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INCINERATOR AND CEMENT KILN CAPACITY FOR HAZARDOUS WASTE TREATMENT

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FOREWORD

Today's rapidly developing and changing technologies, industrial products and practices frequently carry with them the increased generation of solid and hazardous wastes. These materials, if improperly dealt with, can threaten both public health and the environment. Abandoned waste sites and accidental releases of toxic and hazardous substances to the environment also have important environmental and public health implications. The Hazardous Waste Engineering Research Laboratory assists in providing an authoritative and defensible engineering basis for assessing and solving these problems. Its products support the policies, programs, and regulations of the Environmental Protection Agency, the permitting and other responsibilities of State and local governments and the needs of both large and small businesses in handling their wastes responsibly and economically.

This report describes the potential incinerator and cement kiln capacities for burning hazardous waste. These capacity estimates are to be used by EPA's Office of Solid Waste (OSW) in determining implementation decisions under the 1984 Resource Conservation and Recovery Act (RCRA) Amendment. These decisions focus on allowing the postponement of landfilling bans for certain chemical substances if insufficient incineration or other high temperature destruction process capacity is available.

This information is specifically provided for the personnel in OSW charged with making these decisions as well as the EPA permit writers in both State and Federal Agencies. Additionally, incinerator manufacturers, owners, and operators should find this information helpful in making plans for their future activities.

For further information, please contact the Alternative Technologies Division of the Hazardous Waste Engineering Research Laboratory.

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ABSTRACT

Estimates of incinerator and cement kiln capacities for hazardous waste treatment are required to evaluate the impacts of banning land disposal of hazardous wastes. RCRA Part B permit applications were reviewed to obtain information about incinerator design capacity, utilization and the incinerated hazardous wastes. MITRE identified 221 incinerators within the RCRA regulatory program that are presently destroying approximately two million metric tons of hazardous waste annually. The unused potential capacity of these units is estimated to be one million metric tons of waste per year. The Congressional Budget Office estimates that 265.3 million metric tons of hazardous waste are generated annually.

MITRE estimates that the annual hazardous waste treatment capacity available in cement kilns between two and six million metric tons. Less than five percent of the potential hazardous waste treatment capacity in cement kilns has been permitted under RCRA. Factors affecting this low utilization include the large geographic distances separating some major waste generation sites from cement kilns, marginal economic benefits, and the uncertainty of some kiln operators about regulatory requirements.

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1.0 INTRODUCTION

The Environmental Protection Agency has been authorized to ban the land disposal of hazardous wastes under the Resource Conservation and Recovery Act (RCRA). If insufficient capacity exists to dispose of banned wastes using alternative treatment technologies, EPA is authorized to delay the effective date of such a ban. Incineration and thermal destruction of specific wastes in cement kilns and incinerators are preferred to land disposal. EPA requested that MITRE prepare an estimate of incinerator and kiln capacity.

1.1 Approach

The purpose of this study is to estimate the potential hazardous waste destruction capacities of incinerators and cement kilns beyond current utilization. Between 1980 and 1982 The MITRE Corporation conducted several studies of domestic hazardous waste incinerator manufacturers, owners and operators.[1,2] The information from these studies and new data obtained from RCRA Part B permit applications under this task were used to estimate incinerator capacity.

Incinerator capacity estimates are presented in Chapter 2.0. A matrix is developed to match selected waste characterictics with the appropriate incineration technology. A computerized data management system permits sorting and retrieving information in accordance with the waste-incinerator matrix. The significance of several such retrievals with respect to prohibiting land disposal of some wastes is discussed.

Since MITRE had no previous information regarding cement kiln capacities, new data were gathered from sources throughout the industry. Estimates of cement kiln capacities and current utilization for hazardous waste destruction are presented in Chapter 3.0.

An update of the manufacturers study conducted by The MITRE Corporation in 1981 is presented in Chapter 4.0 of this report.

1.2 Summary of Findings

MITRE identified 221 hazardous waste incinerators in the RCRA regulatory program. As a result of this study, it was found that the total design capacity of these units is approximately three million metric tons of hazardous waste per year and slightly more than two million metric tons of waste are burned annually. A typical incinerator operates at two-thirds of its design capacity, leaving approximately one million tons of unused hazardous waste capacity available annually. Half of the available capacity is suitable for burning halogenated wastes. Nearly all of the available capacity is suitable for burning liquid wastes. Up to one-third of the available capacity is suitable for burning solid wastes.

Aqueous, corrosive wastes (identified by EPA waste code D002 in 40 CFR 261.21) are burned in the greatest quantity, accounting for 29 percent of the two million metric tons of incinerated hazardous wastes. These wastes are likely to be contaminated wastewaters having a low or a high pH and little value as a fuel. Approximately eight percent of the wastes are ignitable (D001), eight percent are reactive (D003) and five percent are spent halogenated solvents (F001). Forty-six (46) percent of incinerated hazardous wastes are halogenated. The average heating value of incinerated hazardous wastes is 8,582 Btu per pound (19,948 Joules per gram) and the average water content is 50 percent.

Data on cement kiln production capacities were obtained and verified from sources within the industry. Annual cement production capacities and typical hazardous waste burning parameters were used to estimate the potential waste destruction capacity in cement kilns. The estimates range from 2.27 to 6.05 million metric tons of waste based on current practices. Approximately 60,000 to 90,000 metric tons of hazardous waste are presently being destroyed in cement kilns, which represents only a small fraction of their potential capacity.

2.0 HAZARDOUS WASTE INCINERATOR CAPACITY

In order to accurately estimate incinerator capacities for selected hazardous wastes, the waste and incinerator characteristics that govern technology selection for safe and efficient waste destruction were identified. A specific matrix of waste and incinerator characteristics indicating successful technology applications is presented in Section 2.1. These characteristics guided data collection efforts and the development of a computerized data base to assemble and retrieve capacity information. The elements of the data base are identified in the discussion of incinerator and waste characteristics. The operation and structure of the data base are explained in Appendix A. The data collection effort is described in Section 2.2. Incinerator capacity estimates and data summaries are presented in Section 2.3.

2.1 Incinerator and Waste Characteristics

The incinerator design and the presence of air pollution control equipment were determined to be the most important characteristics governing the selection of an appropriate incinerator to destroy a hazardous waste. Other incinerator characteristics such as combustion zone temperature, gas residence time, waste atomization and turbulence are also significant, but consideration of these factors is beyond the scope of this effort. In addition, this study focuses on facilities that have submitted Part B permit applications, indicating that compliance with the RCRA regulatory performance requirements is either anticipated or demonstrated and that analysis of the other characteristics may not be required.

Incinerator designs are classified by the primary combustion chamber. The five major designs include rotary kilns, liquid injection incinerators, fume incinerators, hearths and fluidized beds. Other designs, including infrared units, molten salt combustors, fluid wall reactors, drum reconditioning furnaces and other thermal devices, account for very little of the present incinerator capacity. All types of incinerators may be equipped with a liquid injection port or atomizer in addition to other waste feed devices. The capabilities and restrictions inherent in each of the five major designs are discussed later.

Incinerator air pollution control equipment refers to particulate and acid gas removal equipment such as scrubbers, absorbers, baghouses and precipitators. Afterburners are not considered as air pollution control equipment for the purposes of this study. The presence of any single air pollution control device was recorded during data collection. In actual practice, details of equipment design and operation should be known prior to incinerating any new waste. The broad scope of this study prohibited such detailed analysis.

Knowledge of the following waste characteristics assists in selecting an appropriate incineration technology:

- Physical state
- Heat content or heating value
- Halogen content
- Solids content
- Water content

The significance of these waste and incinerator characteristics is illustrated in Table 2-1. The waste characteristics are listed in the left column and the incinerator types are listed across the table. The matrix may be used to direct wastes that are presently landfilled to the appropriate incineration technology. Suitable applications are indicated by the appropriate range of values for each waste characteristic. As an illustration, sludges with halogen contents greater than two percent and a solids content greater than 0.5 percent can be incinerated in rotary kilns and hearths equipped with air pollution control equipment, but the wastes must be filtered and heated, if necessary, to ensure proper atomization in liquid injection incinerators equipped with air pollution control equipment.

2.2 Data Sources

All facilities operating hazardous waste incinerators after 19 November 1980 were required to file RCRA Part A permit applications. The hazardous waste incineration facilities included within the scope of this study have filed RCRA Part A permit applications and the Part A information has been verified.

RCRA Part B permit applications are presently being received by the EPA regional offices. The Part B information requirements are much more detailed than the Part A applications. The Part B applications and trial burn results are reviewed at the EPA regional offices or by offices within states authorized by EPA. Permits to

TABLE 2-1

HAZARDOUS WASTE AND INCINERATOR APPLICABILITY MATRIX
INDICATING RANGES OF ACCEPTABLE VALUES

	Incinerator Type				
Waste Characteristics	Liquid Injection	Rotary Kiln	Hearth	Fume	Cement Kiln
Heating Value, Btu/lb	0-20,000	2,000-20,000	2,000-20,000	5,000-20,000	8,000-18,000
Halogen Content, percent	< 2[1]	< 2[1]	< 2[1]	< 2[1]	< 10
Solids Content, percent	< 0.5[2]	0-100	0-100	< 0.5[2]	< 12
Water Content, percent	0-100	0-100	0-100	0-60	< 10

[1]Acceptable upper limit can increase to 80 percent with the installation of proper pollution abatement equipment.

[2]May be achieved by filtering. Kinematic viscosity must be less than 750 Standard Saybolt Units (SSU).

incinerate hazardous wastes are issued or denied based on evaluations of the Part B applications and trial burn results. MITRE visited four EPA regional offices to obtain information from incinerator Part B applications.

Seventeen Part B applications were reviewed at the Region 2 offices, 17 applications were reviewed at Region 3 offices, 30 applications were reviewed at Region 4, and 38 applications were reviewed at Region 5. The status of incinerators at other regional offices was determined through data verification forms for the Incineration Permitting Study conducted by A.T. Kearney, Inc. of Alexandria, Virginia. These forms were completed during November and December 1985. In addition, offices in California, Louisiana and Texas were contacted to verify permit status data.

The following data sources provided information about incinerators for which Part B permit applications were not reviewed:

- MITRE telephone survey to verify Part A permit application information(1)

- MITRE site visit reports for 15 hazardous waste incineration facilities

- EPA site visit reports for 9 hazardous waste incineration facilities (non-confidential portions only)

- Responses to the EPA Office of Solid Waste Hazardous Waste Incinerator Questionnaire--90 responses were reviewed and 70 had data useful to this study

- 32 state permits from Louisiana and Texas

- A study of the composition of 104 selected hazardous waste streams(8)

Most supplementary information was obtained from the telephone logs used to prepare Reference 1. Data for 173 incinerators were obtained from this source. In the cases where both Part B and telephone log data were available for an incinerator, agreement among the two sources was generally observed.

