FINAL

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)

BACKGROUND DOCUMENT

FOR

DISTILLATION BOTTOMS FROM THE PRODUCTION OF ANILINE

K083

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1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA or Agency) is establishing best demonstrated available technology (BDAT) treatment standards for the listed hazardous waste identified in Title 40, Code of Federal Regulations, Section 261.32 (40 CFR 261.32) as K083, distillation bottoms from the production of aniline. These BDAT treatment standards are being established in accordance with the amendments to the Resource Conservation and Recovery Act (RCRA) of 1976, enacted by the Hazardous and Solid Waste Amendments (HSWA) of November 8, 1984. BDAT treatment standards will be effective no later than May 8, 1990, and on or after the effective date, compliance with these BDAT treatment standards will be a prerequisite under 40 CFR Part 268 for placement of the waste in land disposal units.

This background document provides the Agency's rationale and technical support for selecting constituents for regulation in K083 and for developing treatment standards for these constituents. The document also provides waste characterization data that serve as a basis for determining whether a variance from a treatment standard may be warranted for a particular type of K083 that is more difficult to treat than the wastes that were analyzed in developing treatment standards for K083.

The Agency's legal authority and promulgated methodology for establishing treatment standards and the petition process necessary for requesting a variance from the treatment standards are summarized in EPA's Methodology for Developing BDAT Treatment Standards (Reference 1).

Under 40 CFR 261.32, wastes identified as K083 are listed as distillation bottoms from aniline production. The four-digit Standard Industrial Classification (SIC) code associated with the production of nitrobenzene is 2865 (Industrial Organic Chemicals: cyclic crudes, cyclic intermediates, dyes, and organic pigments). The Agency estimates that there are six domestic facilities that may generate K083.

The Agency is revising the "No Land Disposal Based on No Generation" treatment standard that was published for nonwastewater forms of K083 on August 17, 1988 and is establishing treatment standards for wastewater forms of K083, which have been subject to the "soft hammer" provisions of Section 3004(g)(6) of RCRA. The "No Land Disposal" standard for K083 nonwastewaters (containing <0.01% by weight ash) was based on the premise that current waste treatment processes do not generate K083 residuals requiring land disposal. The Agency believes that this standard should be revised for several reasons: (1) a facility intending to manufacture aniline in the future using a process that generates distillation bottoms would be forced to apply for a variance from the "No Land Disposal" treatment standard (40 CFR 268.44); (2) a facility disposing of K083 from past aniline manufacturing operations as part of a corrective action would also be forced to apply for a variance from the treatment standard; and (3) a facility changing its treatment process from one that does not generate treatment residuals to one that may generate residuals would be forced to apply for a variance from the treatment standard.

The Agency is regulating six organic constituents and one metal constituent in nonwastewater forms of K083, and seven organic constituents and one metal constituent in wastewater forms of K083. To determine the applicability of the treatment standards, wastewaters are defined as wastes containing less than 1% (weight basis) total suspended solids[1] (TSS) and less than 1% (weight basis) total organic carbon (TOC). Wastes not meeting this definition are classified as nonwastewaters and must comply with nonwastewater treatment standards.

The Agency does not have any performance data for treatment of K083. Treatment performance tests for this waste have not been pursued because the

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[1]The term "total suspended solids" (TSS) clarifies EPA's previously used terminology of "total solids" and "filterable solids." Specifically, total suspended solids is measured by Method 209C (total suspended solids dried at 103-105°C) in <u>Standard Methods for the Examination of Water and Wastewater, Sixteenth Edition</u> (Reference 2).

Agency believes that adequate treatment performance data are available from similar wastes previously tested by the BDAT Land Disposal Restrictions Program. Therefore, treatment performance data were transferred to K083 from other previously tested wastes.

For organic constituents in nonwastewater forms of K083, BDAT treatment standards are based on treatment performance data transferred from incineration of RCRA Blend waste that was co-treated with K019 (Reference 3). For metal constituents in nonwastewater forms of K083, BDAT treatment standards are based on treatment performance data transferred from stabilization of F024 incinerator ash.

For wastewater forms of K083, BDAT treatment standards are based on wastewater treatment performance data transferred from wastes judged to be similar. The Agency prefers, whenever possible, to use wastewater treatment data from well-designed and well-operated wastewater treatment units rather than to base wastewater treatment standards on constituent concentrations in incinerator scrubber water. EPA has compiled a database of wastewater treatment data for use in establishing treatment standards for wastewater forms of U and P wastes and multi-source leachate. These data, compiled from a variety of sources, were transferred on a constituent-by-constituent basis to K083 organic constituents. For K083 metals, EPA transferred treatment performance data from chemical precipitation followed by vacuum filtration of K062 mixed with metal-bearing characteristic hazardous wastes.

Tables 1-1 and 1-2 at the end of this section list the BDAT treatment standards for nonwastewater and wastewater forms of K083, respectively. These treatment standards are based on the total concentration of each constituent in the waste for organic constituents, and on the TCLP analysis for metal constituents in nonwastewaters. The units used for total constituent concentration of organic constituents are mg/kg (parts per million on a weight-by-weight basis) for K083 nonwastewaters, and mg/l (parts per million on a weight-by-volume basis) for K083 wastewaters. The units used for

TCLP analysis of nonwastewaters are mg/l (parts per million on a weight-by-volume basis). If the concentrations of the constituents regulated in K083 nonwastewaters and wastewaters, as generated, are lower than or are equal to the treatment standards, then treatment of the waste would not be required prior to "land disposal," as defined by 40 CFR Part 268.

This background document presents waste-specific information on the number and locations of facilities that may be affected by the land disposal restrictions for K083, the processes generating this waste, the waste characterization data, the technologies used to treat the waste (or similar wastes, if any), and the treatment performance data on which the treatment standards are based (Sections 2.0 - 4.0). This document also explains how EPA determines BDAT, selects constituents to be regulated, and calculates treatment standards (Sections 5.0 - 7.0).

Table 1-1

BDAT TREATMENT STANDARDS FOR K083

NONWASTEWATERS

Maximum for Any Single Grab Sample

BDAT List Constituent		Total Concentration (mg/kg)
4.	Benzene	6.6
56.	Aniline	14
106./219.	Diphenylamine/Diphenylnitrosamine	14[a]
126.	Nitrobenzene	14
142.	Phenol	5.6

BDAT List Constituent		TCLP Leachate Concentration (mg/l)
163.	Nickel	0.088

[a]This value represents the sum of the diphenylamine and diphenylnitrosamine concentrations.

Table 1-2

BDAT TREATMENT STANDARDS FOR K083

WASTEWATERS

Maximum for Any Single Grab Sample

BDAT List Constituent	Total Concentration (mg/l)
56. Aniline	0.81
142. Phenol	0.039
232. Cyclohexanone	0.36
163. Nickel	0.47

Maximum for Any 24-Hour Composite Sample

BDAT List Constituent	Total Concentration (mg/l)
4. Benzene	0.14
106. Diphenylamine	0.52
219. Diphenylnitrosamine	0.40
126. Nitrobenzene	0.068

2.0 INDUSTRY AFFECTED AND WASTE CHARACTERIZATION

This section describes the industries that may be affected by the land disposal restrictions for K083, the processes generating the waste, and the available waste characterization data. All tables and figures are presented at the end of this section.

2.1 Industry Affected and Process Description

Under 40 CFR Part 261.32, K083 is defined as distillation bottoms from the production of aniline. The Agency estimates that there are approximately six potential generators of K083, which are identified by location and EPA region in Table 2-1.

There are several commercial processes used for the production of aniline, including vapor- or liquid-phase hydrogenation of nitrobenzene, iron reduction of nitrobenzene, and vapor-phase ammonolysis of phenol. Vapor-phase hydrogenation of nitrobenzene is the most widely used method in the United States.

2.1.1 Vapor-Phase Hydrogenation of Nitrobenzene

As illustrated in Figure 2-1, nitrobenzene is vaporized in a stream of hydrogen and fed to the reactor, where it is reduced to aniline in the presence of a catalyst (copper, nickel, vanadium, or cobalt). The reaction products are condensed, and the unreacted hydrogen is recycled. The condensed product stream is sent to a separator. The upper layer is pumped to an aniline extractor. The lower layer is purified in a two-step distillation process into the aniline product. The heavy ends or distillation bottoms from the refined aniline column constitute the listed waste K083.

2.1.2 Liquid-Phase Hydrogenation of Nitrobenzene

The liquid-phase process, as shown in Figure 2-2, uses a catalyst suspended in liquid nitrobenzene and liquid hydrogen to produce aniline. Aniline is then purified by distillation. Bottoms from distillation comprise the listed waste K083.

2.1.3 Iron Reduction of Nitrobenzene

The Bechamp process, as illustrated in Figure 2-3, reduces nitrobenzene in the presence of iron fillings with ferrous chloride solution to produce aniline. The product stream is neutralized with lime and is sent to a separator. The organic phase containing aniline is withdrawn while the remaining separator solution is sent to residual aniline recovery and iron oxide production. The organic phase is sent to a stripper, where water is removed. A final distillation produces aniline. The distillation bottoms constitute the listed waste K083.

2.1.4 Vapor-Phase Ammonolysis of Phenol

Vapor-phase ammonolysis of phenol to produce aniline is illustrated in Figure 2-4. Phenol and ammonia are vaporized and combined in a reactor with a silica-alumina catalyst. The reaction products are passed through a distillation column, where ammonia is recovered and recycled and water is removed. The organic stream from the distillation column is sent to a drying column where additional water is removed. Product aniline and phenol (to recycle) are removed from a final finishing column. Distillation bottoms from the finishing column comprise the listed waste K083.

2.2 Waste Characterization

Available data sources (References 4, 5, 6, 7) indicate the following general composition for K083:

Constituent	Concentration (%)
Aniline	35
Other organics	46
Inorganics	1
Solids	15
Oils	2
Water	1
Total:	100%

Specific waste characterization data are presented in Table 2-2. These data represent K083 generated by three different processes:

- The Bechamp process (K083-1);
- Liquid-phase hydrogenation of nitrobenzene (K083-2); and
- Vapor-phase hydrogenation of nitrobenzene (K083-3 and K083-4).

Table 2-1

POTENTIAL GENERATORS OF K083

Facility	Location	EPA Region
Aristech Chemical Corp.	Haverhill, OH	V
E.I. duPont de Nemours	Beaumont, TX	VI
First Chemical Corp.	Pascagoula, MS	IV
Mallinckrodt, Inc.	Raleigh, NC	IV
Mobay Chemicals	New Martinsville, WV	III
Rubicon, Inc.	Geismar, LA	VI

Source: Directory of Chemical Producers, United States of America. (Reference 8).

Table 2-2

K083 CHARACTERIZATION DATA

BDAT List Constituent	Concentration in Untreated Waste (ppm) K083-1	K083-2	K083-3	K083-4
56. Aniline	301,000-550,000	40,000	200,000-400,000	387,000
4. Benzene	NA	NA	58,000	2,000
232. Cyclohexanone	NA	NA	NA	2,000
106. Diphenylamine	NA	NA	1,700	NA
126. Nitrobenzene	1,000-1,900	NA	NA	10,000
142. Phenol	NA	NA	NA	35,000
160. Copper	NA	2.5	NA	NA
161. Lead	1.9-3.0	NA	NA	NA
163. Nickel	345	NA	NA	NA
171. Sulfide	NA	21,000	NA	NA
Other Parameters				
Condensation by-products (%)	NA	40.0-65.0	NA	NA
Non-volatiles (%)	32.24-66.04	NA	NA	NA
Oils (%)	0.0-5.0	NA	NA	NA
Other Heavy Organics (%)	NA	NA	20-40	NA
Ash (%)	7.0-24.0	<0.01	NA	NA
Carbon (%)	NA	71.6	NA	NA
Total Organic Carbon (%)	NA	72.3	NA	NA
Hydrolyzed Chlorides (%)	2.03	<0.001	NA	NA
Total Chlorides (%)	1.0-7.0	0.3	NA	NA
Total Organic Halides (%)	NA	0.185	NA	NA
Hydrogen (%)	NA	6.2	NA	NA
Nitrogen (%)	4.52	11.5	NA	NA
Oxygen (%)	NA	11.5	NA	NA
Suspended Solids (%)	14.0-22.9	NA	18	NA
Water (%)	0.5-2.0	<0.01	NA	NA
Unknown (%)	2.11	NA	NA	NA
Acidity (as HCl, %)	5.14	NA	NA	NA
Basicity (as NaOH, %)	0.101-0.73	NA	NA	NA
Flash Point (F)	158	NA	NA	NA
Heat Value (Btu/lb)	13,000-16,000	13,000	NA	NA
Specific Gravity @ 25 C	1.06-1.33	NA	NA	NA
Viscosity (cps @ 25 C)	400-14,000	NA	NA	NA

NA - Not available.

Note: K083-1 represents K083 generated by the Bechamp process.
K083-2 represents K083 generated by liquid-phase hydrogenation of nitrobenzene.
K083-3 and K083-4 represent K083 generated by vapor-phase hydrogenation of nitrobenzene.

