	INCINERATION	CHLORDANE	SOIL	B	980-TS1-RT-EZYN-1	1
76	0.969800	0.06300		0.00190	ND	INCINERATION	CHLORDANE	SOIL	B	980-TS1-RT-EZYN-1	1
77	0.789744	390.00000		82.00000		INCINERATION	ENDRIN	SOIL	B	980-TS1-RT-FDBP-1	14
78	0.484849	3300.00000		1700.00000		INCINERATION	ALDRIN	SOIL	B	980-TS1-RT-FDBP-1	14
79	0.200000	200.00000		160.00000		INCINERATION	ISODRIN	SOIL	B	980-TS1-RT-FDBP-1	14

SOIL = 79 data points SLUDGE (SLUD) = 0 data points

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W05 HAL CYC ALIPHATICS/ETHERS/ESTERS/KETONES
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999996	131.80000	E1	0.00050	ND	ROTARY KILN	ALPHA-BHC	SOIL	P	980-TS1-RT-EZUY-1	1
2	0.999994	78.21500		0.00050	ND	ROTARY KILN	DELTA-BHC	SOIL	P	980-TS1-RT-EZUY-1	1
3	0.999991	198.90000	E1	0.00180		ROTARY KILN	ALPHA-BHC	SOIL	P	980-TS1-RT-EZUY-1	1
4	0.999991	54.89500		0.00050	ND	ROTARY KILN	HEPTACHLOR	SOIL	P	980-TS1-RT-EZUY-1	1
5	0.999989	45.28200		0.00050	ND	ROTARY KILN	BETA-BHC	SOIL	P	980-TS1-RT-EZUY-1	1
6	0.999988	206.80000	E1	0.00250	ND	ROTARY KILN	ALPHA-BHC	SOIL	P	980-TS1-RT-EZUY-1	1
7	0.999988	40.72600		0.00050	ND	ROTARY KILN	BETA-BHC	SOIL	P	980-TS1-RT-EZUY-1	1
8	0.999987	39.12700		0.00050	ND	ROTARY KILN	DELTA-BHC	SOIL	P	980-TS1-RT-EZUY-1	1
9	0.999985	34.26900		0.00050	ND	ROTARY KILN	GAMMA-BHC (LINDANE)	SOIL	P	980-TS1-RT-EZUY-1	1
10	0.999981	26.05400		0.00050	ND	ROTARY KILN	DELTA-BHC	SOIL	P	980-TS1-RT-EZUY-1	1
11	0.999979	23.61700		0.00050	ND	ROTARY KILN	HEPTACHLOR	SOIL	P	980-TS1-RT-EZUY-1	1
12	0.999978	22.71100		0.00050	ND	ROTARY KILN	BETA-BHC	SOIL	P	980-TS1-RT-EZUY-1	1
13	0.999976	20.82500		0.00050	ND	ROTARY KILN	GAMMA-BHC (LINDANE)	SOIL	P	980-TS1-RT-EZUY-1	1
14	0.999957	11.75600		0.00050	ND	ROTARY KILN	HEPTACHLOR	SOIL	P	980-TS1-RT-EZUY-1	1
15	0.999922	12.74000		0.00100	ND	ROTARY KILN	ENDOSULFAN II	SOIL	P	980-TS1-RT-EZUY-1	1
16	0.999905	26.39300		0.00250	ND	ROTARY KILN	GAMMA-BHC (LINDANE)	SOIL	P	980-TS1-RT-EZUY-1	1
17	0.999762	4.20600		0.00100	ND	ROTARY KILN	DIELDRIN	SOIL	P	980-TS1-RT-EZUY-1	1
18	0.999761	4.18700		0.00100	ND	ROTARY KILN	DIELDRIN	SOIL	P	980-TS1-RT-EZUY-1	1
19	0.999724	7.24100		0.00200	ND	ROTARY KILN	ENDOSULFAN II	SOIL	P	980-TS1-RT-EZUY-1	1
20	0.999719	3.56700		0.00100	ND	ROTARY KILN	DIELDRIN	SOIL	P	980-TS1-RT-EZUY-1	1
21	0.999502	2.00800		0.00100	ND	ROTARY KILN	ENDOSULFAN II	SOIL	P	980-TS1-RT-EZUY-1	1
22	0.998480	0.33000		0.00050	ND	ROTARY KILN	HEPTACHLOR EPOXIDE	SOIL	P	980-TS1-RT-EZUY-1	1
23	0.998480	0.33000		0.00050	ND	ROTARY KILN	HEPTACHLOR EPOXIDE	SOIL	P	980-TS1-RT-EZUY-1	1
24	0.998480	0.33000		0.00050	ND	ROTARY KILN	HEPTACHLOR EPOXIDE	SOIL	P	980-TS1-RT-EZUY-1	1
25	0.998480	0.33000		0.00050	ND	ROTARY KILN	ALDRIN	SOIL	P	980-TS1-RT-EZUY-1	1
26	0.998480	0.33000		0.00050	ND	ROTARY KILN	ALDRIN	SOIL	P	980-TS1-RT-EZUY-1	1
27	0.998480	0.33000		0.00050	ND	ROTARY KILN	ALDRIN	SOIL	P	980-TS1-RT-EZUY-1	1
28	0.996970	0.33000		0.00100	ND	ROTARY KILN	ENDRIN	SOIL	P	980-TS1-RT-EZUY-1	1
29	0.996970	0.33000		0.00100	ND	ROTARY KILN	ENDRIN	SOIL	P	980-TS1-RT-EZUY-1	1
30	0.996970	0.33000		0.00100	ND	ROTARY KILN	ENDRIN	SOIL	P	980-TS1-RT-EZUY-1	1
31	0.996970	0.33000		0.00100	ND	ROTARY KILN	ENDOSULFAN I	SOIL	P	980-TS1-RT-EZUY-1	1
32	0.996970	0.33000		0.00100	ND	ROTARY KILN	ENDOSULFAN I	SOIL	P	980-TS1-RT-EZUY-1	1
33	0.996970	0.33000		0.00100	ND	ROTARY KILN	ENDOSULFAN I	SOIL	P	980-TS1-RT-EZUY-1	1
34	0.993940	0.33000		0.00200	ND	ROTARY KILN	ENDOSULFAN SULFATE	SOIL	P	980-TS1-RT-EZUY-1	1
35	0.993940	0.33000		0.00200	ND	ROTARY KILN	ENDOSULFAN SULFATE	SOIL	P	980-TS1-RT-EZUY-1	1
36	0.993940	0.33000		0.00200	ND	ROTARY KILN	ENDOSULFAN SULFATE	SOIL	P	980-TS1-RT-EZUY-1	1
37	0.993940	0.33000		0.00200	ND	ROTARY KILN	ENDRIN ALDEHYDE	SOIL	P	980-TS1-RT-EZUY-1	1
38	0.993940	0.33000		0.00200		ROTARY KILN	ENDRIN ALDEHYDE	SOIL	P	980-TS1-RT-EZUY-1	1
39	0.993940	0.33000		0.00200	ND	ROTARY KILN	ENDRIN ALDEHYDE	SOIL	P	980-TS1-RT-EZUY-1	1

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W05 HAL CYC ALIPHATICS/ETHERS/ESTERS/KETONES
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num

SOIL = 39 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W06 NITRATED AROMATIC & ALIPHATIC COMPOUNDS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999998	158000.00000	E1	0.30000	ND	INCINERATION	TRINITROPHENLYMETHYLNITRAMINE (TETRYL)	SOIL	B	980-TS1-RT-EUWW-1	13
2	0.999995	424000.00000	E1	2.00000	ND	INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	4
3	0.999995	424000.00000	E1	2.00000	ND	INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	5
4	0.999995	424000.00000	E1	2.00000	ND	INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	6
5	0.999995	424000.00000	E1	2.00000	ND	INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	7
6	0.999995	424000.00000	E1	2.00000	ND	INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	8
7	0.999995	424000.00000	E1	2.00000	ND	INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	9
8	0.999995	424000.00000	E1	2.00000	ND	INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	10
9	0.999995	424000.00000	E1	2.00000	ND	INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	11
10	0.999995	424000.00000	E1	2.00000	ND	INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	12
11	0.999995	424000.00000	E1	2.00000	ND	INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	13
12	0.999995	424000.00000	E1	2.00000	ND	INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	14
13	0.999995	424000.00000	E1	2.00000	ND	INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	15
14	0.999994	159000.00000	E1	1.00000	ND	INCINERATION	1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	1
15	0.999994	159000.00000	E1	1.00000	ND	INCINERATION	1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	2
16	0.999994	159000.00000	E1	1.00000	ND	INCINERATION	1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	4
17	0.999994	159000.00000	E1	1.00000	ND	INCINERATION	1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	5
18	0.999994	159000.00000	E1	1.00000	ND	INCINERATION	1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	6
19	0.999994	159000.00000	E1	1.00000	ND	INCINERATION	1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	7
20	0.999994	159000.00000	E1	1.00000	ND	INCINERATION	1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	8
21	0.999994	159000.00000	E1	1.00000	ND	INCINERATION	1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	9
22	0.999994	159000.00000	E1	1.00000	ND	INCINERATION	1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	10
23	0.999994	159000.00000	E1	1.00000	ND	INCINERATION	1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	11
24	0.999994	159000.00000	E1	1.00000	ND	INCINERATION	1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	13
25	0.999994	159000.00000	E1	1.00000	ND	INCINERATION	1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	14
26	0.999994	159000.00000	E1	1.00000	ND	INCINERATION	1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	15
27	0.999981	15800.00000		0.30000	ND	INCINERATION	TRINITROPHENLYMETHYLNITRAM	SOIL	B	980-TS1-RT-EUWW-1	2

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W06 NITRATED AROMATIC & ALIPHATIC COMPOUNDS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
28	0.999981	15800.00000		0.30000	ND	INCINERATION	INE (TETRYL) TRINITROPHENLYMETHYLNITRAM	SOIL	B	980-TS1-RT-EUWW-1	4
29	0.999981	15800.00000		0.30000	ND	INCINERATION	INE (TETRYL) TRINITROPHENLYMETHYLNITRAM	SOIL	B	980-TS1-RT-EUWW-1	5
30	0.999981	15800.00000		0.30000	ND	INCINERATION	INE (TETRYL) TRINITROPHENLYMETHYLNITRAM	SOIL	B	980-TS1-RT-EUWW-1	6
31	0.999981	15800.00000		0.30000	ND	INCINERATION	INE (TETRYL) TRINITROPHENLYMETHYLNITRAM	SOIL	B	980-TS1-RT-EUWW-1	7
32	0.999981	15800.00000		0.30000	ND	INCINERATION	INE (TETRYL) TRINITROPHENLYMETHYLNITRAM	SOIL	B	980-TS1-RT-EUWW-1	8
33	0.999981	15800.00000		0.30000	ND	INCINERATION	INE (TETRYL) TRINITROPHENLYMETHYLNITRAM	SOIL	B	980-TS1-RT-EUWW-1	9
34	0.999981	15800.00000		0.30000	ND	INCINERATION	INE (TETRYL) TRINITROPHENLYMETHYLNITRAM	SOIL	B	980-TS1-RT-EUWW-1	10
35	0.999981	15800.00000		0.30000	ND	INCINERATION	INE (TETRYL) TRINITROPHENLYMETHYLNITRAM	SOIL	B	980-TS1-RT-EUWW-1	11
36	0.999981	15800.00000		0.30000	ND	INCINERATION	INE (TETRYL) TRINITROPHENLYMETHYLNITRAM	SOIL	B	980-TS1-RT-EUWW-1	12
37	0.999981	15800.00000		0.30000	ND	INCINERATION	INE (TETRYL) TRINITROPHENLYMETHYLNITRAM	SOIL	B	980-TS1-RT-EUWW-1	14
38	0.999981	15800.00000		0.30000	ND	INCINERATION	INE (TETRYL) TRINITROPHENLYMETHYLNITRAM	SOIL	B	980-TS1-RT-EUWW-1	15
39	0.999979	47300.00000		1.00000	ND	INCINERATION	INE (TETRYL) TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	27
40	0.999937	47300.00000		3.00000		INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	26
41	0.999937	15900.00000		1.00000	ND	INCINERATION	1,3,5-TRINITROHEXAHYDRO-1, 3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	12
42	0.999857	2100.00000		0.30000	ND	INCINERATION	TRINITROPHENLYMETHYLNITRAM INE (TETRYL)	SOIL	B	980-TS1-RT-EUWW-1	22
43	0.999857	2100.00000		0.30000	ND	INCINERATION	TRINITROPHENLYMETHYLNITRAM INE (TETRYL)	SOIL	B	980-TS1-RT-EUWW-1	24
44	0.999857	2100.00000		0.30000	ND	INCINERATION	TRINITROPHENLYMETHYLNITRAM INE (TETRYL)	SOIL	B	980-TS1-RT-EUWW-1	26
45	0.999857	2100.00000		0.30000	ND	INCINERATION	TRINITROPHENLYMETHYLNITRAM INE (TETRYL)	SOIL	B	980-TS1-RT-EUWW-1	27
46	0.999686	15900.00000		5.00000		INCINERATION	1,3,5-TRINITROHEXAHYDRO-1, 3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	26
47	0.999619	2100.00000		0.80000		INCINERATION	TRINITROPHENLYMETHYLNITRAM INE (TETRYL)	SOIL	B	980-TS1-RT-EUWW-1	25
48	0.999577	47300.00000		20.00000		INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	22
49	0.999571	2100.00000		0.90000		INCINERATION	TRINITROPHENLYMETHYLNITRAM	SOIL	B	980-TS1-RT-EUWW-1	23

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W06 NITRATED AROMATIC & ALIPHATIC COMPOUNDS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
							INE (TETRYL)				
50	0.999556	47300.00000		21.00000		INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	23
51	0.999371	15900.00000		10.00000		INCINERATION	1,3,5-TRINITROHEXAHYDRO-1, 3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	22
52	0.999371	15900.00000		10.00000		INCINERATION	1,3,5-TRINITROHEXAHYDRO-1, 3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	23
53	0.999371	15900.00000		10.00000		INCINERATION	1,3,5-TRINITROHEXAHYDRO-1, 3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	24
54	0.999366	47300.00000		30.00000		INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	25
55	0.999260	47300.00000		35.00000		INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	24
56	0.999154	47300.00000		40.00000		INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	21
57	0.998742	15900.00000		20.00000		INCINERATION	1,3,5-TRINITROHEXAHYDRO-1, 3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	21
58	0.998742	15900.00000		20.00000		INCINERATION	1,3,5-TRINITROHEXAHYDRO-1, 3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	25
59	0.998113	15900.00000		30.00000		INCINERATION	1,3,5-TRINITROHEXAHYDRO-1, 3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	27
60	0.997143	2100.00000		6.00000		INCINERATION	TRINITROPHENLYMETHYLNITRAM INE (TETRYL)	SOIL	B	980-TS1-RT-EUWW-1	21
61	0.996816	424000.00000	E1	1350.00000		INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	3
62	0.996462	424000.00000	E1	1500.00000		INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	2
63	0.996237	47300.00000		178.00000	ND	INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	19
64	0.996237	47300.00000		178.00000	ND	INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	20
65	0.992785	15800.00000		114.00000		INCINERATION	TRINITROPHENLYMETHYLNITRAM INE (TETRYL)	SOIL	B	980-TS1-RT-EUWW-1	1
66	0.990818	15900.00000		146.00000		INCINERATION	1,3,5-TRINITROHEXAHYDRO-1, 3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	18
67	0.976415	424000.00000	E1	10000.00000		INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	1
68	0.975264	47300.00000		1170.00000		INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	18
69	0.972727	47300.00000		1290.00000		INCINERATION	TRINITROTOLUENE (TNT)	SOIL	B	980-TS1-RT-EUWW-1	17
70	0.969182	15900.00000		490.00000	ND	INCINERATION	1,3,5-TRINITROHEXAHYDRO-1, 3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	17
71	0.969182	15900.00000		490.00000	ND	INCINERATION	1,3,5-TRINITROHEXAHYDRO-1, 3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	19
72	0.969182	15900.00000		490.00000	ND	INCINERATION	1,3,5-TRINITROHEXAHYDRO-1, 3,5-TRIAZINE	SOIL	B	980-TS1-RT-EUWW-1	20
73	0.966667	2100.00000		70.00000	ND	INCINERATION	TRINITROPHENLYMETHYLNITRAM INE (TETRYL)	SOIL	B	980-TS1-RT-EUWW-1	17
74	0.966667	2100.00000		70.00000	ND	INCINERATION	TRINITROPHENLYMETHYLNITRAM INE (TETRYL)	SOIL	B	980-TS1-RT-EUWW-1	18
75	0.966667	2100.00000		70.00000	ND	INCINERATION	TRINITROPHENLYMETHYLNITRAM	SOIL	B	980-TS1-RT-EUWW-1	19

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W06 NITRATED AROMATIC & ALIPHATIC COMPOUNDS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
76	0.966667	2100.00000		70.00000	ND	INCINERATION	INE (TETRYL) TRINITROPHENLYMETHYLNITRAMINE (TETRYL)	SOIL	B	980-TS1-RT-EUWW-1	20
	SOIL = 76 data points			SLUDGE (SLUD) = 0 data points							
1	0.999998	406000.00000		1.00000	ND	ROTARY KILN	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURP-1	7
2	0.999996	264000.00000		1.00000		ROTARY KILN	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURP-1	5
3	0.999996	263000.00000		1.00000	ND	ROTARY KILN	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURP-1	9
4	0.999993	150000.00000		1.00000		ROTARY KILN	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURP-1	2
5	0.999993	142000.00000		1.00000	ND	ROTARY KILN	2-AMINO-4,6-DINITROTOLUENE	SOIL	P	980-TS1-RT-EURP-1	12
6	0.999992	121000.00000		1.00000	ND	ROTARY KILN	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURP-1	6
7	0.999990	99500.00000		1.00000	ND	ROTARY KILN	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURP-1	1
8	0.999989	88100.00000		1.00000	ND	ROTARY KILN	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURP-1	4
9	0.999989	92500.00000		1.00000	ND	ROTARY KILN	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURP-1	16
10	0.999988	81100.00000		1.00000	ND	ROTARY KILN	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURP-1	15
11	0.999984	60600.00000		1.00000		ROTARY KILN	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURP-1	14
12	0.999982	55200.00000		1.00000	ND	ROTARY KILN	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURP-1	18
13	0.999930	142000.00000		10.00000		ROTARY KILN	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURP-1	10
14	0.999913	115000.00000		10.00000		ROTARY KILN	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURP-1	3
15	0.999837	61200.00000		10.00000		ROTARY KILN	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURP-1	17
16	0.999797	98500.00000		20.00000		ROTARY KILN	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURP-1	13
17	0.999498	59700.00000		30.00000		ROTARY KILN	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURP-1	12
18	0.998305	590.00000		1.00000	ND	ROTARY KILN	2-AMINO-4,6-DINITROTOLUENE	SOIL	P	980-TS1-RT-EURP-1	11
19	0.998241	108000.00000		190.00000		ROTARY KILN	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURP-1	11
20	0.997826	460.00000		1.00000	ND	ROTARY KILN	2-AMINO-4,6-DINITROTOLUENE	SOIL	P	980-TS1-RT-EURP-1	17
21	0.997561	410.00000		1.00000	ND	ROTARY KILN	2-AMINO-4,6-DINITROTOLUENE	SOIL	P	980-TS1-RT-EURP-1	13
22	0.996552	290.00000		1.00000	ND	ROTARY KILN	2-AMINO-4,6-DINITROTOLUENE	SOIL	P	980-TS1-RT-EURP-1	14
23	0.996296	270.00000		1.00000	ND	ROTARY KILN	2-AMINO-4,6-DINITROTOLUENE	SOIL	P	980-TS1-RT-EURP-1	16
24	0.996154	260.00000		1.00000	ND	ROTARY KILN	TRINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	5
25	0.996154	260.00000		1.00000		ROTARY KILN	TRINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	10
26	0.996000	250.00000		1.00000	ND	ROTARY KILN	TRINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	7
27	0.995833	240.00000		1.00000	ND	ROTARY KILN	TRINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	16
28	0.995238	210.00000		1.00000	ND	ROTARY KILN	2-AMINO-4,6-DINITROTOLUENE	SOIL	P	980-TS1-RT-EURP-1	18
29	0.994118	170.00000		1.00000	ND	ROTARY KILN	2-AMINO-4,6-DINITROTOLUENE	SOIL	P	980-TS1-RT-EURP-1	15
30	0.993750	160.00000		1.00000	ND	ROTARY KILN	TRINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	9
31	0.992308	130.00000		1.00000	ND	ROTARY KILN	TRINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	2
32	0.992308	130.00000		1.00000	ND	ROTARY KILN	TRINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	8
33	0.991667	120.00000		1.00000	ND	ROTARY KILN	TRINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	3
34	0.990909	110.00000		1.00000	ND	ROTARY KILN	TRINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	6

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W06 NITRATED AROMATIC & ALIPHATIC COMPOUNDS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
35	0.990000	100.00000		1.00000	ND	ROTARY KILN	TRINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	18
36	0.988889	90.00000		1.00000	ND	ROTARY KILN	TRINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	1
37	0.988889	90.00000		1.00000	ND	ROTARY KILN	TRINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	4
38	0.988889	90.00000		1.00000	ND	ROTARY KILN	TRINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	11
39	0.988889	90.00000		1.00000	ND	ROTARY KILN	TRINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	12
40	0.988889	90.00000		1.00000	ND	ROTARY KILN	TRINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	15
41	0.988816	228000.00000		2550.00000		ROTARY KILN	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURP-1	8
42	0.987500	40.00000		0.50000	ND	ROTARY KILN	DINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	5
43	0.985714	70.00000		1.00000	ND	ROTARY KILN	TRINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	13
44	0.985714	70.00000		1.00000	ND	ROTARY KILN	TRINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	17
45	0.983333	30.00000		0.50000	ND	ROTARY KILN	DINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	7
46	0.983333	30.00000		0.50000	ND	ROTARY KILN	DINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	9
47	0.983333	30.00000		0.50000	ND	ROTARY KILN	DINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	10
48	0.983333	60.00000		1.00000	ND	ROTARY KILN	TRINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	14
49	0.975000	20.00000		0.50000	ND	ROTARY KILN	DINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	13
50	0.975000	20.00000		0.50000	ND	ROTARY KILN	DINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	14
51	0.975000	20.00000		0.50000	ND	ROTARY KILN	DINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	18
52	0.966667	30.00000		1.00000	ND	ROTARY KILN	2-AMINO-4,6-DINITROTOLUENE	SOIL	P	980-TS1-RT-EURP-1	7
53	0.950000	10.00000		0.50000	ND	ROTARY KILN	DINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	2
54	0.950000	10.00000		0.50000	ND	ROTARY KILN	DINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	4
55	0.950000	10.00000		0.50000	ND	ROTARY KILN	DINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	6
56	0.950000	10.00000		0.50000	ND	ROTARY KILN	DINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	8
57	0.950000	10.00000		0.50000	ND	ROTARY KILN	DINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	11
58	0.950000	10.00000		0.50000	ND	ROTARY KILN	DINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	15
59	0.950000	10.00000		0.50000	ND	ROTARY KILN	DINITROBENZENE	SOIL	P	980-TS1-RT-EURP-1	17
60	0.666667	30.00000		10.00000		ROTARY KILN	1,3,5-TRINITROHEXAHYDRO-1, 3,5-TRIAZINE	SOIL	P	980-TS1-RT-EURP-1	1

SOIL = 60 data points SLUDGE (SLUD) = 0 data points

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999560	25000.00000		11.00000		AQUEOUS THERMAL DECO	TRINITROTOLUENE (TNT)	SLUD	B	980-TS1-RT-EURN-1	1
2	0.997600	25000.00000		60.00000		AQUEOUS THERMAL DECO	TRINITROTOLUENE (TNT)	SLUD	B	980-TS1-RT-EURN-1	2
3	0.995998	867000.00000		3470.00000		AQUEOUS THERMAL DECO	TRINITROTOLUENE (TNT)	SLUD	B	980-TS1-RT-EURN-1	6
4	0.995663	867000.00000		3760.00000		AQUEOUS THERMAL DECO	TRINITROTOLUENE (TNT)	SLUD	B	980-TS1-RT-EURN-1	5
5	0.994536	732.00000		4.00000		AQUEOUS THERMAL DECO	TRINITROTOLUENE (TNT)	SLUD	B	980-TS1-RT-EURN-1	4
6	0.976776	732.00000		17.00000		AQUEOUS THERMAL DECO	TRINITROTOLUENE (TNT)	SLUD	B	980-TS1-RT-EURN-1	3

SOIL = 0 data points SLUDGE (SLUD) = 6 data points

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W06 NITRATED AROMATIC & ALIPHATIC COMPOUNDS
Technology Group: BIOREMEDIATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999172	20404.00000		16.90000	ND	COMPOSTING	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURT-2	2
2	0.999172	20404.00000		16.90000	ND	COMPOSTING	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURT-2	2
3	0.999141	19678.00000		16.90000	ND	COMPOSTING	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURT-2	1
4	0.999141	19678.00000		16.90000	ND	COMPOSTING	TRINITROTOLUENE (TNT)	SOIL	P	980-TS1-RT-EURT-2	1
5	0.997036	8433.00000		25.00000	ND	COMPOSTING	NITROCELLULOSE	SLUD	P	980-TS1-RT-EURS-1	4
6	0.993651	31500.00000		200.00000		COMPOSTING	TRINITROTOLUENE (TNT)	SLUD	P	980-TS1-RT-EURS-1	3
7	0.977353	7065.00000		160.00000		COMPOSTING	NITROCELLULOSE	SLUD	P	980-TS1-RT-EURS-1	5
8	0.962839	46178.00000		1716.00000		COMPOSTING	TRINITROTOLUENE (TNT)	SLUD	P	980-TS1-RT-EURS-1	1
9	0.936585	2255.00000		143.00000		COMPOSTING	TRINITROPHENLYMETHYLNITRAMINE (TETRYL)	SLUD	P	980-TS1-RT-EURS-1	1
10	0.932432	7400.00000		500.00000		COMPOSTING	1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE	SLUD	P	980-TS1-RT-EURS-1	3
11	0.905836	1508.00000		142.00000		COMPOSTING	TRINITROPHENLYMETHYLNITRAMINE (TETRYL)	SLUD	P	980-TS1-RT-EURS-1	2
12	0.888889	900.00000		100.00000		COMPOSTING	TRINITROPHENLYMETHYLNITRAMINE (TETRYL)	SLUD	P	980-TS1-RT-EURS-1	3
13	0.864351	9414.00000		1277.00000		COMPOSTING	1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE	SOIL	P	980-TS1-RT-EURT-2	4
14	0.832402	3580.00000		600.00000		COMPOSTING	1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE	SLUD	P	980-TS1-RT-EURS-1	1
15	0.777778	1800.00000		400.00000		COMPOSTING	HMX	SLUD	P	980-TS1-RT-EURS-1	3
16	0.733765	39236.00000		10446.00000		COMPOSTING	TRINITROTOLUENE (TNT)	SLUD	P	980-TS1-RT-EURS-1	2
17	0.718261	575.00000		162.00000		COMPOSTING	HMX	SLUD	P	980-TS1-RT-EURS-1	1
18	0.659957	9240.00000		3142.00000		COMPOSTING	1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE	SOIL	P	980-TS1-RT-EURT-2	3
19	0.644589	9240.00000		3284.00000		COMPOSTING	1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE	SOIL	P	980-TS1-RT-EURT-2	3
20	0.631084	6698.00000		2471.00000		COMPOSTING	1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE	SLUD	P	980-TS1-RT-EURS-1	2
21	0.458997	9414.00000		5093.00000		COMPOSTING	1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE	SOIL	P	980-TS1-RT-EURT-2	4
22	0.049896	962.00000		914.00000		COMPOSTING	HMX	SLUD	P	980-TS1-RT-EURS-1	2

SOIL = 8 data points SLUDGE (SLUD) = 14 data points

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W06 NITRATED AROMATIC & ALIPHATIC COMPOUNDS
Technology Group: CHEMICAL EXTRACTION AND SOIL WASHING

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999640	19300.00000	E1	7.00000		CHEMICAL EXTRACTION	TRINITROTOLUENE (TNT)	SLUD	B	980-TS1-RT-EURU-1	2
2	0.995161	1240.00000		6.00000		CHEMICAL EXTRACTION	TRINITROTOLUENE (TNT)	SLUD	B	980-TS1-RT-EURU-1	1
3	0.983333	60.00000		1.00000	ND	CHEMICAL EXTRACTION	TRINITROBENZENE	SLUD	B	980-TS1-RT-EURU-1	3

SOIL = 0 data points SLUDGE (SLUD) = 3 data points

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W07 HETEROCYCLICS & SIMPLE NON-HAL AROMATICS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999473	9.50000		0.00500	ND	INCINERATION	XYLENES (TOTAL)	SOIL	B	980-TS1-RT-FDBP-1	21
2	0.998000	500.00000	J	1.00000	J	INCINERATION	BENZENE, TOLUENE, ETHYLBENZENE, XYLENES	SOIL	F	980-TS1-RT-FCQC-1	2
3	0.997500	400.00000	J	1.00000	J	INCINERATION	BENZENE, TOLUENE, ETHYLBENZENE, XYLENES	SOIL	F	980-TS1-RT-FCQC-1	1
4	0.943478	4.60000		0.26000		INCINERATION	TOLUENE	SOIL	B	980-TS1-RT-FDBP-1	21
5	0.867500	4.00000		0.53000		INCINERATION	TOLUENE	SOIL	B	980-TS1-RT-FDBP-1	20
	SOIL =	5 data points		SLUDGE (SLUD) =		0 data points					
1	0.999999	3600.00000		0.00500	ND	ROTARY KILN	ETHYLBENZENE	SOIL	P	ORD-TS1-RT-EUZM-1	1
2	0.999999	4000.00000		0.00500	ND	ROTARY KILN	ETHYLBENZENE	SOIL	P	ORD-TS1-RT-EUZM-1	3
3	0.999999	5800.00000		0.00500	ND	ROTARY KILN	XYLENES (TOTAL)	SOIL	P	ORD-TS1-RT-EUZM-1	1
4	0.999999	6000.00000		0.00500	ND	ROTARY KILN	XYLENES (TOTAL)	SOIL	P	ORD-TS1-RT-EUZM-1	3
5	0.999994	770.00000		0.00500	ND	ROTARY KILN	STYRENE	SOIL	P	ORD-TS1-RT-EUZM-1	1
6	0.999994	810.00000		0.00500	ND	ROTARY KILN	STYRENE	SOIL	P	ORD-TS1-RT-EUZM-1	3
7	0.999992	2400.00000		0.01900		ROTARY KILN	ETHYLBENZENE	SOIL	P	ORD-TS1-RT-EUZM-1	2
8	0.999992	4000.00000		0.03400		ROTARY KILN	XYLENES (TOTAL)	SOIL	P	ORD-TS1-RT-EUZM-1	2
9	0.999991	580.00000		0.00500	ND	ROTARY KILN	STYRENE	SOIL	P	ORD-TS1-RT-EUZM-1	2
10	0.999967	240.00000		0.00800		ROTARY KILN	ETHYLBENZENE	SOIL	P	ORD-TS1-RT-EUZM-1	4
11	0.999962	520.00000		0.02000		ROTARY KILN	XYLENES (TOTAL)	SOIL	P	ORD-TS1-RT-EUZM-1	6
12	0.999961	330.00000		0.01300		ROTARY KILN	ETHYLBENZENE	SOIL	P	ORD-TS1-RT-EUZM-1	6
13	0.999960	150.00000		0.00600		ROTARY KILN	XYLENES (TOTAL)	SOIL	P	ORD-TS1-RT-EUZM-1	5
14	0.999941	84.00000		0.00500	ND	ROTARY KILN	ETHYLBENZENE	SOIL	P	ORD-TS1-RT-EUZM-1	5
15	0.999925	67.00000		0.00500	ND	ROTARY KILN	STYRENE	SOIL	P	ORD-TS1-RT-EUZM-1	6
16	0.999908	120.00000		0.01100		ROTARY KILN	XYLENES (TOTAL)	SOIL	P	ORD-TS1-RT-EUZM-1	4
17	0.999902	51.00000		0.00500	ND	ROTARY KILN	STYRENE	SOIL	P	ORD-TS1-RT-EUZM-1	4
18	0.999886	44.00000		0.00500	ND	ROTARY KILN	TOLUENE	SOIL	P	980-TS1-RT-EXPC-1	1
19	0.999688	16.00000		0.00500	ND	ROTARY KILN	STYRENE	SOIL	P	ORD-TS1-RT-EUZM-1	5
20	0.999019	5.10000		0.00500	ND	ROTARY KILN	TOLUENE	SOIL	P	980-TS1-RT-EXPC-1	4
21	0.998648	3.70000		0.00500	ND	ROTARY KILN	BENZENE	SOIL	P	980-TS1-RT-EXPC-1	1
	SOIL =	21 data points		SLUDGE (SLUD) =		0 data points					
1	0.999969	160.00000		0.00500	ND	INFRARED	ETHYLBENZENE	SOIL	P	980-TS1-RT-EZZB-1	1
2	0.999969	160.00000		0.00500	ND	INFRARED	ETHYLBENZENE	SOIL	P	980-TS1-RT-EZZB-1	2
3	0.999964	140.00000		0.00500	ND	INFRARED	STYRENE	SOIL	P	980-TS1-RT-EZZB-1	1
4	0.999964	140.00000		0.00500	ND	INFRARED	STYRENE	SOIL	P	980-TS1-RT-EZZB-1	2
5	0.999643	14.00000		0.00500	ND	INFRARED	ETHYLBENZENE	SOIL	P	980-TS1-RT-EZZB-1	7

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W07 HETEROCYCLICS & SIMPLE NON-HAL AROMATICS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
6	0.999643	14.00000		0.00500	ND	INFRARED	ETHYLBENZENE	SOIL	P	980-TS1-RT-EZZB-1	8
7	0.999500	10.00000		0.00500	ND	INFRARED	ETHYLBENZENE	SOIL	P	980-TS1-RT-EZZB-1	3
8	0.999500	10.00000		0.00500	ND	INFRARED	ETHYLBENZENE	SOIL	P	980-TS1-RT-EZZB-1	4
9	0.999500	10.00000		0.00500	ND	INFRARED	STYRENE	SOIL	P	980-TS1-RT-EZZB-1	7
10	0.999500	10.00000		0.00500	ND	INFRARED	STYRENE	SOIL	P	980-TS1-RT-EZZB-1	8
11	0.999324	7.40000		0.00500	ND	INFRARED	ETHYLBENZENE	SOIL	P	980-TS1-RT-EZZB-1	5
12	0.999324	7.40000		0.00500	ND	INFRARED	ETHYLBENZENE	SOIL	P	980-TS1-RT-EZZB-1	6
13	0.998936	4.70000		0.00500	ND	INFRARED	STYRENE	SOIL	P	980-TS1-RT-EZZB-1	5
14	0.998936	4.70000		0.00500	ND	INFRARED	STYRENE	SOIL	P	980-TS1-RT-EZZB-1	6
15	0.979166	3.60000		0.07500		INFRARED	BENZENE	SOIL	P	980-TS1-RT-EZZB-1	2
16	0.974444	3.60000		0.09200		INFRARED	BENZENE	SOIL	P	980-TS1-RT-EZZB-1	1

SOIL = 16 data points SLUDGE (SLUD) = 0 data points

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W07 HETEROCYCLICS & SIMPLE NON-HAL AROMATICS
Technology Group: DECHLORINATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999980	2916.00000		0.06230		DECHLORINATION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUTV-1	4
2	0.999970	7451.00000		0.21600		DECHLORINATION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUTV-1	4
3	0.999950	721.00000		0.03490		DECHLORINATION	STYRENE	SOIL	B	ORD-TS1-RT-EUTV-1	4
4	0.999730	3917.00000		1.05000		DECHLORINATION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUTV-1	1
5	0.999640	10063.00000		3.67000		DECHLORINATION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUTV-1	1
6	0.999560	827.00000		0.36700		DECHLORINATION	STYRENE	SOIL	B	ORD-TS1-RT-EUTV-1	1
7	0.999540	123.00000		0.05680		DECHLORINATION	STYRENE	SOIL	B	ORD-TS1-RT-EUTV-1	2
8	0.999510	188.00000		0.09180		DECHLORINATION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUTV-1	3
9	0.999440	500.00000		0.28000		DECHLORINATION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUTV-1	3
10	0.998650	40.50000		0.05470		DECHLORINATION	STYRENE	SOIL	B	ORD-TS1-RT-EUTV-1	3
11	0.997550	101.00000		0.24700		DECHLORINATION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUTV-1	2
12	0.997470	28.40000		0.07180		DECHLORINATION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUTV-1	2
13	0.996030	123.00000		0.48800		DECHLORINATION	STYRENE	SOIL	B	ORD-TS1-RT-EUTV-1	6
14	0.988110	7451.00000		88.60000		DECHLORINATION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUTV-1	8
15	0.986970	2916.00000		38.00000		DECHLORINATION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUTV-1	8
16	0.983780	188.00000		3.05000		DECHLORINATION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUTV-1	7
17	0.981970	721.00000		13.00000		DECHLORINATION	STYRENE	SOIL	B	ORD-TS1-RT-EUTV-1	8
18	0.981090	40.50000		0.76600		DECHLORINATION	STYRENE	SOIL	B	ORD-TS1-RT-EUTV-1	7
19	0.980480	500.00000		9.76000		DECHLORINATION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUTV-1	7
20	0.975700	3917.00000		95.20000		DECHLORINATION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUTV-1	5
21	0.973670	10063.00000		265.00000		DECHLORINATION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUTV-1	5
22	0.971090	101.00000		2.92000		DECHLORINATION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUTV-1	6
23	0.968940	28.40000		0.88200		DECHLORINATION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUTV-1	6
24	0.967350	827.00000		27.00000		DECHLORINATION	STYRENE	SOIL	B	ORD-TS1-RT-EUTV-1	5

SOIL = 24 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W07 HETEROCYCLICS & SIMPLE NON-HAL AROMATICS
Technology Group: BIOREMEDIATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999993	2257.50000	E2	0.01600	ND	AEROBIC	ETHYLBENZENE	SOIL	P	980-TS1-RT-EZZA-1	2
2	0.999979	285.75000	E1	0.00600	ND	AEROBIC	TOLUENE	SOIL	P	980-TS1-RT-EZZA-1	2
3	0.999979	285.75000	E1	0.00600	ND	AEROBIC	TOLUENE	SOIL	P	980-TS1-RT-EZZA-1	2
4	0.999975	2257.50000	E2	0.05700	ND	AEROBIC	ETHYLBENZENE	SOIL	P	980-TS1-RT-EZZA-1	2
5	0.999971	104.70000	E1	0.00300	ND	AEROBIC	STYRENE	SOIL	P	980-TS1-RT-EZZA-1	2
6	0.999969	128.25000	E1	0.00400	ND	AEROBIC	ETHYLBENZENE	SOIL	P	980-TS1-RT-EZZA-1	1
7	0.999965	593.58800	E1	0.02100	ND	AEROBIC	ETHYLBENZENE	SOIL	P	980-TS1-RT-EZZA-1	4
8	0.999965	285.75000	E1	0.01000	ND	AEROBIC	TOLUENE	SOIL	P	980-TS1-RT-EZZA-1	2
9	0.999960	226.25000	E1	0.00900	ND	AEROBIC	ETHYLBENZENE	SOIL	P	980-TS1-RT-EZZA-1	3
10	0.999952	2257.50000	E2	0.10900	ND	AEROBIC	ETHYLBENZENE	SOIL	P	980-TS1-RT-EZZA-1	2
11	0.999943	104.70000	E1	0.00600	ND	AEROBIC	STYRENE	SOIL	P	980-TS1-RT-EZZA-1	2
12	0.999939	593.58800	E1	0.03600	ND	AEROBIC	ETHYLBENZENE	SOIL	P	980-TS1-RT-EZZA-1	4
13	0.999939	65.21800		0.00400	ND	AEROBIC	TOLUENE	SOIL	P	980-TS1-RT-EZZA-1	4
14	0.999939	65.21800		0.00400	ND	AEROBIC	TOLUENE	SOIL	P	980-TS1-RT-EZZA-1	4
15	0.999936	94.32500		0.00600	ND	AEROBIC	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EZZA-1	2
16	0.999933	104.70000	E1	0.00700	ND	AEROBIC	STYRENE	SOIL	P	980-TS1-RT-EZZA-1	2
17	0.999915	94.32500		0.00800	ND	AEROBIC	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EZZA-1	2
18	0.999915	94.32500		0.00800	ND	AEROBIC	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EZZA-1	2
19	0.999897	19.47500		0.00200	ND	AEROBIC	TOLUENE	SOIL	P	980-TS1-RT-EZZA-1	3
20	0.999895	38.12200		0.00400	ND	AEROBIC	STYRENE	SOIL	P	980-TS1-RT-EZZA-1	4
21	0.999895	38.12200		0.00400	ND	AEROBIC	STYRENE	SOIL	P	980-TS1-RT-EZZA-1	4
22	0.999863	226.25000	E1	0.03100		AEROBIC	ETHYLBENZENE	SOIL	P	980-TS1-RT-EZZA-1	3
23	0.999852	593.58800	E1	0.08800	ND	AEROBIC	ETHYLBENZENE	SOIL	P	980-TS1-RT-EZZA-1	4
24	0.999808	26.00000		0.00500	ND	AEROBIC	TOLUENE	SOIL	P	980-TS1-RT-EZZA-1	1
25	0.999790	38.12200		0.00800	ND	AEROBIC	STYRENE	SOIL	P	980-TS1-RT-EZZA-1	4
26	0.999782	27.51200		0.00600	ND	AEROBIC	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EZZA-1	4
27	0.999753	16.20000		0.00400	ND	AEROBIC	BENZENE	SOIL	P	980-TS1-RT-EZZA-1	2
28	0.999743	19.47500		0.00500	ND	AEROBIC	TOLUENE	SOIL	P	980-TS1-RT-EZZA-1	3
29	0.999731	26.00000		0.00700	ND	AEROBIC	TOLUENE	SOIL	P	980-TS1-RT-EZZA-1	1
30	0.999724	65.21800		0.01800	ND	AEROBIC	TOLUENE	SOIL	P	980-TS1-RT-EZZA-1	4
31	0.999709	27.51200		0.00800	ND	AEROBIC	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EZZA-1	4
32	0.999673	27.51200		0.00900	ND	AEROBIC	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EZZA-1	4
33	0.999630	16.20000		0.00600	ND	AEROBIC	BENZENE	SOIL	P	980-TS1-RT-EZZA-1	2
34	0.999613	10.32500		0.00400	ND	AEROBIC	STYRENE	SOIL	P	980-TS1-RT-EZZA-1	1
35	0.999568	16.20000		0.00700	ND	AEROBIC	BENZENE	SOIL	P	980-TS1-RT-EZZA-1	2
36	0.999538	12.97500		0.00600	ND	AEROBIC	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EZZA-1	1
37	0.999461	12.97500		0.00700		AEROBIC	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EZZA-1	1
38	0.999431	128.25000	E1	0.07300		AEROBIC	ETHYLBENZENE	SOIL	P	980-TS1-RT-EZZA-1	1
39	0.999384	6.50000		0.00400		AEROBIC	STYRENE	SOIL	P	980-TS1-RT-EZZA-1	3
40	0.999322	10.32500		0.00700		AEROBIC	STYRENE	SOIL	P	980-TS1-RT-EZZA-1	1
41	0.999213	6.35200		0.00500		AEROBIC	BENZENE	SOIL	P	980-TS1-RT-EZZA-1	4

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W07 HETEROCYCLICS & SIMPLE NON-HAL AROMATICS
Technology Group: BIOREMEDIATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
42	0.999134	226.25000	E1	0.19600		AEROBIC	ETHYLBENZENE	SOIL	P	980-TS1-RT-EZZA-1	3
43	0.999127	19.47500		0.01700	ND	AEROBIC	TOLUENE	SOIL	P	980-TS1-RT-EZZA-1	3
44	0.999089	5.49000		0.00500		AEROBIC	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EZZA-1	3
45	0.999089	5.49000		0.00500		AEROBIC	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EZZA-1	3
46	0.999077	6.50000		0.00600		AEROBIC	STYRENE	SOIL	P	980-TS1-RT-EZZA-1	3
47	0.999055	6.35200		0.00600		AEROBIC	BENZENE	SOIL	P	980-TS1-RT-EZZA-1	4
48	0.999055	6.35200		0.00600		AEROBIC	BENZENE	SOIL	P	980-TS1-RT-EZZA-1	4
49	0.999000	26.00000		0.02600		AEROBIC	TOLUENE	SOIL	P	980-TS1-RT-EZZA-1	1
50	0.998907	5.49000		0.00600	ND	AEROBIC	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EZZA-1	3
51	0.998459	12.97500		0.02000		AEROBIC	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EZZA-1	1
52	0.998307	6.50000		0.01100		AEROBIC	STYRENE	SOIL	P	980-TS1-RT-EZZA-1	3
53	0.997232	128.25000	E1	0.35500		AEROBIC	ETHYLBENZENE	SOIL	P	980-TS1-RT-EZZA-1	1
54	0.996610	10.32500		0.03500		AEROBIC	STYRENE	SOIL	P	980-TS1-RT-EZZA-1	1

SOIL = 54 data points SLUDGE (SLUD) = 0 data points

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W07 HETEROCYCLICS & SIMPLE NON-HAL AROMATICS
Technology Group: LOW TEMPERATURE THERMAL DESORPTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	1.000000	3116.00000		0.00600		LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	1
2	1.000000	3116.00000		0.01100		LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	2
3	1.000000	3116.00000		0.00900		LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	3
4	1.000000	3116.00000		0.01500		LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	10
5	1.000000	5277.00000		0.02000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EZYQ-1	1
6	1.000000	5277.00000		0.02600		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EZYQ-1	3
7	0.999992	651.00000		0.00500	ND	LOW TEMP DESORPTION	STYRENE	SOIL	B	ORD-TS1-RT-EZYQ-1	1
8	0.999992	651.00000		0.00500	ND	LOW TEMP DESORPTION	STYRENE	SOIL	B	ORD-TS1-RT-EZYQ-1	2
9	0.999992	651.00000		0.00500	ND	LOW TEMP DESORPTION	STYRENE	SOIL	B	ORD-TS1-RT-EZYQ-1	3
10	0.999992	651.00000		0.00500	ND	LOW TEMP DESORPTION	STYRENE	SOIL	B	ORD-TS1-RT-EZYQ-1	5
11	0.999992	651.00000		0.00500	ND	LOW TEMP DESORPTION	STYRENE	SOIL	B	ORD-TS1-RT-EZYQ-1	6
12	0.999992	651.00000		0.00500	ND	LOW TEMP DESORPTION	STYRENE	SOIL	B	ORD-TS1-RT-EZYQ-1	9
13	0.999992	651.00000		0.00500		LOW TEMP DESORPTION	STYRENE	SOIL	B	ORD-TS1-RT-EZYQ-1	10
14	0.999990	3116.00000		0.03500		LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	9
15	0.999990	5277.00000		0.03000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EZYQ-1	2
16	0.999990	5227.00000		0.04000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EZYQ-1	10
17	0.999989	651.00000		0.00700	ND	LOW TEMP DESORPTION	STYRENE	SOIL	B	ORD-TS1-RT-EZYQ-1	8
18	0.999980	5227.00000		0.08200		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EZYQ-1	9
19	0.999978	230.00000		0.00500	ND	LOW TEMP DESORPTION	BENZENE	SLUD	P	980-TS1-RT-FCSP-1	2
20	0.999960	3116.00000		0.12000		LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	8
21	0.999960	5227.00000		0.22000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EZYQ-1	8
22	0.999898	49.00000		0.00500	ND	LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EUQS-1	28
23	0.999870	3116.00000		0.41000		LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	5
24	0.999870	3116.00000		0.39000		LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	6
25	0.999870	5277.00000		0.71000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EZYQ-1	5
26	0.999850	3116.00000		0.48000		LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	4
27	0.999850	5277.00000		0.77000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EZYQ-1	4
28	0.999740	5277.00000		1.37000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EZYQ-1	6
29	0.999636	82.50000		0.03000		LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	15
30	0.999588	82.50000		0.03400		LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	14
31	0.999588	82.50000		0.03400		LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	16
32	0.999523	155.00000		0.07400		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EZYQ-1	16
33	0.999467	82.50000		0.04400		LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	13
34	0.999426	155.00000		0.08900		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EZYQ-1	15
35	0.999374	155.00000		0.09700		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EZYQ-1	14
36	0.999305	59.00000		0.04100		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EUQS-1	14
37	0.999201	651.00000		0.52000		LOW TEMP DESORPTION	STYRENE	SOIL	B	ORD-TS1-RT-EZYQ-1	4
38	0.999097	155.00000		0.14000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EZYQ-1	13
39	0.999040	2800.00000		2.70000		LOW TEMP DESORPTION	TOLUENE	SLUD	P	980-TS1-RT-FCSP-1	4
40	0.998826	23.00000		0.02700		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EUQS-1	27
41	0.998810	840.00000		1.00000	ND	LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	F	980-TS1-RT-EXPE-1	1

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W07 HETEROCYCLICS & SIMPLE NON-HAL AROMATICS
Technology Group: LOW TEMPERATURE THERMAL DESORPTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
42	0.998360	2800.00000		4.60000		LOW TEMP DESORPTION	TOLUENE	SLUD	P	980-TS1-RT-FCSP-1	3
43	0.998154	13.00000		0.02400		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EUQS-1	20
44	0.997930	2800.00000		5.80000		LOW TEMP DESORPTION	TOLUENE	SLUD	P	980-TS1-RT-FCSP-1	1
45	0.997833	180.00000		0.39000		LOW TEMP DESORPTION	ETHYLBENZENE	SLUD	P	980-TS1-RT-FCSP-1	4
46	0.997820	2800.00000		6.10000		LOW TEMP DESORPTION	TOLUENE	SLUD	P	980-TS1-RT-FCSP-1	2
47	0.997818	82.50000		0.18000		LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EZYQ-1	17
48	0.997478	230.00000		0.58000		LOW TEMP DESORPTION	BENZENE	SLUD	P	980-TS1-RT-FCSP-1	4
49	0.997464	280.00000		0.71000		LOW TEMP DESORPTION	M-XYLENE	SLUD	P	980-TS1-RT-FCSP-1	4
50	0.997429	280.00000		0.72000		LOW TEMP DESORPTION	O&P XYLENE	SLUD	P	980-TS1-RT-FCSP-1	4
51	0.997217	230.00000		0.64000		LOW TEMP DESORPTION	BENZENE	SLUD	P	980-TS1-RT-FCSP-1	3
52	0.996786	280.00000		0.90000		LOW TEMP DESORPTION	O&P XYLENE	SLUD	P	980-TS1-RT-FCSP-1	3
53	0.996778	180.00000		0.58000		LOW TEMP DESORPTION	ETHYLBENZENE	SLUD	P	980-TS1-RT-FCSP-1	3
54	0.996679	280.00000		0.93000		LOW TEMP DESORPTION	M-XYLENE	SLUD	P	980-TS1-RT-FCSP-1	3
55	0.996323	155.00000		0.57000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EZYQ-1	17
56	0.996122	49.00000		0.19000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EUQS-1	11
57	0.996111	180.00000		0.70000		LOW TEMP DESORPTION	ETHYLBENZENE	SLUD	P	980-TS1-RT-FCSP-1	1
58	0.995783	230.00000		0.97000		LOW TEMP DESORPTION	BENZENE	SLUD	P	980-TS1-RT-FCSP-1	1
59	0.995417	120.00000		0.55000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EUQS-1	10
60	0.995357	280.00000		1.30000		LOW TEMP DESORPTION	M-XYLENE	SLUD	P	980-TS1-RT-FCSP-1	1
61	0.995333	180.00000		0.84000		LOW TEMP DESORPTION	STYRENE	SLUD	P	980-TS1-RT-FCSP-1	1
62	0.995000	280.00000		1.40000		LOW TEMP DESORPTION	O&P XYLENE	SLUD	P	980-TS1-RT-FCSP-1	1
63	0.993750	160.00000		1.00000	ND	LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	F	980-TS1-RT-EXPE-1	1
64	0.993333	180.00000		1.20000		LOW TEMP DESORPTION	STYRENE	SLUD	P	980-TS1-RT-FCSP-1	4
65	0.992857	140.00000		1.00000	ND	LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	F	980-TS1-RT-EXPE-1	1
66	0.992308	130.00000		1.00000	ND	LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
67	0.992308	130.00000		1.00000	ND	LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
68	0.991111	180.00000		1.60000		LOW TEMP DESORPTION	STYRENE	SLUD	P	980-TS1-RT-FCSP-1	3
69	0.988333	180.00000		2.10000		LOW TEMP DESORPTION	ETHYLBENZENE	SLUD	P	980-TS1-RT-FCSP-1	2
70	0.988095	84.00000		1.00000	ND	LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	F	980-TS1-RT-EXPE-1	1
71	0.986429	280.00000		3.80000		LOW TEMP DESORPTION	M-XYLENE	SLUD	P	980-TS1-RT-FCSP-1	2
72	0.986111	72.00000		1.00000	ND	LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
73	0.985507	69.00000		1.00000	ND	LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-FCSF-1	1
74	0.984375	160.00000		2.50000		LOW TEMP DESORPTION	STYRENE	SLUD	P	980-TS1-RT-FCSP-1	2
75	0.984286	280.00000		4.40000		LOW TEMP DESORPTION	O&P XYLENE	SLUD	P	980-TS1-RT-FCSP-1	2
76	0.983871	62.00000		1.00000	ND	LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	F	980-TS1-RT-EXPE-1	1
77	0.979211	380.00000		7.90000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EUQS-1	6
78	0.978438	320.00000		6.90000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EUQS-1	5
79	0.978261	23.00000		0.50000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EUQS-1	13
80	0.977273	44.00000		1.00000	ND	LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	F	980-TS1-RT-EXPE-1	1
81	0.976991	56.50000		1.30000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	B	980-TS1-RT-FCMK-1	4
82	0.973684	38.00000		1.00000	ND	LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	F	980-TS1-RT-EXPE-1	1

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W07 HETEROCYCLICS & SIMPLE NON-HAL AROMATICS
Technology Group: LOW TEMPERATURE THERMAL DESORPTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
83	0.971429	35.00000		1.00000	ND	LOW TEMP DESORPTION	TOLUENE	SOIL	F	980-TS1-RT-EXPE-1	1
84	0.970588	34.00000		1.00000	ND	LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	F	980-TS1-RT-EXPE-1	1
85	0.964444	180.00000		6.40000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EUQS-1	15
86	0.964286	28.00000		1.00000	ND	LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
87	0.959756	8.20000		0.33000	J	LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	B	980-TS1-RT-FCMK-1	3
88	0.959183	4.90000		0.20000	ND	LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	F	980-TS1-RT-EXPE-1	1
89	0.953060	0.49000		0.02300	J	LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	B	980-TS1-RT-FCMK-1	1
90	0.950000	20.00000		1.00000	ND	LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
91	0.950000	20.00000		1.00000	ND	LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
92	0.947368	19.00000		1.00000	ND	LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
93	0.945946	3.70000		0.20000	ND	LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	F	980-TS1-RT-EXPE-1	1
94	0.943836	73.00000		4.10000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EUQS-1	16
95	0.939394	3.30000		0.20000	ND	LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	F	980-TS1-RT-EXPE-1	1
96	0.933333	87.00000		5.80000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EUQS-1	26
97	0.924200	0.06600		0.00500	ND	LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EUQS-1	3
98	0.922481	12.90000		1.00000	ND	LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	F	980-TS1-RT-EXPE-1	1
99	0.900000	2.00000		0.20000	ND	LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
100	0.866666	1.50000		0.20000	ND	LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
101	0.850000	50.00000		7.50000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EUQS-1	12
102	0.846154	1.30000		0.20000	ND	LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
103	0.800000	18.00000		3.60000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EUQS-1	2
104	0.775000	0.16000		0.03600		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EUQS-1	21
105	0.773333	1.50000		0.34000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	B	980-TS1-RT-FCMK-1	2
106	0.750000	4.00000		1.00000	ND	LOW TEMP DESORPTION	TOLUENE	SOIL	F	980-TS1-RT-EXPE-1	1
107	0.733333	240.00000		64.00000		LOW TEMP DESORPTION	XYLENES (TOTAL)	SOIL	P	980-TS1-RT-EUQS-1	8
108	0.629629	2.70000		1.00000	ND	LOW TEMP DESORPTION	BENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
109	0.500000	2.00000		1.00000	ND	LOW TEMP DESORPTION	TOLUENE	SOIL	P	980-TS1-RT-FCSF-1	1
110	0.444444	1.80000		1.00000	ND	LOW TEMP DESORPTION	ETHYLBENZENE	SOIL	F	980-TS1-RT-EXPE-1	1
111	0.333330	0.30000		0.20000	ND	LOW TEMP DESORPTION	TOLUENE	SOIL	F	980-TS1-RT-EXPE-1	1

SOIL = 87 data points SLUDGE (SLUD) = 24 data points

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W07 HETEROCYCLICS & SIMPLE NON-HAL AROMATICS
Technology Group: CHEMICAL EXTRACTION AND SOIL WASHING

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999980	2708.00000		0.05100		SOIL WASHING	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	49
2	0.999980	5576.00000		0.11200		SOIL WASHING	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUQW-1	49
3	0.999970	2708.00000		0.08000		SOIL WASHING	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	43
4	0.999970	5576.00000		0.18000		SOIL WASHING	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUQW-1	43
5	0.999963	707.00000		0.02600	ND	SOIL WASHING	STYRENE	SOIL	B	ORD-TS1-RT-EUQW-1	1
6	0.999960	3329.00000		0.13000		SOIL WASHING	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	1
7	0.999959	123.00000		0.00500		SOIL WASHING	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	19
8	0.999959	630.00000		0.02600	J	SOIL WASHING	STYRENE	SOIL	B	ORD-TS1-RT-EUQW-1	43
9	0.999956	707.00000		0.03100	ND	SOIL WASHING	STYRENE	SOIL	B	ORD-TS1-RT-EUQW-1	2
10	0.999930	5555.00000		0.38000		SOIL WASHING	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUQW-1	1
11	0.999927	123.00000		0.00900		SOIL WASHING	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	25
12	0.999925	630.00000		0.04700		SOIL WASHING	STYRENE	SOIL	B	ORD-TS1-RT-EUQW-1	49
13	0.999895	210.00000		0.02200		SOIL WASHING	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUQW-1	19
14	0.999886	123.00000		0.01400		SOIL WASHING	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	13
15	0.999883	707.00000		0.08300		SOIL WASHING	STYRENE	SOIL	B	ORD-TS1-RT-EUQW-1	7
16	0.999878	123.00000		0.01500		SOIL WASHING	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	26
17	0.999867	210.00000		0.02800		SOIL WASHING	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUQW-1	25
18	0.999850	5576.00000		0.86000		SOIL WASHING	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUQW-1	55
19	0.999844	32.00000		0.00500	J	SOIL WASHING	STYRENE	SOIL	B	ORD-TS1-RT-EUQW-1	37
20	0.999810	2708.00000		0.52000		SOIL WASHING	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	55
21	0.999810	210.00000		0.04000		SOIL WASHING	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUQW-1	13
22	0.999810	210.00000		0.04000		SOIL WASHING	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUQW-1	26
23	0.999722	144.00000		0.04000		SOIL WASHING	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	31
24	0.999720	325.00000		0.09100		SOIL WASHING	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUQW-1	37
25	0.999680	325.00000		0.10400		SOIL WASHING	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUQW-1	31
26	0.999590	3329.00000		1.35000		SOIL WASHING	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	2
27	0.999562	707.00000		0.31000	J	SOIL WASHING	STYRENE	SOIL	B	ORD-TS1-RT-EUQW-1	8
28	0.999532	630.00000		0.29500	J	SOIL WASHING	STYRENE	SOIL	B	ORD-TS1-RT-EUQW-1	50
29	0.999529	123.00000		0.05800		SOIL WASHING	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	20
30	0.999508	630.00000		0.31000	J	SOIL WASHING	STYRENE	SOIL	B	ORD-TS1-RT-EUQW-1	56
31	0.999420	5555.00000		3.20000		SOIL WASHING	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUQW-1	2
32	0.999333	123.00000		0.08200		SOIL WASHING	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	14
33	0.999302	630.00000		0.44000		SOIL WASHING	STYRENE	SOIL	B	ORD-TS1-RT-EUQW-1	55
34	0.999300	3329.00000		2.32000		SOIL WASHING	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	7
35	0.999280	5555.00000		3.98000		SOIL WASHING	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUQW-1	7
36	0.999188	32.00000		0.02600		SOIL WASHING	STYRENE	SOIL	B	ORD-TS1-RT-EUQW-1	31
37	0.999024	210.00000		0.20500		SOIL WASHING	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUQW-1	20
38	0.998524	210.00000		0.31000		SOIL WASHING	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUQW-1	14
39	0.997450	3329.00000		8.50000		SOIL WASHING	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	8
40	0.997390	5555.00000		14.50000		SOIL WASHING	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUQW-1	8
41	0.997270	2708.00000		7.40000		SOIL WASHING	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	56

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W07 HETEROCYCLICS & SIMPLE NON-HAL AROMATICS
Technology Group: CHEMICAL EXTRACTION AND SOIL WASHING

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
42	0.996285	144.00000		0.53500		SOIL WASHING	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	37
43	0.995880	5576.00000		23.00000		SOIL WASHING	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUQW-1	50
44	0.995550	5576.00000		24.80000		SOIL WASHING	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUQW-1	44
45	0.995430	5576.00000		25.50000		SOIL WASHING	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUQW-1	56
46	0.995380	2708.00000		12.50000		SOIL WASHING	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	50
47	0.994610	2708.00000		14.60000		SOIL WASHING	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	44
48	0.992000	325.00000		2.60000		SOIL WASHING	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUQW-1	32
49	0.991429	630.00000		5.40000		SOIL WASHING	STYRENE	SOIL	B	ORD-TS1-RT-EUQW-1	44
50	0.990833	144.00000		1.32000		SOIL WASHING	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	32
51	0.988923	325.00000		3.60000		SOIL WASHING	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-EUQW-1	38
52	0.985764	144.00000		2.05000		SOIL WASHING	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-EUQW-1	38
53	0.982813	32.00000		0.55000		SOIL WASHING	STYRENE	SOIL	B	ORD-TS1-RT-EUQW-1	38
54	0.982188	32.00000		0.57000		SOIL WASHING	STYRENE	SOIL	B	ORD-TS1-RT-EUQW-1	32
55	0.812500	240.00000		45.00000		SOIL WASHING	AROMATIC HYDROCARBONS	SLUD	F	980-TS1-RT-EUTT-3	1

SOIL = 54 data points SLUDGE (SLUD) = 1 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W08 POLYNUCLEAR AROMATICS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999996	227.00000	E1	0.00100	ND	INCINERATION	NAPHTHALENE	SOIL	B	980-TS1-RT-EZYN-1	1
2	0.999937	31.80000		0.00200	ND	INCINERATION	NAPHTHALENE	SOIL	B	980-TS1-RT-EZYN-1	1
3	0.997000	1000.00000	J	3.00000	J	INCINERATION	TOTAL POLYCYCLIC AROMATIC HYDROCARBONS	SOIL	F	980-TS1-RT-FCQC-1	1
4	0.996590	0.88000		0.00300	ND	INCINERATION	ACENAPHTHENE	SOIL	B	980-TS1-RT-EZYN-1	1
5	0.993750	0.32000		0.00200	ND	INCINERATION	PHENANTHRENE	SOIL	B	980-TS1-RT-EZYN-1	1
6	0.993620	0.47000		0.00300	ND	INCINERATION	FLUORENE	SOIL	B	980-TS1-RT-EZYN-1	1
7	0.972730	0.11000		0.00300	ND	INCINERATION	ACENAPHTHENE	SOIL	B	980-TS1-RT-EZYN-1	1
8	0.956500	0.06900		0.00300	ND	INCINERATION	FLUORENE	SOIL	B	980-TS1-RT-EZYN-1	1
9	0.945400	0.05500		0.00300	ND	INCINERATION	PHENANTHRENE	SOIL	B	980-TS1-RT-EZYN-1	1
	SOIL = 9 data points			SLUDGE (SLUD) = 0 data points							
1	0.999961	8500.00000		0.33000	ND	ROTARY KILN	ANTHRACENE	SOIL	P	ORD-TS1-RT-EUZM-1	2
2	0.999947	6200.00000		0.33000	ND	ROTARY KILN	ANTHRACENE	SOIL	P	ORD-TS1-RT-EUZM-1	1
3	0.999938	5300.00000		0.33000	ND	ROTARY KILN	ANTHRACENE	SOIL	P	ORD-TS1-RT-EUZM-1	3
4	0.999313	480.00000		0.33000	ND	ROTARY KILN	ANTHRACENE	SOIL	P	ORD-TS1-RT-EUZM-1	4
5	0.999250	440.00000		0.33000	ND	ROTARY KILN	ANTHRACENE	SOIL	P	ORD-TS1-RT-EUZM-1	6
6	0.999214	420.00000		0.33000	ND	ROTARY KILN	ANTHRACENE	SOIL	P	ORD-TS1-RT-EUZM-1	5
	SOIL = 6 data points			SLUDGE (SLUD) = 0 data points							
1	0.999975	4000.00000	J	0.10000	J	FLUIDIZED BED COMBUS	TOTAL POLYCYCLIC AROMATIC HYDROCARBONS	SOIL	F	980-TS1-RT-FCQC-2	1
	SOIL = 1 data points			SLUDGE (SLUD) = 0 data points							
1	0.999207	416.00000		0.33000	ND	INFRARED	PHENANTHRENE	SOIL	P	980-TS1-RT-EZZB-1	1
2	0.999207	416.00000		0.33000	ND	INFRARED	PHENANTHRENE	SOIL	P	980-TS1-RT-EZZB-1	2
3	0.998764	267.00000		0.33000	ND	INFRARED	PHENANTHRENE	SOIL	P	980-TS1-RT-EZZB-1	3
4	0.998764	267.00000		0.33000	ND	INFRARED	PHENANTHRENE	SOIL	P	980-TS1-RT-EZZB-1	4
5	0.997643	140.00000		0.33000	ND	INFRARED	NAPHTHALENE	SOIL	P	980-TS1-RT-EZZB-1	1
6	0.997643	140.00000		0.33000	ND	INFRARED	NAPHTHALENE	SOIL	P	980-TS1-RT-EZZB-1	2
7	0.993529	51.00000		0.33000	ND	INFRARED	PHENANTHRENE	SOIL	P	980-TS1-RT-EZZB-1	7
8	0.993529	51.00000		0.33000	ND	INFRARED	PHENANTHRENE	SOIL	P	980-TS1-RT-EZZB-1	8
	SOIL = 8 data points			SLUDGE (SLUD) = 0 data points							

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W08 POLYNUCLEAR AROMATICS
Technology Group: DECHLORINATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.970320	4210.04000		124.96000		DECHLORINATION	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUTV-1	8
2	0.963310	4554.42000		167.10000		DECHLORINATION	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUTV-1	5
3	0.960240	4210.04000		167.38000		DECHLORINATION	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUTV-1	4
4	0.913160	4554.42000		395.50000		DECHLORINATION	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUTV-1	1
5	0.755720	227.54000		55.58300		DECHLORINATION	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUTV-1	2

SOIL = 5 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W08 POLYNUCLEAR AROMATICS
Technology Group: BIOREMEDIATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999837	2143.00000		0.35000		BIOREMEDIATION	TOTAL POLYCYCLIC AROMATIC HYDROCARBONS	SOIL	P	980-TS1-RT-EWGC-1	3
2	0.999326	519.00000		0.35000		BIOREMEDIATION	TOTAL POLYCYCLIC AROMATIC HYDROCARBONS	SOIL	P	980-TS1-RT-EWGC-1	2
3	0.995392	651.00000		3.00000		BIOREMEDIATION	TOTAL POLYCYCLIC AROMATIC HYDROCARBONS	SOIL	P	980-TS1-RT-EWGC-1	1

SOIL = 3 data points SLUDGE (SLUD) = 0 data points

1	0.997752	50.70000		0.11400		AEROBIC	2-METHYLNAPHTHALENE	SOIL	P	980-TS1-RT-EZZA-1	2
2	0.997663	46.65000		0.10900		AEROBIC	NAPHTHALENE	SOIL	P	980-TS1-RT-EZZA-1	2
3	0.997199	50.70000		0.14200		AEROBIC	2-METHYLNAPHTHALENE	SOIL	P	980-TS1-RT-EZZA-1	2
4	0.995606	46.65000		0.20500		AEROBIC	NAPHTHALENE	SOIL	P	980-TS1-RT-EZZA-1	2
5	0.994427	46.65000		0.26000		AEROBIC	NAPHTHALENE	SOIL	P	980-TS1-RT-EZZA-1	2
6	0.994141	12.80000		0.07500		AEROBIC	NAPHTHALENE	SOIL	P	980-TS1-RT-EZZA-1	3
7	0.992891	12.80000		0.09100		AEROBIC	NAPHTHALENE	SOIL	P	980-TS1-RT-EZZA-1	3
8	0.991716	50.70000		0.42000		AEROBIC	2-METHYLNAPHTHALENE	SOIL	P	980-TS1-RT-EZZA-1	2
9	0.986834	9.95000		0.13100		AEROBIC	NAPHTHALENE	SOIL	P	980-TS1-RT-EZZA-1	1
10	0.986834	9.95000		0.13100		AEROBIC	NAPHTHALENE	SOIL	P	980-TS1-RT-EZZA-1	1
11	0.981464	8.63200		0.16000	ND	AEROBIC	NAPHTHALENE	SOIL	P	980-TS1-RT-EZZA-1	4
12	0.962233	8.63200		0.32600		AEROBIC	NAPHTHALENE	SOIL	P	980-TS1-RT-EZZA-1	4
13	0.938600	8.63200		0.53000		AEROBIC	NAPHTHALENE	SOIL	P	980-TS1-RT-EZZA-1	4
14	0.930452	9.95000		0.69200		AEROBIC	NAPHTHALENE	SOIL	P	980-TS1-RT-EZZA-1	1
15	0.925938	12.80000		0.94800		AEROBIC	NAPHTHALENE	SOIL	P	980-TS1-RT-EZZA-1	3
16	0.921875	73.60000		5.75000		AEROBIC	PHENANTHRENE	SOIL	P	980-TS1-RT-EZZA-1	2
17	0.860206	19.40000		2.71200		AEROBIC	PHENANTHRENE	SOIL	P	980-TS1-RT-EZZA-1	3
18	0.841712	73.60000		11.65000		AEROBIC	PHENANTHRENE	SOIL	P	980-TS1-RT-EZZA-1	2
19	0.821332	73.60000		13.15000		AEROBIC	PHENANTHRENE	SOIL	P	980-TS1-RT-EZZA-1	2
20	0.794435	27.85000		5.72500		AEROBIC	PHENANTHRENE	SOIL	P	980-TS1-RT-EZZA-1	1
21	0.783457	24.36000		5.27500		AEROBIC	PHENANTHRENE	SOIL	P	980-TS1-RT-EZZA-1	4
22	0.568223	27.85000		12.02500		AEROBIC	PHENANTHRENE	SOIL	P	980-TS1-RT-EZZA-1	1
23	0.526888	24.36000		11.52500		AEROBIC	PHENANTHRENE	SOIL	P	980-TS1-RT-EZZA-1	4
24	0.463793	24.36000		13.06200		AEROBIC	PHENANTHRENE	SOIL	P	980-TS1-RT-EZZA-1	4
25	0.454897	19.40000		10.57500		AEROBIC	PHENANTHRENE	SOIL	P	980-TS1-RT-EZZA-1	3
26	0.353680	27.85000		18.00000		AEROBIC	PHENANTHRENE	SOIL	P	980-TS1-RT-EZZA-1	1
27	0.327320	19.40000		13.05000		AEROBIC	PHENANTHRENE	SOIL	P	980-TS1-RT-EZZA-1	3

SOIL = 27 data points SLUDGE (SLUD) = 0 data points

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W08 POLYNUCLEAR AROMATICS
Technology Group: BIOREMEDIATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.994737	19.00000		0.10000	ND	COMPOSTING	1-METHYLNAPHTHALENE	SOIL	B	980-TS1-RT-EUQX-1	1
2	0.994444	18.00000		0.10000	ND	COMPOSTING	NAPHTHALENE	SOIL	B	980-TS1-RT-EUQX-1	1
3	0.990580	138.00000		1.30000		COMPOSTING	PHENANTHRENE	SOIL	B	980-TS1-RT-EUQX-1	1
4	0.990000	20.00000		0.20000		COMPOSTING	ACENAPHTHENE	SOIL	B	980-TS1-RT-EUQX-1	1
5	0.983333	30.00000		0.50000		COMPOSTING	FLUORENE	SOIL	B	980-TS1-RT-EUQX-1	1
6	0.956701	97.00000		4.20000		COMPOSTING	ANTHRACENE	SOIL	B	980-TS1-RT-EUQX-1	1
7	0.891892	37.00000		4.00000		COMPOSTING	FLUORANTHENE	SOIL	B	980-TS1-RT-EUQX-1	1

SOIL = 7 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W08 POLYNUCLEAR AROMATICS
Technology Group: LOW TEMPERATURE THERMAL DESORPTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.998760	7271.00000		9.00000		LOW TEMP DESORPTION	ANTHRACENE	SOIL	B	ORD-TS1-RT-EZYQ-1	10
2	0.998710	7271.00000		9.40000	ND	LOW TEMP DESORPTION	ANTHRACENE	SOIL	B	ORD-TS1-RT-EZYQ-1	1
3	0.998570	7271.00000		10.40000		LOW TEMP DESORPTION	ANTHRACENE	SOIL	B	ORD-TS1-RT-EZYQ-1	9
4	0.997390	7271.00000		19.00000	ND	LOW TEMP DESORPTION	ANTHRACENE	SOIL	B	ORD-TS1-RT-EZYQ-1	2
5	0.997250	7271.00000		20.00000	ND	LOW TEMP DESORPTION	ANTHRACENE	SOIL	B	ORD-TS1-RT-EZYQ-1	3
6	0.995320	7271.00000		34.00000		LOW TEMP DESORPTION	ANTHRACENE	SOIL	B	ORD-TS1-RT-EZYQ-1	8
7	0.992979	47.00000		0.33000	ND	LOW TEMP DESORPTION	ACENAPHTHENE	SLUD	P	980-TS1-RT-FCSP-1	2
8	0.992979	47.00000		0.33000	ND	LOW TEMP DESORPTION	ACENAPHTHENE	SLUD	P	980-TS1-RT-FCSP-1	3
9	0.992979	47.00000		0.33000	ND	LOW TEMP DESORPTION	ACENAPHTHENE	SLUD	P	980-TS1-RT-FCSP-1	4
10	0.984286	21.00000		0.33000	ND	LOW TEMP DESORPTION	ACENAPHTHYLENE	SLUD	P	980-TS1-RT-FCSP-1	2
11	0.976571	350.00000		8.20000	ND	LOW TEMP DESORPTION	ANTHRACENE	SOIL	B	ORD-TS1-RT-EZYQ-1	14
12	0.973143	350.00000		9.40000	ND	LOW TEMP DESORPTION	ANTHRACENE	SOIL	B	ORD-TS1-RT-EZYQ-1	15
13	0.972000	350.00000		9.80000	ND	LOW TEMP DESORPTION	ANTHRACENE	SOIL	B	ORD-TS1-RT-EZYQ-1	13
14	0.971429	350.00000		10.00000	ND	LOW TEMP DESORPTION	ANTHRACENE	SOIL	B	ORD-TS1-RT-EZYQ-1	16
15	0.968628	765.00000		24.00000		LOW TEMP DESORPTION	NAPHTHALENE	SLUD	P	980-TS1-RT-FCSP-1	4
16	0.952381	21.00000		1.00000		LOW TEMP DESORPTION	ACENAPHTHYLENE	SLUD	P	980-TS1-RT-FCSP-1	3
17	0.939869	765.00000		46.00000		LOW TEMP DESORPTION	NAPHTHALENE	SLUD	P	980-TS1-RT-FCSP-1	3
18	0.934286	350.00000		23.00000		LOW TEMP DESORPTION	ANTHRACENE	SOIL	B	ORD-TS1-RT-EZYQ-1	17
19	0.874684	790.00000		99.00000		LOW TEMP DESORPTION	2-METHYLNAPHTHALENE	SLUD	P	980-TS1-RT-FCSP-1	4
20	0.848101	790.00000		120.00000		LOW TEMP DESORPTION	2-METHYLNAPHTHALENE	SLUD	P	980-TS1-RT-FCSP-1	3
21	0.838120	7271.00000		1177.00000		LOW TEMP DESORPTION	ANTHRACENE	SOIL	B	ORD-TS1-RT-EZYQ-1	6
22	0.821210	7271.00000		1300.00000		LOW TEMP DESORPTION	ANTHRACENE	SOIL	B	ORD-TS1-RT-EZYQ-1	4
23	0.779950	7271.00000		1600.00000		LOW TEMP DESORPTION	ANTHRACENE	SOIL	B	ORD-TS1-RT-EZYQ-1	5
24	0.765013	766.00000		180.00000		LOW TEMP DESORPTION	NAPHTHALENE	SLUD	P	980-TS1-RT-FCSP-1	1
25	0.725000	1.20000		0.33000	ND	LOW TEMP DESORPTION	ANTHRACENE	SOIL	F	980-TS1-RT-EXPE-1	1
26	0.659574	47.00000		16.00000		LOW TEMP DESORPTION	ACENAPHTHENE	SLUD	P	980-TS1-RT-FCSP-1	1
27	0.654321	40.50000		14.00000		LOW TEMP DESORPTION	PYRENE	SLUD	P	980-TS1-RT-FCSP-1	1
28	0.609524	21.00000		8.20000		LOW TEMP DESORPTION	ACENAPHTHYLENE	SLUD	P	980-TS1-RT-FCSP-1	1
29	0.594937	790.00000		320.00000		LOW TEMP DESORPTION	2-METHYLNAPHTHALENE	SLUD	P	980-TS1-RT-FCSP-1	1
30	0.592590	0.81000		0.33000	ND	LOW TEMP DESORPTION	ANTHRACENE	SOIL	F	980-TS1-RT-EXPE-1	1
31	0.587500	0.80000		0.33000	ND	LOW TEMP DESORPTION	FLUORANTHENE	SOIL	F	980-TS1-RT-EXPE-1	1
32	0.587500	0.80000		0.33000	ND	LOW TEMP DESORPTION	NAPHTHALENE	SOIL	F	980-TS1-RT-EXPE-1	1
33	0.582280	0.79000		0.33000	ND	LOW TEMP DESORPTION	ANTHRACENE	SOIL	F	980-TS1-RT-EXPE-1	1
34	0.560000	0.75000		0.33000	ND	LOW TEMP DESORPTION	NAPHTHALENE	SOIL	F	980-TS1-RT-EXPE-1	1
35	0.532164	85.50000		40.00000		LOW TEMP DESORPTION	FLUORENE	SLUD	P	980-TS1-RT-FCSP-1	1
36	0.486487	37.00000		19.00000		LOW TEMP DESORPTION	DIBENZOFURAN	SLUD	P	980-TS1-RT-FCSP-1	1
37	0.469231	13.00000		6.90000		LOW TEMP DESORPTION	BENZO(B)FLUORANTHENE	SLUD	P	980-TS1-RT-FCSP-1	1
38	0.469231	13.00000		6.90000		LOW TEMP DESORPTION	BENZO(K)FLUORANTHENE	SLUD	P	980-TS1-RT-FCSP-1	1
39	0.459459	37.00000		20.00000		LOW TEMP DESORPTION	DIBENZOFURAN	SLUD	P	980-TS1-RT-FCSP-1	3
40	0.407407	40.50000		24.00000		LOW TEMP DESORPTION	PYRENE	SLUD	P	980-TS1-RT-FCSP-1	2
41	0.333333	21.00000		14.00000		LOW TEMP DESORPTION	ACENAPHTHYLENE	SLUD	P	980-TS1-RT-FCSP-1	4

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W08 POLYNUCLEAR AROMATICS
Technology Group: LOW TEMPERATURE THERMAL DESORPTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
42	0.320261	765.00000		520.00000		LOW TEMP DESORPTION	NAPHTHALENE	SLUD	P	980-TS1-RT-FCSP-1	2
43	0.297297	37.00000		26.00000		LOW TEMP DESORPTION	DIBENZOFURAN	SLUD	P	980-TS1-RT-FCSP-1	2
44	0.274854	85.50000		62.00000		LOW TEMP DESORPTION	FLUORENE	SLUD	P	980-TS1-RT-FCSP-1	3
45	0.251462	85.50000		64.00000		LOW TEMP DESORPTION	FLUORENE	SLUD	P	980-TS1-RT-FCSP-1	2
46	0.189189	37.00000		30.00000		LOW TEMP DESORPTION	DIBENZOFURAN	SLUD	P	980-TS1-RT-FCSP-1	4
47	0.164557	790.00000		660.00000		LOW TEMP DESORPTION	2-METHYLNAPHTHALENE	SLUD	P	980-TS1-RT-FCSP-1	2
48	0.150000	20.00000		17.00000		LOW TEMP DESORPTION	ANTHRACENE	SLUD	P	980-TS1-RT-FCSP-1	1
49	0.111111	225.00000		200.00000		LOW TEMP DESORPTION	PHENANTHRENE	SLUD	P	980-TS1-RT-FCSP-1	2
50	0.100000	20.00000		18.00000		LOW TEMP DESORPTION	ANTHRACENE	SLUD	P	980-TS1-RT-FCSP-1	2
51	0.029412	0.34000		0.33000	ND	LOW TEMP DESORPTION	FLUORANTHENE	SOIL	F	980-TS1-RT-EXPE-1	1
52	0.022222	225.00000		220.00000		LOW TEMP DESORPTION	PHENANTHRENE	SLUD	P	980-TS1-RT-FCSP-1	3

SOIL = 21 data points SLUDGE (SLUD) = 31 data points

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W08 POLYNUCLEAR AROMATICS
Technology Group: CHEMICAL EXTRACTION AND SOIL WASHING

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999380	5361.00000		3.30000		SOIL WASHING	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUQW-1	7
2	0.998790	5361.00000		6.50000		SOIL WASHING	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUQW-1	1
3	0.998720	1920.00000		2.45000		SOIL WASHING	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUQW-1	55
4	0.995326	353.00000		1.65000		SOIL WASHING	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUQW-1	25
5	0.992818	181.00000		1.30000		SOIL WASHING	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUQW-1	31
6	0.990935	353.00000		3.20000		SOIL WASHING	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUQW-1	13
7	0.990608	181.00000		1.70000		SOIL WASHING	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUQW-1	37
8	0.985420	1920.00000		28.00000		SOIL WASHING	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUQW-1	43
9	0.981340	1779.40000		33.20000		SOIL WASHING	TOTAL POLYCYCLIC AROMATIC HYDROCARBONS	SOIL	F	980-TS1-RT-EVAR-1	2
10	0.980556	36.00000		0.70000		SOIL WASHING	TOTAL POLYCYCLIC AROMATIC HYDROCARBONS	SLUD	F	980-TS1-RT-EUTT-2	1
11	0.978910	1920.00000		40.50000		SOIL WASHING	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUQW-1	49
12	0.975213	353.00000		8.75000		SOIL WASHING	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUQW-1	19
13	0.949153	295.00000		15.00000		SOIL WASHING	TOTAL POLYCYCLIC AROMATIC HYDROCARBONS	SLUD	F	980-TS1-RT-EUTT-3	1
14	0.903566	947.80000		91.40000		SOIL WASHING	TOTAL POLYCYCLIC AROMATIC HYDROCARBONS	SOIL	F	980-TS1-RT-EVAR-1	3
15	0.866071	728.00000		97.50000		SOIL WASHING	TOTAL POLYCYCLIC AROMATIC HYDROCARBONS	SOIL	F	980-TS1-RT-EVAR-1	1
16	0.645892	353.00000		125.00000		SOIL WASHING	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUQW-1	26
17	0.635420	1920.00000		700.00000		SOIL WASHING	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUQW-1	50
18	0.533670	5361.00000		2500.00000		SOIL WASHING	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUQW-1	8
19	0.504249	353.00000		175.00000		SOIL WASHING	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUQW-1	14
20	0.412420	5361.00000		3150.00000		SOIL WASHING	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUQW-1	2
21	0.410765	353.00000		208.00000		SOIL WASHING	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUQW-1	20
22	0.036460	1920.00000		1850.00000		SOIL WASHING	ANTHRACENE	SOIL	B	ORD-TS1-RT-EUQW-1	56

SOIL = 20 data points SLUDGE (SLUD) = 2 data points

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.952632	190.00000	J	9.00000	J	CHEMICAL EXTRACTION	TOTAL POLYCYCLIC AROMATIC HYDROCARBONS	SOIL	F	980-TS1-RT-FCQC-3	2
2	0.941379	290.00000	J	17.00000	J	CHEMICAL EXTRACTION	TOTAL POLYCYCLIC AROMATIC HYDROCARBONS	SOIL	F	980-TS1-RT-FCQC-3	1

SOIL = 2 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W09 OTHER POLAR ORGANIC COMPOUNDS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999982	170.00000	E1	0.00300	ND	INCINERATION	ISOPHORONE	SOIL	B	980-TS1-RT-EZYN-1	1
2	0.999864	22.00000		0.00300	ND	INCINERATION	ISOPHORONE	SOIL	B	980-TS1-RT-EZYN-1	1
3	0.999850	20.00000		0.00300	ND	INCINERATION	DI-N-BUTYL PHTHALATE	SOIL	B	980-TS1-RT-EZYN-1	1
4	0.999761	280.00000	E1	0.06700		INCINERATION	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	980-TS1-RT-EZYN-1	1
5	0.999750	12.00000		0.00300	ND	INCINERATION	PHENOL	SOIL	B	980-TS1-RT-EZYN-1	1
6	0.999730	74.00000		0.02000		INCINERATION	DI-N-BUTYL PHTHALATE	SOIL	B	980-TS1-RT-EZYN-1	1
7	0.999612	85.00000		0.03300		INCINERATION	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	980-TS1-RT-EZYN-1	1
8	0.999188	16.00000		0.01300	ND	INCINERATION	BUTYLBENZYL PHTHALATE	SOIL	B	980-TS1-RT-EZYN-1	1
9	0.997200	5.00000		0.01400	ND	INCINERATION	BUTYLBENZYL PHTHALATE	SOIL	B	980-TS1-RT-EZYN-1	1
10	0.996590	0.88000		0.00300	ND	INCINERATION	PHENOL	SOIL	B	980-TS1-RT-EZYN-1	1
11	0.930130	0.73000		0.05100		INCINERATION	DI-N-OCTYL PHTHALATE	SOIL	B	980-TS1-RT-EZYN-1	1
12	0.857143	1.40000		0.20000		INCINERATION	DI-N-OCTYL PHTHALATE	SOIL	B	980-TS1-RT-EZYN-1	1
	SOIL = 12 data points			SLUDGE (SLUD) = 0 data points							
1	0.999930	6000.00000		0.42000		ROTARY KILN	ACETONE	SOIL	P	ORD-TS1-RT-EUZM-1	2
2	0.999867	3300.00000		0.44000		ROTARY KILN	ACETONE	SOIL	P	ORD-TS1-RT-EUZM-1	1
3	0.999836	3300.00000		0.54000		ROTARY KILN	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	P	ORD-TS1-RT-EUZM-1	2
4	0.999767	2700.00000		0.63000		ROTARY KILN	ACETONE	SOIL	P	ORD-TS1-RT-EUZM-1	3
5	0.999721	680.00000		0.19000		ROTARY KILN	ACETONE	SOIL	P	ORD-TS1-RT-EUZM-1	4
6	0.999664	2200.00000		0.74000		ROTARY KILN	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	P	ORD-TS1-RT-EUZM-1	3
7	0.999632	570.00000		0.21000		ROTARY KILN	ACETONE	SOIL	P	ORD-TS1-RT-EUZM-1	5
8	0.999429	2800.00000		1.60000		ROTARY KILN	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	P	ORD-TS1-RT-EUZM-1	1
9	0.997370	270.00000		0.71000		ROTARY KILN	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	P	ORD-TS1-RT-EUZM-1	5
10	0.997074	270.00000		0.79000		ROTARY KILN	ACETONE	SOIL	P	ORD-TS1-RT-EUZM-1	6
11	0.996724	290.00000		0.95000		ROTARY KILN	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	P	ORD-TS1-RT-EUZM-1	4
	SOIL = 11 data points			SLUDGE (SLUD) = 0 data points							
1	0.999744	39.00000		0.01000	ND	INFRARED	ACETONE	SOIL	P	980-TS1-RT-EZZB-1	7
2	0.999744	39.00000		0.01000	ND	INFRARED	ACETONE	SOIL	P	980-TS1-RT-EZZB-1	8
3	0.999217	120.00000		0.09400		INFRARED	ACETONE	SOIL	P	980-TS1-RT-EZZB-1	2