2.3 Data Summary and Capacity Estimate

This section contains a summary of hazardous waste incinerator permit status, design features and waste characteristics. A list of the 276 facilities having the 350 incinerators studied during this project is presented in Appendix B. Ten percent, or 34 incinerators, of these incinerators have RCRA operating permits or permits to construct an incineration facility. Part B permit applications are being reviewed for 55 percent, or 187 of the units. EPA has requested the submission of all incinerator permit applications so that this number is not expected to significantly increase except for new construction.

Permit applications for approximately 30 percent, or 99 units, of the incinerators identified by MITRE have been withdrawn. Permits are withdrawn if the incinerator ceases operation, no longer burns hazardous waste, or burns hazardous wastes that have been delisted. Most incinerators have ceased operation through voluntary action, although a few have been closed through regulatory enforcement. The statistics indicate that incinerators for which permit applications have been withdrawn are generally smaller than the average design capacity.

The permit status of ten percent, or 34 units, of the potential hazardous waste incinerators identified by MITRE is unknown. Many of these incinerators are located in Texas, where many permit applications have recently been received. The applications had not been reviewed to determine whether an incinerator is listed among the waste treatment methods for which a permit is sought in time for inclusion in this report.

This report focuses on the capacity of the 221 incinerators that are in the RCRA regulatory program. For the record, MITRE projects the design capacity of the 99 incinerators that have withdrawn from the RCRA program to be 1.4 billion Btu/hr based on data available for 98 percent of the units. MITRE also projects the capacity of the 34 incinerators of unknown status to be 1.6 billion Btu/hr based on information available for 72 percent of the units.

The incinerator design capacities for the 221 units that are permitted or have filed an application are summarized in Table 2-2 by EPA regions to indicate geographic distribution. For the approximately 87 percent of facilities reporting capacity data, the total reported design capacity is 6.28 billion Btu/hr. Extrapolating this statistic to include all 221 incinerators in the RCRA regulatory program, the projected national capacity is 7.2 billion Btu/hr, which is equivalent to approximately three million metric tons of hazardous waste per year. Approximately half of the incinerators in the RCRA regulatory program are located in EPA Regions 5 and 6.

TABLE 2-2

NUMBER OF INCINERATORS AND THEIR
DESIGN CAPACITIES WITHIN EPA REGIONS

EPA REGION	NUMBER OF INCINERATORS		DESIGN CAPACITY (Million Btu/hr)		PERCENT OF TOTAL CAPACITY	
	REPORTING DATA	TOTAL	REPORTED	PROJECTED	REPORTED	PROJECTED
1	3	4	22.0	55	0.4	0.8
2	27	30	524.1	623	8.2	8.6
3	19	21	386.4	453	6.2	6.3
4	36	38	979.7	1,046	15.6	14.5
5	42	44	1,957.3	2,023	31.2	28.1
6	53	64	1,986.0	2,350	31.6	32.6
7-10	13	20	425.9	657	6.8	9.1
Total	193	221	6,281.4	7,207	100	100

The incinerator capacities are itemized by incinerator design in Table 2-3. The average design capacities are based on data reported for approximately 70 percent of the projected number of RCRA units. The number of data base records listed as the source of the values in Table 2-3 and subsequent tables is not the same as the number of incinerators. The information on the 221 RCRA incinerators is contained in 162 records resulting from multiple incinerators existing at some facilities. Rotary kilns have the largest average capacity and are most likely to have air pollution control equipment. The relatively high utilization of rotary kilns is expected because of their high equipment cost. Utilization of liquid injection incinerators is relatively low and less than half are equipped with air pollution control equipment. Many of these units are operated intermittently as needed. The average design capacity for fume incinerators in Table 2-3 represents only the liquid destruction capability; installed units have additional capacity to burn fumes. The high utilization results from integration of fume incinerators with continuously operating production processes. Hearth incinerators have the smallest average capacity and the lowest incidence of air pollution control equipment installation.

The available capacity estimates in Table 2-3 are calculated by multiplying the number of units by the average design capacity by one minus the utilization. The total available capacity estimate of 2.38 billion Btu/hr is roughly equivalent to 900,000 to one million metric tons of waste a year using a waste heating value of 9000 Btu per pound and annual operating schedules ranging from 7400 to 7900 hours as conversion factors. Halogenated wastes could use half of the available capacity because half of the incinerators are equipped with air pollution control devices. Most incinerator air pollution control systems include scrubbers. The average capacity of incinerators with air pollution control equipment approximately equals the average capacity of those without such equipment. Approximately 350,000 metric tons of available capacity exist for solid waste destruction in rotary kilns and hearths.

Information for 26 commercial incinerators is included in the data summaries for the 221 units in the RCRA program. Commercial incinerators are defined as units for which the owners are known to or intending to, advertise that they will accept wastes from off-site generators for incineration at a fee. Private arrangements to incinerate wastes generated off-site for a fee would not be classified as commercial under this definition. The design capacity of the commercial incinerators that are permitted or have filed applications totals 781,000 metric tons of waste annually. However, 34 percent of this capacity has not yet been constructed. The

TABLE 2-3

ESTIMATION OF AVAILABLE INCINERATOR CAPACITY BY INCINERATOR DESIGN
(Number of data base records used to obtain averages are in parentheses)

INCINERATOR DESIGN	NUMBER OF UNITS REPORTED	NUMBER OF UNITS PROJECTED	REPORTED AVERAGE DESIGN CAPACITY (Million Btu/hr)	REPORTED UTILIZATION (Percent)	PROJECTED AVAILABLE CAPACITY (Million Btu/hr)	PERCENT WITH AIR POLLUTION CONTROL EQUIPMENT
Rotary Kiln	42	45	61.37 (30)	77 (9)	635	90
Liquid Injection	95	101	28.26 (74)	55 (33)	1284	42
Fume	25	26	33.14 (23)	94 (13)	52	40
Hearth	32	34	22.75 (24)	62 (16)	294	38
Other	14	15	19.29 (3)	-- (0)	95	--
Total or Average Values	208	221	32.37 (154)	67 (71)	2360	50

utilization of commercial incinerators is generally regarded as confidential business information but is probably not significantly different from the utilization of private units. Nearly all commercial incinerators have air pollution control equipment.

Information about the characteristics of incinerated wastes were obtained for approximately 81 percent of permitted incinerators and those for which applications have been filed. These facilities indicated that 1.72 million metric tons of hazardous wastes are destroyed annually. An annual volume of 2.1 million metric tons for all 221 incinerators in the RCRA program may be extrapolated from these statistics. This estimate correlates with the design capacity estimate of three million metric tons and the average utilization of 67 percent presented in Table 2-3.

The waste incinerated in the greatest amount is identified by EPA waste code D002, accounting for 29 percent of the weight of wastes incinerated under the RCRA program. Approximately 8 percent of the wastes are D001, 8 percent are D003, 5 percent are F001 and the remainder of the wastes are P, U and other F codes. The characteristics of these coded wastes are summarized in Table 2-4.

Approximately 32 percent of the D001 wastes contain halogens and the average halogen content of those wastes is 17.0 percent. If non-halogenated D001 wastes are included in the average, the average halogen content is 4.2 percent. All of the average values in Table 2-4 are based on non-zero data entries; default values of zero for waste parameters are not included in the averages. The D002 corrosive wastes are primarily aqueous spent caustic and acidic solutions with no halogen content. The halogen content of D003 reactive wastes is similar to the D001 waste; 29 percent of the wastes are halogenated and the average halogen content is 12.3 percent. The average halogen content of F001 spent halogenated solvents is 54.1 percent.

The average heating value of the reported wastes is 8,582 Btu per pound. Forty-six percent by weight of the wastes are halogenated with an average halogen content of 33.2 percent. The average solids content of the reported wastes is 7.9 percent and the average water content is 50.5 percent.

Waste characteristics and the amounts incinerated are summarized in Table 2-5 for each type of incinerator. The average halogen content is calculated for only halogenated wastes; the average value for all wastes would be significantly lower. The waste quantity data in Table 2-5 may be compared with the incinerator design capacity data in Table 2-3. From such a mathematical

TABLE 2-4

SUMMARY OF WASTE CHARACTERISTICS
(Number of data base records used to obtain averages are in parentheses)

EPA WASTE NUMBER	OCCURRENCES	AVERAGE HEATING VALUE (Btu per pound)	AVERAGE HALOGEN CONTENT OF HALOGENATED WASTES (Percent)	PERCENT OF WASTES THAT ARE HALOGENATED	AVERAGE SOLIDS CONTENT (Percent)	AVERAGE WATER CONTENT (Percent)
D001	84	8498 (72)	17.0 (27)	32	5.5 (22)	49.1 (54)
D002	17	3711 (9)	0 (10)	0	6.4 (5)	89.9 (14)
D003	17	7140 (12)	12.3 (5)	29	11.0 (8)	59.5 (11)
F001	9	5369 (8)	54.1 (8)	100	1.0 (7)	15.5 (3)
Average of all D, F, P and U Code Wastes		8582 (210)	33.2 (97)	46	7.9 (66)	50.5 (117)

Basis: 178 incinerators reporting some waste composition data.

TABLE 2-5

WASTE CHARACTERISTICS AND ANNUAL AMOUNT BURNED FOR EACH INCINERATOR DESIGN
(Number of data base records used to obtain averages are in parentheses)

INCINERATOR DESIGN	AVERAGE HEATING VALUE OF WASTES (Btu per pound)	AVERAGE HALOGEN CONTENT OF HALOGENATED WASTES (Percent)	AMOUNT INCINERATED ANUALLY (Metric Tons)	PERCENT OF TOTAL AMOUNT INCINERATED
Rotary Kiln	8034 (38)	23.2 (31)	250,800 (41)	15
Liquid Injection	9106 (74)	31.6 (36)	862,600 (93)	50
Fume with Liquid Injection	6673 (30)	59.5 (13)	119,600 (35)	7
Hearth	9817 (43)	21.8 (13)	489,800 (44)	28
		Total	1,722,800	

Basis: 177 incinerators reported waste amounts.

analysis, it appears that although the utilization of rotary kilns is high, they are generally fired with hazardous waste at significantly less than their rated capacity. Many rotary kilns also burn trash and non-hazardous wastes so that a low hazardous waste firing rate may be expected. Hearth units burn 28 percent of the reported hazardous waste annually while their design capacity is only 9 percent of the total, indicating that hearth throughputs are higher than their design ratings. However, the average heating value of wastes burned in hearths appears to be higher than current practice indicates and may be biased by the data sample. The design capacity and waste throughput would correlate if the average heating value were 5,000 Btu per pound.