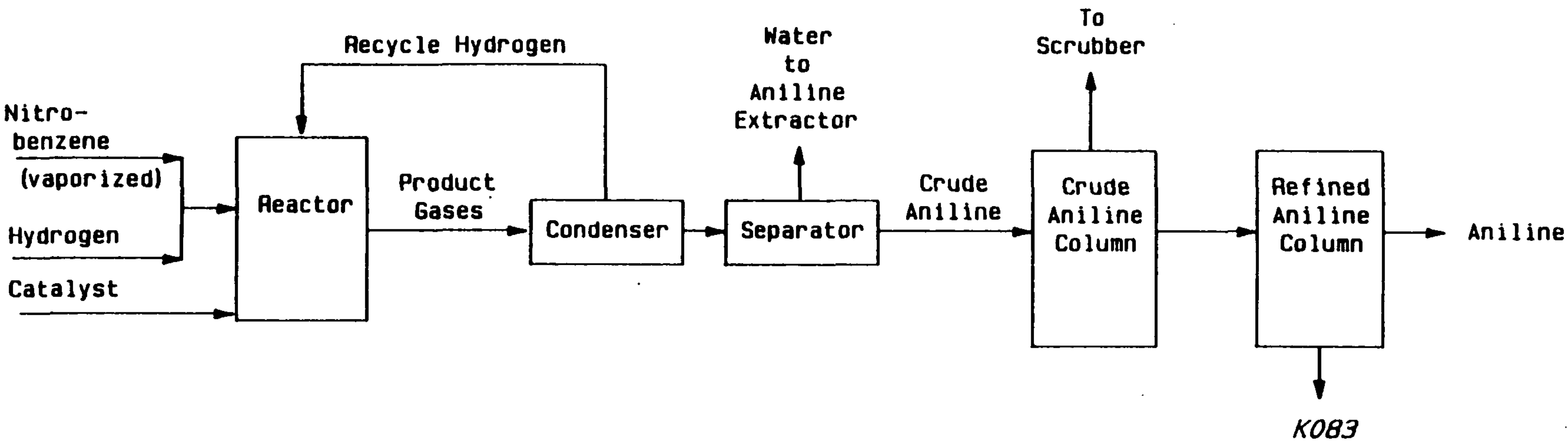

Figure 2-1. Simplified Flow Diagram for the Production of Aniline by Vapor-Phase Hydrogenation of Nitrobenzene

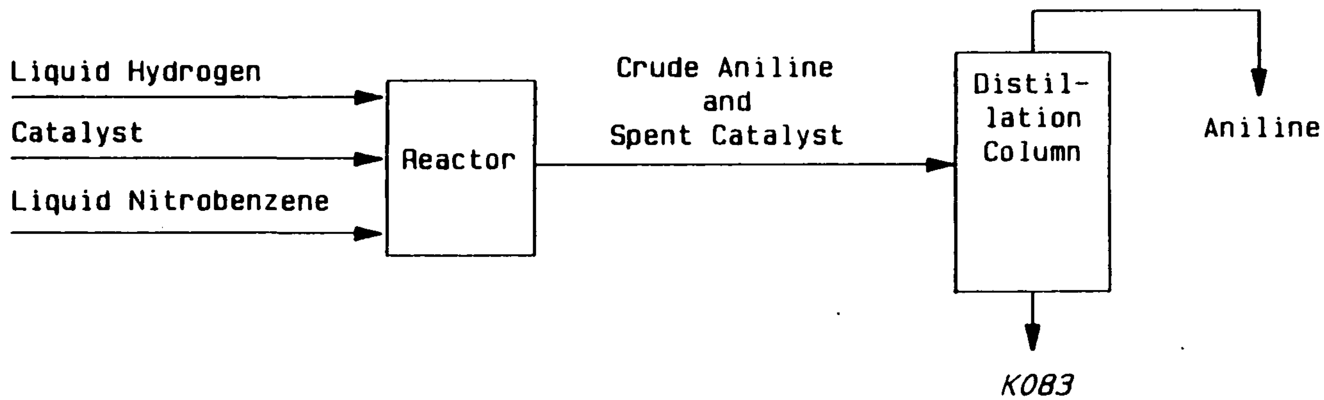

Figure 2-2. Simplified Flow Diagram for the Production of Aniline by Liquid-Phase Hydrogenation of Nitrobenzene

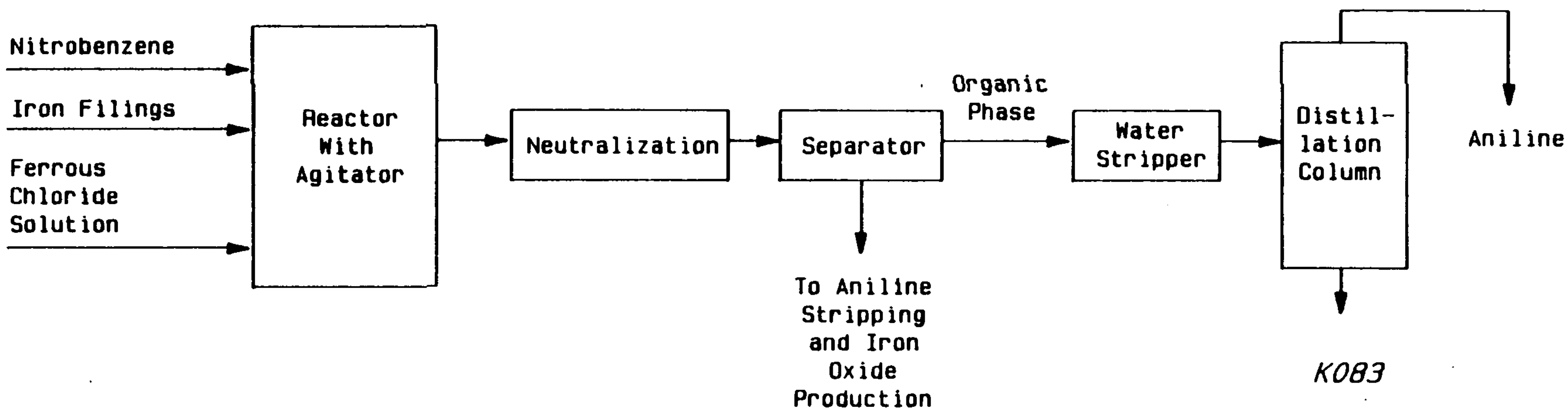

Figure 2-3. Simplified Flow Diagram for the Production of Aniline by the Iron Reduction of Nitrobenzene (the Bechamp process)

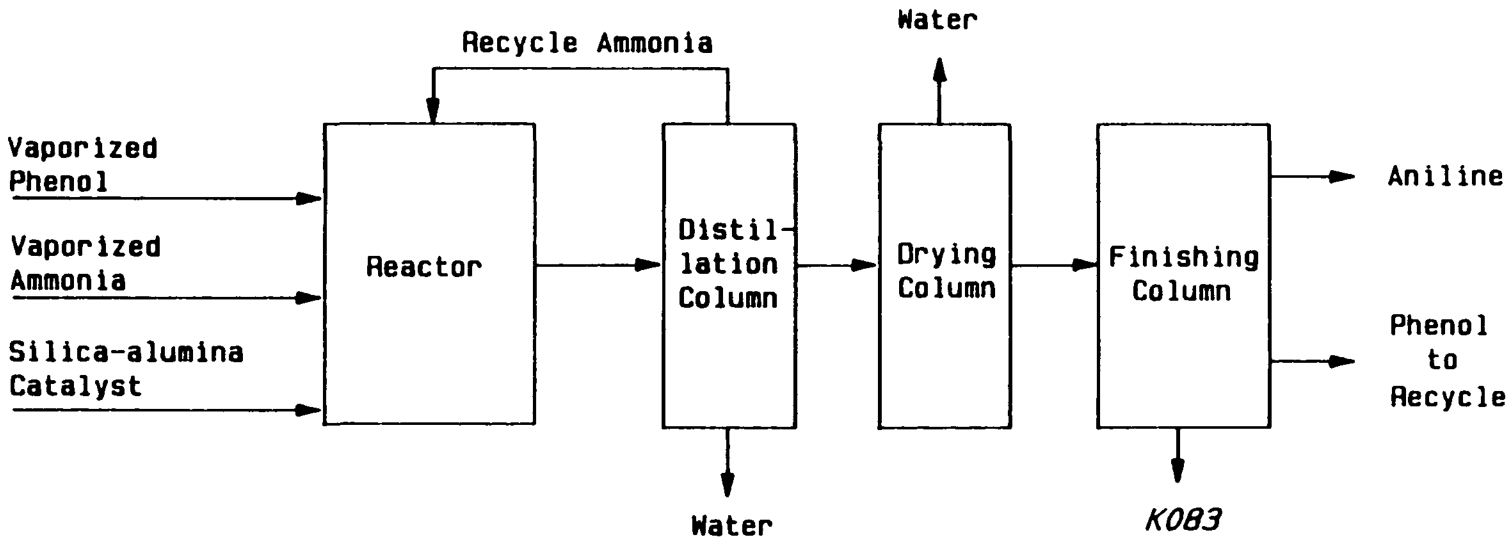

Figure 2-4. Simplified Flow Diagram for the Production of Aniline by Vapor-Phase Ammonolysis of Phenol

3.0 APPLICABLE AND DEMONSTRATED TREATMENT TECHNOLOGIES

This section discusses the technologies that are applicable to treatment of K083 nonwastewaters and wastewaters and determines which, if any, of the applicable technologies can be considered demonstrated for the purpose of establishing BDAT.

To be applicable, a technology must theoretically be usable to treat the waste in question or a waste that is similar in terms of parameters that affect treatment selection. (Detailed descriptions of technologies that are applicable to listed hazardous wastes are provided in EPA's Treatment Technology Background Document (Reference 9).) To be demonstrated, a technology must be employed in full-scale operation for treatment of the waste in question or a similar waste. Technologies available only at pilot- or bench-scale operations are not considered in identifying demonstrated technologies.

3.1 Applicable Treatment Technologies

The following subsections present applicable technologies for treatment of nonwastewater and wastewater forms of K083.

3.1.1 Nonwastewaters

Since nonwastewater forms of K083 consist primarily of organic compounds (as shown in Section 2.0), applicable treatment technologies include those that destroy or reduce the total amount of various organic compounds in the waste. The Agency has identified the following treatment technologies as potentially applicable for K083 nonwastewaters: (1) incineration (fluidized-bed and rotary kiln) followed by stabilization of incinerator ash; (2) solvent extraction followed by incineration or recycle of the extract; and (3) critical fluid extraction followed by recycle or incineration of the contaminated solvents. These treatment technologies were identified based on current waste treatment practices and engineering judgment.

Incineration. Incineration is a destruction technology in which energy, in the form of heat, is transferred to the waste to destabilize chemical bonds and destroy organic constituents. In a fluidized-bed incinerator, waste is injected into the fluidized-bed material (generally sand and/or incinerator ash), where it is heated to its ignition temperature. Heat energy from the combustion reactions is then transferred back to the fluidized bed. Ash is removed periodically during operation and during bed change-outs.

In a rotary kiln incinerator, wastes are fed into the elevated end of the kiln, and the rotation of the kiln mixes the waste with hot gases to heat the waste to its ignition temperature. Ash is removed from the lower end of the kiln. Combustion gases from the kiln enter the afterburner for complete destruction of organic waste constituents. Other wastes may also be injected into the afterburner.

Combustion gases from the fluidized-bed or kiln afterburner are then fed to a scrubber system for cooling and removal of entrained particulates and acid gases, if present. In general, two residuals are generated by incineration processes: ash and scrubber water. Metals and other inorganic constituents in incinerator ash can be treated using stabilization. Metals and other inorganic constituents in scrubber water can be treated using chemical precipitation and vacuum filtration.

Stabilization. Stabilization refers to a broad class of treatment processes that physically or chemically reduce the mobility of metal constituents in a waste by binding these constituents into a solid material that is resistant to leaching.

Solvent Extraction. Solvent extraction is a separation technology in which organics are removed from the waste due to greater constituent solubility in the solvent phase than in the waste phase. This technology results in the generation of two treatment residuals: a treated waste residual and an extract. Metals and other inorganic constituents in the treated waste residual can be treated by stabilization. The extract may be recycled or may be further treated by incineration.

Critical Fluid Extraction. Critical fluid extraction is a solvent extraction technology in which the solvent is brought to its critical state to aid in the extraction of organic constituents from the wastes. After the extraction step, the solvent (liquified gas at its critical state) is brought to its normal condition in the gaseous state and generates a small volume of extract that is concentrated in hazardous organic constituents. This technology results in the generation of two treatment residuals: a treated waste and an extract. The extract may be recycled or may be further treated by incineration.

3.1.2 Wastewaters

Since wastewater forms of K083 may contain organic and metal constituents at treatable concentrations, applicable treatment technologies include those that destroy or reduce the total amount of various constituents in the waste. Technologies that are applicable for treatment of the organic and metal constituents in K083 are identified the Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A (Reference 14).

3.2 Demonstrated Treatment Technologies

The following subsections present demonstrated technologies for treatment of nonwastewater and wastewater forms of K083.

3.2.1 Nonwastewaters

The Agency is aware of four facilities that incinerate K083 nonwastewaters and of two facilities that incinerate K083 nonwastewaters as fuel. In addition, the Agency tested rotary kiln incineration for similar wastes, as discussed in Section 4.0.

EPA is not aware of any facilities that treat metal constituents in nonwastewater forms of K083 by stabilization. However, stabilization is demonstrated for metal constituents in wastes judged to be similar, such as F024, as discussed in Section 4.0.

3.2.2 Wastewaters

Technologies that are demonstrated for treatment of the organic constituents in K083 wastewaters are discussed in the Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A (Reference 14).

EPA is not aware of any facilities that treat metal constituents in K083 wastewaters. However, chemical precipitation followed by vacuum filtration is demonstrated for metal constituents in similar wastes, such as K062, as discussed in Section 4.0. Additionally, all of the treatment technologies that were identified as applicable for treatment of metal constituents in K083 wastewaters in EPA's Final Best Demonstrated Available Technology Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A (Reference 14) are considered to be demonstrated for treatment of these constituents.

The Agency is not aware of any other technologies that are demonstrated for treatment of K083.

4.0 TREATMENT PERFORMANCE DATA

This section presents the treatment performance data that were used to develop treatment standards for nonwastewater and wastewater forms of K083.