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W09 OTHER POLAR ORGANIC COMPOUNDS
Technology Group: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
4	0.999123	5.70000		0.00500	ND	INFRARED	CARBON DISULFIDE	SOIL	P	980-TS1-RT-EZZB-1	1
5	0.999123	5.70000		0.00500	ND	INFRARED	CARBON DISULFIDE	SOIL	P	980-TS1-RT-EZZB-1	2
6	0.998000	2.50000		0.00500	ND	INFRARED	CARBON DISULFIDE	SOIL	P	980-TS1-RT-EZZB-1	3
7	0.998000	2.50000		0.00500	ND	INFRARED	CARBON DISULFIDE	SOIL	P	980-TS1-RT-EZZB-1	4
8	0.992583	120.00000		0.89000		INFRARED	ACETONE	SOIL	P	980-TS1-RT-EZZB-1	1
9	0.990380	0.52000		0.00500	ND	INFRARED	CARBON DISULFIDE	SOIL	P	980-TS1-RT-EZZB-1	6
10	0.903800	0.05200		0.00500	ND	INFRARED	CARBON DISULFIDE	SOIL	P	980-TS1-RT-EZZB-1	5
	SOIL = 10 data points			SLUDGE (SLUD) = 0 data points							
1	0.705882	3.40000		1.00000	ND	PYROLYSIS	PHENOL	SOIL	P	980-TS1-RT-EURE-1	1
	SOIL = 1 data points			SLUDGE (SLUD) = 0 data points							

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W09 OTHER POLAR ORGANIC COMPOUNDS
Technology Group: DECHLORINATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999560	7885.00000		3.46000		DECHLORINATION	ACETONE	SOIL	B	ORD-TS1-RT-EUTV-1	1
2	0.998900	3059.00000		3.35000		DECHLORINATION	ACETONE	SOIL	B	ORD-TS1-RT-EUTV-1	4
3	0.990390	7885.00000		75.80000		DECHLORINATION	ACETONE	SOIL	B	ORD-TS1-RT-EUTV-1	5
4	0.990200	496.00000		4.86000		DECHLORINATION	ACETONE	SOIL	B	ORD-TS1-RT-EUTV-1	3
5	0.975540	539.68000		13.20000		DECHLORINATION	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUTV-1	5
6	0.975250	936.56000		23.18000		DECHLORINATION	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUTV-1	8
7	0.970720	936.56000		27.42000		DECHLORINATION	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUTV-1	4
8	0.968550	496.00000		15.60000		DECHLORINATION	ACETONE	SOIL	B	ORD-TS1-RT-EUTV-1	7
9	0.964200	212.00000		7.59000		DECHLORINATION	ACETONE	SOIL	B	ORD-TS1-RT-EUTV-1	2
10	0.955900	40.20000		1.77300		DECHLORINATION	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUTV-1	2
11	0.946630	62.24000		3.32200		DECHLORINATION	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUTV-1	7
12	0.937220	539.68000		33.88000		DECHLORINATION	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUTV-1	1
13	0.930660	212.00000		14.70000		DECHLORINATION	ACETONE	SOIL	B	ORD-TS1-RT-EUTV-1	6
14	0.928730	62.24000		4.43600		DECHLORINATION	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUTV-1	3
15	0.918270	3059.00000		250.00000		DECHLORINATION	ACETONE	SOIL	B	ORD-TS1-RT-EUTV-1	8
16	0.908060	40.20000		3.69600		DECHLORINATION	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUTV-1	6

SOIL = 16 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W09 OTHER POLAR ORGANIC COMPOUNDS
Technology Group: BIOREMEDIATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.992529	870.00000		6.50000		BIOREMEDIATION	PHENOL	SOIL	P	980-TS1-RT-EURK-1	1
	SOIL = 1 data points			SLUDGE (SLUD) = 0 data points							
1	0.999760	50.00000		0.01200	ND	AEROBIC	ACETONE	SOIL	P	980-TS1-RT-EZZA-1	2
2	0.999667	42.00000		0.01400	ND	AEROBIC	2-BUTANONE	SOIL	P	980-TS1-RT-EZZA-1	2
3	0.999640	50.00000		0.01800	ND	AEROBIC	ACETONE	SOIL	P	980-TS1-RT-EZZA-1	2
4	0.999549	24.40000		0.01100	ND	AEROBIC	2-BUTANONE	SOIL	P	980-TS1-RT-EZZA-1	4
5	0.999429	42.00000		0.02400		AEROBIC	2-BUTANONE	SOIL	P	980-TS1-RT-EZZA-1	2
6	0.999351	23.12500		0.01500		AEROBIC	ACETONE	SOIL	P	980-TS1-RT-EZZA-1	4
7	0.999143	42.00000		0.03600		AEROBIC	2-BUTANONE	SOIL	P	980-TS1-RT-EZZA-1	2
8	0.999135	23.12500		0.02000		AEROBIC	ACETONE	SOIL	P	980-TS1-RT-EZZA-1	4
9	0.999049	23.12500		0.02200		AEROBIC	ACETONE	SOIL	P	980-TS1-RT-EZZA-1	4
10	0.999020	50.00000		0.04900		AEROBIC	ACETONE	SOIL	P	980-TS1-RT-EZZA-1	2
11	0.998893	24.40000		0.02700		AEROBIC	2-BUTANONE	SOIL	P	980-TS1-RT-EZZA-1	4
12	0.998689	24.40000		0.03200		AEROBIC	2-BUTANONE	SOIL	P	980-TS1-RT-EZZA-1	4
13	0.998489	15.22500		0.02300		AEROBIC	ACETONE	SOIL	P	980-TS1-RT-EZZA-1	1
14	0.998179	18.12500		0.03300		AEROBIC	2-BUTANONE	SOIL	P	980-TS1-RT-EZZA-1	1
15	0.997793	18.12500		0.04000		AEROBIC	2-BUTANONE	SOIL	P	980-TS1-RT-EZZA-1	1
16	0.997793	18.12500		0.04000		AEROBIC	2-BUTANONE	SOIL	P	980-TS1-RT-EZZA-1	1
17	0.997570	15.22500		0.03700		AEROBIC	ACETONE	SOIL	P	980-TS1-RT-EZZA-1	1
18	0.997044	15.22500		0.04500		AEROBIC	ACETONE	SOIL	P	980-TS1-RT-EZZA-1	1
19	0.996351	7.40000		0.02700		AEROBIC	ACETONE	SOIL	P	980-TS1-RT-EZZA-1	3
20	0.996216	7.40000		0.02800		AEROBIC	ACETONE	SOIL	P	980-TS1-RT-EZZA-1	3
21	0.995000	7.40000		0.03700		AEROBIC	ACETONE	SOIL	P	980-TS1-RT-EZZA-1	3
	SOIL = 21 data points			SLUDGE (SLUD) = 0 data points							

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W09 OTHER POLAR ORGANIC COMPOUNDS
Technology Group: LOW TEMPERATURE THERMAL DESORPTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999850	4330.00000		0.67000		LOW TEMP DESORPTION	ACETONE	SOIL	B	ORD-TS1-RT-EZYQ-1	10
2	0.999600	2527.00000		1.00000		LOW TEMP DESORPTION	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EZYQ-1	10
3	0.999540	4330.00000		2.00000		LOW TEMP DESORPTION	ACETONE	SOIL	B	ORD-TS1-RT-EZYQ-1	9
4	0.998750	4330.00000		5.40000		LOW TEMP DESORPTION	ACETONE	SOIL	B	ORD-TS1-RT-EZYQ-1	3
5	0.998750	4330.00000		5.40000		LOW TEMP DESORPTION	ACETONE	SOIL	B	ORD-TS1-RT-EZYQ-1	8
6	0.996280	2527.00000		9.40000	ND	LOW TEMP DESORPTION	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EZYQ-1	1
7	0.995650	2527.00000		11.00000	ND	LOW TEMP DESORPTION	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EZYQ-1	9
8	0.992480	2527.00000		19.00000	ND	LOW TEMP DESORPTION	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EZYQ-1	2
9	0.992090	2527.00000		20.00000	ND	LOW TEMP DESORPTION	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EZYQ-1	3
10	0.992090	2527.00000		20.00000	ND	LOW TEMP DESORPTION	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EZYQ-1	8
11	0.989150	4330.00000		47.00000		LOW TEMP DESORPTION	ACETONE	SOIL	B	ORD-TS1-RT-EZYQ-1	4
12	0.988910	4330.00000		48.00000		LOW TEMP DESORPTION	ACETONE	SOIL	B	ORD-TS1-RT-EZYQ-1	1
13	0.986610	4330.00000		58.00000		LOW TEMP DESORPTION	ACETONE	SOIL	B	ORD-TS1-RT-EZYQ-1	6
14	0.982220	4330.00000		77.00000		LOW TEMP DESORPTION	ACETONE	SOIL	B	ORD-TS1-RT-EZYQ-1	5
15	0.981250	17.60000		0.33000	ND	LOW TEMP DESORPTION	DI-N-OCTYL PHTHALATE	SLUD	P	980-TS1-RT-FCSP-1	1
16	0.981143	17.50000		0.33000	ND	LOW TEMP DESORPTION	DI-N-OCTYL PHTHALATE	SLUD	P	980-TS1-RT-FCSP-1	2
17	0.963050	4330.00000		160.00000		LOW TEMP DESORPTION	ACETONE	SOIL	B	ORD-TS1-RT-EZYQ-1	2
18	0.945333	150.00000		8.20000	ND	LOW TEMP DESORPTION	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EZYQ-1	14
19	0.937333	150.00000		9.40000	ND	LOW TEMP DESORPTION	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EZYQ-1	15
20	0.934667	150.00000		9.80000	ND	LOW TEMP DESORPTION	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EZYQ-1	13
21	0.933333	150.00000		10.00000	ND	LOW TEMP DESORPTION	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EZYQ-1	16
22	0.844186	430.00000		67.00000		LOW TEMP DESORPTION	ACETONE	SOIL	B	ORD-TS1-RT-EZYQ-1	13
23	0.767442	430.00000		100.00000		LOW TEMP DESORPTION	ACETONE	SOIL	B	ORD-TS1-RT-EZYQ-1	15
24	0.767442	430.00000		100.00000		LOW TEMP DESORPTION	ACETONE	SOIL	B	ORD-TS1-RT-EZYQ-1	17
25	0.744186	430.00000		110.00000		LOW TEMP DESORPTION	ACETONE	SOIL	B	ORD-TS1-RT-EZYQ-1	16
26	0.720930	430.00000		120.00000		LOW TEMP DESORPTION	ACETONE	SOIL	B	ORD-TS1-RT-EZYQ-1	14
27	0.640000	150.00000		54.00000		LOW TEMP DESORPTION	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EZYQ-1	17
28	0.582280	0.79000		0.33000	ND	LOW TEMP DESORPTION	ISOPHORONE	SOIL	F	980-TS1-RT-EXPE-1	1
29	0.554050	0.74000		0.33000	ND	LOW TEMP DESORPTION	ISOPHORONE	SOIL	F	980-TS1-RT-EXPE-1	1
30	0.445980	2527.00000		1400.00000		LOW TEMP DESORPTION	BIS(2-ETHYLHEXYL)	SOIL	B	ORD-TS1-RT-EZYQ-1	5

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W09 OTHER POLAR ORGANIC COMPOUNDS
Technology Group: LOW TEMPERATURE THERMAL DESORPTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
31	0.378710	2527.00000		1570.00000		LOW TEMP DESORPTION	PHTHALATE BIS(2-ETHYLHEXYL)	SOIL	B	ORD-TS1-RT-EZYQ-1	6
32	0.366840	2527.00000		1600.00000		LOW TEMP DESORPTION	PHTHALATE BIS(2-ETHYLHEXYL)	SOIL	B	ORD-TS1-RT-EZYQ-1	4
33	0.266660	0.45000		0.33000	ND	LOW TEMP DESORPTION	PHTHALATE ISOPHORONE	SOIL	F	980-TS1-RT-EXPE-1	1
34	0.250000	0.44000		0.33000	ND	LOW TEMP DESORPTION	BUTYLBENZYL PHTHALATE	SOIL	F	980-TS1-RT-EXPE-1	1

SOIL = 32 data points SLUDGE (SLUD) = 2 data points

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W09 OTHER POLAR ORGANIC COMPOUNDS
Technology Group: CHEMICAL EXTRACTION AND SOIL WASHING

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999550	4353.00000		1.95000		SOIL WASHING	ACETONE	SOIL	B	ORD-TS1-RT-EUQW-1	2
2	0.999280	8030.00000		5.80000		SOIL WASHING	ACETONE	SOIL	B	ORD-TS1-RT-EUQW-1	43
3	0.999280	8030.00000		5.80000		SOIL WASHING	ACETONE	SOIL	B	ORD-TS1-RT-EUQW-1	44
4	0.999129	356.00000		0.31000		SOIL WASHING	ACETONE	SOIL	B	ORD-TS1-RT-EUQW-1	14
5	0.998880	1958.00000		2.20000		SOIL WASHING	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUQW-1	7
6	0.998708	356.00000		0.46000		SOIL WASHING	ACETONE	SOIL	B	ORD-TS1-RT-EUQW-1	25
7	0.998582	356.00000		0.50500		SOIL WASHING	ACETONE	SOIL	B	ORD-TS1-RT-EUQW-1	13
8	0.998357	356.00000		0.58500		SOIL WASHING	ACETONE	SOIL	B	ORD-TS1-RT-EUQW-1	19
9	0.998190	8030.00000		14.50000		SOIL WASHING	ACETONE	SOIL	B	ORD-TS1-RT-EUQW-1	55
10	0.998160	4353.00000		8.00000		SOIL WASHING	ACETONE	SOIL	B	ORD-TS1-RT-EUQW-1	8
11	0.998142	646.00000		1.20000		SOIL WASHING	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUQW-1	55
12	0.998130	8030.00000		15.00000		SOIL WASHING	ACETONE	SOIL	B	ORD-TS1-RT-EUQW-1	56
13	0.998060	8030.00000		15.55000		SOIL WASHING	ACETONE	SOIL	B	ORD-TS1-RT-EUQW-1	49
14	0.997960	1958.00000		4.00000		SOIL WASHING	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUQW-1	1
15	0.997933	358.00000		0.74000		SOIL WASHING	ACETONE	SOIL	B	ORD-TS1-RT-EUQW-1	31
16	0.997893	356.00000		0.75000		SOIL WASHING	ACETONE	SOIL	B	ORD-TS1-RT-EUQW-1	26
17	0.997680	4353.00000		10.10000		SOIL WASHING	ACETONE	SOIL	B	ORD-TS1-RT-EUQW-1	1
18	0.997420	8030.00000		20.75000		SOIL WASHING	ACETONE	SOIL	B	ORD-TS1-RT-EUQW-1	50
19	0.997332	358.00000		0.95500		SOIL WASHING	ACETONE	SOIL	B	ORD-TS1-RT-EUQW-1	37
20	0.996770	356.00000		1.15000		SOIL WASHING	ACETONE	SOIL	B	ORD-TS1-RT-EUQW-1	20
21	0.995251	358.00000		1.70000		SOIL WASHING	ACETONE	SOIL	B	ORD-TS1-RT-EUQW-1	32
22	0.994830	4353.00000		22.50000		SOIL WASHING	ACETONE	SOIL	B	ORD-TS1-RT-EUQW-1	7
23	0.994530	585.00000		3.20000		SOIL WASHING	PHENOL	SOIL	F	980-TS1-RT-EVAR-1	2
24	0.992598	358.00000		2.65000		SOIL WASHING	ACETONE	SOIL	B	ORD-TS1-RT-EUQW-1	38
25	0.991022	646.00000		5.80000		SOIL WASHING	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUQW-1	43
26	0.985062	646.00000		9.65000		SOIL WASHING	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUQW-1	49
27	0.980702	114.00000		2.20000		SOIL WASHING	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUQW-1	31
28	0.978050	48300.00000		1060.00000		SOIL WASHING	PHENOL	SOIL	B	980-TS1-RT-EUZE-1	7
29	0.969737	114.00000		3.45000		SOIL WASHING	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUQW-1	37
30	0.959752	646.00000		26.00000		SOIL WASHING	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUQW-1	56
31	0.952760	1958.00000		92.50000		SOIL WASHING	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUQW-1	2
32	0.946594	646.00000		34.50000		SOIL WASHING	BIS(2-ETHYLHEXYL)	SOIL	B	ORD-TS1-RT-EUQW-1	44

APPENDIX D

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W09 OTHER POLAR ORGANIC COMPOUNDS
Technology Group: CHEMICAL EXTRACTION AND SOIL WASHING

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
33	0.946370	1958.00000		105.00000		SOIL WASHING	PHTHALATE BIS(2-ETHYLHEXYL)	SOIL	B	ORD-TS1-RT-EUQW-1	8
34	0.939130	115.00000		7.00000		SOIL WASHING	PHENOL	SOIL	F	980-TS1-RT-EVAR-1	1
35	0.935088	114.00000		7.40000		SOIL WASHING	PHTHALATE BIS(2-ETHYLHEXYL)	SOIL	B	ORD-TS1-RT-EUQW-1	32
36	0.927950	48300.00000		3480.00000		SOIL WASHING	PHENOL	SOIL	B	980-TS1-RT-EUZE-1	1
37	0.927950	48300.00000		3480.00000		SOIL WASHING	PHENOL	SOIL	B	980-TS1-RT-EUZE-1	6
38	0.910970	48300.00000		4300.00000		SOIL WASHING	PHENOL	SOIL	B	980-TS1-RT-EUZE-1	2
39	0.910970	48300.00000		4300.00000		SOIL WASHING	PHENOL	SOIL	B	980-TS1-RT-EUZE-1	3
40	0.910970	48300.00000		4300.00000		SOIL WASHING	PHENOL	SOIL	B	980-TS1-RT-EUZE-1	5
41	0.890867	646.00000		70.50000		SOIL WASHING	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUQW-1	50
42	0.883930	452300.00000		52500.00000		SOIL WASHING	PHENOL	SOIL	B	980-TS1-RT-EUZE-1	12
43	0.878050	48300.00000		5890.00000		SOIL WASHING	PHENOL	SOIL	B	980-TS1-RT-EUZE-1	4
44	0.863636	165.00000		22.50000		SOIL WASHING	PHENOL	SOIL	F	980-TS1-RT-EVAR-1	3
45	0.822910	452300.00000		80100.00000		SOIL WASHING	PHENOL	SOIL	B	980-TS1-RT-EUZE-1	11
46	0.795930	452300.00000		92300.00000		SOIL WASHING	PHENOL	SOIL	B	980-TS1-RT-EUZE-1	10
47	0.795930	452300.00000		92300.00000		SOIL WASHING	PHENOL	SOIL	B	980-TS1-RT-EUZE-1	13
48	0.778020	452300.00000		100400.00000		SOIL WASHING	PHENOL	SOIL	B	980-TS1-RT-EUZE-1	16
49	0.769231	117.00000		27.00000		SOIL WASHING	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUQW-1	13
50	0.760684	117.00000		28.00000		SOIL WASHING	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUQW-1	25
51	0.730769	117.00000		31.50000		SOIL WASHING	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUQW-1	26
52	0.720980	452300.00000		126200.00000		SOIL WASHING	PHENOL	SOIL	B	980-TS1-RT-EUZE-1	9
53	0.715900	452300.00000		128500.00000		SOIL WASHING	PHENOL	SOIL	B	980-TS1-RT-EUZE-1	14
54	0.676980	452300.00000		146100.00000		SOIL WASHING	PHENOL	SOIL	B	980-TS1-RT-EUZE-1	15
55	0.653846	117.00000		40.50000		SOIL WASHING	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUQW-1	19
56	0.619658	117.00000		44.50000		SOIL WASHING	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUQW-1	20
57	0.602564	117.00000		46.50000		SOIL WASHING	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUQW-1	14
58	0.444737	114.00000		63.30000		SOIL WASHING	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-EUQW-1	38

SOIL = 58 data points SLUDGE (SLUD) = 0 data points

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APPENDIX E

EXTRACTION PROTOCOL WASTE TREATMENT RESULTS FOR INORGANICS

This appendix tabulates the data used to develop the conclusions in the report for chemical extraction and soil washing and immobilization of inorganics. The untreated and treated extraction protocol concentrations in the wastes are reported, as well as the corresponding reductions in mobility. The data are sorted by treatability group, technology group, and contaminant. Not all treatability groups have data for all technology groups.

APPENDIX E

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Reduction in Mobility
For Individual Treatment Technologies
Untreated Soil Extract - Treated Soil Extract

Treatability Group: W10 NON-VOLATILE METALS
Technology Group: CHEMICAL EXTRACTION AND SOIL WASHING

Rnk	Mobility Reduction	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.989931	159.90000		1.61000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	52
2	0.987867	159.90000		1.94000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	58
3	0.985750	80.70000		1.15000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	40
4	0.983643	80.70000		1.32000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	34
5	0.982776	80.70000		1.39000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	41
6	0.981176	159.90000		3.01000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	46
7	0.963060	26.80000		0.99000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	52
8	0.960448	26.80000		1.06000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	58
9	0.955050	0.89000		0.04000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	16
10	0.954105	26.80000		1.23000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	46
11	0.946286	17.50000		0.94000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	41
12	0.943820	0.89000		0.05000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	28
13	0.938211	159.90000		9.88000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	53
14	0.934420	0.61000		0.04000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	4
15	0.928000	17.50000		1.26000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	34
16	0.924571	17.50000		1.32000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	40
17	0.920818	80.70000		6.39000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	35
18	0.910857	17.50000		1.56000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	35
19	0.905970	26.80000		2.52000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	53
20	0.901640	0.61000		0.06000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	10
21	0.900000	0.40000		0.04000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	22
22	0.887640	0.89000		0.10000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	22
23	0.887640	0.89000		0.10000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	23
24	0.851850	0.27000		0.04000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	4
25	0.851850	0.27000		0.04000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	10
26	0.833300	0.06000		0.01000		SOIL WASHING	CHROMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	46
27	0.833300	0.06000		0.01000		SOIL WASHING	CHROMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	52
28	0.833300	0.06000		0.01000		SOIL WASHING	CHROMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	53
29	0.833300	0.06000		0.01000		SOIL WASHING	CHROMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	58
30	0.777780	0.27000		0.06000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	11
31	0.725000	0.40000		0.11000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	23
32	0.704920	0.61000		0.18000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	11
33	0.700000	0.40000		0.12000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	28
34	0.625000	0.40000		0.15000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	16

SOIL = 34 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Reduction in Mobility
For Individual Treatment Technologies
Untreated Soil Extract - Treated Soil Extract

Treatability Group: W10 NON-VOLATILE METALS
Technology Group: IMMOBILIZATION

Rnk	Mobility Reduction	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.440000	1.00000		0.56000		STABILIZATION	CHROMIUM	SOIL	B	980-TS1-RT-FCAK-1	1
2	0.250000	1.00000		0.75000		STABILIZATION	CHROMIUM	SOIL	B	980-TS1-RT-FCAK-1	1
3	0.200000	1.00000		0.80000		STABILIZATION	CHROMIUM	SOIL	B	980-TS1-RT-FCAK-1	1
4	0.070000	1.00000		0.93000		STABILIZATION	CHROMIUM	SOIL	B	980-TS1-RT-FCAK-1	1
	SOIL = 4 data points			SLUDGE (SLUD) = 0 data points							
1	0.901640	0.61000		0.06000		CEMENT SOLIDIFICATIO	COPPER	SOIL	B	ORD-TS1-RT-FHMF-1	1
2	0.859340	0.22750		0.03200		CEMENT SOLIDIFICATIO	COPPER	SOIL	B	980-TS1-RT-EUXT-1	1
3	0.851850	0.27000		0.04000		CEMENT SOLIDIFICATIO	NICKEL	SOIL	B	ORD-TS1-RT-FHMF-1	1
4	0.300000	0.05000		0.03500		CEMENT SOLIDIFICATIO	CHROMIUM	SOIL	B	980-TS1-RT-EUXT-1	1
	SOIL = 4 data points			SLUDGE (SLUD) = 0 data points							
1	0.999885	87.00000		0.01000	ND	FLYASH SOLIDIFICATIO	NICKEL	SLUD	P	980-TS1-RT-FAAP-1	1
2	0.999885	87.00000		0.01000	ND	FLYASH SOLIDIFICATIO	NICKEL	SLUD	P	980-TS1-RT-FAAP-1	1
3	0.999868	76.00000		0.01000	ND	FLYASH SOLIDIFICATIO	NICKEL	SLUD	P	980-TS1-RT-FAAP-1	2
4	0.999091	22.00000		0.02000		FLYASH SOLIDIFICATIO	CHROMIUM	SLUD	P	980-TS1-RT-FAAP-1	1
5	0.998636	22.00000		0.03000		FLYASH SOLIDIFICATIO	CHROMIUM	SLUD	P	980-TS1-RT-FAAP-1	1
6	0.998507	26.80000		0.04000		FLYASH SOLIDIFICATIO	NICKEL	SOIL	B	ORD-TS1-RT-FHMF-1	2
7	0.998026	76.00000		0.15000		FLYASH SOLIDIFICATIO	NICKEL	SLUD	P	980-TS1-RT-FAAP-1	2
8	0.989556	159.90000		1.67000		FLYASH SOLIDIFICATIO	COPPER	SOIL	B	ORD-TS1-RT-FHMF-1	2
9	0.980000	3.50000		0.07000		FLYASH SOLIDIFICATIO	CHROMIUM	SLUD	P	980-TS1-RT-FAAP-1	2
10	0.980000	3.50000		0.07000		FLYASH SOLIDIFICATIO	CHROMIUM	SLUD	P	980-TS1-RT-FAAP-1	2
11	0.966290	0.89000		0.03000		FLYASH SOLIDIFICATIO	COPPER	SOIL	B	ORD-TS1-RT-FHMF-1	5
12	0.900000	0.40000		0.04000		FLYASH SOLIDIFICATIO	NICKEL	SOIL	B	ORD-TS1-RT-FHMF-1	4
13	0.900000	0.40000		0.04000		FLYASH SOLIDIFICATIO	NICKEL	SOIL	B	ORD-TS1-RT-FHMF-1	5
14	0.898870	0.89000		0.09000		FLYASH SOLIDIFICATIO	COPPER	SOIL	B	ORD-TS1-RT-FHMF-1	4
	SOIL = 6 data points			SLUDGE (SLUD) = 8 data points							
1	0.997143	17.50000		0.05000		CARBONATE IMMOBILIZA	NICKEL	SOIL	B	ORD-TS1-RT-FHMF-1	3
2	0.967906	80.70000		2.59000		CARBONATE IMMOBILIZA	COPPER	SOIL	B	ORD-TS1-RT-FHMF-1	3
	SOIL = 2 data points			SLUDGE (SLUD) = 0 data points							

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Reduction in Mobility
For Individual Treatment Technologies
Untreated Soil Extract - Treated Soil Extract

Treatability Group: W11 VOLATILE METALS
Technology Group: CHEMICAL EXTRACTION AND SOIL WASHING

Rnk	Mobility Reduction	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.995028	70.40000		0.35000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	46
2	0.994318	70.40000		0.40000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	52
3	0.992898	70.40000		0.50000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	58
4	0.992466	14.60000		0.11000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	28
5	0.971233	14.60000		0.42000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	22
6	0.967808	14.60000		0.47000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	16
7	0.958900	0.73000		0.03000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	28
8	0.954108	35.30000		1.62000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	52
9	0.948630	14.60000		0.75000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	23
10	0.935045	33.10000		2.15000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	41
11	0.934801	70.40000		4.59000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	53
12	0.931500	0.73000		0.05000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	22
13	0.931500	0.73000		0.05000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	23
14	0.925244	358.50000		26.80000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	41
15	0.921712	9.58000		0.75000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	52
16	0.921608	19.90000		1.56000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	41
17	0.915581	35.30000		2.98000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	46
18	0.914280	0.70000		0.06000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	16
19	0.913928	6.39000		0.55000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	41
20	0.907608	9.20000		0.85000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	10
21	0.904348	9.20000		0.88000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	4
22	0.904110	0.73000		0.07000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	16
23	0.902174	9.20000		0.90000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	11
24	0.901879	9.58000		0.94000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	46
25	0.899843	6.39000		0.64000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	40
26	0.898747	9.58000		0.97000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	58
27	0.896439	395.90000		41.00000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	52
28	0.892650	395.90000		42.50000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	58
29	0.889124	33.10000		3.67000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	40
30	0.871130	358.50000		46.20000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	40
31	0.865415	6.39000		0.86000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	34
32	0.862040	35.30000		4.87000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	58
33	0.860530	358.50000		50.00000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	34
34	0.852441	358.50000		52.90000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	35
35	0.850453	33.10000		4.95000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	34
36	0.843060	35.30000		5.54000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	53
37	0.800626	9.58000		1.91000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	53
38	0.800202	395.90000		79.10000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	46
39	0.785710	0.70000		0.15000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	22
40	0.785710	0.70000		0.15000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	23
41	0.785710	0.70000		0.15000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	28

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Reduction in Mobility
For Individual Treatment Technologies
Untreated Soil Extract - Treated Soil Extract

Treatability Group: W11 VOLATILE METALS
Technology Group: CHEMICAL EXTRACTION AND SOIL WASHING

Rnk	Mobility Reduction	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
42	0.773580	0.53000		0.12000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	10
43	0.764653	33.10000		7.79000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	35
44	0.735176	19.90000		5.27000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	40
45	0.726134	6.39000		1.75000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	35
46	0.716980	0.53000		0.15000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	4
47	0.693880	0.49000		0.15000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	4
48	0.693880	0.49000		0.15000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	10
49	0.693880	0.49000		0.15000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	11
50	0.675377	19.90000		6.46000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	34
51	0.666660	0.15000		0.05000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	10
52	0.654206	395.90000		136.90000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	53
53	0.509430	0.53000		0.26000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	11
54	0.413568	19.90000		11.67000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	35

SOIL = 54 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Reduction in Mobility
For Individual Treatment Technologies
Untreated Soil Extract - Treated Soil Extract

Treatability Group: W11 VOLATILE METALS
Technology Group: IMMOBILIZATION

Rnk	Mobility Reduction	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999823	6200.00000		1.10000		STABILIZATION	LEAD	SOIL	B	980-TS1-RT-FCAK-2	1
2	0.999774	6200.00000		1.40000		STABILIZATION	LEAD	SOIL	B	980-TS1-RT-FCAK-2	1
3	0.999516	6200.00000		3.00000		STABILIZATION	LEAD	SOIL	B	980-TS1-RT-FCAK-2	1
4	0.999387	16.30000		0.01000		STABILIZATION	LEAD	SOIL	B	980-TS1-RT-FCAK-3	1
5	0.998990	59.40000		0.06000	ND	STABILIZATION	LEAD	SOIL	B	980-TS1-RT-EURY-1	1
6	0.998990	59.40000		0.06000	ND	STABILIZATION	LEAD	SOIL	B	980-TS1-RT-EURY-1	1
7	0.998773	16.30000		0.02000		STABILIZATION	LEAD	SOIL	B	980-TS1-RT-FCAK-3	1
8	0.998569	59.40000		0.08500		STABILIZATION	LEAD	SOIL	B	980-TS1-RT-EURY-1	1
9	0.995092	16.30000		0.08000		STABILIZATION	LEAD	SOIL	B	980-TS1-RT-FCAK-3	1
10	0.990184	16.30000		0.16000		STABILIZATION	LEAD	SOIL	B	980-TS1-RT-FCAK-3	1
11	0.948979	9.80000		0.50000		STABILIZATION	LEAD	SOIL	B	980-TS1-RT-FCAK-1	1
12	0.948979	9.80000		0.50000		STABILIZATION	LEAD	SOIL	B	980-TS1-RT-FCAK-1	1
13	0.795918	9.80000		2.00000		STABILIZATION	LEAD	SOIL	B	980-TS1-RT-FCAK-1	1
14	0.632653	9.80000		3.60000		STABILIZATION	LEAD	SOIL	B	980-TS1-RT-FCAK-1	1

SOIL = 14 data points SLUDGE (SLUD) = 0 data points

1	0.999689	123.70000		0.03850		CEMENT SOLIDIFICATIO	ZINC	SOIL	B	980-TS1-RT-EUXT-1	1
2	0.998721	12.11500		0.01550		CEMENT SOLIDIFICATIO	LEAD	SOIL	B	980-TS1-RT-EUXT-1	1
3	0.981130	0.53000		0.01000		CEMENT SOLIDIFICATIO	CADMIUM	SOIL	B	ORD-TS1-RT-FHMF-1	1
4	0.976500	0.01700		0.00040		CEMENT SOLIDIFICATIO	CADMIUM	SOIL	B	980-TS1-RT-EUXT-1	1
5	0.946739	9.20000		0.49000		CEMENT SOLIDIFICATIO	ZINC	SOIL	B	ORD-TS1-RT-FHMF-1	1
6	0.693880	0.49000		0.15000		CEMENT SOLIDIFICATIO	LEAD	SOIL	B	ORD-TS1-RT-FHMF-1	1

SOIL = 6 data points SLUDGE (SLUD) = 0 data points

1	0.999717	35.30000		0.01000		FLYASH SOLIDIFICATIO	CADMIUM	SOIL	B	ORD-TS1-RT-FHMF-1	2
2	0.998630	14.60000		0.02000		FLYASH SOLIDIFICATIO	ZINC	SOIL	B	ORD-TS1-RT-FHMF-1	5
3	0.990477	395.90000		3.77000		FLYASH SOLIDIFICATIO	ZINC	SOIL	B	ORD-TS1-RT-FHMF-1	2
4	0.986300	0.73000		0.01000		FLYASH SOLIDIFICATIO	CADMIUM	SOIL	B	ORD-TS1-RT-FHMF-1	4
5	0.986300	0.73000		0.01000		FLYASH SOLIDIFICATIO	CADMIUM	SOIL	B	ORD-TS1-RT-FHMF-1	5
6	0.971816	9.58000		0.27000		FLYASH SOLIDIFICATIO	ARSENIC	SOIL	B	ORD-TS1-RT-FHMF-1	2
7	0.946575	14.60000		0.78000		FLYASH SOLIDIFICATIO	ZINC	SOIL	B	ORD-TS1-RT-FHMF-1	4
8	0.785710	0.70000		0.15000		FLYASH SOLIDIFICATIO	LEAD	SOIL	B	ORD-TS1-RT-FHMF-1	5
9	0.696023	70.40000		21.40000		FLYASH SOLIDIFICATIO	LEAD	SOIL	B	ORD-TS1-RT-FHMF-1	2
10	0.471430	0.70000		0.37000		FLYASH SOLIDIFICATIO	LEAD	SOIL	B	ORD-TS1-RT-FHMF-1	4

SOIL = 10 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Reduction in Mobility
For Individual Treatment Technologies
Untreated Soil Extract - Treated Soil Extract

Treatability Group: W11 VOLATILE METALS
Technology Group: IMMOBILIZATION

Rnk	Mobility Reduction	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999396	33.10000		0.02000		CARBONATE IMMOBILIZA	CADMIUM	SOIL	B	ORD-TS1-RT-FHMF-1	3
2	0.988926	358.50000		3.97000		CARBONATE IMMOBILIZA	ZINC	SOIL	B	ORD-TS1-RT-FHMF-1	3
3	0.876369	6.39000		0.79000		CARBONATE IMMOBILIZA	ARSENIC	SOIL	B	ORD-TS1-RT-FHMF-1	3

SOIL = 3 data points SLUDGE (SLUD) = 0 data points

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APPENDIX F

EXTRACTION PROTOCOL WASTE TREATMENT RESULTS FOR ORGANICS

This appendix tabulates the data used to develop the conclusions in the report for immobilization of organics. Data used to develop the conclusions on thermal destruction, dechlorination, bioremediation, low temperature thermal desorption, and chemical extraction and soil washing treatment technologies are presented in Appendix D. The untreated and treated extraction protocol concentrations in the wastes are reported, as well as the corresponding reductions in mobility. The data are sorted by treatability group, technology group, and contaminant. Not all treatability groups have data for all technology groups.

APPENDIX F

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Reduction in Mobility
For Individual Treatment Technologies
Untreated Soil Extract - Treated Soil Extract

Treatability Group: W01 HALOGENATED NON-POLAR AROMATIC COMPOUNDS
Technology Group: IMMOBILIZATION

Rnk	Mobility Reduction	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.746154	5.20000		1.32000		CEMENT SOLIDIFICATIO	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-FHMF-1	1
	SOIL = 1 data points			SLUDGE (SLUD) = 0 data points							
1	0.811940	6.70000		1.26000		FLYASH SOLIDIFICATIO	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-FHMF-1	2
2	0.800000	0.05000		0.01000		FLYASH SOLIDIFICATIO	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-FHMF-1	5
	SOIL = 2 data points			SLUDGE (SLUD) = 0 data points							
1	0.947370	0.38000		0.02000		CARBONATE IMMOBILIZA	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-FHMF-1	3
	SOIL = 1 data points			SLUDGE (SLUD) = 0 data points							

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Reduction in Mobility
For Individual Treatment Technologies
Untreated Soil Extract - Treated Soil Extract

Treatability Group: W03 HAL PHENOLS, CRESOLS, ETHERS, & THIOLS
Technology Group: IMMOBILIZATION

Rnk	Mobility Reduction	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.503846	7.80000		3.87000		CEMENT SOLIDIFICATIO	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-FHMF-1	1
	SOIL = 1 data points			SLUDGE (SLUD) = 0 data points							
1	0.955550	0.90000		0.04000		FLYASH SOLIDIFICATIO	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-FHMF-1	4
2	0.877780	0.90000		0.11000		FLYASH SOLIDIFICATIO	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-FHMF-1	5
	SOIL = 2 data points			SLUDGE (SLUD) = 0 data points							
1	0.117650	0.34000		0.30000		CARBONATE IMMOBILIZA	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-FHMF-1	3
	SOIL = 1 data points			SLUDGE (SLUD) = 0 data points							

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Reduction in Mobility
For Individual Treatment Technologies
Untreated Soil Extract - Treated Soil Extract

Treatability Group: W04 HALOGENATED ALIPHATIC COMPOUNDS
Technology Group: IMMOBILIZATION

Rnk	Mobility Reduction	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.994211	76.00000		0.44000		CEMENT SOLIDIFICATIO	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-FHMF-1	1
2	0.781818	3.30000		0.72000		CEMENT SOLIDIFICATIO	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-FHMF-1	1
	SOIL = 2 data points			SLUDGE (SLUD) = 0 data points							
1	0.998462	13.00000		0.02000		FLYASH SOLIDIFICATIO	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-FHMF-1	2
2	0.800000	0.05000		0.01000		FLYASH SOLIDIFICATIO	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-FHMF-1	4
3	0.800000	0.05000		0.01000		FLYASH SOLIDIFICATIO	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-FHMF-1	5
4	0.800000	0.05000		0.01000		FLYASH SOLIDIFICATIO	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-FHMF-1	5
5	0.786666	4.50000		0.96000		FLYASH SOLIDIFICATIO	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-FHMF-1	2
	SOIL = 5 data points			SLUDGE (SLUD) = 0 data points							
1	0.980000	0.50000		0.01000		CARBONATE IMMOBILIZA	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-FHMF-1	3
2	0.939390	0.33000		0.02000		CARBONATE IMMOBILIZA	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-FHMF-1	3
	SOIL = 2 data points			SLUDGE (SLUD) = 0 data points							

APPENDIX F

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Reduction in Mobility
For Individual Treatment Technologies
Untreated Soil Extract - Treated Soil Extract

Treatability Group: W07 HETEROCYCLICS & SIMPLE NON-HAL AROMATICS
Technology Group: IMMOBILIZATION

Rnk	Mobility Reduction	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.777419	62.00000		13.80000		CEMENT SOLIDIFICATIO	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-FHMF-1	1
2	0.691111	9.00000		2.78000		CEMENT SOLIDIFICATIO	STYRENE	SOIL	B	ORD-TS1-RT-FHMF-1	1
3	0.618519	27.00000		10.30000		CEMENT SOLIDIFICATIO	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-FHMF-1	1
	SOIL = 3 data points			SLUDGE (SLUD) = 0 data points							
1	0.759000	100.00000		24.10000		FLYASH SOLIDIFICATIO	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-FHMF-1	2
2	0.750000	0.12000		0.03000		FLYASH SOLIDIFICATIO	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-FHMF-1	4
3	0.712766	47.00000		13.50000		FLYASH SOLIDIFICATIO	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-FHMF-1	2
4	0.700000	0.30000		0.09000		FLYASH SOLIDIFICATIO	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-FHMF-1	4
5	0.627273	11.00000		4.10000		FLYASH SOLIDIFICATIO	STYRENE	SOIL	B	ORD-TS1-RT-FHMF-1	2
6	0.333330	0.30000		0.20000		FLYASH SOLIDIFICATIO	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-FHMF-1	5
	SOIL = 6 data points			SLUDGE (SLUD) = 0 data points							
1	0.963636	11.00000		0.40000		CARBONATE IMMOBILIZA	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-FHMF-1	3
2	0.943478	4.60000		0.26000		CARBONATE IMMOBILIZA	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-FHMF-1	3
3	0.880000	0.50000		0.06000		CARBONATE IMMOBILIZA	STYRENE	SOIL	B	ORD-TS1-RT-FHMF-1	3
	SOIL = 3 data points			SLUDGE (SLUD) = 0 data points							

APPENDIX F

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Reduction in Mobility
For Individual Treatment Technologies
Untreated Soil Extract - Treated Soil Extract

Treatability Group: W08 POLYNUCLEAR AROMATICS
Technology Group: IMMOBILIZATION

Rnk	Mobility Reduction	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.988461	2.60000		0.03000		CEMENT SOLIDIFICATIO	ANTHRACENE	SOIL	B	ORD-TS1-RT-FHMF-1	1
	SOIL = 1 data points			SLUDGE (SLUD) = 0 data points							
1	0.991176	3.40000		0.03000		FLYASH SOLIDIFICATIO	ANTHRACENE	SOIL	B	ORD-TS1-RT-FHMF-1	2
	SOIL = 1 data points			SLUDGE (SLUD) = 0 data points							

APPENDIX F

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Reduction in Mobility
For Individual Treatment Technologies
Untreated Soil Extract - Treated Soil Extract

Treatability Group: W09 OTHER POLAR ORGANIC COMPOUNDS
Technology Group: IMMOBILIZATION

Rnk	Mobility Reduction	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.556522	2.30000		1.02000		CEMENT SOLIDIFICATIO	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-FHMF-1	1
	SOIL = 1 data points			SLUDGE (SLUD) = 0 data points							
1	0.954540	0.22000		0.01000		FLYASH SOLIDIFICATIO	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-FHMF-1	5
2	0.910000	3.00000		0.27000		FLYASH SOLIDIFICATIO	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-FHMF-1	2
3	0.772730	0.22000		0.05000		FLYASH SOLIDIFICATIO	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-FHMF-1	4
4	0.729231	130.00000		35.20000		FLYASH SOLIDIFICATIO	ACETONE	SOIL	B	ORD-TS1-RT-FHMF-1	2
	SOIL = 4 data points			SLUDGE (SLUD) = 0 data points							
1	0.777800	0.09000		0.02000		CARBONATE IMMOBILIZA	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-FHMF-1	3
2	0.676056	7.10000		2.30000		CARBONATE IMMOBILIZA	ACETONE	SOIL	B	ORD-TS1-RT-FHMF-1	3
	SOIL = 2 data points			SLUDGE (SLUD) = 0 data points							

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APPENDIX G

OTHER WASTE TREATMENT RESULTS

This appendix tabulates the data reported by both total constituent analyses and extraction protocols which were not indicative of the "best" performance. These data passed the initial screens, but not the secondary screens described in Appendix C. The data are sorted by treatability group, technology group, and contaminant. Not all treatability groups have data for all technology groups.

APPENDIX G

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W01 HALOGENATED NON-POLAR AROMATIC COMPOUNDS
Treatment Technology: IMMOBILIZATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.712120	330.00000		95.00000		CEMENT SOLIDIFICATIO	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-FHMF-1	1
	SOIL = 1 data points			SLUDGE (SLUD) = 0 data points							
1	0.999350	9.20000		0.00600		FLYASH SOLIDIFICATIO	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-FHMF-1	4
2	0.992500	9.20000		0.06900		FLYASH SOLIDIFICATIO	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-FHMF-1	5
3	0.944440	270.00000		15.00000		FLYASH SOLIDIFICATIO	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-FHMF-1	2
	SOIL = 3 data points			SLUDGE (SLUD) = 0 data points							
1	0.964050	8.90000		0.32000		CARBONATE IMMOBILIZA	CHLOROBENZENE	SOIL	B	ORD-TS1-RT-FHMF-1	3
	SOIL = 1 data points			SLUDGE (SLUD) = 0 data points							

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W02 DIOXINS/FURANS/PCBS & THEIR PRECURSORS
Treatment Technology: IMMOBILIZATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.783330	6000.00000		1300.00000		STABILIZATION	TOTAL PCB'S	SOIL	F	980-TS1-RT-EWFQ-1	2

SOIL = 1 data points SLUDGE (SLUD) = 0 data points

APPENDIX G

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W03 HAL PHENOLS, CRESOLS, ETHERS, & THIOLS
Treatment Technology: CHEMICAL EXTRACTION AND SOIL WASHING

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.992490	333.00000		2.50000	J	CHEMICAL EXTRACTION	PENTACHLOROPHENOL	SOIL	B	125-RI1-RT-CLMS-1	2
2	0.686790	333.00000		104.30000	J	CHEMICAL EXTRACTION	PENTACHLOROPHENOL	SOIL	B	125-RI1-RT-CLMS-1	1
3	0.496400	333.00000		167.70000	J	CHEMICAL EXTRACTION	PENTACHLOROPHENOL	SOIL	B	125-RI1-RT-CLMS-1	3
4	0.456160	333.00000		181.10000	J	CHEMICAL EXTRACTION	PENTACHLOROPHENOL	SOIL	B	125-RI1-RT-CLMS-1	4
5	0.371470	333.00000		209.30000	J	CHEMICAL EXTRACTION	PENTACHLOROPHENOL	SOIL	B	125-RI1-RT-CLMS-1	6
6	0.369070	333.00000		210.10000	J	CHEMICAL EXTRACTION	PENTACHLOROPHENOL	SOIL	B	125-RI1-RT-CLMS-1	5

SOIL = 6 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W03 HAL PHENOLS, CRESOLS, ETHERS, & THIOLS
Treatment Technology: IMMOBILIZATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.999340	395.00000		0.26000		STABILIZATION	PENTACHLOROPHENOL	SOIL	F	980-TS1-RT-EWFQ-1	6
2	0.995190	395.00000		1.90000		STABILIZATION	PENTACHLOROPHENOL	SOIL	F	980-TS1-RT-EWFQ-1	6
3	0.994180	395.00000		2.30000		STABILIZATION	PENTACHLOROPHENOL	SOIL	F	980-TS1-RT-EWFQ-1	5
4	0.994180	395.00000		2.30000		STABILIZATION	PENTACHLOROPHENOL	SOIL	F	980-TS1-RT-EWFQ-1	6
5	0.975440	395.00000		9.70000		STABILIZATION	PENTACHLOROPHENOL	SOIL	F	980-TS1-RT-EWFQ-1	5
6	0.903800	395.00000		38.00000		STABILIZATION	PENTACHLOROPHENOL	SOIL	F	980-TS1-RT-EWFQ-1	4
7	0.870890	395.00000		51.00000		STABILIZATION	PENTACHLOROPHENOL	SOIL	F	980-TS1-RT-EWFQ-1	5
8	0.868350	395.00000		52.00000		STABILIZATION	PENTACHLOROPHENOL	SOIL	F	980-TS1-RT-EWFQ-1	4
9	0.865820	395.00000		53.00000		STABILIZATION	PENTACHLOROPHENOL	SOIL	F	980-TS1-RT-EWFQ-1	4
	SOIL = 9 data points			SLUDGE (SLUD) = 0 data points							
1	0.629630	135.00000		50.00000		CEMENT SOLIDIFICATIO	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-FHMF-1	1
	SOIL = 1 data points			SLUDGE (SLUD) = 0 data points							
1	0.209680	62.00000		49.00000		FLYASH SOLIDIFICATIO	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-FHMF-1	4
2	0.179490	78.00000		64.00000		FLYASH SOLIDIFICATIO	PENTACHLOROPHENOL	SOIL	B	ORD-TS1-RT-FHMF-1	2
	SOIL = 2 data points			SLUDGE (SLUD) = 0 data points							

APPENDIX G

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W04 HALOGENATED ALIPHATIC COMPOUNDS
Treatment Technology: IMMOBILIZATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.971050	380.00000		11.00000		CEMENT SOLIDIFICATIO	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-FHMF-1	1
2	0.860000	600.00000		84.00000		CEMENT SOLIDIFICATIO	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-FHMF-1	1
	SOIL =	2 data points		SLUDGE (SLUD) =		0 data points					
1	1.000000	16.00000		0.00500	ND	FLYASH SOLIDIFICATIO	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-FHMF-1	4
2	0.997940	16.00000		0.03300		FLYASH SOLIDIFICATIO	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-FHMF-1	5
3	0.995640	3.90000		0.01700		FLYASH SOLIDIFICATIO	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-FHMF-1	4
4	0.990360	830.00000		8.00000		FLYASH SOLIDIFICATIO	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-FHMF-1	2
5	0.975930	540.00000		13.00000		FLYASH SOLIDIFICATIO	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-FHMF-1	2
6	0.971800	3.90000		0.11000		FLYASH SOLIDIFICATIO	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-FHMF-1	5
	SOIL =	6 data points		SLUDGE (SLUD) =		0 data points					
1	0.983080	13.00000		0.22000		CARBONATE IMMOBILIZA	TETRACHLOROETHENE	SOIL	B	ORD-TS1-RT-FHMF-1	3
2	0.935480	3.10000		0.20000		CARBONATE IMMOBILIZA	1,2-DICHLOROETHANE	SOIL	B	ORD-TS1-RT-FHMF-1	3
	SOIL =	2 data points		SLUDGE (SLUD) =		0 data points					

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W07 HETEROCYCLICS & SIMPLE NON-HAL AROMATICS
Treatment Technology: IMMOBILIZATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.719400	3350.00000		940.00000		CEMENT SOLIDIFICATIO	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-FHMF-1	1
2	0.690140	710.00000		220.00000		CEMENT SOLIDIFICATIO	STYRENE	SOIL	B	ORD-TS1-RT-FHMF-1	1
3	0.662650	4150.00000		1400.00000		CEMENT SOLIDIFICATIO	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-FHMF-1	1
	SOIL = 3 data points			SLUDGE (SLUD) = 0 data points							
1	0.999620	210.00000		0.08000		FLYASH SOLIDIFICATIO	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-FHMF-1	4
2	0.999590	74.00000		0.03000		FLYASH SOLIDIFICATIO	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-FHMF-1	4
3	0.999230	26.00000		0.02000		FLYASH SOLIDIFICATIO	STYRENE	SOIL	B	ORD-TS1-RT-FHMF-1	4
4	0.994620	26.00000		0.14000		FLYASH SOLIDIFICATIO	STYRENE	SOIL	B	ORD-TS1-RT-FHMF-1	5
5	0.991430	210.00000		1.80000		FLYASH SOLIDIFICATIO	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-FHMF-1	5
6	0.987160	74.00000		0.95000		FLYASH SOLIDIFICATIO	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-FHMF-1	5
7	0.932000	2500.00000		170.00000		FLYASH SOLIDIFICATIO	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-FHMF-1	2
8	0.929730	3700.00000		260.00000		FLYASH SOLIDIFICATIO	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-FHMF-1	2
9	0.916670	540.00000		45.00000		FLYASH SOLIDIFICATIO	STYRENE	SOIL	B	ORD-TS1-RT-FHMF-1	2
	SOIL = 9 data points			SLUDGE (SLUD) = 0 data points							
1	0.965000	100.00000		3.50000		CARBONATE IMMOBILIZA	ETHYLBENZENE	SOIL	B	ORD-TS1-RT-FHMF-1	3
2	0.950000	24.00000		1.20000		CARBONATE IMMOBILIZA	STYRENE	SOIL	B	ORD-TS1-RT-FHMF-1	3
3	0.947330	150.00000		7.90000		CARBONATE IMMOBILIZA	XYLENES (TOTAL)	SOIL	B	ORD-TS1-RT-FHMF-1	3
	SOIL = 3 data points			SLUDGE (SLUD) = 0 data points							

APPENDIX G

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W08 POLYNUCLEAR AROMATICS
Treatment Technology: LOW TEMPERATURE THERMAL DESORPTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.575000	1.20000		0.51000		LOW TEMP DESORPTION	PHENANTHRENE	SOIL	F	980-TS1-RT-EXPE-1	1
2	0.509090	1.10000		0.54000		LOW TEMP DESORPTION	PHENANTHRENE	SOIL	F	980-TS1-RT-EXPE-1	1
3	0.494740	19.00000		9.60000		LOW TEMP DESORPTION	BENZO(A)ANTHRACENE	SLUD	P	980-TS1-RT-FCSP-1	1
4	0.468750	32.00000		17.00000		LOW TEMP DESORPTION	CHRYSENE	SLUD	P	980-TS1-RT-FCSP-1	1
5	0.450000	14.00000		7.70000		LOW TEMP DESORPTION	BENZO(A)PYRENE	SLUD	P	980-TS1-RT-FCSP-1	1
6	0.258820	0.85000		0.63000		LOW TEMP DESORPTION	PHENANTHRENE	SOIL	F	980-TS1-RT-EXPE-1	1
7	0.142860	14.00000		12.00000		LOW TEMP DESORPTION	BENZO(A)PYRENE	SLUD	P	980-TS1-RT-FCSP-1	2
8	0.031250	32.00000		31.00000		LOW TEMP DESORPTION	CHRYSENE	SLUD	P	980-TS1-RT-FCSP-1	2

SOIL = 3 data points SLUDGE (SLUD) = 5 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W08 POLYNUCLEAR AROMATICS
Treatment Technology: IMMOBILIZATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.010640	940.00000		930.00000		CEMENT SOLIDIFICATIO	ANTHRACENE	SOIL	B	ORD-TS1-RT-FHMF-1	1
	SOIL = 1 data points			SLUDGE (SLUD) = 0 data points							
1	0.720000	275.00000		77.00000		FLYASH SOLIDIFICATIO	ANTHRACENE	SOIL	B	ORD-TS1-RT-FHMF-1	5
2	0.490910	275.00000		140.00000		FLYASH SOLIDIFICATIO	ANTHRACENE	SOIL	B	ORD-TS1-RT-FHMF-1	4
	SOIL = 2 data points			SLUDGE (SLUD) = 0 data points							
1	0.245280	265.00000		200.00000		CARBONATE IMMOBILIZA	ANTHRACENE	SOIL	B	ORD-TS1-RT-FHMF-1	3
	SOIL = 1 data points			SLUDGE (SLUD) = 0 data points							

APPENDIX G

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W09 OTHER POLAR ORGANIC COMPOUNDS
Treatment Technology: CHEMICAL EXTRACTION AND SOIL WASHING

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.910970	48300.00000		4300.00000		SOIL WASHING	PHENOL	SOIL	B	980-TS1-RT-EUZE-1	8

SOIL = 1 data points SLUDGE (SLUD) = 0 data points

APPENDIX G

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W09 OTHER POLAR ORGANIC COMPOUNDS
Treatment Technology: IMMOBILIZATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.822220	3150.00000		560.00000		CEMENT SOLIDIFICATIO	ACETONE	SOIL	B	ORD-TS1-RT-FHMF-1	1
	SOIL = 1 data points			SLUDGE (SLUD) = 0 data points							
1	0.986150	13000.00000		180.00000		FLYASH SOLIDIFICATIO	ACETONE	SOIL	B	ORD-TS1-RT-FHMF-1	2
2	0.981740	230.00000		4.20000		FLYASH SOLIDIFICATIO	ACETONE	SOIL	B	ORD-TS1-RT-FHMF-1	4
3	0.752170	230.00000		57.00000		FLYASH SOLIDIFICATIO	ACETONE	SOIL	B	ORD-TS1-RT-FHMF-1	5
4	0.647060	34.00000		12.00000		FLYASH SOLIDIFICATIO	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-FHMF-1	5
5	0.176470	34.00000		28.00000		FLYASH SOLIDIFICATIO	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-FHMF-1	4
	SOIL = 5 data points			SLUDGE (SLUD) = 0 data points							
1	0.542860	140.00000		64.00000		CARBONATE IMMOBILIZA	BIS(2-ETHYLHEXYL) PHTHALATE	SOIL	B	ORD-TS1-RT-FHMF-1	3
2	0.363640	220.00000		140.00000		CARBONATE IMMOBILIZA	ACETONE	SOIL	B	ORD-TS1-RT-FHMF-1	3
	SOIL = 2 data points			SLUDGE (SLUD) = 0 data points							

APPENDIX G

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W10 NON-VOLATILE METALS
Treatment Technology: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.941860	43.00000		2.50000	ND	INCINERATION	CHROMIUM	SOIL	B	980-TS1-RT-EUWW-1	13
2	0.837209	43.00000		7.00000	ND	INCINERATION	CHROMIUM	SOIL	B	980-TS1-RT-EUWW-1	14
3	0.837209	43.00000		7.00000	ND	INCINERATION	CHROMIUM	SOIL	B	980-TS1-RT-EUWW-1	15
4	0.791667	24.00000		5.00000		INCINERATION	CHROMIUM	SOIL	B	980-TS1-RT-EUWW-1	27
5	0.708333	24.00000		7.00000		INCINERATION	CHROMIUM	SOIL	B	980-TS1-RT-EUWW-1	20
6	0.583333	24.00000		10.00000		INCINERATION	CHROMIUM	SOIL	B	980-TS1-RT-EUWW-1	17
7	0.583333	24.00000		10.00000		INCINERATION	CHROMIUM	SOIL	B	980-TS1-RT-EUWW-1	18
8	0.583333	24.00000		10.00000		INCINERATION	CHROMIUM	SOIL	B	980-TS1-RT-EUWW-1	19
9	0.583333	24.00000		10.00000		INCINERATION	CHROMIUM	SOIL	B	980-TS1-RT-EUWW-1	21
10	0.583333	24.00000		10.00000		INCINERATION	CHROMIUM	SOIL	B	980-TS1-RT-EUWW-1	23
11	0.583333	24.00000		10.00000		INCINERATION	CHROMIUM	SOIL	B	980-TS1-RT-EUWW-1	24
12	0.166667	24.00000		20.00000		INCINERATION	CHROMIUM	SOIL	B	980-TS1-RT-EUWW-1	25
13	0.069767	43.00000		40.00000		INCINERATION	CHROMIUM	SOIL	B	980-TS1-RT-EUWW-1	4

SOIL = 13 data points SLUDGE (SLUD) = 0 data points

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.884615	1040.00000		120.00000		ROTARY KILN	BARIUM	SOIL	P	980-TS1-RT-EXPC-1	1
2	0.740741	27.00000		7.00000	E3	ROTARY KILN	CHROMIUM	SOIL	P	ORD-TS1-RT-EUZM-1	5
3	0.692308	39.00000		12.00000	E3	ROTARY KILN	CHROMIUM	SOIL	P	ORD-TS1-RT-EUZM-1	3
4	0.675000	28.00000		9.10000	E3	ROTARY KILN	NICKEL	SOIL	P	ORD-TS1-RT-EUZM-1	5
5	0.629630	27.00000		10.00000	E3	ROTARY KILN	CHROMIUM	SOIL	P	ORD-TS1-RT-EUZM-1	6
6	0.600000	30.00000		12.00000	E3	ROTARY KILN	NICKEL	SOIL	P	ORD-TS1-RT-EUZM-1	4
7	0.600000	30.00000		12.00000	E3	ROTARY KILN	CHROMIUM	SOIL	P	ORD-TS1-RT-EUZM-1	4
8	0.592593	27.00000		11.00000	E3	ROTARY KILN	NICKEL	SOIL	P	ORD-TS1-RT-EUZM-1	3
9	0.583333	24.00000		10.00000	E3	ROTARY KILN	CHROMIUM	SOIL	P	ORD-TS1-RT-EUZM-1	1
10	0.576000	250.00000		106.00000	E3	ROTARY KILN	COPPER	SOIL	P	ORD-TS1-RT-EUZM-1	5
11	0.575758	33.00000		14.00000	E3	ROTARY KILN	CHROMIUM	SOIL	P	ORD-TS1-RT-EUZM-1	2
12	0.571429	28.00000		12.00000	E3	ROTARY KILN	NICKEL	SOIL	P	ORD-TS1-RT-EUZM-1	1
13	0.571429	28.00000		12.00000	E3	ROTARY KILN	NICKEL	SOIL	P	ORD-TS1-RT-EUZM-1	6
14	0.556738	282.00000		125.00000	E3	ROTARY KILN	COPPER	SOIL	P	ORD-TS1-RT-EUZM-1	4
15	0.545082	244.00000		111.00000	E3	ROTARY KILN	COPPER	SOIL	P	ORD-TS1-RT-EUZM-1	1
16	0.505618	267.00000		132.00000	E3	ROTARY KILN	COPPER	SOIL	P	ORD-TS1-RT-EUZM-1	2
17	0.500000	30.00000		15.00000	E3	ROTARY KILN	NICKEL	SOIL	P	ORD-TS1-RT-EUZM-1	2
18	0.390805	261.00000		159.00000	E3	ROTARY KILN	COPPER	SOIL	P	ORD-TS1-RT-EUZM-1	3
19	0.364706	255.00000		162.00000	E3	ROTARY KILN	COPPER	SOIL	P	ORD-TS1-RT-EUZM-1	6
20	0.256757	740.00000		550.00000		ROTARY KILN	BARIUM	SOIL	P	980-TS1-RT-EXPC-1	2
21	0.097561	820.00000		740.00000		ROTARY KILN	BARIUM	SOIL	P	980-TS1-RT-EXPC-1	4

SOIL = 21 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W10 NON-VOLATILE METALS
Treatment Technology: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.064516	6.20000		5.80000		PYROLYSIS	COPPER	SOIL	P	980-TS1-RT-EURE-1	1

SOIL = 1 data points SLUDGE (SLUD) = 0 data points

APPENDIX G

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W10 NON-VOLATILE METALS
Treatment Technology: DECHLORINATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.529410	68.00000		32.00000		DECHLORINATION	NICKEL	SOIL	B	ORD-TS1-RT-EUTV-1	1
2	0.528570	70.00000		33.00000		DECHLORINATION	NICKEL	SOIL	B	ORD-TS1-RT-EUTV-1	2
3	0.423190	11678.00000		6736.00000		DECHLORINATION	COPPER	SOIL	B	ORD-TS1-RT-EUTV-1	3
4	0.347550	1407.00000		918.00000		DECHLORINATION	CHROMIUM	SOIL	B	ORD-TS1-RT-EUTV-1	4
5	0.329600	2409.00000		1615.00000		DECHLORINATION	NICKEL	SOIL	B	ORD-TS1-RT-EUTV-1	3
6	0.303030	33.00000		23.00000		DECHLORINATION	CHROMIUM	SOIL	B	ORD-TS1-RT-EUTV-1	2
7	0.300000	30.00000		21.00000		DECHLORINATION	CHROMIUM	SOIL	B	ORD-TS1-RT-EUTV-1	1
8	0.289770	1163.00000		826.00000		DECHLORINATION	CHROMIUM	SOIL	B	ORD-TS1-RT-EUTV-1	3
9	0.280800	349.00000		251.00000		DECHLORINATION	COPPER	SOIL	B	ORD-TS1-RT-EUTV-1	1
10	0.141560	10928.00000		9381.00000		DECHLORINATION	COPPER	SOIL	B	ORD-TS1-RT-EUTV-1	4
11	0.122340	376.00000		330.00000		DECHLORINATION	COPPER	SOIL	B	ORD-TS1-RT-EUTV-1	2
12	0.047390	2448.00000		2332.00000		DECHLORINATION	NICKEL	SOIL	B	ORD-TS1-RT-EUTV-1	4

SOIL = 12 data points SLUDGE (SLUD) = 0 data points

APPENDIX G

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W10 NON-VOLATILE METALS
Treatment Technology: LOW TEMPERATURE THERMAL DESORPTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.169060	278.00000		231.00000		LOW TEMP DESORPTION	COPPER	SOIL	B	ORD-TS1-RT-EZYQ-1	15
2	0.097120	278.00000		251.00000		LOW TEMP DESORPTION	COPPER	SOIL	B	ORD-TS1-RT-EZYQ-1	14
3	0.080000	30.00000		27.60000		LOW TEMP DESORPTION	NICKEL	SOIL	B	ORD-TS1-RT-EZYQ-1	17
4	0.079140	278.00000		256.00000		LOW TEMP DESORPTION	COPPER	SOIL	B	ORD-TS1-RT-EZYQ-1	17
5	0.068350	278.00000		259.00000		LOW TEMP DESORPTION	COPPER	SOIL	B	ORD-TS1-RT-EZYQ-1	16
6	0.053731	33.50000		31.70000		LOW TEMP DESORPTION	CHROMIUM	SOIL	B	ORD-TS1-RT-EZYQ-1	17
7	0.044440	225.00000		215.00000		LOW TEMP DESORPTION	COPPER	SOIL	B	ORD-TS1-RT-EZYQ-1	1
8	0.016667	30.00000		29.50000		LOW TEMP DESORPTION	NICKEL	SOIL	B	ORD-TS1-RT-EZYQ-1	15
9	0.002985	33.50000		33.40000		LOW TEMP DESORPTION	CHROMIUM	SOIL	B	ORD-TS1-RT-EZYQ-1	15

SOIL = 9 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W10 NON-VOLATILE METALS
Treatment Technology: CHEMICAL EXTRACTION AND SOIL WASHING

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.997349	1207.00000		3.20000		SOIL WASHING	CHROMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	40
2	0.996852	1207.00000		3.80000		SOIL WASHING	CHROMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	34
3	0.995750	9082.00000		38.60000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	40
4	0.995510	1314.00000		5.90000		SOIL WASHING	CHROMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	58
5	0.995129	1314.00000		6.40000		SOIL WASHING	CHROMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	52
6	0.994140	1314.00000		7.70000		SOIL WASHING	CHROMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	46
7	0.993990	10503.00000		63.10000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	58
8	0.992470	9082.00000		68.40000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	34
9	0.992378	1207.00000		9.20000		SOIL WASHING	CHROMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	41
10	0.992330	10503.00000		80.60000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	52
11	0.990534	1479.00000		14.00000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	58
12	0.988550	9082.00000		104.00000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	41
13	0.988247	1489.00000		17.50000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	40
14	0.987508	1489.00000		18.60000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	34
15	0.986883	1479.00000		19.40000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	52
16	0.985910	10503.00000		148.00000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	46
17	0.981061	1489.00000		28.20000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	41
18	0.980545	257.00000		5.00000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	16
19	0.979851	1479.00000		29.80000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	46
20	0.977321	1314.00000		29.80000		SOIL WASHING	CHROMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	53
21	0.971659	1489.00000		42.20000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	35
22	0.970930	9082.00000		264.00000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	35
23	0.968571	28.00000		0.88000		SOIL WASHING	CHROMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	16
24	0.968390	10503.00000		332.00000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	53
25	0.968093	257.00000		8.20000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	22
26	0.964981	257.00000		9.00000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	28
27	0.954113	231.00000		10.60000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	4
28	0.952197	1479.00000		70.70000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	53
29	0.948918	231.00000		11.80000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	10
30	0.942857	28.00000		1.60000		SOIL WASHING	CHROMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	22
31	0.939300	257.00000		15.60000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	23
32	0.937500	24.00000		1.50000		SOIL WASHING	CHROMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	4
33	0.915790	38.00000		3.20000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	28
34	0.904888	1207.00000		114.80000		SOIL WASHING	CHROMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	35
35	0.903571	28.00000		2.70000		SOIL WASHING	CHROMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	28
36	0.900000	32.00000		3.20000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	4
37	0.894737	38.00000		4.00000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	16
38	0.889474	38.00000		4.20000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	22
39	0.878571	28.00000		3.40000		SOIL WASHING	CHROMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	23
40	0.875000	24.00000		3.00000		SOIL WASHING	CHROMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	10
41	0.875000	24.00000		3.00000		SOIL WASHING	CHROMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	11

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W10 NON-VOLATILE METALS
Treatment Technology: CHEMICAL EXTRACTION AND SOIL WASHING

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
42	0.850217	231.00000		34.60000		SOIL WASHING	COPPER	SOIL	B	ORD-TS1-RT-EUQW-1	11
43	0.840625	32.00000		5.10000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	10
44	0.815790	38.00000		7.00000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	23
45	0.787500	32.00000		6.80000		SOIL WASHING	NICKEL	SOIL	B	ORD-TS1-RT-EUQW-1	11
	SOIL = 45 data points			SLUDGE (SLUD) = 0 data points							
1	0.916667	900.00000	J	75.00000	J	CHEMICAL EXTRACTION	NICKEL	SOIL	F	980-TS1-RT-FCQC-3	3
	SOIL = 1 data points			SLUDGE (SLUD) = 0 data points							

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W10 NON-VOLATILE METALS
Treatment Technology: IMMOBILIZATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.150260	193.00000		164.00000		CEMENT SOLIDIFICATIO	COPPER	SOIL	B	ORD-TS1-RT-FHMF-1	1
	SOIL = 1 data points			SLUDGE (SLUD) = 0 data points							
1	0.687270	1650.00000		516.00000		FLYASH SOLIDIFICATIO	CHROMIUM	SOIL	B	ORD-TS1-RT-FHMF-1	2
2	0.674640	1380.00000		449.00000		FLYASH SOLIDIFICATIO	NICKEL	SOIL	B	ORD-TS1-RT-FHMF-1	2
3	0.634590	13300.00000		4860.00000		FLYASH SOLIDIFICATIO	COPPER	SOIL	B	ORD-TS1-RT-FHMF-1	2
4	0.592310	260.00000		106.00000		FLYASH SOLIDIFICATIO	COPPER	SOIL	B	ORD-TS1-RT-FHMF-1	5
5	0.486490	37.00000		19.00000		FLYASH SOLIDIFICATIO	CHROMIUM	SOIL	B	ORD-TS1-RT-FHMF-1	5
6	0.411540	260.00000		153.00000		FLYASH SOLIDIFICATIO	COPPER	SOIL	B	ORD-TS1-RT-FHMF-1	4
7	0.375000	32.00000		20.00000		FLYASH SOLIDIFICATIO	NICKEL	SOIL	B	ORD-TS1-RT-FHMF-1	5
8	0.270270	37.00000		27.00000		FLYASH SOLIDIFICATIO	CHROMIUM	SOIL	B	ORD-TS1-RT-FHMF-1	4
	SOIL = 8 data points			SLUDGE (SLUD) = 0 data points							
1	0.851750	1140.00000		169.00000		CARBONATE IMMOBILIZA	NICKEL	SOIL	B	ORD-TS1-RT-FHMF-1	3
2	0.827980	9650.00000		1660.00000		CARBONATE IMMOBILIZA	COPPER	SOIL	B	ORD-TS1-RT-FHMF-1	3
3	0.765550	1190.00000		279.00000		CARBONATE IMMOBILIZA	CHROMIUM	SOIL	B	ORD-TS1-RT-FHMF-1	3
	SOIL = 3 data points			SLUDGE (SLUD) = 0 data points							

APPENDIX G

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W11 VOLATILE METALS
Treatment Technology: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.930667	75.00000		5.20000		INCINERATION	LEAD	SOIL	B	980-TS1-RT-EUWW-1	14
2	0.760000	75.00000		18.00000		INCINERATION	LEAD	SOIL	B	980-TS1-RT-EUWW-1	15
3	0.615384	6.50000		2.50000	ND	INCINERATION	CADMIUM	SOIL	B	980-TS1-RT-EUWW-1	14
4	0.615384	6.50000		2.50000	ND	INCINERATION	CADMIUM	SOIL	B	980-TS1-RT-EUWW-1	15
5	0.419355	31.00000		18.00000		INCINERATION	LEAD	SOIL	B	980-TS1-RT-EUWW-1	18
6	0.387097	31.00000		19.00000		INCINERATION	LEAD	SOIL	B	980-TS1-RT-EUWW-1	19
7	0.338461	6.50000		4.30000		INCINERATION	CADMIUM	SOIL	B	980-TS1-RT-EUWW-1	6
8	0.323077	6.50000		4.40000		INCINERATION	CADMIUM	SOIL	B	980-TS1-RT-EUWW-1	10
9	0.322581	31.00000		21.00000		INCINERATION	LEAD	SOIL	B	980-TS1-RT-EUWW-1	25
10	0.322581	31.00000		21.00000		INCINERATION	LEAD	SOIL	B	980-TS1-RT-EUWW-1	27
11	0.276923	6.50000		4.70000		INCINERATION	CADMIUM	SOIL	B	980-TS1-RT-EUWW-1	4
12	0.276923	6.50000		4.70000		INCINERATION	CADMIUM	SOIL	B	980-TS1-RT-EUWW-1	5
13	0.169231	6.50000		5.40000		INCINERATION	CADMIUM	SOIL	B	980-TS1-RT-EUWW-1	9
14	0.161290	31.00000		26.00000		INCINERATION	LEAD	SOIL	B	980-TS1-RT-EUWW-1	23
15	0.161290	31.00000		26.00000		INCINERATION	LEAD	SOIL	B	980-TS1-RT-EUWW-1	26
16	0.123077	6.50000		5.70000		INCINERATION	CADMIUM	SOIL	B	980-TS1-RT-EUWW-1	7
17	0.096774	31.00000		28.00000		INCINERATION	LEAD	SOIL	B	980-TS1-RT-EUWW-1	17
18	0.064516	31.00000		29.00000		INCINERATION	LEAD	SOIL	B	980-TS1-RT-EUWW-1	20
19	0.013333	75.00000		74.00000		INCINERATION	LEAD	SOIL	B	980-TS1-RT-EUWW-1	4
20	0.013333	75.00000		74.00000		INCINERATION	LEAD	SOIL	B	980-TS1-RT-EUWW-1	6
	SOIL = 20 data points			SLUDGE (SLUD) = 0 data points							
1	0.992308	26.00000		0.20000	ND	ROTARY KILN	CADMIUM	SOIL	P	ORD-TS1-RT-EUZM-1	1
2	0.992308	26.00000		0.20000	ND	ROTARY KILN	CADMIUM	SOIL	P	ORD-TS1-RT-EUZM-1	3
3	0.992308	26.00000		0.20000	E3	ROTARY KILN	CADMIUM	SOIL	P	ORD-TS1-RT-EUZM-1	4
4	0.992308	26.00000		0.20000	ND	ROTARY KILN	CADMIUM	SOIL	P	ORD-TS1-RT-EUZM-1	5
5	0.992308	26.00000		0.20000	ND	ROTARY KILN	CADMIUM	SOIL	P	ORD-TS1-RT-EUZM-1	6
6	0.992000	25.00000		0.20000	ND	ROTARY KILN	CADMIUM	SOIL	P	ORD-TS1-RT-EUZM-1	2
7	0.950000	1.00000		0.05000	ND	ROTARY KILN	LEAD	SOIL	P	980-TS1-RT-FCNN-1	1
8	0.818182	11.00000		2.00000	ND	ROTARY KILN	ARSENIC	SOIL	P	980-TS1-RT-EXPC-1	4
9	0.785441	261.00000		56.00000	E3	ROTARY KILN	LEAD	SOIL	P	ORD-TS1-RT-EUZM-1	1
10	0.750831	301.00000		75.00000	E3	ROTARY KILN	LEAD	SOIL	P	ORD-TS1-RT-EUZM-1	5
11	0.708609	302.00000		88.00000	E3	ROTARY KILN	LEAD	SOIL	P	ORD-TS1-RT-EUZM-1	6
12	0.668919	296.00000		98.00000	E3	ROTARY KILN	LEAD	SOIL	P	ORD-TS1-RT-EUZM-1	2
13	0.633562	292.00000		107.00000	E3	ROTARY KILN	LEAD	SOIL	P	ORD-TS1-RT-EUZM-1	3
14	0.608268	508.00000		199.00000	E3	ROTARY KILN	ZINC	SOIL	P	ORD-TS1-RT-EUZM-1	5
15	0.588022	551.00000		227.00000	E3	ROTARY KILN	ZINC	SOIL	P	ORD-TS1-RT-EUZM-1	2
16	0.563107	1030.00000		450.00000		ROTARY KILN	LEAD	SOIL	P	980-TS1-RT-EXPC-1	4
17	0.554878	328.00000		146.00000	E3	ROTARY KILN	LEAD	SOIL	P	ORD-TS1-RT-EUZM-1	4

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W11 VOLATILE METALS
Treatment Technology: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
18	0.540146	548.00000		252.00000	E3	ROTARY KILN	ZINC	SOIL	P	ORD-TS1-RT-EUZM-1	4
19	0.524715	526.00000		250.00000	E3	ROTARY KILN	ZINC	SOIL	P	ORD-TS1-RT-EUZM-1	3
20	0.518847	451.00000		217.00000	E3	ROTARY KILN	ZINC	SOIL	P	ORD-TS1-RT-EUZM-1	1
21	0.252595	2890.00000		2160.00000		ROTARY KILN	LEAD	SOIL	P	980-TS1-RT-EXPC-1	1
	SOIL =	21 data points		SLUDGE (SLUD) =		0 data points					
1	0.493333	15.00000	J	7.60000		PYROLYSIS	LEAD	SOIL	P	980-TS1-RT-EURE-1	1
2	0.114286	70.00000		62.00000		PYROLYSIS	ZINC	SOIL	P	980-TS1-RT-EURE-1	1
	SOIL =	2 data points		SLUDGE (SLUD) =		0 data points					

APPENDIX G

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W11 VOLATILE METALS
Treatment Technology: DECHLORINATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.959900	24262.00000		973.00000		DECHLORINATION	ZINC	SOIL	B	ORD-TS1-RT-EUTV-1	3
2	0.753150	3488.00000		861.00000		DECHLORINATION	CADMIUM	SOIL	B	ORD-TS1-RT-EUTV-1	3
3	0.595000	20.00000		8.10000		DECHLORINATION	ARSENIC	SOIL	B	ORD-TS1-RT-EUTV-1	1
4	0.565000	20.00000		8.70000		DECHLORINATION	ARSENIC	SOIL	B	ORD-TS1-RT-EUTV-1	2
5	0.554090	379.00000		169.00000		DECHLORINATION	LEAD	SOIL	B	ORD-TS1-RT-EUTV-1	2
6	0.533330	45.00000		21.00000		DECHLORINATION	CADMIUM	SOIL	B	ORD-TS1-RT-EUTV-1	1
7	0.521400	1028.00000		492.00000		DECHLORINATION	ZINC	SOIL	B	ORD-TS1-RT-EUTV-1	1
8	0.502960	338.00000		168.00000		DECHLORINATION	ARSENIC	SOIL	B	ORD-TS1-RT-EUTV-1	4
9	0.487470	359.00000		184.00000		DECHLORINATION	ARSENIC	SOIL	B	ORD-TS1-RT-EUTV-1	3
10	0.427830	17175.00000		9827.00000		DECHLORINATION	LEAD	SOIL	B	ORD-TS1-RT-EUTV-1	4
11	0.423730	59.00000		34.00000		DECHLORINATION	CADMIUM	SOIL	B	ORD-TS1-RT-EUTV-1	2
12	0.370630	23414.00000		14736.00000		DECHLORINATION	ZINC	SOIL	B	ORD-TS1-RT-EUTV-1	4
13	0.358550	304.00000		195.00000		DECHLORINATION	LEAD	SOIL	B	ORD-TS1-RT-EUTV-1	1
14	0.264350	1725.00000		1269.00000		DECHLORINATION	ZINC	SOIL	B	ORD-TS1-RT-EUTV-1	2
15	0.214590	14451.00000		11350.00000		DECHLORINATION	LEAD	SOIL	B	ORD-TS1-RT-EUTV-1	3
16	0.210310	6148.00000		4855.00000		DECHLORINATION	CADMIUM	SOIL	B	ORD-TS1-RT-EUTV-1	4

SOIL = 16 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W11 VOLATILE METALS
Treatment Technology: LOW TEMPERATURE THERMAL DESORPTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.083916	14.30000		13.10000		LOW TEMP DESORPTION	ARSENIC	SOIL	B	ORD-TS1-RT-EZYQ-1	17
2	0.078292	28.10000		25.90000		LOW TEMP DESORPTION	CADMIUM	SOIL	B	ORD-TS1-RT-EZYQ-1	17
3	0.058824	13.60000		12.80000		LOW TEMP DESORPTION	ARSENIC	SOIL	B	ORD-TS1-RT-EZYQ-1	5
4	0.052190	594.00000		563.00000		LOW TEMP DESORPTION	ZINC	SOIL	B	ORD-TS1-RT-EZYQ-1	17
5	0.031532	222.00000		215.00000		LOW TEMP DESORPTION	LEAD	SOIL	B	ORD-TS1-RT-EZYQ-1	9
6	0.029412	13.60000		13.20000		LOW TEMP DESORPTION	ARSENIC	SOIL	B	ORD-TS1-RT-EZYQ-1	4
7	0.013986	14.30000		14.10000		LOW TEMP DESORPTION	ARSENIC	SOIL	B	ORD-TS1-RT-EZYQ-1	14

SOIL = 7 data points SLUDGE (SLUD) = 0 data points

APPENDIX G

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W11 VOLATILE METALS
Treatment Technology: CHEMICAL EXTRACTION AND SOIL WASHING

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.995360	14748.00000		68.40000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	58
2	0.993150	14318.00000		98.10000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	40
3	0.993080	14748.00000		102.00000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	52
4	0.991480	14318.00000		122.00000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	34
5	0.988610	14748.00000		168.00000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	46
6	0.988060	14318.00000		171.00000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	41
7	0.986799	303.00000		4.00000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	16
8	0.984310	31871.00000		500.00000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	40
9	0.983720	31871.00000		519.00000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	41
10	0.982930	27060.00000		462.00000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	58
11	0.982490	31871.00000		558.00000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	34
12	0.981560	14748.00000		272.00000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	53
13	0.979538	303.00000		6.20000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	22
14	0.979380	27060.00000		558.00000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	52
15	0.971947	303.00000		8.50000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	28
16	0.968220	31871.00000		1013.00000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	35
17	0.967740	27060.00000		873.00000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	46
18	0.967290	642.00000		21.00000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	16
19	0.966800	97300.00000		3230.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	8
20	0.965710	14318.00000		491.00000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	35
21	0.959813	642.00000		25.80000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	28
22	0.958416	303.00000		12.60000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	23
23	0.957203	236.00000		10.10000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	10
24	0.955919	642.00000		28.30000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	22
25	0.954090	5750.00000		264.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	7
26	0.952966	236.00000		11.10000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	4
27	0.948670	2260.00000		116.00000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	41
28	0.943865	652.00000		36.60000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	40
29	0.942160	3631.00000		210.00000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	53
30	0.940000	500.00000		30.00000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	58
31	0.931035	29.00000		2.00000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	22
32	0.929040	5750.00000		408.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	5
33	0.925860	3790.00000		281.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	5
34	0.924770	44400.00000		3340.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	8
35	0.924680	3850.00000		290.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	5
36	0.923160	3631.00000		279.00000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	52
37	0.921779	652.00000		51.00000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	41
38	0.920720	44400.00000		3520.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	9
39	0.919350	3670.00000		296.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	7
40	0.916258	652.00000		54.60000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	34
41	0.915170	3631.00000		308.00000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	58

APPENDIX G

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W11 VOLATILE METALS
Treatment Technology: CHEMICAL EXTRACTION AND SOIL WASHING

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
42	0.911350	3790.00000		336.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	7
43	0.908570	3850.00000		352.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	6
44	0.907438	484.00000		44.80000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	4
45	0.904160	3631.00000		348.00000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	46
46	0.901033	484.00000		47.90000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	10
47	0.900935	642.00000		63.60000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	23
48	0.892670	1500.00000		161.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	3
49	0.891892	1480.00000		160.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	3
50	0.877880	2260.00000		276.00000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	35
51	0.873200	500.00000		63.40000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	52
52	0.871680	2260.00000		290.00000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	40
53	0.869286	1400.00000		183.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	1
54	0.862069	29.00000		4.00000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	23
55	0.854000	1500.00000		219.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	1
56	0.853378	1480.00000		217.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	4
57	0.853333	750.00000	R	110.00000		SOIL WASHING	ARSENIC	SOIL	B	980-TS1-RT-EUZE-1	17
58	0.852941	17.00000		2.50000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	16
59	0.850000	5000.00000		750.00000		SOIL WASHING	ARSENIC	SOIL	B	980-TS1-RT-EUZE-1	23
60	0.848830	3850.00000		582.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	7
61	0.844172	652.00000		101.60000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	35
62	0.835400	2260.00000		372.00000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	34
63	0.834483	29.00000		4.80000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	28
64	0.833784	1480.00000		246.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	1
65	0.833333	18.00000		3.00000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	4
66	0.830085	236.00000		40.10000		SOIL WASHING	LEAD	SOIL	B	ORD-TS1-RT-EUQW-1	11
67	0.825200	27060.00000		4730.00000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	53
68	0.823710	3670.00000		647.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	5
69	0.823529	17.00000		3.00000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	28
70	0.816600	500.00000		91.70000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	53
71	0.810000	5000.00000		950.00000		SOIL WASHING	ARSENIC	SOIL	B	980-TS1-RT-EUZE-1	25
72	0.810000	5000.00000		950.00000		SOIL WASHING	ARSENIC	SOIL	B	980-TS1-RT-EUZE-1	26
73	0.793103	29.00000		6.00000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	16
74	0.791322	484.00000		101.00000		SOIL WASHING	ZINC	SOIL	B	ORD-TS1-RT-EUQW-1	11
75	0.786487	1110.00000		237.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	1
76	0.777330	1500.00000		334.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	2
77	0.770588	17.00000		3.90000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	22
78	0.750000	5000.00000		1250.00000		SOIL WASHING	ARSENIC	SOIL	B	980-TS1-RT-EUZE-1	28
79	0.750000	18.00000		4.50000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	10
80	0.750000	100.00000	J	25.00000	J	SOIL WASHING	LEAD	SLUD	F	980-TS1-RT-EUTT-2	1
81	0.748000	500.00000		126.00000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	46
82	0.741177	17.00000		4.40000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	23