3.0 CEMENT KILN CAPACITY

Cement kilns can be adapted to burn liquid wastes as a fuel supplement. Most kilns formerly burned fuel oil but have been converted to burn coal because of the increase in fuel oil prices over the last ten years. The installation of a liquid waste injector would be similar to a fuel conversion.

Hazardous waste destruction in cement kilns has been recommended in several studies because the following characteristics of the cement production process promote waste oxidation and emission control:

- Cement clinker production requires the maintenance of temperatures greater than 1900°F in the kiln.
- Combustion gas residence times in the kilns range from 2 to 10 seconds, which are theoretically sufficient to ensure waste destruction.
- Particulate pollution control equipment exists on most cement kilns.
- Acidic combustion gases and some metals react with alkaline cement ingredients thereby improving the quality of the cement and reducing pollution from the kiln.

The potential cement kiln capacity for hazardous waste destruction is examined in Section 3.1. The characteristics of wastes suitable for destruction in cement kilns are discussed in Section 3.2. Present waste destruction activities in cement kilns are summarized in Section 3.3.

3.1 Potential Waste Destruction Capacity

Based on information obtained from Reference 3 and several sources in the cement industry, MITRE estimates that the present annual capacity for cement production in the United States and Puerto Rico is 92.1 million tons. Cement production in 1983 was 71.3 million tons,(4) indicating a utilization rate of approximately 77 percent. MITRE identified 52 companies manufacturing cement whereas the Portland Cement Association indicates that in 1982, 46 companies manufactured cement at 135 locations in 246 kilns.(5) MITRE was not able to reconcile the number of kilns and locations, but the limited information available to MITRE support the Portland Cement Association statistics. The cement companies, kiln locations and capacities identified by MITRE are presented in Appendix C.

Cement is produced by wet and dry processes, depending on whether the raw materials are reduced in size using water. The current trend favors the dry process because less energy is required than in the wet process where considerable amounts of water must be evaporated and heated. A breakdown of cement production capacity by process type and the associated energy consumption are shown in Table 3-1.

Problems with kiln operation and increased particulate emissions were encountered during a hazardous waste trial burn at a dry process cement kiln in Canada.[6] Other tests at dry kilns indicated that particulate emissions may or may not increase.[5] No difficulties have been encountered burning hazardous wastes in wet kilns. For the purpose of estimating potential waste destruction capacity, it is assumed that both wet and dry processes can be used.

Fuel requirements for cement kilns range from 3 million Btu per ton of product for dry kilns to 6 million Btu per ton of product for wet kilns. Using these generalizations, the annual energy requirement for cement kilns is estimated to be approximately 400 trillion Btu. For the five cases of waste destruction in cement kilns analyzed in Reference 5, the waste supplied between 10 and 60 percent of the heat input. Other available waste heat input data are within this range and a typical value is approximately 30 percent.

The heating values of wastes burned in cement kilns range from 8,000 to 18,000 Btu per pound based on current practice. The wastes with low heating values are probably burned at low firing rates to prevent kiln upsets. Wastes with high heating values similar to fuels can replace large percentages of fuel input. Annual waste capacities can be estimated knowing the total annual fuel input, the replacement rate of fuel by hazardous waste, and the heating value of the waste. Waste destruction capacities in cement kilns are estimated below to indicate a probable upper and lower bound and a typical value:

Fuel Replacement Rate (Percent)	Waste Heating Value (Btu/lb)	Annual Cement Kiln Waste Capacity (Million of Metric tons)
10	8,000	2.27
30	12,000	4.54
60	18,000	6.05

TABLE 3-1

CEMENT KILN CAPACITIES BY PROCESS TYPE

PROCESS	ANNUAL CEMENT CAPACITY (Thousands of tons)	ESTIMATED ENERGY USE RATE (Million Btu per ton of cement)	ESTIMATED ANNUAL ENERGY CONSUMPTION (Trillion Btu)
Wet kiln	26,783	6	160.70
Dry kiln	39,384	3	118.15
Both Wet and Dry kilns at same location	17,172	4.5	77.27
Process Unknown	8,803	5	44.02
TOTALS	92,142		400.14

Using the Congressional Budget Office estimates[7] of 265.3 million metric tons of hazardous waste, cement kilns have the potential capacity to manage from 0.86 to 2.28 percent of the hazardous wastes generated in the United States. Considering only the chemicals industry wastes, 1.78 to 4.76 percent of the amount generated in 1983 could be accommodated in cement kilns. The percentages of wastes that could be destroyed in cement kilns in the six states generating the largest annual quantities of hazardous wastes are estimated in Table 3-2.

3.2 Waste Characteristics

Most of the wastes reported to have been burned in cement kilns are either spent solvents, paint wastes or still bottoms from solvent recovery operations. These liquid wastes contain metals such as titanium, lead, chromium, manganese, zinc and barium. The metals in the spent solvents come from metal cleaning operations and the pigments in paint wastes. If these wastes were destroyed in conventional hazardous wastes incinerators, high efficiency particulate collection devices would be required to control the emission of very fine metal oxide particles. In cement kilns, a limited amount of metal oxides can be incorporated in the cement without affecting the quality of the product and particulate emissions are controlled by existing fabric filters, electrostatic precipitators or other high efficiency devices.

Cement kiln operators typically place limits on selected waste characteristics to ensure a uniform high quality product. A summary of the range of acceptable waste characteristics is presented in Table 3-3 for the 12 cases of waste incineration in cement kilns available to MITRE. Other important characteristics of acceptable wastes include a sufficiently low viscosity to permit atomization and being single-phase, non-volatile and non-corrosive to process equipment. EPA hazardous waste streams identified in 40 CFR 261 with these characteristics include D001, D003, F003, F005 and F017. From the limited information available to MITRE, D001 is the largest volume waste. The quantity of D001 waste burned in cement kilns is probably greater than the combined quantities of the other wastes. The principal organic hazardous constituents in these wastes are typically toluene, methyl ethyl ketone, methylene chloride, and trichloroethylene.

The destruction of solid wastes such as refuse derived fuel, coal tar, coal mining wastes, and shredded tires in cement kilns has been investigated but is currently not practiced based on available information. Solid wastes may be blended with the coal used to heat the kiln. For the purposes of this report, the destruction of solid wastes in cement kilns will not be evaluated as an option.

TABLE 3-2

ESTIMATED CEMENT KILN CAPACITY IN MAJOR WASTE GENERATING STATES IN 1983

STATE	GENERATED WASTE AMOUNT (Thousands of metric tons)	CEMENT KILN WASTE CAPACITY (Thousands of metric tons)	KILN CAPACITY AS A PERCENTAGE OF WASTE AMOUNT GENERATED IN-STATE
Texas	34,866	624	1.79
Ohio	19,692	89	0.45
Pennsylvania	18,260	361	1.98
California	17,284	676	3.91
Illinois	14,873	97	0.66
Louisiana	14,810	43	0.29

TABLE 3-3

RANGE OF ACCEPTABLE WASTE CHARACTERISTICS FOR DESTRUCTION IN CEMENT KILNS

Waste Parameter	Acceptable Range
Heating Value	8,000 Btu/lb to 18,000 Btu/lb
Sulfur	1% to 3%
Ash	5% to 12%
Water	1% to 10%
Chlorine	3% to 10%
pH	4 to 11
Lead	less than 4,000 ppm
Chromium	1,500 to 3,000 ppm
Zinc	1,000 to 3,000 ppm
Barium	less than 3,000 ppm
Titanium	less than 6,000 ppm
Mercury	less than 10 ppm
Arsenic	less than 10 ppm

It is interesting to note that the waste characteristics for the Canadian cement kiln test(6) were significantly different from the limits established by domestic kiln operators presented in Table 3-3. The chlorine content of the waste in the Canadian test was 40 percent compared to a domestic maximum of 10 percent and the heating value of 6,000 Btu per pound is lower than the domestic minimum of 8,000 Btu per pound. The high chlorine content of the waste may have been responsible for some of the problems encountered during the trial burn.

3.3 Present Waste Destruction Capacity

The quantity of wastes destroyed in three permitted cement kilns was obtained from the Economic Analysis Branch, Office of Solid Waste, EPA. In 1983, the three kilns burned 21,741 metric tons of hazardous waste. The Economic Analysis Branch has estimated that 8 to 12 cement kilns have received hazardous waste storage permits necessary to burn hazardous wastes. Extrapolating the known waste destruction quantities for the three kilns provides estimates of 58,000 metric tons destroyed in 8 kilns and 87,000 metric tons destroyed in 12 kilns.

These estimates of the quantities of wastes currently destroyed in cement kilns are one to four percent of the potential cement kiln capacity estimated in Section 3.1. Subtracting the estimated present waste destruction capacity from potential capacity yields available capacity estimates for wastes that could be destroyed in cement kilns ranging from 2.18 to 5.99 million metric tons per year. The major barrier to using this capacity is the lack of specific information that shows an overall economic benefit from waste destruction in cement kilns.

Based on conversations with cement kiln operators, the profitability of waste destruction in cement kilns is marginal. Expenses include storage tank construction, burner modification, additional monitoring equipment, operating and maintenance costs, waste analyses and the cost of the hazardous waste which ranges from 10 to 70 cents per pound. Economic benefits include the reduction of fuel costs and the receipt of disposal fees. A major factor affecting the decision to burn hazardous wastes is the expense associated with obtaining a permit.

4.0 UPDATE OF THE HAZARDOUS WASTE INCINERATOR MANUFACTURING INDUSTRY

This section contains a summary of the numbers, types, and characteristics of hazardous waste incinerator systems currently operating in the United States, based on information obtained from incinerator manufacturers. The information presented in this section is an update of the previous MITRE effort conducted in 1981.(1) The new information gathered is integrated with the previous information to present the status of the industry at this time.

4.1 Identification of Manufacturers

During May and June 1985, fifty-five incinerator manufacturers were contacted in order to determine those marketing hazardous waste units. Attempts to contact an additional fifteen incinerator manufacturers were unsuccessful. The manufacturers contacted were those identified in Reference 1 and any additional firms identified in:

- 1985 Chemical Engineering Catalog
- February 1985 Buyer's Guide, Solid Waste Management Magazine
- Directory and Resource Book, Air Pollution Control Association.

Some of the manufacturers identified in Reference 1 are no longer in the hazardous waste incinerator business. The thirty-seven companies that are still active or presumed active in the business are listed in Appendix D of this report.