Where data are not available on the treatment of the specific waste of concern, the Agency may elect to transfer performance data from a demonstrated technology used to treat a similar waste or wastes. EPA's methodology for the transfer of treatment performance data is provided in EPA's Methodology for Developing BDAT Treatment Standards (Reference 1). Transfer of treatment performance data is technically valid in cases where the untested wastes are generated from similar industries or similar processing steps, or have waste characteristics affecting treatment selection and performance that are similar to those of the tested wastes.

4.1 Nonwastewaters

The Agency does not have any treatment performance data for treatment of K083 nonwastewaters. However, treatment performance data were available from other wastes previously tested by EPA and were transferred to develop treatment standards for nonwastewater forms of K083. Sources of treatment performance data for potential transfer to K083 include wastes previously tested by incineration (including rotary kiln and fluidized-bed) followed by stabilization of incinerator ash. These technologies were identified as applicable and demonstrated for treatment of these wastes, as discussed in Section 3.0.

4.1.1 Organic Constituents

Previous incineration tests conducted by the Agency are listed in Table 4-1 at the end of this section. EPA examined the wastes incinerated in these tests to identify the best data source(s), if any, for transfer of treatment performance data to K083 nonwastewaters. Specifically, EPA examined (1) whether the untested K083 is generated from a similar industry or processing step, and (2) whether the waste has similar waste characteristics affecting treatment performance as do the previously tested wastes.

Wastes included in Tests 3, 4, 5, 11, 12, 13, and 14 are generated by the organic chemicals industry. Like K083, wastes incinerated in Tests 3, 4, 5, 11, and 14 were generated by distillation or some other type of separation process.

Of the wastes generated by a process similar to that generating K083, those incinerated in Tests 3, 4, and 14 contain nitrogenated compounds, and are therefore most structurally similar to K083. The wastes incinerated in these tests are also similar to K083 in that they are all organic wastes. The waste incinerated in Test 3 has a high concentration of water, while the water content of K083 and the wastes incinerated in Tests 4 and 14 is quite low. The constituents in the RCRA Blend waste incinerated in Test 4 are more similar to K083 than those in Tests 3 and 14 with respect to structure and physical properties that affect the treatment performance of incineration, such as boiling points. In addition, the RCRA Blend waste incinerated in Test 4 is expected to have a similar thermal conductivity to K083. Therefore, the Agency believes that treatment performance similar to that achieved for RCRA Blend waste could be achieved for K083.

Based on the similarities discussed above, treatment standards for organic constituents being regulated in K083 nonwastewaters were developed based on treatment performance data transferred from rotary kiln incineration of the RCRA Blend waste that was co-incinerated with K019 in Test 4.

K019 and three other wastes, referred to as "RCRA Blend," "PCB Blend," and "Mercaptan-contaminated waste," were treated in Test 4. K019, RCRA Blend waste, PCB Blend waste, and Mercaptan-contaminated waste comprised approximately 20%, 23%, 41%, and 16%, respectively, of the waste treated. K019 and RCRA Blend were fed to the rotary kiln; PCB Blend and Mercaptan-contaminated waste were fed to the afterburner (secondary combustor). Accordingly, the ash generated from rotary kiln incineration resulted from treatment of the K019 and RCRA Blend wastes only. The ash data from the incineration of K019 and RCRA Blend wastes were transferred to K083 nonwastewaters. Tables 4-2 and 4-3 present the BDAT List constituents detected in the untreated wastes and in the kiln ash residual for six sample sets collected by EPA from the rotary kiln incineration treatment system. Design and operating data are presented in Table 4-4 for each sample set. All tables are presented at the end of this section.

4.1.2 Metal Constituents

The Agency examined all of the available nonwastewater treatment performance data for metal constituents. Treatment of F024 incinerator ash by stabilization was the sole source of data for the constituent of concern, nickel; these treatment performance data were also the only data from stabilization of incinerator ash. EPA examined the F024 ash stabilization data to evaluate whether transferring these treatment performance data to K083 nonwastewater metals was appropriate. Specifically, EPA examined whether the untested K083 is (1) generated from a similar industry or processing step, and (2) whether the waste has similar waste characteristics affecting treatment performance as does the previously tested waste.

Both K083 and F024 are generated by the organic chemicals industry. They are also both generated by a separation process.

After determining that the wastes are generated by similar industries and processes, EPA examined the relative treatability of metal constituents in K083 nonwastewater and in F024 nonwastewater. As discussed in the Treatment Technology Background Document (Reference 9), waste characteristics that affect the performance of stabilization are the concentrations of the following parameters in the untreated waste: fine particulates, oil and grease, organic compounds, sulfate, and chloride compounds.

K083 and F024 are expected to have similar concentrations of these parameters. F024 is also expected to have a similar or higher concentration of the constituent of concern, nickel; than K083. Because of these similarities, the wastes are believed to be similar and are expected to be treated to similar concentrations by stabilization of incinerator ash.

Based on these analyses, transfer of treatment performance data from stabilization of F024 nonwastewater metals to K083 nonwastewater metals is valid. Treatment performance data for stabilization of F024 incinerator ash are included in Table 4-5, and associated design and operating data are included in Table 4-6.

4.2 Wastewaters

The Agency does not have any treatment performance data for treatment of K083 wastewaters. However, treatment performance data were available from other wastes previously tested by EPA and were transferred to develop treatment standards for wastewater forms of K083.

4.2.1 Organic Constituents

The treatment performance data that were used to develop treatment standards for organic constituents in K083 wastewaters are summarized in Appendix A of this document, and are discussed in greater detail in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A (Reference 14). These treatment performance data were used to develop treatment standards for organic constituents in K083 wastewaters. If the Agency has appropriate wastewater treatment performance data from well-designed and well-operated wastewater treatment units, it prefers to use these data, rather than constituent concentrations in scrubber water, to develop treatment standards. Constituent concentrations in scrubber water represent the only other source of data available for transfer to K083 wastewaters. The Agency believes that the wastewater performance data summarized in Appendix A represent the best source of treatment performance data available for transfer to wastewater forms of K083. On a constituent-by-constituent basis, the tested wastes represented in these treatment performance data have similar waste characteristics affecting treatment performance and selection as the untested K083 wastewaters.

4.2.2 Metal Constituents

The Agency examined all of the available wastewater treatment performance data. Performance data for treatment of metal constituents in various industrial wastewaters were developed by EPA's Office of Water. Additionally, EPA's database for chemical precipitation followed by filtration of wastewaters is included in the California List Notice of Data Availability (52 Federal Register 29992)(Reference 15). EPA screened the available data to determine whether any wastes are generated from similar industries or similar processing steps, or have similar waste characteristics affecting treatment performance as those expected for wastewater forms of K083. The metal constituent of concern in K083 is nickel, as shown by the waste characterization data included in Table 2-2. Waste characterization data for the metal-bearing wastes tested by the Agency's Office of Water were insufficient to compare these wastes to K083 in terms of waste generation and waste characterization. However, based on waste characterization data, K062 mixed with metal-bearing characteristic hazardous wastes and K083 wastewater are expected to contain nickel at similar concentrations.

EPA then examined the relative treatability of K083 wastewater and the mixture of K062 and metal-bearing characteristic hazardous wastes. As discussed in the Treatment Technology Background Document (Reference 9), waste characteristics that affect treatment performance for chemical precipitation include the concentrations and types of metals in the waste, the concentrations of dissolved solids in the waste, the oil and grease content of the waste, and whether the metals exist in the wastewater as a complex. EPA considers K062 wastewaters to be more difficult to treat than K083 wastewaters because equal or higher concentrations of metals and dissolved solids are anticipated in K062 than in wastewater forms of K083. These higher concentrations of metals and dissolved solids would interfere with the effectiveness of the precipitation reactions intended to remove the metals of concern. Since K083 wastewaters are frequently scrubber waters generated from incineration, oil and grease would not be expected to be present at significant concentrations. However, the K062 mixture contains oil and grease and may therefore be more difficult to treat than K083 scrubber water. Complex metals are not considered to be significant parameters in either waste. In consideration of these points, the mixture of K062 and metal-bearing characteristic hazardous wastes is considered to be more difficult to treat than wastewater forms of K083.

Based on these analyses, transfer of treatment performance data from chemical precipitation and vacuum filtration of K062 mixed with metal-bearing characteristic hazardous wastes to K083 wastewaters was judged to be valid. Treatment performance data for chemical precipitation followed by vacuum filtration of K062 mixed with metal-bearing characteristic hazardous wastes are included in Table 4-7.

Table 4-1

WASTES TESTED BY INCINERATION AND SAMPLED BY EPA

Test Number	Waste Code(s)	Treatment Technology Used
1	K001 - Pentachlorophenol	Rotary kiln incineration
2	K001 - Creosote	Rotary kiln incineration
3	K011, K013, K014	Rotary kiln incineration
4	K019	Rotary kiln incineration
5	K024	Rotary kiln incineration
6	K037	Rotary kiln incineration
7	K048, K051	Fluidized-bed incineration
8	K087	Rotary kiln incineration
9	K101	Rotary kiln incineration
10	K102	Rotary kiln incineration
11	F024	Rotary kiln incineration
12	K015	Liquid injection incineration
13	D014, D016, P059[a], U127[a], and U192[a]	Rotary kiln incineration
14	U141[a], U028[a], P020[a], U112[a], U226[a], U239[a], U080[a], U220[a], U166[a], U161[a], and U188[a]	Rotary kiln incineration

[a]Commercial chemical products were used in these test burns as surrogates for these wastes.

Table 4-2

WASTE CHARACTERIZATION DATA COLLECTED BY EPA FOR K019
AND OTHER WASTES TREATED BY ROTARY KILN INCINERATION

		Wastes Fed to the Rotary Kiln[a]		Wastes Fed to the Secondary Combustor	
	BDAT List Constituent	K019 (ppm)	RCRA Blend (ppm)	PCB Blend (ppm)	Mercaptan-Contaminated Waste (ppm)
	VOLATILES				
4.	Benzene	<2,000	2,000	2,000	17.0
7.	Carbon tetrachloride	3,500-4,100	<8	<2,000	1.9
9.	Chlorobenzene	<2,000-3,000	<8	<2,000	<0.4
14.	Chloroform	4,600-6,000	<8	<2,000	<0.4
22.	1,1-Dichloroethane	<2,000-2,200	<8	<2,000	<0.4
23.	1,2-Dichloroethane	87,000-130,000	<8	<2,000	<0.4
34.	Methyl ethyl ketone	<10,000	940	<10,000	3.5
38.	Methylene chloride	<10,000	910	<10,000	<2.0
42.	Tetrachloroethene	6,000-7,800	490	<2,000	<0.4
43.	Toluene	<2,000	2,300	41,000	3.7
45.	1,1,1-Trichloroethane	33,000-81,000	130	<2,000	2.3
47.	Trichloroethene	2,200-3,210	360	3,600	<0.4
215-217.	Xylene (total)	<2,000	3,400	36,000	4.4
222.	Acetone	<10,000	1,200	<10,000	<2.0
226.	Ethyl benzene	<2,000	2,200	16,000	4.1
229.	Methyl isobutyl ketone	<10,000	1,100	<10,000	<2.0

[a]Six sample sets of K019 were collected; results are presented as ranges, where appropriate. One sample of RCRA Blend, PCB Blend, and Mercaptan-Contaminated wastes was collected.

Note: This table shows the concentrations in the untreated waste for all constituents that were detected in the untreated waste.

Source: BDAT Background Document for K016, K018, K019, K020, K030 (Reference 3).

Table 4-2 (Continued)

WASTE CHARACTERIZATION DATA COLLECTED BY EPA FOR K019
AND OTHER WASTES TREATED BY ROTARY KILN INCINERATION

BDAT List Constituent	Wastes Fed to the Rotary Kiln[a] K019 (ppm)	Wastes Fed to the Rotary Kiln[a] RCRA Blend (ppm)	Wastes Fed to the Secondary Combustor PCB Blend (ppm)	Wastes Fed to the Secondary Combustor Mercaptan-Contaminated Waste (ppm)
SEMIVOLATILES				
51. Acenaphthalene	<10	150	120	<0.002
52. Acenaphthene	<10	<20	480	<0.002
56. Aniline	<25	<50	<250	1.220
57. Anthracene	<10	110	400	<0.002
65. Benzo(k)fluoranthene	<10	67	<100	<0.002
68. Bis(2-chloroethyl)ether	280-340	<20	<100	<0.002
70. Bis(2-ethylhexyl)phthalate	<10	40	<100	0.079
80. Chrysene	SNA	28	<100	<0.002
81. ortho-Cresol	<10	<20	<100	0.020
87. o-Dichlorobenzene	<10	250	1,060	2.550
88. p-Dichlorobenzene	74-90	32	460	0.260
90. 2,4-Dichlorophenol	<25	<50	<250	0.420
91. 2,6-Dichlorophenol	<25	<50	500	0.430
98. Di-n-butyl phthalate	<10	31	120	0.012
104. Di-n-octyl phthalate	<10	<20	430	<0.002
108. Fluoranthene	<10	120	300	<0.002
109. Fluorene	16-22	53	340	<0.002

[a]Six sample sets of K019 were collected; results are presented as ranges, where appropriate. One sample of RCRA Blend, PCB Blend, and Mercaptan-Contaminated wastes was collected.

Note: This table shows the concentrations in the untreated waste for all constituents that were detected in the untreated waste.

Source: BDAT Background Document for K016, K018, K019, K020, K030 (Reference 3).