APPENDIX G

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W11 VOLATILE METALS
Treatment Technology: CHEMICAL EXTRACTION AND SOIL WASHING

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
83	0.723571	1400.00000		387.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	2
84	0.716216	1110.00000		315.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	2
85	0.686364	22.00000		6.90000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	10
86	0.677778	18.00000		5.80000		SOIL WASHING	ARSENIC	SOIL	B	ORD-TS1-RT-EUQW-1	11
87	0.668182	22.00000		7.30000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	4
88	0.666667	81.00000		27.00000		SOIL WASHING	ZINC	SLUD	F	980-TS1-RT-EUTT-2	1
89	0.620000	5000.00000		1900.00000		SOIL WASHING	ARSENIC	SOIL	B	980-TS1-RT-EUZE-1	24
90	0.613333	750.00000		290.00000		SOIL WASHING	ARSENIC	SOIL	B	980-TS1-RT-EUZE-1	20
91	0.586667	750.00000		310.00000		SOIL WASHING	ARSENIC	SOIL	B	980-TS1-RT-EUZE-1	21
92	0.570000	5000.00000		2150.00000		SOIL WASHING	ARSENIC	SOIL	B	980-TS1-RT-EUZE-1	27
93	0.500000	22.00000		11.00000		SOIL WASHING	CADMIUM	SOIL	B	ORD-TS1-RT-EUQW-1	11
94	0.480000	750.00000		390.00000		SOIL WASHING	ARSENIC	SOIL	B	980-TS1-RT-EUZE-1	19
95	0.439865	1480.00000		829.00000		SOIL WASHING	LEAD	SOIL	B	980-TS1-RT-EXNH-1	2
96	0.426667	750.00000		430.00000		SOIL WASHING	ARSENIC	SOIL	B	980-TS1-RT-EUZE-1	18
97	0.426667	750.00000		430.00000		SOIL WASHING	ARSENIC	SOIL	B	980-TS1-RT-EUZE-1	22
	SOIL = 95 data points			SLUDGE (SLUD) = 2 data points							
1	0.998570	1750.00000	J	2.50000	J	CHEMICAL EXTRACTION	CADMIUM	SOIL	F	980-TS1-RT-FCQC-3	1
2	0.963410	2050.00000	J	75.00000	J	CHEMICAL EXTRACTION	LEAD	SOIL	F	980-TS1-RT-FCQC-3	3
3	0.925000	2000.00000	J	150.00000	J	CHEMICAL EXTRACTION	LEAD	SOIL	F	980-TS1-RT-FCQC-3	1
4	0.857143	1400.00000	J	200.00000	J	CHEMICAL EXTRACTION	ZINC	SOIL	F	980-TS1-RT-FCQC-3	2
	SOIL = 4 data points			SLUDGE (SLUD) = 0 data points							

APPENDIX G

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W11 VOLATILE METALS
Treatment Technology: IMMOBILIZATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.183670	392.00000		320.00000		CEMENT SOLIDIFICATIO	ZINC	SOIL	B	ORD-TS1-RT-FHMF-1	1
2	0.166670	18.00000		15.00000		CEMENT SOLIDIFICATIO	ARSENIC	SOIL	B	ORD-TS1-RT-FHMF-1	1
3	0.005260	190.00000		189.00000		CEMENT SOLIDIFICATIO	LEAD	SOIL	B	ORD-TS1-RT-FHMF-1	1
	SOIL = 3 data points			SLUDGE (SLUD) = 0 data points							
1	0.692900	16900.00000		5190.00000		FLYASH SOLIDIFICATIO	LEAD	SOIL	B	ORD-TS1-RT-FHMF-1	2
2	0.665430	810.00000		271.00000		FLYASH SOLIDIFICATIO	ARSENIC	SOIL	B	ORD-TS1-RT-FHMF-1	2
3	0.657340	1430.00000		490.00000		FLYASH SOLIDIFICATIO	CADMIUM	SOIL	B	ORD-TS1-RT-FHMF-1	2
4	0.574390	28900.00000		12300.00000		FLYASH SOLIDIFICATIO	ZINC	SOIL	B	ORD-TS1-RT-FHMF-1	2
5	0.521740	23.00000		11.00000		FLYASH SOLIDIFICATIO	CADMIUM	SOIL	B	ORD-TS1-RT-FHMF-1	5
6	0.492650	544.00000		276.00000		FLYASH SOLIDIFICATIO	ZINC	SOIL	B	ORD-TS1-RT-FHMF-1	5
7	0.441670	240.00000		134.00000		FLYASH SOLIDIFICATIO	LEAD	SOIL	B	ORD-TS1-RT-FHMF-1	5
8	0.257350	544.00000		404.00000		FLYASH SOLIDIFICATIO	ZINC	SOIL	B	ORD-TS1-RT-FHMF-1	4
9	0.195830	240.00000		193.00000		FLYASH SOLIDIFICATIO	LEAD	SOIL	B	ORD-TS1-RT-FHMF-1	4
10	0.166670	18.00000		15.00000		FLYASH SOLIDIFICATIO	ARSENIC	SOIL	B	ORD-TS1-RT-FHMF-1	4
11	0.130430	23.00000		20.00000		FLYASH SOLIDIFICATIO	CADMIUM	SOIL	B	ORD-TS1-RT-FHMF-1	4
	SOIL = 11 data points			SLUDGE (SLUD) = 0 data points							
1	0.909550	53400.00000		4830.00000		CARBONATE IMMOBILIZA	ZINC	SOIL	B	ORD-TS1-RT-FHMF-1	3
2	0.817110	15200.00000		2780.00000		CARBONATE IMMOBILIZA	LEAD	SOIL	B	ORD-TS1-RT-FHMF-1	3
3	0.803910	1280.00000		251.00000		CARBONATE IMMOBILIZA	CADMIUM	SOIL	B	ORD-TS1-RT-FHMF-1	3
4	0.800880	904.00000		180.00000		CARBONATE IMMOBILIZA	ARSENIC	SOIL	B	ORD-TS1-RT-FHMF-1	3
	SOIL = 4 data points			SLUDGE (SLUD) = 0 data points							

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Removal Efficiency
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil TCA

Treatability Group: W11 VOLATILE METALS
Treatment Technology: OTHER

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.977360	53000.00000		1200.00000		CHELATION AND EXTRAC	LEAD	SOIL	B	980-TS1-RT-EXNJ-1	1
2	0.962500	24000.00000		900.00000		CHELATION AND EXTRAC	LEAD	SOIL	B	980-TS1-RT-EXNJ-1	2
3	0.958330	24000.00000		1000.00000		CHELATION AND EXTRAC	LEAD	SOIL	B	980-TS1-RT-EXNJ-1	2
4	0.945950	18500.00000		1000.00000		CHELATION AND EXTRAC	LEAD	SOIL	B	980-TS1-RT-EXNJ-1	1

SOIL = 4 data points SLUDGE (SLUD) = 0 data points

APPENDIX G

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Reduction in Mobility
For Individual Treatment Technologies
Untreated Soil Extract - Treated Soil Extract

Treatability Group: W01 HALOGENATED NON-POLAR AROMATIC COMPOUNDS
Treatment Technology: THERMAL DESTRUCTION

Rnk	Mobility Reduction	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.993817	6.47000		0.04000	J	ROTARY KILN	CHLOROBENZENE	SOIL	P	ORD-TS1-RT-EUZM-1	7
2	0.873420	0.79000		0.10000	ND	ROTARY KILN	CHLOROBENZENE	SOIL	P	ORD-TS1-RT-EUZM-1	8

SOIL = 2 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Reduction in Mobility
For Individual Treatment Technologies
Untreated Soil Extract - Treated Soil Extract

Treatability Group: W04 HALOGENATED ALIPHATIC COMPOUNDS
Treatment Technology: THERMAL DESTRUCTION

Rnk	Mobility Reduction	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.994709	18.90000		0.10000	ND	ROTARY KILN	1,2-DICHLOROETHANE	SOIL	P	ORD-TS1-RT-EUZM-1	7
2	0.988858	3.59000		0.04000	J	ROTARY KILN	TETRACHLOROETHENE	SOIL	P	ORD-TS1-RT-EUZM-1	7
3	0.852940	0.68000		0.10000	ND	ROTARY KILN	TETRACHLOROETHENE	SOIL	P	ORD-TS1-RT-EUZM-1	8
4	0.791660	0.48000		0.10000	ND	ROTARY KILN	1,2-DICHLOROETHANE	SOIL	P	ORD-TS1-RT-EUZM-1	8

SOIL = 4 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Reduction in Mobility
For Individual Treatment Technologies
Untreated Soil Extract - Treated Soil Extract

Treatability Group: W09 OTHER POLAR ORGANIC COMPOUNDS
Treatment Technology: THERMAL DESTRUCTION

Rnk	Mobility Reduction	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.997376	282.00000		0.74000		ROTARY KILN	ACETONE	SOIL	P	ORD-TS1-RT-EUZM-1	7
2	0.994636	26.10000		0.14000		ROTARY KILN	ACETONE	SOIL	P	ORD-TS1-RT-EUZM-1	8

SOIL = 2 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Reduction in Mobility
For Individual Treatment Technologies
Untreated Soil Extract - Treated Soil Extract

Treatability Group: W07 HETEROCYCLICS & SIMPLE NON-HAL AROMATICS
Treatment Technology: THERMAL DESTRUCTION

Rnk	Mobility Reduction	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.987589	84.60000		1.05000		ROTARY KILN	XYLENES (TOTAL)	SOIL	P	ORD-TS1-RT-EUZM-1	7
2	0.986922	49.70000		0.65000		ROTARY KILN	ETHYLBENZENE	SOIL	P	ORD-TS1-RT-EUZM-1	7
3	0.985443	15.80000		0.23000		ROTARY KILN	XYLENES (TOTAL)	SOIL	P	ORD-TS1-RT-EUZM-1	8
4	0.974008	7.31000		0.19000		ROTARY KILN	ETHYLBENZENE	SOIL	P	ORD-TS1-RT-EUZM-1	8
5	0.947619	2.10000		0.11000		ROTARY KILN	STYRENE	SOIL	P	ORD-TS1-RT-EUZM-1	7
6	0.827580	0.58000		0.10000	ND	ROTARY KILN	STYRENE	SOIL	P	ORD-TS1-RT-EUZM-1	8

SOIL = 6 data points SLUDGE (SLUD) = 0 data points

APPENDIX G

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Reduction in Mobility
For Individual Treatment Technologies
Untreated Soil Extract - Treated Soil Extract

Treatability Group: W10 NON-VOLATILE METALS
Treatment Technology: THERMAL DESTRUCTION

Rnk	Mobility Reduction	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.701150	0.87000		0.26000		INCINERATION	BARIUM	SOIL	B	980-TS1-RT-EZYN-1	1
2	0.579710	0.69000		0.29000		INCINERATION	BARIUM	SOIL	B	980-TS1-RT-EZYN-1	1
	SOIL = 2 data points			SLUDGE (SLUD) = 0 data points							
1	0.984733	1.31000		0.02000	ND	ROTARY KILN	COPPER	SOIL	P	ORD-TS1-RT-EUZM-1	7
2	0.936893	4.12000		0.26000		ROTARY KILN	COPPER	SOIL	P	ORD-TS1-RT-EUZM-1	8
3	0.923070	0.65000		0.05000		ROTARY KILN	NICKEL	SOIL	P	ORD-TS1-RT-EUZM-1	8
4	0.882350	0.34000		0.04000	ND	ROTARY KILN	NICKEL	SOIL	P	ORD-TS1-RT-EUZM-1	7
5	0.428600	0.07000		0.04000		ROTARY KILN	CHROMIUM	SOIL	P	ORD-TS1-RT-EUZM-1	8
	SOIL = 5 data points			SLUDGE (SLUD) = 0 data points							

CONTAMINATED SOIL TREATMENT RESULTS
Ranked by Reduction in Mobility
For Individual Treatment Technologies
Untreated Soil Extract - Treated Soil Extract

Treatability Group: W11 VOLATILE METALS
Treatment Technology: THERMAL DESTRUCTION

Rnk	Mobility Reduction	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	0.879520	0.83000		0.10000	ND	INCINERATION	LEAD	SOIL	B	980-TS1-RT-EZYN-1	1
2	0.771900	0.05700		0.01300		INCINERATION	CADMIUM	SOIL	B	980-TS1-RT-EZYN-1	1
3	0.722890	0.83000		0.23000		INCINERATION	LEAD	SOIL	B	980-TS1-RT-EZYN-1	1
4	0.444400	0.01800		0.01000		INCINERATION	CADMIUM	SOIL	B	980-TS1-RT-EZYN-1	1
	SOIL = 4 data points			SLUDGE (SLUD) = 0 data points							
1	0.996231	7.96000		0.03000	ND	ROTARY KILN	ZINC	SOIL	P	ORD-TS1-RT-EUZM-1	7
2	0.987010	0.77000		0.01000	ND	ROTARY KILN	CADMIUM	SOIL	P	ORD-TS1-RT-EUZM-1	8
3	0.983870	0.62000		0.01000	ND	ROTARY KILN	CADMIUM	SOIL	P	ORD-TS1-RT-EUZM-1	7
4	0.963704	13.50000		0.49000		ROTARY KILN	ZINC	SOIL	P	ORD-TS1-RT-EUZM-1	8
5	0.913793	1.74000		0.15000	ND	ROTARY KILN	LEAD	SOIL	P	ORD-TS1-RT-EUZM-1	8
6	0.673910	0.46000		0.15000	ND	ROTARY KILN	LEAD	SOIL	P	ORD-TS1-RT-EUZM-1	7
	SOIL = 6 data points			SLUDGE (SLUD) = 0 data points							

APPENDIX G

CONTAMINATED SOIL TREATEMENT RESULTS
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil Extract

Treatability Group: W02 DIOXINS/FURANS/PCBS & THEIR PRECURSORS
Treatment Technology: IMMOBILIZATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	N/A	6000.00000		0.00008		STABILIZATION	TOTAL PCB'S	SOIL	F	980-TS1-RT-EWFQ-1	2

SOIL = 1 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATEMENT RESULTS
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil Extract

Treatability Group: W04 HALOGENATED ALIPHATIC COMPOUNDS
Treatment Technology: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	N/A	62.00000		0.02500	ND	PYROLYSIS	METHYLENE CHLORIDE (DICHLOROMETHANE)	SOIL	P	980-TS1-RT-EUXQ-1	1
2	N/A	7.20000		0.04500		PYROLYSIS	CHLOROFORM	SOIL	P	980-TS1-RT-EUXQ-1	1

SOIL = 2 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATEMENT RESULTS
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil Extract

Treatability Group: W07 HETEROCYCLICS & SIMPLE NON-HAL AROMATICS
Treatment Technology: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	N/A	25.70000		0.02500	ND	PYROLYSIS	TOLUENE	SOIL	P	980-TS1-RT-EUXQ-1	1

SOIL = 1 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATEMENT RESULTS
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil Extract

Treatability Group: W07 HETEROCYCLICS & SIMPLE NON-HAL AROMATICS
Treatment Technology: IMMOBILIZATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	N/A	7.00000		0.00500	ND	STABILIZATION	XYLENES (TOTAL)	SLUD	P	980-TS1-RT-FBTR-1	2
2	N/A	43.00000		0.10000	ND	STABILIZATION	O&P XYLENE	SLUD	F	980-TS1-RT-EWFQ-1	7
3	N/A	41.00000		0.10000	ND	STABILIZATION	M-XYLENE	SLUD	F	980-TS1-RT-EWFQ-1	7
4	N/A	1.50000		0.00500	ND	STABILIZATION	TOLUENE	SLUD	P	980-TS1-RT-FBTR-1	2
5	N/A	0.76000		0.00500	ND	STABILIZATION	ETHYLBENZENE	SLUD	P	980-TS1-RT-FBTR-1	2
6	N/A	10.00000		0.10000	ND	STABILIZATION	ETHYLBENZENE	SLUD	F	980-TS1-RT-EWFQ-1	7

SOIL = 0 data points SLUDGE (SLUD) = 6 data points

CONTAMINATED SOIL TREATEMENT RESULTS
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil Extract

Treatability Group: W08 POLYNUCLEAR AROMATICS
Treatment Technology: IMMOBILIZATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	N/A	320.00000		0.10000	ND	STABILIZATION	2-METHYLNAPHTHALENE	SLUD	F	980-TS1-RT-EWFQ-1	7
2	N/A	158.00000		0.10000	ND	STABILIZATION	PHENANTHRENE	SLUD	F	980-TS1-RT-EWFQ-1	7
3	N/A	53.00000		0.10000	ND	STABILIZATION	NAPHTHALENE	SLUD	F	980-TS1-RT-EWFQ-1	7
4	N/A	150.00000		0.33000	ND	STABILIZATION	CHRYSENE	SLUD	P	980-TS1-RT-FBTR-1	2
5	N/A	29.00000		0.10000	ND	STABILIZATION	CHRYSENE	SLUD	F	980-TS1-RT-EWFQ-1	7
6	N/A	79.00000		0.33000	ND	STABILIZATION	PHENANTHRENE	SLUD	P	980-TS1-RT-FBTR-1	2
7	N/A	19.00000		0.10000	ND	STABILIZATION	ANTHRACENE	SLUD	F	980-TS1-RT-EWFQ-1	7
8	N/A	48.00000		0.33000	ND	STABILIZATION	PYRENE	SLUD	P	980-TS1-RT-FBTR-1	2
9	N/A	45.00000		0.33000	ND	STABILIZATION	2-METHYLNAPHTHALENE	SLUD	P	980-TS1-RT-FBTR-1	2

SOIL = 0 data points SLUDGE (SLUD) = 9 data points

CONTAMINATED SOIL TREATEMENT RESULTS
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil Extract

Treatability Group: W09 OTHER POLAR ORGANIC COMPOUNDS
Treatment Technology: IMMOBILIZATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	N/A	120.00000		0.13000		STABILIZATION	ORGANIC CYANIDE	SLUD	F	980-TS1-RT-EWFQ-1	8
2	N/A	2.80000		0.01000	ND	STABILIZATION	2-HEXANONE	SLUD	P	980-TS1-RT-FBTR-1	2
3	N/A	59.00000		0.50000		STABILIZATION	ACROLEIN	SLUD	F	980-TS1-RT-EWFQ-1	8
4	N/A	120.00000		1.50000		STABILIZATION	ACRYLONITRILE	SLUD	F	980-TS1-RT-EWFQ-1	8
5	N/A	5.00000		0.10000		STABILIZATION	PROPANOIC ACID,2-METHYL	SLUD	F	980-TS1-RT-EWFQ-1	8
6	N/A	150.00000		3.90000		STABILIZATION	ACETONITRILE	SLUD	F	980-TS1-RT-EWFQ-1	8

SOIL = 0 data points SLUDGE (SLUD) = 6 data points

APPENDIX G

CONTAMINATED SOIL TREATEMENT RESULTS
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil Extract

Treatability Group: W10 NON-VOLATILE METALS
Treatment Technology: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	N/A	1040.00000		0.33000		ROTARY KILN	BARIUM	SOIL	P	980-TS1-RT-EXPC-1	1
2	N/A	820.00000		0.32000		ROTARY KILN	BARIUM	SOIL	P	980-TS1-RT-EXPC-1	4
3	N/A	740.00000		0.45000		ROTARY KILN	BARIUM	SOIL	P	980-TS1-RT-EXPC-1	2
4	N/A	65.00000		0.10000	ND	ROTARY KILN	CHROMIUM	SOIL	P	980-TS1-RT-EXPC-1	4
5	N/A	55.00000		0.10000	ND	ROTARY KILN	CHROMIUM	SOIL	P	980-TS1-RT-EXPC-1	2
6	N/A	46.00000		0.10000	ND	ROTARY KILN	CHROMIUM	SOIL	P	980-TS1-RT-EXPC-1	1
7	N/A	23.00000		0.10000	ND	ROTARY KILN	BARIUM	SOIL	P	980-TS1-RT-EXPC-1	3
8	N/A	12.00000		0.17000		ROTARY KILN	CHROMIUM	SOIL	P	980-TS1-RT-EXPC-1	3

SOIL = 8 data points SLUDGE (SLUD) = 0 data points

1	N/A	540.00000		0.01400		PYROLYSIS	CHROMIUM	SOIL	P	980-TS1-RT-EUXQ-1	3
2	N/A	520.00000		0.02100		PYROLYSIS	CHROMIUM	SOIL	P	980-TS1-RT-EUXQ-1	4
3	N/A	500.00000		0.04600		PYROLYSIS	CHROMIUM	SOIL	P	980-TS1-RT-EUXQ-1	1
4	N/A	360.00000		0.03400		PYROLYSIS	BARIUM	SOIL	P	980-TS1-RT-EUXQ-1	4
5	N/A	410.00000		0.05100		PYROLYSIS	BARIUM	SOIL	P	980-TS1-RT-EUXQ-1	3
6	N/A	390.00000		0.20200		PYROLYSIS	BARIUM	SOIL	P	980-TS1-RT-EUXQ-1	1

SOIL = 6 data points SLUDGE (SLUD) = 0 data points

APPENDIX G

CONTAMINATED SOIL TREATEMENT RESULTS
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil Extract

Treatability Group: W10 NON-VOLATILE METALS
Treatment Technology: IMMOBILIZATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	N/A	33700.00000		0.10000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	26
2	N/A	630.00000		0.00004		STABILIZATION	CHROMIUM	SLUD	F	980-TS1-RT-EWFQ-1	7
3	N/A	33700.00000		0.35000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	2
4	N/A	33700.00000		0.40000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	3
5	N/A	33700.00000		0.46000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	4
6	N/A	33700.00000		0.46000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	5
7	N/A	33700.00000		0.48000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	6
8	N/A	33700.00000		0.35000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	9
9	N/A	33700.00000		0.50000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	28
10	N/A	33700.00000		0.42000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	30
11	N/A	33700.00000		0.51000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	7
12	N/A	33700.00000		0.62000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	8
13	N/A	33700.00000		0.55000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	10
14	N/A	33700.00000		0.60000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	28
15	N/A	33700.00000		1.21000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	27
16	N/A	33700.00000		1.53000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	13
17	N/A	33700.00000		2.60000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	29
18	N/A	103.50000		0.00900		STABILIZATION	CHROMIUM	SLUD	P	980-TS1-RT-FBTR-1	1
19	N/A	534.00000		0.05000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	2
20	N/A	534.00000		0.05000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	3
21	N/A	534.00000		0.05000	ND	STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	6
22	N/A	534.00000		0.05000	ND	STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	7
23	N/A	534.00000		0.05000	ND	STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	8
24	N/A	534.00000		0.05000	ND	STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	9
25	N/A	534.00000		0.05000	ND	STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	10
26	N/A	534.00000		0.05000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	27
27	N/A	534.00000		0.05000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	30
28	N/A	33700.00000		3.48000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	17
29	N/A	33700.00000		3.32000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	22
30	N/A	33700.00000		3.48000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	23
31	N/A	33700.00000		3.50000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	29
32	N/A	33700.00000		3.59000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	14
33	N/A	33700.00000		3.59000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	21
34	N/A	534.00000		0.06000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	4
35	N/A	534.00000		0.06000	ND	STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	5
36	N/A	33700.00000		4.04000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	15
37	N/A	33700.00000		4.00000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	20
38	N/A	33700.00000		4.50000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	28
39	N/A	103.50000		0.01400		STABILIZATION	CHROMIUM	SLUD	P	980-TS1-RT-FBTR-1	1
40	N/A	33700.00000		5.00000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	28
41	N/A	33700.00000		5.25000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	16
42	N/A	534.00000		0.10000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	28

Treatability Group: W10 NON-VOLATILE METALS
Treatment Technology: IMMOBILIZATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
43	N/A	534.00000		0.11000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	26
44	N/A	534.00000		0.20000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	28
45	N/A	534.00000		0.20000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	28
46	N/A	534.00000		0.25000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	28
47	N/A	534.00000		0.25000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	29
48	N/A	410.00000		0.20000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	2
49	N/A	410.00000		0.20000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	3
50	N/A	410.00000		0.20000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	4
51	N/A	410.00000		0.20000	ND	STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	5
52	N/A	410.00000		0.20000	ND	STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	6
53	N/A	410.00000		0.20000	ND	STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	8
54	N/A	410.00000		0.20000	ND	STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	9
55	N/A	410.00000		0.20000	ND	STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	10
56	N/A	410.00000		0.20000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	26
57	N/A	410.00000		0.20000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	28
58	N/A	410.00000		0.20000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	28
59	N/A	410.00000		0.20000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	30
60	N/A	534.00000		0.35000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	29
61	N/A	33700.00000		24.90000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	24
62	N/A	33700.00000		29.50000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	28
63	N/A	410.00000		0.39000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	27
64	N/A	33700.00000		33.00000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	28
65	N/A	410.00000		0.45000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	29
66	N/A	534.00000		0.63000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	21
67	N/A	534.00000		0.73000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	19
68	N/A	534.00000		0.75000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	13
69	N/A	534.00000		0.75000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	22
70	N/A	33.50000		0.05000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	13
71	N/A	33.50000		0.05000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	14
72	N/A	33.50000		0.05000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	20
73	N/A	33.50000		0.05000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	21
74	N/A	534.00000		0.83000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	15
75	N/A	410.00000		0.64000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	29
76	N/A	534.00000		0.84000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	12
77	N/A	534.00000		0.84000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	18
78	N/A	68.00000		0.11400		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EZUT-1	2
79	N/A	33700.00000		57.80000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	12
80	N/A	33700.00000		57.80000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	18
81	N/A	534.00000		0.98000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	16
82	N/A	33700.00000		62.90000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	19
83	N/A	68.00000		0.13200		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EZUT-1	2
84	N/A	534.00000		1.05000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	14

Treatability Group: W10 NON-VOLATILE METALS
Treatment Technology: IMMOBILIZATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
85	N/A	534.00000		1.07000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	24
86	N/A	534.00000		1.30000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	17
87	N/A	534.00000		1.30000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	23
88	N/A	78.00000		0.20000		STABILIZATION	COPPER	SLUD	F	980-TS1-RT-EWFQ-1	8
89	N/A	534.00000		1.46000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	20
90	N/A	534.00000		1.59000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	25
91	N/A	33.50000		0.10000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	12
92	N/A	33.50000		0.10000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	18
93	N/A	33.50000		0.10000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	19
94	N/A	534.00000		1.60000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	28
95	N/A	534.00000		1.70000		STABILIZATION	COPPER	SLUD	B	980-TS1-RT-EURH-1	28
96	N/A	33.50000		0.11000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	22
97	N/A	410.00000		1.40000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	13
98	N/A	33.50000		0.14000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	4
99	N/A	33.50000		0.14000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	5
100	N/A	41.00000		0.20000	ND	STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	7
101	N/A	131.00000		0.70000		STABILIZATION	BARIUM	SLUD	B	980-TS1-RT-EZUT-1	2
102	N/A	33700.00000		199.00000		STABILIZATION	CHROMIUM	SLUD	B	980-TS1-RT-EURH-1	25
103	N/A	410.00000		2.44000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	21
104	N/A	33.50000		0.22000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	3
105	N/A	410.00000		2.70000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	17
106	N/A	410.00000		2.70000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	23
107	N/A	410.00000		2.83000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	20
108	N/A	33.50000		0.24000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	2
109	N/A	410.00000		2.96000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	16
110	N/A	410.00000		2.96000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	22
111	N/A	131.00000		0.95000		STABILIZATION	BARIUM	SLUD	B	980-TS1-RT-EZUT-1	2
112	N/A	410.00000		3.03000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	14
113	N/A	33.50000		0.28000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	17
114	N/A	33.50000		0.28000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	23
115	N/A	33.50000		0.29000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	16
116	N/A	410.00000		3.90000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	28
117	N/A	33.50000		0.40000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	7
118	N/A	33.50000		0.40000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	9
119	N/A	410.00000		5.20000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	28
120	N/A	33.50000		0.62000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	6
121	N/A	410.00000		9.28000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	24
122	N/A	33.50000		0.78000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	10
123	N/A	410.00000		10.00000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	28
124	N/A	33.50000		0.84000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	8
125	N/A	410.00000		11.40000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	12
126	N/A	410.00000		11.40000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	18

Treatability Group: W10 NON-VOLATILE METALS
Treatment Technology: IMMOBILIZATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
127	N/A	410.00000		11.40000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	19
128	N/A	410.00000		13.00000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	28
129	N/A	33.50000		1.25000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	15
130	N/A	410.00000		21.60000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	25
131	N/A	41.00000		2.57000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	15
132	N/A	33.50000		23.70000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	24
133	N/A	6.09000		5.01000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	11
134	N/A	6.09000		5.39000		STABILIZATION	NICKEL	SLUD	B	980-TS1-RT-EURH-1	11
135	N/A	0.25000		0.23000		STABILIZATION	CHROMIUM (HEXAVALENT)	SLUD	B	980-TS1-RT-EURH-1	11

SOIL = 0 data points SLUDGE (SLUD) = 135 data points

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	N/A	35.60000		0.01000	ND	FLYASH SOLIDIFICATIO	CHROMIUM	SOIL	P	980-TS1-RT-EZTZ-1	3
2	N/A	35.60000		0.05000		FLYASH SOLIDIFICATIO	CHROMIUM	SOIL	P	980-TS1-RT-EZTZ-1	3
3	N/A	35.60000		0.05000	ND	FLYASH SOLIDIFICATIO	CHROMIUM	SOIL	P	980-TS1-RT-EZTZ-1	3
4	N/A	79.10000		0.20000	ND	FLYASH SOLIDIFICATIO	BARIUM	SOIL	P	980-TS1-RT-EZTZ-1	3
5	N/A	79.10000		0.34000		FLYASH SOLIDIFICATIO	BARIUM	SOIL	P	980-TS1-RT-EZTZ-1	3
6	N/A	79.10000		0.43000		FLYASH SOLIDIFICATIO	BARIUM	SOIL	P	980-TS1-RT-EZTZ-1	3

SOIL = 6 data points SLUDGE (SLUD) = 0 data points

CONTAMINATED SOIL TREATEMENT RESULTS
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil Extract

Treatability Group: W11 VOLATILE METALS
Treatment Technology: THERMAL DESTRUCTION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	N/A	2890.00000		0.23000		ROTARY KILN	LEAD	SOIL	P	980-TS1-RT-EXPC-1	1
2	N/A	760.00000		0.10000	ND	ROTARY KILN	LEAD	SOIL	P	980-TS1-RT-EXPC-1	2
3	N/A	1030.00000		1.00000	ND	ROTARY KILN	LEAD	SOIL	P	980-TS1-RT-EXPC-1	4
4	N/A	46.00000		0.10000	ND	ROTARY KILN	LEAD	SOIL	P	980-TS1-RT-EXPC-1	3
SOIL = 4 data points				SLUDGE (SLUD) = 0 data points							
1	N/A	4.00000		0.00020	ND	PYROLYSIS	MERCURY	SOIL	P	980-TS1-RT-EUXQ-1	4
2	N/A	74.00000		0.00700		PYROLYSIS	SILVER	SOIL	P	980-TS1-RT-EUXQ-1	3
3	N/A	180.00000		0.02000	ND	PYROLYSIS	LEAD	SOIL	P	980-TS1-RT-EUXQ-1	4
4	N/A	54.00000		0.00600	ND	PYROLYSIS	SILVER	SOIL	P	980-TS1-RT-EUXQ-1	1
5	N/A	1.70000		0.00020	ND	PYROLYSIS	MERCURY	SOIL	P	980-TS1-RT-EUXQ-1	3
6	N/A	150.00000		0.02000	ND	PYROLYSIS	LEAD	SOIL	P	980-TS1-RT-EUXQ-1	3
7	N/A	67.00000		0.00900		PYROLYSIS	SILVER	SOIL	P	980-TS1-RT-EUXQ-1	4
8	N/A	1.40000		0.00022	ND	PYROLYSIS	MERCURY	SOIL	P	980-TS1-RT-EUXQ-1	1
9	N/A	120.00000		0.02000	ND	PYROLYSIS	LEAD	SOIL	P	980-TS1-RT-EUXQ-1	1
10	N/A	56.00000		0.06000		PYROLYSIS	CADMIUM	SOIL	P	980-TS1-RT-EUXQ-1	3
11	N/A	44.00000		0.05400		PYROLYSIS	CADMIUM	SOIL	P	980-TS1-RT-EUXQ-1	4
12	N/A	52.00000		0.18500		PYROLYSIS	CADMIUM	SOIL	P	980-TS1-RT-EUXQ-1	1
SOIL = 12 data points				SLUDGE (SLUD) = 0 data points							

CONTAMINATED SOIL TREATEMENT RESULTS
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil Extract

Treatability Group: W11 VOLATILE METALS
Treatment Technology: IMMOBILIZATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
1	N/A	291.00000		0.00005		STABILIZATION	LEAD	SLUD	F	980-TS1-RT-EWFQ-1	7
2	N/A	880.00000		0.02000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	2
3	N/A	880.00000		0.02000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	3
4	N/A	880.00000		0.02000	ND	STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	6
5	N/A	880.00000		0.02000	ND	STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	7
6	N/A	880.00000		0.02000	ND	STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	8
7	N/A	880.00000		0.02000	ND	STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	9
8	N/A	880.00000		0.02000	ND	STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	10
9	N/A	880.00000		0.02000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	30
10	N/A	880.00000		0.04000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	26
11	N/A	880.00000		0.06000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	4
12	N/A	880.00000		0.06000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	5
13	N/A	11.80000		0.00100	ND	STABILIZATION	ARSENIC	SLUD	B	980-TS1-RT-EZUT-1	2
14	N/A	11.80000		0.00100	ND	STABILIZATION	ARSENIC	SLUD	B	980-TS1-RT-EZUT-1	2
15	N/A	880.00000		0.10000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	28
16	N/A	880.00000		0.10000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	28
17	N/A	880.00000		0.21000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	27
18	N/A	0.34950		0.00020		STABILIZATION	MERCURY	SLUD	B	980-TS1-RT-EZUT-1	2
19	N/A	880.00000		0.63000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	29
20	N/A	880.00000		0.84000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	29
21	N/A	0.34950		0.00040		STABILIZATION	MERCURY	SLUD	B	980-TS1-RT-EZUT-1	2
22	N/A	8.40000		0.01000	ND	STABILIZATION	SELENIUM	SLUD	P	980-TS1-RT-FBTR-1	1
23	N/A	8.40000		0.01000	ND	STABILIZATION	SELENIUM	SLUD	P	980-TS1-RT-FBTR-1	1
24	N/A	265.00000		0.50300		STABILIZATION	LEAD	SLUD	B	980-TS1-RT-EZUT-1	2
25	N/A	265.00000		0.50300		STABILIZATION	LEAD	SLUD	B	980-TS1-RT-EZUT-1	2
26	N/A	13.20000		0.02800		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EZUT-1	2
27	N/A	13.20000		0.02800		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EZUT-1	2
28	N/A	1450.00000		3.18000		STABILIZATION	LEAD	SLUD	P	980-TS1-RT-FBTR-1	1
29	N/A	0.40500		0.00100	ND	STABILIZATION	CADMIUM	SLUD	P	980-TS1-RT-FBTR-1	1
30	N/A	0.40500		0.00100	ND	STABILIZATION	CADMIUM	SLUD	P	980-TS1-RT-FBTR-1	1
31	N/A	3.85000		0.01000	ND	STABILIZATION	ARSENIC	SLUD	P	980-TS1-RT-FBTR-1	1
32	N/A	3.85000		0.01000	ND	STABILIZATION	ARSENIC	SLUD	P	980-TS1-RT-FBTR-1	1
33	N/A	880.00000		2.45000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	12
34	N/A	880.00000		2.96000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	13
35	N/A	1450.00000		5.36000		STABILIZATION	LEAD	SLUD	P	980-TS1-RT-FBTR-1	1
36	N/A	880.00000		3.44000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	15
37	N/A	880.00000		4.07000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	16
38	N/A	880.00000		4.08000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	17
39	N/A	880.00000		4.08000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	23
40	N/A	880.00000		4.23000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	21
41	N/A	880.00000		4.36000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	24
42	N/A	7.50000		0.03800		STABILIZATION	SILVER	SLUD	B	980-TS1-RT-EZUT-1	2

CONTAMINATED SOIL TREATEMENT RESULTS
For Individual Treatment Technologies
Untreated Soil TCA - Treated Soil Extract

Treatability Group: W11 VOLATILE METALS
Treatment Technology: IMMOBILIZATION

Rnk	Removal Efficiency	Untreated Concen (PPM)	Qul Unt	Treated Concen (PPM)	Qul Trt	Treatment Technology	Contaminant Name	Media	Scale	Document Number	Test Num
43	N/A	880.00000		4.50000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	22
44	N/A	880.00000		4.83000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	20
45	N/A	7.50000		0.04800		STABILIZATION	SILVER	SLUD	B	980-TS1-RT-EZUT-1	2
46	N/A	880.00000		5.97000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	25
47	N/A	880.00000		6.09000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	14
48	N/A	880.00000		12.20000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	28
49	N/A	880.00000		15.60000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	19
50	N/A	880.00000		16.20000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	28
51	N/A	880.00000		16.65000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	18
52	N/A	880.00000		18.50000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	28
53	N/A	0.08000		0.00200	ND	STABILIZATION	MERCURY	SLUD	P	980-TS1-RT-FBTR-1	1
54	N/A	880.00000		22.40000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	28
55	N/A	13.00000		0.70000		STABILIZATION	ANTIMONY	SLUD	F	980-TS1-RT-EWFQ-1	8
56	N/A	0.08000		0.00500	ND	STABILIZATION	MERCURY	SLUD	P	980-TS1-RT-FBTR-1	1
57	N/A	11.90000		7.84000		STABILIZATION	CADMIUM	SLUD	B	980-TS1-RT-EURH-1	11

SOIL = 0 data points SLUDGE (SLUD) = 57 data points

1	N/A	32496.00000		0.03000	ND	FLYASH SOLIDIFICATIO	LEAD	SOIL	P	980-TS1-RT-EZTZ-1	3
2	N/A	32496.00000		0.40000		FLYASH SOLIDIFICATIO	LEAD	SOIL	P	980-TS1-RT-EZTZ-1	3
3	N/A	52.40000		0.02000		FLYASH SOLIDIFICATIO	ARSENIC	SOIL	P	980-TS1-RT-EZTZ-1	3
4	N/A	52.40000		0.03000		FLYASH SOLIDIFICATIO	ARSENIC	SOIL	P	980-TS1-RT-EZTZ-1	3
5	N/A	7.50000		0.00500	ND	FLYASH SOLIDIFICATIO	CADMIUM	SOIL	P	980-TS1-RT-EZTZ-1	3
6	N/A	52.40000		0.05000		FLYASH SOLIDIFICATIO	ARSENIC	SOIL	P	980-TS1-RT-EZTZ-1	3
7	N/A	32496.00000		38.00000		FLYASH SOLIDIFICATIO	LEAD	SOIL	P	980-TS1-RT-EZTZ-1	3
8	N/A	4.00000	J	0.00500	ND	FLYASH SOLIDIFICATIO	SILVER	SOIL	P	980-TS1-RT-EZTZ-1	3
9	N/A	7.50000		0.01000		FLYASH SOLIDIFICATIO	CADMIUM	SOIL	P	980-TS1-RT-EZTZ-1	3
10	N/A	0.34000		0.00080	ND	FLYASH SOLIDIFICATIO	MERCURY	SOIL	P	980-TS1-RT-EZTZ-1	3
11	N/A	0.34000		0.00080	ND	FLYASH SOLIDIFICATIO	MERCURY	SOIL	P	980-TS1-RT-EZTZ-1	3
12	N/A	0.34000		0.00080	ND	FLYASH SOLIDIFICATIO	MERCURY	SOIL	P	980-TS1-RT-EZTZ-1	3
13	N/A	4.00000	J	0.02000	ND	FLYASH SOLIDIFICATIO	SILVER	SOIL	P	980-TS1-RT-EZTZ-1	3
14	N/A	4.00000	J	0.02000	ND	FLYASH SOLIDIFICATIO	SILVER	SOIL	P	980-TS1-RT-EZTZ-1	3
15	N/A	0.32600		0.00200	ND	FLYASH SOLIDIFICATIO	SELENIUM	SOIL	P	980-TS1-RT-EZTZ-1	3
16	N/A	0.32600		0.00200	ND	FLYASH SOLIDIFICATIO	SELENIUM	SOIL	P	980-TS1-RT-EZTZ-1	3
17	N/A	7.50000		0.06000		FLYASH SOLIDIFICATIO	CADMIUM	SOIL	P	980-TS1-RT-EZTZ-1	3
18	N/A	0.32600		0.00300	ND	FLYASH SOLIDIFICATIO	SELENIUM	SOIL	P	980-TS1-RT-EZTZ-1	3

SOIL = 18 data points SLUDGE (SLUD) = 0 data points

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APPENDIX H

TREATABILITY STUDY SUMMARIES

This appendix contains summaries of the 68 treatability studies which contain quantitative data and form the basis of the data base discussed in this report.

Refer to Superfund Treatability Clearinghouse Abstracts for additional information on these referenced documents (U.S. EPA, 1989, EPA/540/2-89-001).

Treatment Process:	Low Temperature Thermal Desorption
Media:	Soil/Sandy and Silty
Document Reference:	Roy F. Weston, Inc. "Pilot Investigation of Low-Temperature Stripping of Volatile Organic Compounds (VOCs) From Soil: Volume 1 - Technical Report and Volume II - Appendices." Technical report prepared for USATHAMA 123 pp. June 1986
Document Type:	Contractor/Vendor Treatability Study
Contract:	Wayne Sisk U.S. DOD/USATHAMA Aberdeen Proving Ground, MD 21010-5401 301-571-2054
Site Name:	Letterkenney Army Depot, Chambersburg, PA (NPL - Federal facility)
Location of Test:	West Chester, PA

BACKGROUND: The U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) is investigating technologies to treat soils contaminated with solvents. A pilot study of low temperature thermal stripping was conducted at Letterkenny Army Depot (LEAD) near Chambersburg, Pennsylvania, from 8/5/85 to 9/16/85.

OPERATIONAL INFORMATION: Soils from two lagoons at LEAD that were used for the disposal of organic liquids were chosen for treatment. The total VOC concentrations in feed soils were approximately 3503 ppm. The soils were sandy and treated at 10 pounds per feed cycle. The unit was designed for processing 385 pounds per hour. Soils were treated in a thermal processor, an indirect heat exchanger which was used to heat and consequently dry the contaminated soil and volatilize the contaminants. Contaminants in the off-gases were thermally destroyed in an afterburner.

The pilot investigation was completed in two phases. Phase I consisted of 18 test runs completed to evaluate the effect on VOC removal efficiency of varying operating conditions (i.e., soil discharge temperature, soil residence time, and air inlet temperature). The 18 test runs were designed in a matrix format to investigate three levels of soil discharge temperature: 50°C, 100°C and 150°C; three levels of soil residence time: 30 minutes, 45 minutes, and 60 minutes; and two levels of air inlet temperature: ambient and 90°C. Phase II of the Pilot study consisted of 10 "optimization" test runs.

There were four primary purposes for the optimization runs: 1) to evaluate the effect on VOC removal efficiency of varying operating conditions beyond the limits set for Phase I of the investigation (i.e., maximum soil discharge temperature and maximum soil residence time); 2) to evaluate the VOC removal rate along the length of the unit; 3) to evaluate the VOC removal efficiency associated with three "duplicate" test runs; and 4) to evaluate the VOC removal efficiency associated with reprocessing soils.

PERFORMANCE: The study concludes that process variables can be manipulated to achieve desired effluent concentrations (i.e., 100 ppm, 10 ppm, 1 ppm, etc.) As conducted, VOCs were removed to concentrations below 100 ppm. The level of removal was a direct and predictable function of VOC feed concentration, residence time, moisture content, heat input, and generating temperature.

VOC removal efficiencies associated with an elevated air inlet temperature were generally lower than those associated with ambient air inlet temperature. The appendices provide extensive analytical methods information and other QA/QC information.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W04-Halogenated Aliphatic Compounds	127-18-4	Tetrachlorethene
	156-60-5	Trans-1,2-dichloroethene
	79-01-6	Trichloroethene
W07-Heterocyclics and Simple Non Halogenated Aromatics	1330-20-7	Xylenes (Total)
W13-Other Organics	TOT-VOC	Total Volatile Organics

Treatment Process:	Chemical Extraction and Soil Washing
Media:	Soil/Generic
Document Reference:	PEI Associates, Inc. "CERCLA BDAT SARM Preparation and Results of Physical Soils Washing Experiments (Final Report)." Prepared for U.S. EPA. Approximately 75 pp. October 1987.
Document Type:	EPA ORD Report
Contract:	Richard Traver, Staff Engineer U.S. EPA, ORD HWERL-Releases Control Branch Woodbridge Avenue Edison, NJ 08837 201-321-6677
Site Name:	BDAT SARM - Manufactured Waste (Non-NPL)
Location of Test:	ORD - Edison, NJ

BACKGROUND: This study reports on the results of work preparing 30,000 lbs of SARM or synthetic analytical reference matrix, a surrogate soil containing a wide range of contaminants. It also reports the results of bench scale treatability experiments designed to simulate EPA's mobile soil washing system, where SARM samples were washed to determine the efficiency of using chelating reagent and surfactants to remove contaminants from the SARMs.

OPERATIONAL INFORMATION: SARMs were developed to support testing of various cleanup technologies in support of the Superfund BDAT program. Superfund sites were surveyed to evaluate the type of soils present and the concentrations of contaminant in the soils. The final soil composition selected consists of 30% clay, 25% silt, 20% sand, 20% topsoil and 5% gravel. A prescribed list of chemicals were added to the soils. The contaminants include volatile and semi-volatile organics, chlorinated organic compounds and the metals Pb, Zn, Cd, As, Cu, Cr and Ni. Four different SARM formulations were prepared containing high and low levels of metals and organics. They will be used by the EPA in subsequent treatability studies.

Different solutions containing SARM samples were tested in bench scale shaker tests to determine the ability of a chelant (EDTA), a surfactant (TIDE) and plain water solvent to remove various contaminants from the fine and coarse fractions of soils. The degree of contamination in both the coarse and fine fraction was determined by TCLP tests and total waste analysis (SW-846, 3rd edition). A QA/QC discussion is contained in the report and a complete QA/QC plan is appended.

PERFORMANCE: After samples were treated on the bench scale shaker table the SARM soils were put through a wet sieve to separate fine from coarse materials and the fractions were analyzed using TCLP tests and total analysis. Tap water was as effective in removing the VOC as the other solutions. PH and temperature had very little effect on VOC reduction. The semi-volatile organics were removed slightly better by the 0.5% TIDE than plain tap water. A chelant concentration of 3 moles of EDTA to total metals was most effective in removing metals. Chelant reaction time for removal was 15 to 30 minutes. Arsenic and chromium showed the poorest removal efficiencies while Cd, Zn, Cu and Ni were easily chelated by EDTA. The soil is divided into three particle size classes > 2 mm, 2 mm to 250 um and < 250 um. The washes removed contaminants from the 2 larger

classes of soils to levels below the proposed TCLP limits. These soil classes comprise 42% by weight of the SARM and could potentially be classified as non-hazardous and be returned to the site. The contaminated fines could be stabilized and treated further. This study revealed the SARM could be cleaned by soils washing and the contaminated soil volume could be reduced.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Groups	CAS Number	Contaminants
W01-Halogenated Nonpolar Aromatic Compounds	108-90-7	Chlorobenzene
W03-Halogenated Phenols, Cresols, Ethers, and Thiols	87-86-5	Pentachlorophenol
W04-Halogenated Aliphatic Compounds	107-06-2 127-18-4	1,2-Dichloroethane Tetrachloroethene
W07-Heterocyclics and Simple Non-Hal. Aromatics	100-42-5 1330-30-7 100-41-4	Styrene Xylenes Ethylbenzene
W08-Polynuclear Aromatics	120-12-7	Anthracene
W09-Other Polar Organic Compounds	117-18-7 67-64-1	Bis(2-ethylhexyl)phthalate Acetone
W10-Non-Volatile Metals	7440-50-8 7440-02-0 7440-47-3	Copper Nickel Chromium
W11-Volatile Metals	7439-92-1 7440-66-6 7440-43-9 7440-38-2	Lead Zinc Cadmium Arsenic

Treatment Process:	Bioremediation - Composting/Biodegradation
Media:	Soil/Sandy
Document Reference:	Portier R., et al. "Field Plot Test Report, Phase III Engineering Design, Old Inger Superfund Site, Darrow, Louisiana." Approximately 250 pp. November 1986.
Document Type:	Contractor/Vendor Treatability Study
Contract:	Timothy Mahon U.S. EPA - Region VI 1445 Ross Avenue 12th Floor, Suite 1200 Dallas, TX 75202 214-655-6444
Site Name:	Old Inger Site, LA (NPL)
Location of Test:	Ascension Parish, LA

BACKGROUND: This project report describes the results of biodegradation with indigenous microorganisms on soils at an oil reclamation plant. The site occupied about 16 acres including a 7.5 acre swamp. The wastes were oily sludges found in lagoons, diked tank containment areas, buried waste areas and in the swamp. Wastes identified at the site were consistent with hazardous materials used at an oil reclamation plant. Benzene, toluene and PAHs were present; no PCBs were found and very low levels of chlorinated hydrocarbons and heavy metals were detected. Numerous PAHs such as naphthalene, methyl naphthalene, anthracene and fluorene were detected in lagoon soils and buried waste soils. The concentrations of PAH compounds ranged from less than 100 ppm to approximately 5700 ppm for phenanthrene.

OPERATIONAL INFORMATION: The purpose of the study was to determine microorganism loading rate on the silt and sandy clay soils. Task I was a screening test to determine the maximum toxicant loading rates. After selection of the loading rate, Task II included mesocosm tests in the laboratory where loading, nutrients and other parameters could be controlled. This included evaluation of commercially available bacterial cultures. Field verification studies (Task III) were conducted on special plots set off at the site and the plots were loaded sequentially with different waste types. The volume of soil which was treated was not reported. The duration of the treatment was 35 days. The report contains a discussion of the mechanism of biodegradation and an appendix showing the actual chemical reaction pathways associated with the biodegradation of various PAH compounds.

PERFORMANCE: Optimal loading rates of the various contaminants were shown to induce microbial biotransformations. All of the compounds studied decreased in concentration over time, but no specific correlations were presented or discussed by the authors. Data that was generated only indicated gross trends and no contaminant destruction efficiencies were reported. Also there was no analysis for toxic intermediates in this study and the authors suggested that toxic intermediate production needed to be evaluated further. No specific QA/QC procedures were reported. The authors state that microbial degradation and detoxification of the site is scientifically verifiable and economically feasible although no discussion of the economics was contained in the study. Post closure monitoring of soils and leachate from the site was recommended for 30 years.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatment Group	CAS Number	Contaminants
W08-Polynuclear Aromatics	120-12-7	Anthracene
	91-20-3	Naphthalene
	85-01-8	Phenanthrene
	208-96-9	Acenaphthylene
	86-73-7	Fluorene
	206-44-0	Fluroanthene

Treatment Process:	Thermal Destruction - Incineration
Media:	Soil/generic
Document Reference:	EG&G Idaho, Inc. "High-Temperature Fluid-Wall Reactor Technology Research Test and Evaluation Performed at Naval Construction Battalion Center, Gulfport, MS, for the USAF Installation Restoration Program." Vols. I and II. Document No. ELS-TR-87-06, approximately 550 pp. Prepared for AFESC, Tyndall Air Force Base. March 1987.
Document Type:	Contractor/Vendor Treatability Study
Contract:	Major Terry Stoddart U.S. DOD/AFESC Bldg 1117 Tyndall Air Force Base, FL 32403 904-283-2949
Site Name:	Naval Construction Battalion Center (NCBC)
Location of Test:	Gulfport, MS

BACKGROUND: In June 1985, the J.M. Huber Advanced Electric Reactor (AER) mobile pilot plant, a high-temperature fluid wall reactor, was successfully used to treat 1,100 pounds of soil contaminated with 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) at the Naval Construction Battalion Center (NCBC) in Gulfport, Mississippi. The contamination resulted from earlier spills at an Herbicide Orange storage area at NCBC. Since this pilot plant was mobile, it was a quick and inexpensive means of demonstrating AER technology under field conditions as part of the research, test, and evaluation phase of the U.S. Air Force Installation Restoration (AFIRM) Program.

OPERATIONAL INFORMATION: The AER process, which operated in a nitrogen atmosphere at a temperature of 3600 to 4100°F, destroys dioxins, furans, and other organic compounds by pyrolysis. The AER is lined with electrode-heated graphite, which has an inside diameter of 3 inches and a heated length of 36 inches. Screw-fed soil feedstock falls by gravity flow through the reactor, and the treated soil is collected in an enclosed bin. A gaseous blanket of nitrogen separates the graphite from the reactants. Gas effluent is passed through a particulate filter and two activated carbon filters before emission from a stack. A detailed analytical section is contained in the report.

PERFORMANCE: After AER demonstration testing was completed, samples of the NCBC feedstock and test-treated soil were sent to two laboratories to determine dioxin concentrations. NCBC Soil feedstock was analyzed and found to contain 193 ppb and 111 ppb of 2,3,7,8-TCDD, based on two composite samples. Treated soil was analyzed and found to have a total dioxin/furan concentration of less than 1 ppb, which met test criteria.

Concentrations of inorganics in the treated soil were sufficiently low to be not considered hazardous according to the EPA delisting criteria. Because the AER test operating temperature was 3650°F, inorganics, especially lead and zinc, were volatilized from the soil. They were then transported in the exhaust stream and collected in a baghouse filter. The costs to restore 20,000 tons of contaminated soil at the NCBC site using a full-scale AER is estimated to be 14.3 million dollars.

The AER process demonstrated the capability to treat dioxin-contaminated soil to meet Air Force test criteria, and may be considered for full scale soil restoration of dioxin-furan contaminated soils.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability	CAS Number	Contaminants
W02-Dioxins/Furans/PCBs	1746-01-6	2,3,7,8-Tetrachloro-dibenzo-p-dioxin
	F1746-01-6	2,3,7,8-Tetrachlorodi-benzofurans
	PCDF	Pentachlorodibenzo-furans
	HEXCDD	Hexachlorodibenzo-dioxins
	HEXCDF	Hexachlorodibenzo-furans
	PCDD	Pentachlorodibenzo-dioxins
	TCDD	Tetrachlorodibenzo-dioxins
	TCDF	Tetrachlorodibenzo-furans
W03-Halogenated Phenols, Cresols, Ethers, and Thiols	120-83-1	2,4-Dichlorophenol
	88-06-2	2,4,6-Trichlorophenol
W09-Other Polar Organic Compounds	108-95-2	Phenol
W10-Non-Volatile Metals	7440-50-8	Copper
W11-Volatile Metals	7439-92-1	Lead
	7440-66-6	Zinc
W12-Other Inorganics	74-9-8	Hydrocyanic Acid

Treatment Process:	Thermal Destruction- Aqueous Thermal Decomposition
Media:	Sediment
Document Reference:	Environmental Science and Engineering, Inc. "Final Report: Development of Optimum Treatment System for Wastewater Lagoons, Phase II, Aqueous Thermal Decomposition Laboratory Testing." Prepared for USATHAMA. January 1985.
Document Type:	Contractor/Vendor Treatability Study
Contract:	Wayne Sisk U.S. DOD/USATHMA Aberdeen Proving Ground, MD 21010-5401 301-671-2054
Site Name:	USATHAMA
Location of Test:	Gainesville, Fla.

BACKGROUND: This study of innovative treatment techniques was for the restoration of hazardous-waste lagoons. The study was conducted by Environmental Science and Engineering, Inc. (ESE) for the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA). The results are detailed in a four-volume report (DRXTH-TE-83232, September 1983). The primary objective of the study was to identify and evaluate cost-effective restoration methods, implementable by the late 1980s, which would be both applicable to similar problems at a number of locations and easily transportable. Broad applicability of treatment was required, because lagoons at different installations are of various sizes, depths, and configurations and contain various amounts of water and sediments with a diverse range of contaminants.

OPERATIONAL INFORMATION: This report distinguishes organic and inorganic-ladened lagoons, and concentrates on the former. Organic-ladened lagoons contain primarily reactive organic residues that may be converted into nonreactive compounds. The state-of-the-art treatment technology for hazardous organic materials is incineration; therefore, incineration serves as a baseline for evaluating treatment alternatives. The ESE report identified two promising alternative treatment methods: aqueous thermal decomposition and solvent extraction. Aqueous thermal decomposition involves the heating of sediment in an aqueous medium, under pressure, to temperatures of 200° - 250°C.

This laboratory-scale study was conducted to test the technical feasibility of aqueous thermal decomposition for the treatment of explosives-ladened lagoon sediments. Aqueous thermal decomposition involves heating explosives-ladened material to temperatures of 200 to 250°C in aqueous media, under pressure. The experimental approach was to determine individual explosive chemical kinetic parameters in dilute aqueous solution, then to determine chemical kinetic parameters of mixed explosives in dilute aqueous solution. After kinetic parameters were determined, experiments were run using aqueous thermal decomposition of actual lagoon sediments.

PERFORMANCE: The conclusion of the report is that the data generated in this study will be used by USATHAMA for further evaluation for scale-up design.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of contaminants by treatability group is:

Treatability	CAS Number	Contaminant
W06-Nitrated Aromatic and Aliphatic Compounds	118-96-7	Trinitrotoluene (TNT)

Treatment Process:	Chemical Extraction and Soil Washing
Media:	Soil/Lagoon Sediment
Document Reference:	Environmental Science and Engineering, Inc. "Final Report: Development of Optimum Treatment System for Wastewater Lagoons Phase II - Solvent Extraction Laboratory Testing". Prepared for USATHMA, 85 pp. October 1984.
Document Type:	Contractor/Vendor Treatability Study
Contract:	Wayne Sisk U.S. DOD/USATHAMA Aberdeen Proving Ground, MD 21010-5401 301-671-2054
Site Name:	Ft. Wingate, NM; Navajo, AZ; and Shreveport, LA (NPL - Federal facility)
Location of Test:	Gainsville, FL

BACKGROUND: The U.S. Army surveyed innovative treatment techniques for restoration of hazardous waste lagoons and selected solvent extraction as cost-effective restoration for further study. This treatability study focuses on treatment of organic (explosive) contaminated lagoon sediments which are the result of munitions production operations. Primary contaminants of concern included the following explosives: TNT, DNT, RDX and Tetryl. This was a laboratory study of solid extraction where the solvent is used in excess and the effectiveness of a single contact is limited by the ability to physically separate the liquid and soil fractions. The treatability goal is to reduce explosive contaminant level to 10 mg/kg.

OPERATIONAL INFORMATION: Sediments tested were obtained from Navajo Army Depot (AD), AZ (predominantly volcanic cinders); Ft. Wingate AD, NM (mostly clay); and Louisiana Army Ammunition Plant. Explosive content of sediments ranged from 0.1-99% and moisture content ranged from 23.8-42.8%. (Report provides characteristics information on sediments.) Acetone was selected as the leaching agent based on the solubility of contaminants, cost, and availability. Laboratory tests included: solubility, leaching efficiencies, and settling tests. Solubility tests evaluated water/acetone ratios to determine optimum operational range for individual contaminants and mixtures. Leaching tests evaluated effectiveness of countercurrent extraction to determine contact time required for equilibrium of explosives between leachate and the sediments. Multiple leaching tests were performed by shaking sediment with acetone/water mixture in 1-liter graduated cylinders for 30 minutes followed by solid-liquid separation. Settling tests were performed on two soils with significant solid content to determine settling rate to aid in design of waste water treatment unit.

Report provides a discussion of sampling and analysis methods and provides limited QA/QC information.

PERFORMANCE: Laboratory leachability studies indicated that wet, explosive-ladened sediments can be effectively decontaminated by leaching with an acetone/water mixture. In general, three to four contact stages of 30 minutes each were required to reduce the explosives level to less than 10 mg/kg. A fifth contact stage with a 50% efficiency would have been required to achieve the goal for the Louisiana sediment. Solubility tests demonstrated a non-linear solubility of explosives with

acetone/water. Saturated solutions between 50 and 90% acetone form a two-phase liquid solution which should be avoided since this could hinder penetration of solvent through sediment. A conceptual treatment system design is provided based on results of tests. Calculated 4 stage removal efficiencies are shown in the bottom table.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO6-Nitrated Aromatics Compounds	118-96-7	Trinitrotolune (TNT)
	99-35-4	Trinitrobenzene (TNB)
	121-82-4	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)

TABLE 1

INITIAL SEDIMENT EXPLOSIVES CONCENTRATION, FINAL SEDIMENT EXPLOSIVES CONCENTRATION, AND CALCULATED 4-STAGE REMOVAL EFFICIENCIES

	Initial Explosives Concentrations (mg/kg)	Final Explosives Concentrations (mg/kg)	4-Stage Removal Efficiency (%)
Sediment Ft. Wingate AD	1,200	6.0	99.6
Navajo AD	19,000	7.0	99.96
Louisiana	420,000	17.0	99.996

Note: This is a partial listing of data. Refer to the document for more information

Treatment Process:	Bioremediation - Combine Biological
Media:	Soil/Generic
Document Reference:	GCA Corp. "Endangerment Assessment and Feasibility Study, Picillo Site, Coventry, Rhode Island." Vol. I, III. Prepared for U.S. EPA, OFfice of Waste Programs Enforcement. 15 pp. March 1985.
Document Type:	Contractor/Vendor Treatability Study
Contract:	Kenneth Wrenger Enforcement Project Manager U.S. EPA - Region I John F. Kennedy Federal Bldg. Room 2003 Boston, MA 02203 617-565-3637
Site Name:	Picillo Site, RI (NPL)
Location of Test:	Coventry, RI

BACKGROUND: This treatability study report consists of limited pages from the GCA Corp. Endangerment Assessment and Feasibility Study on the Picillo Site, Coventry, R.I. which reported on the change in contaminant concentrations in several stockpiles of soils. One stockpile containing phenol concentrations up to 870 ppm was landfarmed by spreading and irrigating the waste with microorganisms. Other stockpiles are mentioned but insufficient details are provided to determine treatment methods or results.

OPERATIONAL INFORMATION: Excavated soils were stockpiled in three impoundments. The soils in the area are mainly sand and gravel till. The largest pile (3500 cubic yards) has PCB contamination. A second stockpile (2000 cubic yards) which was contaminated with phenols was landfarmed by spreading the soil on an underdrain and liner system, and irrigating the soil. No details are provided on the microorganisms or other facts related to this irrigation.

PERFORMANCE: Concentrations of PCBs, phenols, and volatile organics were reduced by the treatment. In the large impoundment, concentrations of PCBs were decreased from approximately 700 ppm to an average of 37 ppm after 3 1/2 years by the use of landfarming. Several volatile organics were also present in this stockpile, although the concentrations were not discussed. Landfarming in the second impoundment reduced phenol concentrations from approximately 900 ppm to 70 ppm.

The limited data available does not allow the treatment performance to be accurately assessed. There is no one-to-one correspondence in the analysis of the influent and effluent concentrations. Some contaminants reported effluent concentrations greater than the influent concentrations.

There is no QA/QC information, however, a laboratory working for the state provided the analytical services.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminant
W09-Other Polar Organic Compounds	108-95-2	Phenol

Treatment Process:	Thermal Destruction - Rotary Kiln
Media:	Soil/Generic
Document Reference:	Roy F. Weston, Inc. "Incineration Test of Explosives Contaminated Soils at Savanna Army Depot Activity, Savanna, Illinois." Prepared for USATHAMA. Approximately 200 pp. April 1984.
Document Type:	ContractorVendor Treatability Study
Contract:	Wayne Sisk U.S. DOD/USATHAMA Aberdeen Proving Ground, MD 21010-5401 301-671-2054
Site Name:	Savanna Army Depot (NPL - Federal facility)
Location of Test:	Savanna, IL

BACKGROUND: The primary objective of these tests was to demonstrate the effectiveness of incineration as a decontami-nation method for explosives contaminated soils. A pilot-scale rotary kiln incinerator, manufactured by ThermAll, Inc., was used to treat both sandy and clayey soils which had been contaminated by waste-water from explosives production and demilitarization. The test was performed at Savanna Army Depot Activity (SADA), Illinois, the sandy soils came from SADA and the clayey soils were shipped in from the Louisiana Army Ammunition Plant (LAAP), Louisiana.

OPERATIONAL INFORMATION: The feed soil TNT concentrations ranged from 88,100 ppm to 406,000 ppm. The SADA soil was purposely excavated from more concentrated regions of the lagoon so that a higher destruction removal efficiency (DRE) could be achieved. There were 19 daily tests completed in 20 consecutive days. After the initial run at 500 lb/hr. and 800°F, elevated levels of explosives were detected in the ash, fabric filter ash, and flue gas. Therefore, subsequent runs were conducted on feed rates no higher than 400 lb/hr. and afterburner temperatures no lower than 1200°F. Each run was with approximately 1000 pounds of soil. Primary chamber temperatures of greater than 1400°F were not required.

In addition to these trial burns 25,000 pounds of soil were treated in a six day steady-state production run. This run was at 400 lb/hr, a primary chamber temperature of 1400°F and secondary chamber temperature of 1800°F. These conditions had consistently demonstrated complete destruction of explosives in the stack gas and kiln, ash and successfully disposed of all excavated test materials.

PERFORMANCE: The soil residence times could not be measured in the field, so they were estimated from the ash production rate. The residence time averaged 83 minutes for the SADA runs and 72 minutes for the LAAP runs.

TNT concentrations in the soil ash ranged from 2.55 to 26.9 ppm. Only RDX and TNB were detected on one occasion, each as a residual explosive or a combustion by-product in the ash. Ash residues were not hazardous due to the characteristics of EP Toxicity or reactivity.

The document concludes that this incineration system is transportable and can operate under a wide range of conditions. It also demonstrated that ash residues are non-hazardous and stack emissions measured were in compliance with all Federal and state regulations.

QA/QC procedures are included in the report and detailed in an appendix.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group was:

Treatability Group	CAS Number	Contaminant
W06-Nitrated Aromatics & Aliphatics	135-HMX	1,3,5,7-Tetranitro-octahydro-1,3,5,7-tetracyclo-octane (HMX)
	121-82-4	Hexahydro-1,2,5-trinitro-1.3.5-triazine (RDX)
	99-35-4	Triunitrobenzene
	118-96-7	Trinitrotoluene (TNT)
	25154-54-5	Dinitrobenzene
	T99--55-8	2-Amino-4,6-dinitrotoluene

Treatment Process:	Bioremediation - Composting
Media:	Soil/Lagoon Sediment
Document Reference:	Atlantic Research Corp. "Composting Explosives/Organics Contaminated Soils." Technical report prepared for USATHAMA. 198 pp. May 1986.
Document Type:	Contractor/Vendor Treatability Study
Contract:	Wayne Sisk U.S. DOD/USATHAMA Aberdeen Proving Ground, MD 21010-5401 301-671-2054
Site Name:	Badger Army Ammunition Plant (Non-NPL - Federal facility) and Louisiana AAP (NPL - Federal facility)
Location of Test:	Baraboo, WI and Shreveport, LA

BACKGROUND: Laboratory scale and pilot scale studies were conducted to evaluate composting to treat sediments and soils containing explosive and organic compounds. Sediment and soil from lagoons at Army ammunition plants, located in Louisiana, Wisconsin and Pennsylvania contained high concentrations of TNT, nitrocellulose, and RDX, and moderate levels of HMX and tetryl. Laboratory experiments using ^{14}C-labeled tracers were used to follow the fate of each explosive. Two types of composts (hay-horse feed and sewage sludge-wood shavings) and three rates of sediment/soil addition to the compost were utilized in these studies.

OPERATIONAL INFORMATION: Six 488 gallon tanks 5 feet in diameter and 4 feet in height were used as composters. These were placed in greenhouses. Two drums of contaminated sediment from a dredging mound were used. The composts were incubated at 60°C with continuous aeration for 6-10 weeks. Offgasses from the composts were monitored for ^{14}C and at the completion of the incubation, composts were analyzed for the explosives, extractable ^{14}C-labeled degradates and unextracted residual ^{14}C.

PERFORMANCE: TNT degraded rapidly in all the sewage sludge composts but breakdown in a hay-horse feed compost was adversely affected by the higher rates of sediment addition. Cleavage of the benzene ring during TNT breakdown did not appear to be significant.

RDX was almost completely degraded in composts amended with sediment during 10 weeks of incubation. Increased rates of sediment addition significantly decreased the rate of RDX breakdown in both hay-horse feed and to a lesser extent in sewage sludge composts. Substantial losses of 14C from the composts as $^{14}CO_2$ demonstrated that RDX is completely metabolized to natural products.

HMX did not degrade in the hay-horse feed composts, but levels were reduced by 30-50% during 10 weeks of incubation in the sewage sludge composts. HMX losses were lowest in the composts with the higher rates of sediment addition.

Tetryl was highly susceptible to degradation by composting. 90-100% tetryl was lost after composting for 44 days. Apparent rates of tetryl breakdown were not strongly influenced by the sediment loading rates.

The half-lives for TNT, RDX, and HMX using the hay-horse feed compost were 1.6, 3.0, and 4.7 weeks, respectively. No loss of explosives in the sewage sludge compost was observed during 7 weeks of composting. Half-lives of TNT, RDX, HMX, and tetryl in the compost of manure mixed with hay and saw dust were 1.0, 2.5, 3.3, and 1.2 weeks, respectively. In the sewage sludge composts 92-97% degradation of cellulose occurred within 4 weeks. Leaching of explosives and heavy metals from the composts was minimal. The economics of full scale composting are presented.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability	CAS Number	Contaminant
W06-Nitrated Aromatics & Aliphatics	118-96-7	Trinitrotoluene (TNT)
	121-82-4	Hexahydro-1,3,5-Trinitro-1,3,5,-triazine (RDX)
	135-HMX	1,3,5,7-Tetranitro-octahydro-1,3,5,7-tetracyclooctane (HMX)
	479-45-8	Tetryl
	9004-70-0	Nitrocellulose

Treatment Process:	Bioremediation - Composting
Media:	Soil/Sandy
Document Reference:	Atlantic Research Corp. "Composting of Explosives." Prepared for USATHAMA. 107 pp. September 1982.
Document Type:	Contractor/Vendor Treatability Study
Contract:	Wayne Sisk U.S. DOD/USATHAMA Aberdeen Proving Ground, MD 21010-5401 301-671-2054
Site Name:	Manufactured Waste (NPL - Federal facility)
Location of Test:	Aberdeen, MD (USATHAMA)

BACKGROUND: This treatability study was conducted by Atlantic Research Corporation for the U.S. Army Toxic and Hazardous Material Agency. The objective of this bench-scale study was to determine the extent to which TNT and RDX concentrations were reduced by composting for a six week period. A second objective was to determine if bench-scale composting studies accurately simulate the activity of larger composts by comparison of parallel studies monitoring TNT and RDX reductions in laboratory studies (50g dry weight) and pilot-scale greenhouse composts (10kg dry weight). A final objective of the study was to determine the leachability of TNT and RDX from the compost.

OPERATIONAL INFORMATION: Labeled 14C-TNT or 14C-RDX were used in the laboratory studies. Radio tracer compounds were utilized to determine the amount of explosives degraded and the mechanism of degradation by composting. Sandy soils were spiked with production grade explosives and a compost consisting of hay and horse feed. This mixture was incubated at approximately 55°C under aerobic conditions.

In the greenhouse studies, pilot-scale composts of approximately 10,000 g of sandy soil containing production grade TNT (2% by weight) RDX (1% by weight) were composted for four to six weeks. Aerobic conditions were maintained in these composts by a forced aeration system and frequent mixing. No external heat source was utilized.

PERFORMANCE: In the laboratory, TNT concentrations were reduced by 82.6% at the end of six weeks of composting. No significant quantities of 14CO2 were evolved, indicating that composting did not result in cleavage of the ring structure of the TNT molecule. Trace quantities of reduction products (4-amino-2, 6-dinitrotoluene and 2-amino-4, 6-dinitrotoluene) were found in one of three replicate composts after six weeks of composting. The RDX laboratory composts showed a reduction in the RDX concentration of 78.3% after six weeks of composting. Significant amounts of 14CO2 were produced by the RDX compost, indicating that cleavage of the RDX molecule occurred.

The greenhouse compost studies demonstrated a very rapid decrease in the TNT concentration. At the three week sampling time, the initial TNT concentration of 2% had been reduced by 99.9%. Analysis of the four week TNT compost extract confirmed that the TNT concentration in the composed material was below the detection limit of 16.9 ppm. Greenhouse composting of RDX resulted in a 61% reduction in the RDX concentration after three weeks from an initial concentration of 1%, with

total reduction of 82% following six weeks of composting. Reduction of RDX and TNT in the leachate to 13 ppm and 1.4 ppm respectively paralleled the above results.

QA/QC procedures for the study are not stated; however, the document does report several standard operational procedures for the laboratory analysis.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO6-Nitrated Aromatic and Aliphatics	118-96-7	Trintrotoluene (TNT)
	121-82-4	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
	Aliphatics	

Treatment Process:	Immobilization - Cement and Fly Ash Solidification
Media:	Soil/Clay
Document Reference:	Ecology and Environment, Inc. "Summary Report on the Field Investigation of the Sapp Battery Site." Jackson County, Florida. Approximately 170 pp. in two volumes. Technical report prepared for Florida Department of Environmental Regulation (FDER). November 1986.
Document Type:	Contractor/Vendor Treatability Study
Contract:	Kristen Teepen U.S. EPA - Region IV 345 Courtland Street, N.E. Atlanta, GA 30365 404-347-4727
Site Name:	Sapp Battery Site, Jackson County, FL (NPL)
Location of Test:	Jackson County, FL

BACKGROUND: This treatability study presents the results of field investigations at the Sapp Battery site in Florida, an abandoned battery recycling operation. The site is estimated to contain 14,300 cubic yards of soils with lead levels in excess of 1,000 ppm. The soils in the immediate vicinity of the site are a mixture of brown sand and yellow-brown sandy loam to a depth of five feet. A detailed QA/QC plan and analytical protocols are described in the second volume to the study. A sampling program and fixation study was conducted to evaluate cementitious and pozzolanic cementation technologies for leachate minimization potential. This abstract will focus on the fixation study and the ability of the processes evaluated to immobilize heavy metals.

OPERATIONAL INFORMATION: The cement base solidification process involves sealing the contaminated soil in a portland cement matrix. The pozzolanic process involves sealing the contaminated soil in a matrix of lime and fly ash. Soil samples from 0 to 5 and 5 to 10 foot depth intervals were composited and used. Analysis of the composite sample showed 7100 mg/kg of lead. Soil samples were mixed with varying percentages of solidification agent and water and allowed to set.

PERFORMANCE: Three pozzolanic, three cementitious solidification mixes and one control were prepared for the EP Toxicity leaching test. The results of the chemical fixation analysis are shown in the table on the next page. The results indicate that the cementitious mixture was much more effective in binding lead than the pozzolanic cement mixture (fly ash and lime). The portland cement mixture exhibited excellent binding capacity for all samples (1126A through C). Compared to the maximum allowable concentration of 5 mg/liter (EP Toxicity), the analysis of the fixed samples were at or near the lead detection limit. Lead concentrations in the leachate from the pozzolanic mixture were much higher than in the portland cement mixture. The authors offer no explanation for the difference but did indicate that the soils can be solidified to reduce lead concentrations in the leachate to acceptable levels. It is anticipated that cement requirements could be reduced and heavy metal control increased through process optimization.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W11-Volatile Metals	7439-92-1	Lead

NOTE: This is a partial listing of data. Refer to the document for more information.

TABLE 1

RESULTS OF CHEMICAL ANALYSIS OF EXTRACTS
FROM EP TOXICITY TESTS

	Samples				Maximum Allowable EP Samples Toxicity Concentrations (mg/l)
Pozzolanic					
E&E Lab Number 86-*	1126D	1126D	1126D		
Soil Identity	Ash: Lime: Soil	Ash: Lime: Soil 0.25 0.25:1	Ash: Lime: Soil 0.5:0.5:1	Blank 0.75:0.75:1	
Lead (mg/l)	76.4	<0.067.17	7.17	<0.06	5.0
Cementitious					
E&E Lab Number 86-*	1126A	1126B	1126C		
Sample Identity	Concrete: Soil	Concrete: Soil 0.5:1	Concrete: Soil 1:1	1.5:1	
Lead (mg/l)	0.085	<0.06	<0.06		5.0

* 86-1126 is a composite of 9 samples. The untreated composite sample has a lead concentration of 71,000 mg/kg. The EP Toxicity Test on the control sample (untreated composite soils material) yielded 59.4 mg/l.

Treatment Process:	Thermal Destuction - Infrared Incineration
Media:	Soil/generic
Document Reference:	Shirco Infrared Systems. "Final Report: On-Site Incineration of Shirco Infrared Systems Portable Pilot Test Unit, Times Beach Dioxin Research Facility, Times Beach, Missouri". Technical report prepared for U.S. EPA. Approx. 200 pp. November 1985
Document Type:	Contractor/Vendor Treatability Study
Contact:	U.S. EPA - Region VII 726 Minnesota Avenue Kansas City, KS 66101 913-236-2800
Site Name:	Times Beach Dioxin Research Facility, MO (NPL)
Location of Test:	Times Beach, MO

BACKGROUND: During the period of July 8 - July 12, 1985, the Shirco Infrared Systems Portable Pilot Test Unit was in operation at the Times Beach Dioxin Research Facility to demonstrate the capability of Shirco's infrared technology to decontaminate silty soil laden with 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) at a concentration range of 156 to 306 ppb. Emissions sampling and final analysis was performed by Environmental Research & Technology, Inc. (ERT), while laboratory analysis of the emissions and soil samples was performed by Roy F. Weston Inc. Shirco Infrared Systems prepared the testing procedure protocol and operated the furnace system.

OPERATIONAL INFORMATION: A single 55 gallon drum of contaminated road bed soil which had been screened through 1/2 inch mesh and homogenized in a mixer was used. Two primary furnace solid phase residence times were evaluated: 30 minutes and 15 minutes. Emissions and soil sample testing accompanied both of these tests. A consistent furnace feed rate averaging 47.7 lb/hr at a 1 inch bed depth was maintained during the 30 minute residence time test. The feed rate during the 15 minute residence time test averaged 48.1 lb/hr with a 0.75 inch bed depth.

An important process parameter during testing was chamber temperature, in both the primary and secondary chambers. Over the effective process length of the primary chamber, temperature was controlled in two equal length zones. During the 30 minute residence time test, the feed end zone maintained a nominal temperature of 1560°F and the discharge end zone maintained a nominal 1550°F. For the 15 minute residence time test, the respective temperatures were both 1490°F. The secondary combustion chamber was heated by a propane burner and its temperature was maintained above 2200°F during both tests. The nominal secondary chamber temperatures were 2250°F and 2235°F, respectively, for the 30 and 15 minute primary chamber residence time tests.

PERFORMANCE: For both tests, the soil discharge concentration of 2,3,7,8-TCDD was less than 38 parts per trillion. Based upon the expected detection limit of 50 picograms of 2,3,7,8-TCDD as measured by the Weston GC/MS system and the sampling volume capability of the ERT emissions test equipment, the feed rates were more than adequate to confirm the required 99.9999% Destruction Removal Efficiency (DRE). Particulate emissions were well below the standard of .08 gi/SCF @ 7% 02. Laboratory QA/QC procedures are discussed in the report.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO2-Dioxins/Furans/PCBs	1746-01-6	Tetrachlorodibenzo-p-dioxin (TCDD)

Treatment Process:	Chemical Extraction and Soil Washing
Media:	Soil/Silty
Document Reference:	Assink, J.W. "Extractive Methods for Soil Decontamination, A General Survey and Review of Operational Treatment Installations." Apeldoorn, Netherlands. Technical Report. 13 pp. November 1985.
Document Type:	Contractor/Vendor Treatability Study
Contact:	U.S. EPA, ORD HWERL Woodbridge Avenue Edison, NJ 08837-3579 212-264-2525
Site Name:	HWZ Bodemsanering, BV (Non-NPL)
Location of Test:	Netherlands

BACKGROUND: The two primary purposes of this document were (1) to present a general overview of extractive methods and their techniques for treating contaminated soil and (2) to review briefly several full scale extraction operations and to present some results of test runs at several sites in the Netherlands. In particular, the results of the tests performed at HWZ Bodemsanering, BV are discussed in the document. Only a general discussion and brief process description and schematic are presented.

OPERATIONAL INFORMATION: The soil washing process is described by the following steps:

(1) Separation of coarse materials (>10 mm)

(2) Intensive mixing of soil and water in order to disperse all soil particles and to scour off the contaminants (scrubbing)

(3) Washing of the soil with a suitable extracting agent in up-flow column (jet-sizing). The bottom stream consists of sand particles larger than approximately 100 um

(4) Dewatering of the cleaned soil

(5) Separation of coarse, low-density materials, e.g., cokes

(6) Separation of silt (approximately 50-100 um) by hydrocyclones. (This fraction is normally fed to the dewatering of sieve, but may also be handled separately.)

(7) The spent extracting agent is cleaned in a number of steps. Cleaning is carried out by pH-adjustment, coagulation, flocculation, sludge separation in a tiltable plate separator, removal of the surplus of added iron by aeration and flotation and finally a pH-adjustment. The cleaned extracting agent is recirculated to a great extent.

No QA/QC procedures, sampling and analysis procedures, or conclusions are reported.

PERFORMANCE: All types of contaminants may be removed from the soil by extraction if they can be dissolved in the extracting agent or dispersed in the extraction phase. Extraction is especially suitable for sandy soil, low in humus and clay content, because of the sand particles' (50-80 um) relatively high settling velocity. Sludge residue from this process generally has to be disposed of. The operational soil washing installations have proven successful for removing cyanides; PNAs (polynuclear aromatics) and mineral oil; heavy metals; halogenated hydrocarbons and other contaminants with efficiencies exceeding 80% (see Table 1).

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO8-Polynuclear Aromatics	TOT-PAH	Total Polycyclic Aromatic Hydrocarbons
W11-Volatile Metals	7439-92-1 7440-66-6	Lead Zinc
W12-Other Inorganics	57-12-5	Cyanide
W13-Other Organics	TOX	Total Organic Halogens

TABLE 1

CONTAMINANT REMOVAL EFFICIENCY

Concentration	Initial Concentration ppm	Final Concentration After Treatment ppm	Removal Efficiency % (approximate)
CN	100-200	approx 10	approx 95
PNA	36	0.7	98
EOC1	20-24	0.3-0.5	98-99
Zn	81	27	67
Pb	approx 100	approx 25	approx 75

Note: This is a partial listing of data. Refer to the document for more information.

Treatment Process:	Chemical Extraction and Soil Washing
Media:	Soil/Silty
Document Reference:	Assink, J.W. "Extractive Methods for Soil Decontamination, A General Survey and Review of Operational Treatment Installations." Apeldoorn, Netherland. Technical Report. 13 pp. November 1985.
Document Type:	Contractor/Vendor Treatability Study
Contact:	U.S. EPA, ORD HWERL Woodbridge Avenue Edison, NJ 08837-3579 212-264-2525
Site Name:	HWZ Bodemsanering, BV (Non-NPL)
Location of Test:	Netherlands

BACKGROUND: The two primary purposes of this document were (1) to present a general overview of extractive methods and their techniques for treating contaminated soil and (2) to review briefly several full-scale extraction operations and to present some results of test runs at several sites in the Netherlands. In particular, the results of the tests performed at HWZ Bodemsanering, BV are discussed in the document. Only a general discussion and brief process description and schematic are presented.

OPERATIONAL INFORMATION: The soil washing process is described by the following steps:

(1) Separation of coarse materials (>10 mm)
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(3) Washing of the soil with a suitable extracting agent in up-flow column (jet-sizing). The bottom stream consists of sand particles larger than approximately 100 um
(4) Dewatering of the cleaned soil
(5) Separation of coarse, low-density materials, e.g., cokes
(6) Separation of silt (approximately 50-100 um) by hydrocyclones. (This fraction is normally fed to the dewatering of sieve, but may also be handled separately)
(7) The spent extracting agent is cleaned in a number of steps. Cleaning is carried out by pH-adjustment, coagulation, flocculation, sludge separation in a tiltable plate separator, removal of the surplus of added iron by aeration and flotation and finally a pH-adjustment. The cleaned extracting agent is recirculated to a great extent.

No QA/QC procedures, sampling and analysis procedures, or conclusions are reported.

PERFORMANCE: All types of contaminants may be removed from the soil by extraction if they can be dissolved in the extracting agent or dispersed in low in humas and clay content, because of the sand particles' (50-80 um) relatively high settling velocity. Sludge residue from this process generally has to be disposed of. The operational soil washing installation have proven successful for removing cyanides; PNAs (polynuclear aromatics) and mineral oil; heavy metals; halogenated hydrocarbons and other contaminants with efficiencies exceeding 80% (see Tables 1).

CONTAMINANTS:

Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W08-Polynuclear Aromatics Aromatic	TOT-PAH	Total Polycyclic Hydrocarbons
W11-Volatile Metals	7439-92-1 7440-66-6	Lead Zinc
W12-Other Inorganics	57-12-5	Cyanide
W13-Other Organics	TOX	Total Organic Halogens

TABLE 1

CONTAMINANT REMOVAL EFFICIENCY

Contaminant	Initial Concentration ppm	Final Concentration After Treatment	Removal Efficiency % (approximate)
CN	100-200	approx. 10	approx. 95
PNA	36	0,7	98
EOC1	20-24	0,3-0,5	98-99
Zn	81	27	67
Pb	approx. 100	approx. 25	approx. 75

Note: This a partial listing of data. Refer to the document for more information.

Treatment Process:	Chemical Extraction and Soil Washing
Media:	Soil/Silty
Document Reference:	Assink, J.W. "Extractive Methods for Soil Decontamination, A General Survey and Review of Operational Treatment Installations." Apeldoorn, Netherlands. Technical Report. 13 pp. November 1985.
Document Type:	Contractor/Vendor Treatability Study
Contact:	U.S. EPA, ORD HWERL Woodbridge Avenue Edison, NJ 08837-3579 212-264-2525
Site Name:	Bodemsanering, Netherland, BV (Non-NPL)
Location of Test:	Netherlands

BACKGROUND: The purpose of this document is two fold. One is to give a general overview of extractive methods and their techniques for treating contaminated soil. The other is to briefly review several extraction operations and present some results of test runs performed at these sites. All sites are located in the Netherlands. The results of the Bodemsanering Netherland BV are discussed here. These operations are considered full scale. The installation of Bodemsanering Netherland (BSN) has been in operation since 1983 and was originally developed to separate oil from sandy soil. Its capacity is approximately 20 tons per hour, and the mobile installation is easy to transport to a contaminated site.

OPERATIONAL INFORMATION: The oil separation is based on a high pressure water jet curtain loosening the contaminants from the sand particles. The process is comprised of the following steps:

(1) Separation of coarse materials (>100 mm)
(2) High pressure washing
(3) Separation of coarse sand by sieves and hydrocylcones (>63 um)
(4) Separation of silt by sedimentation (30-63 um)
(5) Separation of process water, oil and fine mineral fraction (<30 um)
(6) Dewatering of the treated soil

Step 4 and 5 may be enhanced by coagulants and flocculants. The process usually uses water without any additives. This fact offers the option of additional microbiological treatment of the spent process water and/or the treated sand. The process water is recirculated to the high pressure separator.