4.2 Summary of Information Provided by Manufacturers

Hazardous waste incinerator manufacturers were asked to provide information about the types of incinerators manufactured, the approximate number of units sold between 1981 (the date of the previous MITRE survey) and mid-1985, and design and operating information. A summary of the information obtained is presented in Table 4-1. One hundred and eleven incinerators of six different types were reported constructed since 1981 by the 37 manufacturers cooperating in the survey. The four major types of hazardous waste incinerators: hearth, liquid injection, rotary kiln and fluidized bed. Hearth incinerators include fixed hearth, multiple chamber hearth, pulse hearth, rotary hearth, and reciprocating grate units. Liquid injection is still the most prevalent type, with 51.4 percent of the recent market, which is a smaller share than the 64 percent shown in the 1981-82 data. Recent sales of both the pulse hearth and the rotary hearth increased from 0.6 percent to

TABLE 4-1

NUMBER OF HAZARDOUS WASTE INCINERATORS BUILT IN THE UNITED STATES BY DOMESTIC MANUFACTURERS FROM 1981-1985

TYPE OF INCINERATOR	NEW INCINERATORS	PERCENT OF TOTAL
Liquid Injection	57	51.4
Hearth		
Fixed Grate	16	14.4
Moving Grate	10	9.0
Rotary Grate	10	9.0
Rotary Kiln	14	12.6
Fluidized-Bed	4	3.6
Total	111	100.0

TABLE 4-2

TOTAL NUMBER OF HAZARDOUS WASTE INCINERATORS BUILT IN THE UNITED STATES BY DOMESTIC MANUFACTURERS FROM 1969-1985

TYPE OF INCINERATOR	NUMBER OF MANUFACTURING COMPANIES (1981	1985)	INCINERATORS CONSTRUCTED	PERCENT OF TOTAL
Liquid Injection	23	14	276	60.9
Hearth				
Fixed Grate	14	10	82	18.1
Moving Grate	2	2	13	2.9
Rotary Grate	1	1	12	2.6
Rotary Kiln	13	10	56*	12.4
Fluidized Bed	9	6	13	2.9
Salt Bath	1	1	0	—
Infrared Heating	1	1	1	0.2
Total			453	100.0

9 percent. The market share for fixed hearth incinerators decreased to 14.4 percent from 17.3 percent and the fluidized-bed share increased to 3.6 percent from 2.6 percent. The recent rotary kiln market share remained relatively constant at 12.6 percent compared to 12.3 percent earlier.

The information in Table 4-1 is combined with data from the previous study in Table 4-2. Not all of the 453 incinerators have remained in hazardous waste service; many have ceased operation or switched to non-hazardous service. Liquid injection incinerators are most prevalent, representing 60.9 percent of the total units manufactured, hearth incinerators comprise 23.4 percent of the total, and 12.4 percent of the incinerators are rotary kilns. These three types account for 97 percent of the units manufactured. A current classification of incinerator manufacturers by the type of units they sell is presented in Table 4-3.

Of the 57 companies identified as marketing hazardous waste incinerators in Reference 1, 22 have either gone out of business, left the hazardous waste incinerator business, or have put much less emphasis on this activity. Only two new companies are pursuing this market. Apparently many of the companies that were anticipating large growth in the incinerator market in 1981 have abandoned the business as a result of selling only a few or no incinerators since that time. Of the 23 companies marketing liquid injection incinerators in 1981, only 14 are marketing them now; of the 17 companies offering rotary kiln incinerators in 1981, only 10 are doing so now; and of the nine companies offering fluidized-bed incinerators in 1981, only six remain. Of the 12 hearth incinerator manufacturers in 1981, 13 remain. Half of the companies offering innovative incineration technology have left the marketplace.

Trane Thermal and John Zink have established strong market positions in liquid injection incinerators, accounting for sales of 55 percent of those units. C.E. Raymond has sold 52 percent of the rotary kilns in service. Sales of hearth incinerators are distributed evenly among the manufacturers. Six domestic manufacturers (C. E. Raymond, C&H Combustion, Fuller Company, Midland-Ross, Shirco, and Sur-Lite) produce more than one type of incinerator.

4.3 Incinerator Capacity Information

Incinerator design information was obtained from interviews with 23 incinerator manufacturers during this survey and sales literature provided by some of the companies. This discussion focuses on incinerator design capacities and air pollution control equipment.

TABLE 4-3

1985 MANUFACTURERS BY INCINERATOR TYPES

Hearth Incinerators

Basic Environmental Engineering
Bayco
Burn-Zol
Econo-Therm Energy Systems
Ecolaire ECP
Epcon Industrial Systems, Inc.
Midland-Ross
Therm-Tech
Washburn and Granger

Rotary Kiln Incinerators

CE Raymond
C&H Combustion
Environmental Elements (von Roll)
Fuller Company
Industronics
International Incinerators
Thermall, Inc.
Trofe Incineration
Vulcan Iron Works
U.S. Smelting Furnace

Liquid Injection Incinerators

Brule'
C&H Combustion
CE Raymond
CJS Energy Resources, Inc.
Coen
Entech Industrial Systems
Hirt Combustion
McGill
Peabody International
Prenco
Shirco
Sur-Lite
Trane Thermal
John Zink

Fluidized Bed Incinerators

CE Raymond
Copetech
Dorr Oliver
Fuller Company
GA Technologies
Sur-Lite

Other Types of Incinerators

Midland-Ross-Rotary Hearth
Pyro-Magnetics-Induction Heating
Rockwell-Molten Salt
Shirco-Infrared

Design capacities of new incinerators expressed as thermal input are presented in Table 4-4. New hearth incinerators have the smallest average capacity of the three major types, with thermal inputs ranging from 4 to 48 million Btu/hr. Rotary hearths can be constructed with capacities ranging from 25 to 170 million Btu/hr and one manufacturer of a pulse hearth design has built a unit with a capacity of 48 million Btu/hr. Liquid injection and rotary kilns have similar ranges of thermal capacities. Although the largest

TABLE 4-4

THERMAL RATINGS OF NEW HAZARDOUS WASTE INCINERATOR TYPES AS REPORTED BY MANUFACTURERS

INCINERATOR TYPE	RANGE OF RATINGS (10^6 Btu/hr)	AVERAGE RATING (10^6 Btu/hr)	NUMBER REPORTING CAPACITY
Liquid Injection	4 - 200	56	21
Hearth	4 - 48	20	28
Rotary Kiln	0.5 - 100	44	6

incinerator listed in Table 4-4 has a capacity of 200 million Btu/hr, some manufacturers have received requests to bid on facilities as large as 300 million Btu/hr. Such large facilities may have several primary combustion chambers ducted to a common secondary chamber.

Nearly all hazardous waste incinerators installed since the previous survey are equipped with some type of air pollution control equipment. Generally, both gaseous and particulate emissions are controlled, although some hazardous waste incinerators are not equipped with any air pollution control equipment. Air pollution control equipment is located downstream of any energy recovery equipment and can consist of one or more of the following components:

- Quench chamber
- Particulate collection device
  - Venturi scrubber
  - Baghouse
  - Electrostatic precipitator
  - Cyclone
  - Ionizing wet scrubber

- Gas absorbing device
  - Packed tower scrubber
  - Plate or tray scrubber
  - Spray tower scrubber
  - Ionizing wet scrubber
- Mist eliminator

The application of high-efficiency particulate equipment such as baghouses and electrostatic precipitators on hazardous waste incinerators is limited.

5.0 REFERENCES

1. E. Keitz et al. Hazardous Waste Control Technology Data Base, MTR-82W170, The MITRE Corporation, November 1982.

2. G. Vogel et al. Composition of Hazardous Waste Streams Currently Incinerated, WP-83W00065, The MITRE Corporation, April 1983.

3. The American Cement Directory 1985, Published by The Bradley Pulverizer Co., Allentown, Pennsylvania, June 1985.

4. U.S. Bureau of the Census. Statistical Abstract of the U.S. 1985, 105th edition, Washington, D.C., 1985.

5. Background Information Document for Preparing a Regulatory Impact Analysis of Burning Hazardous Wastes in Rotary Kilns, 9266.00/39A-D, Engineering Science, Fairfax, Virginia, June 1985.

6. L. MacDonald et al. Burning Waste Chlorinated Hydrocarbons in a Cement Kiln, for Environmental Protection Service, Fisheries and Environment Canada, Report No. EPS 4-WP-77-2, March 1977.

7. U.S. Congressional Budget Office. Hazardous Waste Management: Recent Changes and Policy Alternatives, Washington, D.C., 1985.

8. S. Haus et al. Composition of Selected Hazardous Waste Streams, WP-81W00465 Revision 1, The MITRE Corporation, November 1981.

APPENDIX A

COMPUTERIZED DATA MANAGEMENT SYSTEM

The software chosen for this project was dBASE III (Ashton-Tate, Version 1.1), database management system for the IBM PC or IBM compatible microcomputer. dBASE III possesses all of the basic management capabilities such as sorting, searching, adding, deleting, editing, reporting, and other features to create the database management standard for today's 16-bit microcomputers. A rudimentary knowledge of dBASE III is essential for further management of the databases that have been created and organized by MITRE for this project.

Using dBASE III, MITRE has created two databases: (1) Incinerators.dbf and (2) Wastes.dbf. Each data element (record) in Incinerators.dbf describes a company, its location, number of incinerators, and appropriate incinerator characteristics. The structure of Incinerators.dbf is as follows:

Field	Field Name	Description
1	COMPANY	Company name
2	CITY	City
3	STATE	State
4	FACILITYNO	Facility number assigned by MITRE
5	ONSITE	Incinerator destroys waste generated on-site (Marked "X")
6	COMMERCIAL	Incinerator destroys waste generated off-site for a fee (Marked "X")
7	ROTARY	Incinerator design - Rotary Kiln (Marked "X")
8	LIQUID	Incinerator design - Liquid Injection (Marked "X")
9	FUME	Incinerator design - Fume (Marked "X")
10	HEARTH	Incinerator design - Hearth (Marked "X")
11	CEMENT	Incinerator design - Cement Kiln (Marked "X")
12	FLUIDIZED	Incinerator design - Fluidized Bed (Marked "X")
13	LIQUIDOPT	Incinerator design - Liquid injection capabilities (Marked "X")
14	OTHER	Any other type of incinerator technology (Marked "X")
15	DCAPACBTU	Design capacity in millions Btu/hr
16	DCAPACLB	Design capacity in lbs/hr
17	DCAPACGAL	Design capacity in gal/hr
18	UTILIZE	Percent utilization
19	ACAPACBTU	Available capacity in millions Btu/hr
20	ACAPACLB	Available capacity in lbs/hr
21	ACAPACGAL	Available capacity in gal/hr
22	APCSYES	Air pollution control system-YES (Marked "X")

Field	Field Name	Description
23	APCSNO	Air pollution control system-NO "
24	APCSUNK	Air pollution control system-Unknown "
25	AHCYES	Ash handling capability - YES (Marked "X")
26	AHCNO	Ash handling capability - NO "
27	AHCUNK	Ash handling capability - Unknown "
28	SCHEDULE	Operating schedule in hrs/yr
29	PERMIT	Permit status (A-approved, F-filed, W-withdrawn, U-unknown)
30	NUMBERINC	Number of incinerators
31	SICCODE 1	First SIC code
32	SICCODE 2	Second SIC code
33	SICCODE 3	Third SIC code
34	SOURCE	Data source (B-Part B, T-MITRE 1981 telephone survey, Q-RIA questionnaire mailed by EPA)
35	EPAID	EPA RCRA facility identification number

In addition to indicating the incinerator design and the presence of air pollution control equipment, data base elements contain the other information described below. The name of the company operating the incinerator, the location of the incinerator, the EPA RCRA identification number and the SIC codes of the industry generating the incinerated waste are recorded. Each incinerator is identified as either commercial or private. Private incinerators serve only the company owning the unit whereas commercial units destroy wastes from off-site sources for a fee. If more than one incinerator exists at a facility, the capacity and design information entered in the remainder of the record is the sum of all incinerators of the same design. If incinerators of different designs exist at one facility, separate records are used for each design.