Table 4-2 (Continued)

WASTE CHARACTERIZATION DATA COLLECTED BY EPA FOR K019
AND OTHER WASTES TREATED BY ROTARY KILN INCINERATION

		Wastes Fed to the Rotary Kiln[a]		Wastes Fed to the Secondary Combustor	
	BDAT List Constituent	K019 (ppm)	RCRA Blend (ppm)	PCB Blend (ppm)	Mercaptan-Contaminated Waste (ppm)
	SEMIVOLATILES				
110.	Hexachlorobenzene	60-87	<100	<500	0.002
111.	Hexachlorobutadiene	<50	210	<500	0.079
113.	Hexachloroethane	85-120	<100	<500	0.018
121.	Naphthalene	314-470	<20	400	0.133
122.	1,4-Naphthoquinone	<10	<20	<100	0.078
126.	Nitrobenzene	<25	3,400	8,200	0.027
136.	Pentachlorobenzene	51-65	<100	1,000	0.020
141.	Phenanthrene	11-21	240	950	<0.002
142.	Phenol	<10	78	1,000	4.56
145.	Pyrene	<10	200	260	<0.002
148.	1,2,4,5-Tetrachlorobenzene	62-86	<50	1,400	0.008
150.	1,2,4-Trichlorobenzene	65-100	<50	19,000	1.24
152.	2,4,5-Trichlorophenol	<50	<100	<500	0.037
	METALS				
155.	Arsenic	<0.2-1.2	94	7.4	<0.02
156.	Barium	<0.9-0.97	1.3	<19	1.67

[a]Six sample sets of K019 were collected; results are presented as ranges, where appropriate. One sample of RCRA Blend, PCB Blend, and Mercaptan-Contaminated wastes was collected.

Note: This table shows the concentrations in the untreated waste for all constituents that were detected in the untreated waste.

Source: BDAT Background Document for K016, K018, K019, K020, K030 (Reference 3).

Table 4-2 (Continued)

WASTE CHARACTERIZATION DATA COLLECTED BY EPA FOR K019
AND OTHER WASTES TREATED BY ROTARY KILN INCINERATION

		Wastes Fed to the Rotary Kiln[a]		Wastes Fed to the Secondary Combustor	
BDAT List Constituent		K019 (ppm)	RCRA Blend (ppm)	PCB Blend (ppm)	Mercaptan-Contaminated Waste (ppm)
	METALS (Continued)				
158.	Cadmium	<0.3-0.63	<0.3	<33	<0.003
159.	Chromium	1.8-5.3	40	23.7	<0.009
160.	Copper	<1.0-3.6	23.7	107	0.027
161.	Lead	2.1-3.5	165	<7.3	0.0064
163.	Nickel	2.2-6.0	27	6.2	0.037
168.	Zinc	4.4-9.4	8.8 4,170	6,810	0.071
	INORGANICS				
171.	Sulfide	790	830	16,000	17

[a]Six sample sets of K019 were collected; results are presented as ranges, where appropriate. One sample of RCRA Blend, PCB Blend, and Mercaptan-Contaminated wastes was collected.

Note: This table shows the concentrations in the untreated waste for all constituents that were detected in the untreated waste.

Source: BDAT Background Document for K016, K018, K019, K020, K030 (Reference 3).

Table 4-3

TREATMENT PERFORMANCE DATA COLLECTED BY EPA FOR K019
AND OTHER WASTES TREATED BY ROTARY KILN INCINERATION

KILN ASH RESIDUAL

BDAT List Constituent		Detection Limit	Concentration in Kiln Ash - Total Concentration (mg/kg) Sample Set #1	Sample Set #2	Sample Set #3	Sample Set #4	Sample Set #5	Sample Set #6
	SEMIVOLATILES							
70.	Bis(2-ethylhexyl)phthalate	2	ND	ND	ND	12	ND	ND
72.	Di-n-butyl phthalate	2	ND	ND	ND	230	ND	ND
	METALS							
154.	Antimony	6.0	8.0	6.8	9.2	ND	9.1	9.6
155.	Arsenic	0.2	3.6	2.8	5.7	5.7	3.9	2.3
156.	Barium	0.9	26	23	54	8.4	21	11
158.	Cadmium	0.3	0.66	0.96	3.6	ND	1.2	2.2
159.	Chromium	0.9	44	60	202	28	125	141
160.	Copper	1.0	2,370	3,430	2,290	1,270	2,780	2,520
161.	Lead	0.2	120	42	118	25	86	34
163.	Nickel	2.0	66	89	169	69	166	288
165.	Silver	0.9	3.3	3.4	1.9	2.6	3.3	3.1
167.	Vanadium	2.0	4.1	4.8	6.0	ND	5.7	8.7
168.	Zinc	0.6	12	13	16	11	22	13
	INORGANICS							
170.	Fluoride	2	38	ND	6.1	3.2	23	4.7
171.	Sulfide	50	68	5.1	64	ND	64	92

ND - The compound was not quantified at or above the detection limit.

Note: This table shows the concentrations in the kiln ash for all constituents that were detected in the nonwastewater residuals generated from treatment of the waste.

Source: BDAT Background Document for K016, K018, K019, K020, K030 (Reference 3).

Table 4-4

DESIGN AND OPERATING DATA FOR THE ROTARY KILN AND SECONDARY COMBUSTOR

Parameter (units)	Design Value	Sample Set #1	Sample Set #2	Sample Set #3	Sample Set #4	Sample Set #5	Sample Set #6
Kiln Outlet Temperature (°F)	*	1,825-1,900	1,800-1,880	1,775-1,900	1,775-1,900	1,775-1,800	1,775-1,850
Kiln Solids Residence Time (min)	*	120	120	120	120	120	120
Kiln Waste Feed Rate (MMBtu/hr)	*						
K019:		13.1	12.2	12.4	12.7	11.7	11.5
RCRA Blend, Burner #1:		3.9-5.5	5.2-5.5	5.2-5.8	5.2-5.8	5.2-6.0	5.2-5.8
RCRA Blend, Burner #2:		4.4-9.7	4.4-9.7	4.4-8.4	4.4-7.3	5.2-9.7	5.2-9.7
Total:		21.4-28.3	21.8-27.4	22.0-26.6	22.3-25.8	22.1-27.4	21.9-27.0
Kiln Rotational Speed (RPM)	*	0.19-0.21	0.19-0.21	0.19-0.21	0.19-0.21	0.19-0.21	0.19-0.21
Afterburner Temperature (oF)	*	2380	2400	2400	2400	2400	2350
Afterburner Residence Time (sec)	*	2	2	2	2	2	2
Afterburner Waste Feed Rate (MMBtu/hr)	*						
PCB Blend:		36.1	36.5	36.5	36.5	37.5	37.5
Mercaptan-Contaminated Waste:		0.18	0.18	0.18	0.18	0.18	0.18
Total:		36.28	36.68	36.68	36.68	37.68	37.68
Stack Oxygen Concentration (%)	NA	6.8	7.0	7.2	6.4	6.8	7.0
Stack Carbon Monoxide Concentration (ppm volume)	NA	NR	NR	0	0	NR	NR

NA - Not applicable.
NR - Not recorded.

*This information has been claimed as RCRA Confidential Business Information and is available in the confidential portion of the Admininistrative Record for the First Third Rulemaking of August 17, 1988.

Source: BDAT Background Document for K016, K018, K019, K020, K030 (Reference 3).

Table 4-5

TCLP ANALYTICAL RESULTS FOR THE F024 ROTARY KILN INCINERATOR ASH SAMPLES

CEMENT BINDER

Binder-to-Ash Ratio: 0.55
Water-to-Ash Ratio: 0.2

BDAT List Constituent	Detection Limit (mg/l)	Concentration in the TCLP Extract of the Untreated Waste (mg/l) Sample Set 1	2	3	Concentration in the TCLP Extract of the Treated Waste (28-Day Cure) (mg/l) Sample Set 1	2	3	Detection Limit (mg/l)	Concentration in the TCLP Extract of the Treated Waste (24-Hour Cure) (mg/l)
154. Antimony	0.076	ND	ND	ND	ND	ND	ND	0.11	ND
155. Arsenic	0.002	0.013	0.015	0.014	0.004	0.002	0.002	0.002	0.002
156. Barium	0.002	1.99	1.72	1.67	1.84	0.88	1.02	0.002	3.19
157. Beryllium	0.001	0.002	0.002	0.002	ND	ND	ND	0.002	ND
158. Cadmium	0.003	0.021	0.021	0.021	ND	ND	ND	0.004	ND
159. Chromium (total)	0.007	0.4	0.41	0.42	0.031	0.01	0.013	0.003	0.031
221. Chromium (VI)	0.006	0.34	0.075	0.049	0.19	0.15	0.14	0.045	0.045
160. Copper	0.18	5.54	6.71	9.59	ND	ND	ND	0.013	0.014
161. Lead	0.057	63.3	33.3	14.9	0.011	0.006	0.007	0.001	0.24
162. Mercury	0.0003	0.0006	ND	ND	ND	ND	ND	0.0003	ND
163. Nickel	0.025	4.39	3.96	3.93	ND	ND	ND	0.042	ND
164. Selenium	0.002	ND	ND	ND	ND	ND	ND	0.002	0.003
165. Silver	0.004	ND	ND	ND	ND	ND	ND	0.006	ND
166. Thallium	0.004	ND	ND	ND	ND	ND	ND	0.004	ND
167. Vanadium	0.007	ND	ND	ND	ND	ND	ND	0.008	ND
168. Zinc	0.003	2.06	2.07	2.06	0.041	0.05	0.173	0.023	0.11
* Aluminum	0.023	15.8	16.9	16.4	0.45	0.28	0.26	0.021	0.41
* Calcium	0.001	588	584	588	2,003	1,870	1,880	0.003	2,340
* Cobalt	0.01	0.06	0.053	0.049	ND	0.012	ND	0.023	ND
* Iron	0.012	13.1	12.8	13.2	0.022	0.037	0.17	0.023	0.074
* Magnesium	0.001	146	140	145	0.095	0.30	1.28	0.002	0.046
* Manganese	0.001	1.98	2.19	2.21	ND	ND	0.001	0.002	ND
* Molybdenum	0.037	ND	0.041	ND	0.062	0.056	0.078	0.088	ND
* Sodium	0.021	45	44.8	45.1	37.4	37.2	37.4	0.028	35.2
* Tin	0.105	1.04	0.43	0.32	ND	ND	ND	0.103	ND

ND - Not detected.
* - Non-BDAT List Constituent.

Source: Onsite Engineering Report of Stabilization of F024 Rotary Kiln Incinerator Ash at Waterways Experiment Station (Reference 10).

Table 4-6

TEST CONDITIONS COMMON TO ALL BATCHES OF STABILIZED F024 INCINERATION ASH

Parameter	Specification
Mixing Vessel	Hobart K455S Mixer With Teflon Beaters 4-Liter Stainless Steel Bowl
Mixing Conditions	Mixing Procedure Used for All Batches: Mix 5 minutes Stir with stainless steel spatula
Cure Conditions	Hot Pack Model 41750 Large Capacity Humidity Chamber with set point conditions of: Temperature: 23°C Humidity: 95-98%

Source: Onsite Engineering Report of Stabilization of F024 Rotary Kiln Incinerator Ash at Waterways Experiment Station (Reference 10).

Table 4-7

PERFORMANCE DATA COLLECTED BY EPA FOR TREATMENT OF K062 BY CHEMICAL PRECIPITATION FOLLOWED BY VACUUM FILTRATION[a]

BDAT LIST METAL CONSTITUENT	Sample Set #8		Sample Set #11		Sample Set #12	
	Concentration in Untreated K062 Mixture (ppm)	Concentration in Treated K062 Mixture Waste-water (ppm)	Concentration in Untreated K062 Mixture (ppm)	Concentration in Treated K062 Mixture Waste-water (ppm)	Concentration in Untreated K062 Mixture (ppm)	Concentration in Treated K062 Mixture Waste-water (ppm)
154. Antimony	<10	<1	<10	<1	<10	<1.00
155. Arsenic	<1	<0.1	<1	<0.1	<1	<0.10
156. Barium	<10	<1	<10	<1	12	<1.00
157. Beryllium	<2	<0.2	<2	<0.2	<2	<0.20
158. Cadmium	<5	<0.5	<5	<0.5	23	<5
221. Chromium (hexavalent)	0.13	<0.01	0.08	0.106	0.30	<0.01
159. Chromium (total)	831	0.15	395	0.12	617	0.18
160. Copper	217	0.16	191	0.14	137	0.24
161. Lead	212	<0.01	<10	<0.01	136	<0.01
162. Mercury	<1	<0.1	<1	<0.1	<1	<0.10
163. Nickel	669	0.36	712	0.33	382	0.39
164. Selenium	<10	<1	<10	<1	<10	<1.00
165. Silver	<2	<0.2	<2	<0.2	<2	<0.20
166. Thallium	<10	<1	<10	<1	<10	<1.00
168. Zinc	151	0.130	5	0.070	135	0.100

[a]Only 3 of the 12 data sets analyzed at Plant B represented treatment by this treatment train. Other data sets included pretreatment technologies such as chromium reduction and treatment for cyanide. These data are not included here, since they were not considered for transfer, as discussed in Section 3.2 of this document.

Source: Envirite Onsite Engineering Report (Reference 16).

5.0 IDENTIFICATION OF BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)

This section discusses technologies that are available for treatment of organic and metal constituents in K083 nonwastewaters and metal constituents in K083 wastewaters, and identifies BDAT for these constituents. The technologies that are available for treatment of organic constituents in K083 wastewaters, along with identification of BDAT for these constituents, are discussed in EPA's Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A (Reference 14).

To determine BDAT, the Agency examines all available treatment performance data on technologies that are identified as demonstrated for the waste of concern, or for a waste similar to the waste of concern, to evaluate whether one or more of the technologies performs significantly better than the others. If data are available for only one technology for treating a waste, then that technology is "best." When data are available for more than one treatment technology, the "best" performing treatment technology is usually determined by statistical methods, as discussed in EPA's Methodology for Developing BDAT Treatment Standards (Reference 1). In the case of the wastewater treatment performance data available to the Agency for organic constituents (and described in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A (Reference 14)), a data hierarchy was established to determine the "best" technology for each constituent. This hierarchy is described in the latter-referenced document.