No conclusions, QA/QC procedures, or sampling and analysis procedures are given; only a brief process description and process diagram.

PERFORMANCE: The operational soil washing installations have proven successful for removing cyanides; PNAs (polynuclear aromatics) and mineral oil; heavy metals; halogenated hydrocarbons and other contaminants with efficiencies exceeding 80% (see Table 1).

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W07-Heterocyclics and Simple Non-Hal. Aromatics	TOT-AR	Aromatic Hydrocarbons
W08-Polynuclear Aromatics	TOT-PAH	Total Polycyclic Aromatic Hydrocarbons
W13-Other Organics	CRUDE	Crude Oil

TABLE 1

CONTAMINANT REMOVAL EFFICIENCY

Contaminant	Initial Concentration ppm	Final Concentration After Treatment	Removal Efficiency % (approximate)
Aromatics	240	41	81
PNAs	295	15	95
Crude Oil	79	2.3	97

Note: This a partial listing of data. Refer to the document for more information.

Treatment Process:	Dechlorination
Media:	Soil/generic
Document Reference:	U.S. EPA. "Project Summary Report on the Feasibility of APEG Detoxification of Dioxin-Contaminated Soils." Technical report prepared by U.S. EPA ORD Industrial Environmental Research Laboratory, 5 pp. Cincinnati, OH. April 1984.
Document Type:	EPA ORD Report
Contact:	Charles Rogers U.S. EPA, ORD HWERL 26 W. St. Clair St. Cincinnati, OH 45268 513-569-7757
Site Name:	Denny Farm and Timberline Stables, MO
Location of Test:	Shenandoah Stables, MO

BACKGROUND: A pilot scale field study was conducted at Shenandoah Stables in Moscow Mills, Missouri, to evaluate the potential for alkali polyethylene glycolate (APEG) to dechlorinate 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,37,8-TCDD). This document is a summary of the study.

OPERATIONAL INFORMATION: The experimental design for the field study employed a Latin Square to compare five levels of treatments. The treatments were designated (1) APEG-treated and covered soils, (2) APEG-treated and uncovered soils, (3) not treated and covered soils, (4) not treated and uncovered soils, and (5) methoxypolyethylene glycol (MPEG) control and uncovered soils. In addition to this field study, two sections of arena bleachers were tested with APEG to determine the ability of the chemical reagent to decontaminate dust-covered surfaces. It is this data that is reported in the database.

No QA/QC procedures are mentioned in the document; however, it is reported that all analyses of the soil and bleacher samples for 2,3,7,8-TCDD were performed under the auspices of the Superfund National Dioxin Study.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W02-Dioxins/Furans/PCBs	1746-01-6	2,3,7,8-Tetra-chloro-dibenenzo-p-dioxin (TCDD)

Treatment Process:	Dechlorination
Media:	Soil/Generic
Document Reference:	Tierman, T.O., Ph.D., "Development of Treatment Data on the KPEG Process for CERCLA/BDAT Standards" Approximately 60 pp. Prepared for U.S. EPA, HWERL. January 1988.
Document Type:	Contractor/Vendor Treatability Study
Contact:	C. Rodgers U.S. EPA, HWERL Cincinnati, OH 45268 513-569-7757
Site Name:	BDAT SARM - Manufactured Waste (Non-NPL)
Location of Test:	Wright State University, Dayton, Ohio

BACKGROUND: This report describes the results of laboratory studies on KPEG treatment of synthetic soils contaminated with a variety of compounds, both organic and inorganic. The U.S. EPA provided soils to Wright State University to conduct the KPEG study. Problems were encountered in obtaining homogeneous soil samples and in the analysis of contaminants in the soils and in the analysis for VOCs in the reaction products of the KPEG treatment tests.

OPERATIONAL INFORMATION: EPA provided 50 pounds each of four different standard analytical reference matrix (SARM) samples which were prepared under a separate work assignment. Each of the soil samples were spiked with different concentrations of known volatile organic compounds (ethylbenzene, xylene, tetrachloroethylene, chlorobenzene, styrene, 1,2-dichloroethane and acetone), three semi-volatiles (anthracene, bis (2-ethylphenyl) phthalte and pentachlorophenol) and seven metals (Cd, Ca, Cr, Pb, As, Ni and Zn). The authors found the SARM soil samples to be non-homogenous with condensation and pooling of the liquid contaminants occurring in the soil samples. Samples could not be homogenized due to the high moisture content of the sample. 500 gram aliquots of the SARM soils were removed, placed in a two liter reaction vessel and reacted with KPEG for 1 hour at 100°C to observe if the KPEG process effectively removed certain contaminants. The KPEG reagent was provided by the U.S. EPA. Samples before and after treatment were measured by purge/trap GC/MS. The analytical procedures had to be extensively modified due to the high levels of contaminants present in the reaction products. The author attributed the substantial scatter in the results to the problem of the non-homogenous SARM that were used. Heavy metal analyses were performed by an EPA CLP Laboratory.

PERFORMANCE: The metal analysis in treated and untreated samples revealed that KPEG treatment and subsequent water washing did not reduce the metal concentrations. Overall metal materials balance was poor. The volatile and semi-volatile organic data also exhibited very poor mass balance and a large scatter in results. However, the KPEG appears to have reacted with and essentially completely destroyed dichloroethane and tetrachloro-ethylene. The other two chlorinated organics were not destroyed since temperatures higher than 100°C are required to dechlorinate these compounds.

The other organic compounds, xylene, ethylbenzene and styrene do not appear to be destroyed by this treatment. The acetone data is suspect due to volatility problems, instrument saturation, etc. A QA review could not be conducted due to the enormous concentrations of the analyte present in the various samples and the inapplicability of EPA analytical methods. The analytical data obtained are believed to be, at best, semi-quantitative indicators of the KPEG processes ability to treat contaminated soils.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminates by treatability group is:

Treatability Group	CAS Number	Contaminants
WO1-Halogenated Aromatic Compounds	108-90-7	Chlorobenzene
WO3-Halogenated Phenols, Cresols and Thiols	87-86-5	Pentachlorophenol
WO4-Halogenated Aliphatic Solvents	107-06-2 127-18-4	1,2-dichloroethane Tetrachloroethene
WO7-Heterocyclics and Simple Aromatics	100-41-4 100-42-5 1330-20-7	Ethylbenzene Styrene Xylene (total)
WO8-Polynuclear Aromatics	120-12-7	Anthracene
WO9-Other Polar Organic Compounds	67-64-1 117-81-7	Acetone bis (2-ethyl hexyl) phthalate
W10-Non-Volatile Metals	7440-47-3 7440-50-8 7440-02-0	Chromium Copper Nickel
W11-Volatile Metals	7440-38-2 7440-43-9 7439-92-1 7440-66-6	Arsenic Cadium Lead Zinc

Treatment Process:	Thermal Destruction - Incineration
Media:	Soil/Lagoon Sediment
Document Reference:	Atlantic Research Corp. "Engineering and Development Support of General Decon Technology for the U.S. Army's Installation/Restoration Program." Prepared for USATAHMA under contract DAAK11-80-C0027. Four volumes with a total of approximately 500 pp. April-June 1982.
Document Type:	Contractor/Vendor Treatability Study
Contact:	Wayne Sisk U.S. DOD/USATHAMA Aberdeen Proving Ground, MD 21010-5401 301-671-2054
Site Name:	Louisiana Army Ammunition Plant (NPL - Federal facility)
Location of Test:	Atlantic Research Corp., Alexandria, VA

BACKGROUND: This document reports on the results of bench scale tests of treatment technologies for explosive-containing sediment located in lagoons at Army ammunition plants. A companion literature search identified the appropriate explosives remediation technologies to be evaluated. Cost estimates for various treatment technologies were made based on the laboratory data.

OPERATIONAL INFORMATION: Sediment samples contaminated with the explosives TNT, RDX, tetryl and nitro cellulose from the Louisiana Army Ammunition Plant were used in the laboratory tests. Explosive levels in lagoon #4 sediments were at or below 1000 ug/g. Samples from lagoons 9 and 11 had much higher RDX and TNT levels (1000 to 109,000 ug/gm of soil). The report contains a detailed QA/QC plan and analytical protocol.

PERFORMANCE: Incineration tests were conducted by placing approximately 4g of sediment in a crucible and placing the crucibles in a muffle furnace for varying amounts of time. Residues were analyzed for contaminants of interest. Table 1 shows the results of the incineration tests. Incineration at temperatures as low as 300-500°C for 30 minutes time can remove all the contaminants from the sediments. While all of the explosives can be reduced to their detection limits at the lower temperatures, it is possible that some toxic decomposition products may remain. It is, therefore, important to use temperatures which reduce the total organic contents as measured by chemical oxygen demand (COD) to acceptable levels. This can be accomplished at temperatures of 500°-700°C and reaction times of 30 minutes. Since explosive volatilization may occur, it will be important in a pilot scale study to determine whether any vaporized explosivescan be detected in the exhaust gases. Costs for treatment can vary from $100,000/year to $2,000,000/year depending on the water content of the slurry that is incinerated. In addition to incineration, acetone extraction, gamma irradiation, wet air oxidation, and water extraction tests were conducted and results reported in this document. Of the five procedures tested only incineration and acetone extraction proved effective in removing contaminants from sediments. Incineration equipment is available and pilot tests were recommended.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO6-Nitrated Aromatics and Aliphatics	121-82-4	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
	118-96-7	Trinitrotolune (TNT)
W10-Non-Volatile Metals	479-45-8	Trinitrophenylmethyl-nitramine (tetryl)
	7440-47-3	Chromium
W11-Volatile Metals	7439-92-1	Lead
W12-Other Inorganics	7440-43-9	Cadmium
	COD	Chemical Oxygen Deman

TABLE 1

INCINERATION OF LAGOON 9 SEDIMENT - EXPLOSIVES LEVELS

		Concentration in Dry Sediment			
Temperature °C	Time (min)	TNT (ug/g)	RDX (ug/g)	Tetryl (ug/g)	COD (ug/g)
No heat		424,000	159,000	15,800	206,000
200	5	10,000	<1	114	124,500
	30	1,500	<1	<0.3	116,500
	60	1,350	<1	<0.3	149,000
300	5	<2	<1	<0.3	55,200
	30	<2	<1	<0.3	52,300
	60	<2	<1	<0.3	30,000
500	5	<2	<1	<0.3	5,900
	30	<2	<1	<0.3	2,190
	60	<2	<1	<0.3	1,280
700	5	<2	<1	<0.3	8,720
	30	<2	<1	<0.3	1,310
	60	<2	<1	<0.3	2,320
900	5	<2	<1	<0.3	12,200
	30	<2	<1	<0.3	2,410
	60	<2	<1	<0.3	1,670

Note: This is a partial listing of data. Refer to the document for more information.

Treatment Process:	Thermal Destruction - Circulating Bed Combustion (CBC)
Media:	Soil/generic
Document Reference:	GA Technologies, Inc. "PCB Destruction Facility Circulating Bed Combustor." Technical report prepared for U.S. EPA. 24 pp.; December 1985.
Document Type:	Contractor/Vendor Treatability Study
Contact:	Hiroshi Dodohara Ogden Environmental Services, Inc. P.O. Box 85178 San Diego, CA 92138-5178 619-455-2383
Site Name:	Gulf Oil Corp., Berkley Heights, NJ (Non-NPL)
Location of Test:	Berkley Heights, NJ

BACKGROUND: This treatability study reports on an evaluation of a pilot-scale, transportable, circulating bed combustor (CBC) for the incineration of PCB contaminated soils. This May 1985 test was a demonstration to support a permit application for operation in California.

OPERATIONAL INFORMATION: The CBC demonstration utilized a spiked soil (10,000 ppm PCB concentration) at a feed rate of 400 pounds per hour and a CBC operating temperature of 1800°F. No information was provided on the soil. Three four-hour runs were completed; however, because problems occurred in the sampling of particulates in the initial test, a fourth abbreviated run of two hours was conducted solely for collecting a particulates sample. Three supplementary runs were conducted to evaluate low combustion temperatures (1625°F) and to incinerate PCB-contaminated soil. Feed soil, fly ash, and bed ash were sampled and analyzed. Stack emissions samples were collected for particulates, semi-volatile organics, and volatile organics.

PERFORMANCE: Destruction Removal Efficiencies (DREs) ranged from 99.9999% to 99.995% for PCB except for 1 run which resulted in a 99.82% efficiency. No significant PCB stack emissions were indicated. Particulate stack emissions during one test did not meet the standard for stationary air point sources. High particulate emissions were attributed to a high process air supply inadvertently applied to the air bag filtration unit. Another significant test value was the residual dioxin and furan in the treated soil. High values of 1.33 ppb for dioxins and furans were indicated in the fly ash.

Several operational problems were reported. The damp, irregularly shaped soil feed material used during the trials clogged the transfer ducts in the unit. Agglomeration of the soil also occurred in the combustor bed, affecting mixing efficiency with direct reduction in the combustion efficiency.

Other problems occurred with the stack sampling method. During one stack sampling sequence, fly ash was inadvertently dispersed throughout the operating bay, resulting in the evacuation of the entire office/pilot plant building. Siloxanes were present in the stack gas stream and interfered in the laboratory procedures to analyze the stack gas samples. However, the siloxanes may have been from silicone sealant which was used to install an in-line oxygen monitor, or from silicone rubber sealants in the sampling trains or similar sources. The demonstration trial runs and the supplementary tests indicated that the formation of agglomerates affected the combustion efficiency of the CBC unit, and increased the emission of products of incomplete combustion (PICs).

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminant
W01-Halogenated Aromatic Compounds	TOT-TCB	Total Trichlorobenzenes
W02-Dioxins/Furans/PCBs	11096-82-5	PCB-1260
	12672-29-6	PCB-1248

Treatment Process:	Immobilization - Cement Solidification
Media:	Soil/Sand and Slit
Document Reference:	Firestone Resource, Inc. (Three Documents). "Soil Stabilization Pilot Study, United Chrome NPL Site, Corvallis, Oregon" and "Quality Assurance/Quality Control Plan United Chrome NPL Site Pilot Study" and "Health and Safety Program, United Chrome NPL Site Pilot Study." Technical reports prepar4ed for U.S. EPA - Region 10 and DEP of Oregon. Approximately 45 pages. February 1987
Document Type:	Contractor/Vendor Treatability Study
Contact:	John Barich U.S. EPA - Region X Hazardous Waste Division 1200 Sixth Avenue Seattle, WA 98101 206-442-8562
Site Name:	United Chrome, OR (NPL)
Location of Test:	Corvallis, OR

BACKGROUND: This document is a project plan for a pilot study at the United Chrome NPL site, Corvallis, Oregon and includes the health and safety and quality assurance/quality control plans. The plan reports results of a bench scale study of the treatment process as measured by the Toxicity Characteristic Leaching Procedure (TCLP) test. The purpose of this study, conducted by Firestone Resources Inc., was to evaluate the effectiveness of soil stabilization technologies to reduce the leaching of heavy metals and to "pretreat" contaminated soils for subsequent off-site management.

OPERATIONAL INFORMATION: The data available from this 1985 study are bench scale data involving 1400 pounds of soil from the Western Processing NPL site which was generated to support the proposal/work plan for the United Chrome NPL site. Three commercial soil stabilization vendors submitted to EPA 14 stabilized soil cylinders representing the "best achievable performance" of their technology. One of the bench tests was performed by Firestone Resources, Inc. (FRI). The FRI treatment process consisted of using an inorganic polymer with cement that was applied to the excavated site soil. The extraction protocol used in the analysis was TCLP, and both treated and untreated soil were analyzed. Region 10 confirmed with these bench tests that soil stabilization as performed by these vendors is effective in reducing leach rate of heavy metals in sands/silt matrices with little organic co-contamination.

Contained in the document is site description data, work plan description data, and a proposed sample analysis plan.

The QA/QC plan for the pilot test is an attachment to the first volume of the study, and is extensive in the referenced methodology.

PERFORMANCE: The bench tests indicated reduction of heavy metal leachate concentrations to low levels as measured by TCLP procedures. The results of the FRI test are shown in the bottom table. Through groundwater modeling using as inputs the reductions in leachate strength as measured by these tests, soils stabilization was demonstrated to be capable of achieving water quality criteria at the Western Processing test site. Pilot demonstration of this treatment process is planned for the United Chrome NPL site.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W10-Non-Volatile Metals	7440-39-3	Barium
	7440-47-3	Chromium
	7440-50-8	Copper
	7440-02-0	Nickel
W11-Volatile Metals	7440-43-9	Cadium
	7439-92-1	Lead
	7440-66-6	Zinc

TABLE 1

TCLP LEACHATES FROM THE WESTERN PROCESSING NPL SITE

Contaminant	Soil Leachate	Stabilized Soil	Percent Reduction
Zinc	123,700	38.5	99.97%
Lead	12,115	15.5	99.87%
Barium	1,165	ND	100.00%
Copper	227.5	32	85.93%
Nickel	107	ND	100.00%
Chromium	50	35	30.00%
Cadium	17	0.4	97.65%

Notes:
a) All concentration in ug/1
b) ND - Not Detectable
c) This is a partial listing of data. Refer to the document for more information.

Treatment Process:	Dechlorination
Media:	Soil/Generic
Document Reference:	U.S. EPA. "Preliminary Report on Treatment/Detoxification Alternatives for PCBs and Chlorinated Organics." U.S. EPA ORD, HWERL. Cincinnati, Ohio. 31 pp. September 1985.
Document Type:	EPA ORD Report
Contact:	Charles Rogers U.S. EPA, ORD-HWERL 26W St. Clair Street Cincinnati, OH 45268 315-569-7757
Site Name:	Manufactured Waste (Non-NPL)
Location of Test:	Buffalo, NY

BACKGROUND: The EPA Hazardous Waste Engineering Research Laboratory (HWERL) report summarizes the development of systems to dechlorinate polychlorinated biphenyls (PCBs), chlorinated dibenzo-p-dioxins (PCDDs) and chlorinated dibenzofurans (PCDFs) using a series of reagents prepared from alkali metals and polyethylene glycols (KPEG).

OPERATIONAL INFORMATION: The data for this document are pilot-scale data for the KPEG-350 slurry process and bench-scale data with various reagents for the slurry.

The pilot-scale slurry process was tested on a Buffalo, NY PCB contaminated site on July 15-20, 1985. The slurry reactor was a 55-gallon metal drum equipped with a lid, electric heating tape and a rocking mechanism that mixed reagent into soil. The original PCB concentration in soil ranged from 22-66 ppm. Approximately 150 lbs. of soil were added to the reactor along with 50 lbs. of reagent. The treatment time ranged from 2-2.5 hours at temperatures of 75°-100°C. PCBs were reduced from 22-66 ppm to less than 1 ppm after 2.5 hours of reaction with more than 90% of the reagent recovered for reuse.

The bench scale data included several of the tests conducted on the effects of radio-frequency (RF) heating on the in-situ process. The document reports that RF heating of the soil was effective.

PERFORMANCE: The report indicates PCBs and dioxin concentrations can be reduced to less than 1 ppm and 1 ppb respectively by the slurry process. The document concludes that the in-situ process under ambient conditions is not as effective as the slurry process in the destruction of PCB- or PCDD-contaminated soils. It should also be noted that the document does not report any analysis on transformation products. This needs to be addressed, because when chemically altering PCBs, it is necessary to know what the transformation products are and their potential toxicities.

Costs of the process are estimated at $100 to $300/ton with the in-situ cost being higher due to reagent loss. The document reports on some methodology, procedures, and QA/QC protocols and indicates gas chromatograph/mass spectroscopy as the primary method of analysis. Laboratory QA/QC is not discussed in detail.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W02-Dioxins/Furans/PCBs	1336-36-3	Total PCBs

Treatment Process:	Chemical Extraction and Soil Washing
Media:	Soils
Document Reference:	Brugger, John, et al, "Development of a Mobile System for Extracting Spilled Hazardous Material from Soil." U.S. EPA. Risk Reduction Engineering laboratory, Edison, NJ.
Document Type:	Journal Paper
Contact:	Dr. J. Brugger Risk Reduction Engineering Laboratory
Site Name:	Not Applicable - Treatability Studies
Location of Test:	Edison, New Jersey; Milwaukee, WI; Northbrook, IL

BACKGROUND: This treatability study was conducted by the U.S. EPA Risk Reduction Engineering Laboratory. The purpose of the work was to establish the feasibility of extraction for removal of hazardous chemicals from soil and then to design and construct a mobile unit (soil scrubber) for treating hazardous chemical spills onto soil.

The project was approached in three phases. Phase 1 involved establishing the feasibility of the extraction approach. Phase 2 was to include detailed design and construction and Phase 3 tested the unit. This study focused on the results obtained during Phase 1.

OPERATIONAL INFORMATION: Various equipment types were reviewed and their advantages and disadvantages were listed. A water knife system was chosen to provide physical stripping and lump breakdown. A counter-current extraction procedure using hydrocylcone separators was chosen because of cost and capacity constraints. The testing approach was developed with this equipment basis.

Soil types were chosen to represent a range of adsorption capacities and soil structures. Therefore, an organic peat soil with a high organic and water content and an inorganic sand with silt and clay were chosen.

Phenol, a water soluble organic was chosen to establish the basic effectiveness of the scrubbing technique. PCBs were chosen to represent a low-water soluble organic with a high affinity for soils, and arsenic trioxide was used to define the limitations with an inorganic metal having strong affinity for soils.

Tests were set up to simulate a spill situation. Plexiglas columns were packed with clean soils, dosed with chemicals, and allowed to stand for twenty-four hours. This contaminated soil was then treated using laboratory scale procedures by using a water knife and counter current extraction with various water solutions. The resultant solutions were then analyzed for contaminants. No discussion of analytical techniques is contained in the paper. Extraction solution additive concentration and wash solution contact time were varied in the tests.

PERFORMANCE: The lab results indicate that soil scrubbing can be an effective treatment technique in certain circumstances. The contaminants which have the highest potential for effective treatment are those with high water solubility and greater affinity for water than for soil. Phenol remove efficiency from an inorganic soil reached 99% using the procedure. Arsenic removal efficiency ranged from 29 to 59% while PCB efficiency was relatively low, 21 to 28%. The effectiveness of the

extraction can be increased by using additives, such as surfactant and salts, in the wash solutions. Arsenic can be removed to about 50 percent of its original amounts, however, remaining concentrations are still too high for reuse or disposal by alternate methods. PCBs were difficult to remove. Further testing would be desirable to establish the system applications.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W02-Dioxins/Furans/PCB	1336-36-3	Total PCBs
W09-Other Polar Organic Compounds	108-95-2	Phenol
W11-Volatile Metals	7440-38-2	Arsenic

Treatment Process:	Thermal Destruction - Rotary Kiln Incineration
Media:	Soil/Sandy
Document Reference:	AFESC, Tyndall AFB. "Full Scale Rotary Kiln Incinerator Field Trial: Phase I, Verification Trial Burn on Dioxin/Herbicide Orange Contaminated Soil." Internal technical report. 21 pp. Undated.
Document Type:	Contractor/Vendor Treatability Study
Contact:	Major Terry Stoddart U.S. DOD/AFESC Bldg. 1117 Tyndall Air Force Base, FL 32403 904-283-2949
Site Name:	Naval Construction Battalion Center, Gulfport, MS (Non-NPL- Federal facility)
Location of Test:	Gulfport, MS

BACKGROUND: This treatability study reports on the results of one of a series of field trials using various remedial action technologies that may be capable of restoring Herbicide Orange (HO)/Dioxin contaminated sites. A full-scale field trial using a rotary kiln incinerator capable of processing up to 6 tons per hour of dioxin contaminated soil was conducted at the Naval Construction Battalion Center, Gulfport, MS.

OPERATIONAL INFORMATION: Concentrations of HO on the site range from less than 0.1 ppb to over 500 ppb. It was estimated that a total of 11,000 tons of sandy or sandy loam soils contaminated with HO could be excavated and treated. The ENESCO mobile incinerator used in the test was capable of treating 100 tons of dioxin contaminated soil daily. The system successfully demonstrated 99.9999% Destruction Removal Efficiency (DRE) for PCB and Dioxin surrogates. In the incinerator, the soil was heated to 1000-1800°F in the rotary kiln which burned or volatilized all the gases. The gases were then drawn into a secondary combustion chamber (SCC) operated at 2000-2400°F for 2.2 seconds in an excess O_2 atmosphere to ensure complete combustion. The residence time of the contaminated soil in the rotary kiln could be varied from 30 to 60 minutes by altering the kilns' rotation speed and/or the angle of attack. Air pollution control equipment on the system included cyclones for particulate control, a packed tower, a scrubber and a 35 foot stack. The packed tower removed HCl from the gas stream. The scrubber was designed to remove additional HCl and larger particulates (>3 um).

PERFORMANCE: The trial burns were structured to evaluate system performance at various feed rates to ensure the mobile incinerator could be operated over a range of conditions with minimal environmental impacts. A total of five individual tests were conducted with contaminated soil feed rates ranging from 2.6 to 6.3 tons/hour. The unit would be brought to steady state temperatures and the sampling of the feedstock, treated soil and stack gases would be initiated. The "running time" of each test was dictated by the time required to collect a stack gas sample. The results of five different trial runs revealed that the incinerator is capable of removing dioxin and HO from the soil matrix to concentrations not detectable at 10 ug/kg (10 ppb). The results of a test run are shown in the table on the following page. The only operational problem resulted from wet soil from heavy rains. Soil drying should solve the problem.

EPA dioxin protocols from SW 846 were followed. These tests were consideredsuccessful and follow-up tests on incinerator reliability, maintainability, and cost effectiveness are planned. The treated soils should be delistable under RCRA based on the data.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W02-Dioxins/Furans/PCBs	93-76-5	2,4,5-Trichlorophenoxyacetic acid (2,4,5-T)
	94-75-7	2,4-Dichlorophenoxyacetic acid (2,4-D)
	1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin
	F1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-furan
	OCDD	Octachlorobenzodioxins
W03-Halogenated Phenols, Cresols and Thiols	95-95-4	2,4,5-Trichlorophenol
	34DCP	3,4-Dichlorophenol
		3,4-Dichlorophenol

Note: This is a partial listing of data. Refer to the document for more information.

Treatment Process:	Chemical Extraction and Soil Washing
Media:	Soil/Sandy
Document Reference:	Science Applications International Corporation. "Treatment of Contaminated Soils with Aqueous Surfactants (Interim Report)" and "Project Summary: Treatment of Contaminated Soils with Aqueous Surfactants." Prepared for U.S. EPA, HWERL, ORD. 46 pp. December 1985.
Document Type:	EPA ORD Report
Contact:	Richard Traver U.S. EPA, ORD HWERL - Release Control Branch Woodbridge Avenue Edison, NJ 08837 201-321-6677
Site Name:	Manufactured Waste (Non-NPL)
Location of Test:	NWERL/EPA ORD Cincinnati, OH

BACKGROUND: This treatability study reports on the results, conclusions and recommendations of a project performed to develop a technical base for decisions for the use of surfactants in aqueous solutions to wash soils in-situ. The study reports on the selection of soil and contaminants, the test equipment and methods, the results of the various surfactant concentrations tested and the results of tests to remove the surfactants from the leachate.

OPERATIONAL INFORMATION: Aqueous nonionic surfactants, high boiling point crude oil, PCBs and chlorophenols were selected for testing. A fine to coarse loamy soil with 0.12 percent TOC by weight and permeability of 10^{-3}cm/s was selected for testing. Shaker table partitioning experiments were conducted to determine the minimum surfactant concentration required to accomplish acceptable soil cleanup. This was done for each of the selected contaminants. The soil was spiked and packed in a 3 inch by 5 ft. column for washing. Recycling of washing solution was tested and cleaning of the contaminants from the surfactant solution was tested.

PERFORMANCE: The extent of contaminant removal from the soil was 92 percent for the PCBs, using 0.75 percent each of Adsee 799 (Witco Chemical) and Hyonic NP-90 (Diamond Shamrock) in water. For the petroleum hydrocarbons, the removal with a 2 percent aqueous solution of each surfactant was 93 percent. Water alone removed all but 0.56 percent chlorophenol after the tenth pore volume of water. Leachate treatment alternatives of foam fractionations, sorbent adsorption, ultrafiltration and surfactant hydrolysis were tested in the laboratory. The tests were able to concentrate the contaminants in the wastewater to facilitate disposal, and clean the water enough to allow for reuse or disposal in a publicly owned treatment works. The study recommends further tests on other surfactants, in particular their amenability to separation and reuse. Report concludes that the use of aqueous surfactants is a potentially useful technology for in-situ cleanup of hydrophobic and slightly hydrophilic organic contaminants in soil.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W02-Dioxins, Furans, PCBs	1336-36-3	Total PCBs
W03-Halogenated Phenols, Cresols and Thiols	87-86-5	Pentachlorophenol (PCP)

Treatment Process:	Thermal Destruction - Rotary Kiln
Media:	Soil/Generic
Document Reference:	PEI Associates, Inc. "BDAT Incineration of CERCLA SARMS at the John Zink Company Test Facility (Final Project Report)." Technical report prepared for U.S. EPA, ORD, HWERL, Cincinnati, OH 375 pp. November 1987.
Document Type:	EPA ORD Report
Contact:	Robert Thurnau U.S. EPA-ORD 26 W. St. Clair Street Cincinnati, OH 45268 513-569-7629
Site Name:	BDAT SARM-Manufactured Waste (Non-NPL)
Location of Test:	ORD-Edison, NJ

BACKGROUND: This report presents the results of a treatability study of rotary kiln incineration of a synthetic "Superfund soil" bearing a wide range of chemical contaminants typically occurring at Superfund sites. This surrogate soil is referred to as a synthetic analytical reference matrix (SARM), and was composed of clay, sand, silt, topsoil, and gravel. Two concentrations of contaminants were added to this material to produce SARM I and SARM II; volatile and semivolatile organics (3000 ppm in SARM II and 30,000 ppm in SARM I), and metals (1000 ppm in SARM I and II).

OPERATIONAL INFORMATION: Three 4-hour test burns were conducted on each SARM at the John Zink pilot plant facility in Tulsa, Oklahoma using a rotary kiln incineration system capable of handling 1000 lb/hr of low BTU solids. The runs were conducted on September 16-18, 1987. The temperature and feed rates were reasonably close to the goals of 1800°F in the kiln, 2000°F in the secondary chamber, and nominal feed rates of 1000 lb/hr. Excess air was maintained at about 3% in the kiln and about 5% in the secondary. Emissions of O_2, CO_2, and CO were steady throughout the tests.

PERFORMANCE: The contaminant concentrations in the ash, scrubber water, and flue gas were measured to evaluate the performance of the treatment. Little or no volatiles were measured in the ash, except for acetone and phthalate, and these appear to be due to sample contamination. Metal concentrations in the ash were unexpectedly low (50 to 80% lower than in the feed). As expected, cadmium was at least 99.9% lower in the ash, due to volatilization. Only arsenic concentrations increased in the ash (more than double the concentrations in the feed). The scrubber water was essentially free of all organics, and contained only low ppm concentrations of metals. Critical emission parameters (oxygen, HCl, and CO) were within RCRA allowable limits. The DRE performance standard of 99.99% was achieved for the designed critical principal volatile organic contaminants for each SARM type. The DRE for the principal semi-volatile organic contaminants show that anthracene was effectively destroyed. DRE data for bis(2-ethylhexyl)phthalate showed three runs meeting the 99.99% criteria.

The document discusses QA/QC procedures in detail.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W01-Halogenated Aromatic Compounds	108-90-7	Chlorobenzene
W03-Halogenated Phenols, Cresols and Thiols	87-86-5	Pentachlorophenol
W04-Halogenated Aliphatic Solvents	107-06-2	1, 2-Dichloroethan
	127-18-4	Tetrachloroethene
WO7-Heterocyclics and Simple Aromatics	100-41-4	Ethylbenzene
	100-42-5	Styrene
	1330-20-7	Xylenes
WO8-Polynuclear Aromatics	120-12-7	Anthracene
WO9-Other Polar Organic Compounds	67-64-1	Acetone
	117-81-7	Bis(2-ethylhexyl)phthalate
W10-Non-Volatile Metals	7440-02-0	Nickel
	7440-47-3	Chromium
	7440-50-8	Copper
W11-Halogenated Non-Polar Aromatic Compounds	7439-92-1	Lead
	7440-43-9	Cadmium
	7440-66-6	Zinc

Treatment Process:	Chemical Extraction and Soil Washing
Media:	Soil/Sandy
Document Reference:	Summary report. "Harbauer Soil Cleaning System." 10 pp. Received at U.S. EPA Headquarters on November 10, 1987
Document Type:	Contractor/Vendor Treatability Study
Contact:	W. Werner, President Harbauer, Inc. Berlin, West Germany
Site Name:	Pintsch Oil Site (Non-NPL)
Location of Test:	Berlin, West Germany

BACKGROUND: This document reports on the use of a soil cleaning system to remove contaminants from various types of soils by washing and concurrently vibrating the soils to force the contaminant into the liquid phase. The system was developed by Harbauer and is being used in Berlin, Germany at a site contaminated with waste oils.

OPERATIONAL INFORMATION: The contaminated soil is mixed with the extractant liquid and introduced into a decontamination chamber. The chamber contains a device resembling a giant auger to which mechanical energy is applied axially in the form of vibrations. Separation is achieved continuously as the contaminated soil is moved through the system. A vibrating system was utilized as it allows for control of process conditions. The two most important parameters affecting system performance are residence time and the energy density of the vibrations. Residence time is varied by controlling the rotation speed of the auger which moves the material through the chamber. Energy density is controlled by altering the frequency and amplitude of the vibrations. There are four basic process parameters that must be optimized or controlled for a successful cleanup. They are: 1) producing a stable soil/liquid suspension, 2) extraction of the pollutants through the use of mechanical energy, 3) separation of the soil/liquid phases after extraction and 4) separation of the pollutant from the water phase and reuse of the extractant. The system is closed but no information was provided on system capacity. No QA/QC plan is contained in the document. No site specific information on the amount of soils requiring treatment or contaminant levels was provided. Dirty water from the soil washing operation at the Berlin site is incorporated into the overall groundwater cleanup process. This water meets effluent standards and may be released directly into neighboring waterways.

PERFORMANCE: The current state of the art allows for use of this technique in 0.06 mm to 0.6 mm particle size range. Research is being conducted to extend the technique down to the 0.006 mm particle size range to clean clay and other fine materials. Tests were conducted on a variety of different soils (sandy, silt and clay) contaminated with organic petroleum product, phenol chloride, PAH, PCB and cyanides. Removal efficiencies ranged from 84% to 100%. Clay soil had the lowest removal efficiency. The bottom table shows the results of tests on contaminated clay soil. The technique appears to remove various contaminants from the soil, however, no information is provided on the amount of contaminant the water extraction process alone removes versus the amount of contaminant removed by the energy introducedinto the system. No results were provided on the effect of increasing the energy density on contaminant removal efficiency.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W02-Dioxins/Furans/ PCBs	1336-36-3	Total PCBs
WO8-Polynuclear Aromatics	TOT-PAH	Phenol
WO9-Other Polar Compounds	108-95-2	Total Polycyclic Aromatic Hydrocarbons
W13-Other Organics	TEH	Total Extractable Hydro-carbons
	TOC	Total Organic Carbon

TABLE 1

RESULTS OF SOIL WASHING ON A CLAY SOIL

Pollutants	Input Pollutant Level (mg/kg)	Remaining Pollutant Level (mg/kg)	Washing Success % Removed
Total Organics	4440	159	96.4
Petroleum Extract			
Total Phenol	165	22.5	86.4
PAH	948	91.4	90.4
EOX (mgCl-kg)	33.5	ND	100
PCB	11.3	1.3	88.3

ND = None Detected

Note: This is a partial listing of data. Refer to the document for more information.

TABLE 1

API SEPARATOR SLUDGE TESTS

Toxic	Total ppm	Leach Value-ppm
Chromium	630	0.03-0.04
Lead 250-332	.05	
Ethyl benzene	10	N.D.
Xylenes, m	40	N.D.
Xylenes, o & p	43	N.D.
Anthracene	19	N.D.
Chrysene	29	N.D.
Mehtylnaphthalene	170-470	N.D.
Napthalene	13-93	N.D.
Phenathrene	110-206	N.D.

N.D. = Not Detectable Detection Limit 100 ppb

TABLE 2

Toxic	Total ppm	Leach ppm
Acrylonitrile	120	1.5
Acrylic Acid	5	.1
Acrolein	59	0.5
Acetonitrile	150	3.9
Copper 78	0.2	
Antimony	13	0.7
Organic cyanide	120	0.13
Free cyanide	10	0.10

Note: This is a partial listing of data. Refer to the document for more information.

Treatment Process:	Immobilization - Stabilization
Media:	Soil/Sandy, Silty and Clays
Document Reference:	"Presentation of the HWT Chemical Fixation Technology and Japanese in Place Treatment Equipment" International Waste Technologies, 807 North Waco, Suite 31, Wichita, KS 67203
Document Type:	Contractor/Vendor Treatability Study
Contact:	Ms. Joehanna Miller EPA Region IX 215 Freemont St. San Francisco, CA 94105 415-974-7728
Site Name:	Not Applicable (Treatability Study)
Location of Test:	Not Reported

BACKGROUND: This report provides information on the stabilization of various hazardous wastes by a special formulation marketed by International Waste Technologies. The process stabilizes the waste and produces an inert polymeric substance which resists leaching of both organic and inorganic contaminants. The report also contains information on Japanese injection and blending equipment which can be used to deliver and blend the HWT stabilizing agents with hazardous constituents located underground.

OPERATIONAL INFORMATION: The HWT treatment compounds affect various forms of chemical change by ion exchange, substitution reactions, intermolecular forces and by molecular displacement of the toxic organic and inorganic components of the waste. The HWT process imparts a cement-like stabilization to hazardous constituents in addition to encapsulating and reacting with the hazardous constituents. The compounds are formulated in acid solution at pH 3 and once solidified are highly acid resistant. The solidified HWT compound is made up of selected polyvalent inorganic elements that contain branches and cross linked polymers that produce an interpenetrating polymer network. The solidified mass containing the trapped contaminants transitions from a sol to a gel to a three dimensional inorganic polmer which should pass the required leaching tests within seven to twenty-eight days. Certain special mixtures such as surfactants are used to disperse the polymer producing reagents.

This report provided only very generic information on what was taking place. No information on the strength of the matrix, leachability test procedures or the ratios of constituents used to produce the stable matrix were provided. No QA/QC procedures are discussed in the document.

PERFORMANCE: The following is a summary of test results on organic toxics and heavy metals:

(1) The untreated PCB concentration in soil averaged 1140 ppm. The sample was treated at 15% by weight with HWT-20. Using the TCLP leach test, after two weeks curing time, the average leach PCB level of three samples was 6 ppb.

(2) The untreated PCB concentration in soil averaged 6,000 ppm. The sample was treated at 25% by weight with HWT-20 to cause solidification. Leach values after four weeks using the EP Toxicity test procedure with glass fiber filter was 80 ppt (parts per trillion).

(3) Soil contaminated with 11,000 ppm, of pentachlorophenol was solidified using the HWT-20 compound at 15% by weight. There was only 450 ppm of pentachlorophenol (PCP) leached out by methylene chloride extraction of the solid sample.

(4) A sample of K051 AP1 separator bottoms contaminated by oil and grease contained the toxic inorganic and organics shown in Table 1. The TCLP leaching procedure was used. The sludge was treated with 15% to 25% by weight of HWT. The reduction in contaminant levels leached out after solidification is significant.

(5) A sludge sample containing 70% water with the toxic components listed in Table 2 was treated at 15% by weight of HWT-20. Leaching procedure was TCLP except for cyanide. Cyanide was leached by deionized water. The reduction in contaminant levels leached out after solidification is significant. HWT-20 immobilizes a variety of hazardous wastes in the form of soils or sludges and does not allow any appreciable leaching of organics or heavy metals.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W02-Dioxins/Furans/PCBs	1336-36-3	Total PCBs
W03-Hal. Phenols, Cresols, Ethers, and Thiols	87-86-5	Pentachlophenol
W07-Hetrocyclics and Simple Aromatics	100-41-4	Ethylbenzene
	108-38-3	M-Xylene
	95-47-6	O&P Xylene
W08-Polynuclear Aromatics	120-12-7	Anthracene
	218-01-9	Chrysene
	85-01-8	Phenanthrene
	91-20-3	Naphthalene
	91-57-6	2-Methylnapthalene
W09-Other Polar Organic Compounds	107-02-8	Acrolein
	107-37-1	Acrylonitrile
	74381-40-1	Propanoic Acid, 2- Methyl
	75-05-8	Acetonitrile
	C57-12-5	Organic Cyanide
W10-Non-Volatile Metals	7440-47-3	Chromium
	7440-50-8	Copper
W11-Volatile Metals	7439-92-1	Lead
	7440-36-0	Antimony
W12-Other Inorganics	74-90-8	Hydrocyanic Acid

TABLE 1

API SEPARATOR SLUDGE TESTS

Toxic	Total ppm	Leach Value-ppm
Chromium	630	0.03-0.04
Lead 250-332	.05	
Ethyl benzene	10	N.D.
Xylenes, m	40	N.D.
Xylenes, o & p	43	N.D.
Anthracene	19	N.D.
Chrysene	29	N.D.
Methylnaphthalene	170-470	N.D.
Napthalene	13-93	N.D.
Phenanthrene	110-206	N.D.
N.D. = Not Detectable	Detection Limit	N.D.
	100 ppb	N.D.

TABLE 2

IMMOBILIZATION OF METALS IN SLUDGE

Toxic	Total ppm	Leachable ppm
Acrylonitrile	120	1.5
Acrylic Acid	5	.1
Acrolein	59	0.5
Acetonitrile	150	3.9
Copper 78	0.2	
Antimony	13	0.7
Organic cyanide	120	0.13
Free cyanide	10	0.10

Note: This is a partial listing of data. Refer to the document for more information.

Treatment Process:	Bioremediation - Aerobic
Media:	Soil/generic
Document Reference:	Koppers Co., Inc. "Evaluation of an Engineered Biodegradation System at the Nashua, N.H. Site." Technical report prepared for Keystone Environmental Resources, Inc. Approximately 106 pages. April 1987
Document Type:	Contractor/Vendor Treatability Study
Contact:	Ann Hegnauer Keystone Environmental Resources, Inc. 1050 Connecticut Avenue, NW, Suite 300 Washington, DC 20036 202-429-6552
Site Name:	Nashua Site NH (NPL)
Location of Test:	Nashua, NH

BACKGROUND: The treatability study report presents the results of both laboratory and field studies conducted by Koppers on soils from the Nashua, N.H., NPL site. The purpose of these studies was to provide the necessary data to evaluate a full-scale design for the Engineered Biodegradation System (EBDS) to treat wood preservative residues found in the soils at this site.

OPERATIONAL INFORMATION: The laboratory bench scale studies consisted of a soil pan study and a soil column study. The soil pan study evaluated the influence of soil moisture, nutrients, and level of waste application on biodegradation. The soil column study evaluated the mobility of waste constituents in soil, air, and water.

In the pilot-scale field study, which was performed onsite, the treatment unit with an area of 10,000 sq ft was loaded with 1 foot of contaminated soil. The soil from the Nashua site was not characterized. Cow manure, lime, water, and fertilizer were added, and the mixture was rototilled to maintain aerobic conditions. The test was run for approximately 6 months.

PERFORMANCE: Highest initial contaminant concentrations were 7707 ppm for oil and grease, 2143 ppm for PAH, and 133 ppm for PCP. In the field investigation, over 80% of PCP and napthalene, and 90% of the PAHs were chemically/biologically degraded by the pilot scale EBDS. The pilot-scale aerobic design was applied to the soils utilizing operating parameters (i.e., moisture content, additive agents like fertilizer and lime) established from the bench scale study. The EBDS unit promotes the growth of unspecified indigenous microorganisms to biodegrade contaminants.

Both the potential problems of fugitive emissions and leachate run-off were addressed in the pilot study design. Tests results for both of the potential problems showed that negligible amounts of runoff and fugitive emissions were generated. Bench scale data and pilot scale data is available in the document.

The study does not report the analysis for potential toxic intermediates (transformation products) that may be produced from the microbial degradation. Further, no QA/QC protocols are reported in the document. The document reports total waste analysis and toxicity characteristic leaching procedure

(TCLP) extract analysis data. There were no influent TCLP analyses to match the effluent TCLP concentrations remaining in the soil.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W03-Halogenated Phenols, Cresols and Thiols	87-86-5	Pentachlorophenols
W08-Polynuclear Aromatics	TOT-PAH	Total Polycyclic Aromatic Hydrocarbons
W13-Other Organics	TOT-OIL	Oil and Grease

Treatment Process:	Thermal Destruction - UV Photolysis
Media:	Soil/Generic
Document Reference:	International Technology Corp., AFESC, EG&G Idaho, Inc. "Technology Demonstration of a Thermal Desorption/UV Photolysis Process for Decontaminating Soils Containing Herbicide Orange." Prepared for EG&G Idaho. 14 pp. Technical report.
Document Type:	Contractor/Vendor Treatability Study
Contact:	Major Terry Stoddart U.S. DOD/AFESC BLDG 1117 Tyndall Air Force Base, FL 32403 904-283-2949
Site Name:	NCBC Gulfport, MS; Johnston Island; and Guam (Non-NPL)
Location of Test:	Gulfport, MS and Guam

BACKGROUND: This treatability study report presents the results of laboratory and field tests on the effectiveness of a new decontamination process for soils containing 2,4-D/2,4,5-T and traces of dioxin. The process employs three operations, thermal desorption, condensation and absorption of contaminants into a solvent and photo decomposition. Bench scale tests were conducted to establish the relationships between time and temperature and treatment efficiency. A pilot scale (100 lbs/hr) system evaluation was conducted at two sites to evaluate system performance and develop scale-up information.

OPERATIONAL INFORMATION: The intent of the laboratory and pilot scale tests was to reduce the combined dibenzo dioxin and furan constituents, which originate from Herbicide Orange (HO), to less than 1 ng/g. This level represents the anticipated soil cleanup criteria. The soils used had similar concentrations of HO contaminants, but were different types of soil. In the laboratory the contaminated soil is passed through thermal desorber and the off gases from the soils, including the contaminants, are passed through a scrubber that uses a hydrocarbon solvent.

Contaminants dissolve in the solvent and the solvents are passed through a flow reactor which subjects the contaminant to UV radiation to decompose the contaminant molecules. Testing was conducted on soil samples from three HO contaminated sites; Johnson Island, Eglin AFB and NCBC in Biloxi, MS. The soils tested had 2,3,7,8-TCDD concentrations greater than 100 ng/g of soil and 2,4,-D/2,4,5-T levels greater than 1000 ng/g soil. Tests were run at three different temperatures and two different power levels using high intensity UV quartz mercury vapor lamps.

Pilot tests were conducted at the NCBC site using a rotary indirect calciner as the desorber, an off gas transfer and scrubber system and a photochemical reactor to irradiate the contaminants contained in the scrubber solution. A 1200-watt high intensity mercury vapor lamp was used to irradiate the contaminated scrubber solution. No QA/QC plan was contained in the document. No discussion of analytical techniques utilized to detect HO and associated compounds is contained in the paper. A detailed list of soil properties (particle size distribution, surface area, organic matter, etc.) from the three different sites is contained in the document.

PERFORMANCE: Laboratory studies revealed that thermal desorption/UV photolysis destroyed all compounds to below their analytical detection limit (which was generally less than 0.1 ng/g). The concentration of 2,3,7,8-TCDD was reduced from 200 ng/g to less than 1 ng/g. Insoluble brown tars (presumably phenolic tars) were deposited on the surfaces of the reactor vessel and lamp well. Reaction kinetics quantum yields and rate constants were determined. Pilot tests also produced soil containing less than 1 ng/g of 2,3,7,8-TCDD. The bottom table shows the results of the tests.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W02-Dioxins/Furans/ PCBs	1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)

TABLE 1

EFFECT OF TREATMENT CONDITIONS ON RESIDUAL 2,3,7,8-TCDD DURING NBC PILOT THERMAL DESORPTION TESTS

Test No.	Soil Feed Rate (kg/hr)	Residence Time[a] (min)	Soil Temperature (°C)	2,3,7,8-TCDD[b] (ng/g) Initial	Residual
1	13.6	40	560	260	ND
2	13.6	40	560	272	ND
3	25	19	560	236	ND
4	44	10.5	560	266	ND
5	20	24	460	233	0.5

Notes:
a) Soil residence time in heated zone.
b) Detection level for 2,3,7,8-TCDD was generally less than 0.1 ng/g with a range of 0.018 to 0.51 ng/g.
c) This is a partial listing of data. Refer to the document for more information.

Treatment Process:	Chemical Extraction and Soil Washing
Media:	Sediments/sludges
Document Reference:	"Development and Evaluation of a Low Energy Process Technology for Extraction and Chemical Destruction of Polychlorinated Biphenyls from Contaminated Sediments and Sludges." Barry Rugg, Walter Brenner, Principal Investigators, NYU/DAS 87-165, April 1987.
Document Type:	Contractor/Vendor Treatability Study
Contact:	Mr. Bill Smith U.S. EPA Risk Reduction Engineering Laboratory Edison, NJ 201-321-6740
Site Name:	Not Applicable
Location of Test:	New York University Department of Applied Science New York, New York

BACKGROUND: This study has resulted in the development of a process concept for the decontamination of soils and sediments containing organic solvents, PCBs and other undesirable compounds. PCB-contaminated soils and sludges are effectively extracted from soils and sludge in a solvent and then destroyed by incineration or by chemical reaction.

OPERATIONAL INFORMATION: The extraction process is accomplished in the following major steps: (1) a solid/liquid separation for sediments (which is not necessary for contaminated soils); (2) a solvent leaching with a hydrophilic solvent, usually carried out in counter-current stages (the number of stages is determined by the required degree of decontamination); and (3) the transfer and simultaneous concentration of the organic contaminant from the hydrophilic solvent to a hydrophobic solvent, ready for final treatment and disposal. The system is designed so that all solvents can be recycled internally and only decontaminated soil and water are returned to the environment.

Exploratory studies were conducted on the solvent extraction of PCBs from contaminated sediments obtained from Waukegan Harbor, IL. This research led to a process scheme for the extraction of PCBs which offers significant technical and cost advantages over currently available technology.

The survey of solvent extraction and support equipment comprised investigations of the major industrially available types of chemical processing equipment for the extraction of PCBs from contaminated sediments and sludges. Specific industrial equipment for solvent extraction includes both continuous and batch type contactors. Type of contactors studied were agitated columns, pulsed columns, rotary agitation columns, reciprocating plate columns, perforated plate columns, various mixer settlers and centrifugal extractors. the sampling and analysis and the resulting data were obtained in accordance with the QA/QC protocol of EPA. Third party sampling and analysis contractors were used (along) with on-site and in-lab observation by EPA.

PERFORMANCE: Destruction and removal efficiencies (DREs) were greater than 99.9999% and PCB levels in combustor ash were less than 200 ppb (see Table 1). no chlorinated dioxins or furans were detected in the stack gas, bed ash, or fly ash. In addition, no significant concentrations of the

Products of Incomplete Combustion (PICs) were detected. Combustion efficiencies were greater than 99.9% with CO concentrations less than 50 ppm an NO concentrations less than 75 ppm. Particulate emissions were generally below 0.08 grain/dscf and HCL emissions were maintained below 4.0 1b/hr by introducing limestone directly into the combustor. It is noted that PCB test data led to the first TSCA permit for transportable PCB incinerator in all 10 EPA regions.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W02-Dioxins, Furans, PCBs	1336-36-3	Total PCBs

Note: This is a partial listing of data. Refer to the document for more information.

Treatment Process:	Thermal Destruction - Circulating Bed Combustion (CBC)
Media:	Soil/Clay
Document Reference:	Ogden Environmental Services, Inc. "BDAT Treatability Data for Soils, Sludges and Debris From the Circulating Bed Combustion (CBC) Process." Technical report prepared for U.S. EPA. 31 pp. June 1987.
Document Type:	Memo and Conference Paper
Contact:	Major Terry Stoddart U.S. DOD/AFESC Bldg. 1117 Tyndall Air Force Base, FL 32403 904-283-2949
Site Name:	Circulating Bed Combustion Demonstration Facility (Non-NPL)
Location of Test:	California

BACKGROUND: The two papers provide a general overview of the Ogden circulating bed combustion and summary data of both PCB laden soils for EPA-TSCA and a test on RCRA liquid organic wastes for the California Air Resources Board (CARB). This abstract will discuss the results of the PCB test, which was planned, monitored and approved by the EPA.

OPERATIONAL INFORMATION: The primary CBC components are the combustion chamber, hot cyclone collector, flue gas cooler, baghouse, and stack. Auxiliary systems include feeders (solids, liquids, sludges), forced-draft and induced-draft fans, ash conveyer, compressed air, cooling tower, and building ventilation. Operating parameters, schematic diagram and cost estimates are provided.

Atmospheric primary air is pumped into the lower portion of the combustion chamber where the bed material is fluidized by turbulent mixing of the air and solids. Larger solids gravitate downward to form a more dense fluidized bed in the lowest combustor zone. The forced-draft primary air carries smaller solids up to the top of the combustor.

Secondary air is supplied to various locations in the combustion chamber to ensure complete combustion and minimize formation of nitrogen oxides (NOx).

Auxiliary fuel and pressurized contaminated soil feed are individually introduced into the lower combustion chamber. Capability also exists to feed liquid wastes. Dry limestone sorbent is added to control gaseous emissions of sulfur, phosphates, chlorines, or other halogens.

Elutriated solids are separated from the flue gas by a hot cyclone and reinjected into the lower combustor using a proprietary non-mechanical seal. Injection, burning and reaction of fuel, contaminated soil feed, sorbent, and ash components are the inputs and outputs of a continuing chemical process which destroys the hazardous wastes.

A trial burn of PCB-contaminated soils was completed in GA Technologies transportable Circulating Bed Combustor (CBC). Over 4000 pounds of soil containing 1% PCB were treated in three identical 4-hour runs at 1800° F. The sampling and analysis and the resulting data were obtained in

accordance with the QA/QC protocol of EPA. Third party sampling and analysis contractors were used (along) with on-site and in-lab observation by EPA.

PERFORMANCE: Destruction and removal efficiencies (DREs) were greater than 99.9999% and PCB levels in combustor ash were less than 200 ppb (see the table on the following page). No chlorinated dioxins or furans were detected in the stack gas, bed ash, or fly ash. In addition, no significant concentrations of the Products of Incomplete Combustion (PICs) were detected. Combustion efficiencies were greater than 99.9%, with CO concentrations less than 50 ppm and NOx concentrations less than 75 ppm. Particulate emissions were generally below 0.08 grain/dscf and HCL emissions were maintained below 4.0 lb/hr by introducing limestone directly into the combustor. It is noted that PCB test data led to the first TSCA permit for transportable PCB incinerator operation in all 10 EPA regions.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W02-Dioxins/Furans/ PCBs	1336-36-3	Total PCBs

TABLE 1

PCB TRIAL BURN OPERATIONAL DATA AND TEST RESULTS

Parameter	TSCA Requirement	Test Number 1	2	3
Test Duration, hr	4	4	4	4
Operating Temperature, °F	-	1800	1800	1800
Soil Feed Rate, lb/hr	-	328	412	324
Total Soil Feed, lb	-	1592	1312	1711
PCB Concentration in Feed.	ppm	11,000	12,000	9,800
DRE%	>99.9999	99.999995	99.999981	99.999977
PCB Concentration				
- Bed Ash, ppm	<2	0.0035	0.033	0.186
- Fly Ash, ppm	<2	0.066	0.0099	0.0032
Dioxin/Furan Concentration				
- Stach Gas, ppm	-	ND[1]	ND	ND
- Bed Ash, ppm	-	ND	ND	ND
- Fly Ash, ppm	-	ND	ND	ND
Combustion Efficiency, %	>99.9	99.94	99.95	99.97
Acid Gas Release, lb/hr	<4.0	0.16	0.58	0.70
Particulate Emissions, grain/scf (dry)	<0.08	0.095[2]	0.043	0.0024
Excess Oxygen, %	>3.0	7.9	6.8	6.8
CO, ppm	-	35	28	22
CO_2, %	-	6.2	6.0	7.5
NO_x, ppm	-	26	25	76

[1] ND = Not Detected

[2] Derived from 2-hour makeup test

Note: This is a partial listing of data. Refer to the document for more information.

Treatment Process:	Thermal Destruction - Infrared
Media:	Soil/Generic
Document Reference:	Shirco Infrared System, Inc. "Abstract On-Site Incineration Testing of Shirco Infrared Systems Portable Demonstration Unit-Contaminated Soils Treatability Study." Prepared for Dakonto Gmbh Hamburg and Ingelheim, West Germany, 3 pp. June 1987
Document Type:	Abstract
Contact:	Scott P. Berdine Ecova Corporation (formerly Shirco) 14145 Whitlock Lane Suite 100 Carrollton, TX 7506 214-404-7540
Site Name:	Boehringer's Lindane Facility (Non-NPL)
Location of Test:	West Germany

BACKGROUND: In August of 1986, Shirco was contracted by Dekonta GmbH, a West German hazardous waste treatment company, to perform treatability studies at one of the largest dioxin-contaminated sites in the world. The Shirco Infrared process was selected by Dekonta after a two year study and evaluation of existing and emerging technologies for soils decontamination.

The West German hazardous waste management regulations, which are established and enforced on a state by state basis, differ somewhat from those in the U .S. Transportation of dioxin-bearing wastes, for instance, is strictly prohibited. Hence, mobile technologies offer distinct advantages for multiple site remediation.

OPERATIONAL INFORMATION: Tests were conducted using the Shirco Portable Demonstration Unit during the months of November 1986 and February 1987. Over 3000 kg of contaminated soil were processed in 100 hours of testing. Various operating condition's including soil contaminant level, feed rate, primary chamber temperature and residence time, co-flow and counterflow operation, and gas atmosphere (air vs. nitrogen) were tested to determine the effect on soils decontamination levels and exhaust gas emissions. The organic contaminants in the soils included dioxins, furans, chlorobenzenes, chlorophenols, 2,4,5-T, and hexachlorocyclohexanes. Contaminant concentrations on soils ranged from 4 to 7500 ppb for dioxins, 3 to 5700 for furans and from 33 to 16,600 ppm for chlorobenzenes. No QA/QC data was presented.

PERFORMANCE: Results of approximately 20 tests indicate exhaust gas concentrations of 2,3,7,8-TCDD from less than 20 pg/m3 to 88 pg/m3, whereas field "blanks" showed concentrations ranging from 33 pg/m3 to 73 pg/m3. The source of the high blank concentrations is currently under investigation, therefore, the validity of the reported values cannot be established at present. A brief summary of the data is on the attached table.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W01-Halogenated Compounds	108-90-7	Total Chlorobenzenes
W02-Dioxins/Furans/PCBs	HEPCDD	Total Heptachlorodibenzo-dioxin
	OCDF	Octachlorodibenzofurans
	OCDD	Octachlorodibenzodioxin
	PCDD	Total Hexachlorodibenzo-dioxin
	HEXCDD	Total Hexachlorodibenzo-dioxin
	TCDF	TotalTetrachlorodibenzo-furan
	1746-01-6	2,3,7,8 Tetrachlorodibenzop-dioxin (TCDD)
	TCDD	Total Tetrachlorodibenzo-dioxins
	HEPCDD	Total Heptachlorodibenzo-dioxin
	PCDF	Total Pentachlorodibenzo-furans
	HEXCDF	Total Hexachlorodibenzo-furans
	HEPCDF	Total Heptachlorodibenzo-furans

NOTE: This is a partial listing of data. Refer to the document for more information.

TABLE 1

WEST GERMANY DIOXIN TEST SUMMARY
SOIL FEED AND ASH QUALITY DATA

SOIL IDENTIFICATION	DIOXINS 2,3,7,8 TCDD	DIOXINS TCDD	DIOXINS PCDD	DIOXINS HXCDD	DIOXINS HPCDD	DIOXINS OCDD	FURANS TCDF	FURANS PCDF	FURANS HXCDF	FURANS HPCDF	FURANS OCDF	CHLOROBENZENES
2 Feed (ppb)	6.7	6.7	4.0	17	50	202	--	3.1	9.4	14.6	35.3	58,000
2 Ash	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1,200
2 Feed (ppb)	4.4	6.0	18	121	340	2301	12	53	58	98	358	169,000
2 Ash (ppt)	ND	ND	ND	5.1	18	60	15	27	20	24	12	9,600
1 Feed (ppb)	24	33	36	115	292	7458	33	41	54	174	3151	242,000
1 Ash (ppt)	ND	ND	ND	ND	15	50	52	45	26	23	12	4,700
4 Feed (ppb)	38	42	41	109	280	5940	67	44	129	128	5660	33,000
4 Ash (ppt)	ND	ND	ND	17	6.8	15	125	111	58	34	12	16,000
6 Feed (ppb)	34	38	27	90	238	5160	49	34	80	106	4700	40,000
6 Ash (ppt)	ND	ND	ND	15	9.2	20	70	54	24	13	6.2	4,600
2 Feed (ppb)	NOT YET AVAILABLE											16,612,000
2 Ash (ppt)												11,000
1 Feed (ppb)	NOT YET AVAILABLE											16,526,000
1 Ash (ppt)												7,400

NOTE: ND = Not Detectable

Detection Limits:
a. 2,3,7,8 TCDD = 1-2 ppt
b. All others = 5 ppt

Primary Chamber Temperature: 1550-1650°F
Solid Phase Residence Time: 15 minutes

Treatment Process:	Thermal Destruction - Rotary Kiln
Media:	Soil/Clay
Document Reference:	Acurex Corp., Environmental Systems Divisions, Combustion Research Facility. "CRF Test Burn of PCB-Contaminated Wastes from the BROS Superfund Site." Approximatelly 300 pp. Prepared for U.S. EPA Office of Research and Development. March 1987.
Document Type:	EPA ORD Report
Contact:	Donald Lynch U.S. EPA - Region I 26 Federal Plaza New York, NY 10278 212-264-8216
Site Name:	BROS Superfund Site (NPL)
Location of Test:	Jefferson, AR

BACKGROUND: This report provides results of test burns at the EPA Combustion Research Facility on waste from Bridgeport Rental and Oil Service (BROS) Superfund site, NJ. The purpose of the study was to: (1) determine if waste could be incinerated safely; (2) comply with the Toxic Substances Control Act (TSCA) regulations governing PCB-contaminated waste; and (3) determine if residuals could be classified as non-hazardous.

OPERATIONAL INFORMATION: Rotary kiln was cocurrent propane fired and had a maximum design capacity of 900°C (1650°F) with a gaseous residence time of 1.7 seconds for 10% excess O_2 in flue gas. Containerized solvents were fed in 1.5 gallon fiber packs using a ram feeder. Liquids and sludge were fed using a progressive cavity pump through a water-cooled lance. Air pollution control (APC) equipment included a venturi scrubber/quench with a 30 inch. W.D. pressure drop followed by a packed tower scrubber. A backup dry air pollution control system was utilized to ensure ultimate emissions would be within the applicable regulatory limits. Scrubber system blowdown was directed to a chemical sewer, if non-hazardous, or stored in tanks for management at a RCRA facility, if hazardous. Waste included: lagoon surface oil, lagoon sludge, and soil. Average composition: 210-600 ppm PCB, low to 38% water, 23.2-10,000 Btu/lb. The soil was a clay mud containing rocks, grass, roots, and twigs.

Twelve tests were performed during 7/21/88 through 9/4/88 (test time was five weeks). Tests involved variation of: waste feed, kiln temperature, excess O_2, rotation time (solid retention time). The report provides specific information on unit design (schematic diagram included) and provides test data. Sampling and analysis and QA information is also provided.

PERFORMANCE: The PCB emission results are summarized in the table on the following page. The test failed to meet the TSCA regulations for 99.9999 percent destruction efficiency (DE) at the stack gas effluent as measured after the scrubber discharge flue gas. DE results ranged from 99.992 to 99.9998. On average DEs were highest for surface oil and lowest for the soil sludge mixtures. Data indicated no clear correlation between key process parameters and DE. Analysis indicates that

a gas residence time of 2.0 seconds in the afterburner and a temperature of 1200oC would be required for this unit to achieve TSCA requirements. This is twice the residence time achieved in this test.

Scrubber blowdown PCB content was below detection levels (<1 ug/L). Kiln ash was below detection level for PCBs except for ash from surface oil which tested at 2.55 ug/g. Particulate and HCL emissions were within regulatory limits. Metal concentrations in leachate samples from ash were below the EP toxicity limit.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO4-Halogenated Aliphatic Solvents	75-35-4	1,1-Dichloroethene
	78-87-5	1,2-Dichloropropane
	56-23-5	Carbon Tetrachloride
	79-01-6	Trichloroethene
	75-34-3	1,1-Dichloroethane
WO7-Heterocyclics and Simple Aromatics	71-43-2	Benzene
	108-88-3	Toluene
	71-43-2	Benzene
W10-Non-Volatile Metals	7440-39-3	Barium
	7440-47-3	Chromium
W11-Volatile Metals	7439-92-1	Lead
	7440-38-2	Arsenic
W13-Other Organics	110-54-3	Hexane

Note: This is a partial listing of data. Refer to the document for more information.

TABLE 1

PCB EMMISSION RATE AND DE SUMMARY

Waste Type	Test No.	Feed (Arochlor 1254) Concentration (mg/kg)	Feed (Arochlor 1254) Rate (mg/s)	Emission (Arochlor 1254) at scrubber discharge Concentration (ng/dscm)	Emission (Arochlor 1254) at scrubber discharge Rate (ug/s)	DE (percent)	Weighted average DE (percent)
Lagoon surface oil	1	282	1.38	207	0.097	99.9930	99.9944
	2	296	1.68	212	0.12	99.9929	
	3	280	1.85	180	0.060	99.9968	
Soil	1	67.3	0.834	32	0.0093	99.9989	99.9990
	2	167	2.02	39	0.011	99.9995	
	3	95.4	1.20	52	0.021	99.9983	
Sludge	1	250	2.77	9	0.0039	99.99986	99.9992
	2	250	2.46	42	0.019	99.99923	
	3	250	2.27	82	0.037	99.9984	
Soil plus sludge	1	78.6	0.913	49	0.021	99.9977	99.979
	2	120	1.39	73	0.031	99.9978	
	3	170	2.04	109	0.041	99.9980	

Document Number: EXPC.TAB

Treatment Process:	Thermal Destruction - Pyrolysis
Media:	Soil/Sandy
Document Reference:	J. M. Huber Corp. "Advanced Electric Reactor (AER) for the Treatment of Dioxin-Contaminated Soils." 14 pp. February 1984.
Document Type:	Memo
Contact:	James Boyd J.M. Huber Corporation P.O. Box 2831 Borgen, TX 79007 806-274-6331
Site Name:	J.M. Huber Corp. - Borgen, TX (Non-NPL)
Location of Test:	Borgen, TX

BACKGROUND: This newsletter reports on the Huber Technology Groups (HTG) high temperature advanced hazardous waste treatment technology capable of very high destruction and removal efficiencies of various hazardous wastes. This newsletter addresses the destruction of PCBs in an EPA certification test of the HTG Advanced Electric Reactor.

OPERATIONAL INFORMATION: The Advanced Electric Reactor of HTG is a high temperature electrically heated low gas flow reactor, capable of attaining temperatures of 4,000°F to 4,500°F under low flow conditions, which allows for relatively long residence times; i.e., 5 seconds. For comparison purposes, a rotary kiln has only a one to two second residence time. Soils can also be treated and after removal of contaminants they can be landfilled. The reactor can be connected to off-the-shelf stack gas cleaning equipment to ensure high removal of all pollutants. The reactor vessel uses nitrogen gas. Oxygen is absent from the combustion process thus preventing the formation of unwanted oxygen containing by-products, such as dioxin and furans. The system is mobile and was used in a PCB destruction test witnessed by the U.S. EPA and Texas Air Board. There is no discussion of the analytical techniques used to measure PCBs. No QA/QC discussion is included.

PERFORMANCE: The results of a trial burn run of the HTG Advanced Electrical Reactor in removing PCBs are shown in the table on the following page. Initial concentration of Arochlor 1260 was 3000 ppm. The Destruction Efficiencies were 99.9999% in all but one of the tests. Solid phase soil PCB concentrations were well below the 50 ppm level after treatment. No HCl, Cl_2, dioxins or furans were observed at the stack. Only trace NO_x and particulate levels were observed. Chlorine removal efficiency in the scrubber and carbon beds were greater than 99.999%. An accompanying document indicated that the reactor technique could also destroy dioxin contaminated material to below current detection levels. However, there were no detailed results of dioxin tests reported in the newsletter.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO2-Dioxins/Furans/PCBs	11096-82-5	PCB-1260

Note: This is a partial listing of data. Refer to the document for more information.

TABLE 1

SUMMARY OF RESULTS: EPA CERTIFICATION TEST

Run #	Date	Feed #/Min	R. Temp. (°F)	Total N2 (scfm)	% Gas - Phase Cyclone (DE)	Control Stack (DRE)	Solid Phase PCBs, PPM Treated Feed
1	9/27/83	15.1	4100	147.2	99.99992	99.9999950	0.0005
2	9/28/83	15.7	4100	147.2	99.99992	99.9999994	<0.0005
3	9/29/83	15.7	4100	147.2	99.99960	99.9999980	0.0006
4	9/29/83	15.8	4100	147.2	99.99995	99.9999940	0.0010

Documber Number: EXPD.TAB

Treatment Process:	Low Temperature Thermal Desorption
Media:	Soil/Generic
Document Reference:	Canonie Environmental Services Corp. "Soil Remediation and Site Closure McKin Superfund Site", Gray, Maine. Technical report of approximately 250 pp. prepared for U.S. EPA. July 1987.
Document Type:	Contractor/Vendor Treatability Study
Contact:	U.S. EPA - Region I John F. Kennedy Federal Bldg. Room 2203 Boston, MA 02203 617-565-3715
Site Name:	McKin Superfund Site, Gray, ME (NPL)
Location of Test:	Gray, ME

BACKGROUND: This treatability study report describes soil remediation and site closure activities conducted at the McKin Superfund site in Maine. The work described in this report involves the removal of volatile organic compounds and petroleum residues from contaminated soils by low temperature thermal aeration in an enclosed environment. The report discusses the enclosed aeration process, impact of the operation on ambient air quality, effectiveness of the system, cleanup costs, and disposal of accumulated on-site materials used in the project.

OPERATIONAL INFORMATION: The soil aeration system utilized during the site cleanup consisted of a thermal dryer, a baghouse for control of particulate matter, a scrubber to remove water soluble gases, and a vapor phase carbon treatment system to remove organics from the vapor phase. Soils were screened to remove boulders and debris, and fed through the system a number of times via a conveyer to ensure complete aeration. Soil temperatures were maintained at 250 - 400°F to facilitate volatilization of organics. Soil was solidified with concrete after treatment. 11,500 cubic yards of soil were processed at the site. Soil types are discussed in reports on previous studies conducted on the site. Organic vapor concentrations were monitored at the site boundaries, periodic air quality monitoring was conducted at 10 nearby residences and high volume particulate sampling was conducted at the site. Ambient hydrocarbon levels were well below (between 0.002 to 0.01 ppm) the level established as a health standard (2 ppm).

During the pilot study, ambient particulate standards were exceeded on three occasions. Changes in the material handling system reduced fugitive dust emissions and allowed for the processing of 10,000 cubic yards of soils without further exceedences of the air quality standard for total solid particles. Various references are made to QA/QC and to the EPA standard methods for VOC analysis.

PERFORMANCE: The excavated/aerated soils from the site satisfy the performance standard specified in the site Record of Decision (ROD)(0.1 ppm of TCE). Concentrations of VOCs and petroleum products before and after treatment of soils are shown in the table on the following page.

Significant reduction in the levels of various contaminants before and after treatment are noted. Groundwater modeling demonstrated that groundwater criteria specified in the ROD were met. A

detailed cost breakdown of the use of aeration to remediate soils contaminated with VOC and petroleum hydrocarbons is provided. Based on this data, the average cost for treating the soils at this Superfund site is $252 per cubic yard. Aeration was utilized to remediate contaminated soil and not violate ambient air quality criteria at this site.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO1-Halogenated Aromatic Compounds	95-50-1	1,2-Dichlorobenzene
WO4-Halogenated Aliphatic Solvents	71-55-6	1,1,1-Trichloroethane
	75-35-4	1,1-Dichloroethene
	127-18-4	Tetrachloroethene
	79-01-6	Trichloroethene
WO7-Heterocyclics and Simple Non Halogenated Aromatics	71-43-2	Benzene
	100-41-4	Ethylbenzene
	108-88-3	Toluene
	1330-20-7	Xylene
WO8-Polynuclear Aromatics	120-12-7	Anthracene
	91-20-3	Naphthalene
	206-44-0	Fluoranthene
	85-01-8	Phenanthrene
WO9-Other Polar Organic Compounds	85-68-7	Butylbenzylphthalate
	78-59-1	Isophorone
W13-Other Organics	TEH	Total Extractable Hydrocarbons

TABLE 1

Compound	Pretreatment Soil Concentration (mg/kg)	Post-treatment Soil Concentration (mg/kg)
trans 1,1,-dichloroethane	0.11	ND .02
trichloroethene (TCE)	7.3	ND .02
1,1,1,-trichloroethene	0.13	ND .02
Toluene	35	ND 1.0
Xylenes	84	ND 1.0

ND - None detected at 0.02 or 1.0 ppm

Note: This is a partial listing of data. Refer to the document for more information.

Treatment Process:	Chemical Extraction and Soil Washing
Media:	Soil/generic
Document Reference:	Martin Marietta Energy Systems, Inc. "Removal of PCB from Soil Using Solvent Leaching." Technical report. 8 pp. April 1985.
Document Type:	Contractor/Vendor Treatability Study
Contact:	Robert W. Schede Martin Marietta Energy Systems, Inc. P.O. Box Y Oak Ridge, TN 37831 615-576-5454
Site Name:	Oak Ridge Y-12 Plant, TN
Location of Test:	Oak Ridge, TN

BACKGROUND: This document is a brief description of the Oak Ridge Y-12 Pilot Plant's ability to remove PCBs from soils. The report was written for the U.S. Department of Energy by Martin Marietta Energy Systems.

OPERATIONAL INFORMATION: A process was developed for the removal of polychlorinated biphenyl (PCB) from contaminated soils. A pilot plant was operated to determine the optimum component ratios (soil-water-kerosene) and the optimum mixing time. A solvent composed of water and kerosene is used to extract PCB from soil. The water-kerosene mixture leaving the extraction system is phase separated and both components are reused. The kerosene containing the concentrated PCB is steam distilled to further concentrate the PCB. The distilled kerosene is reused. The PCB concentrate from the distillation must be discarded using other methods, such as incineration. Pilot plan experience on the process is discussed. No conclusions, QA/QC procedures, or sampling and analysis procedures are given.

PERFORMANCE: Soil-to-water ratios of 3 to 5 and soil-to-kerosene ratios of 3 to 5 were found to be best. A three-stage batch pilot plant operating with a 6 to 1 volume ratio experienced soil feed PCB concentrations of 300 mg/l and discharged soil contaminant levels of 10-15 mg/l. No difference was found between the 15 and 30 minute mixing times. Results from only one test run were presented in the test. The document, however, comments that "lower soil contaminant values could be obtained using additional stages." It also states that about 25-30% of the kerosene was absorbed into the leached soils. This appears to create additional contamination. The kerosene was later steam-stripped.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W02-Dioxins/Furans/PCBs	1336-36-3	Total PCBs

Treatment Process:	Bioremediation - Aerobic and Anaerobic
Media:	Soil/Generic
Document Reference:	NUS Corporation. "Leetown Pesticide Site Treatability Study." Four progress reports in internal memorandum form. 62 pp. (total). Written under EPA Contract. July 1986 - January 1987
Document Type:	Contractor/Vendor Treatability Study
Contract:	William Hagel Regional Project Manager U.S. EPA - Region III 841 Chestnut Street Philadelphia, PA 19107 215-597-9800
Site Name:	Leetown Pesticide Site, Leetown, WV (NPL)
Location of Test:	NUS, Pittsburgh, PA

BACKGROUND: This document is composed of a series of progress reports pertaining to a bench scale treatability study which utilized biodegradation to remediate pesticide contaminated soils (DDT and DDE) at the Leetown Pesticide NPL site. Treatment consisted of aerobic, anaerobic and fungal processes to biodegrade the DDT and DDE.

OPERATIONAL INFORMATION: Nutrients such as manure, sewage sludge and wood chips were added to the soils to promote the growth of microbes capable of degrading the pesticides. More than 400 biodegradation cells were used over four test periods. Efforts to control temperature, pH and moisture content were attempted during the study. One report states that DDT degradation appears to take place at 35° under anaerobic conditions and that DDE degradation takes place in acidic media. The microbes used in the test were not specified but are indigenous to the site. Baseline DDT and DDE levels were approximately 7,000 ug of DDT per Kg soil and 1000 ug of DDE per Kg of soil.

An extraction procedure with hexane done on the soil to analyze for DDT was criticized for being a quick and dirty extraction with no cleanup of the extract. Other concerns reported were strongly sorbed compounds may not be detected, interference from naturally occurring organic matter could skew the results and lack of standard analytical protocols could introduce extraneous variables into the data. Specific information pertaining to the quantity or type of contaminated soils was not included in the report.

PERFORMANCE: In December of 1986 an analysis of variance (ANOVA) of the results was conducted to determine if there is any statistically significant difference between the various samples collected from each of the different treatment cells and to determine if there is a significant difference in DDT and DDE concentrations from one cell treatment to the next. The ANOVA indicated there is no significant difference between the various cell configurations. Hence the average concentration calculated for each cell configuration is representative of the population mean. A review of the sampling data reported in the December 30th progress report suggests that anaerobic vessels operating under incubated conditions represented the best method of degrading DDT in the soils. The authors report that the indigenous microbial populations can be used to degrade DDT at the Leetown Pesticide Site. A preliminary estimate of the time for this process to reduce DDT plus DDE to desired

Pesticide Site. A preliminary estimate of the time for this process to reduce DDT plus DDE to desired action levels of 300 ug/kg of under anaerobic conditions, and anaerobic vessels operating under incubated conditions represent the best method of degrading DDT. Further work was recommended on the toxicity and environmental mobility of the metabolites present from the recommended composting scheme as well as controlled bench and pilot testing.

No QA/QC procedures were reported; however, quality control issues were discussed and this work was done under an EPA contract.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminant
W01-Halogenated Non-polar Aromatic Compounds	50-29-3	1,1,1-trichloro-2,2-bis (4-chlorophenyl)ethane (4,4-DDT) 72-55-91,1-dichloro-2,2-bis (4-chlorophenyl)ethene (4,4-DDE)

Treatment Process:	Thermal Destruction - Rotary Kiln
Media:	Soil/Generic
Document Reference:	Vesta Technology, Ltd. "Trial Burn Test Report, Part I - Data Summaries." Draft report of approximately 25 pp. Prepared for U.S. EPA, Region IV, March 1987.
Document Type:	Contractor/Vendor Treatability Study
Contact:	Ned Jessup U.S. EPA - Region IV 345 Courtland Street, NE. Atlanta, GA 30365 404-347-4727
Site Name:	Aberdeen, NC, Superfund Site (NPL)
Location of Test:	Aberdeen, NC

BACKGROUND: This treatability study summary reports on the results of a trial burn of pesticide-contaminated soil from the Aberdeen, NC Superfund site. The trial burn using the Vesta mobile rotary kiln incinerator was designed to demonstrate that this system can destroy the pesticides in a manner consistent with RCRA standards.

OPERATIONAL INFORMATION: The soil was fed to the incinerator at rates of 960 to 1023 pounds per hour. There were three trial runs completed, each for approximately 3 hours. No details are provided on the soil matrix or QA/QC accomplished. Since this Trial Burn Test Report is a summary of analytical results, additional operational information is not presented.

PERFORMANCE: The primary standards of performance were:

1. Destruction of the pesticides from the soil fed to the incinerator.
2. Destruction/removal of the designated principal organic hazardous pollutants (POHC's).
3. Particulate stack emissions.
4. Hydrogen chloride stack emissions.

Secondary standards included:

1. Other pesticide stack emissions.
2. Carbon monoxide emissions.
3. Dioxin, furan and other chlorinated organic emissions.

The soil treated had initial concentrations of P,P-DDT and alpha-BHC of greater than 131 and 29 ppm, respectively. The pesticides in the soil fed to the incinerator were effectively removed, as evidenced by the removal of the principal organic hazardous pollutants, P, P-DDT and alpha-BHC (99.993% and 99.998% removal efficiency, respectively). All other pesticides found in the contaminated soil were not detected in the treated soil. TCDD (dioxins) and TCDF (furans) were not found in the treated soil. The destruction and removal efficiency, of 99.993 percent particulate stack emissions to .02 grains/dscf and hydrogen chloride stack emissions of 99.2 percent removal were in compliance with RCRA criteria for particulate stack emissions of .08 grains/dscf and hydrogen chloride stack emissions removal of 99 percent. Carbon monoxide stack emissions and combustion efficiency were indicative of good combustion, except for one test run which experienced startup difficulties. Other stack emission parameters (flow,temperature, moisture, oxygen, and carbon dioxide) indicated successful operation. Quality control field blanks were collected and described.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W01-Halogenated Aromatic Compounds	72-55-9	1,1-Dichloro-2-2-bis (4-chlorophenyl)ethene (4,4-DDE)
	72-54-8	1,1-Dichloro-2,2-bis (4-chlorophenyl)ethane (4,4-DDD)
	50-29-3	1,1,1-Trichloro-2,2-bis (4-chlorophenyl)ethane (4,4-DDT)
W05-Halogenated Cyclic Aliphatics/Ethers/ Esters/Ketones	1024-57-3	Heptachlor Epoxide
	1031-07-8	Endosulfan Sulfate
	309-00-2	Aldrin
	319-85-7	Beta-BHC
	33213-65-9	Endosulfan II
	58-89-9	Gamma-BHC
	60-57-1	Dieldrin
	72-20-8	Endrin
	7421-93-4	Endrin Aldehyde
	76-44-8	Heptachlor
	959-98-8	Endosulfan I
	319-86-8	Delta-BHC

Treatment Process:	Thermal Destruction - Incineration
Media:	Soil/Generic
Document Reference:	Environmental Science and Engineering, Inc. "Final Report, Phase I - Immediate Assessment, Acme Solvents Site." Technical report of approximately 40 pp. submitted to the Acme Solvents Technical Committee. November 1985.
Document Type:	Contractor/Vendor Treatability Study
Contact:	David Favero U.S. EPA - Region V 230 South Dearborn Street Chicago, IL 60604 312-386-4749
Site Name:	Acme Solvents Site (NPL)
Location of Test:	Rockford, IL

BACKGROUND: This is a site assessment and feasibility study of incineration alternatives at the ACME Solvents Site at Rockford, Illinois. The document contains laboratory results that are reported to simulate incineration conditions but no details on test methods were provided.

OPERATIONAL INFORMATION: The document summarizes the geophysical investigation, the delineation of the contaminated zones and their volumes and the sampling locations. Out of 43 samples taken at 18 locations, 20 were selected to be sent to an environmental laboratory for analysis of percent moisture (volatiles), percent ash, total chloride, total sulfur, Btu value and total PCBs. Two samples were analyzed for organic priority pollutants, pesticides and PCBs. No details on test methods were provided. Details on the soil matrix of each sample were summarized (the majority are silty soil). The ash from each of the 20 samples was analyzed for EP toxic metals. The data from these 20 samples is summarized as well as the more complete analysis results from the two samples.

This basic data was used in an analysis of feasibility, costs and relative merits of off-site and onsite incineration of the contaminated site material. Specific alternatives are costed for an onsite rotary kiln and an off-site rotary kiln.

PERFORMANCE: The laboratory test on the soil for EP toxicity showed the resulting ash/decontaminated soil was consistently well below EPA limits for hazardous wastes classification. Heavy metal levels in the decontaminated ash ranged from a high of 2.26 mg/l for Cr to a low of less than .009 mg/l for Se. All were well below the EP toxicity levels defined in 40 CFR 261.4 except for chromium which is about 50% of the allowed EP toxicity level of 5 mg/l. PCBs were reduced from 3600 to less than 4 ug/kg (dry weight). There are no details provided on the laboratory incineration process, sampling protocols, QA/QC protocols or conclusions.

The economic analysis comparing onsite and off-site incineration showed on-site incineration could be accomplished at one-third the cost and with the same implementation time as the off-site incineration.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO2-Dioxins/Furans/PCBs	12674-11-2	PCB-1016
	11096-82-5	PCB-1260
WO5-Halogenated Cyclic Aliphatics/Ethers/ Esters/Ketones	57-74-9	Chlordane
	58-89-9	Gamma-BHC (Lindane)
WO8-Polynuclear Aromatics Compounds	83-32-9	Acenaphthene
	91-20-3	Naphthalene
	85-01-8	Phenanthrene
	86-73-7	Fluorene
WO9-Other Polar Organic Compunds	117-81-7	Bis (2-ethyl hexyl) phthalate
	85-68-7	Butylbenzylphthalate
	84-74-2	Di-n-butylphthalate
	117-84-0	Di-n-octylphthalate
	78-59-1	Isophorene
	108-95-2	Phenol
W10-Non-Volatile Metals	7440-39-3	Barium
W11-Volatile Metals	7439-92-1	Lead
	7439-97-6	Mercury
	7440-22-4	Silver
	7440-43-9	Cadmium

Treatment Process:	Low Temperature Thermal Desorption
Media:	Soil/Generic
Document Reference:	PEI Associates, Inc. "Low Temperature Treatment of CERCLA Soils and Debris Using the IT Laboratory Scale Thermal Desorption Furnaces." Prepared for U.S. EPA, HWERL, Cincinnati, OH; 120 pp.; October 1987
Document Type:	EPA ORD Report
Contact:	Robert Thurnau U.S. EPA, ORD HWERL 26 W. St. Clair Street Cincinnati, OH 45268 513-596-7692
Site Name:	BDAT SARM-Manufactured Waste (Non-NPL)
Location of Test:	ORD - Edison, NJ

BACKGROUND: This study report laboratory experiments on low temperature treatment of soils using thermal desorption. The purpose of the study was to determine if thermal desorption could remove volatile and semi-volatile contaminants from a synthetically prepared soil spiked with predetermined quantities of contaminants. This study supports the U.S. EPA's program to demonstrate various technologies for treating contaminated soils for the purposes of CERCLA/SARA compliance with the proposed 1988 banning of land disposal of wastes.

OPERATIONAL INFORMATION: The laboratory testing program consisted of 15 separate bench scale tests. The EPA synthetic soil had two levels of contaminants which are shown in the table on the next page. Thermal desorption tests were conducted at three temperatures 150°C, 350°C and 500°C for 30 minutes to determine the effect of temperature on thermal desorption efficiency. The surrogate soil or synthetic analytical reference matrix (SARM) is similar to Superfund site soils and is 30% by volume clay, 25% silt, 20% sand, 20% topsoil and 5% gravel. The SARMs were air dried to minimize moisture. Approximately 80 gms of SARM soil were used in the tests in the tray furnace. The tray furnace interior space is approximately 10 cm wide, 14 cm high and 21 cm deep. A QA/QC plan is contained in the study. Gas bags were utilized to collect off gas samples from the furnace and THC, CO, CH_4 and C_2H_6 were analyzed by GC. Soils were analyzed for the remaining SARM constituents using GC/MS.