The data element for the incinerator design capacity indicates the nameplate rating as a thermal input, mass feed rate or volume feed rate. An incinerator may actually operate at throughputs either higher or lower than the design capacity. All design capacities were entered as or converted to thermal inputs (millions of Btu per hour) using a waste heating value of 8,000 Btu per pound and a density of 8.34 pounds per gallon if the actual heating value and density are not specified.

Information about the incinerator operating schedule is entered for estimating the unused capacity of each incinerator. The value indicated by the owner or operator for annual hours of incinerator operation is divided by a theoretical value for full-time operation to obtain a utilization rate. The full-time operation estimate derived from incinerator reliability and maintenance schedules is 7,426 hours per year at an availability of 84.8 percent. During data collection, it was not obvious whether the statistic for annual hours of operation includes burning non-hazardous wastes. MITRE has no information regarding the percentage of time spent burning non-hazardous wastes compared to burning hazardous wastes, although analysis of the data indicates that the utilization rate accurately describes hazardous waste destruction activities.

Each record in the data base references the source of information and the incinerator permit status.

Each record in Wastes.dbf identifies a waste and its characteristics. The structure for Wastes.dbf is as follows:

Field	Field Name	Description
1	FACILITYNO	Facility number assigned by MITRE
2	WASTECODE	EPA RCRA Waste code
3	SOLID	Physical state of waste - Marked "X" if appropriate
4	LIQUID	"
5	SLUDGE	"
6	CONTAIN	" (Containerized)
7	OTHER	"
8	HECONTENT	Heat content in Btu/lb
9	HACONTENT	Halogen content (%)
10	SOCONTENT	Solids content (%)
11	WACONTENT	Water content (%)
12	AMTINGAL	Annual amount incinerated in gallons
13	AMTINLBS	Annual amount incinerated in pounds
14	AMTINMT	Annual amount incinerated in metric tons

The databases are linked by the common field FACILITYNO. Thus each waste in Wastes.dbf corresponds to a facility number in Incinerators.dbf.

Retrieval and manipulation of the data elements can be achieved with knowledge of dBASE III commands. Several "user friendly" programs (command files) have been provided by MITRE for basic management such as adding new records and modifying or deleting existing records from either database. The following programs have been developed: MENU.PRG, INCINSERT.PRG, WASINSERT.PRG, INCEDIT.PRG, INCEDIT.FMT, WASEDIT.PRG, WASEDIT.FMT, and PACK.PRG. Each file contains a heading briefly explaining the purpose of each program.

To access these programs, one must begin at the command file *MENU.PRG, which will in turn call subsequent programs at the user's* request. The following outlines the steps involved:

1) Load dBASE III (See "Setting Up Your System," dBASE III Manual, pp 1-4 - 1-7).

2) Upon receiving the dot prompt ".", type the command "DO MENU.PRG."

3) This will bring up a screen allowing the user six options:
   1. Add new incinerators.
   2. Edit/delete incinerators.
   3. Add new wastes.
   4. Edit/delete wastes.
   5. Pack the database*
   6. Exit dBASE III.

*Note: "Delete" means to mark for deletion; "Pack" means to permanently remove from the database those records marked for deletion.

4) Enter a choice from the list and follow instructions.

Searches, sorts, reports and other similar tasks must be carried out by the user with the tools provided by dBASE III. Since these tasks continually change with the needs of the user, no programs have been provided by MITRE to perform them.

A few examples of the capabilities of dBASE III management will be illustrated henceforth with reference to the dBASE III User's Manual. The following example performs a search on Incinerators.dbf to all companies with rotary kiln incinerators. The following command provides a complete listing of all records for which the field ROTARY contains the character "X":

. USE INCINERATORS (to indicate which database we want to use)

. LIST FOR ROTARY = "X"

The following command is more specific:

. LIST COMPANY, CITY, STATE FOR ROTARY = "X"

Once again, all records describing rotary kiln incinerators will be listed; however, in this case only the name of the company, the city, and the state will be displayed as requested. The following command would be entered to list all rotary kiln incinerators in Texas:

- LIST COMPANY, CITY, STATE FOR ROTARY = "X" .AND. STATE = "TX" TO PRINT

The words "To Print" direct the listing to the printer. These are just a few basic examples of searches that dBASE III can easily perform. Refer to the User's Manual for further information.

Sorts can be performed with one of two commands, SORT or INDEX. When a database is sorted, records on the disk are rearranged in a particular order. Consequently, as databases get larger, SORTS can take a long time to complete. INDEXing is a faster method that keeps records in a particular order without actually rearranging them on the disk. Both methods are explained in depth in Chapter V of the dBASE III User's Manual.

As an example, the following commands will SORT the Wastes.dbf database in order of facility number:

- USE WASTES (to indicate which database we want to use)

- SORT ON FACILITYNO TO TEMP

A new file called TEMP.dbf has been created to store the database in order of ascending facility numbers. These two commands,

- USE TEMP

- LIST

will list the sorted database. Alternatively, the commands

- USE WASTES

- INDEX ON FACILITYNO TO FACILITY

- LIST

would have created and listed the contents of an index file called FACILITY.NDX (dBASE III automatically adds the extension .NDX). Once again, the examples above merely touch on the capabilities that dBASE III possesses.

Reports can be generated by one of two methods. The first is to use the built in dBASE III report generator, explained in Chapter VII in the dBASE III User's Manual. The user inputs various format parameters and follows menu-driver instructions. The report generator is useful for producing straightforward reports of the entire database.

The alternative method is to write a command file, or program, to create the report. A command file is a disk file that contains a series of dBASE III commands arranged by the user. When the program is run, each command is executed one at a time in succession. Command files are the final steps to learning dBASE III. With a working knowledge of most of the commands, the user should be able to write command files to perform a variety of tasks instead of having to repeatedly type each command in one at a time. An appropriate command file can be used to create almost any type of report desired.

However, as stated above, in order to write useful command files, the user must be familiar with dBASE III. Command files are discussed in the dBASE III Manual in Chapters VIII-X. However, it is recommended that all previous chapters are read or skimmed first. Another recommended reference is Understanding dBASE III by Alan Simpson, a short book that presents dBASE III in a clear and effective manner.

APPENDIX B

HAZARDOUS WASTE INCINERATORS

Company	City	State	EPA ID	Permit Status	Data Source
Belding Chemical Industries	Grosvenor	CT	CTD049185515	W	T
Bic Pen Corporation	Milford	CT	CTD001166586	F	T
Combustion Engineering	Windsor	CT	CTD001159557	W	T
Pfizer, Inc.	Groton	CT	CTD001147495	W	T
Pratt and Whitney	East Hartford	CT	CTD990672081	F	T
ICI Americas	Dighton	MA	MAD051505477	W	T
Polaroid Corp.	Waltham	MA	MAD001402320	F	T
Union Chemical Co., Inc.	South Hope	ME	MED042143883	W	T
Amtrol Inc.	West Warwick	RI	RID001192145	W	T
Drew Metalex Corp.	Old Bridge	NJ	NJD081995508	F	B
E.I. DuPont	Deepwater	NJ	NJD002385730	F	B
E.I. DuPont	Deepwater	NJ	NJD002385730	W	B
FMC Corp.	Plainsboro	NJ	NJD000586164	W	T
Intl. Flavors & Fragrances	Union Beach	NJ	NJD002194843	W	T
Ortho Diagnostics Inc.	Raritan	NJ	NJD068715424	F	B
Reichhold Chemicals	Elizabeth	NJ	NJD002202369	W	T
Rollins Environmental Services	Bridgeport	NJ	NJD053288239	F	T
Union Carbide Corp.	Piscataway	NJ	NJD002444719	F	B
Active Steel Drum Inc.	Long Island	NY	NYD003933355	W	T
Battery Disposal Technology	Clarence	NY	NYD000632372	W	T
Bell Test Center AF Plant	Buffalo	NY	NYD467202462	W	T
Bendix Corp.	Sidney	NY	NYD001827633	W	T
Case Hoyt Corporation	Rochester	NY	NYD002206365	W	T
Food & Drug Research Labs.	Waverly	NY	NYD990763096	W	T
G.E. Insulating Materials	Schenectady	NY	NYD052987086	W	T
Hooker Chemicals & Plastics	N. Tonawanda	NY	NYD002106938	W	T
Hooker Chemicals & Plastics	Niagara Falls	NY	NYD000824482	U	T
Kodak Park Div., Eastman Kodak	Rochester	NY	NYD980592497	F	B
Nepera Chemical Co.	Harriman	NY	NYD002014595	W	T
Philips ECG Inc. (GTE Products)	Seneca Falls	NY	NYD002246015	W	T
Reichhold Chemical Co.	Niagara Falls	NY	NYD002103216	W	T
General Electric Noryl Products	Selkirk	NY	NYD066832023	F	B
General Electric Silicone Product	Waterford	NY	NYD002080034	F	B
Eli Lilly and Co.	Mayaguez	PR	PRD091024786	F	B
Merck	Barceloneta	PR	PRD090028101	F	B
Pfizer	Barceloneta	PR	PRD090346909	F	B
Smith Kline	Guayama	PR	PRT000040675	F	T
Squibb	Hamacao	PR	PRD090021056	F	B
American Cyanamid	Linden	NJ	NJD002173276	W	T
Pennwalt	West Deptford	NJ	NJD980753875	F	B
Occidental Chemical	Niagara Falls	NY	NYD000824482	F	B
Janssen Inc.	Gurabo	PR	PRT000019604	F	B
Sterling Pharmaceuticals	Barceloneta	PR	PRD991291949	F	B
DuPont Exp. Station	Wilmington	DE	DED003930807	A	B
Hercules Res. Center	Wilmington	DE	DED001315647	A	B
Central Chemical Corp.	Elkton	MD	MDD041953803	W	T
FMC Corp., Ag. Chem. Group	Baltimore	MD	MDD003071875	F	B