The treatment technology that is found to perform best on a particular waste stream is then evaluated to determine whether it is "available." To be available, the technology must (1) be commercially available, and (2) provide "substantial" treatment of the waste, as determined through evaluation of treatment performance data that have been corrected for accuracy. In determining whether treatment is substantial, EPA may consider data on a treatment technology's performance on a waste similar to the waste in question, provided that the similar waste is at least as difficult to treat. If it is determined that the best performing treatment technology is not available, then the next best technology is evaluated to determine whether it is "available."

5.1 Review of Treatment Performance Data

The treatment performance data (presented in Section 4.0) were reviewed and assessed to determine whether they represent operation of a well-designed and well-operated treatment system, whether sufficient quality assurance/quality control measures were employed to ensure the accuracy of the data, and whether the appropriate measures of performance were used to assess the performance of the particular treatment technology.

The treatment performance data and the design and operating data collected during the tests of rotary kiln incineration and stabilization were reviewed for the points described above. For these tests, the appropriate measures of performance (total constituent concentration for organic constituents in nonwastewater and TCLP leachate concentration for metal constituents in nonwastewater) were used to assess the treatment systems. Additionally, the Agency had no reason to believe that these treatment systems were not well-designed and well-operated, or that insufficient analytical quality assurance/quality control measures were employed in generating treatment performance data.

5.2 Statistical Comparison of Treatment Performance Data

In cases where the Agency has treatment performance data from more than one technology, EPA uses the statistical method known as the analysis of variance (ANOVA) test (discussed in EPA's Methodology for Developing BDAT Treatment Standards (Reference 1)), to determine if one technology performs significantly better than the rest. For K083, the Agency has treatment performance data for only one treatment system; therefore, an ANOVA comparison is not appropriate.

5.3 Best Demonstrated Technology for K083

5.3.1 Nonwastewaters

As discussed in Section 3.0, incineration and stabilization have been determined to be demonstrated technologies for treatment of nonwastewater forms of K083. Because the Agency does not have treatment performance data for any other technologies for treating K083 or similar wastes, these treatment technologies are considered to be the best. Therefore, the best demonstrated technology has been determined to be incineration for organic constituents and incineration followed by stabilization for metal constituents in K083 nonwastewaters.

5.3.2 Wastewaters

BDAT for organic constituents regulated in K083 wastewaters is discussed in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A (Reference 14).

As discussed in Section 3.0, chemical precipitation followed by vacuum filtration has been determined to be a demonstrated technology for treatment of metal constituents in wastewater forms of K083. Because the Agency does not have treatment performance data for any other technologies for treating K083 or similar wastes, this technology is considered to be the best. Therefore, the best demonstrated technology has been determined to be chemical precipitation followed by vacuum filtration for metal constituents in K083 wastewaters.

5.4 Available Treatment Technologies

The best technologies for treatment of K083 nonwastewaters, incineration for organic constituents and stabilization for metal constituents, are considered to be commercially available. Furthermore, the Agency has determined that these technologies provide substantial treatment of K019 and F024, and therefore will provide substantial treatment of organic and metal constituents in K083. Consequently, these technologies are considered BDAT for treatment of K083 nonwastewaters.

Technologies that are considered available and therefore BDAT for treatment of organic constituents in K083 wastewaters, are discussed in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A (Reference 14).

The best technology for treatment of metal constituents in K083 wastewaters, chemical precipitation followed by vacuum filtration, is considered to be commercially available. Furthermore, the Agency has determined that this technology provides substantial treatment of K062, and therefore will provide substantial treatment of metal constituents in K083. Consequently, this technology is considered BDAT for treatment of metal constituents in K083 wastewaters.

6.0 SELECTION OF REGULATED CONSTITUENTS

The Agency has developed a list of hazardous constituents (the BDAT Constituent List, presented in EPA's Methodology for Developing BDAT Treatment Standards (Reference 1)) from which constituents are selected for regulation. EPA may revise this list as additional data and information become available. The list is divided into the following categories: volatile organics, semi-volatile organics, metals, inorganics other than metals, organochlorine pesticides, phenoxyacetic acid herbicides, organophosphorus insecticides, polychlorinated biphenyls (PCBs), and dioxins and furans. This section presents EPA's rationale for the selection of constituents being regulated in wastewater and nonwastewater forms of K083.

Generally, constituents selected for regulation must satisfy the following criteria:

(1) The constituent must be on the BDAT List of regulated constituents. Presence on the BDAT List means that EPA-approved methods exist for analysis of the constituent in treated waste matrices.

(2) The constituent must be present in, or be suspected of being present in, the untreated waste. For example, in some cases, analytical difficulties (such as masking) may prevent a constituent from being identified in the untreated waste, but its identification in a treatment residual may lead the Agency to conclude that it is present in the untreated waste.

From a group of constituents that are eligible for regulation, because they meet the above criteria, EPA may select a subset of constituents that represent the broader group. For example, from a group of constituents that react similarly to treatment, the Agency may select for regulation those constituents that (1) are the most difficult to treat, based on waste characteristics affecting treatment performance; (2) are representative of other constituents in the waste, based on structural similarities; or (3) are present in the untreated waste in the highest concentrations. Selecting a subset of constituents for regulation is done to facilitate implementation of the compliance and enforcement program.

The Agency initially considered all constituents on the BDAT List for regulation. Available K083 characterization data for all BDAT List constituents are summarized in Table 6-1. (All tables are presented at the end of Section 6.0.) When data are available from more than one source, a range of detected concentrations is shown in the table for all constituents quantified in the untreated K083. Constituents for which analytical results were not reported in available literature are identified by the notation "NA" (not available).

6.1 BDAT List Constituents Not Selected for Regulation

The Agency may not regulate all of the BDAT List constituents initially considered for regulation. As discussed further below, a BDAT List constituent is deleted from further consideration for regulation if (1) the constituent was not detected in the untreated waste, (2) the constituent was not analyzed for in the untreated waste, or (3) other reasons, as discussed below. BDAT List constituents that remained following the deletions described in this subsection were further considered for regulation. These constituents were then selected for regulation and are listed in Tables 6-2 and 6-3 at the end of this section.

6.1.1 BDAT List Constituents Not Detected or Analyzed For in the Untreated Waste

Constituents for which the Agency does not have analytical results from characterization samples (identified by "NA" in Table 6-1) were deleted from further consideration for regulation.

6.1.2 BDAT List Constituents Deleted From Further Consideration for Regulation For Other Reasons

Copper was considered for regulation in K083 nonwastewaters and wastewaters but was not selected as a constituent for regulation. Although copper cyanide is listed in Appendix VIII of 40 CFR Part 261, copper is not listed individually. The Agency is only regulating copper when it is an indicator of treatment performance for other Appendix VIII constituents. For K083 nonwastewaters and wastewaters, copper has not been identified as an indicator of treatment performance for other Appendix VIII constituents and therefore is not being regulated.

The Agency has data which indicate that cyclohexanone may not be amenable to quantification in nonwastewater matrices, such as incinerator ash. Accordingly, cyclohexanone was deleted from further consideration for regulation in nonwastewater forms of K083.

Lead was deleted from further consideration for regulation in K083 because it was not present in the untreated waste at treatable concentrations.

Sulfide was deleted from further consideration for regulation in K083 because the technologies determined to be BDAT for K083 (incineration, stabilization, and chemical precipitation followed by vacuum filtration) do not provide effective treatment for sulfide. Moreover, the Agency is unaware of any demonstrated technology for treatment of sulfide in K083 or similar wastes.

6.2 BDAT List Constituents Selected for Regulation

Constituents further considered for regulation in nonwastewater and wastewater forms of K083 were selected from the BDAT List constituents that were detected in the untreated waste, unless they were deleted from consideration as discussed in Section 6.1.

Tables 6-2 and 6-3 present each constituent selected for regulation in K083 nonwastewaters and wastewaters after consideration of (1) the constituent concentration in the untreated waste, (2) whether the constituent is adequately controlled by regulation of another constituent, and (3) the relative difficulty in achieving effective treatment of the constituent by the technology identified as BDAT for K083 (incineration for organic constituents, stabilization for metal constituents in nonwastewater, and chemical precipitation followed by vacuum filtration for metal constituents in wastewater).

The Agency's determination of adequate control for organic constituents was based on (1) an evaluation of the characteristics of the constituents that would affect the performance of incineration relative to the residuals, specifically, their estimated boiling points for ash residuals and their bond dissociation energies for scrubber water residuals, and (2) the structural similarities among the constituents.

Based on the above considerations, all of those constituents that were further considered for regulation were selected for regulation. The seven BDAT List organic constituents selected for regulation (shown in Table 6-2) in K083 are benzene, aniline, diphenylamine, diphenylnitrosamine, nitrobenzene, cyclohexanone (wastewaters only), and phenol. One metal constituent, nickel, was also selected for regulation in nonwastewater and wastewater forms of K083.

Table 6-1

STATUS OF BDAT LIST CONSTITUENT PRESENCE IN UNTREATED K083

BDAT List Constituent		Concentration in Untreated K083 (ppm)
VOLATILES		
222.	Acetone	NA
1.	Acetonitrile	NA
2.	Acrolein	NA
3.	Acrylonitrile	NA
4.	Benzene	2,000-58,000
5.	Bromodichloromethane	NA
6.	Bromomethane	NA
223.	n-Butyl alcohol	NA
7.	Carbon tetrachloride	NA
8.	Carbon disulfide	NA
9.	Chlorobenzene	NA
10.	2-Chloro-1,3-butadiene	NA
11.	Chlorodibromomethane	NA
12.	Chloroethane	NA
13	2-Chloroethyl vinyl ether	NA
14.	Chloroform	NA
15.	Chloromethane	NA
16.	3-Chloropropene	NA
17.	1,2-Dibromo-3-chloropropane	NA
18.	1,2-Dibromoethane	NA
19.	Dibromomethane	NA
20.	trans-1,4-Dichloro-2-butene	NA
21.	Dichlorodifluoromethane	NA
22.	1,1-Dichloroethane	NA
23.	1,2-Dichloroethane	NA
24.	1,1-Dichloroethylene	NA
25.	trans-1,2-Dichloroethene	NA
26.	1,2-Dichloropropane	NA
27.	trans-1,3-Dichloropropene	NA
28.	cis-1,3-Dichloropropene	NA
29.	1,4-Dioxane	NA
225.	Ethyl acetate	NA
226.	Ethyl benzene	NA
30.	Ethyl cyanide	NA
227.	Ethyl ether	NA
31.	Ethyl methacrylate	NA
214.	Ethylene oxide	NA
32.	Iodomethane	NA

NA - Not available.
Source: References 4, 5, 6, and 7.

Table 6-1 (Continued)

STATUS OF BDAT LIST CONSTITUENT PRESENCE IN UNTREATED K083

BDAT List Constituent		Concentration in Untreated K083 (ppm)
VOLATILES (Continued)		
33.	Isobutyl alcohol	NA
228.	Methanol	NA
34.	Methyl ethyl ketone	NA
229.	Methyl isobutyl ketone	NA
35.	Methyl methacrylate	NA
37.	Methacrylonitrile	NA
38.	Methylene chloride	NA
39.	Pyridine	NA
40.	1,1,1,2-Tetrachloroethane	NA
41.	1,1,2,2-Tetrachloroethane	NA
42.	Tetrachloroethene	NA
43.	Toluene	NA
44.	Tribromomethane	NA
45.	1,1,1-Trichloroethane	NA
46.	1,1,2-Trichloroethane	NA
47.	Trichloroethene	NA
48.	Trichloromonofluoromethane	NA
49.	1,2,3-Trichloropropane	NA
231.	1,1,2-Trichloro-1,2,2-trifluoroethane	NA
50.	Vinyl chloride	NA
215.	1,2-Xylene	NA
216.	1,3-Xylene	NA
217.	1,4-Xylene	NA
SEMIVOLATILES		
51.	Acenaphthalene	NA
52.	Acenaphthene	NA
53.	Acetophenone	NA
54.	2-Acetylaminofluorene	NA
233.	Acrylamide	NA
55.	4-Aminobiphenyl	NA
56.	Aniline	40,000-550,000
57.	Anthracene	NA
58.	Aramite	NA
59.	Benz(a)anthracene	NA
218.	Benzal chloride	NA
60.	Benzenethiol	NA
62.	Benzo(a)pyrene	NA

NA - Not available.
Source: References 4, 5, 6, and 7.

Table 6-1 (Continued)

STATUS OF BDAT LIST CONSTITUENT PRESENCE IN UNTREATED K083

BDAT List Constituent		Concentration in Untreated K083 (ppm)
SEMIVOLATILES (Continued)		
63.	Benzo(b)fluoranthene	NA
64.	Benzo(ghi)perylene	NA
65.	Benzo(k)fluoranthene	NA
66.	p-Benzoquinone	NA
67.	Bis(2-chloroethoxy)methane	NA
68.	Bis(2-chloroethyl)ether	NA
69.	Bis(2-chloroisopropyl)ether	NA
70.	Bis(2-ethylhexyl)phthalate	NA
71.	4-Bromophenyl phenyl ether	NA
72.	Butyl benzyl phthalate	NA
73.	2-sec-Butyl-4,6-dinitrophenol	NA
74.	p-Chloroaniline	NA
75.	Chlorobenzilate	NA
76.	p-Chloro-m-cresol	NA
77.	2-Chloronaphthalene	NA
78.	2-Chlorophenol	NA
80.	Chrysene	NA
81.	ortho-Cresol	NA
82.	para-Cresol	NA
232.	Cyclohexanone	2,000
83.	Dibenz(a,h)anthracene	NA
84.	Dibenzo(a,e)pyrene	NA
86.	m-Dichlorobenzene	NA
87.	o-Dichlorobenzene	NA
88.	p-Dichlorobenzene	NA
89.	3,3'-Dichlorobenzidine	NA
234.	cis-1,4-Dichloro-2-butene	NA
90.	2,4-Dichlorophenol	NA
91.	2,6-Dichlorophenol	NA
92.	Diethyl phthalate	NA
93.	3,3'-Dimethoxybenzidine	NA
94.	p-Dimethylaminoazobenzene	NA
95.	3,3'-Dimethylbenzidine	NA
96.	2,4-Dimethylphenol	NA
97.	Dimethyl phthalate	NA
98.	Di-n-butyl phthalate	NA
99.	1,4-Dinitrobenzene	NA
100.	4,6-Dinitro-o-cresol	NA
101.	2,4-Dinitrophenol	NA

NA - Not available.
Source: References 4, 5, 6, and 7.