PERFORMANCE: Thermal desorption of volatile and semi-volatile contaminants from soils at moderate temperatures can be achieved with reasonable success. At 550°C most of the volatile constituents are removed to below the one/ppm level. Acetone appeared to remain in the matrix possibly due to bound water in the soil. Semivolatile constituents are also removed to a large extent except for pentachorophenol. Anthracene and phthalate are removed to levels near the detection limit. At 350°C temperature most of the volatile contaminants are removed down to the 1 ppm level except for acetone. Semivolatiles are reduced at 350°C, though not significantly. The author cautions not to place quantitative credence in the results since the precision of duplicate samples indicated that the data is only useful in a qualitative manner.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W01-Halogenated Non-Polar Aromatic Compounds	108-90-7	Chlorobenzene
WO3-Halogenated Phenols, Cresols, and Thiols	87-86-5	Pentachlorophenol
WO4-Halogenated Aliphatic Compounds	107-06-2	1,2-dichloroethane
	127-18-4	Tetrachloroethene
WO7-Heterocyclics and Simple Non-Halogenated Aromatics	100-42-5	Styrene
	100-41-4	Ethylbenzene
	1330-20-7	Xylenes
WO8-Polynuclear Aromatics	120-12-7	Anthracene
WO9-Other Polar Organic Compounds	67-64-1	Acetone
	117-81-7	Bis(2-ethylhexyl)phthalate
W10-Non-Volatile Metals	7440-02-0	Nickel
	7440-47-3	Chromium
	7440-50-8	Copper
W11-Volatile Metals	7440-38-2	Arsenic
	7440-43-9	Cadmium
	7439-92-1	Lead
	7440-66-6	Zinc

TABLE 1

SARM CONTAMINANTS UTILIZED IN THERMAL DESORPTION TEST AND THEIR CONCENTRATIONS IN THE SOIL (ppm)

	High	Low
Volatiles		
Ethylbenzene	3200	320
Xylene	8200	820
Tetrachloroethylene	600	60
Chlorobezene	400	40
Styrene	1000	100
1,2 Dichloroethane	600	60
Acetone	6800	680
Semivolatiles		
Anthracene	6500	650
Bis (2-ethylhexyl) phthalate	2500	250
Pentachlorophenol	1000	100
Metals		
Lead		280
Zinc		450
Cadmium		20
Arsenic		10
Copper		190
Nickel		30
Chromium		30

Note: This is a partial listing of data. Refer to the document for more information

Treatment Process:	Bioremediation - Aerobic
Media:	Soil/Generic
Document Reference:	ECOVA Corporation. "Final Report: Soil Treatment Pilot Study Brio/DOP Site." Technical Report No. 861014/1 (Ecova No.) prepared for U.S. EPA Brio Site Task Force. Approximately 130 pp. June 1987.
Document Type:	Contractor/Vendor Treatability Study
Contact:	Louis Barinka U.S. EPA - Region VI 1445 Ross Avenue 12th Floor, Suite 1200 Dallas, TX 75202 212-655-6735
Site Name:	Brio DOP Site (NPL)
Location of Test:	Friendswood, TX

BACKGROUND: Bench and pilot scale studies were conducted to demonstrate the feasibility of using solid-phase biodegradation for destroying portions of organic constituents present in the soil. The predominant constituents at the BRIO DOP site located in Texas were volatile compounds such as: methylene chloride, 15-17,000 ppb; 1,2-dichloroethane, 25-195,000 ppb; 1,1,2- trichloroethane, 25-195,000 ppb. Semivolatile compounds were present in lower concentrations: phenanthrene, 1,392-15,083 ppb; anthracene and fluorene, 440-563 ppb (single samples only).

OPERATIONAL INFORMATION: Aerobic microorganisms present in soil samples removed from the site ranged from 103 to 105 colony forming units per gram weight of wet soil, indicating the site contained a diverse microbial population. Bench scale and pilot scale tests were conducted. The pilot scale solid phase treatment facility consisted of a lined soil treatment area with a leachate collection system, water/nutrient distribution system, emission control system, a microbiological management system, and greenhouse enclosure and support facilities. The pilot facility was operated for 94 days commencing in January of 1987. Two hundred cubic yards of soil removed from the site were placed in the pilot facility, inoculated with microorganisms, nutrients were added (inorganic N&P), and the soils were tilled daily to ensure contact and aeration. Tilling also facilitated air stripping of the more volatile organics. Volatile compounds were trapped by activated carbon absorbers at the pilot facility.

PERFORMANCE: The pilot scale treatment facility demonstrated, under field conditions, that a solid-phase treatment process could be used to successfully treat the organic constituents present in the site soil. The process removed the volatile organic compounds by air stripping, and destroyed semivolatile organic compounds by biodegradation. More than 99% of the volatile organic compounds were removed within the first 21 days of operation. However, the biodegradation of the semivolatile organic constituents was much slower. It was estimated that approximately 131 days would be required to reduce the phenanthrene concentrations to non-detectable levels in the treatment facility. The time required to treat affected soils and materials (volatile/ semivolatile organics) in a solid phase treatment process might be unacceptably long if rapid remediation is required.

No actual tests were conducted on a full scale facility. However, the authors discuss the feasibility of full scale tests and postulate that aqueous phase biodegradation could enhance the rate of removal of the organic components by improving the contact between microorganisms, nutrients, and oxygen. No treatment cost data was provided. Numerous references to the biodegradation of specific organic compounds are contained in this document. EPA analytical methods were utilized to analyze for volatile organics. A QA/QC plan is contained in the document along with a statistical analysis of the data.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO1-Halogenated Non-Polar Aromatic Compounds	108-90-7	Chlorobenzene
WO4-Halogenated Aliphatic Compounds	79-34-5	1,1,2,2,-Tetrachloroethane
	79-00-5	1,1,2,-Trichloroethane
	75-09-2	Methylene Chloride
	75-34-3	1,1-Dichloroethane
WO7-Heterocyclics and Simple Non-Halogenated Aromatics	100-41-4	Ethylbenzene
	100-42-5	Styrene
	71-43-2	Benzene
	108-88-3	Toluene
	1330-20-7	Xylenes
WO8-Polynuclear Aromatics	91-20-3	Naphthalene
	85-01-8	Phenanthrene
	91-57-6	2-Methylnaphthalene
WO9-Other Polar Organic Compounds	67-64-1	Acetone
	78-93-3	2-Butanone

Treatment Process:	Thermal Destruction - Infrared
Media:	Soil/Clay
Document Reference:	Shirco Infrared Systems. "Final Report, Onsite Incineration Testing at Brio Site, Friendswood, Texas" Final Technical Report No. 8467-87-1 prepared for the U.S. EPA Brio Task Force. Approximately 750 pp. February 1987.
Document Type:	Contractor/Vendor Treatability Study
Contact:	U.S. EPA - Region I John F. Kennedy Federal Building, Room 2203 Boston, MA 02203 617-565-3715
Site Name:	Brio Refinery Superfund Site (NPL)
Location of Test:	Friendswood, TX

BACKGROUND: Shirco Infrared Systems, operated a pilot-scale infrared unit on-site at the Brio Refinery Site in Texas. Eight tests were run over a four day period with various soil compositions, including clay-like soils from four pits.

OPERATIONAL INFORMATION: The objectives of these thermal pilot treatment tests on excavated pit material were as follows:

1. To determine the incinerator ash chemical composition.

2. To demonstrate that the incinerator feed system can reliably provide a continuous, blended feed to the incinerator and deposit this feed material in a uniform manner on the incinerator belt.

3. To demonstrate that the incinerator can meet the RCRA required >99.99% destruction efficiency for Principal Organic Hazardous Constituents (POHCs).

4. To provide design information and economic data required to evaluate the feasibility of incinerating certain Brio Site pit wastes.

The feed analyses targeted approximately 120 priority pollutants. However, only 18 were usually found above the detection limits. Each sample tested was about 50 pounds and was spiked with carbon tetrachloride as the principal organic hazardous constituent. The soil was mechanically worked and screened to break up clay lumps. The destruction of the spiked contaminant was used to measure the success of the testing. Other analyses performed included analysis of the scrubber inlet and outlet, stack flow, and ash. The ash analyses included a mass and volume reduction analysis.

PERFORMANCE: Removal efficiency under all test conditions with 12 or 18 minute primary chamber residence time at 1600°F was greater than 99.9997%. The cost of treatment with their largest mobile unit, which will process 67,000 tons per year, was estimated at $119 per ton. This does not include costs of feed excavation, feed preparation, interest and taxes. The document details each aspect of the tests, which lends much credibility to its data. QA/QC and sampling protocol are given

along with details of the testing procedures, test equipment, materials, and results. Sections are devoted entirely to results, safety procedures, an economic analysis and conclusions and recommendations.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO1-Halogenated Non-Polar Aromatic Compounds	108-90-7	Chlorobenzene
WO4-Halogenated Aliphatic Compounds	71-55-6	1,1,1-Trichloroethane
	79-34-5	1,1,2,2,-Tetrachloroethane
	75-35-4	1,1-Dichloroethene
	107-06-2	1,2-Dichloroethane
	56-23-5	Carbon Tetrachloride
	67-66-3	Chloroform
	127-18-4	Tetrachloroethene
	79-01-6	Trichloroethene
	75-01-4	Vinyl Chloride
WO7-Heterocyclics and Simple Non-Halogenated Aromatic	71-43-2	Benzene
	100-41-4	Ethylbenzene
		100-42-5Styrene
WO8-Polynuclear Aromatics	91-20-3	Naphthalene
	85-01-8	Phenanthrene
	91-57-6	2-Methylnaphthalene
WO9-Other Polar Organic Compounds	67-64-1	Acetone
	75-15-0	Carbon Disulfide

Treatment Process:	Thermal Destruction - Infrared
Media:	Sludge
Document Reference:	Shirco Infrared Systems Portable Test Unit. "Final Report - Demonstration Test On-Site PCB Destruction, Shirco Infrared Portable Unit at Florida Steel Indiantown Mill Site, Indiantown, Florida." Technical report of approximately 180 pp. prepared for internal use by Shirco. September 1986.
Document Type:	Contractor/Vendor Treatability Study
Contact:	John Kroske U.S. EPA - Region IV 345 Courtland Street, NE Atlanta, GA 30336
Site Name:	Florida Steel Indiantown Mill Site, FL (NPL)
Location of Test:	Shirco, Joplin, MO

BACKGROUND: This document reports on the results of a Florida Steel Corporation study to develop and evaluate cleanup alternatives for onsite treatment of PCB contaminated soils. The results of this study aided in the selection of an approach to remediate the site. Demonstration tests on incinerating PCBs were conducted at the site May 13-15, 1986 by Shirco Infrared Systems of Dallas, Texas. The purpose of the tests was to demonstrate the capability of the Shirco System to meet the requirements of 40 CFR Part 761 while detoxifying the soil.

OPERATIONAL INFORMATION: Soils at the Florida Steel Corporation Site were contaminated with PCBs in the concentration range of 76 to 2970 ppm. The report does not provide any specific details on the amount of site soil contaminated, or the types of soils undergoing treatment. The Shirco Portable Pilot Test Unit used in the tests is a three stage system; infrared furnace, propane fired afterburner, and scrubber. The waste materials are weighed in batches and placed on a conveyer belt which feeds the material to the furnace. The soil is heated in the infrared furnace for a minimum residence time of 15 to 25 minutes, soil/ash is discharged and the exhaust gas passes into the propane-fired afterburner. The afterburner operates at temperatures from 1900 to 2200°F. Minimum afterburner residence time is two seconds. The afterburner exhaust gases are analyzed for various contaminants associated with PCB degradation products, as required by 40 CFR 761. Additionally the afterburner exhaust is continuously monitored for O_2, CO_2, CO and NO_x levels. A QA/QC plan is contained in this report.

PERFORMANCE: Six tests were conducted to determine the Destruction Removal Efficiencies (DRE) for PCBs. In four of six tests the DRE of 99.9999% was achieved. The remaining two tests achieved a slightly lower DRE than required; 99.999 and 99.998. The author believes this was due in one instance to low concentrations of PCB in the waste feed stream, and in the second instance, to a low level of excess O_2. This low excess 0_2 level indicates that for the Shirco unit the minimum permissible 0_2 level in the afterburner exhaust should be increased from that level used in the program. The tests that met the DRE had afterburner O_2 from 9 to 13%. Test five, the low PCB DRE test, had an O_2 concentration of 6.9%. Concentrations of particulates in the flue gas were well within

the limit of 0.08 g/scf. HCl emissions for each test were less than 4 lbs/hr. Also, scrubber effluent and flue gases were analyzed for dioxins and furon in one test run. None were found within detection limits.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO2-Dioxins/Furans/PCBs	APCB	Monochlorobiphenyl
	BPCB	Dichlorobiphenyl
	CPCB	Trichlorobiphenyl
	DPCB	Tetrachlorobiphenyl
	EPCB	Pentachlorobiphenyl
	FPCB	Hexachlorobiphenyl

Treatment Process:	Immobilization - Flyash Solidification
Media:	Sludge/Metal Finishing
Document Reference:	VeriTec Corp. Case Study, Hazardous Waste Management Utilizing Lime. Paper presented at the Annual Meeting of the National Lime Association, Phoenix, Arizona. 13 pp. April 9, 1987.
Document Type:	Conference Paper
Contact:	Andre DuPont National Lime Asociation 3601 North Fairfax Drive Arlington, VA 22201 703-243-LIME
Site Name:	VeriTec Corp. (Non-NPL)
Location of Test:	Knoxville, TN

BACKGROUND: This report presents the results of treating a plating sludge having high levels of Cu, Ni and Cr with a lime fly ash additive. The pozzolonic reaction solidified the sludge. The results of various leaching tests are presented and discussed. An economic analysis suggests that the mixture used was more cost effective than other types of solidifying agents and processes. Various additive sludge ratios are recommended and a conceptual system design along with costs is presented.

OPERATIONAL INFORMATION: The sludge that was investigated was a Cu-Ni-Cr hydroxide sludge from alkaline pH precipitation of a plating-rinse wastewater. The untreated sludge contains 35 g/kg of Cu, 65 g/kg Ni and 72 g/kg of Cr. Sludge density is 1.133 g/cc. Lab tests revealed that solidification was feasible and that the solidified samples displayed considerable unconfined compressive strength. The structural strength was reported to be between 100-125 psi. Lab tests were followed with field tests to determine the effect of leaching on the solid samples. At 21 days treated samples were subject to the EPA-RCRA EP toxicity procedures, deionized water leaching procedures, and the Multiple Extraction Procedure (MEP) leaching test. Detailed explanation of the leaching procedures are given along with methods of analysis used to determine heavy metal concentrations. No QA/QC information is contained in the report.

PERFORMANCE: Laboratory simulation studies revealed that the fixation process could reduce the EP toxicity. EP toxicity tests for Cr, Ni and Cu with initial concentrations of 73.0, 65.6 and 22.0 mg/l, respectively, were reduced by treatment to 2.9, 1.0 and 1.0 mg/l, respectively. Field tests reveal that levels of Ni, Cr and Cu can all be reduced by the fixation process. The following tables show results from the various leaching tests. Cyanide (CN) is not used in the plant, however, CN was found at 0.13 and 0.05 ppm in the raw sludge leachate samples. CN was <0.01 in all treated sludge samples showing this fixation process also retards low level leaching of cyanides. Total chromium was reduced from 22 ppm to .02 - .05 ppm in one set of samples and from 3.5 ppm to 0.4 - 0.1 ppm in another set of samples. Nickel was reduced from 87 to 0.01 ppm with treatment. The authors state that they believe the wastes no longer violate hazardous waste criteria and recommend that the treated wastes be delisted.

An economic analysis of the costs associated with fixing one ton of sludge using a 1:1 mass ratio of fixing agent and sludge was conducted. Pozzolonic process is the cheapest of those evaluated. Cement costs $70 per ton whereas pozzolonic costs as low as $12.50 per ton depending on the type of fly ash used (bulk or bagged). Total disposal costs increase as the mass ratio of fixing agent to dry weight sludge increases. The authors provide a conceptual design of a process along with estimated costs to construct a one ton per day system. Total system capital/construction costs are estimated to be $65,000.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W10-Non-Volatile Metals	7440-47-3	Chromium
	7440-02-0	Nickel
W11-Volatile Metals	7440-43-9	Cadium
W12-Other Inorganics	57-12-5	Cyanide

TABLE 1

LEACHING STUDIES OF RAW AND LFA FIXATED (2:1) CYLINDERS

	Untreated	Treated	Untreated	Treated
	EPA - RCRA	EPA - RCRA	D.I. H20	D.I. H20
Cr	73.0*	2.9	0.63	<0.01
Ni	65.6	1.0	0.61	0.04
Cu	22.0	1.0	0.24	0.07

TABLE 2

EPA-RCRA ELACH TESTING OF LFA TREATED AND UNTREATED SLUDGES

Metals	Untreated	Treated
Arsenic	<0.001*	<0.001
Barium	0.23	0.09
Cadmium	<0.001	<0.001
Chromium	7.4	0.81
Lead	<0.01	<0.01
Mercury	<0.001	<0.001
Selentium	<0.001	0.002
Nickel	3.9	4.8
Copper	2.4	0.02

*All values in mg/1 of leachate.

TABLE 3

PLATING SLUDGE LEACHATE LEVELS
(mg/liter)

	CN[1]	Cd	Ni	Cr
Raw Unreacted	0.13	0.001	87.0	22.0
Fixated #1	<0.01	0.004	<0.01	0.03
	<0.01	<0.001	<0.01	0.02
Fixated #2	<0.01	<0.001	<0.01	0.05
	<0.01	<0.001	<0.01	0.05
Raw Unreacted	0.05	<0.001	76.0	3.5
Fixated #3	<0.01	<0.001	0.15	0.10
	<0.01	<0.001	<0.01	0.04
Fixated #4	<0.01	<0.001	<0.01	0.07
	<0.01	<0.001	<0.01	0.07

*All values in mg/1 of leachate.
[1]CN - Cyanide

Note: This is a partial listing of data. Refer to the document for more information.

Treatment Process:	Dechlorination
Media:	Soil/Generic
Document Reference:	Research Triangle Institute. "PCB Sediment Decontamination Process-Selection for Test and Evaluation," and slide presentation on "Effective Treatment Technologies for the Chemical Destruction of PCB." Approximately 200 pp. Prepared for U.S. EPA, HWERL. May 1987.
Document Type:	EPA ORD Report
Contact:	Dr. Clark Allen Research Triangle Institute P.O. Box 12194 Research Traiangle Park, NC 27709 919-541-5826
Site Name:	Guam (Non-NPL)
Location of Test:	Research Triangle Park, NC

BACKGROUND: This document is a report describing the assessment of seven alternative treatment processes that show potential for decontaminating polychlorinated biphenyl (PCB)-contaminated sediments. The processes are KPEG, MODAR Supercritical Water Oxidation, Bio-Clean, Ultrasonics/UV, CFS Extraction, B.E.S.T., and Low Energy Extraction. Each process was evaluated using five criteria: the probability of cleaning sediments to 2 ppm or less; the availability of a test system; the test and evaluation effort required; the time required for future availability of a commercial treatment process; and the probable cost of treatment using the process. The evaluation of the criteria for each process was carried out by engineering analysis of available data and site visits to developers' facilities. This report deals with the KPEG process for the destruction of PCBs.

OPERATIONAL INFORMATION: The KPEG process was demonstrated in the treatment of contaminated soil on Guam by way of the Galson Terraclean-Cl process. This destroys PCBs by nucleophilic substitution. Potassium hydroxide is reacted with polyethylene glycol (PEG) to form an alkoxide. The alkoxide reacts to produce an ether and potassium chloride.

Addition of an RO-group enhances the solubility of the molecule and makes it less toxic. The reaction may continue until several chlorine atoms are removed from the PCB molecule. The reagent consists of a mixture of PEG, potassium hydroxide, and dimethyl sulfoxide (DMSO).

Contaminated soil or sediment is fed to the reactor from 55-gallon drums. An equal volume of reagent is added to the soil in the reactor. The reagent is blended with the soil using a stainless steel bladed mixer.

During operation of the system, contaminated reagent is mixed with make-up reagent in the reagent storage tank and recirculated into the reaction vessel containing contaminated soil. The reaction vessel is heated (150°C) and the soil and reagent are kept mixed until the reaction is complete. Volatilized material from the bulk storage tank and the reaction vessel are vented through a charcoal adsorption unit. Water vapor is condensed and used as wash water. The reagent is decanted,

weighed, and stored for reuse. The soil is washed twice with water to remove excess reagent, and the wash water is held for analysis and possible treatment with activated carbon.

The treated soil is held for analysis. If PCB concentration is greater than 2 ppm, the soil is retreated. QA/QC procedures are not discussed.

PERFORMANCE: It was found that all of the processes assessed have merit. In selecting the most promising ones, a ranking system was used based on the five criteria mentioned in the background section. The processes were ranked comparatively as to the desirability for thorough testing and evaluation. The KPEG process was ranked 5th with a score of 0.58, within a range of scores from 0.49 to 0.62. Laboratory-scale KPEG treatments were applied and there was a reduction of PCB levels to 17.5 ppm by treating the soil 5 hours at 115° to 120°C. Residual PCBs were qualitatively identified as penta- and hexa-chloro biphenyl. These congeners had been reduced 75% and 60% respectively, by the treatment. Galson reported reduction from 1800 to 2.3 ppm by treatment at 150°C for 2 hours.

CONTAMINANTS:

Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO2-Dioxins/Furans/PCBs	1336-36-3	Total PCBs
	11096-82-5	PCB-1260

Treatment Process:	Thermal Destruction - Critical Water Oxidation
Media:	Soil/Generic
Document Reference:	Research Triangle Institute. "PCB Sediment Decontamination Process-Selection for Test and Evaluation," and slide presentation on "Effective Treatment Technologies for the Chemical Destruction of PCB." Approximately 200 pp. Prepared for U.S. EPA, HWERL. May 1987.
Document Type:	EPA ORD Report
Contact:	Dr. Clark Allen Research Triangle Institute P.O. Box 12194 Research Triangle Park, NC 27709 919-541-5826
Site Name:	Guam (Non-NPL)
Location of Test:	Research Triangle Park, NC

BACKGROUND: This document is a report describing the assessment of seven alternative treatment processes that show potential for decontaminating polychlorinated biphenyl (PCB)-contaminated sediments. The processes are KPEG, MODAR Supercritical Water Oxidation, Bio-Clean, Ultrasonics/UV, CFS Extraction, B.E.S.T., and Low Energy Extraction. Each process was evaluated using five criteria: the probability of cleaning sediments to 2 ppm or less; the availability of a test system; the test and evaluation effort required; the time required for future availability of a commercial treatment process; and the probable cost of treatment using the process. The evaluation of the criteria for each process was carried out by engineering analysis of available data and site visits to developers' facilities. This report deals with the evaluation of a critical water oxidation process to destroy PCBs.

OPERATIONAL INFORMATION: The MODAR Supercritical Water Oxidation process utilizes water above critical conditions (374°C and 22.1 MPa) to increase the solubility of organic materials and oxygen to effect a rapid oxidation, destroying organic contaminants. The PCBs are found in a slurry or sludge type material. The report attempts to evaluate systems available from C.F. System and Enseco. However, the source of the bench-scale study is not given, neither are sampling procedures, QA/QC procedures, or conclusions.

PERFORMANCE: It was found that all of the processes assessed have merit. In selecting the most promising ones, a ranking system was used based on the five criteria mentioned in the background section. The processes were ranked comparatively as to the desirability for thorough testing and evaluation. The MODAR supercritical water system was ranked 6th with a score of 0.57, within scores which ranged from 0.49 to 0.62. The destruction efficiency for PCB is given in the bottom table.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO2-Dioxins/Furans/PCBs	1336-36-3	Total PCBs

TABLE 1

WASTE DESTRUCTION EFFICIENCY MODAR/CECOS
DEMONSTRATION ORGANIC WASTE TEST

Contaminant	Feed rate (g/min)	Liquid effluent rate (g/min)	Gaseous effluent rate (g/min)	Destruction efficiency %
PCB	9.1×10^{-2}	$<3.1 \times 10^{-7}$	$<4.4 \times 10^{-6}$	>99.9995

Note: This is a partial listing of data. Refer to the document for more information.

Treatment Process:	Immobilization - Stabilization
Media:	Soil/Generic
Document Reference:	Lopat Enterprises, Inc. "Representative Selection of Laboratory Experiments and Reports of Full-Scale Commercial Use Which Demonstrate the Effectiveness of K-20 Lead-in Soil Control System in Physical/Chemical Solidification, Fixation, Encapsulation & Stabilization of Certain Soil, Ash, Debris and Similar Wastes." Technical data report. Approximately 60 pp. Assembled for CDM. August 1987
Document Type:	Contractor/Vendor Treatability Study
Contact:	Lou Parent Lopat Enterprises, Inc. 1750 Bloomsbury Avenue Wanamassa, NJ 07712 201-922-6600
Site Name:	Confidential
Location of Test:	Lopat Enterprises, Inc., Wanamassa, NJ

BACKGROUND: The report consists of brief summaries of seven bench-scale tests conducted by Lopat Enterprises for their clients. Lopat Enterprises report that their technique will stabilize solids contaminated with inorganic volatile and non-volatile metals (Cd, Zn, Hg,Pb, Cr, Ni, Cu), non-metallic toxic elements (As), and certain organics (PCBs).

OPERATIONAL INFORMATION: Lopat Enterprises uses a proprietary technology called K-20^{tm} Lead-in-Soil Control System (K-20/LSC) for the physical/chemical fixation, solidification, encapsulation, and stabilization of contaminated soil and soil-like matrices. In the K-20/LSC system, two liquid components are blended and diluted prior to application to dry waste. Dry fixative materials are then added to the wetted waste material, and the dry waste are mixed with the K-20/LSC system components and allowed to cure for a day or more. The formulation of these components is site specific and proprietary. The volume of wastes treated varied with each project and was not reported. EP toxicity tests were performed on treated and untreated sludge. Waste weight increase was about 38% due to an immobilization admixture treatment. The document also reports that the waste volume increase resulting from treatment was between 100% to 151%.

PERFORMANCE: Lopat Enterprises reports that the K-20/LSC system is capable of reducing leachate concentrations by 90%. The document presents EP Toxicity test results before and after fixation of data are presented for Pb, and Cr. Initial concentrations of lead ranged from 9.8 ppm to 6200 ppm, although they are generally between 10 and 500 ppm. The initial concentrations and the percent reductions in metal concentrations in the leachate are summarized in the Table 1. The percent reductions were highest for lead and lowest for chromium. Costs reported were in the range of $15 to $20 per ton. QA/QC was not reported.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W10-Non-Volatile Metals	7440-47-3	Chromium
W11-Volatile Metals	7439-92-1	Lead

Note: This is a partial listing of data. Refer to the document for more information.

TABLE 1

SUMMARY OF PERFORMANCE DATA

The following data is provided by Lopat Enterprises for their K20/LSC stabilization treatment. The upper number is the concentration in the leachate prior to treatment, as determined by the EP Toxicity test. The lower number is the percent reduction in leachate concentration following treatment.

Waste	Pb	Cr
Paint manufacturing sludge	9.8 ppm 63->95%	1 ppm 7-44%

Treatment Process:	Immobilization - Stabilization
Media:	Soil/Generic
Document Reference:	Lopat Enterprises, Inc. "Representative Selection of Laboratory Experiments and Reports of Full-Scale Commercial Use Which Demonstrate the Effectiveness of K-20 Lead-in Soil Control System in Physical/Chemical Solidification, Fixation, Encapsulation & Stabilization of Certain Soil, Ash, Debris and Similar Wastes." Technical data report. Approximately 60 pp. Assembled for CDM. August 1987.
Document Type:	Contractor/Vendor Treatability Study
Contact:	Lou Parent Lopat Enterprises, Inc. 1750 Bloomsbury Avenue Wanamassa, NJ 07712 201-922-6600
Site Name:	Confidential
Location of Test:	Lopat Enterprises, Inc., Wanamassa, NJ

BACKGROUND: The report consists of brief summaries of seven bench-scale tests conducted by Lopat Enterprises for their clients. Lopat Enterprises report that their technique will stabilize solids contaminated with volatile and non-volatile metals (Cd, Zn, Hg, Pb, Cr, Ni, As, Cu) and certain organics (PCBs). This bench scale demonstration was performed on blasting sand contaminated with lead.

OPERATIONAL INFORMATION: Lopat Enterprises uses a proprietary technology called K-20^{tm} Lead-in-Soil Control System (K-20/LSC) for the physical/chemical fixation, solidification, encapsulation, and stabilization of contaminated soil and soil-like matrices. In the K-20/LSC system, two liquid components are blended and diluted prior to application to dry waste. Dry fixative materials are then added to the wetted waste material, and the dry waste are mixed with the K20/LSC system components and allowed to cure for a day or more. The formulation of these components is site specific and proprietary. The volume of wastes treated varied with each project and was not reported. EP Toxicity tests were performed on both the untreated and treated sand. Waste weight increase due to treatment was reported to be 55%, and the resulting volume increase varied between 60% to 80%. A blender or similar equipment for batch processing was required along with a spray apparatus chamber and hopper. No conclusions or operating conditions were reported in the document.

PERFORMANCE: Lopat Enterprises reports that the K-20/LSC system is capable of reducing leachate concentrations by 90%. The document presents EP Toxicity test results before and after fixation of blasting sand. Data are presented for lead. Initial concentrations of lead ranged from 9.8 ppm to 6200 ppm, although they are generally between 10 and 500 ppm. The initial concentration of lead was 6200 ppm and the percent reduction in metal concentration in the leachate was 99%. Of all the bench-scale tests performed by Lopat, the percent reductions were highest for lead. Costs reported were in the range of $15 to $20 per ton. QA/QC was not reported and fugitive emissions generated during soil fixation are not discussed.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W11-Volatile Metals	7439-92-1	Lead

Treatment Process:	Immobilization - Stabilization
Media:	Soil/Generic
Document Reference:	Lopat Enterprises, Inc. "Representative Selection of Laboratory Experiments and Reports of Full-Scale Commercial Use Which Demonstrate the Effectiveness of K-20 Lead-in Soil Control System in Physical/Chemical Solidification, Fixation, Encapsulation & Stabilization of Certain Soil, Ash, Debris and Similar Wastes." Technical data report. Approximately 60 pp. Assembled for CDM. August 1987.
Document Type:	Contractor/Vendor Treatability Study
Contact:	Lou Parent Lopat Enterprises, Inc. 1750 Bloomsbury Avenue Wanamassa, NJ 07712 201-922-6600
Site Name:	Confidential
Location of Test:	Lopat Enterprises, Inc., Wanamassa, NJ

BACKGROUND: The report consists of brief summaries of seven bench-scale tests conducted by Lopat Enterprises for their clients. Lopat Enterprises report that their technique will stabilize solids contaminated with volatile and non-volatile metals (Cd, Zn, Hg, Pb, Cr, Ni, As, Cu) and certain organics (PCBs). This data was from a bench scale design experiment on a soil contaminated with engine oil which had lead in it.

OPERATIONAL INFORMATION: Lopat Enterprises uses a proprietary technology called K-20^{tm} Lead-in-Soil Control System (K-20/LSC) for the physical/chemical fixation, solidification, encapsulation, and stabilization of contaminated soil and soil-like matrices. In the K-20/LSC system, two liquid components are blended and diluted prior to application to dry waste. Dry fixative materials are then added to the wetted waste material, and the dry waste are mixed with the K20/LSC system components and allowed to cure for a day or more. The formulation of these components is site specific and proprietary. The volume of wastes treated varied with each project and was not reported. The lead concentrations were reported at 16.3 mg/l. Waste weight increase after treatment was between 22% and 30%. The reported volume increase, resulting from treatment, ranged from 43% to 86%. No conclusions or operating conditions were reported in the document.

PERFORMANCE: Lopat Enterprises reports that the K-20/LSC system is capable of reducing leachate concentrations by 90%. The document presents EP Toxicity test results before and after fixation of oil-soaked soil. Data are presented for lead. Initial concentrations of lead for all tests ranged from 9.8 ppm to 6200 ppm, although they are generally between 10 and 500 ppm. The initial concentration of lead in the soil contaminated with engine oil was 16.3 ppm and the percent reduction in metal concentration in the leachate was 99%. Of all the bench-scale tests performed by Lopat, the percent reductions were highest for lead. Costs reported were in the range of $15 to $20 per ton. QA/QC was not reported and fugitive emissions generated during soil fixation are not discussed.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
W11-Volatile Metals	7439-92-1	Lead (total)

Treatment Process:	Thermal Destruction - Circulating Bed Combustion
Media:	Soil/Generic
Document Reference:	Alliance Technologies Corp. "Technical Resource Document: Treatment Technologies for Dioxin/Containing Wastes." Technical Report EPA/600/2-86/096. 244 pp. October 1986.
Document Type:	EPA ORD Report
Contact:	Harold Freeman U.S. EPA, ORD 26 W. St. Clair Street HWERL-Thermal Destruction Branch Cincinnati, OH 45268 513-569-7529
Site Name:	Denny Farm Site, MO (Non-NPL)
Location of Test:	Denny Farm, MO

BACKGROUND: GA Technologies conducted the circulating bed combustor (CBC) pilot scale tests using PCB-contaminated soils. This treatability study compiles available information on those technologies for dioxin containing solids, liquids and sludges, many of which are in early stages of development. Discussion of the CBC pilot test is contained in this abstract. Other technologies in this document are discussed in Document Numbers FCFR-4 and FCFR-6. Technologies evaluated were those that destroy or change the form of dioxin to render it less toxic. Those technologies not tested on dioxin-containing wastes had been tested on PCB-containing wastes. The report divides the technologies into thermal and non-thermal groups for discussion. It was noted that incineration was the only sufficiently demonstrated technology for treatment of dioxin containing wastes (51 FR 1733) and RCRA Performance Standards for Thermal Treatment require 99.9999 percent destruction removal efficiency (DRE) of the principal organic hazardous constituent (POHC). Factors which affect the selection/use of a particular technology are discussed. Technical performance for treating a specific waste type and costs are both considered in this discussion. A summary of dioxin treatment processes, their performance/destruction achieved, and estimated costs are provided in Table 1. QA/QC is not discussed.

OPERATIONAL INFORMATION: GA Technologies conducted trial burns on PCB-contaminated soil with 9800 to 12,000 ppm of PCB. Auxiliary fuel was used to maintain the bed temperature at 1600° to 1800°F. A soil feed rate of 325 to 410 pounds per hour was used.

PERFORMANCE: A destruction efficiency exceeding six nines (99.9999 percent) was achieved. Costs of fluidized bed treatment are dependent on fuel requirements, scale and site conditions. Cost estimates of from $27/ton to $150/ton are provided for various assumptions.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO2-Dioxins/Furans/PCBs	1336-36-3	Total PCBs

Note: This is a partial listing of data. Refer to the document for more information.

TABLE 1

SUMMARY OF DIOXIN TREATMENT PROCESSES

Process Name	Performance/Destruction Achieved	Cost
Stationary Rotary Kiln Incineration	Greater than 99.999 DRE demonstrated on dioxin at combustion research facility	$0.25 - $0.70/lb for PCB solids
Mobile Rotary Kiln Incineration	Greater than 99.999 DRE for dioxin by EPA unit; process residuals delisted	NA
Liquid Injection Incineration	Ocean incinerators only demonstrated 99.9 on dioxin-containing herbicide orange	$200 - $500/ton
Fluidized-bed Incineration	Greater than 99.9999 DRE demonstrated on PCBs	$60 - $320/ton
Infrared Incinerator (Shirco)	Greater than 99.9999 DRE on TCDD-contaminated soil	$200 - $1,200 per ton
High Temperature Fluid Wall (Huber AER)	Greater than 99.999 DRE on TCDD-contaminated oil	$300 - $600/ton
Molten Salt (Rockwell Unit)	Up to eleven nines DRE on hexachlorobenzene	NA
Supercritical Water Oxidation	99.9999 DRE on dioxin-containing waste reported by developer	$0.32 - $2.00/gallon
Plasma Arc Pyrolysis	Greater than 99.9999 destruction of PCBs and $CC1_4$	$300 - $1,400/ton
In-Situ Vitrification	Greater than 99.9% destruction on PCB-contaminated soil	$120 - $250/$M^3$

TABLE 1 (Continued)

SUMMARY OF DIOXIN TREATMENT PROCESSES

Process Name	Performance/Destruction Achieved	Cost
Solvent Extraction	Still bottom extraction: 340 ppm TCDD reduced to 0.2 ppm; 60-90% removal from soils	NA Stabilization/Fixation Test using cement decreased leaching of TCDDNA
UV Photolysis	Greater than 98.7% reduction of TCDD	$250 -$1,200/ton
Chemical Dechlorination APEG processes	Reduction of 2,000 ppb TCDD to below 1 ppb for slurry (batch process)	$296/ton for in situ, $91/ton for slurry
Biological in situ addition of microbes	50-60% metabolism of 2,3,7,8-TCDD using white rot fungus	NA
Degradation using Ruthemium Tetroxide	Reduction of 70 ppb TCDD to below 10 ppb in 1 hr	NA
Degradation using Chloroiodides	Up to 92% degradation on solution of TCDD in benzene	NA

Treatment Process:	Thermal Destruction - Pyrolysis
Media:	Soil/Generic
Document Reference:	Alliance Technologies Corp. "Technical Resource Document: Treatment Technologies for Dioxin-Containing Wastes." Technical Report EPA/600/2-86/096. 244 pp. October 1986.
Document Type:	EPA ORD Report
Contact:	Harold Freeman U.S. EPA, ORD HWERL-Thermal Destruction Branch 26 W. St. Clair Street Cincinnati, OH 45268 513-569-7529
Site Name:	Times Beach, MO (NPL)
Location of Test:	Times Beach, MO

BACKGROUND: This report focuses on the pilot scale Advanced Electric Reactor (AER). This treatability study compiles available information on those technologies for dioxin containing solids, liquids and sludges, many of which are in early stages of development. A discussion of the AER pilot test is contained in this abstract. Other technologies in this document are discussed in Document Numbers FCFR-3 and FCFR-6. Technologies evaluated were those that destroy or change the form of dioxin to render it less toxic. Those technologies not tested on dioxin-containing wastes had been tested on PCB-containing wastes. The report divides the technologies into thermal and non-thermal groups of discussion. It was noted that incineration was the only sufficiently demonstrated technology for treatment of dioxin containing wastes (51 FR 1733) and RCRA Performance Standards for Thermal Treatment require 99.9999 percent destruction removal efficiency (DRE) of the principal organic hazardous constituent (POHC). Factors which affect the selection/use of a particular technology are discussed. Technical performance for treating a specific waste type and costs are both considered in this discussion. A summary of dioxin treatment processes, their performance/destruction achieved, and estimated costs are provided in Table 1. OA/QC is not discussed.

OPERATIONAL INFORMATION: The AER, owned and operated by J.M. Huber Corporation, was used to treat, 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). It was also used in other tests including tests at Gulfport, Mississippi, but these tests reported only removal efficiencies. Only two data points are present from the Times Beach trials, one from the treated soil and one from the baghouse catch.

The AER was operated at 3500°F-4000°F. Heating was accomplished using electrically heated carbon electrodes. A nitrogen purge gas provided the reaction atmosphere. Since oxygen was not present, it was run in a pyrolytic manner.

PERFORMANCE: High DREs could not be demonstrated due to the low amount of contamination (79 ppb in the influent soil). One limitation of the AER is that it cannot handle two-phase materials such as sludge. Soils should be dried and sized (smaller than 10 mesh) before being fed into the reactor. Another limitation is that other types of incineration processes are more cost effective for high BTU content material. Since no supplementary fuels are required, this process is better suited

for low BTU material. A cost estimate guideline is included. Recently the U.S. EPA and the Texas Water Commission jointly issued J.M. Huber Corporation a RCRA permit which authorizes the incineration of any non-nuclear RCRA hazardous waste in the AER.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO2-Dioxins/Furans/PCBs	1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin
	1336-36-3	Total PCBs

Note: This is a partial listing of data. Refer to the document for more information.

TABLE 1

SUMMARY OF DIOXIN TREATMENT PROCESSES

Process Name	Performance/Destruction Achieved	Cost
Stationary Rotary Kiln Incineration	Greater than 99.999 DRE demonstrated on dioxin at combustion research facility	$0.25 - $0.70/lb for PCB solids
Mobile Rotary Kiln Incineration	Greater than 99.999 DRE for dioxin by EPA unit; process residuals delisted	NA
Liquid Injection Incineration	Ocean incinerators only demonstrated 99.9 on dioxin-containing herbicide orange	$200 - $500/ton
Fluidized-bed Incineration	Greater than 99.9999 DRE demonstrated on PCBs	$60 - $320/ton
Infrared Incinerator (Shirco)	Greater than 99.9999 DRE on TCDD-contaminated soil	$200 - $1,200 per ton
High Temperature Fluid Wall (Huber AER)	Greater than 99.999 DRE on TCDD-contaminated oil	$300 - $600/ton
Molten Salt (Rockwell Unit)	Up to eleven nines DRE on hexachlorobenzene	NA
Supercritical Water Oxidation	99.9999 DRE on dioxin-containing waste reported by developer	$0.32 - $2.00/gallon
Plasma Arc Pyrolysis	Greater than 99.9999 destruction of PCBs and $CC1_4$	$300 - $1,400/ton
In-Situ Vitrification	Greater than 99.9% destruction on PCB-contaminated soil	$120 - $250/$M^3$
Solvent Extraction	Still bottom extraction: 340 ppm TCDD reduced to 0.2 ppm; 60-90% removal from soils	NA
Stabilization/Fixation	Tests using cement decreased leaching of TCDD	NA
UV Photolysis	Greater than 98.7% reduction of TCDD	$250 -$1,200/ton
Chemical Dechlorination APEG processes	Reduction of 2,000 ppb TCDD to below 1 ppb for slurry (batch process)	$296/ton for in situ, $91/ton for slurry
Biological in situ addition of microbes	50-60% metabolism of 2,3,7,8-TCDD using white rot fungus	NA

TABLE 1 (continued)

SUMMARY OF DIOXIN TREATMENT PROCESSES

Process Name	Performance/Destruction Achieved	Cost
Degradation using Ruthemium Tetroxide	Reduction of 70 ppb TCDD to below 10 ppb in 1 hr	NA
Degradation using Chloroiodides	Up to 92% degradation of solution of TCDD in benzene	NA

Treatment Process:	Dechlorination
Media:	Soil/Generic
Document Reference:	Alliance Technologies Corp. "Technical Resource Document: Treatment Technologies for Dioxin/Containing Wastes." Technical Report EPA/600/2-86/096. 244 pp. October 1986.
Document Type:	EPA ORD Report
Contact:	Harold Freeman U.S. EPA, ORD HWERL-Thermal Destruction Branch 26 W. St. Clair Street Cincinnati, OH 45268 513-569-7529
Site Name:	Denny Farm Site, MO (Non-NPL)
Location of Test:	Denny Farm, MO

BACKGROUND: This document summarizes several case studies on the applications of the Alkali Polyethylene Glycolate (APEG) treatment process applied to dioxin-contaminated soil. This treatability study compiles available information on those technologies for dioxin containing solids, liquids and sludges, many of which are in early stages of development. A discussion of the APEG technology is contained in this abstract. Other technologies are discussed in Document Numbers FCFR-3 and FCFR-4. Technologies evaluated were those that destroy or change the form of dioxin to render it less toxic. Those technologies not tested on dioxin-containing wastes had been tested on PCB-containing wastes. The report divides the technologies into thermal and non-thermal groups for discussion. It was noted that incineration was the only sufficiently demonstrated technology for treatment of dioxin containing wastes (51 FR 1733) and RCRA Performance Standards for Thermal Treatment require 99.9999 percent destruction removal efficiency (DRE) of the principal organic hazardous constituent (POHC). Factors which affect the selection/use of a particular technology are discussed. Technical performance for treating a specific waste type and costs are both considered in this discussion. A summary of dioxin treatment processes, their performance/destruction achieved, and estimated costs are provided in Table 1. OA/QC is not discussed.

OPERATIONAL INFORMATION: This document summarized several case studies on the applications of the Alkali Polyethylene Glycolate (APEG) treatment process applied to dioxin-contaminated soil. All data are either bench or pilot scale. Two different molecular weight APEG reagents were used. Three tests were K-400 (potassium-based reagent and polyethylene glycol of average molecular weight of 400) and two tests were K-120. It is unclear whether the waste matrix was a solvent, soil, or contaminated debris. All analyses reported were total waste analyses.

PERFORMANCE: The document concludes that this technology has a potential for treating soil contaminated with dioxins. Efficiencies improve with increased temperature. Costs for the slurry process is estimated at $91/ton and for the in situ process $296/ton.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO2-Dioxins/Furans/PCBs	1336-36-3	Total PCBs
	1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxins

Note: This is a partial listing of data. Refer to the document for more information.

TABLE 1

SUMMARY OF DIOXIN TREATMENT PROCESSES

Process Name	Performance/Destruction Achieved	Cost
Stationary Rotary Kiln Incineration	Greater than 99.999 DRE demonstrated on dioxin at combustion research facility	$0.25 - $0.70/lb for PCB solids
Mobile Rotary Kiln Incineration	Greater than 99.999 DRE for dioxin by EPA unit; process residuals delisted	NA
Liquid Injection Incineration	Ocean incinerators only demonstrated 99.9 on dioxin-containing herbicide orange	$200 - $500/ton
Fluidized-bed Incineration	Greater than 99.9999 DRE demonstrated on PCBs	$60 - $320/ton
Infrared Incinerator (Shirco)	Greater than 99.9999 DRE on TCDD-contaminated soil	$200 - $1,200 per ton
High Temperature Fluid Wall (Huber AER)	Greater than 99.999 DRE on TCDD-contaminated oil	$300 - $600/ton
Molten Salt (Rockwell Unit)	Up to eleven nines DRE on hexachlorobenzene	NA
Supercritical Water Oxidation	99.9999 DRE on dioxin-containing waste reported by developer	$0.32 - $2.00/gallon
Plasma Arc Pyrolysis	Greater than 99.9999 destruction of PCBs and $CC1_4$	$300 - $1,400/ton
In-Situ Vitrification	Greater than 99.9% destruction on PCB-contaminated soil	$120 - $250/$M^3$
Solvent Extraction	Still bottom extraction: 340 ppm TCDD reduced to 0.2 ppm; 60-90% removal from soils	NA
Stabilization/Fixation	Tests using cement decreased leaching of TCDD	NA
UV Photolysis	Greater than 98.7% reduction of TCDD	$250 -$1,200/ton
Chemical Dechlorination APEG processes	Reduction of 2,000 ppb TCDD to below 1 ppb for slurry (batch process)	$296/ton for in situ, $91/ton for slurry
Biological in situ addition of microbes	50-60% metabolism of 2,3,7,8-TCDD using white rot fungus	NA

TABLE 1 (continued)

SUMMARY OF DIOXIN TREATMENT PROCESSES

Degradation using Ruthemium Tetroxide	Reduction of 70 ppb TCDD to below 10 ppb in 1 hr	NA
Degradation using Chloroiodides	Up to 92% degradation on solution of TCDD in benzene	NA

Treatment Process:	Dechlorination
Media:	Sludge/Generic
Document Reference:	Galson Research Corp. "Bengart and Memel (Bench-Scale), Gulfport (Bench and Pilot-scale), Montana Pole (Bench-scale), and Western Processing (Bench-scale) Treatability Studies." 10 pp. July 1987.
Document Type:	Contractor/Vendor Treatability Study
Contact:	Timothy Geraets Galson Research Corp. 6601 Kirkville Road E. Syracuse, NY 13057 315-463-5160
Site Name:	Bengart and Memel, Buffalo, NY (Non-NPL)
Location of Test:	Galson Technical Services, Syracuse, NY

BACKGROUND: This document presents summary data on the results of various treatability studies (bench and pilot scale), conducted at four different sites where soils were contaminated with dioxins or PCBs. The synopsis is meant to show rough performance levels under a variety of different conditions.

This summary discusses the Bengart-Memel site in Buffalo, NY. Information available in the document consists of parts of two tables containing data on the performance of dechlorination on PCBs. The study was performed on a bench-scale and pilot-scale. No detailed site descriptions were provided.

OPERATIONAL INFORMATION: The APEG process for dechlorinating hydrocarbons was utilized and the amount of reagents/time and temperature were varied. Two different reagent loading rates were used. The soil was tested as a slurry and in-situ. The scope of work for the Bengart & Memel treatability study was to determine if PCB contaminated soils could be treated. Unit cost estimates for soil treatment are not provided. The pilot study treated 50 drums filled with soil; however, the numerical data were not supplied with this document. There was no discussion of laboratory analysis procedures, QA/QC plan, or the amount of soils used in bench scale tests.

PERFORMANCE: The results of the Bengart & Memel study indicate the PCB concentrations could be reduced to less than 50 ppm by adding reagent to the soil, mixing and heating the soil/reagent mass to 120°C for 12-24 hours. However, no significant correlation appears to exist between performance as measured by the amount of contaminant remaining and reagents used, reagent ratios, time, temperature, or reagent loading.

CONTAMINANTS:

Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO2-Dioxins/Furans/PCBs	1336-36-3	Total PCBs

Treatment Process:	Dechlorination
Media:	Sludge/Generic
Document Reference:	Galson Research Corp. "Bengart and Memel (Bench-Scale), Gulfport (Bench and Pilot-scale), Montana Pole (Bench-scale), and Western Processing (Bench-scale) Treatability Studies." 10 pp. July 1987.
Document Type:	Contractor/Vendor Treatability Study
Contact:	Timothy Geraets Galson Research Corp. 6601 Kirkville Road E. Syracuse, NY 13057 315-463-5160
Site Name:	NCBC Gulfport, MS (Non-NPL)
Location of Test:	Galson Technical Services, Syracuse, NY

BACKGROUND: This document presents summary data on the results of various treatability studies (bench and pilot scale), conducted at four different sites where soils were contaminated with dioxins or PCBs. The synopsis is meant to show rough performance levels under a variety of different conditions.

This summary discusses the NCBC site in Gulfport, MS. Information available in the document consists of parts of two tables containing data on the performance of dechlorination on PCBs. The study was performed on a bench-scale and pilot-scale. No detailed site descriptions were provided.

OPERATIONAL INFORMATION: The APEG process for dechlorinating hydrocarbons was utilized and the amount of reagents/time and temperature were varied. Two different reagent loading rates were used. Tests were conducted in slurry form and in-situ. Unit cost estimates for soil treatment are not provided. Costs for each bench-scale test run are estimated at $1,000 for PCBs and $2,000 for dioxin. Dioxin tests are more costly due to the complicated analytical procedures. The scope of work at the NCBC site was to determine the kinetics of processing dioxin contaminated soil using 30 kg batches in a modified 55-gallon drum reactor unit. There was no discussion of laboratory analysis procedures, QA/QC plan, or the amount of soils used in bench scale tests.

PERFORMANCE: The results of the NCBC study showed that the soil from Gulfport, MS could be decontaminated by mixing the soil with APEG reagent and heating to 120°C for 7 hours. However, no significant correlation appears to exist between performance as measured by the amount of contaminant remaining and reagents used, reagent ratios, time, temperature, or reagent loading.

CONTAMINANTS:

Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO2-Dioxins/Furans/PCBs	TOT-DF 30746-58-8	Total Dioxins and Furans 1,2,3,4-Tetrachlorodibenzo-p-dioxin

Note: This is a partial listing of data. Refer to the document for more information.

TABLE 1

BENCH SCALE DATA ON NCBC (GULFPORT)

No.	Source	Com-pound	Process	Reagent	Loading	Temp. °C	Time	Concentration Before	Concentration After
1	Gulfport	TCDD	Slurry	9:9:2-P.D.K.	100%	250	4 hours	2000 ppb	<1 ppb
2	Gulfport	TCDD	Slurry	1:1:1-P.D.K.	100%	160	2 hours	2000 ppb	<1 ppb
3	Gulfport	TCDD	Slurry	9:9:2-M.D.K.	100%	150	2 hours	2000 ppb	<1 ppb
4	Gulfport	TCDD	Slurry	9:9:2-M.D.K.	100%	100	2 hours	2000 ppb	<1 ppb
5	Gulfport	TCDD	Slurry	1:1:1-M.D.K.	100%	70	2 hours	2000 ppb	<1 ppb
6	Gulfport	TCDD	Slurry	9:9:2-M.D.K.	100%	70	2 hours	2000 ppb	<1.5 ppb
7	Gulfport	TCDD	Slurry	9:9:2-M.D.K.	100%	70	0.5 hrs	2000 ppb	<15 ppb
8	Gulfport	TCDD	Slurry	9:9:2-M.D.K.	100%	50	2 hours	2000 ppb	<23 ppb
9	Gulfport	TCDD	Slurry	9:9:2-M.D.K.	100%	25	2 hours	2000 ppb	<36 ppb
10	Gulfport	TCDD	In-Situ	1:1:1-P.D.K.	20%	25	7 days	2000 ppb	1000 ppb
11	Gulfport	TCDD	In-Situ	1:1:1-P.D.K.	20%	70	1 day	2000 ppb	8.5 ppb
12	Gulfport	TCDD	In-Situ	1:1:1-P.D.K.	20%	70	7 days	2000 ppb	<1 ppb
13	Gulfport	TCDD	In-Situ	2:2:2:1-M.D.K.W.	20%	70	1 day	2000 ppb	3.3 ppb
14	Gulfport	TCDD	In-Situ	2:2:2:1-M.D.K.W.	20%	70	2 days	2000 ppb	2.0 ppb
15	Gulfport	TCDD	In-Situ	2:2:2:1-M.D.K.W.	20%	70	4 days	2000 ppb	2.5 ppb
16	Gulfport	TCDD	In-Situ	2:2:2:1-M.D.K.W.	20%	70	7 days	2000 ppb	<1 ppb
17	Gulfport	TCDD	In-Situ	1:1:1:3-M.D.K.W.	20%	70	7 days	2000 ppb	3.2 ppb
18	Gulfport	TCDD	In-Situ	1:1:1:3-M.S.K.W.	50%	70	7 days	2000 ppb	2.7 ppb
19	Gulfport	TCDD	In-Situ	1:1:1:15-M.D.K.W.	20%	70	7 days	2000 ppb	43 ppb
20	Gulfport	TCDD	In-Situ	1:1:1:15-M.D.K.W.	50%	70	7 days	2000 ppb	14 ppb
BENCH SCALE DATA ON BENGART & MEMEL (BUFFALO)									
21	Buffalo	PCB	Slurry	9:9:2:1-M.D.K.W.	100%	100	2 hours	77 ppm	4.2 ppb
22	Buffalo	PCB	Slurry	9:9:2:1-M.S.K.W.	100%	100	2 hours	77 ppm	6.7 ppb
23	Buffalo	PCB	Slurry	1:1:2:2:1-P.T.S.K.W.	100%	150	2 hours	112 ppm	6.7 ppb
24	Buffalo	PCB	In-Situ	2:2:2:1-M.D.K.W.	20%	70	7 days	77 ppm	3.7 ppb
25	Buffalo	PCB	In-Situ	2:2:2:1-M.S.K.W.	20%	70	7 days	77 ppm	4.0 ppb
26	Buffalo	PCB	In-Situ	1:1:2:2:1-P.T.D.K.W.	100%	150	3 days	112 ppm	<0.1 ppb
27	Buffalo	PCB	In-Situ	1:1:2:2:1-P.T.D.K.W.	100%	150	1 day	83 ppm	<0.1 ppb

REAGENT COMPONENTS KEY
D = DMSO = dimethyl sulfoxide
K = KOH = potassium hydroxide
M = MEE = methyl carbitol = methoxy-ethoxy-ethanol
P - PEG = polyethylene glycol, avg. molecular weight of 400
S = SFLN = Sulfolane = tetrahydrothiophene 1.1-dioxide
T = TMH = triethylene glycol methyl ether and highers
W = water

TOXIC COMPOUNDS KEY
TCDD = 1.2.3.4-tetrachlorodibenzo-p-dioxin
PCB = polychorinated biphenyls

Loading (%) = 100 x (reagent mass/soil mass)

Treatment Process:	Low Temperature Thermal Desorption
Media:	Soil/Generic
Document Reference:	McDevitt, N., J. Noland, and P. Marks. "Contract DAAK 11-85-C-0007 (Task Order 4) Bench Scale Investigation of Volatile Organic Compounds (VOC's) from Soil." Technical Report AMXTH-TE-CR-86092 prepared by Roy F. Weston, Inc., for USATHAMA (U.S. Army). 120 pp. January 1987.
Document Type:	Contractor/Vendor Treatability Study
Contact:	Eric Kaufman U.S. DOD/USATHAMA Aberdeen Proving Ground, MD 21009 301-671-2270
Site Name:	Letterkenny Army Depot (NPL - Federal facility)
Location of Test:	Chambersburg, PA

BACKGROUND: The U.S. Army is investigating technologies to effectively treat soil contaminated by organic compounds. Low temperature thermal stripping is one alternative which couples two mechanisms: a) removal by volatilization and b) removal by aeration. Two individual studies were conducted to separate the effects of each mechanism. This treatability study evaluates the effects of aeration on VOC removal efficiency.

OPERATIONAL INFORMATION: Soils at the site are gravelly sand fill, and native material consisting of sandy clay and sandy silt. Soils contaminated with VOCs were taken from Area K of Letterkenney Army Depot and is a mixture of these soils. Average concentration of 1,2 trans dichloroethylene, trichloroethylene (TCE), and tetrachloroethylene were 115, 222 and 95 ppm, respectively. Samples of 4.5 liters each were used in the bench-scale tests. Soils were analyzed for their VOC content and then aerated in a bench scale aeration unit. The target residence time was 260 minutes. Total VOC were analyzed at the aeration unit outlet. In this manner, the input/output VOC concentration could be determined.

Sampling and analytical techniques are explained for soils, moisture content, temperatures and other variables in the experiments. QC measures in the report include explanations of equipment calibration procedures, analyses of blanks and duplicate samples.

PERFORMANCE: The effect of total VOC concentrations in the soils, air temperature, and soil temperature on the VOC removal efficiency were investigated. Results indicated that VOC removal efficiency is directly proportional to the total concentration of contaminants in the soil. Table 1 shows the results of increasing contaminant concentration on the removal efficiency of VOCs. The same table shows no correlation between soil bed temperature and removal efficiency. As the inlet air temperature decreased, there was an increase in removal efficiency. However, this increase may be due to the corresponding increase in total VOC contaminant levels. There appears to be a correlation between the moisture content of the air streams and the removal efficiency, but the authors suggest additional testing prior to drawing conclusion from the currently available data.

A conclusion in the report is a comparison of VOC removal efficiencies associated with aeration element to the thermal element VOC removal efficiencies. The authors claim that the role of aeration in thermal stripping is minimal (a separate June 86 report is referenced). No data is presented from

the companion report concerning the thermal element VOC removal efficiencies. The authors also qualify their statement indicating that their conclusions apply to the conditions evaluated in this study (i.e., inlet air temperature, etc.).

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO4-Halogenated Aliphatic Solvents	127-18-4	Tetrachloroethene
	156-60-5	Trans-1,2-dichlorethene
	79-01-6	Trichloroethene
WO7-Heterocyclics and Simple Aromatics	1330-20-7	Total Xylenes
W13-Other Organics	TOT-VAC	Total Volatile Organics

TABLE 1

SUMMARY OF OPERATING DATA

Test Run #	Total VOC Concentration ug/kg	Average Soil Bed Temp (F)	Average Inlet Temp (F)	Average Inlet Air Moisture Content (% by vol.)	VOC Removal Efficiency (%)
1	647	105	163	1.90	55
2	1,538	90	144	2.20	70
3	291,940	115	148	0.80	81
4	2,256,100	102	137	1.00	93

Note: This is a partial listing of data. Refer to the document for more information.

Treatment Process:	Thermal Destruction - Infrared
Media:	Sludge/Generic
Document Reference:	des Rosiers, Paul E. "Trip Report: Boehringer - Ingelheim, FRG, Test/Evaluation of Shirco Infrared Desorption Process on Dioxin-contaminated Wastes from 2,4,5-Trichlorophenol Manufacture using Hexachlorocyclohexane (Lindane) Wastes as Feedstock." Labeled U.S. EPA, Office of Environmental Engineering and Technology Demonstration, Washington, D.C. May 1987.
Document Type:	U.S. Government Trip Report
Contact:	Paul des Rosiers Chairman EPA Dioxin Disposal Advisory Group 401 M Street, S.W. Washington, D.C. 20460 202-382-2722
Site Name:	C.H. Boehringer Chemical Facility
Location of Test:	Hamburg, Germany

BACKGROUND: This document reports on the results of tests on the infrared desorption of dioxin contaminated soils from the C.H. Boehringer Chemical production facility. Dioxin contamination at the 20-acre site was found to be widespread (soils, buildings, groundwater, etc.) due to the past handling and manufacture of chlorobenzenes, chlorophenols, and pesticides.

Tests on the Shirco unit were conducted from November 1986 through February 1987 at the company facilities located in Hamburg and Ingelheim, Germany. Contaminant concentrations in the soils ranged from a maximum of 4400 ppm for hexachlorocyclohexane to a maximum of 18,300 ppm for hexachlorophenol, from 2 to 315 ppb for 2,3,7,8-TCDD and up to 9500 ppb for OCDD and OCDF. Approximately 3300 kg and 1300 kg of CDD/CDF contaminated soils were processed, respectively.

OPERATION INFORMATION: The desorption unit consists of a belt-fed desorption train, an afterburner section for desorbed gases, an emission treatment module, and a packed tower scrubber/venturi system to neutralize acid gases and remove any particulates produced. The unit is capable of processing 15-75 kg/hr of contaminated soil. The infrared heating rods are capable of achieving 500° to 800°C. Retention time is 10-45 minutes. A controlled gas flow (air or N_2) carries the volatile organic compounds (VOCs) into the afterburner which operates nominally at 1200°C. Scrubber water generated to date is stored pending government review and approval to delist the waste. A mobile analytical laboratory using a flame ionization detector was used to analyze for contaminants. Secondary mixing in the afterburner is necessary to ensure high destruction efficiency since the 2,3,7,8-TCDD molecule is sorbed on the smallest particles. No QA/QC plans were contained in this report. Analytical methods were not specified.

PERFORMANCE: Chlorobenzene contaminated soils processed in the Shirco unit were reduced from a maximum of 16,600 ppm to 5-80 ppb remaining in the soil residue. Hexachlorocyclohexane and chlorophenol contaminated soils experienced similar reductions. Levels of 2,3,7,8-TCDD contaminated soils with concentrations ranging from 2-315 ppb were reduced to between 5-50 parts per trillion (ppt). OCDD and OCDF contaminated soils containing up to 9500 ppb were reduced to

levels between 10-150 ppt using the Shirco unit. Process air emissions data revealed the CO, SO_2, HCL, TOC, particulates and 2,3,7,8-TCDD levels were within permit limits. Minor excursions beyond permit limits were noted during optimization tests. Heavy metal values were also found to be within permit limits (1 to 5 mgs/Nm). Scrubber water effluent limits for dioxin were at the nondetectable level for batch and continuous operations. Other organic scrubber water effluent levels were at the nondetectable, ppt or ppb level.

The Shirco Infrared Desorber treated dioxin contaminated soils at two different sites in Germany and removed approximately 99.99% of the contaminants. In addition to destroying dioxin, it can easily pyrolyze chlorobenzenes and other volatile organic compounds (VOCs). The German company plans to scale up the unit to treat 100 tons/day.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO1-Halogenated Aromatic Compounds	108-90-7	Chlorobenzenes
WO2-Dioxins/Furans/PCBs	OCDF 1746-01-6	Octachlorodibenzofurnas 2,3,7,8-Tetrachlorodibenzo-p-dioxin

Treatment Process:	Thermal Destruction - Fluidized Bed Combustion
Media:	Soils (Generic)
Document Reference:	Soczo, E.R., E.J.H. Verhagen and C.W. Versluijs. "Review of Soil Treatment Techniques in the Netherlands." National Institute of Public Health and Environmental Hygiene, Laboratory for Waste Emission Research (LAE), The Netherlands.
Document Type:	Government Laboratory Report
Contact:	National Institute of Public Health & Environmental Research A. Van Leeuwenhoeklaan 9, P.O. Box 1 3720 BA Bilthoven, The Netherlands
Site Name:	The Netherlands
Location of Test:	Lower Bilthoven, The Netherlands
Media:	Sandy Soil

BACKGROUND: This document is a survey of different soil technologies and treatment sites in the Netherlands. It specifically addresses thermal treatment, bioremediation, and solvent extraction. This document is only a very general summary of work. This abstract deals with thermal treatment.

OPERATIONAL INFORMATION: The Netherlands has six operational thermal treatment plants. One is a pilot plant using a fluidized bed combustor. The type of incineration process associated with the other five plants is not explained in the document. The plants have a capacity ranging from 4000 tons/year for the small pilot plant to 80,000 tons per year for the largest plant. The costs of thermal treatment range from $40 to $85/ton and depends on the moisture content of the soil and the type of contaminants.

PERFORMANCE: A table is presented which lists only a range of influent and effluent concentrations, general classes of contaminants, and soil type. The data was grouped by soil type. The results are considered to be full scale, because the information was gathered from treatment plants that were currently in operation. The table reveals that cyanides, BTEX, polycyclic aromatics (PCA) and diesel fuel can be removed from various soils with efficiencies ranging from 98 to 99.5%. Since this is only a survey of work being done in the Netherlands, QA/QC protocol or sampling and analysis protocol are not given. Therefore, care should be taken when using this data in a quantitative manner.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO7-Heterocyclics and Simple Non-Halogenated Aromatics	BTEX	Benzene, Toluene, Ethylbenzene, Xylene
WO8-Polynuclear Aromatics	TOT-PAH	Total Polycyclic Aromatic Hydrocarbons
W12-Other Organics	57-12-5	Cyanide
W13-Other Inorganics	DIESEL	Diesel fuel, oil, petrol

Treatment Process:	Bioremediation
Media:	Sandy Soil
Document Reference:	Soczo, E.R., E.J.H. Verhagen and C.W. Versluijs. "Review of Soil Treatment Techniques in the Netherlands." National Institute of Public Health and Environmental Hygiene, Laboratory for Waste Emission Research (LAE), The Netherlands.
Document Type:	Government Laboratory Report
Contact:	National Institute of Public Health & Environmental Research A. Van Leeuwenhoeklaan 9, P.O. Box 1 3720 BA Bilthoven, The Netherlands
Site Name:	The Netherlands
Location of Test:	Lower Bilthoven, The Netherlands

BACKGROUND: This document is a survey of different soil treatment sites and techniques in the Netherlands. It specifically addresses thermal destruction, biological treatment, and solvent extraction. This abstract deals with biological treatment.

OPERATIONAL INFORMATION: Biological treatment techniques are currently being developed. Seven research projects were initiated in 1985. The research is aimed at: optimizing conditions for landfarming; establishing what contaminants can be treated by landfarming; and the development of other types of biological treatment methods such as in-situ biorestoration.

PERFORMANCE: Studies revealed that landfarming can remove pollutants such as fuel oil and cutting oil within 4-6 months. Table 1 shows the results of tests conducted on a variety of petroleum products.

Crude oil and mineral oil degradation is very slow. No specific information was available on in-situ bioremediation or on bioreactors. Research in this area has not been completed. Since this is only a survey of work being done in the Netherlands, no QA/QC protocol or sampling and analysis protocol are given. Therefore, care should be taken when using this data in a quantitative manner.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO8-Polynuclear Aromatics	TOT-PAH	Total Polycyclic Aromatic Hydrocarbons
W12-Other Inorganics	57-12-5	Cyanide

TABLE 1

DEGRADATION OF SOIL PRODUCTS BY MEANS OF LANDFARMING METHODS
(mg/kg dry w. total oil concentrations in the soil)

Type of Oil	Initial Concentration	Concentration After 1 Growing Season*	Concentration After 2 Growing Seasons*
crude oil	35,000	small reduction	**
crude oil	8,000	small reduction	**
gas oil	1,800	400	**
fuel oil	6,800	800	300
mineral oil	1,100	small reduction	400
cutting oil	2,400	800	**

* Growing season: the warmest period of the year (4 to 6 months)
** No results available

Note: This is a partial listing of data. Refer to the document for more information.

Treatment Process:	Chemical Extraction and Soil Washing
Media:	Sandy Soil
Document Reference:	Soczo, E.R., E.J.H. Verhagen and C.W. Versluijs. "Review of Soil Treatment Techniques in the Netherlands." National Institute of Public Health and Environmental Hygiene, Laboratory for Waste Emission Research (LAE), The Netherlands.
Document Type:	Laboratory Report
Contact:	National Institute of Public Health & Environmental Hygiene Laboratory for Waste Emission Research A. Van Leeuwenhoeklaan 9, P.O. Box 1 3720 BA Bilthoven, The Netherlands
Site Name:	The Netherlands
Location of Test:	Lower Bilthoven, The Netherlands

BACKGROUND: This document is a review of soil treatment techniques in the Netherlands. The various techniques reviewed were thermal treatment, biological, and solvent extraction. This report focuses on full scale extraction technologies.

OPERATIONAL INFORMATION: There are five full-scale extraction plants in the Netherlands. Plant capacity varies from a low of 8,000 tons/year to a maximum of 34,000 tons/year. Cost of treatment varies between $25 and $100/ton depending on soil type.

PERFORMANCE: Only a summary of different extraction operations is presented. Different contaminants for different types of soil and a range of influent and effluent concentrations are given. The data points do not appear to represent specific tests; they are values estimated from the range given. Each test represents a different soil type. It is estimated that 90-99% of contaminants like oil, cyanides, and polycyclic aromatics (PCA) can be removed from soil by solvent extraction. Removal efficiency for heavy metals varies between 70 and 95%.

No sampling and analysis procedures, or QA/QC procedures are given. No discussion of the type of solvents used in the extraction process is included in the report. Due to this lack of information, care should be taken when using the data in a quantitative manner. The data was used because it came from full scale plants in operation.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO8-Polynuclear Aromatics	TOT-PAH	Total Polycyclic Aromatic Hydrocarbons
W10-Non-Volatile Metals	7440-02-0	Nickel
W11-Volatile Metals	7439-92-1 7440-43-9 7440-66-6	Lead Cadium Zinc
W12-Other Inorganics	57-12-5	Cyanide
W13-Other Organics	8020-83-5	Mineral oil

Treatment Process:	Bioremediation - Aerobic
Media:	Sludge/Generic
Document Reference:	Detox Industries, Inc. "Work Plan for Biodegradation of Poly-Chlorinated Biphenyls (PCBs) at a Superfund Site." Technical report of three volumes with a total of about 20 pages and related correspondence. Work plan prepared for General Motors Corporation, Massena, New York. September 1986.
Document Type:	Contractor/Vendor Treatability Study
Contact:	Melvin Hauptman U.S. EPA - Region II Emergency & Remedial Response Division 26 Federal Plaza New York, NY 10278 212-264-7681
Site Name:	Massena, NY (NPL)
Location of Test:	Hearne Utilities, Hearne, TX

BACKGROUND: This document is composed of a work plan and additional technical information which demonstrates the qualifications of Detox Industries, Inc. to conduct remediation of a PCB contaminated sludge at General Motors (GM) plant in New York. Provided are the results of a field demonstration conducted on sludge containing PCB at Hearne Utilities in Hearne, TX. Bench scale biodegradation studies were also conducted by Detox Inc. on samples of sludge provided by GM from their Massena, NY site. Significant reductions in PCB levels were noted in the tests.

OPERATIONAL INFORMATION: The technical summary provided by Detox Industries, Inc. provides a description of a field test conducted on approximately 500 lbs. of a PCB contaminated sludge at the Hearne Utility site in Hearne, Texas. The sludge was placed into a non-leaking bioreactor open to ambient air. PCB transformer oil was added to the sludge to bring the total PCB concentration to approximately 2000 ppm. The mixture was stirred constantly to ensure aerobic conditions and microbes and nutrients were added to the reactor. Testing time was approximately two months (September 83 - December 83). Samples were provided to NUS Laboratories in Houston, Texas for PCB analysis.

Bench tests were conducted by Detox Industries, Inc. on PCB contaminated sludge samples provided by General Motors from their site in Massena, New York. Samples were inoculated with microorganisms and agitated in a water bath for 16 days. Aliquots were taken and sent to Southwestern Laboratories for PCB analysis.

The technical summaries provided very few details on the microbes that Detox Industries, Inc. has developed for the biodegradation of PCB other than generic statements indicating that oxygen, moisture and nutrients must be present for the process to occur and that Detox Industries microbes are not affected by PCB. The work plan refers to QA/QC procedures, but they are not included in the plan.

PERFORMANCE: The field test at Hearne, Texas showed a significant reduction of PCB from the initial concentration at 2000 ppm. Final concentrations were as low as 0.12 ppm PCB. Results of

bench scale tests of samples of PCB contaminated sludge taken from the GM site in New York also showed reductions in PCB levels. Table 1 shows the results after 16 days of treatment.

Results of the various studies revealed that the Detox Industries, Inc. biodegradation process reduced PCB levels in contaminated materials. The U.S. EPA approved the GM request to conduct a full-scale pilot study of this process at the GM site in Massena, New York.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO2-Dioxins/Furans/PCBs	1336-36-3	Total PCBs

TABLE 1

PCB (1248) BIODEGRADATION

	Untreated Soil	Treated Soil	% Reduction
GM Lagoon #1	338 ppm	107 ppm	68.3
GM Digester	110 ppm	63 ppm	42.7
GM Activated Sludge	63 ppm	6.5 ppm	89.6

Notes: a) Treatment time - 16 days
b) This is a partial listing of data. Refer to the document for more information.

Treatment Process:	Low Temperature Thermal Desorption
Media:	Soil/Sandy
Document Reference:	Webster, David M. "Pilot Study of Enclosed Thermal Soil Aeration for Removal of Volatile Organic Contamination at the McKin Superfund Site." Journal of the Air Pollution Control Association. Volume 36, No. 10, pp. 1156-1163. October 1986.
Document Type:	Contractor/Vendor Treatability Study
Contact:	David Webster U.S. EPA - Region I John F. Kennedy Federal Bldg. Room 2203 Boston, MA 02203 617-565-3715
Site Name:	McKin Superfund Site, Gray, ME (NPL)
Location of Test:	Gray, ME

BACKGROUND: This paper reports on the results of a pilot study that treated vadose zone soil contaminated with VOCs in an enclosed thermal aeration system. The McKin site, an NPL site in Gray, Maine, was the location of the pilot study. The pilot study was chosen to demonstrate the viability of excavating the soil, treating the soil in a material dryer to aerate the soils and drive off the VOCs, and treating the vapors to remove contaminants. Results of the pilot study revealed that VOCs were reduced to non-detectable levels.

OPERATIONAL INFORMATION: The on-site sandy soil is contaminated with high levels of VOCs including up to 3310 ppm of trichloroethene (TCE) and 1,1,1-trichloroethane. Soils were aerated in a materials dryer at 150°F and 380°F. Three cubic yards of soils could be treated per run and the soils passed through the system from 3 to 8 times to ensure adequate volatilization of the contaminants. Exhaust gases from the materials dryer were treated with a 3-stage process including a baghouse, a scrubber and vapor phase carbon bed to remove particulates and organic vapors prior to release. Aerated soils were solidified and returned to the excavated area. An important objective of the study was to determine whether ambient air quality could be maintained during soil excavation and aeration. Continuous air quality monitoring for organic vapors was conducted during testing at the site and on the perimeter of the site. Techniques to minimize uncontrolled volatilization of organic chemicals from the soil during excavation and aeration and to control dust emissions were implemented. An on-site laboratory was utilized to augment off-site analysis of soils for organic contaminants by gas chromatography. Methods utilized were EPA Method 8010 and a modified EPA Method 8020. QA/QC is not reported.

PERFORMANCE: Treatability tests were conducted from February to May 1986. During the test, parameters such as drying temperature, dust control and the number of drying cycles were varied to test their effect on the VOC removal efficiency. Test results indicated that high drying temperatures and increasing number of drying cycles produced the greatest amount of VOC reduction. Treated soils were able to achieve the EPA target of 0.1 PPM TCE. The results of various tests are shown in Table 1.

The results of air monitoring for organic vapors during the pilot study revealed that on-site activities had a negligible effect on air quality at the site perimeter. Pilot test results indicated that concentrations of VOCs can be significantly reduced to non-detectable levels and that thermal soil aeration can virtually eliminate volatile organic contaminants from the vadose zone.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO1-Halogenated Aromatic Compounds	95-50-1	1,2-Dichlorobenzene
WO4-Halogenated Aliphatic Solvents	127-18-4 79-01-6	Tetrachloroethene Trichloroethene
WO7-Heterocyclics and Simple Aromatics	108-88-3 1330-20-7	Toluene Xylene

TABLE 1

PRE-AERATION AND POST-AERATION CONCENTRATIONS OF DETECTED CONTAMINANTS IN SELECTED SOIL AERATION RUNS (ppm)

	Pre-aeration range	Post-aeration concentrations
Trichloroethene (TCE)	17-115	ND 0.05[a]
Tetrachloroethene	11-19	ND 0.05[a]
1,1,1-Trichloroethane	0.11-0.3	ND 0.05[a]
1,2-Dichlorobenzene	3.5-50	ND 1[b]
Toluene	1-2	ND 1[b]
Xylenes	5-69	ND 1[b]

Notes:
a) Not detected at a laboratory detection limit of 0.05 ppm.
b) Not detected at a laboratory detection limit of 1 ppm.
c) This is a partial listing of data. Refer to the document for more information.

Treatment Process:	Low Temperature Thermal Desorption
Media:	Sludge/Oily
Document Reference:	Research Triangle Institute. Information: "Input/Output Data for Several Treatment Technologies." Center for Hazardous Material Research. 10 pp. May 1987.
Document Type:	EPA ORD Report
Contact:	Dr. Clark Allen Research Triangle Institute P.O. Box 12194 Research Triangle Park, NC 27709 919-541-5826
Site Name:	Luwa Corp., Charlotte, NC (Non-NPL)
Location of Test:	Charlotte, NC

BACKGROUND: This treatability study is a pilot scale evaluation of a thin-film evaporator (TFE) for volatile organics (VO) removal from oily sludges such as refinery sludges. TFEs were studied to evaluate their use to remove and recover VO from these sludges prior to land treatment. This would reduce the amount of VO available for release during land treatment of the sludges. The process can also be operated to remove water and low boiling point oils, reducing sludge volume while recovering oil from the sludges prior to disposal. The organics were recovered as a condensate and recycled to the petroleum refinery as product.

OPERATIONAL INFORMATION: The pilot test was conducted September 8-12, 1986, on non-hazardous (as defined by RCRA) refinery wastes, similar to hazardous refinery wastes such as API separator sludge. The TFE equipment selected included a mechanical agitator device for producing and agitating the film, permitting the processing of high viscosity liquids and sludges with suspended solids. The mechanical agitation at the heat transfer surface promotes heat transfer and maintains precipitated or crystallized solids in manageable suspension without fouling the heat transfer surface. A total of 22 runs were performed using two different wastes, three temperatures, three flow rates and under both atmospheric and vacuum conditions. Five 55-gallon drums of emulsion tank sludge were used on Test 1-18 while the balance of the tests were conducted on oily tank bottoms. Temperatures used were 150°C, 230°C and 310°C. Flow rates of 70-150 lb/hr were evaluated. Sampling and analysis are discussed but no QA/QC is reported.

PERFORMANCE: The fraction of feed removed by the TFE ranged from 11 to 95.7 percent. From 98.5 to 99.5 percent of the VO and 10 to 75 percent of the semi-volatiles were removed from the sludge. Results for VO for the extremes of feed rate and temperature range are provided in Table 1. The removal efficiency for volatiles was greater at higher temperatures. At 150°C some of the water in the feed was evaporated along with most of the VO. At 320°C essentially all of the water and VO was removed along with much of the higher boiling point oils. At this higher temperature, the amount of bottom sludge produced ranged between 10 and 13 percent of the feed rate, substantially reducing the amount of material to dispose of. This sludge was still pumpable. The vacuum runs produced a milky-white emulsion as condensate which would require further processing. At 320°C the bottoms product was only 4.3 percent of the feed. This would indicate a two stage process to first remove VO and semi-volatiles at atmospheric pressure and then heavier oils under vacuum operation could substantially reduce the amount of sludge material requiring disposal.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO7-Heterocyclics and Simple Aromatics	71-43-2	Benzene
	100-41-4	Ethylbenzene
	108-38-3	M-Xylene
	95-47-6	O&P Xylene
	100-42-5	Styrene
	108-88-3	Toluene
WO8-Polynuclear Aromatics	91-57-6	2-Methylnaphthalene
	83-32-9	Acenaphthene
	208-96-8	Acenaphthylene
	120-12-7	Anthracene
	205-99-2	Benzo(B)fluoranthene
	207-08-9	Benzo(K)fluoranthene
	132-64-9	Dibenzofuran
	91-20-3	Naphthalene
	129-00-0	Pyrene
	86-73-7	Flourene
	218-01-9	Chrysene
	50-32-8	Benzo(A)pyrene
	56-55-3	Benzo(A)anthracene
	85-01-8	Phenanthrene
WO9-Other Polar Organic Organic Compounds	117-84-0	Di-n-octylphthalate

TABLE 1

TFE VOLATILE ORGANICS REMOVAL FOR SELECTED COMPOUNDS

Operating Conditions		Reduction in concentrations from feed (%)[a]				
Test No.	Tempert ure(°C)	Flow rate (lb/hr)	Benzene	Toluene	Ethyl-benzene	m-Xylene
5	150	71.6	99.58	99.61	99.48	99.54
7	150	153.7	99.73	99.78	98.83	98.64
8	310	68.5	99.72	99.84	99.68	99.67
10	310	143.4	99.76	99.90	99.78	99.75

Notes: a) Based on GC/MS analysis.
b) This is a partial listing of data. Refer to the document for more information.

Treatment Process:	Thermal Destruction - Incineration
Media:	Sandy Soil
Document Reference:	Stoddart, Terry L. "Demonstration of Innovative Remedial Action Technologies at United States Military Dioxin Contaminated Sites." Chemosphere, Vol. 15, Nos. 9-12, pp 1535-1541, 1986.
Document Type:	Journal Article
Contact:	Major Terry Stoddart USDOD/AFESC Chief Engineering Branch Tyndall AFB, FL 32403-6001 904-283-4628
Site Name:	Naval Construction Batallion Center (NCBC)
Location of Test:	Gulfport, MS

BACKGROUND: This document provides an overview of technologies used to treat soils at different sites containing 2,3,7,8-TCDD (Dioxin). The testing reported here was performed using a J.M. Huber Corp. pilot scale Advanced Electric Reactor (AER).

OPERATIONAL INFORMATION: The AER uses a technology which rapidly heats feed materials to the range of 4000-4500°F. Feed stock is isolated from the reactor core by means of a nitrogen blanket. Pyrolysis occurs since there is no O_2 present. Solids are gravity fed to the reactor and solid and gas phase residence times can be varied to achieve desired destructions efficiency. Off gases are conveyed to a bag filter for removal of particulates. A gas cleaning train removes trace levels or organics and chlorine. The AER was run at 3700°F with a solids feed rate of 37 lbs/hr at the NCBC field test.

PERFORMANCE: Only one data pair is given from the tests performed from May to June, 1985. Replicate analysis of the feed stock indicated an average 2,3,7,8 TCDD concentration of 240 ppb. Analysis of the treated soil indicated a concentration of 0.04 ppb 2,3,7,8 TCDD. No sampling or QA/QC protocol or other information is given. No conclusions are included except that this technology may be useful for site cleanup. It is believed that this information is the summary of a larger report, especially since it appears that this summary is from a journal article.

CONTAMINANTS:

Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO2-Dioxins/Furans/PCBs	1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin

Treatment Process:	Thermal Destruction - UV Photolysis
Media:	Sandy Soils
Document Reference:	Stoddart, Terry L. "Demonstration of Innovative Remedial Action Technologies at United States Military Dioxin Contaminated Sites." Chemosphere, Vol. 15, Nos. 9-12, pp 1535-1541, 1986.
Document Type:	Journal Article
Contact:	Major Terry Stoddart USDOD/AFESC Chief Engineering Branch Tyndall AFB, FL 32403-6001 904-283-4628
Site Name:	Naval Construction Batallion Center (NCBC)
Location of Test:	Gulfport, MS

BACKGROUND: This document provides an overview of technologies used to treat soils at different sites containing 2,3,7,8-TCDD (Dioxin). This document reports the results of the thermal desorption/U.V. photolysis tests.

OPERATIONAL INFORMATION: The thermal desorption step involves passing contaminated soil through a thermal treatment unit operating at approximately 500°C. Dioxin and other volatile organics evaporate and are collected in an organic solvent and destroyed by UV photolysis.

Contaminated soil is heated to desorb volatiles. Heating and desorption is aided by passing an inert carrier gassed over the soils to constantly remove volatile organics. This carrier gas enters a high boiling hydrocarbon solvent where the dioxin and other contaminates dissolve. The hydrocarbon solvent containing dioxin then undergoes photolysis in a recirculating system for approximately 24 hours.

PERFORMANCE: There were five pilot scale tests performed at different operating conditions from May to June, 1985, at the Naval Construction Battalion Center. Approximately 2,500 pounds of soil were treated. Treated soil was analyzed using two different extraction procedures and the feed soil was analyzed by the standard EPA-CLP extraction procedure. Feed soil dioxin concentration ranged from 232 to 272 ppb. Soil dioxin levels after treatment ranged from 0.49 to 1.9 ppb.

No sampling or QA/QC protocol or other information is given. No conclusions are included except that this technology may be useful for site cleanup. It is believed that this information is the summary of a larger report, since it appears that this summary is from a journal article.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO2-Dioxins/Furans/PCBs	1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin

Treatment Process:	Dechlorination
Media:	Soil/Sand and Silt
Document Reference:	"Treatability Test for APEG Dechlorination of PCBs on Resolve Site Soil." Letter Report, Edwina Milicic, Galston Research Corp., March 18, 1987.
Document Type:	Contractor/Vendor Treatability Study
Contact:	Mr. Colin Baker Camp Dresser & McKee, Inc. One Center Plaza Boston, MA 02108 617-742-5151
Site Name:	Resolve, MA
Location of Test:	Galston Research Corp. 6601 Kirkville Road E. Syracuse, NY 13057

BACKGROUND: This project report describes the results of treatability studies on contaminated soils from the Resolve site. The Resolve site soil is a silty sand, almost saturated with water and contaminated with several chlorinated and non-chlorinated organic solvents and high concentrations of PCBs. A laboratory treatability study was conducted to determine whether the APEG process can be used to remove the PCBs from this soil and whether the other contaminants interfere with processing for PCB removal.

OPERATIONAL INFORMATION: A composite sample of soil from the Resolve site was received on March 2, 1987. The sample was sieved through a screen with 0.25" openings, mixed thoroughly, and returned to its original container. Some of the volatile compounds may have been lost during this process.

Three hundred grams of the sieved soil were weighed into a metal container with a screened bottom. This container was designed to fit inside a special reactor. The reactor was fitted with a mechanical stirrer with glass shaft and paddle, a distillation head, condenser, and receiver, and a thermocouple probe. A charcoal trap was included between the distillate receiver and the vacuum pump so that volatile compounds from the soil could be captured and analyzed at some future time.

Reagent consisting of 50 g of PEG 400 (polyethylene glycol with an average molecular weight of 400), 50 g of Dowanol TMH (triethylene glycol methyl ether and higher homologues), 100 g of DMSO (dimethyl sulfoxide) and 100 g of 66% aqueous potassium hydroxide (KOH) was added to the reactor.