Company	City	State	EPA ID	Permit Status	Data Source
GMC-GMAD	Baltimore	MD	MDD003091972	U	Q
Multichem	Baltimore	MD	MDD093958767	W	T
Avtex Fibers Inc.	Meadville	PA	PAD080639974	W	T
Morton Thiokol	Elkton	MD	MDD003067121	F	B
General Electric	Erie	PA	PAD005033055	W	T
Knoll International Inc.	E. Greenville	PA	PAD053306015	W	T
Koppers Co., Inc.	Bridgeville	PA	PAD063764898	W	T
Letterkenny Army Depot	Chambersburgh	PA	PA6213820503	F	T
Pennwalt	King of Prussia	PA	PAD075538033	W	T
Merck Chemical Division	Danville	PA	PAD003043353	F	B
Smith Kline Chem-Riverside	Conshohocken	PA	PAD980550412	A	B
Trane Thermal Co.	Conshohocken	PA	PAD069006419	F	B
Merck, Sharp & Dohme	West Point	PA	PAD002387926	F	B
Wyeth Labs	Paoli	PA	PAD002323550	W	T
Zapata Industries, Inc.	Frackville	PA	PAD002499440	F	B
Allied Chemical	Hopewell	VA	VAD065385296	F	B
Univ. of Virginia	Charlottesville	VA	VAD000820712	W	T
American Cyanamid Co.	Willow Island	WV	WVD004341491	F	B
Borg-Warner Chem-Weston Pl. #1	Morgantown	WV	WVD980552384	W	B
Borg-Warner Chem-Weston Pl. #1	Morgantown	WV	WVD980552384	W	T
Dupont E.I. deNemours	Parkersburg	WV	WVD045875291	A	B
Mobay Chem. Corp.	New Martinsvill	WV	WVD056866312	F	B
Mobay Chem. Corp	New Martinsvill	WV		A	
Monsanto	Nirto	WV	WVD039990965	W	T
Union Carbide-Plant 514	S. Charleston	WV	WVD005005483	A	B
Union Carbide Tech Center	S. Charleston	WV	WVD060682291	A	B
Gulf Oil	Philadelphia	PA	PAD049791098	F	B
Chemical Waste Management	Emelle	AL	ALD000622464	F	B
Ciba-Geigy	McIntosh	AL	ALD001221902	F	B
Shell Chem Co.-Mobile Plant	Axis	AL	ALD093179315	F	B
Stauffer	Bucks	AL	ALD095688875	W	T
3M	Decatur	AL	ALD004023164	W	T
Alpha Chemical Corp.	Lakeland	FL	FLD057231821	W	T
U.S. Army Anniston Depot	Anniston	AL	ALD210020027	F	B
Honeywell	St. Petersburg	FL	FLD004104105	F	B
JFK Space Center	JFK Space Cntr	FL	FL6800014525	F	B
Olin Corp.	St. Marks	FL	FLD047096524	F	B
South Dade Incinerator	Miami	FL	FLD000648162	W	T
Cargill	Forest Park	GA	GAD084823301	F	B
Bernath Barrel	Mableton	GA	GAD051010148	W	T
Cargill	Forest Park	GA	GAD084823301	F	B
Southeastern Waste Treatment	Dalton	GA	GAD000222083	W	T
U.S. Army Blue Grass Depot	Richmond	KY	KYD213820105	F	B
Union Carbide-Ag Products	Woodbine	GA	GAD030035356	W	T
DuPont	Louisville	KY	KYD003924198	F	B
Heublein Inc.	Paducah	KY	KYD091515502	W	T
LG&S Disposal Co.	Louisville	KY	KYD000831016	W	T

Company	City	State	EPA ID	Permit Status	Data Source
Liquid Waste Disposal	Calvert City	KY	KYD088438817	A	T
Liquid Waste Disposal	Calvert City	KY	KYD088438817	A	T
Olin	Brandenburg	KY	KYD006396246	F	B
First Chemical	Pascagoula	MS	MSD033417031	W	T
Mitchell Systems	Spruce Pine	NC	NCD991277724	F	B
Burroughs Wellcome	Greenville	NC	NCD052547635	F	B
Caldwell Systems	Lenoir	NC	NCD086871282	F	B
General Electric Corp	Wilmington	NC	NCD050409150	A	B
Chem. Ind. Inst. Toxicology	R.T.P.	NC	NONE	W	T
DuPont	Leland	NC	NCD047369046	F	B
Lithium (formerly SCA)	Bessemer City	NC	NCD000771964	W	T
Stablex	Rock Hill	SC	SCD044442333	F	B
Singer Furniture	Lenoir	NC	NCD000604322	W	Q
U.S. Dept. of Energy	Oak Ridge	TN	TND048990018	F	B
ABCO Industries, Inc.	Roebuck	SC	SCD003360393	F	B
American Enka	Central	SC	SCD052944295	F	B
DuPont	Lugoff	SC	SCD003344363	F	B
Owens Corning	Anderson	SC	SCD003349982	F	B
Alpha Resins	Collierville	TN	TND007037765	W	T
DuPont	Memphis	TN	TND007024672	F	B
Eastman Kodak	Kingsport	TN	TND003376928	F	B
Eastman Kodak	Kingsport	TN	TND003376928	F	B
Huyck Formex	Greenville	TN	TND003375441	W	T
Solid & Liquid Waste Disposal	Dyersburg	TN	NONE	W	T
Kay Fries	Theodore	AL		W	T
Monsanto	Anniston	AL		W	T
Union Carbide	Columbia	TN		W	T
Pennwalt	Calvert City	KY	KYD006370159	A	B
U.S. Army - Mississippi Army Ammo	Bay St. Louis	MS	MSD800016123	A	B
USA Volunteer Army Ammo Plant	Chattanooga	TN	TND062120933	U	Q
Monsanto Company	Luling	LA	LAD001700756	W	Q
Uniroyal Chemical	Geismar	LA	LAD008194060	F	
Northern Petrochemical Co Inc	Morris	IL	ILD048296180	F	B
Armak	Morris	IL	ILD065237851	W	T
Koppers Company, Inc.	Chicago	IL	ILD005164611	F	B
Marathon-Robinson Refining	Robinson	IL	ILD005476882	W	T
Meyer Steel Drum, Inc.	Chicago	IL	ILD081037772	W	T
Monsanto Co., Krummrich Plant	Sauget	IL	ILD000802702	U	T
Reilly Tar & Chem. Corp.	Granite City	IL	ILD006278360	W	T
Chemical Waste Management	Chicago	IL	ILD000672121	F	B
Spaulding Fiber Co. Inc.	Dekalb	IL	ILD064000011	W	T
Texaco USA (Refining)	Lockport	IL	ILD041518861	W	T
Trade Waste Inc.	Sauget	IL	ILD098642424	F	T
3M-Cordova	Cordova	IL	ILD054236443	F	B
Dow	Indianapolis	IN	IND000195545	W	B
Lilly (Eli) & Co. Labs	Clinton	IN	IND072040348	F	B
Lilly (Eli) & Co. Clinton Labs	Clinton	IN	IND072040348	F	B

Company	City	State	EPA ID	Permit Status	Data Source
Owens-Corning Fiberglass	Valparaiso	IN	IND980502074	F	B
Union Carbide	East Chicago	IN	IND077001147	W	T
A-1 Disposal Corp.	Plainwell	MI	MID059695452	W	T
Dow Chemical	Midland	MI	MID000724724	F	B
Nor-Am Chemical Co.	Muskegon	MI	MID080358351	A	
Upjohn	Kalamazoo	MI	MID000820381	F	B
3M-Chemolite	Cottage Grove	MN	MND006172969	F	B
Cincinnati Ind. Waste Disp.	Cincinnati	OH	OHD000720250	F	B
Catalyst Resources-Dart Ind.	Elyria	OH	OHD046202602	A	B
GTE Products Corp.	Ottawa	OH	OHD097234876	W	T
Ross Incineration Services Inc.	Grafton	OH	OHD048415665	F	T
SCM Corp.	Huron	OH	OHD002946291	W	T
U.S. Industrial Chemicals	Cincinnati	OH	OHD072865074	A	B
SOHIO-Vistron	Lima	OH	OHD042157644	F	B
Curwood Inc.	New London	WI	WID006144737	F	B
Freeman Chemical Corp.	Saukville	WI	WID980615439	F	B
Commerce Industrial Chemical	Milwaukee	WI	WID980795181	A	B
Johnson, SC & Son, Inc.	Sturtevant	WI	WID006091425	W	T
University of Wisconsin	Madison	WI	WID000713594	A	B
Waste Research & Reclamation	Eau Claire	WI	WID990829475	F	B
Cargill	Carpentersville	IL	ILD005083316	F	B
PPG Industries	Circleville	OH	OHD004304689	A	B
Waste Technologies Industries	East Liverpool	OH	OHD980613541	A	B
Akzo Chemie America	Morris	IL	ILD065237851	F	B
SOHIO-Research	Warrensville Ht	OH	OHD010835619	F	B
BFC Chemicals	N. Muskegon	MI	MID080358351	A	B
Naval Weapons Support Center	Crane	IN	IN5170023498	F	B
Energy Cooperative	East Chicago	IN	IND082547803	W	B
Eli Lilly	Lafayette	IN	IND006050967	F	B
Savannah Army Depot Activity	Savannah	IL	IL3210020803	F	B
Olin Corp.	East Alton	IL	ILD006271696	F	B
Pristine Inc.	Reading	OH	OHD076773712	F	B
Freeman Chemical	Saukville	WI	WID980615439	F	B
Chemical Waste Management (TWI)	Sauget	IL	ILD098642424	F	B
Ravenna Army Ammunition Plant	Ravenna	OH	OH5210020736	W	B
Arkansas Eastman Co.	Batesville	AR	ARD089234884	F	T
ENSCO	El Dorado	AR	ARD069748192	F	T
Natl. Ctr-Toxicological Res.	Jefferson	AR	AR3750030956	U	
U.S. Pine Bluff Arsenal	Pine Bluff	AR	ARD213820707	A	T
Westinghouse Electric Corp.	Little Rock	AR	ARD990722316	W	T
American Cyanamid Co.	Westwego	LA	LAD008175390	F	T
Borden Chemical	Geismar	LA	LAD003913449	F	T
Chevron	Belle Chasse	LA	LAD034199802	F	T
Chevron	Belle Chasse	LA	LAD034199802	F	T
Ciba-Geigy	St. Gabriel	LA	LAD005378544	F	T
Copolymer Rubber & Chemical	Baton Rouge	LA	LAD008182990	W	T
Dow	Plaquemine	LA	LAD008187080	F	T