Table 6-1 (Continued)

STATUS OF BDAT LIST CONSTITUENT PRESENCE IN UNTREATED K083

BDAT List Constituent		Concentration in Untreated K083 (ppm)
SEMIVOLATILES (Continued)		
102.	2,4-Dinitrotoluene	NA
103.	2,6-Dinitrotoluene	NA
104.	Di-n-octyl phthalate	NA
105.	Di-n-propylnitrosamine	NA
106./219.	Diphenylamine/Diphenylnitrosamine	1,700
107.	1,2-Diphenylhydrazine	NA
108.	Fluoranthene	NA
109.	Fluorene	NA
110.	Hexachlorobenzene	NA
111.	Hexachlorobutadiene	NA
112.	Hexachlorocyclopentadiene	NA
113.	Hexachloroethane	NA
114.	Hexachlorophene	NA
115.	Hexachloropropene	NA
116.	Indeno(1,2,3-cd)pyrene	NA
117.	Isosafrole	NA
118.	Methapyrilene	NA
119.	3-Methylcholanthrene	NA
120.	4,4'-Methylenebis(2-chloroaniline)	NA
36.	Methyl methanesulfonate	NA
121.	Naphthalene	NA
122.	1,4-Naphthoquinone	NA
123.	1-Naphthylamine	NA
124.	2-Naphthylamine	NA
125.	p-Nitroaniline	NA
126.	Nitrobenzene	1,000-10,000
127.	4-Nitrophenol	NA
128.	n-Nitrosodi-n-butylamine	NA
129.	n-Nitrosodiethylamine	NA
130.	n-Nitrosodimethylamine	NA
131.	n-Nitrosomethylethylamine	NA
132.	n-Nitrosomorpholine	NA
133.	n-Nitrosopiperidine	NA
134.	n-Nitrosopyrrolidine	NA
135.	5-Nitro-o-toluidine	NA
136.	Pentachlorobenzene	NA
137.	Pentachloroethane	NA
138.	Pentachloronitrobenzene	NA

NA - Not available.
Source: References 4, 5, 6, and 7.

Table 6-1 (Continued)

STATUS OF BDAT LIST CONSTITUENT PRESENCE IN UNTREATED K083

BDAT List Constituent		Concentration in Untreated K083 (ppm)
SEMIVOLATILES (Continued)		
139.	Pentachlorophenol	NA
140.	Phenacetin	NA
141.	Phenanthrene	NA
142.	Phenol	35,000
220.	Phthalic anhydride	NA
144.	Pronamide	NA
145.	Pyrene	NA
146.	Resorcinol	NA
147.	Safrole	NA
148.	1,2,4,5-Tetrachlorobenzene	NA
149.	2,3,4,6-Tetrachlorophenol	NA
150.	1,2,4-Trichlorobenzene	NA
151.	2,4,5-Trichlorophenol	NA
152.	2,4,6-Trichlorophenol	NA
153.	Tris(2,3-dibromopropyl)phosphate	NA
METALS		
154.	Antimony	NA
155.	Arsenic	NA
156.	Barium	NA
157.	Beryllium	NA
158.	Cadmium	NA
159.	Chromium (total)	NA
221.	Chromium (hexavalent)	NA
160.	Copper	2.5
161.	Lead	1.9-3.0
162.	Mercury	NA
163.	Nickel	345
164.	Selenium	NA
165.	Silver	NA
166.	Thallium	NA
167.	Vanadium	NA
168.	Zinc	NA
INORGANICS		
169.	Cyanide	<0.05
170.	Fluoride	NA
171.	Sulfide	21,000

NA - Not available.
Source: References 4, 5, 6, and 7.

Table 6-1 (Continued)

STATUS OF BDAT LIST CONSTITUENT PRESENCE IN UNTREATED K083

BDAT List Constituent		Concentration in Untreated K083 (ppm)
ORGANOCHLORINE PESTICIDES		
172.	Aldrin	NA
173.	alpha-BHC	NA
174.	beta-BHC	NA
175	delta-BHC	NA
176.	gamma-BHC	NA
177.	Chlordane	NA
178.	DDD	NA
235.	o,p'-DDD	NA
179.	DDE	NA
236.	o,p'-DDE	NA
180.	DDT	NA
237.	o,p'-DDT	NA
181.	Dieldrin	NA
182.	Endosulfan I	NA
183.	Endosulfan II	NA
238.	Endosulfan sulfate	NA
184.	Endrin	NA
185.	Endrin aldehyde	NA
186.	Heptachlor	NA
187.	Heptachlor epoxide	NA
188.	Isodrin	NA
189.	Kepone	NA
190.	Methoxychlor	NA
191.	Toxaphene	NA
PHENOXYACETIC ACID HERBICIDES		
192.	2,4-Dichlorophenoxyacetic acid	NA
193.	Silvex	NA
194.	2,4,5-T	NA
ORGANOPHOSPHORUS INSECTICIDES		
195.	Disulfoton	NA
196.	Famphur	NA
197.	Methyl parathion	NA
198.	Parathion	NA
199.	Phorate	NA

NA - Not available.
Source: References 4, 5, 6, and 7.

Table 6-1 (Continued)

STATUS OF BDAT LIST CONSTITUENT PRESENCE IN UNTREATED K083

BDAT List Constituent		Concentration in Untreated K083 (ppm)
POLYCHLORINATED BIPHENYLS (PCBs)		
200.	Aroclor 1016	NA
201.	Aroclor 1221	NA
202.	Aroclor 1232	NA
203.	Aroclor 1242	NA
204.	Aroclor 1248	NA
205.	Aroclor 1254	NA
206.	Aroclor 1260	NA
DIOXINS AND FURANS		
207.	Hexachlorodibenzo-p-dioxins	NA
208.	Hexachlorodibenzofurans	NA
209.	Pentachlorodibenzo-p-dioxins	NA
210.	Pentachlorodibenzofurans	NA
211.	Tetrachlorodibenzo-p-dioxins	NA
212.	Tetrachlorodibenzofurans	NA
213.	2,3,7,8-Tetrachlorodibenzo-p-dioxin	NA

NA - Not available.
Source: References 4, 5, 6, and 7.

Table 6-2

BDAT LIST CONSTITUENTS SELECTED FOR REGULATION IN
K083 NONWASTEWATERS

4. Benzene
56. Aniline
106. Diphenylamine
219. Diphenylnitrosamine
126. Nitrobenzene
142. Phenol
163. Nickel

Table 6-3

BDAT LIST CONSTITUENTS SELECTED FOR REGULATION IN K083 WASTEWATERS

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4. Benzene
56. Aniline
106. Diphenylamine
219. Diphenylnitrosamine
126. Nitrobenzene
142. Phenol
232. Cyclohexanone
163. Nickel

7.0 CALCULATION OF BDAT TREATMENT STANDARDS

The Agency bases numerical treatment standards for regulated constituents on the performance of well-designed and well-operated BDAT treatment systems. These standards must account for analytical limitations in available treatment performance data, and the data must be adjusted for variabilities related to treatment, sampling, and analytical techniques and procedures. The purpose of this section is to calculate treatment standards for the regulated organic constituents and metal constituent in K083 nonwastewaters and the regulated metal constituent in K083 wastewaters. Treatment standard calculations for the organic constituents selected for regulation in K083 wastewaters are presented and discussed in EPA's Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A (Reference 14).

BDAT treatment standards for K083 nonwastewaters are based on the demonstrated technologies of incineration for organic constituents and stabilization for the metal constituent. The BDAT treatment standard for the metal constituent in K083 wastewaters is based on the demonstrated technology of chemical precipitation followed by vacuum filtration.

Before treatment standards are calculated, the treatment performance data are corrected to account for analytical interferences associated with the chemical matrices of the samples. A complete discussion of the accuracy correction of treatment performance data is provided in Appendix B. Appendix B also contains the matrix spike recoveries and accuracy correction factors used to correct the treatment performance data, as well as the corrected treatment performance data.

After treatment performance data are corrected for accuracy, the arithmetic average of the corrected data is calculated for each regulated constituent. In cases where the constituent is not detected in the treatment residual at or above its detection limit, the detection limit is used to calculate the average constituent concentration in the treated waste. Tables 7-1 and 7-2 at the end of this section present the averages of the corrected treatment performance data for organic constituents and metal constituent regulated in K083 nonwastewaters and for the metal constituent regulated in K083 wastewaters, respectively.

The next step in calculating treatment standards is to determine the variability factor (VF) for each regulated constituent. The variability factor accounts for the variability inherent in treatment system performance, treatment residual collection, and treatment sample analysis. (For more information on calculation of variability factors, see EPA's Methodology for Developing BDAT Treatment Standards (Reference 1).) Variability factors for the constituents selected for regulation in K083 are shown in Tables 7-1 and 7-2.

Finally, the treatment standard is calculated for each regulated constituent by multiplying the average of the corrected treatment performance values by the variability factor for the constituent. Treatment standards for the organic constituents and the metal constituent in nonwastewater forms of K083 and for the metal constituent in wastewater forms of K083 are presented in Tables 7-1 and 7-2, respectively, and are discussed in greater detail in the following sections.

Treatment performance data for rotary kiln incineration of organic constituents and stabilization of metal constituents in K083 nonwastewaters are not available. Treatment performance data for chemical precipitation followed by vacuum filtration of metal constituents in K083 wastewaters are also not available. Therefore, the Agency is transferring performance data from treatment of RCRA Blend waste to develop treatment standards for organic constituents in nonwastewater forms of K083, from treatment of F024 to develop a treatment standard for the metal constituent in nonwastewater forms of K083, and from treatment of K062 to develop a treatment standard for the metal constituent in wastewater forms of K083. The rationale for these transfers is presented in Section 4.0 of this document.

7.1 Calculation of Treatment Standards for K083 Nonwastewaters

7.1.1 Organic Constituents

Incineration generally results in the generation of ash (a nonwastewater) and combustion gas scrubber water (a wastewater). The best measure of performance for a destruction technology, such as incineration, is the total amount of each constituent of concern remaining after treatment. Therefore, BDAT treatment standards for organic constituents regulated in K083 nonwastewaters were calculated based on total constituent concentration data transferred from the ash residual from incineration of RCRA Blend waste (Reference 16).

Treatment standards for organic constituents in K083 nonwastewaters were calculated using six sample sets of data for incineration of RCRA Blend waste (Reference 16). Tables 4-2 and 4-3 present the total concentrations of each organic constituent detected in the untreated RCRA Blend waste and the treated nonwastewater residual (ash). Treatment performance data for each constituent being regulated in K083 nonwastewaters were transferred from data for the same constituent in RCRA Blend waste if that constituent was detected in the untreated RCRA Blend waste. For a constituent that was not detected in the untreated RCRA Blend waste, a treatment standard was developed based on treatment performance data from another constituent that was detected in the untreated RCRA Blend waste.

The particular constituent from which data are transferred is determined based on the characteristics of the waste that affect treatment performance by incineration with respect to the nonwastewater residual (i.e., ash), and based on the structural similarities between the constituents from and to which data are transferred. In the rotary kiln, energy in the form of heat is transferred to the waste to volatilize the organic waste constituents. To determine whether one constituent is volatilized similarly to another constituent, the Agency examines the boiling points and the structural similarities of the constituents.

In general, the Agency believes that a constituent with a higher boiling point (bp) is more difficult to treat than a constituent with a lower boiling point. Whenever possible, treatment performance data were transferred to K083 nonwastewaters from constituents detected in untreated RCRA Blend waste that had equal or higher boiling points. Specific cases where data were transferred from another constituent are noted in Table 7-1.

The calculation of the treatment standards for each BDAT List organic constituent regulated in K083 nonwastewaters is shown in Table 7-1.

7.1.2 Metal Constituent

Stabilization is an immobilization technology for metals in non-wastewaters. The best measure of performance for an immobilization technology is the concentration of each constituent of concern in the leachate from the stabilized material. The Agency is transferring performance data from stabilization of metal constituents in F024 incinerator ash to develop a treatment standard for the metal constituent in nonwastewater forms of K083. The rationale for this transfer is presented in Section 4.0.

The treatment standard for the regulated metal constituent in K083 nonwastewaters was calculated using three sample sets of data for stabilization of F024 incinerator ash using a cement binder. Table 4-5 presents the TCLP leachate concentrations for metal constituents in the untreated and treated F024 incinerator ash.

The accuracy-corrected data and the treatment standard calculation for the metal constituent regulated in nonwastewater forms of K083 are presented in Table 7-1.

7.2 Calculation of Treatment Standards for the Metal Constituent Regulated in K083 Wastewaters

Chemical precipitation followed by vacuum filtration is a removal technology for metals in wastewater. The best measure of performance for a removal technology is the total amount of each constituent of concern remaining in the wastewater after treatment. The Agency is transferring performance data from treatment of metal constituents in K062 mixed with metal-bearing characteristic hazardous wastes to develop the treatment standard for the metal constituent in wastewater forms of K083. The rationale for this transfer is presented in Section 4.0.