The reactor was heated by circulating heated oil through the reactor jacket. The oil temperature was adjustable from ambient to 150°C. The reactor was heated slowly in order to observe any distillation of the low boiling contaminants. No distillate was observed in the receiver until the reaction temperature exceeded 110°C. Samples were collected periodically throughout the reaction time. After a total of 8 hours, the circulating heater and stirring motor were turned off and the reactor was allowed to cool. PCB content was determined by gas chromatography. A detailed explanation of the analysis procedure is contained in the report as an appendix.

PERFORMANCE: PCB soil content as a function of time reaction and different temperatures are shown in Table 1. At a temperature greater than 120°C and with three hours reaction time, essentially all of the PCBs are destroyed by the KPEG reagent.

A cost analysis of treating contaminated soil revealed that cost per ton of contaminated soil would range from $140/ton to $186/ton depending on cleanup level, amount of soil to be treated, and soil moisture content. These costs do not include excavation, site support, or permitting costs.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO2-Dioxins/Furans/PCBs	1336-36-3	Total PCBs

TABLE 1

RESULTS OF PCB ANALYSIS

Total Hours	Temp (°C)	Hours over 120°C	ppm PCB in soil
0	25	0	2900
1	75	0	600
2	79	0	580
6	126	1	560
8	128	3	<1

Note: This is a partial listing of data. Refer to the document for more information.

Treatment Process:	Thermal Destruction - Incineration
Media:	Soil/Generic
Document Reference:	EBASCO Services Inc. "Litigation Technical Support and Services, Rocky Mountain Arsenal (Basis F Wastes)." Six-part technical report with a total of approximately 600 pp. prepared for U.S. Army Program Manager's Office for Rocky Mountain Arsenal Cleanup during April and September 1986 and March, April, and May 1987.
Document Type:	Contractor/Vendor Treatability Study
Contact:	Bruce Huenfeld U.S. DOD/USATHAMA Aberdeen Proving Ground, MD 21010-5401 301-617-3446
Site Name:	Rocky Mountain Arsenal, CO (NPL - Federal facility)
Location of Test:	Rocky Mountain, CO

BACKGROUND: This report consists of 5 documents which cover incineration tests at the Rocky Mountain Arsenal (RMA), Denver, CO, ranging from a laboratory test plan and bench scale test to full scale testing. This abstract reports only on the results of bench scale incineration tests of contaminants from Basin F of the RMA. Objectives of the study were to: 1) gather information on properties of the wastes, 2) provide a bench-scale apparatus to determine incinerability characteristics of the wastes, 3) demonstrate 99.99% destruction removal efficiency (DRE), and 4) determine gas residence time, temperature and excess O_2 necessary for 99.99% DRE.

OPERATIONAL INFORMATION: The types of waste discharged into the Basin F lagoon included sodium salts of chloride, fluoride, hydroxide, methyl phosphate, acetate, sulfate and pesticides.

Bench scale tests were conducted on pure compounds and field samples. The technical approach involved using equipment to simulate three of the major incineration mechanisms--pyrolysis, primary incinerator postflame, and afterburner postflame.

The laboratory bench scale unit was designed to evaluate thermal destruction efficiency up to 1200°F and residence times from 2 to 5 seconds. The unit utilized a batch load system with two furnaces and a blended carrier gas. The first furnace volatilized the constituents while the carrier gas moved the constituents to the secondary furnace which added O_2 and simulated an afterburner in a full scale unit.

Residence times in the afterburner were 1 second or 5 seconds. Residence time in the primary burner was one hour. Temperature parameters for the primary and secondary chambers were based on the current limitations of operational practices for waste incineration. Primary burner operating temperatures were 650°, 800° and 900° C. Secondary afterburner operating temperatures were 650°, 900° and 1200°C. O_2 concentrations were 5% to 7%. Sixteen successful runs were performed.

The combustion products in the gases were collected by a sampling train for subsequent analysis. A detailed sampling plan is contained in this study. An outline of QA/QC measures that will be taken are reported in the "Draft Laboratory Test Plan for Incineration of Basin F Wastes at Rocky Mountain Arsenal, April 1986." Samples for analysis were collected from soils, sludge and liquid. GC/MS was

employed to analyze for ten semivolatile compounds in the feed stock. GS/MS selective ion monitoring was used for contaminant residue and off gas analysis.

PERFORMANCE: In all but a few instances, a 99.99% DRE was demonstrated for the ten principal hazardous organic constituents. Residues were tested for EP Toxicity to determine the leachability of heavy metals contained in the Basin F wastes. No heavy metals exceeded the EP Toxicity limit. In summary, Basin F wastes are incinerable and DRE levels were 99.99% under almost all the conditions investigated.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO1-Halogenated Non-Polar Aromatic Compounds		108-90-7Chlorobenzene
WO3-Halogenated Phenols Cresols and Thiols	CPMS	P-Chlorophenylmethyl Sulfide
	CPMSO2	P-Chlorophenylmethyl Sulfone
	CPMSO	P-Chlorophenylmethyl Sulfoxide
	470-90-6	Supona
WO4-Halogenated Aliphatic Solvents	96-12-8	1,2-Dibromo-3-chloropropane
WO5-Halogenated Cyclic Aliphatics/Ethers/ Esters/Ketones	309-00-2	Aldrin
	72-20-8	Endrin
	465-73-6	Isodrin
	60-57-1	Dieldrin
WO7-Heterocyclics and Simple Aromatics	108-88-3	Toluene
	1330-20-7	Xylenes
		ABCAlkyl Benzene
WO9-Other Polar Organic Compounds	109-92-2	Ethoxyethylene
	110-71-4	Dimethoxyethane
	T119-36-8	Benzoic Acid
W13-Other Organics	142-82-5	Heptane
	77-73-6	Dicyclopentadiene

Note: This is a partial listing of data. Refer to the document for more information.

TABLE 1

DESTRUCTION AND REMOVAL EFFICIENCY OF TEN PRINCIPAL HAZARDOUS ORGANIC CONSTITUENTS IN OVERBURDEN SAMPLE

Temp Degrees C in Secondary Burner	650	650	650	900	900	900	900	900	900	900	1200	1200	1200	1200
Temp Degrees C in Primary Burner	650	650	650	650	800	800	900	900	900	900	650	900	900	900
Gas Residence Time in Second Burner (in seconds)	2	2	5	2	2	5	2	2	5	5	5	2	2	5
Oxygen Level in off-gas (%)	5.4	7	7	5.4	7	7	5.4	7	5.4	7	5.4	5.4	7	7
Run Number	14 17	11	6	18	20	18	12	3	9	7	8	10 13	2	5
ALDRIN	100.00 100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.94	100.00	100.00	100.00	100.00 100.00	100.00	100.00
CPMS	100.00 100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.99	100.00	100.00	100.00	100.00 100.00	100.00	100.00
CPMSO	100.00 100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.41	100.00	100.00	100.00	100.00 100.00	100.00	100.00
CPMSO2	100.00 100.00	100.00	100.00	100.00	99.99	100.00	100.00	100.00	100.00	100.00	100.00	100.00 100.00	100.00	100.00
DBCP	99.00 100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00 100.00	100.00	100.00
DIELDRIN	100.00 100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.97	100.00	100.00	100.00	100.00 100.00	100.00	100.00
ENDRIN	100.00 100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00 100.00	100.00	100.00
ISODRIN	100.00 100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.99	100.00	100.00	100.00	100.00 100.00	100.00	100.00
SUPONA	99.74 100.00	99.38	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00 100.00	100.00	100.00

Document Number: FDBP.TAB

Treatment Process:	Immobilization - Solidification
Media:	Soil/Generic
Document Reference:	Acurex Corp. "BDAT for Solidification/Stabilization Technology for Superfund Soils (Draft Final Report)." Prepared for U.S. EPA. 75 pp. November 17, 1987.
Document Type:	EPA ORD Report
Contact:	Edwin Barth U.S. EPA, ORD HWERL 26 W. St. Clair Street Cincinnati, OH 45268 513-569-7669
Site Name:	BDAT SARM-Manufactured Waste (Non-NPL)
Location of Test:	Acurex Corporation Environmental Systems Division 485 Clyde Avenue P.O. Box 7444 Mountain View, CA 94039

BACKGROUND: This report evaluates the performance of solidification as a method for treating solids from Superfund sites. Tests were conducted on four different artificially contaminated soils which are representative of soils found at the sites. Contaminated soils were solidified using common solidification agents or binders. Samples were tested for unconfined compressibility at various times after solidification and certain samples were subjected to the toxic contaminants/leach procedure (TCLP) tests and total waste analysis. Volatile organics levels were also measured during solidification and long term set up the soils.

OPERATIONAL INFORMATION: The testing was done on four different types of Synthetics Analytical References Mixtures (SARM) prepared under separate contract for the EPA. The SARMs varied in concentrations from high to low with respect to organics (2,000-20,000 ppm) and metals (1,000-50,000 ppm). Three different binding agents were used; Portland cement, lime kiln dust and lime-flyash (50/50 by wt). Mixtures were molded according to ASTM procedure 109-86 and the Unconfined Compressive Strength (UCS) was measured at 7, 14, 21, and 28 days after curing according to ASTM 104-86. Optimal percentage of water in the mixture was determined by cone penetrometer tests. Volatile organics (VOC) were analyzed after solidification of the samples using a Gas Chromatograph equipped with a flame ionization detector. Samples were tested on days 14 and 28 to determine whether VOC levels changed during curing. Total Waste Analysis and Toxic Contaminants Leach Procedure (TCLP) tests were conducted on samples having unconfined compressibility greater than 50 psi. This study contains a section on QA/QC procedures.

PERFORMANCE: Compressibility values increased with increasing cure time. The Portland cement samples had the greatest Unconfined Compressibility Test rating (UCS) followed by kiln dust SARM and then the lime flyash SARM samples. The lime flyash samples took up to two weeks to set up. The amount of water in the samples is critical and has as much effect on the final sample properties as the amount of binder used. Analysis of volatile and semivolatile organics by GC/FID revealed that emissions dropped only sightly during the 24 to 28 curing process. This observation is consistent with

earlier work that revealed that VOC emissions occur mostly during the soil mixing period and are relatively constant during the curing process. The result of the TCLP tests revealed that in certain instances none of the heavy metals could be leached out, however other TCLP results showed heavy metal concentrations greater than those in the initial SARM soil samples. The report contained no analysis or comment on the results of the TCLP tests. The results appear too variable to draw any definite conclusions regarding the ability of solidification agents to immobilize heavy metals.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO1-Halogenated Aromatic Compounds	108-90-7	Chlorobenzene
WO3-Halogenated Phenols, Cresols and Thiols	87-86-5	Pentachlorophenol
WO4-Halogenated Aliphatic Compounds	107-06-2	1,2-Dichloroethane
	127-18-4	Tetrachloroethene
WO7-Heterocyclics and Simple Aromatics	100-41-4	Ethylbenzene
	100-42-5	Styrene
	1330-20-7	Xylenes
WO8-Polynuclear Aromatics	120-12-7	Anthracene
WO9-Other Polar Organic Compounds	67-64-1	Acetone
	117-81-7	Bis (2-Ethylhexyl) phthalate
W10-Non-Volatile Metals	7440-47-3	Chromium
	7440-50-8	Copper
	7440-02-0	Nickel
W11-Volatile Metals	7440-43-9	Cadmium
	7439-92-1	Lead
	7440-66-6	Zinc
	7440-38-2	Arsenic

Treatment Process:	Chemical Extraction and Soil Washing
Media:	Soil/Sandy
Document Reference:	IT Corporation. "Laboratory Feasibility Testing of Prototype Soil Washing Concepts." Prepared for U.S. EPA, OHMSB. 47 pp. December 1983.
Document Type:	EPA ORD Report
Contact:	Franklin Freestone U.S. EPA, ORD HWERL - Releases Control Branch Woodbridge Avenue Edison, NJ 08837-3579 201-340-6630
Site Name:	Clarksburg Soil OHMSETT, Leonardo, NJ (Non-NPL)
Location of Test:	Knoxville, TN

BACKGROUND: This draft document reports on laboratory testing of several washing solutions to decontaminate soils contaminated with dioxins. The following extractants were evaluated: surfactant mixtures of 0.5% to 3% Adsee 799 and 0.5% to 3% Hyonic NP90 in distilled water, Freon TF with and without methanol, and kerosene/diesel fuel-water mixtures. A spiked soil was used for the study.

OPERATIONAL INFORMATION: One kilogram of soil was spiked with a solution of TCDD and isooctane. TCDD concentrations were measured using a Soxhlet extraction procedure. The average starting concentration was 0.671 ug TCDD/g soil with a relative standard deviation of 3.78%. The spiked soil was placed into a centrifuge tube, and the solvent to be tested was added at a 3 to 1 ratio of solvent to soil (weight percent). The centrifuge tube was then sealed and placed in the reciprocating shaker for 4 hours at low speed. After shaking, the tube was placed in a centrifuge for ten minutes at 2000 rpm. The clear supernatant was decanted and the residue in the tube weighed. A quantity of solvent equal to the first extract was added to the tube and the procedure repeated until three solvent extractions and a water wash (where appropriate) were completed. The supernatant and the residual soil were extracted and analyzed for TCDD, and a material balance was calculated for the experiment. No analytical QA/QC procedures are described.

PERFORMANCE: The extraction efficiency was measured by Soxhlet extraction of the soil residue after it had undergone three simple batch extractions with a specific solvent system. The study summarizes the data for each of the soil washing solutions. The overall material balance for the extract systems ranged from 94% to 117% with a mean of 101.7% and a relative standard deviation of 6.6%.

The test results indicated that the Freon and Freon/methanol extraction systems were the most effective extractants for the removal of TCDD from the soil. After three batch extractions, 7.4% (50 ppb) and 2.9% (20 ppb), respectively, of TCDD remained on the soil. The overall material balances for these extractions were 101.2% and 96.3%, respectively.

Increasing the concentration of the extractant decreased the residual TCDD concentrations significantly. For example, the residual concentration of TCDD decreased from 27.2% to 13.2% as the concentration of the Adsee/Hyonic increased from 0.5%/0.5% to 3%/3%.

Other variables which may impact the extraction efficiency include the organic content and the soil moisture content of the soils. The organic content of the soil will affect the amount of organics that the soil will absorb, and the ability to desorb these organics. The soil used in this test contained 0.2% organic matter. The moisture content of the soil will significantly affect the final process design for extractants such as methanol which are non-aqueous and have a limited capacity to absorb water.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO2-Dioxins/Furans/PCBs	1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)

Treatment Process:	Thermal Destruction - Infrared
Media:	Sludge
Document Reference:	Enviresponse, Inc. "Peake Oil Site, Tampa, Florida. Project No. 3-60-47190407." Prepared for U.S. EPA, ERT. October 1986.
Document Type:	Contractor/Vendor Treatability Study
Contact:	Robert Evangelista Enviresponse, Inc. GSA Raritan Depot Building 209, Bay F Edison, NJ 88037 201-548-9660
Site Name:	Peake Oil, Tampa, FL (NPL)
Location of Test:	Livingston, NJ

BACKGROUND: This document summarizes the analytical results of the pilot-scale test burns of PCB-contaminated soil at Peake Oil in Tampa, Florida, performed by Shirco, Inc. using the Shirco infrared incinerator. In addition, other site waste streams (i.e., air, scrubber water) were sampled for cross-media contamination. A number of samples were collected for analysis at the Peake Oil NPL site on May 21, 1986. These samples were: 10 air tubes, 2 fly ash samples, 2 sludge samples and 1 duplicate scrubber water sample. On the same day, TRC Inc. performed emissions testing on the Shirco incinerator for: particulates, HCL, PCBs and dioxins, as well as continuous emissions monitoring for oxygen, carbon dioxide, carbon monoxide and nitrogen oxides.

OPERATIONAL INFORMATION: The system consists of a feed metering system, infrared primary chamber, supplemental propane-fired secondary chamber, exhaust gas scrubber, data acquisition and control systems, and heating element power centers, all enclosed in a 45-foot van trailer. Waste material is fed to a hopper mounted over a metering conveyer belt. The conveyer is shrouded and equipped with rubber skirts to minimize infiltration of air or escape of furnace gases. An adjustable guillotine-type gate is provided at the conveyer discharge. The gate distributes the material across the width of the metering belt and assists in furnace sealing. Final feed area sealing is provided by an additional adjustable knife gate in the feed chute into the furnace. The metering belt is synchronized with the furnace conveyer to control the material feed rate.

The incinerator conveyer, a tightly woven wire belt, moves the waste material through the insulated heating modules (primary unit) where it is brought to combustion temperature by infrared heating elements. Rotary rakes gently turn the material to ensure adequate mixing and complete burnout. When the material (ash) reaches the discharge end of the furnace, it drops off through a chute and into an enclosed hopper.

Combustion air is supplied to the primary unit through a series of overfire air ports at various points along the length of the chamber, and flows counter-current to the conveyed waste.

Exhaust gases exit the primary chamber near the feed module to a secondary chamber (afterburner), where a propane-fired burner is used to ignite any combustible gas present in the exhaust stream, and burn them at a predetermined set-point temperature. Secondary air is supplied to the afterburner to ensure adequate excess oxygen levels for complete combustion. Exhaust gases from the

secondary chamber then gas through a venturi scrubber/spray tower to the exhaust stack. QA/QC procedures and tests are reported in the document; however, no conclusions are discussed in the report.

PERFORMANCE: Laboratory results make up the bulk of this report and are too numerous and varied to summarize. The four sample media and the tests performed are listed below:

Sludge - PCBs and Dioxins
Flyash - PCBs, Dioxins, EP Tox Metals
Air Tubes - Inorganic Acids, PCBs, Total Organic Halogens
Scrubber Waters - PCBs and Dioxin

In addition, emissions were measured by various methods. Three methods for emission quantification are used; the EPA methods for source particulates, a modified Method 5 and a 3 1/2 hour continuous monitoring method. Eleven tables of sample results are presented in the report. In fewer than 30 of the 120 sample tests did the concentration rise above the detection limit.

CONTAMINANTS: Analytical data is provided in the treatability study report. The breakdown of the contaminants by treatability group is:

Treatability Group	CAS Number	Contaminants
WO2-Dioxins/Furans/PCBs	OCDD	Octachlorodibenzo-dioxins
	11096-82-5	PCB-1260

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APPENDIX I

BIBLIOGRAPHY

More than 550 documents have been reviewed for this study. Some documents contain information on more than one treatment technology. In this bibliography, these documents are listed with each of the treatment technologies that are discussed in the document.

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HWERL-THERMAL DESTRUCTION BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7529

DOCUMENT NUMBER: 980-TS1-RT-FCNN INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ERIKSSON, D. MEMORANDUM TO FILE. "GASOLINE CONTAMINATED DIRT, ASPHALT KILN RESULTS IN SAN DIEGO COUNTY." PREPARED FOR STATE OF CALIFORNIA DEPARTMENT OF HEALTH SERVICES. SEPTEMBER 1986.

CONTACT NAME: RICHARD ERIKSSON
ORGANIZATION: STATE OF CALIF - DEPT OF HEALTH SERVICES
TOXIC SUBSTANCES CONTROL DIVISION, 714-744 P STREET, SACRAMENTO, CA 95814
PHONE: 919-322-3670

DOCUMENT NUMBER: ORD-TS1-RT-EUZM INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: PEI ASSOCIATES, INC. "BDAT INCINERATION OF CERCLA SARMS AT THE JOHN ZINK COMPANY TEST FACILITY (FINAL PROJECT REPORT)." PREPARED FOR U.S. EPA, ORD, HWERL, CINCINNATI, OH. NOVEMBER 1987.

CONTACT NAME: ROBERT THURNAU
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7692

DOCUMENT NUMBER: 980-TS1-RT-FCFR-2 INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. "TECHNICAL RESOURCE DOCUMENT: TREATMENT TECHNOLOGIES FOR DIOXIN-CONTAINING WASTES." EPA/600/2-86/096. OCTOBER 1986.

CONTACT NAME: HAROLD FREEMAN
ORGANIZATION: U.S. EPA, ORD
HWERL-THERMAL DESTRUCTION BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7529

DOCUMENT NUMBER: 980-TS1-RT-FCLH INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: MCFEE, J.N.; G.P. RASMUSSEN AND C.M. YOUNG. "THE DESIGN AND DEMONSTRATION OF A FLUIDIZED BED INCINERATOR FOR THE DESTRUCTION OF HAZARDOUS ORGANIC MATERIALS IN SOILS." JOURNAL OF HAZARDOUS MATERIALS, 12(1985)129-142.

CONTACT NAME: NOT REPORTED
ORGANIZATION: WASTE-TECH SERVICES, INC
18400 W. 10TH AVENUE, GOLDEN, CO 80401
PHONE: 303-279-9712

DOCUMENT NUMBER: 980-TS1-RT-FCQC-2 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: SOCZO, E.R., E.J.H. VERHAGEN, AND C.W. VERSLUTJS. "REVIEW OF SOIL TREATMENT TECHNIQUES IN THE NETHERLANDS." NATIONAL INSTITUTE OF PUBLIC HEALTH AND ENVIRONMENTAL HYGIENE, LABORATORY FOR WASTE IN EMISSION RESEARCH (LAE), THE NETHERLANDS.

CONTACT NAME: NOT REPORTED
ORGANIZATION: NTL. INST. OF PUB. HEALTH & ENV. HYGIENE
LABORATORY FOR WASTE EMISSION RESEARCH, A. VAN LEEUWENHOEKLAAN 9, P.O. BOX 1, 3720 BA BILTHOVEN, THE NETHERLANDS

DOCUMENT NUMBER: 980-TS1-RT-EUTR INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: SHIRCO INFRARED SYSTEMS. "FINAL REPORT: ON-SITE INCINERATION TESTING OF SHIRCO INFRARED SYSTEMS PORTABLE PILOT TEST UNIT TIMES BEACH DIOXIN RESEARCH FACILITY, TIMES BEACH, MISSOURI." PREPARED FOR U.S. EPA. EPA-815-85-2. NOVEMBER 1985.

CONTACT NAME: DR. RALPH HAZEL TITLE: SPECIAL ASSISTANT TO REGIONAL ADMIN.
ORGANIZATION: U.S. EPA - REGION VII
WASTE MANAGEMENT DIVISION, 726 MINNESOTA AVENUE, KANSAS CITY, KS 66101
PHONE: 913-236-2800

DOCUMENT NUMBER: 980-TS1-RT-EUXR INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: SHIRCO INFRARED SYSTEMS. "FINAL REPORT: ON-SITE INCINERATION TESTING OF SHIRCO INFRARED SYSTEMS PORTABLE PILOT TEST UNIT AT INTERNATIONAL PAPER COMPANY WOOD TREATMENT PLANT - JOPLIN, MISSOURI." PREPARED FOR U.S. EPA. MAY 1986.

CONTACT NAME: DR. RALPH HAZEL TITLE: SPECIAL ASSISTANT TO REGIONAL ADMIN.
ORGANIZATION: U.S. EPA - REGION VII
WASTE MANAGEMENT DIVISION, 726 MINNESOTA AVENUE, KANSAS CITY, KS 66101
PHONE: 913-236-2800

DOCUMENT NUMBER: 980-TS1-RT-EWFM INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: MIDWEST RESEARCH INSTITUTE. "TOTAL MASS EMISSIONS FROM A HAZARDOUS WASTE INCINERATOR." PREPARED FOR U.S. EPA, HAZARDOUS WASTE ENGINEERING RESEARCH LABORATORY.

CONTACT NAME: ROBERT THURNAU
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HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7692

DOCUMENT NUMBER: 980-TS1-RT-EWQD INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: SHIRCO INFRARED SYSTEMS INC. "ABSTRACT ON-SITE INCINERATION TESTING OF SHIRCO INFRARED SYSTEMS PORTABLE DEMONSTRATION UNIT- CONTAMINATED SOILS TREATABILITY STUDY." PREPARED FOR HAMBURG, WEST GERMANY, INGELHEIM, WEST GERMANY. JUNE 1987.

CONTACT NAME: SCOTT P. BERDINE
ORGANIZATION: ECOVA CORPORATION (FORMERLY SHIRCO)
1415 WHITLOCK LANE, SUITE 100, CARROLLTON TX 75005
PHONE: 214-404-7540
COMMENTS: SHIRCO NOW PART OF ECOVA CORP.

DOCUMENT NUMBER: 980-TS1-RT-EZUX-1 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ARCO PETROLEUM PRODUCTS COMPANY. "INTERIM REPORT - ACID SLUDGE TREATABILITY EVALUATION - SAND SPRINGS PETROCHEMICAL COMPLEX." JULY 1987.

CONTACT NAME: PAUL SIEMINSKI
ORGANIZATION: U.S. EPA - REGION VI
1445 ROSS AVENUE, 12TH FLOOR, SUITE 1200, DALLAS, TX 75202
PHONE: 214-655-6444

DOCUMENT NUMBER: 980-TS1-RT-EZZB INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: SHIRCO INFRARED SYSTEMS PORTABLE TEST UNIT. "FINAL REPORT: ON-SITE INCINERATION TESTING AT BRIO SITE, FRIENDSWOOD, TEXAS." PREPARED FOR BRIO SITE TASK FORCE. FEBRUARY 1987.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - REGION I
JOHN F. KENNEDY FEDERAL BUILDING, ROOM 2203, BOSTON, MA 02203
PHONE: 617-565-3715
COMMENTS: DOCUMENS TAKEN FROM FILE ROOM

DOCUMENT NUMBER: 980-TS1-RT-EZZC INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: REPORT NUMBER 821-86-1. "FINAL REPORT - DEMONSTRATION TEST ON-SITE PCB DESTRUCTION SHIRCO INFRARED PORTABLE UNIT AT FLORIDA STEEL INDIANTOWN MILL SITE, INDIANTOWN, FLORIDA." SEPTEMBER 1986.

CONTACT NAME: JOHN KROSKE
ORGANIZATION: U.S. EPA - REGION IV
345 COURTLAND STREET, NE, ATLANTA, GA 30365
PHONE: 404-347-4727

DOCUMENT NUMBER: 980-TS1-RT-FCFR-5 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. "TECHNICAL RESOURCE DOCUMENT: TREATMENT TECHNOLOGIES FOR DIOXIN-CONTAINING WASTES." EPA/600/2-86/096. OCTOBER 1986.

CONTACT NAME: HAROLD FREEMAN
ORGANIZATION: U.S. EPA, ORD
HWERL-THERMAL DESTRUCTION BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7529

DOCUMENT NUMBER: 980-TS1-RT-FCNU INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: DES ROSIERS, PAUL E. "TRIP REPORT: BOEHRINGER-INGELHEIM, FRG, TEST/EVALUATION OF SHIRCO INFRARED DESORPTION PROCESS ON DIOXIN-CONTAMINATED WASTES FROM 2,4,5-TRICHLOROPHENOL MANUFACTURE USING HEXACHLOROCYCLOHEXANE (LINDANE) WASTES AS FEEDSTOCK." LABELED "FOR OFFICIAL USE ONLY." MAY 1987.

CONTACT NAME: PAUL des ROSIER TITLE: CHAIRMAN
ORGANIZATION: EPA DIOXIN DISPOSAL ADVISORY GROUP
401 M STREET, S.W., WASHINGTON, D.C. 20460
PHONE: 202-382-5747
COMMENTS: RECOMMENDED BY MAJOR TERRY STODDART

DOCUMENT NUMBER: 980-TS1-RT-FCNX INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: SLIDE PRESENTATION. "PEAK OIL, TAMPA, FLORIDA."

CONTACT NAME: JOHN GILBERT
ORGANIZATION: U.S. EPA, ORD
HWERL, EMRGENCY RESPONSE TEAM, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-621-2412
COMMENTS: RECOMMENDED BY JAN ROGERS. PEAK OIL SITE. (NO CONTACT MADE TO DATE 7-18-87)

DOCUMENT NUMBER: 980-TS1-RT-FCRG INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: SHIRCO INFRARED SYSTEMS, INC. "FLORIDA STEEL SITE SITE INFORMATION AND DATA PACKAGE."

CONTACT NAME: SCOTT P. BERDINE
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COMMENTS: SHIRCO NOW PART OF ECOVA CORP.

DOCUMENT NUMBER: 980-TS1-RT-FCSK INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: SHIRCO INFRARED SYSTEMS PORTABLE TEST UNIT. "SUMMARY REPORT. ON-SITE INCINERATION TESTING AT TIMES BEACH DIOXIN RESEARCH FACILITY. TIMES BEACH, MISSOURI." REPORT #815-85-1. JULY 1985.

CONTACT NAME: SCOTT P. BERDINE
ORGANIZATION: ECOVA CORPORATION (FORMERLY SHIRCO)
1415 WHITLOCK LANE, SUITE 100, CARROLLTON TX 75005
PHONE: 214-404-7540
COMMENTS: SHIRCO NOW PART OF ECOVA CORP.

DOCUMENT NUMBER: 980-TS1-RT-FCSM INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: SHIRCO INFRARED SYSTEMS, INC. "TESTIMONY OF JIM WELSH, CHIEF EXECUTIVE OFFICER." BEFORE THE SUBCOMMITTEE ON ENERGY, ENVIRONMENT AND SAFETY OF THE SMALL BUSINESS COMMITTEE. U.S. HOUSE OF REPRESENTATIVES. SEPTEMBER 1985.

CONTACT NAME: JAMES WELCH
ORGANIZATION: SHIRCO INFRARED SYSTEMS, INC
1195 EMPIRE CENTRAL, DALLAS, TX 75247-4301
PHONE: 214-630-7511
COMMENTS: SHIRCO NOW PART OF ECOVA CORP.

DOCUMENT NUMBER: 980-TS1-RT-FCUA INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: SHIRCO INFRARED SYSTEMS, INC. (SLIDE PRESENTATION). "THERMAL TREATABILITY TESTING USING THE SHIRCO INFRARED PROCESS."

CONTACT NAME: SCOTT P. BERDINE
ORGANIZATION: ECOVA CORPORATION (FORMERLY SHIRCO)
1415 WHITLOCK LANE, SUITE 100, CARROLLTON TX 75005
PHONE: 214-404-7540
COMMENTS: SHIRCO NOW PART OF ECOVA CORP.

DOCUMENT NUMBER: 980-TS1-RT-FHMC INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: TECHNOLOGY CONSULTING, INC. "A REVIEW OF THE PEAK OIL SITE CLEAN-UP PROGRAM."(4 DOCUMENTS) ("SHIRCO INFRARED INCINERATION SYSTEM"). PREPARED FOR U.S. EPA. BY R.A. CARNES.

CONTACT NAME: JOHN GILBERT
ORGANIZATION: U.S. EPA, ORD
HWERL, EMRGENCY RESPONSE TEAM, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-621-2412
COMMENTS: RECOMMENDED BY JAN ROGERS. PEAK OIL SITE. (NO CONTACT MADE TO DATE 7-18-87)

DOCUMENT NUMBER: 980-TS1-RT-EUTM INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: THE ENERGON COMPANY. "CLOSED-LOOP DETOXIFICATION OF THE LOWRY LANDFILL." PREPARED FOR U.S. EPA. DECEMBER 1985.

CONTACT NAME: EDWARD HOFFMAN TITLE: PRESIDENT
ORGANIZATION: ENERGON CO.
PHONE: 307-742-3458

DOCUMENT NUMBER: 980-TS1-RT-FBZZ-2 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: RESEARCH TRIANGLE INSTITUTE. "PCB SEDIMENT DECONTAMINATION PROCESS-SELECTION FOR TEST AND EVALUATION." AND SLIDE PRESENTATION: "EFFECTIVE TREATMENT TECHNOLOGIES FOR THE CHEMICAL DESTRUCTION OF PCB." PREPARED FOR U.S. EPA, HWERL. MAY 1987.

CONTACT NAME: DR. CLARK ALLEN
ORGANIZATION: RESEARCH TRIANGLE INSTITUTE
P.O. BOX 12194, RESEARCH TRIANGLE PARK, NC 27709
PHONE: 919-541-5826

DOCUMENT NUMBER: 980-TS1-RT-EURE INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: EG&G IDAHO,INC."HIGH-TEMP FLUID-WALL REACTOR TECHNOLOGY RESEARCH TEST AND EVALUATION." VOL. I,II. PREPARED FOR AFESC, TYNDALL AIR FORCE BASE. MARCH 1987.1987.

CONTACT NAME: MAJOR TERRY STODDART
ORGANIZATION: U.S. DOD/AFESC
PHONE: 904-283-2949

DOCUMENT NUMBER: 980-TS1-RT-EUXQ INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: JONES & BEACH ENGINEERS, INC. "THERMAL STABILIZATION PROCESS EVALUATION." PREPARED FOR CITY OF NEWBURYPORT, MASSACHUSETTS. MARCH 1987.

CONTACT NAME: BRADFORD H. JONES
ORGANIZATION: JONES & BEACH ENGINEERS, INC
85 PORTSMOUTH AVENUE, P.O. BOX 219, STRATHAM, NH 03885
PHONE: 605-772-4746

DOCUMENT NUMBER: 980-TS1-RT-EUZR INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: WESTINGHOUSE ELECTRIC CORPORATION. "ELECTRIC PYROLYZER." LETTER AND TREATMENT BROCHURE. AUGUST 1987.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - HEADQUARTERS
401 M STREET, S.W., WASHINGTON, D.C. 20460

DOCUMENT NUMBER: 980-TS1-RT-EWGF INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: HUBER CORP., EG&G IDAHO, INC., AFESC. "DESTRUCTION OF DIOXIN CONTAMINATION BY ADVANCED ELECTRIC REACTOR."

CONTACT NAME: MAJOR TERRY STODDART
ORGANIZATION: U.S. DOD/AFESC
PHONE: 904-283-2949

DOCUMENT NUMBER: 980-TS1-RT-EXPD INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: J.M. HUBER CORPORATION. "ADVANCED ELECTRONIC REACTOR (AER) FOR THE TREATMENT OF DIOXIN-CONTAMINATED SOILS." FEBRUARY 1984.

CONTACT NAME: JAMES BOYD
ORGANIZATION: J.M. HUBER CORPORATION
P.O. BOX 2831, BORGER, TX 79007
PHONE: 806-274-6331
COMMENTS: RECOMMENDED BY MAJOR TERRY STODDART. INFO ON THE HUBER ADVANCED ELECTRIC REACTOR

DOCUMENT NUMBER: 980-TS1-RT-FCFR-4 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. "TECHNICAL RESOURCE DOCUMENT: TREATMENT TECHNOLOGIES FOR DIOXIN-CONTAINING WASTES." EPA/600/2-86/096. OCTOBER 1986.

CONTACT NAME: HAROLD FREEMAN
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HWERL-THERMAL DESTRUCTION BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
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DOCUMENT NUMBER: 980-TS1-RT-FCSS-1 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: STODDART, TERRY L. "DEMONSTRATION OF INNOVATIVE REMEDIAL ACTION TECHNOLOGIES AT UNITED STATES MILITARY DIOXIN CONTAMINATED SITES." PREPARED FOR AIR FORCE HEADQUARTERS. ENGINEERING AND SERVICES CENTER. ENVIRONMENTAL ENGINEERING BRANCH (HQ AFESC/RDW). TYNDALL AFB, FLORIDA.

CONTACT NAME: MAJOR TERRY STODDART
ORGANIZATION: U.S. DOD/AFESC
PHONE: 904-283-2949

DOCUMENT NUMBER: 980-TS1-RT-EURQ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CALIFORNIA AIR RESOURCES BOARD."EVALUATION OF A PILOT-SCALE CIRCULATING BED COMBUSTOR AS A POTENTIAL HAZARDOUS WASTE INCINERATOR." PREPARED FOR SACRAMENTO, CA.

CONTACT NAME: ROBERT ADRIAN TITLE: SENIOR ENGINEER
ORGANIZATION: STATE OF CALIFORNIA
PHONE: 916-322-6025

DOCUMENT NUMBER: 980-TS1-RT-EUXM INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: GA TECHNOLOGIES, INC. "PCB DESTRUCTION FACILITY CIRCULATING BED COMBUSTOR." PREPARED FOR U.S. EPA. DECEMBER 1985.

CONTACT NAME: HIROSHI DODOHARA
ORGANIZATION: OGDEN ENVIRONMENTAL SERVICES, INC
P.O. BOX 85178, SAN DIEGO, CO 92138-5178
PHONE: 619-455-2383

DOCUMENT NUMBER: 980-TS1-RT-EWHC INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: OGDEN ENVIRONMENTAL SERVICES, INC. "BDAT TREATABILITY DATA FOR SOILS, SLUDGES AND DEBRIS FROM THE CIRCULATING BED COMBUSTION (CBC) PROCESS." PREPARED FOR U.S. EPA. JUNE 1987.

CONTACT NAME: HAROLD DIOT
ORGANIZATION: OGDEN ENVIRONMENTAL SERVICES, INC
P.O. BOX 85178, SAN DIEGO, CA 92138-5178
PHONE: 619-455-2383

DOCUMENT NUMBER: 980-TS1-RT-FCFR-3 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. "TECHNICAL RESOURCE DOCUMENT: TREATMENT TECHNOLOGIES FOR DIOXIN-CONTAINING WASTES." EPA/600/2-86/096. OCTOBER 1986.

CONTACT NAME: HAROLD FREEMAN
ORGANIZATION: U.S. EPA, ORD
HWERL-THERMAL DESTRUCTION BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7529

DOCUMENT NUMBER: 980-TS1-RT-EURN INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ENVIRONMENTAL SCIENCE AND ENGINEERING, INC. "FINAL REPORT: DEVELOPMENT OF OPTIMUM TREATMENT SYSTEM FOR WASTEWATER LAGOONS - PHASE II - AQUEOUS THERMAL DECOMPOSITION LABORATORY TESTING." PREPARED FOR USATHMA. JANUARY 1985.

CONTACT NAME: WAYNE SISK
ORGANIZATION: U.S. DOD/USATHAMA
PHONE: 301-671-2054

DOCUMENT NUMBER: 980-TS1-RT-EWGE INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: INTERNATIONAL TECHNOLOGY CORPORATION, AFESC, EG&G IDAHO, INC. "TECHNOLOGY DEMONSTRATION OF A THERMAL DESORPTION/UV PHOTOLYSIS PROCESS FOR DECONTAMINATING SOILS CONTAINING HERBICIDE ORANGE."

CONTACT NAME: MAJOR TERRY STODDART
ORGANIZATION: U.S. DOD/AFESC
PHONE: 904-283-2949

DOCUMENT NUMBER: 980-TS1-RT-FCSS-2 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: STODDART, TERRY L. "DEMONSTRATION OF INNOVATIVE REMEDIAL ACTION TECHNOLOGIES AT UNITED STATES MILITARY DIOXIN CONTAMINATED SITES." PREPARED FOR AIR FORCE HEADQUARTERS. ENGINEERING AND SERVICES CENTER. ENVIRONMENTAL ENGINEERING BRANCH (HQ AFESC/RDVW). TYNDALL AFB, FLORIDA.

CONTACT NAME: MAJOR TERRY STODDART
ORGANIZATION: U.S. DOD/AFESC
PHONE: 904-283-2949

DOCUMENT NUMBER: 980-TS1-RT-EUZA INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: DEV, H., J.E. BRIDGES, G.C. SRESTY AND C. ROGERS. "IN-SITU DECONTAMINATION OF SPILLS AND LANDFILLS BY RADIO FREQUENCY HEATING." DIVISION OF ENVIRONMENTAL CHEMISTRY, AMERICAN CHEMICAL SOCIETY. CHICAGO, IL. SEPTEMBER 1985.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-EUZB INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: DEV, H. AND P.CONDORELLI. "IN-SITU RADIO FREQUENCY HEATING PROCESS FOR DECONTAMINATION OF SOIL." DIVISION OF ENVIRONMENTAL CHEMISTRY, AMERICAN CHEMICAL SOCIETY. NEW YORK, NY. APRIL 1986.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-EUZC INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: DEV, H. "RADIO FREQUENCY ENHANCED IN-SITU DECONTAMINATION OF SOILS CONTAMINATED WITH HALOGENATED HYDROCARBONS." DIVISION OF ENVIRONMENTAL CHEMISTRY, AMERICAN CHEMICAL SOCIETY. NEW YORK, N.Y. APRIL 1986.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-FCFN INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: IIT RESEARCH INSTITUTE. FINAL REPORT. "HIGH TEMPERATURE THERMAL TREATMENT OF SOILS WITH RADIO FREQUENCY HEATING." EPA GRANT NO. CR-811529-01-0. PREPARED FOR DOUG DOWNEY, HQ AFESC/RDV, TYNDALL AFB. JANUARY 1986.

CONTACT NAME: CHARLES ROGERS
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7757
COMMENTS: INFO ON KPEG. ALSO CONTACT GALSON RESEARCH. RECOMMENDED BY MAJOR TERRY STODDART.

DOCUMENT NUMBER: 980-TS1-RT-EURF INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: ROY F. WESTON, INC."INTERIM TECHNOLOGY REPORT, HEAVY METAL CONTAMINATED SOIL TREATMENT: CONCEPTUAL DEVELOPMENT." EPA-11-85-D-0007. PREPARED FOR USATHMA. FEBRUARY 1987.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. DOD/USATHAMA
PHONE: 301-278-5201

DOCUMENT NUMBER: 980-TS1-RT-EWGD INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: PACIFIC NORTHWEST LABORATORY. "IN SITU VITRIFICATION-A CANDIDATE PROCESS FOR IN SITU DESTRUCTION OF HAZARDOUS WASTE." PRESENTED AT THE SEVENTH SUPERFUND CONFERENCE, WASHINGTON, D.C. DECEMBER 1986. (INCLUDES SLIDE PRESENTATION).

CONTACT NAME: J.L. BUELT
ORGANIZATION: BATELLE PACIFIC NW LABORATORY
BATELLE BOULEVARD, RICHLAND, WA 99352
PHONE: 509-376-3926
COMMENTS: INFO ON IN SITU VITRIFICATION

DOCUMENT NUMBER: 980-TS1-RT-EWVS INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: "IN-SITU VITRIFICATION (ISV)." SLIDE PRESENTATION RECEIVED FROM DR. LES DOLE, ORNL, U.S. DOE.

CONTACT NAME: LESLIE DOLE TITLE: PROGRAM MANAGER
ORGANIZATION: WMTC, DOE, ORNL
P.O. BOX P, BUILDING K 1000 MS-183, OAK RIDGE, TN 37831
PHONE: 615-576-7421
COMMENTS: INFO ON THE PEPPER STEEL SITE AND OTHERS

DOCUMENT NUMBER: 980-TS1-RT-FCBY INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: BATTELLE. "IN SITU VITRIFICATION OF TRANSURANIC WASTE: AN UPDATED SYSTEMS EVALUATION AND APPLICATIONS ASSESSMENT." PREPARED FOR U.S. DOE. PNL-4800 SUPPL. 1. MARCH 1987.

CONTACT NAME: R. L. TREAT TITLE: PROGRAM MANAGER
ORGANIZATION: CHEMICAL PROCESS ENGINEERING SECTION
BATTELLE-PACIFIC NORTHWEST LABORATORIES, BATTELLE BOULEVARD, RICHLAND,WASHINGTON 99352
PHONE: 509-376-0330
COMMENTS: IN SITE VITRIFICATION

DOCUMENT NUMBER: 980-TS1-RT-FCSC INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: HAYWARD, DAVID. "GLASS CASE DISARMS BASE WASTE." JOURNAL (GREAT BRITAIN). "NEW CIVIL ENGINEER." INQUIRY CARD 843. OCTOBER 1986.

CONTACT NAME: DONALD SANNING
ORGANIZATION: U.S. EPA, ORD
HWERL-CONTAINMENT BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7875

DOCUMENT NUMBER: 980-TS1-RT-EUTY INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. "PROJECT SUMMARY REPORT ON THE FEASIBILITY OF APEG DETOXIFICATION OF DIOXIN-CONTAMINATED SOILS." ORD INDUSTRIAL ENVIRONMENTAL RESEARCH LABORATORY. CINCINNATI, OH. EPA-600/S2-84-071. APRIL 1984.

CONTACT NAME: CHARLES ROGERS
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7757
COMMENTS: INFO ON KPEG. ALSO CONTACT GALSON RESEARCH. RECOMMENDED BY MAJOR TERRY STODDART.

DOCUMENT NUMBER: 980-TS1-RT-EUZD INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. "PRELIMINARY REPORT ON TREATMENT/DETOXIFICATION ALTERNATIVES FOR PCBS AND CHLORINATED ORGANICS." ORD, HWERL. CINCINNATI, OHIO. SEPTEMBER 1985.

CONTACT NAME: CHARLES ROGERS
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7757
COMMENTS: INFO ON KPEG. ALSO CONTACT GALSON RESEARCH. RECOMMENDED BY MAJOR TERRY STODDART.

DOCUMENT NUMBER: 980-TS1-RT-EUZF INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. "PROJECT SUMMARY: INTERIM REPORT ON THE FEASIBILITY OF USING UV PHOTOLYSIS AND APEG REAGENT FOR TREATMENT OF DIOXIN CONTAMINATED SOILS." HWERL, ORD. CINCINNATI, OH. DECEMBER 1985.

CONTACT NAME: CHARLES ROGERS
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7757
COMMENTS: INFO ON KPEG. ALSO CONTACT GALSON RESEARCH. RECOMMENDED BY MAJOR TERRY STODDART.

DOCUMENT NUMBER: 980-TS1-RT-EWFP INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: PEI ASSOCIATES, INC. "COMPREHENSIVE REPORT ON KPEG, TECHNOLOGY/FIELD TESTS OF THE NEW KPEG, REACTOR ON PCB/PCDD CONTAMINATED SOILS, QUALITY ASSURANCE PROJECT PLAN FOR THE MOREAU, NY SITE." PREPARED BY PEI ASSOCIATES, INC. JUNE 1987.

CONTACT NAME: JOHANNA MILLER
ORGANIZATION: U.S. EPA - REGION IX
215 FREMONT STREET, SAN FRANCISCO, CA 94105
PHONE: 415-974-8071
COMMENTS: TELECON 980-TS1-RT-FASZ

DOCUMENT NUMBER: 980-TS1-RT-EWGN INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: IACONIANNI, F. "PROJECT SUMMARY; DESTRUCTION OF PCBs- ENVIRONMENTAL APPLICATIONS OF ALKALI METAL POLYETHYLENE GLYCOLATE COMPLEXES." EPA/600/S2-85/108. PREPARED FOR U.S. EPA, ORD. DECEMBER 1985.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-EWGP INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: KPEG DECHLORINATION PROCESS (6 DOCUMENTS). RECEIVED FROM CHARLIE ROGERS, U.S. EPA, HWERL, CINCINNATI, OHIO. SEPTEMBER, 1987.

CONTACT NAME: CHARLES ROGERS
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7757
COMMENTS: INFO ON KPEG. ALSO CONTACT GALSON RESEARCH. RECOMMENDED BY MAJOR TERRY STODDART.

DOCUMENT NUMBER: 980-TS1-RT-EWHD INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: TETRA TECH, INC. "IN-SITU TREATMENT OF PESTICIDE CONTAMINATED SOILS."

CONTACT NAME: RICHARD MARTYN
ORGANIZATION: U.S. EPA - REGION IX
215 FREMONT STREET, SAN FRANCISCO, CA 94105
PHONE: 415-974-8071

DOCUMENT NUMBER: 980-TS1-RT-EZYP INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: U.S. EPA. "DESTRUCTION OF PCB'S ENVIRONMENTAL APPLICATIONS OF ALKALI METAL POLYETHYLENE GLYCOLATE COMPLEXES." EPA/600/2-85/108 SEPTEMBER 1985.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-EZZD INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: ROGERS, CHARLES J. ABSTRACT. "CHEMICAL TREATMENT OF PCBS IN THE ENVIRONMENT." U.S. EPA. INDUSTRIAL ENVIRONMENTAL RESEARCH LABORATORY. CINCINNATI, OH.

CONTACT NAME: WILLIAM SMITH
ORGANIZATION: CDM - EDISON, NJ
RARITAN PLAZA I, RARITAN CENTER, EDISON, NJ 08817
PHONE: 201-225-7000

DOCUMENT NUMBER: 980-TS1-RT-FBTQ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA AND GALSON RESEARCH CORPORATION. (PREPRINT EXTENDED ABSTRACT) "COMPARISON OF LABORATORY AND FIELD TEST DATA IN THE CHEMICAL DECONTAMINATION OF DIOXIN CONTAMINATED SOILS USING THE GALSON PKS PROCESS." PRESENTED BEFORE THE DIVISION OF ENVIRONMENTAL CHEMISTRY, AMERICAN CHEMICAL SOCIETY. APRIL 1986.

CONTACT NAME: CHARLES ROGERS
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7757
COMMENTS: INFO ON KPEG. ALSO CONTACT GALSON RESEARCH. RECOMMENDED BY MAJOR TERRY STODDART.

DOCUMENT NUMBER: 980-TS1-RT-FBZZ-1 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: RESEARCH TRIANGLE INSTITUTE. "PCB SEDIMENT DECONTAMINATION PROCESS-SELECTION FOR TEST AND EVALUATION." AND SLIDE PRESENTATION: "EFFECTIVE TREATMENT TECHNOLOGIES FOR THE CHEMICAL DESTRUCTION OF PCB." PREPARED FOR U.S. EPA, HWERL. MAY 1987.

CONTACT NAME: DR. CLARK ALLEN
ORGANIZATION: RESEARCH TRIANGLE INSTITUTE
P.O. BOX 12194, RESEARCH TRIANGLE PARK, NC 27709
PHONE: 919-541-5826

DOCUMENT NUMBER: 980-TS1-RT-FCBT INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: RESEARCH TRIANGLE INSTITUTE. "APPLICATION OF A HEATED IN-SITU APEG TREATMENT PROCESS TO DECONTAMINATE PCB CONTAMINATED SOIL -- A CASE STUDY FINAL REPORT." FOR U.S. EPA HWERL, CINCINNATI, OH, CONTRACT NO. 68-02-3992. JULY 1987.

CONTACT NAME: DAVID FERGUSON
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-FCBU INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: RESEARCH TRIANGLE INSTITUTE. DRAFT REPORT. "INTERIM REPORT ON THE FEASIBILITY OF USING U.V. PHOTOLYSIS AND APEG REAGENT FOR TREATMENT OF DIOXIN CONTAMINATED SOILS." FOR U.S. EPA HWERL, CINCINNATI, OH, CONTRACT NO. 68-03-3149. JUNE 1985.

CONTACT NAME: CHARLES ROGERS
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7757
COMMENTS: INFO ON KPEG. ALSO CONTACT GALSON RESEARCH. RECOMMENDED BY MAJOR TERRY STODDART.

DOCUMENT NUMBER: 980-TS1-RT-FCFM INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. (PRELIMINARY: SUBJECT TO REVIEW). "DETERMINATION OF THE EFFICACY OF SELECTED CHEMICALS TO DESTROY 2,3,7,8-TCDD AND OTHER HALOORGANICS IN CONTAMINATED SOILS." ENERGY POLLUTION CONTROL DIV., INDUSTRIAL ENVIRONMENTAL RESEARCH LAB., ORD HWERL, CINCINNATI, OH. FEBRUARY 1982.

CONTACT NAME: CHARLES ROGERS
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7757
COMMENTS: INFO ON KPEG. ALSO CONTACT GALSON RESEARCH. RECOMMENDED BY MAJOR TERRY STODDART.

DOCUMENT NUMBER: 980-TS1-RT-FCFR-6 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. "TECHNICAL RESOURCE DOCUMENT: TREATMENT TECHNOLOGIES FOR DIOXIN-CONTAINING WASTES." EPA/600/2-86/096. OCTOBER 1986.

CONTACT NAME: HAROLD FREEMAN
ORGANIZATION: U.S. EPA, ORD
HWERL-THERMAL DESTRUCTION BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7529

DOCUMENT NUMBER: 980-TS1-RT-FCLC-1 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: GALSON RESEARCH CORPORATION. "BENGART AND MEMEL (BENCH-SCALE), GULFPORT (BENCH AND PILOT-SCALE), MONTANA POLE (BENCH-SCALE), AND WESTERN PROCESSING (BENCH-SCALE) TREATABILITY STUDIES." JULY 1987.

CONTACT NAME: TIMOTHY GERAETS
ORGANIZATION: GALSON RESEARCH CORPORATION
PHONE: 315-463-5160

DOCUMENT NUMBER: 980-TS1-RT-FCLC-2 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: GALSON RESEARCH CORPORATION. "BENGART AND MEMEL (BENCH-SCALE), GULFPORT (BENCH AND PILOT-SCALE), MONTANA POLE (BENCH-SCALE), AND WESTERN PROCESSING (BENCH-SCALE) TREATABILITY STUDIES." JULY 1987

CONTACT NAME: TIMOTHY GERAETS
ORGANIZATION: GALSON RESEARCH CORPORATION
PHONE: 315-463-5160

DOCUMENT NUMBER: 980-TS1-RT-FCSW INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: SUMMARY PAPER. "APEG TREATMENT OF DIOXIN-CONTAMINATED WASTE IN KENT, WASHINGTON." NOVEMBER 1986.

CONTACT NAME: CHARLES ROGERS
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7757
COMMENTS: INFO ON KPEG. ALSO CONTACT GALSON RESEARCH. RECOMMENDED BY MAJOR TERRY STODDART.

DOCUMENT NUMBER: 980-TS1-RT-FDBA INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: GALSON RESEARCH CORPORATION. "TREATABILITY TEST FOR APEG DECHLORINATION OF PCBs IN RESOLVE SITE SOIL." MARCH 1987.

CONTACT NAME: EDWINA MILICIC
ORGANIZATION: GALSON RESEARCH CORP
6601 KIRKVILLE ROAD, E. SYRACUSE, NY 13057
PHONE: 315-432-0506

DOCUMENT NUMBER: 980-TS1-RT-FHMD INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. "PROJECT SUMMARY: DESTRUCTION OF PCBS - ENVIRONMENTAL APPLICATIONS OF ALKALI METAL POLYETHYLENE GLYCOLATE COMPLEXES." HWERL, ORD CINCINNATI, OH EPA 600/S-2/108 DECEMBER 1985.

CONTACT NAME: FRANK J. IACONIANNI
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-FREN INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: GALSON RESEARCH CORPORATION. "OPERATING AND QUALITY CONTROL PROCEDURES - LABORATORY STUDY FOR APEG CLEANUP OF MGM BRAKE SUPERFUND SITE." SEPTEMBER 1987.

CONTACT NAME: NOT REPORTED
ORGANIZATION: GALSON RESEARCH CORPORATION
6601 KIRKVILLE ROAD, E. SYRACUSE, NY 13057
PHONE: 315-432-0506

DOCUMENT NUMBER: 980-TS1-RT-FYRC INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: GALSON RESEARCH CORP. "TREATABILITY TEST FOR APEG DECHLORINATION OF PCBS IN RESOLVE SITE SOIL." MARCH 18,1987

CONTACT NAME: EDWINA MILICIC
ORGANIZATION: GALSON RESEARCH CORP
6601 KIRKVILLE ROAD, E. SYRACUSE, NY 13057
PHONE: 315-432-0506

DOCUMENT NUMBER: 982-TS3-RT-GKXJ INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: "APPENDIX B, TREATABILITY STUDY" COLEMAN EVANS WOOD PRESERVING SITE, WHITEHOUSE, FLORIDA. PP.13.

CONTACT NAME: CAROLINE ROE
ORGANIZATION: U.S. EPA - HEADQUARTERS
HAZARDOUS SITE CONTROL DIVISION, WH548E, 401 M STREET, S.W., WASHINGTON, D.C. 20460
PHONE: 201-475-9754

DOCUMENT NUMBER: 982-TS3-RT-GKXM INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: GALSON CORP., "SUPPLEMENTARY REPORT ON RESOLVE SITE SOIL TREATABILITY TEST." APRIL 1987.

CONTACT NAME: CAROLINE ROE
ORGANIZATION: U.S. EPA - HEADQUARTERS
HAZARDOUS SITE CONTROL DIVISION, WH548E, 401 M STREET, S.W., WASHINGTON, D.C. 20460
PHONE: 201-475-9754

DOCUMENT NUMBER: ORD-TS1-RT-EUTV-1 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: (3 DOCS) (1)TIERNAN, THOMAS, WRIGHT STATE. STATUS REPORT ON THE DEVELOPMENT OF TREATMENT DATA ON THE KPEG PROCESS FOR SARA/BDAT STANDARDS FOR THE U.S. EPA. (2)FINAL REPORT- DEVELOPMENT OF TREATMENT DATA ON THE KPEG PROCESS FOR CERCLA/BDAT STANDARDS." PREPARED FOR U.S. EPA. DECEMBER 1987. (3)JAMES KINARD, ANALYTICAL ENTERPRISES, INC. "REPORT ON METAL ANALYSES TO DEVELOPMENT OF TREATMENT DATA ON THE KPEG PROCESS FOR SARA/BDAT STANDARDS."

CONTACT NAME: THOMAS O. TIERNAN TITLE: Ph.D. - PROFESSOR OF CHEMISTRY
ORGANIZATION: WRIGHT STATE UNIVERSITY

DOCUMENT NUMBER: 980-TS1-RT-EUQH INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: SCIENCE APPLICATIONS INTERNATIONAL CORPORATION."IN-SITU BIOLOGICAL DEGREDATION TEST AT KELLY AIR FORCE BASE, VOLUME I: SITE CHARACTERIZATION, LABORATORY STUDIES AND TREATMENT DESIGN AND INSTALLATION: FINAL REPORT."ESL-TR-85-52. PREPARED FOR AFESC, TYNDALL AIR FORCE BASE. APRIL 1986.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. DOD/AFESC
COMMENTS: AIR FORCE HEADQUARTERS DOCUMENT

DOCUMENT NUMBER: 980-TS1-RT-EURK INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: GCA CORPORATION. "ENDANGERMENT ASSESSMENT AND FEASIBILITY STUDY, PICILLO SITE, COVENTRY, RHODE ISLAND." VOL. I,III. PREPARED FOR U.S. EPA, OFFICE OF WASTE PROGRAMS ENFORCEMENT. MARCH 1985.

CONTACT NAME: KENNETH WRENGER TITLE: ENFORCEMENT PROJECT MANAGER
ORGANIZATION: U.S. EPA - REGION I
JOHN F. KENNEDY FEDERAL BUILDING, ROOM 2203, BOSTON, MA 02203
PHONE: 617-565-3637

DOCUMENT NUMBER: 980-TS1-RT-EURT-2 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ATLANTIC RESEARCH CORPORATION. "COMPOSTING OF EXPLOSIVES." PREPARED FOR USATHMA. SEPTEMBER 1982.

CONTACT NAME: WAYNE SISK
ORGANIZATION: U.S. DOD/USATHAMA
PHONE: 301-671-2054

DOCUMENT NUMBER: 980-TS1-RT-EUTG INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: SCIENCE APPLICATIONS INTERNATIONAL CORPORATION. "EFFECTIVENESS OF IN SITU BIOLOGICAL TREATMENT OF CONTAMINATED GROUNDWATER AND SOILS AT KELLY AIR FORCE BASE, TEXAS." PREPARED FOR AFESC, TYNDALL AIR FORCE BASE

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. DOD/AFESC
COMMENTS: AIR FORCE HEADQUARTERS DOCUMENT

DOCUMENT NUMBER: 980-TS1-RT-EWFS-2 INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: CALIFORNIA ANALYTICAL LABORATORIES, INC. "LAND TREATMENT DEMONSTRATION STUDY RESULTS." PREPARED FOR KOPPERS COMPANY, INC. SEPTEMBER 1985.

CONTACT NAME: JOHN KEMMERER
ORGANIZATION: U.S. EPA - REGION IX
215 FREMONT STREET, SAN FRANCISCO, CA 94105
PHONE: 415-974-8071

DOCUMENT NUMBER: 980-TS1-RT-EWFT INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC. "FEATHER RIVER ON SITE SOIL TREATABILITY STUDY." PREPARED FOR KOPPERS COMPANY, INC. AUGUST 1985.

CONTACT NAME: JOHN KEMMERER
ORGANIZATION: U.S. EPA - REGION IX
215 FREMONT STREET, SAN FRANCISCO, CA 94105
PHONE: 415-974-8071

DOCUMENT NUMBER: 980-TS1-RT-EWGC INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: KOPPERS COMPANY, INC. "EVALUATION OF AN ENGINEERED BIODEGRADATION SYSTEM AT THE NASHUA, N.H. SITE." PREPARED FOR KEYSTONE ENVIRONMENTAL RESOURCES, INC. APRIL 1987.

CONTACT NAME: ANN HEGNAUER
ORGANIZATION: KEYSTONE ENVIRONMENTAL RESOURCES, INC
1050 CONNECTICUT AVE, NW, SUITE 300, WASHINGTON, D.C. 20036
PHONE: 202-429-6552

DOCUMENT NUMBER: 980-TS1-RT-EWHB INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: U.S. EPA. "ENHANCED IN SITU BIODEGRADATION OF JET FUEL (A FULL-SCALE FIELD DEMONSTRATION AT EGLIN AFB)." (2 VOLUMES). AFESC/RDV TYNDALL AFB FLORIDA.

CONTACT NAME: LT. COL. THOMAS WALKER
ORGANIZATION: U.S. DOD/AFESC
PHONE: 904-283-4628
COMMENTS: ARRANGED MEETINGS W/ PREVIOUS CONTACTS FOR FIELD TEAM. SUGGESTED FIELD TEAM CONTACT HIM IF HE COULD BE OF FURTHER ASSISTANCE.

DOCUMENT NUMBER: 980-TS1-RT-EZUU INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: NUS CORPORATION. "LEETOWN PESTICIDE SITE TREATABILITY STUDY - PROGRESS REPORTS IN MEMO FORM." JULY 1986 - JANUARY 1987.

CONTACT NAME: WILLIAM HAGEL TITLE: REGIONAL PROJECT MANAGER
ORGANIZATION: U.S. EPA - REGION III
841 CHESTNUT STREET, PHILADELPHIA, PA 19107
PHONE: 215-597-9800

DOCUMENT NUMBER: 980-TS1-RT-EZZA INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ECOVA CORPORATION. "FINAL REPORT: SOIL TREATMENT PILOT STUDY BRIO/DOP SITE." PREPARED FOR BRIO SITE TASK FORCE. JUNE 1987.

CONTACT NAME: LOUIS BARINKA
ORGANIZATION: U.S. EPA - REGION VI
1445 ROSS AVENUE, 12TH FLOOR, SUITE 1200, DALLAS, TX 75202
PHONE: 214-655-6735
COMMENTS: EPA REGION 6 ALLIED BANK TOWER AT FOUNTAIN PLACE

DOCUMENT NUMBER: 980-TS1-RT-EZZF INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: BIO-ENGINEERING CORPORATION. "DEMONSTRATION OF INNOVATIVE TECHNOLOGIES FOR HAZARDOUS WASTE SITE CLEANUP." TECHNICAL PROPOSAL. RFP SITE-002. PREPARED FOR U.S. EPA HWERL, CINCINNATI, OHIO. MARCH 1987.

CONTACT NAME: ROBERT DOGGETT TITLE: PRESIDENT & CEO
ORGANIZATION: BIO-ENGINEERING CORP.
PHONE: 214-586-3045

DOCUMENT NUMBER: 980-TS1-RT-FCBS INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: SCIENCE APPLICATIONS INTNAT'L CORP. FINAL REPORT. "FIELD DEMONSTRATION OF IN SITU BIOLOGICAL DEGRADATION." FOR ENGINEERING AND SERVICES LAB., AIR FORCE ENGINEERING AND SERVICES CENTER AND U.S. EPA HWERL. SEPTEMBER 1985

CONTACT NAME: CAPT. EDWARD HEYSE TITLE: CAPT. & ENGINEER
ORGANIZATION: U.S. DOD/AFESC/RDV
PHONE: 904-283-4628

DOCUMENT NUMBER: 980-TS1-RT-FCEW INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: LEE, M.D., J.T. WILSON AND C.H. WARD. (CHAPTER 47) "MICROBIAL DEGRADATION OF SELECTED AROMATICS IN A HAZARDOUS WASTE SITE." PREPARED FOR NATIONAL CENTER FOR GROUND WATER RESEARCH, DEPT. OF ENV. SCIENCE AND ENGINEERING, RICE UNIVERSITY.

CONTACT NAME: ALLAN HANCOCK
ORGANIZATION: U.S. EPA - REGION VII
726 MINNESOTA STREET, KANSAS CITY, KS 66101
PHONE: 916-236-2891

DOCUMENT NUMBER: 980-TS1-RT-FCFA INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: NORRIS, R.D. AND R.A. BROWN. "IN SITU BIORECLAMATION - A COMPLETE ON-SITE SOLUTION." PREPARED FOR FMC CORP. AQUIFER REMEDIATION SYSTEMS.

CONTACT NAME: ALLAN HANCOCK
ORGANIZATION: U.S. EPA - REGION VII
726 MINNESOTA STREET, KANSAS CITY, KS 66101
PHONE: 916-236-2891

DOCUMENT NUMBER: 980-TS1-RT-FCLE INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: ECOVA. TABLES. "GULF COAST PILOT STUDY LAND TREATMENT." MAY 1987.

CONTACT NAME: DAVID ASHCOM TITLE: DIRECTOR OF OPERATIONS
ORGANIZATION: ECOVA
15555 NE 33RD, REDMOND, WA 98052
PHONE: 206-881-6485

DOCUMENT NUMBER: 980-TS1-RT-FCNY INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: NATO-CCMS PILOT STUDY ON DEMONSTRATION OF REMEDIAL ACTION TECHNOLOGIES FOR CONTAMINATED LAND AND GROUNDWATER.
"PLANNING QUESTIONNAIRE: THE NETHERLANDS." FEBRUARY 1987.

CONTACT NAME: NOT REPORTED
ORGANIZATION: NTL. INST. OF PUB. HEALTH & ENV. HYGIENE
LABORATORY FOR WASTE EMISSION RESEARCH, A. VAN LEEUWENHOEKLAAN 9, P.O. BOX 1, 3720 BA BILTHOVEN, THE NETHERLANDS

DOCUMENT NUMBER: 980-TS1-RT-FCQF INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: NATO-CCMS PILOT STUDY ON DEMONSTRATION OF REMEDIAL ACTION TECHNOLOGIES FOR CONTAMINATED LAND AND GROUNDWATER.
"PROJECT: IN SITU BIORESTORATION OF SOIL, CONTAMINATED WITH PETROL."

CONTACT NAME: JANETTE HANSEN
ORGANIZATION: U.S. EPA
OFFICE OF SOLID WASTE, RMS-263D/WH-563, 401 M STREET S.W., WASHINGTON, D.C. 20460
PHONE: 202-382-4754

DOCUMENT NUMBER: 980-TS1-RT-FCTE INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: GEOSCIENCE CONSULTANTS, LTD. SOIL TREATMENT STUDIES. "EXCERPTS FROM THE GIANT BLOOMFIELD REFINERY REPORT."

CONTACT NAME: CLAUDE SCHLEYER TITLE: PROFESSIONAL ENGINEER
ORGANIZATION: GEOSCIENCE CONSULTANTS, LTD.
500 COPPER, NW, SUITE 200, ALBEQUERQUE, NM 87102
PHONE: 505-842-0001

DOCUMENT NUMBER: 980-TS1-RT-FCUB INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: DETOX INDUSTRIES, INC. COMPANY PROFILE AND ASSORTED DETOX-RELATED ARTICLES.

CONTACT NAME: NOT REPORTED
ORGANIZATION: DETOX INDUSTRIES, INC.
12919 DAIRY ASHFORD, SUGARLAND, TX 77478
PHONE: 713-240-0892

DOCUMENT NUMBER: 980-TS1-RT-FDAX INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. "BENCH SCALE BIOREMEDIATION STUDY AT THE FRENCH LIMITED SITE, IN CROSBY, TX."

CONTACT NAME: MARILYN PLITNICK
ORGANIZATION: U.S. EPA - REGION VI
AIR AND HAZARDOUS MATERIALS DIVISION, 1201 ELM STREET, DALLAS, TX 75270
PHONE: 214-655-6715

DOCUMENT NUMBER: 980-TS1-RT-FHYK INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC. (ERT). "TREATMENT DEMONSTRATION REPORT. CREOSOTE CONTAMINATED SOILS." PREPARED FOR BURLINGTON NORTHERN RAILROAD. DOCUMENT D245. APRIL 1985.

CONTACT NAME: MARY GADE
ORGANIZATION: U.S. EPA - REGION V
EMERGENCY AND REMEDIAL RESPONSE BRANCH, 230 SOUTH DEARBORN STREET, CHICAGO, IL 60604
PHONE: 312-353-2000
COMMENTS: R.WYER LETTER TO REGIONS SENT 7/21/87

DOCUMENT NUMBER: 980-TS1-RT-FRDK INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: EXNER, JURGEN H.-EDITOR - INTERNATIONAL TECHNOLOGY CORPORATION. "SOLVING HAZARDOUS WASTE PROBLEMS - LEARNING FROM DIOXINS. BIODEGRADATION OF CHLORINATED ORGANIC COMPOUNDS BY PHANEROCHAETE CHRYSOSPORIUM, A WOOD-ROTTING FUNGUS." PREPARED FOR AMERICAN CHEMICAL SOCIETY. APRIL 1986.

CONTACT NAME: STEVEN D. AUST
ORGANIZATION: UTAH STATE UNIVERSITY
BIOTECHENOLOGY CENTER, UTAH STATE UNIVERSITY, LOGAN, UTAH 84322-4430
PHONE: 801-750-2753
COMMENTS: FORMERLY OF MICHIGAN STATE UNIVERSITY . CONTACT ABOUT FUNGAL DEGRADATION

DOCUMENT NUMBER: 980-TS1-RT-FRDL INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: THREE ARTICLES FROM HAZTECH NEWS. "BIOREMEDIATION BEING STUDIED FOR TEXAS SUPERFUND CLEANUP." "FIRM TO MARKET PEROXYGEN FORMULATION FOR ENHANCEMENT OF BIODEGRADATION." "EPA SELECTS DECHLORINATION TO CLEAN SOIL AT MASSACHUSETTS SUPERFUND SITE." SEPTEMBER 10, 1987.

CONTACT NAME: NOT REPORTED
ORGANIZATION: HAZTECH
7820 PROFESSIONAL PLACE, TAMPA, FL 33637

DOCUMENT NUMBER: 980-TS1-RT-FRDS INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: BUMPUS, TIEN, WRIGHT, AUST - "BIODEGRADATION OF ENVIRONMENTAL POLLUTANTS BY THE WHITE ROT FUNGUS PHANEROCHAETE CHRYSOSPORIUM" - DEPARTMENT OF BIOCHEMISTRY, MICHIGAN STATE UNIVERSITY

CONTACT NAME: STEVEN D. AUST
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PHONE: 801-750-2753
COMMENTS: FORMERLY OF MICHIGAN STATE UNIVERSITY . CONTACT ABOUT FUNGAL DEGRADATION

DOCUMENT NUMBER: 980-TS1-RT-FRDX INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: HAEMMERLI, LEISOLA, SANGLARD, AND FIECHTER. "OXIDATION OF BENZO(A)PYRENE BY EXTRACELLULAR LIGNINASES OF PHANEROCHAETE CHRYSOSPORIUM - VERATRYL ALCOHOL AND STABILITY OF LIGNINASE." THE JOURNAL OF BIOLOGICAL CHEMISTRY, VOL. 261, NO.15, MAY 25, 1986.

CONTACT NAME: MATTI S.A. LEISOLA
ORGANIZATION: SWISS FEDERAL INSTITUTE OF TECHNOLOGY

DOCUMENT NUMBER: 980-TS1-RT-EWFS-1 INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: KOPPERS COMPANY, INC. "CHARACTERIZATION/TREATABILITY STUDY REPORT-KOPPERS COMPANY, INC., FEATHER RIVER PLANT." JULY 1986.

CONTACT NAME: JOHN KEMMERER
ORGANIZATION: U.S. EPA - REGION IX
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PHONE: 415-974-8071

DOCUMENT NUMBER: 980-TS1-RT-EZUD-2 INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: CH2M HILL. "IN SITU TREATMENT PROCESS DEVELOPMENT PROGRAM."VOLUMES I - IV. PREPARED FOR UNION PACIFIC RAILROAD. JUNE 1987.

CONTACT NAME: NOT REPORTED
ORGANIZATION: CH2M HILL
ROCKY MOUNTAIN OFFICE, P.O BOX 22508, DENVER, CO 80222
PHONE: 303-771-0900

DOCUMENT NUMBER: 980-TS1-RT-FCQP INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: DETOX INDUSTRIES, INC. "WORK PLAN FOR BIODEGRADATION OF POLYCHLORINATED BIPHENYLS (PCBS) AT A SUPERFUND SITE." (3 VOLUMES). PREPARED FOR GENERAL MOTORS CORPORATION, MASSENA, NEW YORK. SEPTEMBER 1986.

CONTACT NAME: MELVIN HAUPTMAN
ORGANIZATION: U.S. EPA - REGION II
EMERGENCY & REMEDIAL RESPONSE DIVISION, 26 FEDERAL PLAZA, NEW YORK, NY 10278
PHONE: 212-264-7681
COMMENTS: MOREAU DRAGSTRIP SITE, NY. CALL HAUPTMAN JULY '87 ABOUT THIS SITE

DOCUMENT NUMBER: 980-TS1-RT-FCRY INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: O.H. MATERIALS CO. "PROPOSAL FOR BIODEGRADATION OF PHENOLS IN WASTE SOIL AT THE PICILLO SITE. WEST COVENTRY, RHODE ISLAND." SUBMITTED TO RHODE ISLAND DEPARTMENT OF ENVITONMENTAL MANAGEMENT JULY 1982

CONTACT NAME: DIANE BADOREK
ORGANIZATION: RHODE ISLAND DEPT. OF ENVIRONMENTAL MGMT
204 CANNON BLDG., 75 DAVIS STREET, PROVIDENCE, RI 02908
PHONE: 401-277-2797

DOCUMENT NUMBER: 980-TS1-RT-FRAH INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: PAMELA S. ZURER, C&EN WASHINGTON. "FUNGUS SHOWS PROMISE IN HAZARDOUS WASTE TREATMENT." CHEMICAL AND ENGINEERING NEWS MAGAZINE. SEPTEMBER 14, 1987.

CONTACT NAME: PAMELA S. ZURER TITLE: WASHINGTON OFFICE
ORGANIZATION: CHEMICAL & ENGINEERING NEWS
1155 16th STREET, N.W., WASHINGTON, D.C. 20036
PHONE: 202-872-4495

DOCUMENT NUMBER: 982-TS3-RT-GKWP INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ERT, PREPARED FOR FRENCH LIMITED TASK GROUP, "IN SITU BIODEGRADATION DEMONSTRATION REPORT, VOLUME 1 - EXECUTIVE SUMMARY, FRENCH LIMITED SITE." PUBLICATION FOR THE U.S. EPA. OCTOBER 1987.

CONTACT NAME: CAROLINE ROE
ORGANIZATION: U.S. EPA - HEADQUARTERS
HAZARDOUS SITE CONTROL DIVISION, WH548E, 401 M STREET, S.W., WASHINGTON, D.C. 20460
PHONE: 201-475-9754

(NO DATA ON THIS PAGE)

DOCUMENT NUMBER: 980-TS1-RT-EWHH INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: RADIAN CORPORATION. "FINAL REPORT REMEDIATION OF TOXAPHENE-CONTAMINATED SOILS AT THE BELL ROAD SITE IN SURPRISE, AZ." PREPARED FOR BILL ROSE, UNIVESITY FINANCIAL INVESTORS. DECEMBER 1986.

CONTACT NAME: RICHARD MARTYN
ORGANIZATION: U.S. EPA - REGION IX
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PHONE: 415-974-8071

DOCUMENT NUMBER: 980-TS1-RT-EWHJ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: RADIAN CORPORATION. "RESULTS OF SAMPLING AND ANALYSIS OF THE TAXAPHENE TREATMENT PIT AT THE BELL ROAD SITE IN SURPRISE, AZ." PREPARED FOR MR. WILLIAM ROSE, UNIVERSITY FINANCIAL INVESTORS. JULY 1986.

CONTACT NAME: RICHARD MARTYN
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DOCUMENT NUMBER: 980-TS1-RT-EUQX INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: LOUSIANA DEPARTMENT OF ENVIRONMENTAL QUALITY, BATON ROUGE, LA. "FIELD PLOT TEST REPORT-PHASE III ENGINEERING DESIGN, OLD INGER SUPERFUND SITE, DARROW, LA." NOVEMBER 1986.

CONTACT NAME: TIMOTHY MAHON
ORGANIZATION: U.S. EPA - REGION VI
1445 ROSS AVENUE, 12TH FLOOR, SUITE 1200, DALLAS, TX 75202
PHONE: 214-655-6444

DOCUMENT NUMBER: 980-TS1-RT-EURS INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ATLANTIC RESEARCH CORPORATION. "COMPOSTING EXPLOSIVES/ORGANICS CONTAMINATED SOILS." PREPARED FOR USATHMA. MAY 1986.

CONTACT NAME: WAYNE SISK
ORGANIZATION: U.S. DOD/USATHAMA
PHONE: 301-671-2054

DOCUMENT NUMBER: 980-TS1-RT-EURT-1 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ATLANTIC RESEARCH CORPORATION. "COMPOSTING OF EXPLOSIVES." PREPARED FOR USATHMA. SEPTEMBER 1982.

CONTACT NAME: WAYNE SISK
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PHONE: 301-671-2054

DOCUMENT NUMBER: 980-TS1-RT-EUQS INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ROY F. WESTON, INC."PILOT INVESTIGATION OF LOW TEMPERATURE THERMAL STRIPPING OF VOLATILE ORGANIC COMPOUNDS (VOC'S) FROM SOIL: VOLUME I-TECHNICAL REPORT AND VOLUME II-APPENDICES." AMXTH-TE-CR-86074. PREPARED FOR USATHMA. JUNE 1986.

CONTACT NAME: WAYNE SISK
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DOCUMENT NUMBER: 980-TS1-RT-EUQT INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: ROY F. WESTON, INC. "ECONOMIC EVALUATION OF LOW TEMPERATURE THERMAL STRIPPING OF VOLATILE ORGANIC COMPOUNDS FROM SOIL." AMXTH-TE-CR-86085. PREPARED FOR USATHMA. AUGUST 1986.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. DOD/USATHAMA
PHONE: 301-278-5201

DOCUMENT NUMBER: 980-TS1-RT-EXPE INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: CANONIE ENVIRONMENTAL SERVICES CORP. "SOIL REMEDIATION AND SITE CLOSURE McKIN SUPERFUND SITE." PREPARED FOR POTENTIALLY RESPONSIBLE PARTIES. JULY 1987.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - REGION I
JOHN F. KENNEDY FEDERAL BUILDING, ROOM 2203, BOSTON, MA 02203
PHONE: 617-565-3715
COMMENTS: DOCUMENS TAKEN FROM FILE ROOM

DOCUMENT NUMBER: 980-TS1-RT-FCFL INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: KOLTUNIAK, D.L. "TREATMENT OF VOC CONTAMINATED SOILS." JOURNAL. ARMY RESEARCH, DEVELOPMENT & ACQUISITION MAGAZINE. MARCH-APRIL 1986.

CONTACT NAME: TIMOTHY TRAVERS TITLE: REGIONAL PROJECT MANAGER
ORGANIZATION: U.S. EPA - REGION III
841 CHESTNUT STREET, PHILADELPHIA, PA 19107
PHONE: 215-597-8751

DOCUMENT NUMBER: 980-TS1-RT-FCMK INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ROY F. WESTON, INC. "CONTRACT DAAK 11-85-C-0007 (TASK ORDER 4) BENCH-SCALE INVESTIGATION OF AIR STRIPPING OF VOLATILE ORGANIC COMPOUNDS (VOC'S) FROM SOIL." TECHNICAL REPORT. PREPARED FOR USATHAMA. JANUARY 1987.

CONTACT NAME: ERIC KAUFMAN
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PHONE: 301-671-2270
COMMENTS: INFO. ON LETTERKENNY SITE

DOCUMENT NUMBER: 980-TS1-RT-FCSF INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: WEBSTER, DAVID M. "PILOT STUDY OF ENCLOSED THERMAL SOIL AERATION FOR REMOVAL OF VOLATILE ORGANIC CONTAMINATION AT THE McKIN SUPERFUND SITE." "JOURNAL OF THE AIR POLLUTION CONTROL ASSOCIATION." VOLUME 36, NO. 10. OCTOBER 1986.

CONTACT NAME: DAVID WEBSTER
ORGANIZATION: U.S. EPA - REGION I
JOHN F. KENNEDY FEDERAL BUILDING, ROOM 2203, BOSTON, MA 02203
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DOCUMENT NUMBER: 980-TS1-RT-FCSP INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: RESEARCH TRIANGLE INSTITUTE. INFORMATION: "INPUT/OUTPUT DATA FOR SEVERAL TREATMENT TECHNOLOGIES." CENTER FOR HAZARDOUS MATERIALS RESEARCH. MAY 1987.

CONTACT NAME: DR. CLARK ALLEN
ORGANIZATION: RESEARCH TRIANGLE INSTITUTE
P.O. BOX 12194, RESEARCH TRIANGLE PARK, NC 27709
PHONE: 919-541-5826

DOCUMENT NUMBER: ORD-TS1-RT-EZYQ INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: PEI ASSOCIATES, INC. "LOW TEMPERATURE TREATMENT OF CERCLA SOILS AND DEBRIS USING THE IT LABORATORY SCALE THERMAL DESORPTION FURNACES." PREPARED FOR U.S. EPA, HWERL, CINCINNATI, OH. OCTOBER 1987.

CONTACT NAME: ROBERT THURNAU
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7692

DOCUMENT NUMBER: 980-TS1-RT-EUTT-2 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ASSINK J.W. "EXTRACTIVE METHODS FOR SOIL DECONTAMINATION, A GENERAL SURVEY AND REVIEW OF OPERATIONAL TREATMENT INSTALLATIONS." APELDOORN, NETHERLAND. NOVEMBER 1985.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, WOODBRIDGE AVENUE, EDISON, NJ 08837-3579
PHONE: 212-264-2525

DOCUMENT NUMBER: 980-TS1-RT-EUTT-3 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ASSINK J.W. "EXTRACTIVE METHODS FOR SOIL DECONTAMINATION, A GENERAL SURVEY AND REVIEW OF OPERATIONAL TREATMENT INSTALLATIONS." APELDOORN, NETHERLAND. NOVEMBER 1985

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, WOODBRIDGE AVENUE, EDISON, NJ 08837-3579
PHONE: 212-264-2525

DOCUMENT NUMBER: 980-TS1-RT-EUYQ INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: ELLIS W.D. AND J.R. PAYNE. "THE DEVELOPMENT OF CHEMICAL COUNTERMEASURES FOR HAZARDOUS WASTE CONTAMINATED SOIL." 1984 HAZARDOUS MATERIAL SPILLS CONFERENCE. NASHVILLE, TN. APRIL 1984.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-EUZE INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. "DEVELOPMENT OF A MOBILE SYSTEM FOR EXTRACTING SPILLED HAZARDOUS MATERIALS FROM SOIL." ORD, HWERL, OIL AND HAZARDOUS MATERIALS SPILLS BRANCH, EDISON, NJ.

CONTACT NAME: DR. JOHN BRUGGER
ORGANIZATION: U.S. EPA, ORD
HWERL-RELEASES CONTROL BRANCH, WOODBRIDGE AVENUE, EDISON, NJ 08837-3579
PHONE: 201-340-6634

DOCUMENT NUMBER: 980-TS1-RT-EUZN INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: U.S. EPA AND AIR FORCE (AFESC). "INSITU TREATMENT OF JP-4 CONTAMINATED SOIL." PREPARED FOR WISCONSIN DEPARTMENT OF NATURAL RESOURCES. MAY 1985. (2 VOLUMES AND 4 APPENDIX DOCUMENTS).

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. DOD/AFESC
COMMENTS: AIR FORCE HEADQUARTERS DOCUMENT

DOCUMENT NUMBER: 980-TS1-RT-EUZT INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: SCIENCE APPLICATIONS INTERNATIONAL CORPORATION. "TREATMENT OF SOILS CONTAMINATED WITH HEAVY METALS." PROJECT SUMMARY, EPA AND INTERIM REPORTS. PREPARED FOR U.S EPA, HWERL, ORD. SEPTEMBER 1985.

CONTACT NAME: ANTHONY TAFURI
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HWERL-RELEASES CONTROL BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-6604

DOCUMENT NUMBER: 980-TS1-RT-EUZU INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: SCIENCE APPLICATIONS INTERNATIONAL CORPORATION. "TREATMENT OF CONTAMINATED SOILS WITH AQUEOUS SURFACTANTS (INTERIM REPORT)." AND "PROJECT SUMMARY: TREATMENT OF CONTAMINATED SOILS WITH AQUEOUS SURFACTANTS ." PREPARED FOR U.S. EPA, HWERL, ORD.

CONTACT NAME: RICHARD TRAVER TITLE: STAFF ENGINEER
ORGANIZATION: U.S. EPA, ORD
HWERL-RELEASES CONTROL BRANCH, WOODBRIDGE AVENUE, EDISON, NJ 08837
PHONE: 201-321-6677

DOCUMENT NUMBER: 980-TS1-RT-EUZW INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: SCIENCE APPLICATION INTERNATIONAL CORPORATION. "TREATMENT OF SOILS CONTAMINATED WITH HEAVY METALS."1984 HAZARDOUS MATERIALS SPILLS CONFERENCE. NASHVILLE, TN. APRIL 1984.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-EUZX INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: NASH J., AND R.P. TRAVER. "FIELD EVALUATION OF IN SITU WASHING OF CONTAMINATED SOILS WITH WATER/SURFACTANTS." 1984 HAZARDOUS MATERIALS SPILLS CONFERENCE. NASHVILLE, TN. APRIL 1984.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-EUZZ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. DRAFT RESEARCH PROJECT PLAN. "REMOVING LEAD WITH EDTA CHELATING AGENT FROM CONTAMINATED SOIL AT THE MICHAEL BATTERY COMPANY." U.S. EPA, HWERL, ORD. DECEMBER 1985.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-EVAB INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. "PROJECT SUMMARY: MOBILE SYSTEM FOR EXTRACTING SPILLED HAZARDOUS MATERIALS FROM EXCAVATED SOILS." ORD, HWERL. CINCINNATI, OHIO.

CONTACT NAME: RICHARD TRAVER TITLE: STAFF ENGINEER
ORGANIZATION: U.S. EPA, ORD
HWERL-RELEASES CONTROL BRANCH, WOODBRIDGE AVENUE, EDISON, NJ 08837
PHONE: 201-321-6677

DOCUMENT NUMBER: 980-TS1-RT-EVAR INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: SUMMARY REPORT. "HARBAUER SOIL CLEANING SYSTEM." RECEIVED U. S. EPA HEADQUARTERS, NOVEMBER 20, 1987.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - HEADQUARTERS
401 M STREET, S.W., WASHINGTON, D.C. 20460

DOCUMENT NUMBER: 980-TS1-RT-EXNH INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ENVIRESPONSE, INC. "SOIL WASHING TREATABILITY STUDY FOR SAPP BATTERY SITE, JACKSON COUNTY, FLORIDA."

CONTACT NAME: ROBERT EVANGELISTA
ORGANIZATION: ENVIRESPONSE
GSA RARITAN DEPOT, WOODBRIDGE AVE, BUILDING 209, BAY F, EDISON, NJ 88037
PHONE: 201-548-9660

DOCUMENT NUMBER: 980-TS1-RT-EZUD-1 INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: CH2M HILL. "IN SITU TREATMENT PROCESS DEVELOPMENT PROGRAM."VOLUMES I - IV. PREPARED FOR UNION PACIFIC RAILROAD. JUNE 1987.