Company	City	State	EPA ID	Permit Status	Data Source
Dresser P&M	Eunice	LA	LAD087025870	W	
DuPont	La Place	LA	LAD001890367	F	
Evans Cooperage	Harvey	LA	LAD008158289	W	T
Georgia-Gulf	Plaquemine	LA	LAD057117434	F	T
Grant Chemical-Ferro Corp.	Zachary	LA	LAD092104389	W	T
Hooker Chem.	Addis	LA	LAD094916491	W	T
LA Army Ammunition Plant	Shreveport	LA	LAD213820533	F	
Morton Chemical	Weeks Island	LA	LAD059122177	F	T
Olin	Lake Charles	LA	LAD008080681	F	T
PPG	Westlake	LA	LAD008086506	F	T
Rollins Environmental Services	Baton Rouge	LA	LAD001395127	F	T
Rubicon	Geismar	LA	LAD008213191	F	T
Shell Chemical	Norco	LA	LAD098622104	F	T
Shell Chemical	Norco	LA	LAD098622104	F	T
Stauffer Chemical	St. Gabriel	LA	LAD980627061	F	T
Union Carbide	Taft	LA	LAD041581422	F	T
Union Carbide	Taft	LA	LAD041581422	F	T
Vulcan Materials Co.	Geismar	LA	LAD092681824	F	T
Holloman AFB	Holloman AFB	NM	NM6572124422	W	Q
Conoco	Ponca City	OK	OKD007233836	F	T
Eagle Pitcher/Boron Dept.	Quapaw	OK	OKD098623037	F	T
John Zink Co.	Tulsa	OK	OKD055940647	F	T
Zapata Industries, Inc.	Muskogee	OK	OKD099751059	F	T
Aztec/Purechem-Dart	Pasadena	TX	TXD077874634	W	T
Badische	Freeport	TX	TXD008081697	F	T
Dow Chemical	Freeport	TX	TXD008092792	U	T
Dresser P&M	Dallas	TX	TXD077874634	W	T
DuPont	Beaumont	TX	TXD008081101	U	T
DuPont	La Porte	TX	TXD008079212	U	T
DuPont	Victoria	TX	TXD008123317	F	T
El Paso Products	Odessa	TX	TXD980626014	U	T
FMC	Pasadena	TX	TXD083570051	U	T
General Tire & Rubber Co.	Odessa	TX	TXD057422685	U	T
Goodyear Tire & Rubber	Beaumont	TX	TXD008077190	U	T
Goodyear Tire & Rubber	Houston	TX	TXD008077562	U	T
IBM	Austin	TX	TXD041470543	F	T
Mobay	Baytown	TX	TXD058260977	F	T
Monsanto	Texas City	TX	TXD008079527	F	T
NASA, Johnson Space Center	Houston	TX	TX8800016125	F	T
PPG	Beaumont	TX	TXD020805446	F	
Peterbilt Motors Co.	Denton	TX	TXD096445069	U	T
Phillips	Pasadena	TX	TXD008098725	U	T
Texas Eastman	Longview	TX	TXD007330202	A	
Shell	Deer Park	TX	TXD067285973	F	T
Sheridan Disposal Service, Inc.	Hempstead	TX	TXD062132147	W	T
Stauffer	Baytown	TX	TXD082688896	F	T
Texaco Chemical Co.	Conroe	TX	TXD008076853	U	T

Company	City	State	EPA ID	Permit Status	Data Source
Texaco Chemical Co.	Port Neches	TX	TXD008076846	F	T
Texas A&M	College Station	TX	TXD000789800	W	T
U.S. Industrial Chemicals	La Porte	TX	TXD058276130	U	T
Univ. of Texas	Galveston	TX	TXD000821264	F	T
Upjohn Polymer	La Porte	TX	TXD000017756	U	
Vistron-SOHIO	Green Lake	TX	TXD000751172	F	T
Vought	Dallas	TX	TXD041089467	W	T
Diamond Shamrock Plastics Corp.	La Porte	TX	NONE	W	T
Petro-Tex Chemical Corp.	Houston	TX	TXD008072134	W	T
Shintech Inc.	Freeport	TX	TXD065095390	W	T
US EPA - Combustion Research Fac	Pine Bluff	AR	AR6140090006	A	Q
IT Corp. of Louisiana	Burnside	LA	LAD000757385	A	B
Phillips Research Center	Bartlesville	OK	OKD000803601	A	Q
Eastman Kodak	Longview	TX	TXD007330202	A	
Rollins Environmental Services	Deer Park	TX	TXD055141378	F	T
Maytag	Newton	IA	IAD005285689	W	
Univ. of Iowa	Oakdale	IA	IAT200010924	F	
Abbott	Wichita	KS	KSD007237746	U	
American Cyanamid	Palmyra	MO	MOD050226075	F	
University of Missouri	Columbia	MO	MOD006326904	F	
Alcolac Inc.	Sedalia	MO	MOD084093368		
US EPA - Mobile Incinerator	McDowell	MO	MO6680090010	A	
McDonnell Douglas	St. Charles	MO	MOD075888487	A	
Shell (RMA)	Commerce City	CO	CO5210020769	F	
University of Arizona	Tucson	AZ	AZD000819615	F	
Aerojet General-Sacramento Rancho	Cordova	CA	CAD000030494	W	T
Alpha Resins	Perris	CA	CAD050270975	F	T
Ashland	Los Angeles	CA	CAD044046274	F	
Cargill	Lynwood	CA	CAD076180843	F	B
Chevron Chemical Co.	Richmond	CA	CAD043237486	F	
Dow	Pittsburg	CA	CAD076528678	F	T
Edwards Air Force Base	Edwards	CA	CA1570024504	W	T
IT Corp.-Vine Hill Facility	Martinez	CA	CAD000094771	F	T
Koppers	Oxnard	CA	CAD087163267	W	T
Lawrence Livermore	Livermore	CA	CA2890012584	F	B
PPG	Torrance	CA	CAD008323438	W	B
Shell	Martinez	CA	CAD009164021	F	B
Unitek Environmental Ser.	Ewa Beach	HI	HIT000603514	F	T
Hawthorne Army Ammunition Plt.	Hawthorne	NV	NV1210090006	F	
Washington State University	Pullman	WA	WAD041485301	A	

Permit Status Code:
- A = Approved RCRA permit
- F = RCRA Part B filed
- W = No Part B application
- U = Unknown

Data Source Code:
- B = Part B permit application
- T = MITRE telephone survey
- Q = EPA, OSW questionnaire

APPENDIX C

CEMENT KILN LOCATIONS AND PRODUCT CAPACITIES

Company	State	Wet	Dry	Both	Estimated
		Annual Capacity in 1000 Tons			
BLUE CIRCLE	AL	0	775	0	0
GENERAL PORTLAND	AL	0	750	0	0
IDEAL BASIC INDUSTRIES	AL	0	1500	0	0
LEHIGH PC CO	AL	0	0	608	0
NATIONAL C CO	AL	0	775	0	0
ARKANSAS C CORP	AR	921	0	0	0
IDEAL BASIC INDUSTRIES	AR	395	0	0	0
CALMAT	AZ	0	1400	0	0
GIFFORD-HILL & CO	AZ	0	630	0	0
CALMAT	CA	0	750	0	0
CALMAT	CA	0	1150	0	0
GENERAL PORTLAND	CA	0	610	0	0
GENSTAR	CA	600	0	0	0
GENSTAR	CA	0	600	0	0
GIFFORD-HILL & CO	CA	0	840	0	0
GIFFORD-HILL & CO	CA	0	1150	0	0
KAISER C CO	CA	0	0	1760	0
KAISER C CO	CA	0	0	1760	0
LONE STAR INDUSTRIES	CA	0	775	0	0
MONOLITH PC CO	CA	500	0	0	0
SOUTHWESTERN PC CO	CA	0	0	1400	0
IDEAL BASIC INDUSTRIES	CO	460	0	0	0
IDEAL BASIC INDUSTRIES	CO	0	885	0	0
SOUTHWESTERN PC CO	CO	0	0	675	0
GENERAL PORTLAND	FL	650	0	0	0
GENERAL PORTLAND	FL	528	0	0	0
LONE STAR FLORIDA HOLDING CO	FL	1200	0	0	0
MOORE McCORMACK C	FL	0	1200	0	0
RINKER MATERIALS CORP	FL	0	0	600	0
BLUE CIRCLE	GA	0	775	0	0
MEDUSA C CO	GA	0	0	0	970
KAISER C CO	HI	0	0	350	0
LONE STAR HAWAII C CORP	HI	0	270	0	0
DAVENPORT C CO	IA	0	775	0	0
LEHIGH PC CO	IA	0	0	0	422
MONARCH C CO	IA	0	0	0	437
NORTHWESTERN STATES PC CO	IA	0	775	0	0
LEHIGH PC CO	IA	0	0	0	422
ASH GROVE C CO	ID	205	0	0	0
ILLINOIS C CO	IL	0	470	0	0
LONE STAR INDUSTRIES	IL	0	470	0	0
MISSOURI PC CO	IL	0	775	0	0
MARQUETTE CO	IL	0	450	0	0
LEHIGH PC CO	IN	0	0	118	0
LEHIGH PC CO	IN	0	0	827	0
LONE STAR INDUSTRIES	IN	752	0	0	0