The treatment standard for the metal constituent in K083 wastewaters was calculated using three sample sets of data for chemical precipitation followed by vacuum filtration of K062 mixed with metal-bearing characteristic hazardous wastes. Table 4-7 presents the total concentrations for metal constituents in the untreated and treated K062 mixed with metal-bearing characteristic hazardous wastes.

The accuracy-corrected data and the treatment standard calculation for the metal constituent regulated in wastewater forms of K083 are presented in Table 7-2.

Table 7-1

CALCULATION OF TREATMENT STANDARDS FOR CONSTITUENTS REGULATED IN K083

NONWASTEWATERS

BDAT List Constituent Regulated in K083	Constituent from Which Treatment Performance Data in RCRA Blend Waste Were Transferred	Arithmetic Average of Corrected Treatment Performance Values (ppm)	Variability Factor (VF)	Treatment Standard (Average x VF) (ppm)
4. Benzene	Benzene	2.352	2.8	6.6
56. Aniline	Nitrobenzene	5.0	2.8	14
106./219. Diphenylamine/ Diphenylnitrosamine	Nitrobenzene	5.0	2.8	14[a]
126. Nitrobenzene	Nitrobenzene	5.0	2.8	14
142. Phenol	Phenol	2.0	2.8	5.6
163. Nickel	Nickel	0.031	2.8	0.088

[a]The treatment standard represents the sum of the concentrations of diphenylamine and diphenylnitrosamine.

Table 7-2

CALCULATION OF TREATMENT STANDARDS FOR THE METAL CONSTITUENT REGULATED IN K083 WASTEWATERS

BDAT List Constituent Regulated in K083	Constituent from Which Treatment Performance Data in RCRA Blend Waste Were Transferred	Arithmetic Average of Corrected Treatment Performance Values (ppm)	Variability Factor (VF)	Treatment Standard (Average x VF) (ppm)
163. Nickel	Nickel	0.387	1.212	0.47

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The following personnel from Radian Corporation were involved in preparing this document: John Williams, Program Manager; Mary Willett, Project Director; and Chrisanti Haretos, Task Leader.

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APPENDIX A

SUMMARY OF TREATMENT PERFORMANCE DATA FOR ORGANIC CONSTITUENTS IN K083 WASTEWATERS

Aniline (U012). The data available for aniline were compiled from the NPDES, WERL, and BDAT databases and are presented in Table 4-55. Technologies for which data are available include AS, BT, CA, LL, LL+SS, and LL+SS+AC. The treatment performance data represent both pilot- and full-scale studies. The resulting effluent concentrations ranged from 4.95 ppb to 165,000 ppb.

BDAT for aniline is being promulgated as proposed and is identified as liquid liquid extraction followed by steam stripping followed by activated carbon (LL+SS+AC). LL+SS+AC was selected as BDAT because it represents the best full-scale technology with data developed under BDAT guidelines (K103/K104). The BDAT treatment standard for aniline was calculated using the effluent concentration of 262 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for aniline (0.81 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-55
WASTEWATER TREATMENT PERFORMANCE DATA
FOR ANILINE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		CT0001341			1	10.000			NPDES
		NJ0005291			16	7383.300			NPDES
		SC0000914			12	10.000			NPDES
AS	Pilot	226B		100000-1000000	13	80.000		99.93	WERL
BT	Full	TX0002933			49	22.670			NPDES
CA	Full	NJ0004219			2	4.950			NPDES
LL	Full	K104	30	150000-300000	5	165000.000	91		BDAT
LL	Full	K103	30	33000000-53000000	5	90800.000	91		BDAT
LL+SS	Full	K103/K104	30	150000-53000000	5	2400.000	91		BDAT
* LL+SS+AC	Full	K103/K104	30	150000-53000000	4	262.000	91		BDAT *

* Data used in developing proposed standard.

Benzene (U019). Several sources of wastewater treatment performance data were available for benzene, including data from the ITD, BDAT, and WERL databases as well as literature PACT[R] data. These data are presented in Table 4-5. Technologies for which data are available include aerobic lagoons (AL), aerobic lagoons followed by activated sludge (AL+AS), API oil/water separation followed by dissolved air flotation and activated sludge (API+DAF+AS), AS, AS+Fil, air stripping (AirS), air stripping followed by granular activated carbon, (AirS+GAC), GAC, liquid, liquid extraction (LL), liquid, liquid extraction followed by steam stripping (LL+SS), liquid, liquid extraction followed by steam stripping and activated carbon (LL+SS+AC), PACT[R], RO, SS, trickling filter (TF), trickling filter followed by activated sludge (TF+AS), and WOx. The treatment performance data represent bench- and full-scale studies.

The treatment performance data available from the ITD database were used for setting the proposed and promulgated BDAT standard for this constituent for the following reasons:

(1) The ITD data represent treatment performance data from the OCPSF sampling episodes. The data collected by ITD include long-term sampling of several industries. These data are therefore a good reflection of the total organic chemical industry and can adequately represent a wastewater of unknown characteristics.

(2) The ITD data were carefully screened prior to inclusion in the OCPSF database. These data were used in determining an ITD promulgated limit.

(3) A promulgated ITD limit represents data that have undergone both EPA and industry review and acceptance.

BDAT for benzene is being promulgated as proposed and is identified as steam stripping (SS). The BDAT treatment standard was calculated using the ITD median long-term average of 10 ppb and the ITD Option 1 variability factor. The calculation of the resulting BDAT treatment standard for benzene (0.14 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-5
WASTEWATER TREATMENT PERFORMANCE DATA
FOR BENZENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AL	Bench	371D		1000-10000		60.000		98	WERL
AL	Full	6B		100-1000	2	10.000		98.9	WERL
AL	Full	1B		100-1000	6	10.000		94.4	WERL
AL	Full	6B		100-1000	2	10.000		92.3	WERL
AL+AS	Full	233D		10000-100000	21	13.000		99.9	WERL
API+DAF+AS	Full	1482D		1000-10000	4	3.700		99.96	WERL
AS	Full	6B		100-1000	7	10.000		98.8	WERL
AS	Bench	200B		100-1000	16	0.800		99.3	WERL
AS	Bench	200B		100-1000	8	1.000		99.83	WERL
AS	Full	1B		100-1000	6	2.000		99	WERL
AS	Full	6B		100-1000	22	30.000		91.7	WERL
AS	Full	1B		100-1000	6	1.000		99.55	WERL
AS	Full	6B		100-1000	14	10.000		95.7	WERL
AS	Full	6B		100-1000	3	10.000		95.6	WERL
AS	Full	1B		100-1000	6	2.000		98.9	WERL
AS	Bench	202D		100000-1000000		40.000		99.97	WERL
AS	Full	6B		1000-10000	3	10.000		99.09	WERL
AS	Full	6B		1000-10000	27	11.000		99.8	WERL
AS	Full	6B		1000-10000	3	10.000		99.71	WERL
AS	Full	6B		0-100	28	10.000		89.6	WERL
AS	Bench	200B		0-100	16	0.500		97.8	WERL
AS	Full	6B		10000-100000	15	10.000		99.97	WERL
AS	Full	234A		100-1000		0.600		99.83	WERL
AS	Full	201B		0-100	10	6.000		81	WERL
AS	Full	1B		0-100	6	16.000		84	WERL
AS	Pilot	206B		0-100	20	0.200		99.73	WERL
AS	Full	234A		0-100		0.700		97.4	WERL
AS+Fil	Full	6B		100000-1000000	3	20.000		99.99	WERL
AirS	Bench	1328E		10000-100000	5	9300.000		90	WERL
AirS	Full	322B		100-1000	22	0.440		99.74	WERL
AirS	Pilot	224B		100-1000	1	0.500		99.67	WERL
AirS	Full	322B		1000-10000	19	52.000		98.7	WERL
AirS	Pilot	1362E		100-1000	3	1.000		99.09	WERL
AirS+GAC	Full	229A		0-100	19	1.000		90.9	WERL

TABLE 4-5 (Continued)
WASTEWATER TREATMENT PERFORMANCE DATA
FOR BENZENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
GAC	Full	245B		1000-10000	1	10.000		99.28	WERL
LL	Full	K104	5	4500-320000	5	35600.000	76.0		BDAT
LL	Full	K103	5	32000-81000	5	3560.000	76.0		BDAT
LL+SS	Full	K103/K104	5	4500-320000	5	5.600	76.0		BDAT
LL+SS+AC	Full	K103/K104	5	4500-320000	4	19.000	76.0		BDAT
PACT	Bench	242E		0-100		5.000		83	WERL
PACT	Bench	200B		100-1000	12	0.700		99.34	WERL
PACT	Bench	Zimpro		290	1	1.000		99.7	WAO
PACT	Bench	Zimpro		29	1	5.000		83	WAO
RO	Full	250B		1000-10000		140.000		92.2	WERL
RO	Full	250B		0-100		3.800		95.1	WERL
RO	Pilot	323B		0-100	1	32.000		19	WERL
RO	Pilot	250B		100-1000		50.000		78	WERL
RO	Full	250B		100-1000		67.000		92.7	WERL
* SS	Full	0415	10	22300-48100	4	38.800			ITD-L *
* SS	Full	2680	10	34693-147212	10	10.000			ITD-L *
* SS	Full	1494	10	239-2008310	13	44.800			ITD-L *
* SS	Full	0415	10	274000-412000	3	200.300			ITD-L *
SS	Full	6B		100000-1000000	3	200.000		99.94	WERL
SS	Full	6B		100000-1000000	12	48.000		99.99	WERL
SS	Full	6B		10000-100000	2	10.000		99.97	WERL
SS	Full	6B		10000-100000	10	10.000		99.99	WERL
SS	Full	251B		100-1000	10	10.000		96.3	WERL
TF	Full	1B		0-100	5	1.000		97.5	WERL
TF+AS	Full	6B		10000-100000	3	10.000		99.97	WERL
UF	Pilot	250B		1000-10000		230.000		78	WERL
WOx	Full	242E		1000-10000		29.000		99.64	WERL
WOx [B]	Bench	1054E		1000-10000		500.000		53	WERL
WOx [B]	Bench	1054E		100000-1000000		180000.000		82	WERL

* Data used in developing proposed standard.

Cyclohexanone (U057). No wastewater treatment performance data were available for cyclohexanone from any of the examined sources. Treatment performance data were therefore transferred to this constituent from a constituent judged to be similar in elemental composition and functional groups within the structure of the chemical. For constituents represented by a U or P code, this means that constituents included in the same waste treatability group (see Appendix B) were candidates for transfer of data. Cyclohexanone is in treatability group III.A.3.e and the constituent used to transfer treatment performance data from was methyl ethyl ketone. The treatment performance data for methyl ethyl ketone are presented in Tables 4-32A and 4-32B. Using a transfer from this constituent results in a BDAT for cyclohexanone of biological treatment and a BDAT treatment standard of 0.36 ppm as described in Section 6.0 and shown in Table 6-10.

Diphenylamine. No wastewater treatment performance data were available for diphenylamine from any of the examined sources. Treatment performance data were therefore transferred to this constituent from a constituent judged to be similar in elemental composition and functional groups within the structure of the chemical. For constituents represented by a U or P code, this means that constituents included in the same waste treatability group (see Appendix B) were candidates for transfer of data. Diphenylamine is similar in structure to constituents in treatability group III.A.3.f.(2) and the constituent used to transfer treatment performance data from was 2-naphthylamine. The treatment performance data for 2-naphthylamine are presented in Table 4-101. Using a transfer from this constituent results in a BDAT for diphenylamine of activated sludge biological treatment and a BDAT treatment standard of 0.52 ppm as described in Section 6.0 and shown in Table 6-10.

Diphenylnitrosamine. No wastewater treatment performance data were available for diphenylnitrosamine from any of the examined sources. Treatment performance data were therefore transferred to this constituent from a constituent judged to be similar in elemental composition and functional groups within the structure of the chemical. For constituents represented by a U or P code, this means that constituents included in the same waste treatability group (see Appendix B) were candidates for transfer of data. Diphenylnitrosamine is similar in structure to constituents in treatability group III.A.3.f.(6) and the constituent used to transfer treatment performance data from was N-nitrosodimethylamine. The treatment performance data for N-nitrosodimethylamine are presented in Table 4-105. Using a transfer from this constituent results in a BDAT for diphenylnitrosamine of activated sludge biological treatment and a BDAT treatment standard of 0.40 ppm as described in Section 6.0 and shown in Table 6-10.

Nitrobenzene (U169). Several sources of wastewater treatment performance data were available for nitrobenzene, including data from the ITD, BDAT, and WERL databases, BDAT Solvents Rule data, and literature WAO data. These data are presented in Table 4-103. Technologies for which data are available include AL, AS, AirS, BT, BT+AC, ChOx, LL, LL+SS, LL+SS+AC, PACT®, SS, SS+AC, and WOx. The treatment performance data represent bench-, pilot-, and full-scale studies.

The treatment performance data available from the ITD database were used for setting the proposed and promulgated BDAT standard for this constituent for the following reasons:

(1) The ITD data represent treatment performance data from the OCPSF sampling episodes. The data collected by ITD include long-term sampling of several industries. These data are therefore a good reflection of the total organic chemical industry and can adequately represent a wastewater of unknown characteristics.

(2) The ITD data were carefully screened prior to inclusion in the OCPSF database. These data were used in determining an ITD promulgated limit.

(3) A promulgated ITD limit represents data that have undergone both EPA and industry review and acceptance.