CONTACT NAME: NOT REPORTED
ORGANIZATION: CH2M HILL
ROCKY MOUNTAIN OFFICE, P.O BOX 22508, DENVER, CO 80222
PHONE: 303-771-0900

DOCUMENT NUMBER: 980-TS1-RT-EZUJ INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: MARTIN MARIETTA ENERGY SYSTEMS, INC. "REMOVAL OF PCB FROM SOIL USING SOLVENT LEACHING." APRIL 1985.

CONTACT NAME: ROBERT W. SCHEDE TITLE: TECHNOLOGY APPLICATIONS REPRESENTATIVE
ORGANIZATION: MARTIN MARIETTA ENERGY SYSTEMS, INC
P.O. BOX Y, OAK RIDGE, TN 37831
PHONE: 615-576-5454

DOCUMENT NUMBER: 980-TS1-RT-FCPZ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: HEIMHARD, HANS-JURGEN. KLOCKNER OECOTEC GMBH. "HIGH PRESSURE SOIL WASHING. A PROCESS FOR CLEANING POLLUTED SOIL." DUISBURG, 26.01.87. [JANUARY 1987].

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OFFICE OF SOLID WASTE, RMS-263D/WH-563, 401 M STREET S.W., WASHINGTON, D.C. 20460
PHONE: 202-382-4754

DOCUMENT NUMBER: 980-TS1-RT-FCRK INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: TRAVER, RICHARD P. "IN SITU FLUSHING & SOILS WASHING TECHNOLOGIES FOR SUPERFUND SITES." PRESENTED AT RCRA/SUPERFUND ENGINEERING TECHNOLOGY TRANSFER SYMPOSIUM. U.S. EPA. ORD HWERL.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-FCUW INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: U.S. EPA. "FACILITY DECONTAMINATION - FIELD DEMONSTRATION OF IN SITU SOIL-WASHING." RELEASES CONTROL BRANCH, EDISON, NJ AND HQ AFESC ENVIRONICS DIVISION. (SCHEDULE OF WORK SUMMARY FOR VOLK AIR FIELD DEMONSTRATION).

CONTACT NAME: DOUG DOWNEY
ORGANIZATION: U.S. DOD/AFESC
PHONE: 904-283-2942

DOCUMENT NUMBER: 980-TS1-RT-FRET INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: IT CORPORATION. "LABORATORY FEASIBILITY TESTING OF PROTOTYPE SOIL WASHING CONCEPTS." PREPARED FOR U.S. EPA , OHMSB. DECEMBER 1983.

CONTACT NAME: FRANKLIN FREESTONE
ORGANIZATION: U.S. EPA, ORD
HWERL-RELEASES CONTROL BRANCH, WOODBRIDGE AVENUE, EDISON, NJ 08837-3579
PHONE: 201-340-6634

DOCUMENT NUMBER: 980-TS1-RT-FREU INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: MASON & HANGER-SILAS MASON CO., INC. "LABORATORY STUDY OF AQUEOUS WASHING OF SOIL FROM POLYCARB SITE, WELLS, NEVADA." MARCH 1987

CONTACT NAME: RICHARD TRAVER TITLE: STAFF ENGINEER
ORGANIZATION: U.S. EPA, ORD
HWERL-RELEASES CONTROL BRANCH, WOODBRIDGE AVENUE, EDISON, NJ 08837
PHONE: 201-321-6677

DOCUMENT NUMBER: 982-TS3-RT-GKXL INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. DEPT OF THE INTERIOR, LETTER REPORT UNDER INTERAGENCY AGREEMENT FOR THE UNITED SCRAP LEAD SUPERFUND SITE. SEPTEMBER 1987.

CONTACT NAME: CAROLINE ROE
ORGANIZATION: U.S. EPA - HEADQUARTERS
HAZARDOUS SITE CONTROL DIVISION, WH548E, 401 M STREET, S.W., WASHINGTON, D.C. 20460
PHONE: 201-475-9754

DOCUMENT NUMBER: 125-RI1-RT-CLMS INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: CAMP, DRESSER, AND MCKEE, INC. "COLEMAN EVANS WOOD PRESERVING SITE - REMEDIAL INVESTIGATION FINAL REPORT." (APPENDIX B - TREATABILITY STUDY.) PREPARED FOR U.S. EPA. APRIL 1986.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - REGION IV
345 COURTLAND STREET, NE, ATLANTA, GA 30365
PHONE: 404-347-4727

DOCUMENT NUMBER: 980-TS1-RT-EURU INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ENVIRONMENTAL SCIENCE AND ENGINEERING, INC. "FINAL REPORT: DEVELOPMENT OF OPTIMUM TREATMENT SYSTEM FOR WASTEWATER LAGOONS - PHASE II - SOLVENT EXTRACTION LABORATORY TESTING." PREPARED FOR USATHAMA. OCTOBER 1984.

CONTACT NAME: WAYNE SISK
ORGANIZATION: U.S. DOD/USATHAMA
PHONE: 301-671-2054

DOCUMENT NUMBER: 980-TS1-RT-EUYV INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: ENVIRONMENTAL SCIENCE AND ENGINEERING, INC. "SUPERCRITICAL FLUID TECHNOLOGY APPLICATION STUDY." PREPARED FOR USATHMA. OCTOBER 1982.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. DOD/USATHAMA
PHONE: 301-278-5201

DOCUMENT NUMBER: 980-TS1-RT-EWGX INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: RUGG, B. AND W. BRENNER. NEW YORK UNIVERSITY. "DEVELOPMENT AND EVALUATION OF A LOW ENERGY PROCESS TECHNOLOGY FOR EXTRACTION AND CHEMICAL DESTRUCTION OF POLYCHLORINATED BIPHENYLS FROM CONTAMINATED SEDIMENTS AND SLUDGES." NYU/DAS 87-165. SPONSORED UNDER EPA GRANT NO. CR-812123-01-0. APRIL 1987.

CONTACT NAME: WILLIAM SMITH
ORGANIZATION: CDM - EDISON, NJ
RARITAN PLAZA I, RARITAN CENTER, EDISON, NJ 08817
PHONE: 201-225-7000

DOCUMENT NUMBER: 980-TS1-RT-FCAE INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: O.H. MATERIALS CORP. "DRAFT: INTERIM TECHNOLOGY REPORT OF SOLVENT EXTRACTION OF PCBS FROM CONTAMINATED SOIL AT THE SCHAFFER EQUIPMENT SITE - MINDEN, WEST VIRGINIA." PREPARED FOR U.S. EPA. JANUARY 1986.

CONTACT NAME: ROBERT CARON
ORGANIZATION: U.S. EPA - REGION III
841 CHESTNUT STREET, 6TH FLOOR, PHILADELPHIA, PA 19107
PHONE: 215-597-2771
COMMENTS: ON SCENE COORDINATOR FOR THE MINDEN SITE IN W.VA

DOCUMENT NUMBER: 980-TS1-RT-FCPW INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: NATO-CCMS PILOT STUDY ON DEMONSTRATION OF REMEDIAL ACTION TECHNOLOGIES FOR CONTAMINATED LAND AND GROUNDWATER. "PLANNING QUESTIONNAIRE: FEDERAL REPUBLIC OF GERMANY." MARCH 1987.

CONTACT NAME: JANETTE HANSEN
ORGANIZATION: U.S. EPA
OFFICE OF SOLID WASTE, RMS-263D/WH-563, 401 M STREET S.W., WASHINGTON, D.C. 20460
PHONE: 202-382-4754

DOCUMENT NUMBER: 980-TS1-RT-FCQC-3 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: SOCZO, E.R., E.J.H. VERHAGEN, AND C.W. VERSLUIJS. "REVIEW OF SOIL TREATMENT TECHNIQUES IN THE NETHERLANDS." NATIONAL INSTITUTE OF PUBLIC HEALTH AND ENVIRONMENTAL HYGIENE, LABORATORY FOR WASTE EN EMISSION RESEARCH (LAE), THE NETHERLANDS.

CONTACT NAME: NOT REPORTED
ORGANIZATION: NTL. INST. OF PUB. HEALTH & ENV. HYGIENE
LABORATORY FOR WASTE EMISSION RESEARCH, A. VAN LEEUWENHOEKLAAN 9, P.O. BOX 1, 3720 BA BILTHOVEN, THE NETHERLANDS

DOCUMENT NUMBER: 980-TS1-RT-FCQM INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: SAVANNAH LABORATORIES AND ENVIRONMENTAL SERVICES, INC. "B.E.S.T. PROCESS ANALYTICAL RESULTS." LOG NO. 86-2101. AUGUST 1986.

CONTACT NAME: NOT REPORTED
ORGANIZATION: HAZTECH
7820 PROFESSIONAL PLACE, TAMPA, FL 33637

DOCUMENT NUMBER: 980-TS1-RT-FCQN INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: RESOURCES CONSERVATION CO. SOILS/SLUDGES/DEBRIS TREATMENT. "B.E.S.T.(tm) SLUDGE PROCESSING SYSTEM STATUS REPORT." JUNE 1987.

CONTACT NAME: PAUL McGOUGH
ORGANIZATION: RESOURCES CONSERVATION CO.
PHONE: 206-828-2455
COMMENTS: CONTACT PERSON FOR INFO ON THE "BOX" OF B.E.S.T. DATA

DOCUMENT NUMBER: 980-TS1-RT-FCQT INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: VAN LUIN, B. AND H. WARMER. "TREATMENT OF POLLUTED WATER FROM THE CLEAN-UP OF CONTAMINATED SOIL." LELYSTAD, NETHERLANDS.

CONTACT NAME: RICHARD TRAVER TITLE: STAFF ENGINEER
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HWERL-RELEASES CONTROL BRANCH, WOODBRIDGE AVENUE, EDISON, NJ 08837
PHONE: 201-321-6677

DOCUMENT NUMBER: 980-TS1-RT-FYRB INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. DEPT. OF INTERIOR-BUREAU OF MINES. PROGRESS REPORT ON LAB STUDIES USING EDTA AND FLUOSILICIC ACID TO EXTRACT LEAD FROM LEAD-CONTAMINATED SOIL. SUBMITTED TO US EPA SEPTEMBER, 1987

CONTACT NAME: WILLIAM SCHMIDT
ORGANIZATION: US DEPARTMENT OF INTERIOR/BUREAU OF MINE
BUREAU OF MINES, 2401 E STREET, NW, WASHINGTON, DC 20241

DOCUMENT NUMBER: 980-TS1-RT-FYRK INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: GENERAL REFINING, SAVANNAH, GA. - SITE REPORT AND LOG BOOK OF SITE CLEANUP USING B.E.S.T. - HAZTECH AND RESOURCES CONSERVATION CO. INVOLVED. 9/11/85-2/7/87

CONTACT NAME: PAUL McGOUGH
ORGANIZATION: RESOURCES CONSERVATION CO.
PHONE: 206-828-2455
COMMENTS: CONTACT PERSON FOR INFO ON THE "BOX" OF B.E.S.T. DATA

DOCUMENT NUMBER: ORD-TS1-RT-EUQW INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: PEI ASSOCIATES, INC. "CERCLA BDAT SARM PREPARATION AND RESULTS OF PHYSICAL SOILS WASHING EXPERIMENTS (FINAL REPORT)." VOLUMES I, II. PREPARED FOR U.S. EPA, HWERL, CINCINNATI, OH. OCTOBER 1987.

CONTACT NAME: RICHARD TRAVER TITLE: STAFF ENGINEER
ORGANIZATION: U.S. EPA, ORD
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PHONE: 201-321-6677

DOCUMENT NUMBER: 289-ES1-IO-EVXK INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: KENNEDY/JENKS/CHILTON. MEMORANDUM - REVIEW OF FIXATION TECHNOLOGIES FOR MGM BRAKES SITE PCBS IN SOIL

CONTACT NAME: JOHN WONDOLLECK
ORGANIZATION: U.S. EPA - REGION IX
215 FREMONT STREET, SAN FRANCISCO, CA 94105
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DOCUMENT NUMBER: 980-TS1-RT-EURL INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: U.S. DOE. "DRAFT: CORRECTIVE ACTIONS FOR LAND DISPOSAL." ENVIRONMENTAL SCIENCES DIVISION, OAK RIDGE NATIONAL LABORATORY. OAK RIDGE, TN.

CONTACT NAME: BRIAN SPALDING
ORGANIZATION: U.S. DOE/WMTC
U.S. DEPT. OF ENERGY, ORNL, OAK RIDGE, TN 37831
PHONE: FTS 574-7265
COMMENTS: INFO ON INSITU VITRIFICATION, CHEMICAL GROUTS

DOCUMENT NUMBER: 980-TS1-RT-EWVF INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: OAK RIDGE NATIONAL LABORATORY. "IMMOBILIZATION OF MIXED WASTE." PUBLISHED IN WASTE MANAGEMENT '87. VOL.3: LOW-LEVEL WASTE. 1987.

CONTACT NAME: LESLIE DOLE TITLE: PROGRAM MANAGER
ORGANIZATION: WMTC, DOE, ORNL
P.O. BOX P, BUILDING K 1000 MS-183, OAK RIDGE, TN 37831
PHONE: 615-576-7421
COMMENTS: INFO ON THE PEPPER STEEL SITE AND OTHERS

DOCUMENT NUMBER: 980-TS1-RT-EWVM INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: OAK RIDGE NATIONAL LABORATORY, DOW CHEMICAL COMPANY. "APPLICATIONS OF A STANDARD LEACHING TEST FOR WASTE FORMS." TO BE PRESENTED AT 1987 INTERNATIONAL WASTE MANAGEMENT CONFERENCE.

CONTACT NAME: LESLIE DOLE TITLE: PROGRAM MANAGER
ORGANIZATION: WMTC, DOE, ORNL
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COMMENTS: INFO ON THE PEPPER STEEL SITE AND OTHERS

DOCUMENT NUMBER: 980-TS1-RT-FYRD INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: KENNEDY/JENKS/CHILTON. "WORKPLAN FOR THE FIXATION PILOT STUDY AT THE MGM BRAKES SITE IN CLOVERDALE, CALIFORNIA."

CONTACT NAME: JOHN WONDOLLECK
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PHONE: 415-974-8071

DOCUMENT NUMBER: 982-TS3-RT-GKXE INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: "SECTION 7.0, BENCH STUDIES" MARATHON BATTERY SITE.

CONTACT NAME: CAROLINE ROE
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PHONE: 201-475-9754

DOCUMENT NUMBER: 982-TS3-RT-GKXN INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: SAIC & CALIFORNIA DHS, "PRELIMINARY DRAFT REPORT, STRINGFELLOW FACILITY REMEDIAL INVESTIGATION/FEASIBILITY STUDY. TASK XIII: TREATABILITY STUDIES TREATMENT BY ENCAPSULATION/FIXATION TECHNIQUES." PREPARED FOR CALIFORNIA DEPT OF HEALTH SERVICES. JUNE 1987.

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PHONE: 201-475-9754

DOCUMENT NUMBER: ORD-TS1-RT-FHMF INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ACUREX CORPORATION. "DRAFT FINAL REPORT: BDAT FOR SOLIDIFICATION/STABILIZATION TECHNOLOGY FOR SUPERFUND SOILS." PREPARED FOR U.S. EPA, HWERL, CINCINNATI, OH. NOVEMBER 1987.

CONTACT NAME: EDWIN BARTH
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7931

DOCUMENT NUMBER: 106-RI1-RT-CXRK INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: ROY F. WESTON, INC. "REMEDIAL INVESTIGATION/FEASIBILITY STUDY REPORT BRUIN LAGOON SITE, BRUIN, PENNSYLVANIA." VOLUME I,II,III. JUNE 30, 1986.

CONTACT NAME: JEFFREY PIKE TITLE: REGIONAL PROJECT MANAGER
ORGANIZATION: U.S. EPA - REGION III
841 CHESTNUT STREET, PHILADELPHIA, PA 19107
PHONE: 215-597-0517

DOCUMENT NUMBER: 980-TS1-RT-EUQY INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. "TREATMENT OF HAZARDOUS WASTE WITH SOLIDIFICATION/STABALIZATION." LAND POLLUTION CONTROL DIVISION, HWERL, ORD. CINCINNATI, OH.

CONTACT NAME: CARLTON WILES, Ph.D.
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HWERL-CONTAINMENT BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7795

DOCUMENT NUMBER: 980-TS1-RT-EURH INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: CENTEC CORPORATION. "AN INVESTIGATION OF TECHNOLOGIES FOR HAZARDOUS SLUDGE REDUCTION AT AFLC INDUSTRIAL WASTE TREATMENT PLANTS." VOL. I,II,III. PREPARED FOR AFESC, TYNDALL AIR FORCE BASE, FL. DECEMBER 1983.

CONTACT NAME: MAJOR TERRY STODDART
ORGANIZATION: U.S. DOD/AFESC
PHONE: 904-283-2949

DOCUMENT NUMBER: 980-TS1-RT-EURY INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ECOLOGY AND ENVIRONMENT, INC."SUMMARY REPORT ON THE FIELD INVESTIGATION OF THE SAPP BATTERY SITE, JACKSON COUNTY, FLORIDA." VOL. 1 AND 2. PREPARED FOR FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION. NOVEMBER 1986.

CONTACT NAME: KRISTEEN TEEPEN
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345 COURTLAND STREET, NE, ATLANTA, GA 30365
PHONE: 404-347-4727

DOCUMENT NUMBER: 980-TS1-RT-EWFQ INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: INTERNATIONAL WASTE TECHNOLOGIES. "PRESENTATION OF THE HWT CHEMICAL FIXATION TECHNOLOGY AND JAPANESE IN-PLACE TREATMENT EQUIPMENT."

CONTACT NAME: NOT REPORTED
ORGANIZATION: INTERNATIONAL WASTE TECHNOLOGIES
807 NORTH WACO, SUITE 31, WICHITA, KS 67203
PHONE: 316-262-1338

DOCUMENT NUMBER: 980-TS1-RT-EWVQ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: OAK RIDGE NATIONAL LABORATORY. "INTERRELATIONSHIP OF EXPERIMENTAL RESULTS OBTAINED BY SEVERAL DIFFERENT LEACHING TESTS ON SPECIMENS OF THE SAME MATERIAL." PRESENTED AT 4th INTERNATIONAL WASTE SYMPOSIUM ON ENVIRONMENTAL ASPECTS OF STABILIZATION/SOLIDIFICATION OF HAZARDOUS AND RADIOACTIVE WASTES. OCTOBER 1986.

CONTACT NAME: LESLIE DOLE TITLE: PROGRAM MANAGER
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PHONE: 615-576-7421
COMMENTS: INFO ON THE PEPPER STEEL SITE AND OTHERS

DOCUMENT NUMBER: 980-TS1-RT-EWWB INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: OAK RIDGE NATIONAL LABORATORY. "RADWASTE GROUTING TECHNOLOGIES APPLICABLE TO HAZARDOUS WASTE MANAGEMENT." PRESENTED AT 2ND CONFERENCE ON MUNICIPAL, HAZARDOUS, AND COAL WASTES MANAGEMENT. DECEMBER 1983.

CONTACT NAME: LESLIE DOLE TITLE: PROGRAM MANAGER
ORGANIZATION: WMTC, DOE, ORNL
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COMMENTS: INFO ON THE PEPPER STEEL SITE AND OTHERS

DOCUMENT NUMBER: 980-TS1-RT-EWWC INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: WASTE IMMOBILIZATION TECHNOLOGY, ENGINEERING DEVELOPMENT SECTION, CHEMICAL TECHNOLOGY DIVISION, ORNL. "DESIGN OF PUMPABLE CEMENT-BASED GROUTS FOR THE IMMOBILIZATION OF HAZARDOUS MATERIALS." PRESENTED AT WORLD CONGRESS III OF CHEMICAL ENGINEERING, TOKYO, JAPAN. SEPTEMBER 1986.

CONTACT NAME: LESLIE DOLE TITLE: PROGRAM MANAGER
ORGANIZATION: WMTC, DOE, ORNL
P.O. BOX P, BUILDING K 1000 MS-183, OAK RIDGE, TN 37831
PHONE: 615-576-7421
COMMENTS: INFO ON THE PEPPER STEEL SITE AND OTHERS

DOCUMENT NUMBER: 980-TS1-RT-EXNW INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: ENVIRONMENT CANADA, ZENON ENVIRONMENTAL LTD. "AN APPROACH FOR EVALUATING LONG-TERM LEACHABILITY FROM MEASUREMENT OF INTRISTIC WASTE PROPERTIES." HAZARDOUS AND INDUSTRIAL SOLID WASTE TESTING AND DISPOSAL: SIXTH VOLUME. 1986.

CONTACT NAME: PIERRE COTE
ORGANIZATION: ENVIRONMENT CANADA
WASTEWATER TECHNOLOGY CENTRE, P.O. BOX 5050, 867 LAKESHORE ROAD, BURLINGTON, ONTARIO L7R 4A6

DOCUMENT NUMBER: 980-TS1-RT-EXNZ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: ENVIRONMENT CANADA, U.S. EPA, ALBERTA ENVIRONMENT, CANADIAN AND U.S. RESEARCH FACILITIES, VENDORS OF COMMERCIAL SOLIDIFICATION PROCESSES. "INVESTIGATION OF TEST METHODS FOR SOLIDIFIED WASTE CHARACTERIZATION."

CONTACT NAME: CARLTON WILES, Ph.D.
ORGANIZATION: U.S. EPA, ORD
HWERL-CONTAINMENT BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7795

DOCUMENT NUMBER: 980-TS1-RT-EZTV INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: FLORIDA POWER AND LIGHT CO. "SOILS FIXATION AND STABILIZATION AND REMEDIAL ACTION ALTERNATIVE." PREPARED FOR PEPPER'S STEEL AND ALLOYS SITE LOCATED AT MEDLEY, FLORIDA.

CONTACT NAME: JOHN KROSKE
ORGANIZATION: U.S. EPA - REGION IV
345 COURTLAND STREET, NE, ATLANTA, GA 30365
PHONE: 404-347-4727

DOCUMENT NUMBER: 980-TS1-RT-EZUA INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: GENERAL ELECTRIC."BENCH SCALE TESTING PROGRAM EVALUATION OF SOLIDIFICATION/FIXATION AGENT." DECEMBER 1986.

CONTACT NAME: RONALD UNTERMAN
ORGANIZATION: GENERAL ELECTRIC COMPANY
CORPORATE RESEARCH AND DEVELOPMENT, P.O. BOX 8, SCHENECTADY, NY 12301
PHONE: 518-387-5803
COMMENTS: NOW WORKING FOR JOHNSON ASSOCIATES, INC. 181 CHERRY VALLEY ROAD PRINCETON, NJ 08540 609-924-3420

DOCUMENT NUMBER: 980-TS1-RT-EZUB INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: GE SERVICE SHOP. "REMEDIAL ACTION WORK PLAN." DECEMBER 1986.

CONTACT NAME: NOT REPORTED
ORGANIZATION: GENERAL ELECTRIC COMPANY
CORPORATED RESEARCH AND DEVELOPMENT, P.O. BOX 8, SCHENECTADY, NY 12301

DOCUMENT NUMBER: 980-TS1-RT-EZUK INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: EBASCO SERVICES INCORPORATED. "TREATABILITY TESTS REMEDIAL DESIGN AND CONSTRUCTION ENGINEERING SERVICES BURNT FLY BOG SITE, MARLBORO TOWNSHIP, MONMOUTH COUNTY, NJ." PREPARED FOR NJ DEPARTMENT OF ENVIRONMENTAL PROTECTION. OCTOBER 1984.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - HEADQUARTERS
401 M STREET, S.W., WASHINGTON, D.C. 20460

DOCUMENT NUMBER: 980-TS1-RT-EZUT INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: HAZCON, INC. "SITE - 001. TECHNICAL PROPOSAL FOR DEMONSTRATION OF INNOVATIVE TECHNOLOGY FOR HAZARDOUS WASTE SITE CLEANUP." PREPARED FOR U.S. EPA. IN RESPONSE TO RFP SITE - 001.

CONTACT NAME: DAVID FAVERO
ORGANIZATION: U.S. EPA - REGION V
230 SOUTH DEARBORN STREET, CHICAGO, IL 60604
PHONE: 312-886-4749

DOCUMENT NUMBER: 980-TS1-RT-EZUX-2 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ARCO PETROLEUM PRODUCTS COMPANY. "INTERIM REPORT - ACID SLUDGE TREATABILITY EVALUATION - SAND SPRINGS PETROCHEMICAL COMPLEX." JULY 1987.

CONTACT NAME: PAUL SIEMINSKI
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1445 ROSS AVENUE, 12TH FLOOR, SUITE 1200, DALLAS, TX 75202
PHONE: 214-655-6444

DOCUMENT NUMBER: 980-TS1-RT-EZVA INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: WOODWARD-CLYDE CONSULTANTS. "REMEDIAL ALTERNATIVES ANALYSIS, BIO-ECOLOGY SITE GRAND PRAIRIE, TEXAS." PREPARED FOR TEXAS DEPARTMENT OF WATER RESOURCES AUSTIN, TEXAS. JULY 1983.

CONTACT NAME: DONALD WILLIAMS
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1445 ROSS AVENUE, 12TH FLOOR, SUITE 1200, DALLAS, TX 75202
PHONE: 214-655-6444

DOCUMENT NUMBER: 980-TS1-RT-EZZG INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: SUCH, C. AND C. LEROUX. ABSTRACT. "TREATMENT OF WASTES FROM OIL SPILLS." SCIENCE AND TECHNOLOGY LETTERS 1981. APRIL 1981.

CONTACT NAME: ANDRE DuPONT
ORGANIZATION: NATIONAL LIME ASSOCIATION
PHONE: 703-243-LIME

DOCUMENT NUMBER: 980-TS1-RT-FBTR INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: SEPARATION AND RECOVERY SYSTEMS, INC. "THE SRS/EIF OILY SLUDGE FIXATION PROCESS." CONSULTING ASSISTANCE BY MITTELHAUSER CORPORATION.

CONTACT NAME: JERRY CLARK
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23272 MILL CREEK ROAD, SUITE 300, LAGUNA HILLS, CA 92653
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DOCUMENT NUMBER: 980-TS1-RT-FCAA INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: UNIVERSITY OF CALIFORNIA, HUGO NEU-PROLER COMPANY, CALIFORNIA DEPARTMENT OF HEALTH SERVICES, AND LOPAT ENTERPRISES, INC. "FIELD EXPERIENCES WITH SILICATE-BASED SYSTEMS FOR THE TREATMENT OF HAZARDOUS WASTES."

CONTACT NAME: DAVID J. LEU, Ph.D. TITLE: CHIEF
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PHONE: 916-322-2822
COMMENTS: STATE OF CALIFORNIA, DEPT. OF HEALTH SERVIVES TOXIC SUBSTANCES CONTROL DIVISION ALTERNATIVE TECHNOLOGY SECTION

DOCUMENT NUMBER: 980-TS1-RT-FCAD INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA, ORD, HWERL. "AN ASSESSMENT OF MATERIALS THAT INTERFERE WITH STABILIZATION/SOLIDIFICATION PROCESSES." FEBRUARY 1987.

CONTACT NAME: ROBERT THURNAU
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7692

DOCUMENT NUMBER: 980-TS1-RT-FCAK-1 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: LOPAT ENTERPRISES, INC. "REPRESENTATIVE SELECTION OF LABORATORY EXPERIMENTS & REPORTS OF FULL-SCALE COMMERCIAL USE WHICH DEMONSTRATE EFFECTIVENESS OF K-20 LEAD-IN SOIL CONTROL SYSTEM IN PHYSICAL/CHEMICAL SOLIDIFICATION, FIXATION, ENCAPSULATION & STABILIZATION OF CERTAIN SOIL, ASH, DEBRIS AND SIMILAR WASTES." AUGUST 1987.

CONTACT NAME: LOU PARENT TITLE: PRESIDENT OF LOPAT ENTERPRISES
ORGANIZATION: LOPAT ENTERPRISES, INC.
PHONE: 201-922-6600

DOCUMENT NUMBER: 980-TS1-RT-FCAK-2 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: LOPAT ENTERPRISES, INC. "REPRESENTATIVE SELECTION OF LABORATORY EXPERIMENTS & REPORTS OF FULL-SCALE COMMERCIAL USE WHICH DEMONSTRATE EFFECTIVENESS OF K-20 LEAD-IN SOIL CONTROL SYSTEM IN PHYSICAL/CHEMICAL SOLIDIFICATION, FIXATION, ENCAPSULATION & STABILIZATION OF CERTAIN SOIL, ASH, DEBRIS AND SIMILAR WASTES." AUGUST 1987

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DOCUMENT NUMBER: 980-TS1-RT-FCAK-3 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: LOPAT ENTERPRISES, INC. "REPRESENTATIVE SELECTION OF LABORATORY EXPERIMENTS & REPORTS OF FULL-SCALE COMMERCIAL USE WHICH DEMONSTRATE EFFECTIVENESS OF K-20 LEAD-IN SOIL CONTROL SYSTEM ON PHYSICAL/CHEMICAL SOLIDIFICATION, FIXATION, ENCAPSULATION & STABILIZATION OF CERTAIN SOIL, ASH, DEBRIS AND SIMILAR WASTES." AUGUST 1987

CONTACT NAME: LOU PARENT TITLE: PRESIDENT OF LOPAT ENTERPRISES
ORGANIZATION: LOPAT ENTERPRISES, INC.
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DOCUMENT NUMBER: 980-TS1-RT-FCCC INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: IDAHO NAT'L ENGINEERING LAB. EG&G. EGG-WM-7225. INFORMAL REPORT. "HAZARDOUS AND MIXED WASTE SOLIDIFICATION DEVELOPMENT CONDUCTED AT THE IDAHO NATIONAL ENGINEERING LABORATORY." DOE CONTRACT DE-AC07-761D01570. APRIL 1986

CONTACT NAME: ANN M. BOEHMER TITLE: CHEMICAL ENGINEER
ORGANIZATION: INEL
EG&G IDAHO, INC., P.O. BOX 1625, IDAHO FALLS, ID 83415
PHONE: 208-526-9105

DOCUMENT NUMBER: 980-TS1-RT-FCFZ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: ENVIROSPHERE COMPANY. "DRAFT FEASIBILITY STUDY OF THE TACOMA HISTORICAL COAL GASIFICATION SITE." SUBMITTED TO WASHINGTON NATURAL GAS COMPANY, JOSEPH SIMON AND SON, INC., HYGRADE FOOD PRODUCTS CORP., AND BURLINGTON NORTHERN RAILROAD COMPANY. JULY 1987.

CONTACT NAME: WAYNE GROTHEER
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1200 SIXTH AVENUE, SEATTLE, WA 98101
PHONE: 206-442-2723
COMMENTS: TACOMA TAR PITS SITE

DOCUMENT NUMBER: 980-TS1-RT-FCST INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: WOODWARD-CLYDE CONSULTANTS. "REMEDIAL TECHNOLOGIES, BIO-ECOLOGY SITE." REPORT RECEIVED JULY 1987.

CONTACT NAME: DONALD WILLIAMS
ORGANIZATION: U.S. EPA - REGION VI
1445 ROSS AVENUE, 12TH FLOOR, SUITE 1200, DALLAS, TX 75202
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DOCUMENT NUMBER: 980-TS1-RT-FCTA INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: MCLAUGHLIN ENTERPRISES INC. REPORT. "SUMMARY OF THE TEST RESULTS OF THE TREATED FLUFF FROM ORANGE COUNTY STEEL SALVAGE." JUNE 1987.

CONTACT NAME: RONALD E. LEWIS TITLE: ASSOCIATE WASTE MANAGEMENT ENGINEER
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PHONE: 916-322-3670
COMMENTS: STATE OF CALIFORNIA, DEPT. OF HEALTH SERVICES TOXIC SUBSTANCES CONTROL DIVISION ALTERNATIVE TECHNOLOGY SECTION

DOCUMENT NUMBER: 980-TS1-RT-FCTR INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: ACUREX CORPORATION. "DRAFT FINAL REPORT. VOLATILE EMISSIONS FROM STABLIZED WASTE IN HAZARDOUS WASTE LANDFILLS." PREPARED FOR U.S. EPA. AIR AND ENERGY ENGINEERING RESEARCH LABORATORY. RTP. PROJECT 8186. JANUARY 1987.

CONTACT NAME: PAUL F. de PERCIN
ORGANIZATION: U.S. EPA, ORD
HWERL-CONTAINMENT BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7787

DOCUMENT NUMBER: 980-TS1-RT-FCUE INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ROSENCRANCE, ALAN B. AND RAMCHANDRA K. KULKARNI, PH.D. "FIXATION OF TOBYHANNA ARMY DEPOT ELECTROPLATING WASTE SAMPLES BY ASPHALT ENCAPSULATION PROCESS." PREPARED FOR U.S. ARMY MEDICAL BIOENGINEERING RESEARCH & DEVELOPMENT LABORATORY, FORT DETRICK, FREDERICK, MD. JANUARY 1979.

CONTACT NAME: DAVID ENEGESS TITLE: ENGINEER
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ONE KALISA WAY, PARAMUS, NJ 07652
PHONE: 201-599-2900
COMMENTS: NOW WORKING FOR JOHNSON ASSOCIATES, INC. 181 CHERRY VALLEY ROAD PRINCETON, NJ 08540 609-924-3420

DOCUMENT NUMBER: 980-TS1-RT-FCUT INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: PEI ASSOCIATES, INC. "TABLE 3. ANALYTICAL RESULTS FOR SITE NOS. 1 AND 1a." AUGUST 1987.

CONTACT NAME: EDWIN BARTH
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7931

DOCUMENT NUMBER: 980-TS1-RT-FCUV INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: CALIFORNIA STATE DEPARTMENT OF HEALTH SERVICES (DHS). "CCBA PROJECT PHASE III. FIRST PROGRESS REPORT." TOXIC SUBSTANCES CONTROL DIVISION. DHS AGREEMENT NO. 85-82150. SEPTEMBER 1986.

CONTACT NAME: ROBERT LUDWIG
ORGANIZATION: STATE OF CALIF - DEPT OF HEALTH SERVICES
TOXIC SUBSTANCES CONTROL DIVISION, 714-744 P STREET, SACRAMENTO, CA 95814
PHONE: 916-324-1807

DOCUMENT NUMBER: 980-TS1-RT-FDAY INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: TREATMENT DATA FOR THE SAND SPRINGS, OKLAHOMA PILOT STUDY. "SUMMARY AND COMPARISON OF ANALYTICAL DATA (TOTAL)--SRS TREATMENT DEMONSTRATION." RECEIVED FROM EDWIN BARTH (HWERL), AUGUST 1987.

CONTACT NAME: EDWIN BARTH
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7931

DOCUMENT NUMBER: 980-TS1-RT-FDBB INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: EG&G IDAHO, INC. ENGINEERING DESIGN FILE. "RADIOACTIVE WASTE MANAGEMENT COMPLEX. SOIL GROUT FACILITY PROGRAMMATICAL CONCERNS." DECEMBER 1986.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - HEADQUARTERS
401 M STREET, S.W., WASHINGTON, D.C. 20460

DOCUMENT NUMBER: 980-TS1-RT-FDBC INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: EG&G IDAHO, INC. "RADIOACTIVE WASTE MANAGEMENT COMPLEX (RWMC). SMALL SCALE SOIL GROUT TEST REPORT." SEPTEMBER 1986.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - HEADQUARTERS
401 M STREET, S.W., WASHINGTON, D.C. 20460

DOCUMENT NUMBER: 980-TS1-RT-FDBG INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: EG&G IDAHO, INC. ENGINEERING DESIGN FILE. "RWMC. CONTAMINATED SOIL GROUT BENEFIT-COST STUDY." SEPTEMBER 1985.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - HEADQUARTERS
401 M STREET, S.W., WASHINGTON, D.C. 20460

DOCUMENT NUMBER: 980-TS1-RT-FDEE INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: EG&G IDAHO, INC. "RADIOACTIVE WASTE MANAGEMENT COMPLEX (RWMC). SOIL GROUT SMALL SCALE TESTING PROGRAM." JANUARY 1986.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - HEADQUARTERS
401 M STREET, S.W., WASHINGTON, D.C. 20460

DOCUMENT NUMBER: 980-TS1-RT-FREW INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: 3M, INDUSTRIAL CHEMICAL PRODUCTS DIVISION. PRODUCT DATA ON 3M BRAND FOAM CONCENTRATE FX-9162. 12 SEPARATE DOCUMENTS. MAY 1987.

CONTACT NAME: KEITH BROBST
ORGANIZATION: 3M
INDUSTRIAL CHEMICAL PRODUCTS DIVISION, 3M CENTER, ST. PAUL, MINN 55144-1000
PHONE: 612-733-1110

DOCUMENT NUMBER: 980-TS1-RT-FREX INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: RADIAN CORP. "3M TEMPORARY FOAM FX9162 AND STABILIZED FOAM FX9161/9162 EVALUATION FOR VAPOR MITIGAION AT 29 PALMS, CALIFORNIA." PREPARED FOR 3M. JUNE 1987.

CONTACT NAME: KEITH BROBST
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PHONE: 612-733-1110

DOCUMENT NUMBER: 980-TS1-RT-EZUX-3 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ARCO PETROLEUM PRODUCTS COMPANY. "INTERIM REPORT - ACID SLUDGE TREATABILITY EVALUATION - SAND SPRINGS PETROCHEMICAL COMPLEX." JULY 1987.

CONTACT NAME: PAUL SIEMINSKI
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1445 ROSS AVENUE, 12TH FLOOR, SUITE 1200, DALLAS, TX 75202
PHONE: 214-655-6444

DOCUMENT NUMBER: 980-TS1-RT-FCRX INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: SOLIDITECH, INC. "GMS ANALYSIS OF ORIGINAL WASTE SAMPLE - K051 (RMA SAMPLE NO. 63009-02)." AUGUST 1987.

CONTACT NAME: EDWIN BARTH
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7931

DOCUMENT NUMBER: 980-TS1-RT-EUQU INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: JACA CORPORATION."CRITICAL CHARACTERISTICS AND PROPERTIES OF HAZARDOUS WASTE SOLIDIFICATION/STABILIZATION." PREPARED FOR U.S. EPA, ORD, WATER ENGINEERING RESEARCH LABORATORY, CINCINNATI, OHIO.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-EUWW-2 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ATLANTIC RESEARCH CORPORATION. "ENGINEERING AND DEVELOPMENT SUPPORT OF GENERAL DECON TECHNOLOGY FOR THE DORCOM INSTALLATION RESTORATION PROGRAM. TASK 4. GENERAL TECHNOLOGY LITERATURE SEARCHES (II) SOLIDIFICATION TECHNIQUES FOR LAGOON WATER." PREPARED FOR USATHAMA. DECEMBER 1980

CONTACT NAME: WAYNE SISK
ORGANIZATION: U.S. DOD/USATHAMA
PHONE: 301-671-2054

DOCUMENT NUMBER: 980-TS1-RT-EUXS INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: FLORIDA POWER & LIGHT COMPANY. "FIXATION/STABILIZATION FINAL REPORT PEPPER'S STEEL & ALLOYS SITE; MEDLEY, FLORIDA." NOVEMBER 1985.

CONTACT NAME: JOHN KROSKE
ORGANIZATION: U.S. EPA - REGION IV
345 COURTLAND STREET, NE, ATLANTA, GA 30365
PHONE: 404-347-4727

DOCUMENT NUMBER: 980-TS1-RT-EUXT INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: FIRESTONE RESOURCES, INC. (3 DOCUMENTS). "SOIL STABILIZATION PILOT STUDY, UNITED CHROME NPL SITE, CORVALLIS, OREGON." AND "QUALITY ASSURANCE/QUALITY CONTROL PLAN UNITED CHROME NPL SITE PILOT STUDY" AND "HEALTH AND SAFETY PROGRAM UNITED CHROME NPL SITE PILOT STUDY." PREPARED FOR U.S. EPA - REGION 10 AND DEQ - OREGON. FEBRUARY 1987.

CONTACT NAME: JOHN BARICH
ORGANIZATION: U.S. EPA - REGION X
HAZARDOUS WASTE DIVISION, 1200 SIXTH AVENUE, SEATTLE, WA 98101
PHONE: 206-442-8562

DOCUMENT NUMBER: 980-TS1-RT-EWFL INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: SCIENCE APPLICATIONS INTERNATIONAL CORPORATION & CALIFORNIA DEPARTMENT OF HEALTH SERVICES ALTERNATIVE TECHNOLOGY AND POLICY DEVELOPMENT SECTION. "PRELIMINARY DRAFT REPORT: STRINGFELLOW FACILITY REMEDIAL INVESTIGATION/FEASIBILITY STUDY- TASK XIII: TREATABILITY STUDIES TREATMENT BY ENCAPSULATION/FIXATION TECHNIQUES." PREPARED FOR CALIFORNIA DEPARTMENT OF HEALTH SERVICES -TOXIC SUBSTANCES CONTROL DIVISION. JUNE 1987.

CONTACT NAME: MICHAEL HIGGINS
ORGANIZATION: STATE OF CALIF - DEPT OF HEALTH SERVICES
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PHONE: 916-324-1807

DOCUMENT NUMBER: 980-TS1-RT-EWUZ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: OAK RIDGE NATIONAL LABORATORY, CHEMICAL TECHNOLOGY DIVISION. "TESTING PROTOCOLS FOR EVALUATING MONOLITHIC WASTE FORMS CONTAINING MIXED WASTE." ADVANCES IN CERAMICS. VOL. 20: NUCLEAR WASTE MANAGEMENT II. 1986.

CONTACT NAME: LESLIE DOLE TITLE: PROGRAM MANAGER
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PHONE: 615-576-7421
COMMENTS: INFO ON THE PEPPER STEEL SITE AND OTHERS

DOCUMENT NUMBER: 980-TS1-RT-EWVG INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: WASTE IMMOBILIZATION TECHNOLOGIES, OAK RIDGE NATIONAL LABORATORY. "LEACH TESTING OF HYDROFRACTURE GROUTS CONTAINING HAZARDOUS WASTE." PUBLISHED IN "UNDERGROUND INJECTION PRACTICES COUNCIL." VOL.1. 1986.

CONTACT NAME: PAUL McGOUGH
ORGANIZATION: RESOURCES CONSERVATION CO.
PHONE: 206-828-2455
COMMENTS: CONTACT PERSON FOR INFO ON THE "BOX" OF B.E.S.T. DATA

DOCUMENT NUMBER: 980-TS1-RT-EWVJ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CHEMICAL TECHNOLOGY DIVISION, ORNL. "SYSTEMATIC APPROACH FOR THE DESIGN OF PUMPABLE CEMENT-BASED GROUTS FOR IMMOBILIZATION OF HAZARDOUS WASTES." PRESENTED AT ASTM 4th INTERNATIONAL HAZARDOUS WASTE SYMPOSIUM. MAY 1987.

CONTACT NAME: LESLIE DOLE TITLE: PROGRAM MANAGER
ORGANIZATION: WMTC, DOE, ORNL
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COMMENTS: INFO ON THE PEPPER STEEL SITE AND OTHERS

DOCUMENT NUMBER: 980-TS1-RT-EWVT INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: MATERIALS AND CHEMISTRY TECHNOLOGY DEPARTMENT, PROCESS SUPPORT DIVISION, MARTIN MARIETTA ENERGY SYSTEMS, INC. "CEMENT FIXATION STUDIES AT OAK RIDGE GASEOUS DIFFUSION PLANT." PREPARED FOR U.S. EPA. FEBRUARY 1986.

CONTACT NAME: LESLIE DOLE TITLE: PROGRAM MANAGER
ORGANIZATION: WMTC, DOE, ORNL
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PHONE: 615-576-7421
COMMENTS: INFO ON THE PEPPER STEEL SITE AND OTHERS

DOCUMENT NUMBER: 980-TS1-RT-EWVV INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: OAK RIDGE NATIONAL LABORATORY. "DEVELOPMENT OF QUALITY ASSURANCE AND PERFORMANCE TESTING FOR THE PROCESS EXPERIMENTAL PILOT PLANT." PREPARED FOR U.S. DOE. AUGUST 1984.

CONTACT NAME: LESLIE DOLE TITLE: PROGRAM MANAGER
ORGANIZATION: WMTC, DOE, ORNL
P.O. BOX P, BUILDING K 1000 MS-183, OAK RIDGE, TN 37831
PHONE: 615-576-7421
COMMENTS: INFO ON THE PEPPER STEEL SITE AND OTHERS

DOCUMENT NUMBER: 980-TS1-RT-EWVY INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: OAK RIDGE NATIONAL LABORATORY. "GROUT FORMULATION STUDIES WITH HANFORD FACILITIES WASTE: AN EXECUTIVE SUMMARY." PREPARED FOR U.S. DOE.

CONTACT NAME: LESLIE DOLE TITLE: PROGRAM MANAGER
ORGANIZATION: WMTC, DOE, ORNL
P.O. BOX P, BUILDING K 1000 MS-183, OAK RIDGE, TN 37831
PHONE: 615-576-7421
COMMENTS: INFO ON THE PEPPER STEEL SITE AND OTHERS

DOCUMENT NUMBER: 980-TS1-RT-EWVZ INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: WASTE IMMOBILIZATION TECHNOLOGIES, ENGINEERING DEVELOPMENT SECTION, CHEMICAL TECHNOLOGY DIVISION, ORNL. "WASTE IMMOBILIZATION IN CEMENT-BASED GROUTS." PRESENTED AT INTERNATIONAL SYMPOSIUM ON INDUSTRIAL AND HAZARDOUS WASTE. JUNE 1985.

CONTACT NAME: LESLIE DOLE TITLE: PROGRAM MANAGER
ORGANIZATION: WMTC, DOE, ORNL
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COMMENTS: INFO ON THE PEPPER STEEL SITE AND OTHERS

DOCUMENT NUMBER: 980-TS1-RT-EWWE INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. DOE, ORNL. "LEACHABILITY STUDIES OF HYDROFRACTURE GROUTS." NOVEMBER 1986.

CONTACT NAME: LESLIE DOLE TITLE: PROGRAM MANAGER
ORGANIZATION: WMTC, DOE, ORNL
P.O. BOX P, BUILDING K 1000 MS-183, OAK RIDGE, TN 37831
PHONE: 615-576-7421
COMMENTS: INFO ON THE PEPPER STEEL SITE AND OTHERS

DOCUMENT NUMBER: 980-TS1-RT-EXNY INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: ENVIRONMENT CANADA. "LONG-TERM LEACHING SCENARIOS FOR CEMENT-BASED WASTE FORMS." WASTE MANAGEMENT & RESEARCH (1987)

CONTACT NAME: PIERRE COTE
ORGANIZATION: ENVIRONMENT CANADA
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DOCUMENT NUMBER: 980-TS1-RT-EZUZ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: "WASTE HANDLING SECTION OF BIOECOLOGY CONTRACT FOR CYANIDE TREATMENT AND FIXATION OF METALS."

CONTACT NAME: DONALD WILLIAMS
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1445 ROSS AVENUE, 12TH FLOOR, SUITE 1200, DALLAS, TX 75202
PHONE: 214-655-6444

DOCUMENT NUMBER: 980-TS1-RT-EZYT INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. DOE. "STABILIZATION OF MIXED WASTE AT THE INEL." IDAHO NATIONAL ENGINEERING LABORATORY, EG & G IDAHO, INC. IDAHO FALLS, IDAHO.

CONTACT NAME: ANN M. BOEHMER TITLE: CHEMICAL ENGINEER
ORGANIZATION: INEL
EG&G IDAHO, INC., P.O. BOX 1625, IDAHO FALLS, ID 83415
PHONE: 208-526-9105

DOCUMENT NUMBER: 980-TS1-RT-FCAS INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: PACIFIC NORTHWEST LABORATORY OPERATED BY BATTELLE MEMORIAL INSTITUTE. "PILOT-SCALE GROUT PRODUCTION TEST WITH A SIMULATED LOW-LEVEL WASTE." PREPARED FOR U.S. DOE. MAY 1987.

CONTACT NAME: R. L. TREAT TITLE: PROGRAM MANAGER
ORGANIZATION: CHEMICAL PROCESS ENGINEERING SECTION
BATTELLE-PACIFIC NORTHWEST LABORATORIES, BATTELLE BOULEVARD, RICHLAND,WASHINGTON 99352
PHONE: 509-376-0330
COMMENTS: IN SITE VITRIFICATION

DOCUMENT NUMBER: 980-TS1-RT-FCBX INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: KOBRAN, M.J. AND W.J. GUARINI. 10CFR61 WASTE FORM CONFORMANCE PROGRAM FOR ASPHALTED RADWASTE." ENGINEERING AND PLANT BETTERMENT, AND WASTECHEM CORPORATION.

CONTACT NAME: DAVID ENEGESS TITLE: ENGINEER
ORGANIZATION: WASTECHEM CORPORATION
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PHONE: 201-599-2900
COMMENTS: NOW WORKING FOR JOHNSON ASSOCIATES, INC. 181 CHERRY VALLEY ROAD PRINCETON, NJ 08540 609-924-3420

DOCUMENT NUMBER: 980-TS1-RT-FCSB INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: BOSTOCK HILL & RIGBY. LONDON. "ASBESTOS." ARTICLE FOR "BUILDING TECHNOLOGY." BUILDING 7. NOVEMBER 1986.

CONTACT NAME: DONALD SANNING
ORGANIZATION: U.S. EPA, ORD
HWERL-CONTAINMENT BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
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DOCUMENT NUMBER: 980-TS1-RT-FCSX INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: "DATA BASE FOR SILICATE-BASED TREATMENT SYSTEM."

CONTACT NAME: RONALD LEWIS
ORGANIZATION: U.S. EPA, ORD
HWERL-CHEM. AND BIOL. DETOX. BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7856

DOCUMENT NUMBER: 980-TS1-RT-FCUG INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: MCLAUGHLIN ENTERPRISES INC. "ACME GALVANIZING COMPOSITE SOIL SAMPLES." MAY 1987.

CONTACT NAME: FREDERICK A. TORNATORE TITLE: ASSOCIATE HAZARDOUS MATERIALS SPECIALIST
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TOXIC SUBSTANCES CONTROL DIVISION, 714-744 P STREET, SACRAMENTO, CA 95814
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DOCUMENT NUMBER: 980-TS1-RT-FCUX INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: CAMP, DRESSER & MCKEE. (6 DOCUMENTS). "NYANZA SOLIDIFICATION TREATABILITY STUDY." JUNE 1987.

CONTACT NAME: MARY SANDERSON
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PHONE: 617-656-3715

DOCUMENT NUMBER: 980-TS1-RT-FDBL INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: WADSWORTH/ALERT LABORATORIES, INC. "ANALYTICAL REPORT. PROJECT NO. 2321-87-0701. MOWBRAY ENGINEERING." PRESENTED TO DOUG DRIVER. HAZTECH. JULY 1987.

CONTACT NAME: NED JESSUP
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DOCUMENT NUMBER: 980-TS1-RT-FREP INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: OAK RIDGE NATIONAL LABORATORY. T. TAMURA, R.D. SPENCE, O.K. TALLENT, O.M. SEALAND. "IN SITU GROUTING OF AN ORNL TRENCH USING A PARTICULATE-TYPE GROUT." PREPARED FOR U.S. DOE. AUGUST 1987.

CONTACT NAME: MIKE GILLIAM
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PHONE: FTS 574-6820

DOCUMENT NUMBER: 980-TS1-RT-FREQ INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: OAK RIDGE NATIONAL LABORATORY- ENVIRONMENTAL SCIENCES DIVISION. T. TAMURA & W.J. BOEGLY, JR. "IN SITU GROUTING OF URANIUM MILL TAILINGS PILES: AN ASSESSMENT." PREPARED FOR U.S. DOE. MAY 1983.

CONTACT NAME: MIKE GILLIAM
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DOCUMENT NUMBER: 980-TS1-RT-EZTZ INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: FLORIDA POWER AND LIGHT COMPANY. "FIXATION/STABILIZATION FINAL REPORT - PEPPER'S STEEL & ALLOYS SITE, MEDLEY, FLORIDA." VOLUMES I & II. NOVEMBER, 1985.

CONTACT NAME: JOHN KROSKE
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PHONE: 404-347-4727

DOCUMENT NUMBER: 980-TS1-RT-EZUF INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS. "INNOVATIVE SOLIDIFICATION TECHNIQUES FOR HAZARDOUS WASTES AT ARMY INSTALLATIONS." PREPARED FOR THE DEPARTMENT OF THE ARMY. NOVEMBER 1985.

CONTACT NAME: TOMMY MYERS
ORGANIZATION: U.S. DOD/USATHAMA

DOCUMENT NUMBER: 980-TS1-RT-FAAP INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: VERITEC CORPORATION. "CASE STUDY HAZARDOUS WASTE MANAGEMENT UTILIZING LIME." PRESENTED AT THE ANNUAL MEETING OF THE NATIONAL LIME ASSOCIATION. PHOENIX, ARIZONA. APRIL 1987.

CONTACT NAME: ANDRE DuPONT
ORGANIZATION: NATIONAL LIME ASSOCIATION
PHONE: 703-243-LIME

DOCUMENT NUMBER: 980-TS1-RT-FCUJ INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: CALIFORNIA ANALYTICAL LAB. "LAB RESULTS ON LASSEN COLLEGE TREATABILITY TESTS." MARCH 1987.

CONTACT NAME: FREDERICK A. TORNATORE TITLE: ASSOCIATE HAZARDOUS MATERIALS SPECIALIST
ORGANIZATION: STATE OF CALIF - DEPT OF HEALTH SERVICES
TOXIC SUBSTANCES CONTROL DIVISION, 714-744 P STREET, SACRAMENTO, CA 95814
PHONE: 916-324-1807
COMMENTS: STATE OF CALIFORNIA - DEPT. OF HEALTH SERVICES TOXIC SUBSTANCES CONTROL DIVISION ALTERNATIVE TECHNOLOGY & POLICY DEVEL. SECTION

DOCUMENT NUMBER: 980-TS1-RT-EUWW-3 INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ATLANTIC RESEARCH CORPORATION. "ENGINEERING AND DEVELOPMENT SUPPORT OF GENERAL DECON TECHNOLOGY FOR THE DARCOM INSTALLATION RESTORATION PROGRAM. TASK 2. GENERAL TECHNOLOGY LITERATURE SEARCHES (II) SOLIDIFICATION TECHNIQUES FOR LAGOON WATER." PREPARED FOR USATHAMA. DECEMBER 1980

CONTACT NAME: WAYNE SISK
ORGANIZATION: U.S. DOD/USATHAMA
PHONE: 301-671-2054

DOCUMENT NUMBER: 980-TS1-RT-EWFX INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: EARTH METRICS INCORPORATED. "EXCESS SOIL TREATMENT PILOT STUDY AND SOILS ABATEMENT ACTION ALTERNATIVES FOR THE BAY CENTER CONSTRUCTION SITE IN EMERYVILLE, CALIFORNIA." PREPARED FOR ALAMEDA COUNTY HAZARDOUS MATERIALS UNIT. FEBRUARY 1987.

CONTACT NAME: RONALD E. LEWIS TITLE: ASSOCIATE WASTE MANAGEMENT ENGINEER
ORGANIZATION: STATE OF CALIF - DEPT OF HEALTH SERVICES
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PHONE: 916-322-3670
COMMENTS: STATE OF CALIFORNIA, DEPT. OF HEALTH SERVICES TOXIC SUBSTANCES CONTROL DIVISION ALTERNATIVE TECHNOLOGY SECTION

DOCUMENT NUMBER: 980-TS1-RT-EWVC INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CHEMICAL TECHNOLOGY DIVISION, WASTECHEM CORPORATION. "LEACHING AND COMPREHENSIVE REGULATORY PERFORMANCE TESTING OF EXTRUDED BITUMEN CONTAINING A SURROGATE, SODIUM NITRATE-BASED, LOW-LEVEL WASTE." PRESENTED AT ASTM 4th INTERNATIONAL HAZARDOUS WASTE SYMPOSIUM. MAY 1987. (PRESENTATION OF RELATED DOCUMENT 980-TS1-RT-EWVE).

CONTACT NAME: LESLIE DOLE TITLE: PROGRAM MANAGER
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PHONE: 615-576-7421
COMMENTS: INFO ON THE PEPPER STEEL SITE AND OTHERS

DOCUMENT NUMBER: 980-TS1-RT-EURA INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: SPALDING, B.P. AND L. HYDER AND I. MUNRO."GROUTING AS A REMEDIAL TECHNIQUE FOR BURIED LOW-LEVEL RADIOACTIVE WASTE." JOURNAL OF ENVIRONMENTAL QUALITY. VOL. 14. NO. 3. JULY-SEPTEMBER 1985.

CONTACT NAME: BRIAN SPALDING
ORGANIZATION: U.S. DOE/WMTC
U.S. DEPT. OF ENERGY, ORNL, OAK RIDGE, TN 37831
PHONE: FTS 574-7265
COMMENTS: INFO ON INSITU VITRIFICATION, CHEMICAL GROUTS

DOCUMENT NUMBER: 980-TS1-RT-EWGB INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: U.S. EPA. PROJECT SUMMARY. "SYSTEMS TO ACCELERATE IN SITU STABILIZATION OF WASTE DEPOSITS." EPA ORD HWERL, CINCINNATI, OH. EPA/540/S2-86/002. MARCH 1987.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-EWVH INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: CHEMICAL TECHNOLOGY DIVISION & ENVIRONMENTAL SCIENCE DIVISION, OAK RIDGE NATIONAL LABORATORY. "IN SITU GROUTING OF SHALLOW LANDFILL RADIOACTIVE WASTE TRENCHES." PRESENTED AT ASTM 4th INTERNATIONAL HAZARDOUS WASTE SYMPOSIUM. MAY 1987.

CONTACT NAME: LESLIE DOLE TITLE: PROGRAM MANAGER
ORGANIZATION: WMTC, DOE, ORNL
P.O. BOX P, BUILDING K 1000 MS-183, OAK RIDGE, TN 37831
PHONE: 615-576-7421
COMMENTS: INFO ON THE PEPPER STEEL SITE AND OTHERS

DOCUMENT NUMBER: 980-TS1-RT-EWWA INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: CHEMICAL TECHNOLOGY DIVISION, ORNL. "WELDON SPRING, MISSOURI, RAFFINATE PITS 1, 2, 3, & 4: PRELIMINARY GROUT DEVELOPMENT SCREENING STUDIES FOR IN SITU WASTE IMMOBILIZATION." PREPARED FOR U.S. DOE, APRIL 1987.

CONTACT NAME: LESLIE DOLE TITLE: PROGRAM MANAGER
ORGANIZATION: WMTC, DOE, ORNL
P.O. BOX P, BUILDING K 1000 MS-183, OAK RIDGE, TN 37831
PHONE: 615-576-7421
COMMENTS: INFO ON THE PEPPER STEEL SITE AND OTHERS

DOCUMENT NUMBER: 980-TS1-RT-EZTY INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: SANWA KIZAI CO., LTD. "INSTANTANEOUS SOIL CONSOLIDATION - JST METHOD."

CONTACT NAME: ELIO ARNIELLA
ORGANIZATION: CDM - ATLANTA, GA
2100 RIVER EDGE PARKWAY, ATLANTA, GA 30328
PHONE: 404-952-8643

DOCUMENT NUMBER: 980-TS1-RT-EZUL INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: CHEMICAL WASTE MANAGEMENT, INC. "FIXATION/SOLIDIFICATION OF HAZARDOUS WASTE AT CHEMICAL WASTE MANAGEMENT'S VICKERY, OHIO FACILITY."

CONTACT NAME: ANDRE DuPONT
ORGANIZATION: NATIONAL LIME ASSOCIATION
PHONE: 703-243-LIME

DOCUMENT NUMBER: 980-TS1-RT-EZYU INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: EG & G, INC. "RWMC - SOIL GROUT PROGRAM." (SLIDE PRESENTATION). RECEIVED AUGUST 1987.

CONTACT NAME: ROBERT M. BROWN TITLE: WASTE MANAGEMENT SPECIALIST
ORGANIZATION: INEL
EG&G IDAHO, INC., P.O. BOX 1625, IDAHO FALLS, ID 83415
PHONE: 208-526-2747

DOCUMENT NUMBER: 980-TS1-RT-FCAP INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: ROCKWELL INTERNATIONAL. "DEVELOPMENT OF EQUIPMENT FOR STABILIZATION AND ISOLATION OF LOW-LEVEL LIQUID WASTE DISPOSAL CRIBS: A DESCRIPTIVE SUMMARY." PREPARED FOR U.S. DOE. DECEMBER 1986.

CONTACT NAME: STEVEN J. PHILLIPS
ORGANIZATION: DOE/ROCKWELL INTERNATIONAL
ROCKWELL HANFORD OPERATIONS, P.O. BOX 800, RICHLAND, WASHINGTON 99352
PHONE: 509-373-3468

DOCUMENT NUMBER: 980-TS1-RT-FCAQ INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: ROCKWELL INTERNATIONAL. "STABILIZATION AND ISOLATION OF LOW-LEVEL WASTE DISPOSAL SITES." PREPARED FOR U.S. DOE. APRIL 1987.

CONTACT NAME: STEVEN J. PHILLIPS
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DOCUMENT NUMBER: 980-TS1-RT-FCCG INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: U.S. EPA. (SUPERFUND) "SYSTEMS TO ACCELERATE IN SITU STABILIZATION OF WASTE DEPOSITS." ORD HWERL, CINCINNATI, OH. EPA/540/2-86/002. SEPTEMBER 1986.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-FCGE INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: McDANIEL, E.W. ORNL-CHEMICAL TECHNOLOGY DIVISION. "GROUTING AS A WASTE IMMOBILIZATION/DISPOSAL METHOD." "WASTE MANAGEMENT FOR THE ENERGY INDUSTRIES CONFERENCE." GRAND RAPIDS, NORTH DAKOTA. APRIL 1987.

CONTACT NAME: EARL W. McDANIEL
ORGANIZATION: U.S. DOE/WMTC
U.S. DEPT. OF ENERGY, ORNL, OAK RIDGE, TN 37831
PHONE: FTS 574-0439
COMMENTS: INFO ON GROUT FORMULATION DATA

DOCUMENT NUMBER: 980-TS1-RT-FCGJ INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: OAK RIDGE NATIONAL LABORATORY. "DEVELOPMENT OF CEMENTITIOUS GROUTS FOR THE INCORPORATION OF RADIOACTIVE WASTES. PART 1: LEACH STUDIES." PREPARED FOR U.S. DOE. ORNL-4962. APRIL 1975.

CONTACT NAME: RICHARD GENUNG
ORGANIZATION: DOE - ORNL
WASTE MANAGEMENT TECHNOLOGY CENTER, P.O. BOX P, OAK RIDGE, TN 37831
PHONE: 615-574-6830

DOCUMENT NUMBER: 980-TS1-RT-FCUN INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: TECHNOLOGY/ECONOMICS. "NEW TECHNOLOGY AVAILABLE FOR IN SITU SOIL TREATMENT." THE HAZARDOUS WASTE CONSULTANT. JANUARY/FEBRUARY 1987.

CONTACT NAME: GREGORY LACY TITLE: CHEMIST
ORGANIZATION: CDM FEDERAL PROGRAMS CORP.
PHONE: 703-968-0900
COMMENTS: BDAT TEAM MEMBER

DOCUMENT NUMBER: 980-TS1-RT-FDBM INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: OAK RIDGE NATIONAL LABORATORY. "DEVELOPMENT OF CEMENTITIOUS GROUTS FOR THE INCORPORATION OF RADIOACTIVE WASTES. PART 2: CONTINUATION OF CESIUM AND STRONTIUM LEACH STUDIES." ORNL-5142. (PART 2 OF ORNL-4962). SEPTEMBER 1976.

CONTACT NAME: RICHARD GENUNG
ORGANIZATION: DOE - ORNL
WASTE MANAGEMENT TECHNOLOGY CENTER, P.O. BOX P, OAK RIDGE, TN 37831
PHONE: 615-574-6830

DOCUMENT NUMBER: 980-TS1-RT-EUXL INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: STEVENS, DR. R.D. SAMUEL. (SOLARCHEM). "SOLVOLOX-AN EFFECTIVE, LOW COST, ON-SITE SOIL/SEDIMENT DECONTAMINATION PROCESS." PRESENTED AT THE HAZMAT CANADA '87 CONFERENCE. TORONTO, ONTARIO. SEPTEMBER 1987.

CONTACT NAME: SAMUEL STEVENS
ORGANIZATION: SOLAR CHEM
516 GORDON BAKER RD., WILLOWDALE, ONTARIO, CANADA. M2H 3B4
PHONE: 416-495-9905

DOCUMENT NUMBER: 980-TS1-RT-EUYR INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: HUIBREGTSE, K.R., J.P. LAFORNARA, AND K.H. KASTMAN, "IN PLACE DETOXIFICATION OF HAZARDOUS MATERIALS SPILLS IN SOIL." HAZARDOUS MATERIAL SPILLS CONFERENCE. NASHVILLE, TN. APRIL 1984.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-EUYZ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. "LABORATORY AND FIELD TESTS OF CHEMICAL REAGENTS FOR IN-SITU DETOXIFICATION OF CHLORINATED DIOXINS IN SOILS." (REPRINT EXTENDED ABSTRACT). PRESENTED BEFORE THE DIVISION OF ENVIRONMENTAL CHEMISTRY, AMERICAN CHEMICAL SOCIETY. CHICAGO, IL. SEPTEMBER 1985.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-EUZK INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. "ATTACHMENT A TREATABILITY STUDY SCOPE OF SERVICES UNITED SCRAP LEAD." REGION V.

CONTACT NAME: ALLEN WOJTAS
ORGANIZATION: U.S. EPA - REGION V
230 SOUTH DEARBORN STREET, CHICAGO, IL 60601
PHONE: 312-886-6941

DOCUMENT NUMBER: 980-TS1-RT-EVAC INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: UNIVERSITY OF WASHINGTON. "TECHNICAL WORK PLAN FOR FIELD TESTING AND QUARTERLY PROGRESS REPORT: TREATMENT OF WASTE-CONTAMINATED GROUND BY ELECTRO-KINETICS -- A FIELD EVALUATION." PREPARED FOR U.S. EPA.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-EWHE INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: "ON-SCENE COORDINATOR REPORT, IMMEDIATE REMOVAL ACTION PESTICIDE CONTAMINATION, GILA RIVER INDIAN COMMUNITY." JULY 1984 TO OCTOBER 1985.

CONTACT NAME: RICHARD MARTYN
ORGANIZATION: U.S. EPA - REGION IX
215 FREMONT STREET, SAN FRANCISCO, CA 94105
PHONE: 415-974-8071

DOCUMENT NUMBER: 980-TS1-RT-FCLP INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: CALIFORNIA DEPARTMENT OF HEALTH SERVICES. "FACT SHEET: SAN PEDRO TERMINAL ANNEX SITE, PORT OF LOS ANGELES, CALIFORNIA. SUMMARY OF REMEDIAL ACTION PLAN AND ANNOUNCEMENT OF PUBLIC COMMENT PERIOD FOR DRAFT REMEDIAL ACTION PLAN." MARCH/APRIL 1987.

CONTACT NAME: CAROLYN MEJIA
ORGANIZATION: STATE OF CALIF - DEPT OF HEALTH SERVICES
TOXIC SUBSTANCES CONTOL DIVISION, 107 SOUTH BROADWAY, ROOM 7011, LOS ANGELES, CA 90012
PHONE: 213-620-2380

DOCUMENT NUMBER: 982-TS3-RT-GKXP INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: SAIC, "DRAFT REPORT, STRINGFELLOW FACILITY, REMEDIAL INVESTIGATION/FEASIBILITY STUDY. TASK XIII: A TREATABILITY STUDY, REVERSE OSMOSIS TREATMENT OF CONTAMINATED GROUNDWATER." JULY 1987.

CONTACT NAME: CAROLINE ROE
ORGANIZATION: U.S. EPA - HEADQUARTERS
HAZARDOUS SITE CONTROL DIVISION, WH548E, 401 M STREET, S.W., WASHINGTON, D.C. 20460
PHONE: 201-475-9754

DOCUMENT NUMBER: 980-TS1-RT-EUQR INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: ROY F. WESTON, INC. FINAL REPORT. "IN SITU AIR STRIPPING OF SOILS PILOT STUDY." PREPARED FOR USATHMA. OCTOBER 1985.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. DOD/USATHAMA
PHONE: 301-278-5201

DOCUMENT NUMBER: 980-TS1-RT-EYTK INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: BVER ENVIRONMENTAL, INC. "INSITU SOIL & GROUNDWATER REMEDIATION PROCESS AND SOIL AIR SAMPLING PROCEDURES." JULY 1987.

CONTACT NAME: CHARLES ASKINS TITLE: SALES MANAGER
ORGANIZATION: BVER ENVIRONMENTAL INC.
PHONE: 304-387-3225

DOCUMENT NUMBER: 980-TS1-RT-FQSP INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: "VAPOR EXTRACTION AS AN IN SITU METHOD TO REMOVE VOLATILE ORGANIC COMPOUNDS FROM THE SOIL - EVALUATION OF RESULTS" SUBMITTED TO EPA REGION IV FROM HARREB GEOTECHNIK

CONTACT NAME: HORST GUDEMANN
ORGANIZATION: HARREB GEOTECHNIK
PHONE: 0203/34-3474
COMMENTS: EUROPEAN VAPOR EXTRACTION TESTS

DOCUMENT NUMBER: 980-TS1-RT-FCBV INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: WASTECHEM CORP. MISC. DOCUMENT. (NO TITLE). CONTAINS THE FOLLOWING SECTIONS REGARDING "THE VRS SYSTEM: 1. SYSTEM ADVANTAGES; 2. SYSTEM DESCRIPTION; 3. ADVANTAGES OVER EXISTING COMPARABLE TECHNOLOGIES; 4. HISTORY OF DEVELOPMENT; 5. APPLICATION TO HAZARDOUS WASTE SITE CLEANUP; 6. COMPLETION OF FIELD TESTS."

CONTACT NAME: DAVID ENEGESS TITLE: ENGINEER
ORGANIZATION: WASTECHEM CORPORATION
ONE KALISA WAY, PARAMUS, NJ 07652
PHONE: 201-599-2900
COMMENTS: NOW WORKING FOR JOHNSON ASSOCIATES, INC. 181 CHERRY VALLEY ROAD PRINCETON, NJ 08540 609-924-3420

DOCUMENT NUMBER: 980-TS1-RT-EURW INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: HART CROWSER. "SITE REMEDIATION DOCUMENTATION REPORT SOURCE CONTROL REMEDIAL ACTION, QUEEN CITY FARMS, WASHINGTON." EPA-J-1264-08. PREPARED FOR U.S. EPA REGION 10. JANUARY 1987.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - REGION X
1200 SIXTH AVENUE, SEATTLE, WA 98101
PHONE: 206-442-5810

DOCUMENT NUMBER: 980-TS1-RT-EXNU INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: UNIVERSITY OF CALIFORNIA, STANDARD OIL COMPANY OF CALIFORNIA. "A HOT WATER FLUIDIZATION PROCESS FOR CLEANING OIL-CONTAMINATED BEACH SAND."

CONTACT NAME: PAUL G. MIKOLAJ
ORGANIZATION: UNIVERSITY OF CALIFORNIA, SANTA BARBARA
UNIVERSITY OF CALIFORNIA, SANTA BARBARA, CA

DOCUMENT NUMBER: 980-TS1-RT-EVAF INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: TWIDWELL, L.G. "METAL VALUE RECOVERY FROM METAL FINISHING HYDROXIDE SLUDGES: SELECTIVE REMOVAL OF IRON AND RECOVERY OF CHROMIUM." CR-8122533-01-0. PREPARED FOR MONTANA COLLEGE OF MINERAL SCIENCE AND TECHNOLOGY. JULY 1986.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-EZUR INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: U.S. EPA, OFFICE OF RADIATION PROGRAMS. "INTERIM RADIUM-226 EFFLUENT GUIDANCE FOR PHOSPHATE CHEMICALS AND PHOSPHATE FERTILIZER MANUFACTURING, STATEMENT OF CONSIDERATIONS." AUGUST 1974.

CONTACT NAME: ANDRE DuPONT
ORGANIZATION: NATIONAL LIME ASSOCIATION
PHONE: 703-243-LIME

DOCUMENT NUMBER: 980-TS1-RT-EUQV INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: REDRAFT PREDESIGN REPORT, PONDERS CORNER, WASHINGTON." EPA-62-ON22. PREPARED FOR U.S. EPA. JANUARY 1987.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - REGION X
1200 SIXTH AVENUE, SEATTLE, WA 98101
PHONE: 206-442-5810

DOCUMENT NUMBER: 980-TS1-RT-EXNJ INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ENVIRESPONSE, INC. "LEAD EXTRACTION PROCESS." JULY 1986.

CONTACT NAME: ROBERT EVANGELISTA
ORGANIZATION: ENVIRESPONSE
GSA RARITAN DEPOT, WOODBRIDGE AVE, BUILDING 209, BAY F, EDISON, NJ 88037
PHONE: 201-548-9660

DOCUMENT NUMBER: 980-TS1-RT-EUYY INFORMATION TYPE: QUANTITATIVE ANALYTICAL DATA
REFERENCE: ROY F. WESTON, INC. "PILOT STUDY REPORT, TRIANGLE CHEMICAL COMPANY, BRIDGE CITY, TX." PREPARED FOR TEXAS WATER COMMISSION AND U.S. EPA. MARCH 1986.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - REGION VI
1445 ROSS AVENUE, 12TH FLOOR, SUITE 1200, DALLAS, TX 75202
PHONE: 214-655-6444

DOCUMENT NUMBER: 175-PD1-RT-CBYB INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: CAMP DRESSER & MCKEE, INC. "REVISED DESIGN ANALYSIS REPORT, SOUTH TACOMA WELL 12A."175-PD1-RT-CBYB-1. PREPARED FOR U.S. EPA. JANUARY 1986.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - REGION X
1200 SIXTH AVENUE, SEATTLE, WA 98101
PHONE: 206-442-5810

DOCUMENT NUMBER: 980-TS1-RT-EUTN INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: WOODWARD-CLYDE CONSULTANTS. "PRELIMINARY DESIGN AND SPECIFICATIONS--MODIFICATION AND EXPANSION OF EXISTING SOIL GAS VAPOR EXTRACTION SYSTEM, TIME OIL CO. PROPERTY--S. TACOMA CHANNEL, WELL 12A PROJECT." DECEMBER 1985.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. DOD/USATHAMA
PHONE: 301-278-5201

DOCUMENT NUMBER: 980-TS1-RT-EUTQ INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: WOODWARD-CLYDE CONSULTANTS. "PERFORMANCE EVALUATION PILOT SCALE INSTALLATION AND OPERATION SOIL GAS VAPOR EXTRACTION SYSTEM,TIME OIL COMPANY SITE." PREPARED FOR US ARMY CORP. OF ENGINEERS. DECEMBER 1985.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. DOD/USATHAMA
PHONE: 301-278-5201

DOCUMENT NUMBER: 980-TS1-RT-EVAL INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: MURPHY, D. "CONTAMINANTS WILL BE STEAM-CLEANED FROM POLLUTED SOIL." LOS ANGELES TIMES. THURSDAY, APRIL 23, 1987.

CONTACT NAME: DEAN MURPHY TITLE: STAFF WRITER
ORGANIZATION: LOS ANGELES TIMES NEWPAPER
L.A. TIMES, LOS ANGELES, CA

DOCUMENT NUMBER: 980-TS1-RT-EWHF INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: CANONIE ENVIRONMENTAL. "CONSTRUCTION DOCUMENTATION IN-SITU SOIL AERATION PILOT STUDY, FAIRCHILD SAN JOSE FACILITY." PREPARED FOR FAIRCHILD SEMICONDUCTOR CORPORATION.

CONTACT NAME: LEO LEVENSON
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215 FREMONT STREET, SAN FRANCISCO, CA 94105
PHONE: 415-974-8071

DOCUMENT NUMBER: 980-TS1-RT-EWHG INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: CANONIE ENVIRONMENTAL. "REVISED PROPOSED PILOT STUDY IN-SITU SOIL AERATION, FAIRCHILD SEMICONDUCTOR CORPORATION, SAN JOSE SITE." PREPARED FOR FAIRCHILD SEMICONDUCTOR CORPORATION.

CONTACT NAME: LEO LEVENSON
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215 FREMONT STREET, SAN FRANCISCO, CA 94105
PHONE: 415-974-8071

DOCUMENT NUMBER: 980-TS1-RT-EXNK INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: "SCOPE OF WORK-FIELD EVALUATION OF 'TERRA-VAC' CORRECTIVE ACTION TECHNOLOGY AT A FLORIDA L.U.S.T. SITE." JULY 1987.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - HEADQUARTERS
401 M STREET, S.W., WASHINGTON, D.C. 20460

DOCUMENT NUMBER: 980-TS1-RT-EZYK INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: CH2M HILL. "OPERABLE UNIT FEASIBILITY STUDY. PUBLIC COMMENT REPORT. VERONA WELL FIELD, THOMAS SOLVENT COMPANY, RAYMOND ROAD FACILITY, BATTLE CREEK, MICHIGAN." PREPARED FOR U.S. EPA HAZARDOUS SITE CONTROL DIVISION. REM/FIT. ZONE II. JUNE 1985.

CONTACT NAME: TOM THOMAS TITLE: REGIONAL PROJECT MANAGER
ORGANIZATION: U.S. EPA - REGION V
230 SOUTH DEARBORN STREET, CHICAGO, IL 60604
PHONE: 312-886-1434

DOCUMENT NUMBER: 980-TS1-RT-FCAH INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: TOXIC TREATMENT, LTD.-SYDNEY, AUSTRALIA."ENGINEERING ASSMT. OF ATW'S IN SITU SOIL DETOXIFICATION SYSTEM DEMONSTRATION PROJECT AT PACIFIC COMMERCE CENTER, LONG BEACH, CALIFORNIA." (NUS PROJECT NO. Y707). AUGUST 1986.

CONTACT NAME: MICHAEL RIDOSH TITLE: VICE PRESIDENT
ORGANIZATION: TOXIC TREATMENTS (USA) INC.
901 MARINERS ISLAND BLVD, SUITE 315, SAN MATEO, CALIFORNIA 94404
PHONE: 213-428-8864

DOCUMENT NUMBER: 980-TS1-RT-FCBN INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: WILSON, D.J., DEPT. OF CHEM., VANDERBILT UNIVERSITY. DRAFT TECHNICAL REPORT. "MATHEMATICAL MODELING OF SOIL CLEAN-UP BY IN-SITU AERATION." FOR AWARE INCORPORATED. JUNE 1987.

CONTACT NAME: TIMOTHY TRAVERS TITLE: REGIONAL PROJECT MANAGER
ORGANIZATION: U.S. EPA - REGION III
841 CHESTNUT STREET, PHILADELPHIA, PA 19107
PHONE: 215-597-8751

DOCUMENT NUMBER: 980-TS1-RT-FCBP INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: TERRA VAC, INC. "VACUUM EXTRACTION PILOT TEST TYSON'S SUPERFUND SITE - UPPER MERION TOWNSHIP, PENNSYVANIA." JUNE 1987.

CONTACT NAME: TIMOTHY TRAVERS TITLE: REGIONAL PROJECT MANAGER
ORGANIZATION: U.S. EPA - REGION III
841 CHESTNUT STREET, PHILADELPHIA, PA 19107
PHONE: 215-597-8751

DOCUMENT NUMBER: 980-TS1-RT-FCFK INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: WILSON, D.J. "PREDICTION OF UPPER BOUNDS TO THE TIME REQUIRED TO REACH A MEAN SOIL CONCENTRATION OF VOLATILES OF 50 PPB AT THE TYSON SITE." PREPARED FOR AWARE INCORPORATED. JULY 1987.

CONTACT NAME: TIMOTHY TRAVERS TITLE: REGIONAL PROJECT MANAGER
ORGANIZATION: U.S. EPA - REGION III
841 CHESTNUT STREET, PHILADELPHIA, PA 19107
PHONE: 215-597-8751

DOCUMENT NUMBER: 980-TS1-RT-FCLJ INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: ASSORTED ARTICLES. "THE TOXIC TREATMENTS BULLETIN." VOLUME 1, NUMBER 1. SPRING 1987.

CONTACT NAME: MICHAEL RIDOSH TITLE: VICE PRESIDENT
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901 MARINERS ISLAND BLVD, SUITE 315, SAN MATEO, CALIFORNIA 94404
PHONE: 213-428-8864

DOCUMENT NUMBER: 980-TS1-RT-FCLK INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: LA MORI, P.N. AND M. RIDOSH. SUMMARY PAPER. "IN SITU TREATMENT PROCESS FOR REMOVAL OF VOLATILE HYDROCARBONS FROM SOILS: RESULTS OF PROTOYPE TEST." PRESENTED AT THE SECOND INTERNATIONAL CONFERENCE ON NEW FRONTIERS FOR HAZARDOUS WASTE MANAGEMENT.

CONTACT NAME: MICHAEL RIDOSH TITLE: VICE PRESIDENT
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DOCUMENT NUMBER: 980-TS1-RT-FCLL INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: TOXIC TREATMENTS (USA) INC. "DETOXIFIER POTENTIAL CAPABILITIES."NEWSLETTER, NOVEMBER 1985.

CONTACT NAME: MICHAEL RIDOSH TITLE: VICE PRESIDENT
ORGANIZATION: TOXIC TREATMENTS (USA) INC.
901 MARINERS ISLAND BLVD, SUITE 315, SAN MATEO, CALIFORNIA 94404
PHONE: 213-428-8864

DOCUMENT NUMBER: 980-TS1-RT-FCLM INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: TOXIC TREATMENTS (USA) INC. "THE IN SITU DETOXIFIER."

CONTACT NAME: MICHAEL RIDOSH TITLE: VICE PRESIDENT
ORGANIZATION: TOXIC TREATMENTS (USA) INC.
901 MARINERS ISLAND BLVD, SUITE 315, SAN MATEO, CALIFORNIA 94404
PHONE: 213-428-8864

DOCUMENT NUMBER: 980-TS1-RT-FCLN INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: TOXIC TREATMENTS (USA) INC. "DETOXIFIER PERFORMANCE HISTORY PRIOR TO ACQUISITION BY TTUSA INC."

CONTACT NAME: MICHAEL RIDOSH TITLE: VICE PRESIDENT
ORGANIZATION: TOXIC TREATMENTS (USA) INC.
901 MARINERS ISLAND BLVD, SUITE 315, SAN MATEO, CALIFORNIA 94404
PHONE: 213-428-8864

DOCUMENT NUMBER: 980-TS1-RT-FCLQ INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: M. GHASSIMI. "INNOVATIVE IN SITU TREATMENT TECHNOLOGIES FOR CLEANUP OF CONTAMINATED SITES." PRESENTED AT THE THIRD ANNUAL HAZARDOUS WASTE LAW AND MANAGEMENT CONFERENCE. SEATTLE, WASHINGTON. OCTOBER 1986. PORTLAND, OREGON. NOVEMBER 1986.

CONTACT NAME: MICHAEL RIDOSH TITLE: VICE PRESIDENT
ORGANIZATION: TOXIC TREATMENTS (USA) INC.
901 MARINERS ISLAND BLVD, SUITE 315, SAN MATEO, CALIFORNIA 94404
PHONE: 213-428-8864

DOCUMENT NUMBER: 980-TS1-RT-FCML INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: ROY F. WESTON, INC. "TASK ORDER 4. LABORATORY STUDY OF IN SITU VOLATILIZATION (ISV) TECHNOLOGY APPLIED TO FORT CAMPBELL SOILS CONTAMINATED WITH JP-4." FINAL REPORT. PREPARED FOR USATHMA. MAY 1987.

CONTACT NAME: ERIC KAUFMAN
ORGANIZATION: U.S. DOD/USATHAMA
PHONE: 301-671-2270
COMMENTS: INFO. ON LETTERKENNY SITE

DOCUMENT NUMBER: 980-TS1-RT-FCMN INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: DYNAMAC CORPORATION. "LITERATURE REVIEW OF FORCED AIR VENTING TO REMOVE SUBSURFACE ORGANIC VAPORS FROM AQUIFERS AND SOILS. SUBTASK STATEMENT NO. 3." SUBMITTED TO LT. EDWARD HEYSE, SUBTASK MONITOR, HQ AFESCK/RDV, TYNDALL AFB, FLORIDA. REVISED JULY 1986.

CONTACT NAME: PAUL F. de PERCIN
ORGANIZATION: U.S. EPA, ORD
HWERL-CONTAINMENT BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7787

DOCUMENT NUMBER: 980-TS1-RT-FCNE INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: ROY F. WESTON, INC. FINAL REPORT AND APPENDICES (2 VOLUMES). "TASK 11. IN ISTU SOLVENT STRIPPING FROM SOILS PILOT STUDY." PREPARED FOR U.S. ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY. MAY 1985.

CONTACT NAME: ERIC KAUFMAN
ORGANIZATION: U.S. DOD/USATHAMA
PHONE: 301-671-2270
COMMENTS: INFO. ON LETTERKENNY SITE

DOCUMENT NUMBER: 980-TS1-RT-FCNV INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: SLIDE PRESENTATION. "VERONA WELL FIELD, THOMAS SOLVENT RAYMOND OPERABLE UNIT, SOIL VAPOR EXTRACTION SYSTEM.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - REGION V
230 SOUTH DEARBORN STREET, CHICAGO, IL 60604
PHONE: 312-353-2000

DOCUMENT NUMBER: 980-TS1-RT-FCRV INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: LIST OF REFERENCES. "IN SITU SOIL VENTING."

CONTACT NAME: CAROL RUSHIN TITLE: SITE MANAGER
ORGANIZATION: U.S. EPA - REGION X
HAZARDOUS WASTE DIVISION, 1200 SIXTH AVENUE, SEATTLE, WA 98101
PHONE: 206-442-2709
COMMENTS: PONDERS CORNERS SITE

DOCUMENT NUMBER: 980-TS1-RT-FCRZ INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: RIEDEL ENVIRONMENTAL SERVICES CO. AND RADIAN CORPORATION. "SUBSURFACE VENTING OF HYDROCARBON VAPORS FROM AN UNDERGROUND AQUIFER." PREPARED FOR AMERICAN PETROLEUM INSTITUTE. API PUBLICATION NO. 4410. SEPTEMBER 1985.

CONTACT NAME: PAUL F. de PERCIN
ORGANIZATION: U.S. EPA, ORD
HWERL-CONTAINMENT BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7787

DOCUMENT NUMBER: 980-TS1-RT-FCSD INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: BOWMAN, ROBERT S. "MANIPULATION OF THE VADOSE ZONE TO ENHANCE TOXIC ORGANIC CHEMICAL REMOVAL." PRESENTED AT THE SECOND INTERNATIONAL WORKSHOP ON: BEHAVIOR OF POLLUTANTS IN POROUS MEDIA. BET DAGAN, ISRAEL. JUNE 1987.

CONTACT NAME: DR. THOMAS SPITTLER
ORGANIZATION: U.S. EPA - REGION I
ENVIRONMENTAL SERVICES DIVISION, 60 WESTVIEW STREET, LEXINGTON, MA 02173

DOCUMENT NUMBER: 980-TS1-RT-FCSG INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: MALOT, JAMES AND P.R. WOOD. "LOW COST, SITE SPECIFIC TOTAL APPROACH TO DECONTAMINATION."