Company	State	Annual Capacity in 1000 Tons Wet	Dry	Both	Estimated
LOUISVILLE C CO	IN	622	0	0	0
LOUISVILLE	IN	0	775	0	0
GENERAL PORTLAND	KN	407	0	0	0
ASH GROVE C CO	KS	512	0	0	0
LEHIGH PC CO	KS	0	0	405	0
LONE STAR INDUSTRIES	KS	451	0	0	0
MONARCH C CO	KS	0	0	0	437
MOORE McCORMACK C	KY	0	670	0	0
LONE STAR INDUSTRIES	LA	750	0	0	0
ATLANTIC C CO	MD	750	0	0	0
COPLAY C CO	MD	0	0	0	350
LEHIGH PC CO	MD	0	0	1013	0
LONE STAR INDUSTRIES	MD	0	500	0	0
THOMASTON	ME	60	0	0	0
DUNDEE C CO	MI	532	0	0	0
MEDUSA C CO	MI	0	0	0	970
NATIONAL GYPSUM CO-CEMENT DIV	MI	0	0	675	0
ST MARYS PURLESS C CO	MI	532	0	0	0
DUNDEE C CO	MO	0	0	675	0
LONE STAR INDUSTRIES	MO	0	1200	0	0
MISSOURI PC CO	MO	0	775	0	0
RIVER C CO	MO	0	1200	0	0
TEXAS INDUSTRIES	MS	0	0	0	888
IDEAL BASIC INDUSTRIES	MT	330	0	0	0
KAISER C CO	MT	0	0	350	0
ASH GROVE C CO	NE	0	900	0	0
IDEAL BASIC INDUSTRIES	NE	235	0	0	0
IDEAL BASIC INDUSTRIES	NM	0	505	0	0
NEVADA C CO	NV	0	450	0	0
ATLANTIC C CO	NY	1500	0	0	0
LEHIGH PC CO	NY	540	0	0	0
MOORE McCORMACK C	NY	0	500	0	0
ALPHA PC CO	NY	525	0	0	0
GENERAL PORTLAND	OH	554	0	0	0
LONE STAR INDUSTRIES	OH	0	260	0	0
SOUTHWESTERN PC CO	OH	0	0	760	0
BLUE CIRCLE	OK	0	775	0	0
IDEAL BASIC INDUSTRIES	OK	610	0	0	0
LONE STAR INDUSTRIES	OK	0	725	0	0
ASH GROVE C CO (western div)	OR	0	485	0	0
ARMSTRONG C & SUPPLY CORP	PA	370	0	0	0
COPLAY C CO	PA	0	0	0	350
COPLAY C CO	PA	0	0	0	350
COPLAY C CO	PA	0	0	0	350
GENERAL PORTLAND	PA	0	800	0	0
HERCULES C CO	PA	0	700	0	0
KEYSTONE PC CO	PA	532	0	0	0
LEHIGH PC CO	PA	0	0	135	0

Company	State	Annual Capacity in 1000 Tons Wet	Dry	Both	Estimated
LONE STAR INDUSTRIES	PA	0	658	0	0
LONE STAR INDUSTRIES	PA	370	0	0	0
MEDUSA C CO	PA	0	0	0	970
NATIONAL GYPSUM CO-CEMENT DIV	PA	0	0	675	0
PUERTO RICAN C CO	PR	1370	0	0	0
SAN JUAN C CO	PR	880	0	0	0
GIANT PORTLAND & MASONRY C CO	SC	532	0	0	0
GIFFORD-HILL & CO	SC	0	600	0	0
SANTEE PC CORP	SC	1100	0	0	0
SOUTH DAKOTA C CO	SD	0	450	0	0
SOUTH DAKOTA C CO	SD	150	0	0	0
SOUTH DAKOTA C CO	SD	150	0	0	0
SOUTH DAKOTA C CO	SD	150	0	0	0
MOORE McCORMACK C	TN	0	550	0	0
SIGNAL MOUNTAIN C CO	TN	0	0	477	0
ALAMO C CO	TX	0	725	0	0
CAPITOL AGGREGATES	TX	0	0	850	0
CENTEX	TX	520	0	0	0
GENERAL PORTLAND	TX	0	731	0	0
GIFFORD-HILL & CO	TX	880	0	0	0
GULF COAST PC CO	TX	532	0	0	0
KAISER C CO	TX	0	0	540	0
LEHIGH PC CO	TX	0	0	321	0
LEHIGH PC CO	TX	0	0	101	0
LONE STAR INDUSTRIES	TX	550	0	0	0
SOUTHWESTERN PC CO	TX	333	0	0	0
SOUTHWESTERN PC CO	TX	0	333	0	0
SOUTHWESTERN PC CO	TX	0	333	0	0
TEXAS C CO	TX	0	1230	0	0
TEXAS INDUSTRIES	TX	0	550	0	0
TEXAS INDUSTRIES	TX	0	0	0	888
GENERAL PORTLAND	TX	0	925	0	0
LONE STAR INDUSTRIES	TX	0	545	0	0
IDEAL BASIC INDUSTRIES	UT	350	0	0	0
LONE STAR INDUSTRIES	UT	420	0	0	0
SOUTHWESTERN PC CO	UT	0	0	675	0
LONE STAR INDUSTRIES	VA	0	1200	0	0
LONE STAR LAFARGE	VA	0	0	675	0
RIVERTON CORP	VA	0	775	0	0
ASH GROVE C CO	WA	218	0	0	0
COLUMBIA C CO	WA	0	675	0	0
IDEAL BASIC INDUSTRIES	WA	0	0	490	0
LEHIGH PC CO	WA	0	0	257	0
ST MARYS PURLESS C CO	WI	532	0	0	0
CAPITOL C CORP	WV	280	0	0	0
CAPITOL C CORP	WV	456	0	0	0
CAPITOL C CORP	WV	280	0	0	0
MONOLITH PC CO	WY	500	0	0	0

APPENDIX D

HAZARDOUS WASTE INCINERATOR MANUFACTURERS

APPENDIX D

Basic Environmental Engineering, Inc.
21 W. 161 Hill Avenue
Glen Ellyn, IL 60137
(312) 469-5340: John Basic, President

Bayco Industries of California
2108 Davis Street
San Leandro, CA 94577
(415) 562-6700: C.H. Beckett, President

Brule C.E. & E., Inc.
13920 Southwestern Avenue
Blue Island, IL 60406
(312) 388-7900: Al Schmid

Burn-Zol Corporation
P.O. Box 109
Dover, NJ 07801
(209) 931-1297: Ed Avencheck

C&H Combustion
1104 East Big Beaver Road
Troy, MI 48083
(313) 524-2007: Douglas Frame

CJS Energy Resources, Inc.
P.O. Box 85
Albertson, NY 11507
(215) 362-2242: Michael Budin

C.E. Raymond Co.
Bartlett Snow Division
Combustion Engineering, Inc.
200 W. Monroe Street
Chicago, IL 60606
(312) 236-4044: Tom Valenti

Coen Company
1510 Rollins Road
Burlingame, CA 94010
(415) 697-0440: Dick Brown

APPENDIX D
(Continued)

Copetech
125 Windsor Drive
Oak Brook, IL 60521
(312) 986-8564: Brian Copeland

Dorr Oliver, Inc.
77 Havemeyer Lane
Stamford, CT 06904
(203) 358-3741: John Mullen

Econo-Therm Energy Systems Corp.
P.O. Box 1229
Tulsa, OK 74101
1-800-322-7867: Bob Malekowski

EPCON Industrial Systems, Inc.
The Woodlands, TX 77380
(713) 353-2319: Aziz Jamaluddin

Ecolaire ECP
11100 Nations Ford Road
P.O. Box 15753
Charlotte, NC 28210
(704) 588-1620: Bud Strope

Environmental Elements Corp.
(Sub. of Koppers Co., Inc.)
P.O. Box 1318
Baltimore, MD 21203
(301) 368-7166: Jim Nicotri

Fuller Company
2040 Avenue C
LeHigh Valley Industrial Park
Bethlehem, PA 18001
(215) 264-6011: R.J. Aldrich

GA Technologies
P.O. Box 85608
San Diego, CA 92138
(619) 455-3000: Harold Diot

APPENDIX D
(Continued)

HPD, Inc.
1717 N. Naper Boulevard
Naperville, IL 60540
(312) 357-7330: John Karoly

Hirt Combustion Engineers
931 South Maple Avenue
Montebello, CA 90640
(213) 728-9164: Ms. Corinne Gordon

Industronics, Inc.
489 Sullivan Avenue
P.O. Drawer G
S. Windsor, CT 06074
(203) 289-1551: Brian E. Caffyn (x307)

International Incinerators, Inc.
P.O. Box 19
Columbus, GA 31902
(404) 327-5475: Ronald Hale

John Zink Company
4401 Peoria Avenue
Tulsa, OK 74105
(918) 747-1371: Duane Schaub (x454)

Lurgi Corporation
One Davis Drive
Belmont, CA 94002
(201) 967-4916: Dieter Schroer

McGill, Inc.
P.O. Box 9667
Tulsa, OK 74107
(918) 445-2431: Jim Newburn

Midland-Ross Corporation
2275 Dorr Street
Toledo, OH 43691
(419) 537-6145: Val Daiga

APPENDIX D
(Continued)

Niro Atomizer, Inc.
9165 Rumsey Road
Columbia, MD 21045
(301) 997-8700: Steve Lancos

Peabody International Corporation
4 Landmark Square
Stamford, CT 06901
(203) 327-7000: Donald Hubickey

Prenco, Inc.
29800 Stephenson Hwy.
Madison Heights, MI 48071
(313) 399-6262: John Brophy

Rockwell International
8900 DeSoto Avenue
Canoga Park, CA 91304
(818) 700-5468: Al Stewart

Shirco Infrared Systems, Inc.
1195 Empire Central
Dallas, TX 75247
(214) 630-7511: Mike Hill

Sur-Lite Corporation
8130 Allport Avenue
Santa Fe Springs, CA 90670
(213) 693-0796: John Sachs

ThermAll, Inc.
P.O. Box 1776
Peapack, NJ 07977
(201) 234-1776: George Fraunfelder

Therm Tech
Box 1105
Tualatin, OR 97062
(503) 692-1490: Dean Robbins

APPENDIX D
(Concluded)

Trane Thermal Company
Brook Road
Conshohocken, PA 19428
(215) 828-5400: Gene Irrgang

Trofe Incineration
Trofe Industrial Park
Pike Road
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INCINERATOR AND KILN CAPACITY FOR HAZARDOUS WASTE TREATMENT

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16. ABSTRACT

Estimates of incinerator and cement kiln capacities for hazardous waste treatment are required to evaluate the impacts of banning land disposal of hazardous wastes. RCRA Part B permit applications were reviewed to obtain information about incinerator design capacity, utilization and the incinerated hazardous wastes. MITRE identified 221 incinerators within the RCRA regulatory program that are presently destroying approximately two million metric tons of hazardous waste annually. The unused potential capacity of these units is estimated to be one million metric tons of waste per year. The Congressional Budget Office estimates that 265.3 million metric tons of hazardous waste are generated annually.

MITRE estimates that the annual hazardous waste treatment capacity available in cement kilns ranges between two and six million metric tons. Less than five percent of the potential hazardous waste treatment capacity in cement kilns has been permitted under RCRA. Factors affecting this low utilization include the large geographic distances separating some major waste generation sites from cement kilns, marginal economic benefits, and the uncertainty of some kiln operators about regulatory requirements.

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