CONTACT NAME: DR. THOMAS SPITTLER
ORGANIZATION: U.S. EPA - REGION I
ENVIRONMENTAL SERVICES DIVISION, 60 WESTVIEW STREET, LEXINGTON, MA 02173

DOCUMENT NUMBER: 980-TS1-RT-FCSH INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: HOAG, GEORGE E. REPORT. "INDUCED SOIL VENTING."

CONTACT NAME: DR. THOMAS SPITTLER
ORGANIZATION: U.S. EPA - REGION I
ENVIRONMENTAL SERVICES DIVISION, 60 WESTVIEW STREET, LEXINGTON, MA 02173

DOCUMENT NUMBER: 980-TS1-RT-FCSJ INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: WOODWARD-CLYDE CONSULTANTS. "INSTALLATION AND OPERATION OF VAPOR EXTRACTION SYSTEMS TO REMOVE VOLATILE ORGANIC COMPOUNDS FROM SOILS." SEPTEMBER 1986.

CONTACT NAME: DR. THOMAS SPITTLER
ORGANIZATION: U.S. EPA - REGION I
ENVIRONMENTAL SERVICES DIVISION, 60 WESTVIEW STREET, LEXINGTON, MA 02173

DOCUMENT NUMBER: 980-TS1-RT-FCSN INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: KOLTUNIAK, DONNA L. "IN-SITU AIR STRIPPING CLEANS CONTAMINATED SOIL." JOURNAL. "CHEMICAL ENGINEERING." AUGUST 1986.

CONTACT NAME: DONNA KOLTUNIAK
ORGANIZATION: U.S. DOD/USATHAMA
USATHAMA, ABERDEEN PROVING GROUND, MD 21009

DOCUMENT NUMBER: 980-TS1-RT-FCTM INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: TEXAS RESEARCH INSTITUTE, INC. "FORCE VENTING TO REMOVE GASOLINE VAPOR FROM A LARGE-SCALE MODEL AQUIFER." PREPARED FOR AMERICAN PETROLEUM INSTITUTE. JANUARY 1984.

CONTACT NAME: PAUL F. de PERCIN
ORGANIZATION: U.S. EPA, ORD
HWERL-CONTAINMENT BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7787

DOCUMENT NUMBER: 980-TS1-RT-FCTN INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: AWARE INCORPORATED. FINAL REPORT. "PHASE I. ZONE I SOIL DECONTAMINATION THROUGH IN-SITU VAPOR STRIPPING PROCESSES." PREPARED FOR U.S. EPA. SMALL BUSINESS INNOVATIVE RESEARCH PROGRAM. CONTRACT NO. 68-02-4446. APRIL 1987.

CONTACT NAME: PAUL F. de PERCIN
ORGANIZATION: U.S. EPA, ORD
HWERL-CONTAINMENT BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7787

DOCUMENT NUMBER: 980-TS1-RT-FCUC INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: SCIENCE ASSOCIATES. FIELD REPORT FOR "INDUSTRIAL HYGIENE SURVEY re MCCALL LAND FILL ACTIVITY ON NOVEMBER 22, 1983." NOVEMBER 1983.

CONTACT NAME: RONALD E. LEWIS TITLE: ASSOCIATE WASTE MANAGEMENT ENGINEER
ORGANIZATION: STATE OF CALIF - DEPT OF HEALTH SERVICES
TOXIC SUBSTANCES CONTROL DIVISION, 714-744 P STREET, SACRAMENTO, CA 95814
PHONE: 916-322-3670
COMMENTS: STATE OF CALIFORNIA, DEPT. OF HEALTH SERVICES TOXIC SUBSTANCES CONTROL DIVISION ALTERNATIVE TECHNOLOGY SECTION

DOCUMENT NUMBER: 980-TS1-RT-FCUU INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: STERRETT, R.J.; G.D. BARNHILL; AND M.E. RANSOM. ABSTRACT. "SITE ASSESSMENT AND ON-SITE TREATMENT OF A PESTICIDE SPILL IN THE VADOSE ZONE."

CONTACT NAME: CAROL RUSHIN TITLE: SITE MANAGER
ORGANIZATION: U.S. EPA - REGION X
HAZARDOUS WASTE DIVISION, 1200 SIXTH AVENUE, SEATTLE, WA 98101
PHONE: 206-442-2709
COMMENTS: PONDERS CORNERS SITE

DOCUMENT NUMBER: 980-TS1-RT-EWDS INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. DOE, ORNL. "DATA ANALYSIS AND REPORT ON MAGNETIC SEPARABILITY OF URANIUM FROM SAND."

CONTACT NAME: ALLEN PORELL
ORGANIZATION: U.S. DOE/HAZWRAP
DOE HAZARDOUS WASTE PROGRAM, OAK RIDGE NATIONAL LABORATORY, P.O. BOX Y, OAK RIDGE, TN 37831
PHONE: 615-576-0518
COMMENTS: INFO ON PARAMAGNETIC SEPARATION

DOCUMENT NUMBER: 980-TS1-RT-EUQZ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. DOE. "DOE HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM ANNUAL REPORT FOR FY 1986." HAZWRAP SUPPORT CONTRACTOR OFFICE. MAY 1987.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. DEPARTMENT OF ENERGY
COMMENTS: OAK RIDGE NATIONAL RESEARCH LABS OR IDAHO NATIONAL ENGINEERING LABS OR HANFORD/RICHLAND, WASHINGTON. NO SINGLE CONTACT PERSON

DOCUMENT NUMBER: 980-TS1-RT-EWFU INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: DAMES & MOORE. "DRAFT-ALTERNATIVES SCREENING REPORT." PREPARED FOR THE KOPPERS COMPANY, INC.

CONTACT NAME: JOHN KEMMERER
ORGANIZATION: U.S. EPA - REGION IX
215 FREMONT STREET, SAN FRANCISCO, CA 94105
PHONE: 415-974-8071

DOCUMENT NUMBER: 980-TS1-RT-EWGZ INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: BRETON,M.,M. ARIENTI, P. FRILLICI, M. KRAVETT, S. PALMER, A. SHAYER, N. SURPRENANT. "PROJECT SUMMARY; TECHNICAL RESOURCE DOCUMENT TREATMENT TECHNOLOGIES FOR SOLVENT CONTAINING WASTES." EPA/600/S2-86/095. PREPARED FOR U.S. EPA, ORD. FEBRUARY 1987.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-EXNL INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: ARTHUR D. LITTLE, INC. "REMEDIAL MEASURES INITIATION DECISION REPORT: VOLUME II-REMEDIAL MEASURES TECHNOLOGIES." PREPARED FOR NAVAL CIVIL ENGINEERING LABORATORY. JUNE 1987.

CONTACT NAME: NICHOLAS J. OLAH TITLE: CHEMICAL ENGINEER
ORGANIZATION: U.S. NAVY ENVIRONMENTAL PROTECTION DIV.
NAVAL CIVIL ENGINEERING LABORATORY, BUILDING 560, ROOM 242 B, PORT HUENEME, CA 93043
PHONE: 805-982-4191

DOCUMENT NUMBER: 980-TS1-RT-EZYR INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: ROY F. WESTON, INC. "ENGINEERING EVALUATION/COST ANALYSIS CARTER INDUSTRIAL SITE, DETROIT, MICHIGAN." PREPARED FOR U.S. EPA. DECEMBER 1986.

CONTACT NAME: WILLIAM SIMES
ORGANIZATION: U.S. EPA - REGION V
EMERGENCY RESPONSE TEAM, 230 SOUTH DEARBORN STREET, CHICAGO, IL 60601
PHONE: 312-353-2000

DOCUMENT NUMBER: 980-TS1-RT-FCCD INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: IDAHO NAT'L ENGINEERING LAB., EG&G. EGG-HWM-7796. INFORMAL REPORT. "EVALUATION OF TECHNOLOGIES TO TREAT SOILS CONTAMINATED WITH HAZARDOUS WASTE." U.S. DOE CONTRACT DE-AC07-761D01570. AUGUST 1987

CONTACT NAME: ANN M. BOEHMER TITLE: CHEMICAL ENGINEER
ORGANIZATION: INEL
EG&G IDAHO, INC., P.O. BOX 1625, IDAHO FALLS, ID 83415
PHONE: 208-526-9105

DOCUMENT NUMBER: 980-TS1-RT-FCCF INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: NUS CORPORATION. "DRAFT EVALUATION OF SOURCE CONTROL TECHNOLOGIES." FOR EBASCO SERVICES INCORPORATED. MAY 1987.

CONTACT NAME: VIC JENOSIK
ORGANIZATION: U.S. EPA - REGION III
841 CHESTNUT STREET, PHILADELPHIA, PA 19107
PHONE: 215-597-9800

DOCUMENT NUMBER: 980-TS1-RT-FCFQ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. "RECLAMATION AND REDEVELOPMENT OF CONTAMINATED LAND: VOLUME 1. U.S. CASE STUDIES." ORD HWERL. EAP/600/2-86/066. AUGUST 1986.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-FCMM INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CH2M HILL. "BAYOU BONFOUCA SITE FOCUSED FEASIBILITY STUDY FOR SOURCE CONTROL." AND "BAYOU BONFOUCA SITE DRAFT PHASE II FREASIBBILITY STUDY, MAY 8, 1986; REVISED JUNE 2, 1986." PREPARED FOR U.S. EPA, HAZARDOUS SITE CONTROL DIVISION.

CONTACT NAME: GARRETT BANDY
ORGANIZATION: U.S. EPA - REGION VI
1445 ROSS AVENUE, DALLAS, TX 75202
PHONE: 215-655-6444

DOCUMENT NUMBER: 980-TS1-RT-FCMZ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: LAMBERT, W.P.; L.J. BOVE AND W.E. SISK. "EVALUATION OF ADVANCED TECHNOLOGIES FOR TREATMENT OF CONTAMINATED SOILS. [JOURNAL?] ALTERNATIVE TECHNOLOGY."

CONTACT NAME: NOT REPORTED
ORGANIZATION: ROY F. WESTON, INC
WESTON WAY, WEST CHESTER, PA 19380
PHONE: 215-692-3030

DOCUMENT NUMBER: 980-TS1-RT-FCUD INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: ROY F. WESTON, INC. "WESTERN STATES REFINING." SPILL PREVENTION & EMERGENCY RESPONSE DIVISION.

CONTACT NAME: MATTHEW MONSEES
ORGANIZATION: U.S. EPA - REGION IX
215 FREMONT STREET, SAN FRANCISCO, CA 94105
PHONE: 415-947-8071

DOCUMENT NUMBER: 980-TS1-EP-EVTE INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CDM FEDERAL PROGRAMS CORPORATION. "FINAL TRIP REPORT FOR DATA COLLECTION VISITS TO U.S. EPA REGION IV AND TYNDALL AIR FORCE BASE - BDAT WORK ASSIGNMENT." JULY 1987.

CONTACT NAME: JOAN O. KNAPP TITLE: WORK ASSIGNMENT MANAGER
ORGANIZATION: CDM FEDERAL PROGRAMS CORP.
PHONE: 703-968-0900
COMMENTS: BDAT TEAM MEMBER - REM CONTRACTOR

DOCUMENT NUMBER: 980-TS1-EP-EXQX INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CDM FEDERAL PROGRAMS CORPORATION. "FINAL TRIP REPORT FOR DATA COLLECTION FIELD VISIT TO BOLLING AIR FORCE BASE - BDAT WORK ASSIGNMENT." JULY 1987.

CONTACT NAME: JOAN O. KNAPP TITLE: WORK ASSIGNMENT MANAGER
ORGANIZATION: CDM FEDERAL PROGRAMS CORP.
PHONE: 703-968-0900
COMMENTS: BDAT TEAM MEMBER - REM CONTRACTOR

DOCUMENT NUMBER: 980-TS1-EP-EXSC INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CDM FEDERAL PROGRAMS CORPORATION. "FINAL TRIP REPORT FOR DATA COLLECTION FIELD VISITS TO OAK RIDGE NATIONAL LABORATORY - BDAT WORK ASSIGNMENT." JULY 1987.

CONTACT NAME: JOAN O. KNAPP TITLE: WORK ASSIGNMENT MANAGER
ORGANIZATION: CDM FEDERAL PROGRAMS CORP.
PHONE: 703-968-0900
COMMENTS: BDAT TEAM MEMBER - REM CONTRACTOR

DOCUMENT NUMBER: 980-TS1-EP-EXUK INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CDM FEDERAL PROGRAMS CORPORATION. "FINAL TRIP REPORT FOR DATA COLLECTION FIELD VISITS TO NEESA, NCEL, CDHS, AND U.S. EPA REGION IX - BDAT." JULY 1987.

CONTACT NAME: JOAN O. KNAPP TITLE: WORK ASSIGNMENT MANAGER
ORGANIZATION: CDM FEDERAL PROGRAMS CORP.
PHONE: 703-968-0900
COMMENTS: BDAT TEAM MEMBER - REM CONTRACTOR

DOCUMENT NUMBER: 980-TS1-EP-FALR INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CDM FEDERAL PROGRAMS CORPORATION. "FINAL TRIP REPORT FOR DATA COLLECTION FIELD VISITS TO U.S. EPA REGION II, NEW YORK, NY, U.S. EPA REGION II, EDISON, NJ, AND SARM REVIEW MEETING AT OHMSETT, NJ - BDAT WORK ASSIGNMENT." AUGUST 1987.

CONTACT NAME: JOAN O. KNAPP TITLE: WORK ASSIGNMENT MANAGER
ORGANIZATION: CDM FEDERAL PROGRAMS CORP.
PHONE: 703-968-0900
COMMENTS: BDAT TEAM MEMBER - REM CONTRACTOR

DOCUMENT NUMBER: 980-TS1-EP-FBSB INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CDM FEDERAL PROGRAMS CORPORATION. "DRAFT TRIP REPORT FOR DATA COLLECTION FIELD VISITS TO U.S. EPA REGION X, SEATTLE, WASHINGTON, U.S. DOE - HANFORD, RICHLAND, WASHINGTON, AND U.S. DOE - INEL, IDAHO FALLS, IDAHO - BDAT WORK ASSIGNMENT." AUGUST 1987.

CONTACT NAME: JOAN O. KNAPP TITLE: WORK ASSIGNMENT MANAGER
ORGANIZATION: CDM FEDERAL PROGRAMS CORP.
PHONE: 703-968-0900
COMMENTS: BDAT TEAM MEMBER - REM CONTRACTOR

DOCUMENT NUMBER: 980-TS1-EP-FDCR INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CDM FEDERAL PROGRAMS CORPORATION. "FINAL TRIP REPORT FOR THE DATA COLLECTION FIELD VISIT TO U.S. EPA REGION III, PENNSYLVANIA." SEPTEMBER 1987.

CONTACT NAME: JOAN O. KNAPP TITLE: WORK ASSIGNMENT MANAGER
ORGANIZATION: CDM FEDERAL PROGRAMS CORP.
PHONE: 703-968-0900
COMMENTS: BDAT TEAM MEMBER - REM CONTRACTOR

DOCUMENT NUMBER: 980-TS1-EP-FGQP INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CDM FEDERAL PROGRAMS CORPORATION. "DRAFT TRIP REPORT FOR THE DATA COLLECTION FIELD VISIT TO U.S. EPA REGION V, CHICAGO, ILLINOIS - BDAT WORK ASSIGNMENT." OCTOBER 1987.

CONTACT NAME: JOAN O. KNAPP TITLE: WORK ASSIGNMENT MANAGER
ORGANIZATION: CDM FEDERAL PROGRAMS CORP.
PHONE: 703-968-0900
COMMENTS: BDAT TEAM MEMBER - REM CONTRACTOR

DOCUMENT NUMBER: 980-TS1-EP-FQKE INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CDM FEDERAL PROGRAMS CORPORATION. "FINAL TRIP REPORT FOR DATA COLLECTION FIELD VISIT TO U.S. EPA REGION I IN BOSTON AND LEXINGTON, MA - BDAT WORK ASSIGNMENT." DECEMBER, 1987

CONTACT NAME: JOAN O. KNAPP TITLE: WORK ASSIGNMENT MANAGER
ORGANIZATION: CDM FEDERAL PROGRAMS CORP.
PHONE: 703-968-0900
COMMENTS: BDAT TEAM MEMBER - REM CONTRACTOR

DOCUMENT NUMBER: 980-TS1-EP-FQYN INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CDM FEDERAL PROGRAMS CORP. "FINAL TRIP REPORT FOR THE DATA COLLECTION FIELD VISITS TO U.S. EPA REGION VII, KANSAS CITY, KS AND U.S. EPA REGION VI, DALLAS, TX. -BDAT WORK ASSN." DECEMBER, 1987

CONTACT NAME: JOAN O. KNAPP TITLE: WORK ASSIGNMENT MANAGER
ORGANIZATION: CDM FEDERAL PROGRAMS CORP.
PHONE: 703-968-0900
COMMENTS: BDAT TEAM MEMBER - REM CONTRACTOR

DOCUMENT NUMBER: 980-TS1-EP-FQYQ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CDM FEDERAL PROGRAMS CORPORATION. "FINAL TRIP REPORT FOR THE DATA COLLECTION FIELD VISIT TO U.S. EPA REGION V, CHICAGO, ILLINOIS-BDAT WORK ASSIGNMENT." DECEMBER, 1987

CONTACT NAME: JOAN O. KNAPP TITLE: WORK ASSIGNMENT MANAGER
ORGANIZATION: CDM FEDERAL PROGRAMS CORP.
PHONE: 703-968-0900
COMMENTS: BDAT TEAM MEMBER - REM CONTRACTOR

DOCUMENT NUMBER: 980-TS1-EP-FRBQ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CDM FEDERAL PROGRAMS CORPORATION. "REVISED FINAL TRIP REPORT FOR DATA COLLECTION FIELD VISITS TO SHIRCO INFRARED SYSTEMS, INC. AND U.S. EPA HWERL-BDAT WORK ASSIGNMENT." DECEMBER, 1987

CONTACT NAME: JOAN O. KNAPP TITLE: WORK ASSIGNMENT MANAGER
ORGANIZATION: CDM FEDERAL PROGRAMS CORP.
PHONE: 703-968-0900
COMMENTS: BDAT TEAM MEMBER - REM CONTRACTOR

DOCUMENT NUMBER: 980-TS1-RT-EURB INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: CH2M HILL. "FINAL WORK PLAN FOCUSED FEASIBILITY STUDY, PONDERS CORNER, WASHINGTON." EPA-112-0L22. PREPARED FOR U.S. EPA, HAZARDOUS SITE CONTROL DIVISON. APRIL 1984.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - REGION X
1200 SIXTH AVENUE, SEATTLE, WA 98101
PHONE: 206-442-5810

DOCUMENT NUMBER: 980-TS1-RT-EURC INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: CH2M HILL." FINAL WORK PLAN WELLWATER TREATMENT FACILITIES PONDERS CORNER, LAKEWOOD." EPA-112-0-22. PREPARED FOR U.S HAZARDOUS SITE CONTROL DIVISION. MAY 1984.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - REGION X
1200 SIXTH AVENUE, SEATTLE, WA 98101
PHONE: 206-442-5810

DOCUMENT NUMBER: 980-TS1-RT-EURD INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: CH2M HILL." PUBLIC COMMENT FEASIBILITY STUDY PONDERS CORNER, WASHINGTON."EPA-112-0L22. PREPARED FOR U.S. EPA HAZARDOUS SITE CONTROL DIVISION. JULY 1985.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - REGION X
1200 SIXTH AVENUE, SEATTLE, WA 98101
PHONE: 206-442-5810

DOCUMENT NUMBER: 980-TS1-RT-EURR INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: AFESC, ENGINEERING & SERVICES LABORATORY. "FINAL REPORT: SOIL CHARACTERIZATION STUDY OF FORMER HERBICIDE STORAGE SITE AT JOHNSTON ISLAND." OCTOBER 1986.

CONTACT NAME: NOT REPORTED
ORGANIZATION: EG&G IDAHO, INC
P.O. BOX 1625, IDAHO FALLS, ID 83415
PHONE: 208-526-4225
COMMENTS: RECOMMEDED BY MAJOR TERRY STODDART

DOCUMENT NUMBER: 980-TS1-RT-EUTL INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: AFESC, ENVIRONICS DIVISION. "HERBICIDE ORANGE MONITORING PROGRAM." PREPARED FOR AFESC, TYNDALL AIR FORCE BASE. APRIL 1984.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. DOD/AFESC
COMMENTS: AIR FORCE HEADQUARTERS DOCUMENT

DOCUMENT NUMBER: 980-TS1-RT-EUUC INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: EG&G IDAHO, INC."HERBICIDE ORANGE SITE CHARACTERIZATION STUDY EGLIN AFB." PREPARED FOR AFESC, TYNDALL AIR FORCE BASE. JANUARY 1987.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. DOD/AFESC
COMMENTS: AIR FORCE HEADQUARTERS DOCUMENT

DOCUMENT NUMBER: 980-TS1-RT-EUUE INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: EG&G IDAHO, INC. "HERBICIDE ORANGE SITE CHARACTERIZATION STUDY NAVAL CONSTRUCTION BATTALION CENTER." PREPARED FOR AFESC, TYNDALL AIR FORCE BASE. JANUARY 1987.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. DOD/AFESC
COMMENTS: AIR FORCE HEADQUARTERS DOCUMENT

DOCUMENT NUMBER: 980-TS1-RT-EUXP INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: MASON, B.J. "STATISTICAL EVALUATION OF FIXED SOILS DATA FROM THE WESTERN PROCESSING SITE IN KENT WASHINGTON." PREPARED FOR U.S. EPA, ENVIRONMENTAL MONITORING SYSTEMS LAB, ORD, LAS VEGAS, NV. JANUARY 1987.

CONTACT NAME: KENNETH BROWN
ORGANIZATION: U.S. DOE, ORD
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DOCUMENT NUMBER: 980-TS1-RT-EUYU INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: PEER CONSULTANTS,INC. "REPORT OF THE DOD/EPA/DOE WORKING GROUP TO EXPLORE HAZARDOUS WASTE TECHNOLOGY COOPERATIVE EFFORTS." PREPARED FOR EPA/DOD/DOE. DECEMBER 1986.

CONTACT NAME: JOHN KINGSCOTT
ORGANIZATION: U.S. EPA - HEADQUARTERS
401 M STREET, S.W., WASHINGTON, D.C. 20460

DOCUMENT NUMBER: 980-TS1-RT-EVAG INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: MEDLIN, W.E., S. SHEALY AND J.A. BROSCIOUS. "REMEDIAL MEASURES INITIATION DECISION REPORT(IDR) LITERATURE REVIEW." PREPARED FOR NAVAL CIVIL ENGINEERING LAB (NCEL). JANUARY 1987.

CONTACT NAME: NOT REPORTED

DOCUMENT NUMBER: 980-TS1-RT-EWFY INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: ENVIRONMENTAL SCIENCE AND ENGINEERING, INC. "REMEDIAL INVESTIGATION/FEASIBILITY STUDY AT SHARPE ARMY DEPOT (SHAD)." PREPARED FOR U.S. ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY, INSTALLATION RESTORATION DIVISION. MAY 1987.

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TOXIC AND WASTE MANAGEMENT DIVISION, 215 FREMONT STREET, SAN FRANCISCO, CA 94105
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DOCUMENT NUMBER: 980-TS1-RT-EWGQ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: SHAREEF, G., A. MILES, B. POST. "PROJECT SUMMARY; HAZARDOUS/TOXIC AIR POLLUTANT CONTROL TECHNOLOGY: A LITERATURE REVIEW." EPA-600/S2-84-194. PREPARED FOR U.S. EPA, ORD. JANUARY 1985.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
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DOCUMENT NUMBER: 980-TS1-RT-EWGT INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: WOLBACH, C., R. WHITNEY, U. SPANNAGEL. "PROJECT SUMMARY; DESIGN AND DEVELOPMENT OF A HAZARDOUS WASTE REACTIVITY TESTING PROTOCOL." EPA-6600/S2-84-057. PREPARED FOR U.S. EPA, ORD. APRIL 1984.

CONTACT NAME: NAOMI BARKLEY
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11499 CHESTER ROAD, CINCINNATI, OH 45246
COMMENTS: RECOMMENDED BY DONALD SANNING.

DOCUMENT NUMBER: 980-TS1-RT-EWVP INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: ENVIRONMENTAL SCIENCES DIVISION & ENGINEERING DIVISION, ORNL, ENVIRONMENTAL CONSULTING ENGINEERS, INC. "THE OAK RIDGE ABOVE-GRADE DISPOSAL FACILITY DEMONSTRATION: BARRIERS TO GROUNDWATER CONTAMINATION."

CONTACT NAME: LESLIE DOLE TITLE: PROGRAM MANAGER
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COMMENTS: INFO ON THE PEPPER STEEL SITE AND OTHERS

DOCUMENT NUMBER: 980-TS1-RT-EWVR INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: TRABALKA, J.R. "OAK RIDGE NATIONAL LABORATORY REMEDIAL ACTION PROGRAM."

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COMMENTS: INFO ON THE PEPPER STEEL SITE AND OTHERS

DOCUMENT NUMBER: 980-TS1-RT-EWWD INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: WASTE IMMOBILIZATION TECHNOLOGIES GROUP, ENGINEERING DEVELOPMENT SECTION, CHEMICAL TECHNOLOGY DIVISION, ORNL. "A REVIEW OF EPA, DOE, AND NRC REGULATIONS REGARDING ESTABLISHMENT OF SOLID WASTE PERFORMANCE CRITERIA."

CONTACT NAME: LESLIE DOLE TITLE: PROGRAM MANAGER
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COMMENTS: INFO ON THE PEPPER STEEL SITE AND OTHERS

DOCUMENT NUMBER: 980-TS1-RT-EXNF INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: EBASCO SERVICES INCORPORATED. "DRAFT WORK PLAN ADDENDUM; SECOND-PHASE FEASIBILITY STUDY & REMEDIAL DESIGN." APRIL 1987.

CONTACT NAME: RICHARD SCWARTZ
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EMERGENCY AND REMEDIAL RESPONSE DIVISION, 26 FEDERAL PLAZA, NEW YORK, NY 10278
PHONE: 212-264-1252
COMMENTS: BOG CREEK SITE. MET AT REGION II, 7/22/87.

DOCUMENT NUMBER: 980-TS1-RT-EZUE INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: RADIAN CORPORATION. "3M FOAM EVALUATION FOR VAPOR MITIGATION TECHNICAL MEMORANDUM." PREPARED FOR HAZARDOUS MATERIAL CONTROL PRODUCTS, 3M CENTER. AUGUST 1986.

CONTACT NAME: NOT REPORTED
ORGANIZATION: RADIAN CORPORATION
10395 OLD PLACERVILLE ROAD, SACRAMENTO, CA 95827
PHONE: 916-362-5332

DOCUMENT NUMBER: 980-TS1-RT-EZUV INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: ERM-SOUTHWEST, INC. "WORK PLAN FOR FIELD STUDIES SUPPORTING RISK ASSESSMENT AND SOURCE CONTROL FEASIBILITY STUDIES - SHERIDAN SITE COMMITTEE." JUNE 1987.

CONTACT NAME: RUTH ISRAELI
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1445 ROSS AVENUE, 12TH FLOOR, SUITE 1200, DALLAS, TX 75202
PHONE: 214-655-6444

DOCUMENT NUMBER: 980-TS1-RT-EZUW INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: ROY F. WESTON, INC. "DRAFT SITE INVESTIGATION REPORT - UNITED CREOSOTING COMPANY SITE CONROE, TEXAS (SECTION 4 - WASTE CHARACTERISTICS AND CONTAMINANT MIGRATION)." MAY 1985.

CONTACT NAME: DONALD WILLIAMS
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1445 ROSS AVENUE, 12TH FLOOR, SUITE 1200, DALLAS, TX 75202
PHONE: 214-655-6444

DOCUMENT NUMBER: 980-TS1-RT-EZYW INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: U.S. DOE - IDAHO NATIONAL ENGINEERING LABORATORY. "WASTE MANAGEMENT PROGRAMS AT EG&G IDAHO, AN OVERVIEW." RECEIVED AUGUST 1987.

CONTACT NAME: NOT REPORTED
ORGANIZATION: EG&G IDAHO, INC
P.O. BOX 1625, IDAHO FALLS, ID 83415
PHONE: 208-526-4225
COMMENTS: RECOMMEDED BY MAJOR TERRY STODDART

DOCUMENT NUMBER: 980-TS1-RT-EZYX INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: U.S. DOE - PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON. "NORTHWEST HAZARDOUS WASTE - RESEARCH, DEVELOPMENT, AND DEMONSTRATION CENTER." (SLIDE PRESENTATION). RECEIVED AUGUST 1987.

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PHONE: 509-376-0330
COMMENTS: IN SITE VITRIFICATION

DOCUMENT NUMBER: 980-TS1-RT-EZYY INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: U.S. DOE - HANFORD, WASHINGTON. "WASTE RECEIVING AND PROCESSING (WRAP) FACILITY." ROCKWELL INTERNATIONAL, ROCKWELL HANFORD OPERATIONS. RECEIVED AUGUST 1987.

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DOCUMENT NUMBER: 980-TS1-RT-EZZE INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: ROY F. WESTON, INC. "CASTLEWOOD REMOVAL ACTION INTERIM REPORT."PREPARED FOR U.S. EPA. JANUARY 1986.

CONTACT NAME: CARL BAILEY
ORGANIZATION: U.S. EPA - REGION VII
726 MINNISOTA STREET, KANSAS CITY, KS 66101
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DOCUMENT NUMBER: 980-TS1-RT-FCAL INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: ROCKWELL INTERNATIONAL. "PRELIMINARY ENGINEERING SPECIFICATIONS FOR A TEST DEMONSTRATION MULTILAYER PROTECTIVE BARRIER COVER SYSTEM." PREPARED FOR U.S. DOE. MARCH 1985.

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ROCKWELL HANFORD OPERATIONS, P.O. BOX 800, RICHLAND, WASHINGTON 99352
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DOCUMENT NUMBER: 980-TS1-RT-FCAM INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: ROCKWELL INTERNATIONAL. "ENGINEERED BARRIER TEST FACILITY STATUS REPORT: 1984." PREPARED FOR U.S. DOE. FEBRUARY 1985.

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DOCUMENT NUMBER: 980-TS1-RT-FCAN INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: ROCKWELL INTERNATIONAL. "ESTIMATION OF GEOMECHANICAL SUBSIDENCE AT HANFORD LOW-LEVEL SOLID WASTE DISPOSAL SITES: EMPIRICAL ANALYSIS BASED ON GEOLOGICAL ENGINEERING." PREPARED FOR U.S. DOE. MARCH 1985.

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DOCUMENT NUMBER: 980-TS1-RT-FCAR INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: ROCKWELL INTERNATIONAL. "NEAR-FIELD EVALUATION OF SUBSIDENCE AND GEOTECHNICAL REMEDIAL ACTIONS AT HAZARDOUS AND RADIOACTIVE MATERIALS DISPOSAL SITES." PREPARED FOR U.S. DOE. MARCH 1985.

CONTACT NAME: STEVEN J. PHILLIPS
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PHONE: 509-373-3468

DOCUMENT NUMBER: 980-TS1-RT-FCFT INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: APPLIED GEOTECHNOLOGY INC. "VOLUME 1 REMEDIAL INVESTIGATION TACOMA TAR PITS, TACOMA, WASHINGTON AGI JOB NO. 14,880.002" FOR WASHINGTON NATURAL GAS CO. JOSEPH SIMON & SONS INC., HYGRADE FOOD PRODUCTS CORP., BURLINGTON NORTHERN RAILROAD CO. MARCH 1986.

CONTACT NAME: WAYNE GROTHEER
ORGANIZATION: U.S. EPA - REGION X
1200 SIXTH AVENUE, SEATTLE, WA 98101
PHONE: 206-442-2723
COMMENTS: TACOMA TAR PITS SITE

DOCUMENT NUMBER: 980-TS1-RT-FCLD INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. "SUPERFUND TECHNOLOGY. ENGINEERING RESEARCH PROGRAM DESCRIPTION AND PLANS." OFFICE OF ENVIRONMENTAL ENGINEERING AND TECHNOLOGY DEMONSTRATION. ORD HWERL. MAY 1987.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-FCQQ INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: U.S. EPA. "PROJECT SUMMARY. GUIDELINES FOR THE USE OF CHEMICALS IN REMOVING HAZARDOUS SUBSTANCES DISCHARGES." ORD. MUNICIPAL ENVIRONMENTAL RESEARCH LABORATORY. EPA-600S2-81-205. OCTOBER 1981.

CONTACT NAME: DR. JOHN BRUGGER
ORGANIZATION: U.S. EPA, ORD
HWERL-RELEASES CONTROL BRANCH, WOODBRIDGE AVENUE, EDISON, NJ 08837-3579
PHONE: 201-340-6634

DOCUMENT NUMBER: 980-TS1-RT-FCQS INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: EDELMAN, TH. AND M. DE BRUIN. NOTICE OF SAMPLE PREPARATION FOR PROCEDURE. "BACKGROUND VALUES OF 32 ELEMENTS IN DUTCH TOPSOILS, DETERMINED WITH NON-DESTRUCTIVE NEUTRON ACTIVATION ANALYSIS."

CONTACT NAME: RICHARD TRAVER TITLE: STAFF ENGINEER
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HWERL-RELEASES CONTROL BRANCH, WOODBRIDGE AVENUE, EDISON, NJ 08837
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DOCUMENT NUMBER: 980-TS1-RT-FCQV INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: PAGE, R.A. AND E. SWIRES-HENNESSY. "A SAFE LEVEL FOR LEAD IN SOIL AND DUST." WELSH OFFICE UNITED KINGDOM.

CONTACT NAME: RICHARD TRAVER TITLE: STAFF ENGINEER
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PHONE: 201-321-6677

DOCUMENT NUMBER: 980-TS1-RT-FCQW INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: ABSTRACTS. "1986-1987 AB685 WASTE REDUCTION GRANT PROJECTS." CALIFORNIA DEPARTMENT OF HEALTH SERVICES.

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COMMENTS: STATE OF CALIFORNIA - DEPT. OF HEALTH SERVICES TOXIC SUBSTANCES CONTROL DIVISION ALTERNATIVE TECHNOLOGY & POLICY DEVEL. SECTION

DOCUMENT NUMBER: 980-TS1-RT-FCQY INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: PROJECT ABSTRACTS. "1985-86 HAZARDOUS WASTE REDUCTION PROJECTS."

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COMMENTS: STATE OF CALIFORNIA - DEPT. OF HEALTH SERVICES TOXIC SUBSTANCES CONTROL DIVISION ALTERNATIVE TECHNOLOGY & POLICY DEVEL. SECTION

DOCUMENT NUMBER: 980-TS1-RT-FCTK INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CASANOVA, J.N. AND LT. COL. R.F. OLFENBUTTEL. "PERMITTING OF REMEDIAL ACTION RESEARCH AT MILITARY SITES CONTAMINATED WITH 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN: PROBLEMS AND POSSIBLE SOLUTIONS."

CONTACT NAME: MAJOR TERRY STODDART
ORGANIZATION: U.S. DOD/AFESC
PHONE: 904-283-2949

DOCUMENT NUMBER: 119-FS1-RT-CMCF INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CAMP DRESSER & MCKEE INC. "HOLLINGSWORTH SOLDERLESS TERMINAL COMPANY FEASIBILITY STUDY, FINAL REPORT." EPA-119-FS1-RT-CMCF-1. MAY 1986.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - REGION IV
345 COURTLAND STREET, NE, ATLANTA, GA 30365
PHONE: 404-347-4727

DOCUMENT NUMBER: 180-FS1-RT-DDJX INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: CAMP DRESSER & MCKEE, INC. "PUBLIC COMMENT DRAFT FEASIBILITY STUDY REPORT BURROWS SANITATION LANDFILL, HARTFORD, MICHIGAN." PREPARED FOR U.S. EPA. EMERGENCY AND REMEDIAL RESPONSE BRANCH. REGION V. 180-FS1-RT-DDJX-1. 80-5L76.5. AUGUST 1986.

CONTACT NAME: TOM THOMAS TITLE: REGIONAL PROJECT MANAGER
ORGANIZATION: U.S. EPA - REGION V
230 SOUTH DEARBORN STREET, CHICAGO, IL 60604
PHONE: 312-886-1434

DOCUMENT NUMBER: 980-TS1-RT-EURG INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: ARTHUR D. LITTLE, INC."EVALUATION/SELECTION OF INNOVATIVE TECHNOLOGIES FOR TESTING WITH BASIN F MATERIALS." PREPARED FOR USATHMA. FEBRUARY 1987.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. DOD/USATHAMA
PHONE: 301-278-5201

DOCUMENT NUMBER: 980-TS1-RT-EURM INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: HAZARDOUS MATERIALS TECHNICAL CENTER. "US ARMY MATERIAL COMMAND POLLUTION ABATEMENT AND INSTALLATION RESTORATION RESEARCH AND DEVELOPMENT PROGRAM ACTIVITIES." PREPARED FOR USATHAMA. DECEMBER 1986.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. DOD/USATHAMA
PHONE: 301-278-5201

DOCUMENT NUMBER: 980-TS1-RT-EURV INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: UNIV. OF CALIFORNIA, DAVIS, ENGINEERING EVALUATION BRANCH, STATIONARY SOURCE DIV. AND DEPT. OF CIVIL ENG. "EVALUATION OF COMBUSTION PROCESSES FOR DESTRUCTION OF LIQUID ORGANIC WASTES." PREPARED FOR THE STATE OF CALIFORNIA AIR RESOURCES BOARD. OCTOBER 1985.

CONTACT NAME: ROBERT ADRIAN TITLE: SENIOR ENGINEER
ORGANIZATION: STATE OF CALIFORNIA
PHONE: 916-322-6025

DOCUMENT NUMBER: 980-TS1-RT-EURZ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: "TEST METHODS FOR SOLIDIFIED WASTE CHARACTERIZATION." DRAFT 31.10.85. RECEIVED FROM U.S. EPA, HWERL, CINCINNATI, OHIO.

CONTACT NAME: CARLTON WILES, Ph.D.
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HWERL-CONTAINMENT BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7795

DOCUMENT NUMBER: 980-TS1-RT-EUTW INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: U.S. EPA. "SPILL CLEAN-UP AT A DEFUNCT INDUSTRIAL WASTE DISPOSAL SITE." THE 1978 NATIONAL CONFERENCE ON CONTROL OF HAZARDOUS MATERIALS SPILLS. MIAMI BEACH, FLORIDA. APRIL 1978.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, WOODBRIDGE AVENUE, EDISON, NJ 08837-3579
PHONE: 212-264-2525

DOCUMENT NUMBER: 980-TS1-RT-EUXK INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: MEMORANDUM-ERT. "FRENCH LIMITED MONTHLY REPORT." JUNE 1987.

CONTACT NAME: MARILYN PLITNICK
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AIR AND HAZARDOUS MATERIALS DIVISION, 1201 ELM STREET, DALLAS, TX 75270
PHONE: 214-655-6715

DOCUMENT NUMBER: 980-TS1-RT-EUXN INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: ALLIANCE TECHNOLOGIES CORPORATION. "STACK TESTING OF THE MOBILE PLASMA ARC UNIT." PREPARED FOR U.S. EPA. HWERL, CINCINNATI, OH. OCTOBER 1986.

CONTACT NAME: C.C. LEE
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-EUZL INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: NOYES DATA CORPORATION. (CONTENTS AND SUBJECT INDEX) "TREATMENT, RECOVERY, AND DISPOSAL PROCESSES FOR RADIOACTIVE WASTES RECENT ADVANCES." 1983

CONTACT NAME: COLLEEN BARNES
ORGANIZATION: INEL
EG&G IDAHO INC., P.O. BOX 1625, IDAHO FALLS, ID 83415
PHONE: 208-526-4225

DOCUMENT NUMBER: 980-TS1-RT-EVAE INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: OPATKEN, E.J., H.K. HOWARD, AND J.J. BOND. "STRINGFELLOW LEACHATE TREATMENT WITH RBC." NATIONAL AICHE MEETING. MIAMI, FL. NOVEMBER 1986.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-EVAH INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: SCHUK, W. AND S. JAMES. "TREATMENT OF LANDFILL LEACHATE AT PUBLICLY OWNED TREATMENT WORKS." NOVEMBER 1986.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-EVAJ INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: SHUCKROW, A.J., A.P. PAJAK, AND C.J. TOUHILL. "GROUNDWATER AND LEACHATE TREATABILITY STUDIES AT FOUR SUPERFUND SITES." PREPARED FOR U.S. EPA, LAND POLLUTION CONTROL DIVISION, HWERL, ORD.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
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DOCUMENT NUMBER: 980-TS1-RT-EVAS INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: CH2M HILL "FINAL FOCUSED FEASIBILITY STUDY, PONDERS CORNER WELL WATER TREATMENT FACILITY." EPA-112-0L22. PREPARED FOR U.S. EPA, HAZARDOUS SITE CONTROL DIVISION. MAY 1985.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - REGION X
1200 SIXTH AVENUE, SEATTLE, WA 98101
PHONE: 206-442-5810

DOCUMENT NUMBER: 980-TS1-RT-EWFN INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: IRVINE,R.L. "PROJECT SUMMARY; TECHNOLOGY ASSESSMENT OF SEQUENCING BATCH REACTORS." EPA/600/S2-85/007. PREPARED FOR U.S. EPA, ORD.MARCH 1985.

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
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DOCUMENT NUMBER: 980-TS1-RT-EWFV INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: DEPARTMENT OF CHEMICAL ENGINEERING, UNIVERSITY OF CALIFORNIA. "CATALYTIC HYDRODECHLORINATION OF PCBs." PREPARED FOR THE CALIFORNIA DEPARTMENT OF HEALTH SERVICES HAZARDOUS WASTE REDUCTION PROGRAM. JUNE 1987.

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DOCUMENT NUMBER: 980-TS1-RT-EWGG INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: BRETON, M., M. ARIENTI, P. FRILLICI, M. KRAVETT, S. PALMER, A. SHAYER, N. SURPRENANT. "PROJECT SUMMARY; TECHNICAL RESOURCE DOCUMENT: TREATMENT TECHNOLOGIES FOR DIOXIN-CONTAINING WASTES." EPA/600/S2-86/096. PREPARED FOR U.S. EPA, ORD. FEBRUARY 1987.

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CONTACT NAME: NOT REPORTED
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7820 PROFESSIONAL PLACE, TAMPA, FL 33637

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CONTACT NAME: TOMMY MYERS
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CONTACT NAME: TOMMY MYERS
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CONTACT NAME: DR. ROBERT J. CASH
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CONTACT NAME: BANERJEE SUNIRMAL
ORGANIZATION: UNIVERSITY OF WASHINGTON

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CONTACT NAME: NOT REPORTED
ORGANIZATION: TETRA TECH (A HONEYWELL SUBSIDIARY)
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CONTACT NAME: MICHAEL R. JUGAN
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COMMENTS: INFO ON GROUT FORMULATION DATA

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COMMENTS: INFO ON HYDROFRACTURE POND FIXATION, GROUT DATA

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COMMENTS: INFO ON GROUT FORMULATION DATA

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COMMENTS: INFO ON GROUT FORMULATION DATA

DOCUMENT NUMBER: 980-TS1-RT-FCGF INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
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COMMENTS: INFO ON GROUT FORMULATION DATA

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COMMENTS: INFO ON GROUT FORMULATION DATA

DOCUMENT NUMBER: 980-TS1-RT-FCGH INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: OAK RIDGE NATIONAL LABORATORY. "GROUT TESTING AND CHARACTERIZATION FOR SHALLOW-LAND BURIAL TRENCHES AT THE IDAHO NATIONAL ENGINEERING LABORATORY." PREPARED FOR U.S. DOE. ORNL/TM-9881. OCTOBER 1986.

CONTACT NAME: EARL W. McDANIEL
ORGANIZATION: U.S. DOE/WMTC
U.S. DEPT. OF ENERGY, ORNL, OAK RIDGE, TN 37831
PHONE: FTS 574-0439
COMMENTS: INFO ON GROUT FORMULATION DATA

DOCUMENT NUMBER: 980-TS1-RT-FCGK INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: OAK RIDGE NATIONAL LABORATORY. "FIXATION OF WASTE MATERIALS IN GROUTS. PART III: EQUATION FOR CRITICAL FLOW RATE." PREPARED FOR U.S. DOE. ORNL/TM-9680/PIII. DECEMBER 1986.

CONTACT NAME: MIKE GILLIAM
ORGANIZATION: U.S. DEPARTMENT OF ENERGY
ORNL, OAK RIDGE, TN 37831
PHONE: FTS 574-6820

DOCUMENT NUMBER: 980-TS1-RT-FCGL INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: OAK RIDGE NATIONAL LABORATORY. "CLEANUP AND TREATMENT OF RADIOACTIVELY CONTAMINATED LAND INCLUDING AREAS NEAR NUCLEAR FACILITIES. A SELECTED BIBLIOGRAPHY." PREPARED FOR U.S. DOE. ORNL/EIS-199. (NVO/AEIC-243). SEPTEMBER 1982.

CONTACT NAME: CATHY FORE
ORGANIZATION: U.S. DOE/HAZWRAP
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PHONE: FTS 574-7769
COMMENTS: INFO ON DATA BASES

DOCUMENT NUMBER: 980-TS1-RT-FCKZ INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: RI/FS REPORT: BOG CREEK FARM SOIL DATA. "SECTION 4.0 HYDORGEOLOGY."

CONTACT NAME: RICHARD SCWARTZ
ORGANIZATION: U.S. EPA - REGION II
EMERGENCY AND REMEDIAL RESPONSE DIVISION, 26 FEDERAL PLAZA, NEW YORK, NY 10278
PHONE: 212-264-1252
COMMENTS: BOG CREEK SITE. MET AT REGION II, 7/22/87.

DOCUMENT NUMBER: 980-TS1-RT-FCLA INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: SLIDE PRESENTATION. "HAZARDOUS WASTE CONTROL TECHNOLOGY."

CONTACT NAME: C.C. LEE
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-FCLB INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: OAK RIDGE NATIONAL LABORATORY. HAZWRAP. "COMMERCIAL TREATMENT, STORAGE, AND DISPOSAL VENDORS: A HANDBOOK OF HAZARDOUS WASTE MANAGEMENT SERVICES. VOLUME 3: APPENDIXES." PREPARED FOR U.S. DOE. DOE/HWP-13/V3. APRIL 1986.

CONTACT NAME: CATHY FORE
ORGANIZATION: U.S. DOE/HAZWRAP
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PHONE: FTS 574-7769
COMMENTS: INFO ON DATA BASES

DOCUMENT NUMBER: 980-TS1-RT-FCLF INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: U.S. EPA. "BACKGROUND MEMORANDUM ON THE NICRO PLATING SITE, LOUISVILLE, KENTUCKY." JUNE 1987.

CONTACT NAME: JAMES KOPOTIC
ORGANIZATION: U.S. EPA - REGION IV
345 COURTLAND STREET, NE, ATLANTA, GA 30365
PHONE: 404-347-4727

DOCUMENT NUMBER: 980-TS1-RT-FCLR INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: WALKER, T.J. AND F.T. LUBOZYNSKI. SLIDE PRESENTATION. "AIR FORCE DERA SUPPLEMENTAL FUNDING DEMONSTRATION PROJECTS." PRESENTED AT THE DOD IRTCC MEETING. JULY 1987.

CONTACT NAME: LT. COL. THOMAS WALKER
ORGANIZATION: U.S. DOD/AFESC
PHONE: 904-283-4628
COMMENTS: ARRANGED MEETINGS W/ PREVIOUS CONTACTS FOR FIELD TEAM. SUGGESTED FIELD TEAM CONTACT HIM IF HE COULD BE OF FURTHER ASSISTANCE.

DOCUMENT NUMBER: 980-TS1-RT-FCMP INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: "SUMMARY OF REMEDIAL ALTERNATIVE SELECTION. GURLEY PIT, EDMONDSON, ARKANSAS. SOURCE CONTROL."

CONTACT NAME: TIMOTHY UNDERWOOD
ORGANIZATION: U.S. EPA - REGION VI
1445 ROSS AVENUE, DALLAS, TX 75202
PHONE: 215-655-6444

DOCUMENT NUMBER: 980-TS1-RT-FCMQ INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: EARTH SCIENCES GROUP. "DIRECT PUSH TECHNOLOGY FOR GROUND WATER CONTAMINATION STUDIES."

CONTACT NAME: PHILIP HILIBAND TITLE: DIRECTOR
ORGANIZATION: EARTH SCIENCES GROUP
PHONE: 305-740-0217

DOCUMENT NUMBER: 980-TS1-RT-FCMR INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: ROBERT S. KERR ENVIRONMENTAL RESEARCH LABORATORY. REPORT. (NO TITLE). GROUND WATER POLLUTION RESEARCH AND DEVELOPMENT TECHNOLOGIES. MARCH 1987.

CONTACT NAME: WILLIAM LUTHENS
ORGANIZATION: U.S. EPA - REGION VI
1445 ROSS AVENUE, DALLAS, TX 75202
PHONE: 215-655-6444

DOCUMENT NUMBER: 980-TS1-RT-FCNL INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: GENUNG, R.K. CHEMICAL TECHNOLOGY DIVISION "AN OVERVIEW OF MARTIN MARIETTA ENERGY SYSTEMS' WASTE MANAGEMENT TECHNOLOGY CENTER."

CONTACT NAME: ROBERT JOLLEY
ORGANIZATION: U.S. DOE/WMTC
U.S. DEPT. OF ENERGY, ORNL, OAK RIDGE, TN 37831
PHONE: FTS 624-6838

DOCUMENT NUMBER: 980-TS1-RT-FCNM INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: U.S. EPA. MEMORANDUM. "FUNDING INCREASE - STANFORD PESTICIDE SITE #1. COCOPAH INDIAN RESERVATION, YUMA COUNTY, ARIZONA." REGION IX. JULY 1987.

CONTACT NAME: DANIEL SHANE
ORGANIZATION: U.S. EPA - REGION IX
EMERGENCY RESPONCE SECTION, 215 FREMONT STREET, SAN FRANCISCO, CA 94105

DOCUMENT NUMBER: 980-TS1-RT-FCNR INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: WASTE MANAGEMENT TECHNOLOGY CENTER. "THE TECHNICAL CENTER FOR IMPLEMENTING THE OAK RIDGE MODEL, THE NEW DOE/ORO APPROACH FOR APPLICATION OF WASTE MANAGEMENT TECHNOLOGY." U.S. DEPARTMENT OF ENERGY.

CONTACT NAME: RICHARD GENUNG
ORGANIZATION: DOE - ORNL
WASTE MANAGEMENT TECHNOLOGY CENTER, P.O. BOX P, OAK RIDGE, TN 37831
PHONE: 615-574-6830

DOCUMENT NUMBER: 980-TS1-RT-FCNZ INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: NAGEL, G.; W. KUEHN, P. WERNER AND H. SONTHEIMER. "SANITATION OF GROUND WATER BY INFILTRATION OF OZONE TREATED WATER." GWF-WASSER/ABWASSER, 123(8):399-407, 1982. TR-3-029. MARCH 1987.

CONTACT NAME: JANETTE HANSEN
ORGANIZATION: U.S. EPA
OFFICE OF SOLID WASTE, RMS-263D/WH-563, 401 M STREET S.W., WASHINGTON, D.C. 20460
PHONE: 202-382-4754

DOCUMENT NUMBER: 980-TS1-RT-FCPA INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: (TO BE READ IN CONJUNCTION WITH TRIP REPORT - KARLSRUHE GERMANY ON THE SAME SUBJECT BY WALTER KOVALICK). "PART II - TRIP REPORT - NATO - CCMS PILOT STUDY." MARCH 1987.

CONTACT NAME: JANETTE HANSEN
ORGANIZATION: U.S. EPA
OFFICE OF SOLID WASTE, RMS-263D/WH-563, 401 M STREET S.W., WASHINGTON, D.C. 20460
PHONE: 202-382-4754

DOCUMENT NUMBER: 980-TS1-RT-FCPF INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: KARLSRUHE. FEDERAL REPUBLIC OF GERMANY. "NATO CCMS PILOT STUDY ON DEMONSTRATION OF REMEDIAL ACTION TECHNOLOGIES FOR CONTAMINATED LAND AND GROUNDWATER." AGENDA. MARCH 1987.

CONTACT NAME: JANETTE HANSEN
ORGANIZATION: U.S. EPA
OFFICE OF SOLID WASTE, RMS-263D/WH-563, 401 M STREET S.W., WASHINGTON, D.C. 20460
PHONE: 202-382-4754

DOCUMENT NUMBER: 980-TS1-RT-FCPH INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: KARLSRUHE. FEDERAL REPUBLIC OF GERMANY. "NATO CCMS PILOT STUDY ON DEMONSTRATION OF REMEDIAL ACTION TECHNOLOGIES FOR CONTAMINATED LAND AND GROUNDWATER." LIST OF COUNTRIES AND THEIR PROJECTS FOR PRESENTATION. MARCH 1987.

CONTACT NAME: JANETTE HANSEN
ORGANIZATION: U.S. EPA
OFFICE OF SOLID WASTE, RMS-263D/WH-563, 401 M STREET S.W., WASHINGTON, D.C. 20460
PHONE: 202-382-4754

DOCUMENT NUMBER: 980-TS1-RT-FCPT INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: NATO-CCMS PILOT STUDY ON DEMONSTRATION OF REMEDIAL ACTION TECHNOLOGIES FOR CONTAMINATED LAND AND GROUNDWATER. "PLANNING QUESTIONNAIRE: CANADA." FEBRUARY 1987.

CONTACT NAME: PIERRE COTE
ORGANIZATION: ENVIRONMENT CANADA
WASTEWATER TECHNOLOGY CENTRE, P.O. BOX 5050, 867 LAKESHORE ROAD, BURLINGTON, ONTARIO L7R 4A6

DOCUMENT NUMBER: 980-TS1-RT-FCPU INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: NATO-CCMS PILOT STUDY ON DEMONSTRATION OF REMEDIAL ACTION TECHNOLOGIES FOR CONTAMINATED LAND AND GROUNDWATER. PLANNING QUESTIONNAIRE: DENMARK. MARCH 1987.

CONTACT NAME: JANETTE HANSEN
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PHONE: 202-382-4754

DOCUMENT NUMBER: 980-TS1-RT-FCQA INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: NATO-CCMS PILOT STUDY ON DEMONSTRATION OF REMEDIAL ACTION TECHNOLOGIES FOR CONTAMINATED LAND AND GROUNDWATER. "PLANNING QUESTIONNAIRE: JAPAN." JANUARY 1987.

CONTACT NAME: JANETTE HANSEN
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DOCUMENT NUMBER: 980-TS1-RT-FCQG INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: SOCZO, E.R. "PROJECT: CLEANUP BY MEANS OF LANDFARMING." PRESENTED AT THE NATO-CCMS PILOT STUDY ON DEMONSTRATION OF REMEDIAL ACTION TECHNOLOGIES FOR CONTAMINATED LAND AND GROUNDWATER.

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PHONE: 202-382-4754

DOCUMENT NUMBER: 980-TS1-RT-FCQH INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. TRIP REPORT. "NATO-CCMS PILOT STUDY OF REMEDIAL ACTION TECHNOLOGIES FOR CONTAMINATED LAND AND GROUNDWATER. MARCH 16-20, 1987 -- KARLSRUHE, GERMANY." OFFICE OF SOLID WASTE AND EMERGENCY RESPONSE. MARCH 1987.

CONTACT NAME: JANETTE HANSEN
ORGANIZATION: U.S. EPA
OFFICE OF SOLID WASTE, RMS-263D/WH-563, 401 M STREET S.W., WASHINGTON, D.C. 20460
PHONE: 202-382-4754

DOCUMENT NUMBER: 980-TS1-RT-FCQL INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: WASTE MANAGEMENT TECHNOLOGY. "THE OAK RIDGE MODEL: AN APPROACH FOR WASTE MANAGEMENT TECHNOLOGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION." PUBLICATION FOR THE UNITED STATES DEPARTMENT OF ENERGY. NO DATE.

CONTACT NAME: RICHARD GENUNG
ORGANIZATION: DOE - ORNL
WASTE MANAGEMENT TECHNOLOGY CENTER, P.O. BOX P, OAK RIDGE, TN 37831
PHONE: 615-574-6830

DOCUMENT NUMBER: 980-TS1-RT-FCQR INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. SLIDE PRESENTATION FOR RCRA/CERCLA ALTERNATIVE TREATMENT TECHNOLOGY SEMINARS. "SOIL WASHING OF LEAD CONTAMINATED SOIL. EPA MOBILE SOILS WASHER. LEEDS, AL."

CONTACT NAME: NOT REPORTED
ORGANIZATION: U.S. EPA - REGION IV
345 COURTLAND STREET, NE, ATLANTA, GA 30365
PHONE: 404-347-4727

DOCUMENT NUMBER: 980-TS1-RT-FCQZ INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: SLIDE PRESENTATION. "MAJOR REMEDIAL ACTION DEMONSTRATIONS."

CONTACT NAME: LESLIE DOLE TITLE: PROGRAM MANAGER
ORGANIZATION: WMTC, DOE, ORNL
P.O. BOX P, BUILDING K 1000 MS-183, OAK RIDGE, TN 37831
PHONE: 615-576-7421
COMMENTS: INFO ON THE PEPPER STEEL SITE AND OTHERS

DOCUMENT NUMBER: 980-TS1-RT-FCRA INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: SLIDE PRESENTATION. "PHASE 2 - 3. RESEARCH AND DEVELOPMENT TASKS."

CONTACT NAME: JAMES EPLER
ORGANIZATION: U.S. DOE/HAZWRAP
U.S. DEPT. OF ENERGY, ORNL, OAK RIDGE, TN 37831
PHONE: FTS 624-0841

DOCUMENT NUMBER: 980-TS1-RT-FCRB INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: SLIDE PRESENTATION. "HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM RESEARCH, DEVELOPMENT & DEMONSTRATION PROGRAM."

CONTACT NAME: JAMES EPLER
ORGANIZATION: U.S. DOE/HAZWRAP
U.S. DEPT. OF ENERGY, ORNL, OAK RIDGE, TN 37831
PHONE: FTS 624-0841

DOCUMENT NUMBER: 980-TS1-RT-FCRH INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: KENNERLY, J.M. "SUPPORT ACTIVITIES FOR THE LOW-LEVEL SOLID WASTE DISPOSAL PROGRAMS." SLIDE PRESENTATION FOR THE CHEMICAL TECHNOLOGY DIVISION INFORMATION MEETING. JUNE 1984.

CONTACT NAME: J.M. KENNERLY
ORGANIZATION: U.S. DOE
OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, TN 37831
PHONE: FTS-624-9935

DOCUMENT NUMBER: 980-TS1-RT-FCRJ INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: ADAMS, R.E. SLIDE PRESENTATION. "HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM TECHNOLOGY DEMONSTRATION PROGRAM." PREPARED FOR HAZWRAP - SUPPORT CONTRACTOR OFFICE, ORNL.

CONTACT NAME: ROBERT ADAMS
ORGANIZATION: U.S. DOE/HAZWRAP
U.S. DEPT. OF ENERGY, ORNL, OAK RIDGE, TN 37831
PHONE: FTS 626-0556
COMMENTS: INFO ON SLUDGE DEMO PROGRAM, PCB BIODEGRADATION, SAVANNAH RIVER PLANT, MAIN SITE GASOLINE SPILL, CENTRAL FACILITIES AREA LANDFILL

DOCUMENT NUMBER: 980-TS1-RT-FCRW INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: JOHN MATHES & ASSOCIATES, INC. " MAP OF SAMPLING LOCATIONS AND TABLES, SAND SPRINGS, OKLAHOMA."

CONTACT NAME: EDWIN BARTH
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7931

DOCUMENT NUMBER: 980-TS1-RT-FCSL INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: PPM INC. MEMO. "PPM SOIL WASHING PROCESS FOR PCB'S/STATUS." MAY 1987.

CONTACT NAME: KENT WOODWARD
ORGANIZATION: PPM, INC.
PHONE: 404-934-0902

DOCUMENT NUMBER: 980-TS1-RT-FCSR INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CH2M HILL. "PROTECTING THE BISCAYNE AQUIFER. ACTIONS TO BE TAKEN AT THE PEPPER'S STEEL AND ALLOYS SITE." PREPARED FOR U.S. EPA. JULY 1987.

CONTACT NAME: ELIO ARNIELLA
ORGANIZATION: CDM - ATLANTA, GA
2100 RIVER EDGE PARKWAY, ATLANTA, GA 30328
PHONE: 404-952-8643

DOCUMENT NUMBER: 980-TS1-RT-FCSU INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: CAMP DRESSER & MCKEE INC. LIPARI SAMPLING DATA. "WELL DATA FROM THE LIPARI LANDFILL SITE." PREPARED FOR U.S. EPA. REGION 2.

CONTACT NAME: KEVIN OATES
ORGANIZATION: U.S. EPA - REGION II
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PHONE: 212-264-4425
COMMENTS: MET AT REGION II, 7/22/87. LIPARI LANDFILL SITE.

DOCUMENT NUMBER: 980-TS1-RT-FCSY INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: PAPER. "APEG TREATMENT OF DIOXIN-CONTAMINATED SOIL IN BUTTE, MONTANA." NOVEMBER 1986.

CONTACT NAME: CHARLES ROGERS
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7757
COMMENTS: INFO ON KPEG. ALSO CONTACT GALSON RESEARCH. RECOMMENDED BY MAJOR TERRY STODDART.

DOCUMENT NUMBER: 980-TS1-RT-FCTF INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: KOPTIC, J. OSC. FIELD REPORT. "HOLLINGSWORTH SOLDERLESS TERMINAL SITE REMOVAL, FT. LAUDERDALE, FL." FEBRUARY 1987.

CONTACT NAME: JAMES KOPOTIC
ORGANIZATION: U.S. EPA - REGION IV
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PHONE: 404-347-4727

DOCUMENT NUMBER: 980-TS1-RT-FCTG INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CALIFORNIA DEPARTMENT OF HEALTH SERVICES. LABORATORY REPORT. "MOBIL/ENSOTECH, GARFIELD AND NEWMARK, MONTERY PARK, CA." JUNE 1987.

CONTACT NAME: RONALD LEWIS
ORGANIZATION: U.S. EPA, ORD
HWERL-CHEM. AND BIOL. DETOX. BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7856

DOCUMENT NUMBER: 980-TS1-RT-FCTJ INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: IIT RESEARCH INSTITUTE. "PRE-PILOT SCALE DECONTAMINATION EXPERIMENT SUMMARY OF EXPERIMENTAL CONDITIONS (CONTAMINATED VOLK FIELD SOIL)."

CONTACT NAME: DOUG DOWNEY
ORGANIZATION: U.S. DOD/AFESC
PHONE: 904-283-2942

DOCUMENT NUMBER: 980-TS1-RT-FCTP INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: U.S. ARMY CORPS OF ENGINEERS. "LANDFILL GAS CONTROL AT MILITARY INSTALLATIONS." TECHNICAL REPORT N-173. JANUARY 1984.

CONTACT NAME: PAUL F. de PERCIN
ORGANIZATION: U.S. EPA, ORD
HWERL-CONTAINMENT BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7787

DOCUMENT NUMBER: 980-TS1-RT-FCTQ INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: RADIAN RESEARCH CORPORATION. "AIR STRIPPING OF CONTAMINATED WATER SOURCES AIR EMISSIONS AND CONTROLS." PREPARED FOR AIR TOXICS CONTROL TECHNOLOGY CENTER. U.S. EPA. RTP. JULY 1987.

CONTACT NAME: PAUL F. de PERCIN
ORGANIZATION: U.S. EPA, ORD
HWERL-CONTAINMENT BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
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DOCUMENT NUMBER: 980-TS1-RT-FCTS INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA. SLIDE PRESENTATION. "POTASSIUM POLYETHYLENE GLYCOL (KPEG) CHEMICAL DETOXIFICATION."

CONTACT NAME: DONALD WILHELM
ORGANIZATION: U.S. EPA, ORD
ORD LABORATORY, ATHENS, GA
PHONE: 404-382-4847
COMMENTS: RECOMMENDED BY JIM ORBAN

DOCUMENT NUMBER: 980-TS1-RT-FCTT INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: LEE, C.C. "A MODEL ANALYSIS OF METAL PARTITIONING IN A HAZARDOUS WASTE INCINERATION SYSTEM." AN ARTICLE FOR THE PEER-REVIEWED JOURNAL, "THE JOURNAL OF THE AIR POLLUTION CONTROL ASSOCIATION (JAPCA)." NOVEMBER 1986.

CONTACT NAME: C.C. LEE
ORGANIZATION: U.S. EPA, ORD
HWERL, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-684-7537

DOCUMENT NUMBER: 980-TS1-RT-FCTV INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: ERIKSSON, INGA-MAJ. "RE USE OF DEGRADED LAND IN URBAN AREAS; A STUDY OF LAND USE, ECONOMICAL AND TECHNICAL FACTORS." (THE ROYAL INSTITUTE OF TECHNOLOGY. STOCKHOLM, SWEDEN).

CONTACT NAME: DONALD SANNING
ORGANIZATION: U.S. EPA, ORD
HWERL-CONTAINMENT BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7875

DOCUMENT NUMBER: 980-TS1-RT-FCTW INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: SPRINGER-VERLAG. "CHEMICAL WASTE HANDLING AND TREATMENT."

CONTACT NAME: DONALD SANNING
ORGANIZATION: U.S. EPA, ORD
HWERL-CONTAINMENT BRANCH, 26 W. ST. CLAIR STREET, CINCINNATI, OH 45268
PHONE: 513-569-7875

DOCUMENT NUMBER: 980-TS1-RT-FCTX INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: MID WEST ANALYTICAL LABORATORIES, INC. LAB REPORTS (7). "PCBs FROM VARIOUS SAMPLE TYPES." PREPARED FOR RIEDEL ENVIRONMENTAL. SEPTEMBER-OCTOBER 1985.

CONTACT NAME: WILLIAM LUTHENS
ORGANIZATION: U.S. EPA - REGION VI
1445 ROSS AVENUE, DALLAS, TX 75202
PHONE: 215-655-6444

DOCUMENT NUMBER: 980-TS1-RT-FCTY INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CENTERS FOR DISEASE CONTROL, DEPARTMENT OF HEALTH & HUMAN SERVICES. "DECON PROCEDURE AND ANALYTICAL WIPE SAMPLE PROCEDURE FOR THE QUAIL RUN SITE, FRANKLIN CITY, MISSOURI." MARCH 1985.

CONTACT NAME: CARL BAILEY
ORGANIZATION: U.S. EPA - REGION VII
726 MINNISOTA STREET, KANSAS CITY, KS 66101
PHONE: 913-236-2891

DOCUMENT NUMBER: 980-TS1-RT-FCUF INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: CALIFORNIA DEPARTMENT OF HEALTH SERVICES. LABORATORY REPORT. "LASSEN COLLEGE COGENERATION PLANT. SUSANVILLE, CA." HML# C1714 TO C1721. MARCH 1987.

CONTACT NAME: FREDERICK A. TORNATORE TITLE: ASSOCIATE HAZARDOUS MATERIALS SPECIALIST
ORGANIZATION: STATE OF CALIF - DEPT OF HEALTH SERVICES
TOXIC SUBSTANCES CONTROL DIVISION, 714-744 P STREET, SACRAMENTO, CA 95814
PHONE: 916-324-1807
COMMENTS: STATE OF CALIFORNIA - DEPT. OF HEALTH SERVICES TOXIC SUBSTANCES CONTROL DIVISION ALTERNATIVE TECHNOLOGY & POLICY DEVEL. SECTION

DOCUMENT NUMBER: 980-TS1-RT-FCUP INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: OAK RIDGE NATIONAL LABORATORY. HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM (HAZWRAP) WASTE INFORMATION NETWORK (WIN) DATA BASE RESPONSE TO A "REQUEST FOR BEST DEMONSTRATED AVAILABLE TECHNOLOGIES FOR THE DEPARTMENT OF ENERGY SUPERFUND WASTES." MAY 1987.

CONTACT NAME: DEAN EYMAN
ORGANIZATION: U.S. DEPARTMENT OF ENERGY
ORNL, OAK RIDGE, TN 37831
PHONE: FTS 574-7299
COMMENTS: RECOMMENDED BY DOUG DOWNEY

DOCUMENT NUMBER: 980-TS1-RT-FCUQ INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: U.S. DOD. "SECTION 00005. CHROMIUM WASTE TREATMENT AND DISPOSAL." SUMMARY REPORT RECEIVED FROM U.S. DEPARTMENT OF THE NAVY, PORT HUENEME, CALIFORNIA.

CONTACT NAME: JACQUELINE R. FRANCIS TITLE: BIOLOGIST
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DOCUMENT NUMBER: 980-TS1-RT-FCUR INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: SLIDE PRESENTATION. "FUEL OIL BIODEGRADATION NAS PATUXENT RIVER PRODUCTS."

CONTACT NAME: RONALD E. HOEPPEL TITLE: SOIL MICROBIOLOGIST, ENVIR. SCIENTIST
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DOCUMENT NUMBER: 980-TS1-RT-FCUS INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: U.S. DOD. SIXTEEN ENVIRONMENTAL POLLUTION REPORTS. SEPTEMBER 1986-MAY 1987. RECEIVED FROM U.S. DEPARTMENT OF THE NAVY, PORT HUENEME, CALIFORNIA.

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DOCUMENT NUMBER: 980-TS1-RT-FDAZ INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: PROPOSED PROJECTS. "ARMY HAZARDOUS WASTE CLEANUP AND ASSOCIATED TECHNOLOGY DEMONSTRATIONS." PRESENTED AT IRTC MEETING.

CONTACT NAME: MR. BARTELL
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DOCUMENT NUMBER: 980-TS1-RT-FDBH INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA, REGION IV. "IMMEDIATE REMOVAL ACTIVITIES, CITY CHEMICAL, ORLANDO, FL." JUNE 1984.

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DOCUMENT NUMBER: 980-TS1-RT-FDBK INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: ENVIRONMENTAL SCIENCE AND ENGINEERING, INC. "SOURCE EMISSIONS AND AMBIENT AIR CONCENTRATIONS FROM THERMAL REMOVAL TEST - CITY CHEMICAL COMPANY CONTAMINATED SOIL." PREPARED FOR U.S. EPA THROUGH ROY F. WESTON. SEPTEMBER 1984.

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DOCUMENT NUMBER: 980-TS1-RT-FHME INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: JBF SCIENTIFIC CORPORATION. "STABALIZATION, TESTING, AND DISPOSAL OF ARSENIC CONTAINING WASTES." PREPARED FOR U.S. EPA, OFFICE OF RESEARCH AND DEVELOPMENT, CINCINNATI, OH.

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DOCUMENT NUMBER: 980-TS1-RT-FQSP INFORMATION TYPE: INFORMATION/DATA ON IN-SITU
REFERENCE: HARRESS GEOTECHNIK. "VAPOR EXTRACTION AS AN IN SITU METHOD TO REMOVE VOLATILE ORGANIC COMPOUNDS FROM THE SOIL - EVALUATION OF RESULTS." "EXAMPLES FOR VACUUM EXTRACTION IN GERMANY."

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401 M STREET, S.W., WASHINGTON, D.C. 20460

DOCUMENT NUMBER: 980-TS1-RT-FRAG INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: JOHN A. BUMPUS & STEVEN D. AUST - DEPARTMENT OF BIOCHEMISTRY, MICHIGAN STATE UNIVERSITY. "MINERALIZATION OF RECALCITRANT ENVIRONMENTAL POLLUTANTS BY A WHITE ROT FUNGUS." PRESENTED AT THE RCRA, 1987.

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DOCUMENT NUMBER: 980-TS1-RT-FRAJ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: "HAZARDOUS WASTE BIOTREATMENT FIGHTS FOR RECOGNITION." CHEMICAL WEEK MAGAZINE. OCTOBER 29, 1987.

CONTACT NAME: MIMI BLUESTONE TITLE: SEATTLE OFFICE
ORGANIZATION: CHEMICAL WEEK MAGAZINE

DOCUMENT NUMBER: 980-TS1-RT-FRAK INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: J.A. BUMPUS, T. FERNANDO, G.J. MILESKI AND S.D. AUST - DEPARTMENT OF BIOCHEMISTRY, MICHIGAN STATE UNIVERSITY. "BIODEGRADATION OF ORGANOPOLLUTANTS BY PHANEROCHAETE CHRYSOSPORIUM: PRACTICAL CONSIDERATIONS." PRESENTED AT U.S. EPA THIRTEENTH ANNUAL RESEARCH SYMPOSIUM, HWERL, CINCINNATI, MAY 6-8, 1987.

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DOCUMENT NUMBER: 980-TS1-RT-FRAL INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: JOHN A. BUMPUS AND STEVEN D. AUST - CENTER FOR THE STUDY OF ACTIVE OXYGEN IN BIOLOGY & MEDICINE, DEPARTMENT OF BIOCHEMISTRY MICHIGAN STATE UNIVERSITY. "STUDIES ON THE BIODEGRADATION OF ORGANOPOLLUTANTS BY A WHITE ROT FUNGUS." PRESENTED AT THE INTERNATIONAL CONFERENCE ON NEW FRONTIERS FOR HAZARDOUS WASTE MANAGEMENT. SEPTEMBER 15-18, 1985, PITTSBURGH, PA, U.S. EPA.

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DOCUMENT NUMBER: 980-TS1-RT-FRAM INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: HWERL, CINCINNATI, OHIO. "ENVIRONMENTAL RESEARCH BRIEF - BIODEGRADATION OF HALOGENATED HYDROCARBONS." PREPARED FOR U.S. EPA. JUNE 1987.

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DOCUMENT NUMBER: 980-TS1-RT-FRDH INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: T. FERNANDO, J.A. BUMPUS, S.D. AUST - DEPARTMENT OF CHEMISTRY, MICHIGAN STATE UNIVERSITY. "CONDITIONS WHICH ENHANCE BIODEGRADATION OF ORGANIC COMPOUNDS BY WHITE ROT FUNGI."

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DOCUMENT NUMBER: 980-TS1-RT-FRDJ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S.D.A. FOREST PRODUCTS LABORATORY & HWERL, CINCINNATI, OHIO. "GROWTH OF THE WHITE-ROT FUNGUS PHANEROCHAETE CHRYSOSPORIUM IN SOIL."

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DOCUMENT NUMBER: 980-TS1-RT-FRDM INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: BEDARD, HABERL, MAY AND BRENNAN. "EVIDENCE FOR NOVEL MECHANISMS OF POLYCHLORINATED BIPHENYL METABOLISM IN ALCALIGENES EUTROPHUS H850." APPLIED AND ENVIRONMENTAL MICROBIOLOGY. MAY 1987.

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COMMENTS: NOW WORKING FOR JOHNSON ASSOCIATES, INC. 181 CHERRY VALLEY ROAD PRINCETON, NJ 08540 609-924-3420

DOCUMENT NUMBER: 980-TS1-RT-FRDN INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: BEDARD, WAGNER, BRENNAN, HABERL, AND BROWN. "EXTENSIVE DEGRADATION OF AROCLORS AND ENVIRONMENTALLY TRANSFORMED POLYCHLORINATED BIPHENYLS BY ALCALIGENES EUTROPHUS H850." APPLIED AND ENVIRONMENTAL MICROBIOLOGY. MAY 1987.

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DOCUMENT NUMBER: 980-TS1-RT-FRDQ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: UNTERMAN, BEDARD, BRENNAN, BOPP, MONDELLO, BROOKS, MOBLEY, MCDERMOTT, SCHWARTZ, DIETRICH. GENERAL ELECTRIC COMPANY. "BIOLOGICAL APPROACHES FOR PCB DEGRADATION."

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DOCUMENT NUMBER: 980-TS1-RT-FRDR INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: JOHN A. BUMPUS AND STEVEN D. AUST. "BIODEGRADATION OF ENVIRONMENTAL POLLUTANTS BY THE WHITE ROT FUNGUS PHANEROCHAETE CHRYSOSPORIUM: INVOLVEMENT OF THE LIGNIN DEGRADING SYSTEM." BIOESSAYS VOL.6, NO.4. APRIL 1987.

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DOCUMENT NUMBER: 980-TS1-RT-FRDT INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: BUMPUS, TIEN, WRIGHT & AUST. "OXIDATION OF PERSISTENT ENVIRONMENTAL POLLUTANTS BY A WHITE ROT FUNGUS." REPRINT - AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, JUNE 21, 1985, VOL.228.

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DOCUMENT NUMBER: 980-TS1-RT-FRDU INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: JOHN A. BUMPUS AND STEVEN D. AUST - CENTER FOR THE STUDY OF ACTIVE OXYGEN IN BIOLOGY AND MEDICINE, DEPARTMENT OF BIOCHEMISTRY, MICHIGAN STATE UNIVERSITY. "BIODEGRADATION OF DDT (1,1,1-TRICHLORO-2,2-BIS(4-CHLOROPHENYL)ETHANE) BY THE WHITE ROT FUNGUS PHANEROCHAETE CHRYSOSPORIUM." APPLIED ENVIRONMENTAL MICROBIOLOGY 1987.

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DOCUMENT NUMBER: 980-TS1-RT-FRDV INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: JOHN A. BUMPUS AND STEVEN D. AUST - CENTER FOR THE STUDY OF ACTIVE OXYGEN IN BIOLOGY AND MEDICINE, DEPARTMENT OF BIOCHEMISTRY, MICHIGAN STATE UNIVERSITY. "BIOLOGICAL OXIDATIONS BY ENZYMES FROM A WHITE ROT FUNGUS." SYMP. OF AMERICAN INSTITUTE OF CHEMICAL ENGINEERS 1986.

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DOCUMENT NUMBER: 980-TS1-RT-FRDW INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: EATON, CHANG, JOYCE - DEPT. OF WOOD AND PAPER SCIENCE, NC STATE UNIVERSITY. JEFFRIES & KIRK - U.S.D.A. FOREST SERVICE, FOREST PRODUCTS LABORATORY. "METHOD OBTAINS FUNGAL REDUCTION OF THE COLOR OF EXTRACTION-STAGE KRAFT BLEACH EFFLUENTS." TAPPI. JUNE 1982.

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DOCUMENT NUMBER: 980-TS1-RT-FRDY INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: MASOOD ARJMAND AND HEINRICH SANDERMANN, JR. "MINERALIZATION OF CHLOROANILINE/LIGNIN CONJUGATES AND OF FREE CHLOROANILINES BY THE WHITE ROT FUNGUS PHANEROCHAETE CHRYSOSPORIUM." JOURNAL OF AGRICULTURE AND FOOD CHEMICALS, VOL.33, NO.6, 1985.

CONTACT NAME: NOT REPORTED
ORGANIZATION: JOURNAL OF AGRICULTURE & FOOD CHEMICALS

DOCUMENT NUMBER: 980-TS1-RT-FRDZ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: BROWN, BEDARD, BRENNAN, CARNAHAN, FENG, AND WAGNER. "POLYCHLORINATED BIPHENYL DECHLORINATION IN AQUATIC SEDIMENTS." REPRINT FROM THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. MAY 8, 1987, VOLUME 236, PP. 709-712.

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DOCUMENT NUMBER: 980-TS1-RT-FREA INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: LAWRENCE H.BOPP, GENERAL ELECTRIC COMPANY. "DEGRADATION OF HIGHLY CHLORINATED PCBS BY PSEUDOMONAS STRAIN LB400." JOURNAL OF INDUSTRIAL MICROBIOLOGY. 1986.

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DOCUMENT NUMBER: 980-TS1-RT-FREB INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: BILOGICAL SCIENCES BRANCH, GENERAL ELECTRIC COMPANY. "RAPID ASSAY FOR SCREENING AND CHARACTERIZING MICROORGANISMS FOR THE ABILITY TO DEGRADE POLYCHLORINATED BIPHENYLS." APPLIED AND ENVIRONMENTAL MICRO BIOLOGY MAGAZINE, APRIL 1987.

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DOCUMENT NUMBER: 980-TS1-RT-FREC INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: DAVID C. EATON. GENEX CORPORATION. "MINERALIZATION OF POLYCHLORINATED BIPHENYLS BY PHANEROCHAETE CHRYSOSPORIUM: A LIGNINOLYTIC FUNGUS." ENZYME MICROBIAL TECHNOLOGY, 1985, RAPID COMMUNICATION, 7:194-196.

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DOCUMENT NUMBER: 980-TS1-RT-FRED INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: KIRK - U.S.D.A. FOREST PRODUCTS LABORATORY & CHANG - N.C. STATE UNIVERSITY. "POTENTIAL APPLICATIONS OF BIO-LIGNINOLYTIC SYSTEMS." ENZYME MICROB. TECHNOL., 1981, VOL.3, JULY.

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DOCUMENT NUMBER: 980-TS1-RT-FREE INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: EATON & CHANG - DEPT OF WOOD AND PAPER SCIENCE, NC STATE UNIVERSITY. KIRK - U.S. FOREST PRODUCTS LABORATORY. "FUNGAL DECOLORIZATION OF DRAFT BLEACH PLANT EFFLUENTS." TAPPI, OCTOBER 1980.

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DOCUMENT NUMBER: 980-TS1-RT-FREF INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: LARRY J. FORNEY, C. ADINARAYANA REDDY, MING TIEN, AND STEVEN D. AUST - DEPARTMENTS OF MICROBIOLOGY AND PUBLIC HEALTH AND BIOCHEMISTRY, MICHIGAN STATE UNIVERSITY. "THE INVOLVEMENT OF HYDROXYL RADICAL DERIVED FROM HYDROGEN PEROXIDE IN LIGNIN DEGRADATION BY THE WHITE ROT FUNGUS PHANEROCHAETE CHRYSOSPORIUM." JOURNAL OF BIOLOGICAL CHEMISTRY, VOL.257, NO. 19, OCTOBER 10, 1987.

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DOCUMENT NUMBER: 980-TS1-RT-FREG INFORMATION TYPE: INFORMATION/DATA ON LIQUID WASTES
REFERENCE: CAMPBELL, GERRARD, JOYCE, & CHANG - NC STATE UNIVERSITY. KIRK - U.S. FOREST LABORATORY. "THE MYCOR PROCESS FOR COLOR REMOVAL FROM BLEACH PLANT EFFLUENT: BENCH SCALE STUDIES." TAPPI, 1982.

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DOCUMENT NUMBER: 980-TS1-RT-FRER INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: OAK RIDGE NATIONAL LABORATORY-CHEMICAL TECHNOLOGY DIVISION. "COST ESTIMATE OF GROUTING THE PROPOSED TEST PITS AT IDAHO NATIONAL ENGINEERING LABORATORY USING THE ORNL-RECOMMENDED GROUTS." PREPARED FOR U.S. DOE. AUGUST 1987.

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DOCUMENT NUMBER: 980-TS1-RT-FRES INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: OAK RIDGE NATIONAL LABORATORY-CHEMICAL TECHNOLOGY DIVISION. "RHEOLOGY OF SLUDGE-SLURRY GROUTS." PREPARED FOR U.S. DOE. OCTOBER 1980.

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DOCUMENT NUMBER: 980-TS1-RT-FREV INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: ENVIRESPONSE, INC. "PEAKE OIL SITE TAMPA, FLORIDA. PROJECT NO. 3-60-47190407." PREPARED FOR U.S. EPA, ERT. OCTOBER 1986.

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DOCUMENT NUMBER: 980-TS1-RT-FREY INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: "REMOVAL OPERATIONS AT HOLLINGSWORTH SOLDERLESS TERMINAL COMPANY, EAST DRAINFIELD, FT. LAUDERDALE, FLORIDA." APRIL 1987.

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DOCUMENT NUMBER: 980-TS1-RT-FREY INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: "REMOVAL OPERATIONS AT HOLLINGWORTH SOLDERLESS TERMINAL COMPANY/EAST DRAINFIELD - FT. LAUDERDALE, FLA."SUBMITTED TO US EPA REGION IV

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DOCUMENT NUMBER: 980-TS1-RT-FYPL INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: HAZARDOUS MATERIALS TECHNICAL CENTER "POLLUTION ABATEMENT AND INSTALLATION RESTORATION RESEARCH AND DEVELOPMENT PROGRAMS ACTIVIES." DECEMBER, 1987

CONTACT NAME: ERIK HANGELAND TITLE: ENGINEER
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DOCUMENT NUMBER: 980-TS1-RT-FYPM INFORMATION TYPE: INFORMATION NOT APPLICABLE TO REGULATION
REFERENCE: ILLINOIS INSTITUTE OF TECHNOLOGY AND ITALIAN NATIONAL RESEARCH COUNCIL. "PROCEEDINGS: INTERNATIONAL SYMPOSIUM ON METALS SPECIATION, SEPARATION, AND RECOVERY." JULY 27-AUGUST 1, 1986

CONTACT NAME: DR. SANFORD SIEGEL
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COMMENTS: PAPER PRESENTED AT SYMPOSIUM ON METAL SPECIATION,SEPARATION AND RECOVERY - ILLINOIS INSTITUTE OF TECHNOLOGY JULY 27 - AUGUST 1, 1986

DOCUMENT NUMBER: 980-TS1-RT-FYRA INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: GALSON RESEARCH CORPORATION. "OPERATING AND QUALITY CONTROL PROCEDURES - LABORATORY STUDY FOR APEG CLEANUP OF MGM BRAKE SUPERFUND SITE." SEPTEMBER 16, 1987

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DOCUMENT NUMBER: 980-TS1-RT-FYRE INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: NATIONAL SANITATION FOUNDATION, ANN ARBOR, MI. "LEACHATE TESTING OF HAZARDOUS CHEMICALS FROM STABILIZEDF AUTOMOTIVE WASTES." JANUARY, 1979

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COMMENTS: LEACH TESTING OF HAZARDOUS CHEMICALS

DOCUMENT NUMBER: 980-TS1-RT-FYRF INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
REFERENCE: U.S. EPA REGION IV, SAVANNAH LABS, RESOURCE CONSERVATION CO. GENERAL REFINING SITE - B.E.S.T. INFORMATION AND ANALYSES." AUGUST 1985 - FEBRUARY 1987 "GENERAL REFINING SITE- B.E.S.T. INFORMATION AND ANALYSES." AUGUST 1985 - FEBRUARY 1987

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COMMENTS: B.E.S.T. INFORMATION ON THE GENERAL REFINING SITE,IN CONJUNCTION WITH SAVANNAH LABS AND RESOURCE CONSERVATION CO.

DOCUMENT NUMBER: 980-TS1-RT-FYRJ INFORMATION TYPE: NO QUANTITATIVE ANALYTICAL DATA
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Executive Summary: Approach and Conclusions

Section 1: Overview

Section 2: Treatability Descriptions and Treatment Recommendations

Section 3: Technology Descriptions and Conclusions

Appendix A: Contaminants Arranged by Waste Treatability Group

Appendix B: Treatment Technology Groups and Individual Treatment Process

Appendix C: Data Screens and Modifications

Appendix D: Total Constituent Analysis - Waste Treatment Results for Organics

Appendix E: Extraction Protocol - Waste Treatment Results for Inorganics

Appendix F: Extraction Protocol - Waste Treatment Results for Organics

Appendix G: Other Waste Treatment Results

Appendix H: Treatability Study Summaries

Appendix I: Bibliography