BDAT for nitrobenzene is being promulgated as proposed and is identified as steam stripping followed by activated carbon (SS+AC). The BDAT treatment standard was calculated using the ITD median long-term average of 14 ppb and the ITD Option 1 variability factor. The calculation of the resulting BDAT treatment standard for nitrobenzene (0.068 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-103
WASTEWATER TREATMENT PERFORMANCE DATA
FOR NITROBENZENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AL	Bench	371D		1000-10000		69.000		97.7	WERL
AS	Full	975B		100-1000		96.000		72	WERL
AS	Full	6B		1000-10000	330	120.000		96.1	WERL
AS	Full	6B		10000-100000	3	150.000		99.8	WERL
AS	Bench	202D		10000-100000		2200.000		97.8	WERL
AS	Bench	200B		100-1000	16	3.000		97.5	WERL
AS	Full	975B		100-1000		3.400		99.48	WERL
AS	Full	6B		1000-10000	28	14.000		99.78	WERL
AS	Pilot	241B		100-1000	4	10.000		92.3	WERL
AS	Full	1B		100-1000	1	23.000		90	WERL
AS	Pilot	241B		100-1000	10	32.000		92.8	WERL
AirS	Bench	1328E		100000-1000000	5	96000.000		16	WERL
BT	Full	P246		821-5559	14	737.000			BDAT ‡
BT+AC	Full	P246		821-90500	18	297.000			BDAT ‡
ChOx	Bench	975B		0-100		2.000		95.9	WERL
LL	Full	K104	30	2200000-3900000	5	2420000.000	115		BDAT
LL	Full	K103	30	1500000-3000000	5	2200000.000	115		BDAT
LL+SS	Full	K103/K104	30	1500000-3900000	5	2400.000	115		BDAT
LL+SS+AC	Full	K103/K104	30	1500000-3900000	4	30.000	115		BDAT
PACT	Bench	190E		100-1000		21.000		96	WERL
PACT	Full	6B		1000-10000	4	14.000		98.8	WERL
PACT	Bench	975B		100-1000		2.000		98.3	WERL
PACT	Bench	200B		100-1000	12	3.700		96.7	WERL
SCOx	Pilot	65D		1000000		22.000		99.99	WERL
SS	Full	P297		87000-330000	10	11793.000			BDAT ‡
SS	Full	P246		91200-1965760	15	251325.000			BDAT ‡
* SS+AC	Full	500	14	14-5460000	37	520.300			ITD-L *
* SS+AC	Full	2680	14	87000-330000	10	712.600			ITD-L *
SS+AC	Full	P297		87000-330000	10	713.000			BDAT ‡
WOx	Bench	Zimpro		5125000	1	255000.000		95	WAO

‡ ITD data presented in the BDAT Solvents Rule F001-F005 Background Document.
* Data used in developing proposed standard.

Phenol (U188). Several sources of wastewater treatment performance data were available for phenol, including data from the ITD, BDAT, and WERL databases as well as literature WAO data. These data are presented in Table 4-109A. In addition, leachate treatment performance data submitted by industry just prior to proposal are presented in Table 4-109B. Technologies for which data are available include AL, API+DAF+AS, AS, ChOx, GAC, BT, LL, LL+SS, LL+SS+AC, PACT®, RBC, RO, SBR, SS, TF, WOx, AS+Fil, and Anff. The treatment performance data represent bench-, pilot-, and full-scale studies.

At proposal, BDAT for phenol was identified as biological treatment and the treatment standard was based on an ITD median long-term average effluent concentration of 10.363 ppb from the ITD database. Between proposal and promulgation, EPA evaluated the industry-submitted leachate data available for phenol. Since this data for biological treatment (BT) showed substantial treatment of phenol, these data were used to calculate the promulgated standards. Therefore, BDAT for phenol is biological treatment.

The BDAT treatment standard for phenol was calculated using the effluent concentration of 10 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for phenol (0.039 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-109A
WASTEWATER TREATMENT PERFORMANCE DATA
FOR PHENOL

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AL	Pilot	203A		100-1000	11	84.000		33	WERL
AL	Pilot	203A		100-1000	11	18.000		86	WERL
AL	Full	6B		100-1000	3	11.000		90.8	WERL
AL	Pilot	192D		100-1000		10.000		98.99	WERL
API+DAF+AS	Full	1482D		100-1000	4	85.000		89.5	WERL
AS	Full	1B		100-1000	5	2.000		98.6	WERL
AS	Full	1B		0-100	6	26.000		63	WERL
AS	Bench	202D		100000-1000000		0.010		99.99	WERL
AS	Full	6B		100-1000	39	10.000		96.4	WERL
AS	Full	1B		100-1000	5	8.000		97.2	WERL
AS	Pilot	203A		100-1000	11	14.000		89	WERL
AS	Full	201B		100-1000	31	20.000		92.6	WERL
AS	Full	1B		100-1000	6	1.000		99.89	WERL
AS	Full	6B		10000-100000	3	10.000		99.94	WERL
AS	Full	1B		100-1000	6	61.000		92.4	WERL
AS	Full	1B		0-100	3	1.000		96.4	WERL
AS	Full	975B		1000-10000		6.600		99.87	WERL
AS	Full	1B		100-1000	5	1.000		99.33	WERL
AS	Bench	1054E		100000-1000000		0.250		99.88	WERL
AS	Pilot	240A		0-100	11	10.000		90	WERL
AS	Full	6B		100-1000	7	15.000		98	WERL
AS	Full	1122E		10000-100000		4000.000		95.2	WERL
AS	Full	6B		100-1000	3	120.000		97.9	WERL
AS	Pilot	241B		100-1000	4	8.000		97.2	WERL
AS	Full	6B		1000-10000	10	21.000		99.64	WERL
AS	Full	975B		100-1000		20.000		87	WERL
AS	Full	6B		100-1000	11	10.000		96.3	WERL
AS	Full	1B		100-1000	6	1.000		99.44	WERL
AS	Full	1B		0-100	6	1.000		98.3	WERL
AS	Full	6B		100-1000	3	10.000		98.6	WERL
AS	Pilot	226B		100000-1000000	6	500.000		99.95	WERL
AS	Full	975B		1000-10000		160.000		95	WERL
AS	Full	6B		100000-1000000	2	10.000		99.99	WERL
AS	Pilot	204A		100-1000	8	14.000		94.6	WERL
AS	Pilot	192D		100-1000		10.000		98.99	WERL
AS	Full	6B		1000-10000	4	56.000		96.9	WERL
AS	Bench	1054E		10000-100000		1000.000		95	WERL
AS	Full	6B		100000-1000000	13	10.000		99.99	WERL
AS	Full	1B		100-1000	6	25.000		94.4	WERL
AS+Fil	Full	6B		10000-100000	3	13.000		99.98	WERL
AS+Fil	Full	6B		100-1000	15	10.000		98	WERL

TABLE 4-109A (Continued)
WASTEWATER TREATMENT PERFORMANCE DATA
FOR PHENOL

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AnFF	Pilot	231A		1000000		700.000		99.98	WERL
AnFF	Pilot	231A		1000000		30.000		99.99	WERL
AnFF	Bench	230A		100000-1000000		10.000		98.97	WERL
AnFF	Pilot	231A		100000-1000000		10.000		99.99	WERL
AnFF	Pilot	231A		100000-1000000		70.000		99.98	WERL
AnFF	Bench	230A		>1000000		1000.000		99.95	WERL
AnFF	Pilot	235D		100000-1000000		240.000		99.86	WERL
AnFFwGAC	Pilot	249D		1000000		50.000		99.99	WERL
CAC	Pilot	203A		100-1000	11	99.000		21	WERL
ChOx	Bench	975B		100-1000		16.000		93.3	WERL
ChOx	Bench	975B		100-1000		2.000		98.3	WERL
ChOx	Bench	975B		1000-10000		12.000		99.37	WERL
GAC	Bench	1054E		100-1000		10.000		99	WERL
GAC	Full	245B		100-1000	1	10.000		92.6	WERL
GAC	Full	237A		1000-10000	1	5.000		99.89	WERL
* BT	Full	1293	10	698564-978672	15	10.000			ITD-L *
LL	Full	K104	30	150000-300000	5	165000.000	21		BDAT
LL	Full	K103	30	1500000-3000000	5	84000.000	21		BDAT
LL+SS	Full	K103/K104	30	150000-3000000	5	2400.000	21		BDAT
LL+SS+AC	Full	K103/K104	30	150000-3000000	4	60.000	21		BDAT
PACT	Bench	190E		10000-100000		1.800		99.99	WERL
PACT	Bench	975B		1000-10000		2.000		99.96	WERL
PACT	Full	6B		1000-10000	3	30.000		98.6	WERL
PACT	Bench	975B		1000-10000		8.000		99.85	WERL
RBC	Pilot	603E		100000-1000000		1700.000		99.6	WERL
RBC	Pilot	192D		100-1000		10.000		98.99	WERL
RO	Full	250B		1000-10000		120.000		93.6	WERL
SBR	Pilot	1433D		10000-100000	16	1000.000		97.7	WERL
SBR	Pilot	227D		100000-1000000	1	1000.000		99.81	WERL
SBR	Bench	64D		100000-1000000		3000.000		99.63	WERL
SBRwPACT	Bench	64D		100000-1000000		1000.000		99.88	WERL
SExt	Pilot	1082E		>1000000		210000.000		95.4	WERL
SS	Pilot	1082E		100000-1000000		160.000		24	WERL
TF	Pilot	203A		100-1000	11	64.000		49	WERL
TF	Full	1B		100-1000	6	47.000		82	WERL
TF	Pilot	240A		0-100	10	8.000		91.3	WERL
TF	Full	1B		0-100	6	1.000		98.2	WERL
WOx	Bench	Zimpro		10000000	1	20000.000		99.8	WAO
WOx [B]	Bench	1054E		100000-1000000		27000.000		97.3	WERL
WOx [B]	Bench	1101D		>1000000		3600.000		99.92	WERL
WOx [B]	Bench	236A		>1000000	1	3000.000		99.97	WERL

* Data used in developing proposed standard.

TABLE 4-109B
INDUSTRY-SUBMITTED LEACHATE TREATMENT PERFORMANCE
DATA FOR PHENOL

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
BT		DOW	10	715-2500	3	10.000		99.32	LEACHATE

APPENDIX B

ACCURACY CORRECTION OF TREATMENT PERFORMANCE DATA

APPENDIX B

ACCURACY CORRECTION OF TREATMENT PERFORMANCE DATA

The treatment performance data used to determine treatment standards for K083 were adjusted to account for analytical interferences associated with the chemical matrices of the samples. Generally, treatment performance data were corrected for accuracy as follows: (1) a matrix spike recovery was determined for each BDAT List constituent detected in the untreated or treated waste; (2) an accuracy correction factor was determined for each of the above constituents by dividing 100 by the matrix spike recovery (percent) for that constituent; and (3) treatment performance data for each BDAT List constituent detected in the untreated or treated waste were corrected by multiplying the reported concentration of each constituent by its corresponding accuracy correction factor. The procedure for accuracy correction of the data is described in further detail below.

Matrix spike recoveries are developed by analyzing a sample of a treated waste for a constituent and then re-analyzing the sample after the addition of a known amount of the same constituent (i.e., spike) to the sample. The matrix spike recovery represents the total amount of constituent recovered after spiking, minus the initial concentration of the constituent in the sample, and the result divided by the spike concentration of the constituent.

Matrix spike recoveries that were used to adjust the treatment performance data transferred to the K083 nonwastewater organic and metal constituents and the wastewater metal constituent are shown in Tables B-1 and B-2. Duplicate matrix spikes were performed for some BDAT List constituents. If a duplicate matrix spike was performed for a constituent, the matrix spike recovery used for that constituent was the lower of the two values from the first matrix spike and the duplicate spike. An accuracy correction factor of 1.00 was used when matrix spike and duplicate matrix spike recoveries both exceeded 100%, so that the data were not adjusted to concentrations below the detection limits.

Where a matrix spike was not performed for an organic constituent, the matrix spike recovery for that constituent was derived from the average matrix spike recoveries of the appropriate group of constituents (e.g., volatile or semivolatile organics) for which recovery data were available. In these cases, the matrix spike recoveries for all volatiles or semivolatiles from the first matrix spike were averaged. Similarly, an average matrix spike recovery was calculated for the duplicate matrix spike recoveries. The lower of the two average matrix spike recoveries of the volatile or semivolatile group was used for any volatile or semivolatile constituent for which no matrix spike was performed.

The accuracy correction factors for the data that were used to adjust the treatment performance data transferred to the K083 nonwastewater organic and metal constituents and the wastewater metal constituent are presented in Table B-3. The corrected treatment concentrations for these regulated constituents are presented in Tables B-4 and B-5.

Table B-1

MATRIX SPIKE RECOVERIES FOR NONWASTEWATER RESIDUALS

Spike Constituent	Original Amount Found (ppm)	Sample Results: Amount Spiked (ppm)	Sample Results: Amount Recovered (ppm)	Sample Results: Percent Recovery[a] (%)	Duplicate Sample Results: Amount Spiked (ppm)	Duplicate Sample Results: Amount Recovered (ppm)	Duplicate Sample Results: Percent Recovery[a] (%)
VOLATILES							
4. Benzene	<2	25	22.6	90	25	21.2	85
9. Chlorobenzene	<2	25	24.8	99	25	25	100
24. 1,1-Dichloroethene	<2	25	21.2	85	25	19.4	78
47. Trichloroethene	<2	25	26.8	107	25	28	112
SEMIVOLATILES (ACID EXTRACTABLES)							
76. p-Chloro-m-cresol	<5	100	110	110	100	120	120
78. 2-Chlorophenol	<2	100	98	98	100	100	100
127. 4-Nitrophenol	<10	100	97	97	100	110	110
139. Pentachlorophenol	<50	100	88	88	100	88	88
142. Phenol	<2	100	90	90	100	97	97
SEMIVOLATILES (BASE/NEUTRAL FRACTION)							
52. Acenaphthene	<2	50	55	110	50	55	110
88. 1,4-Dichlorobenzene	<2	50	45	90	50	49.5	99
102. 2,4-Dinitrotoluene	<50	50	53.5	107	50	55	110
105. N-Nitroso-di-n-propylamine	<5	50	60	120	50	65	130
145. Pyrene	<2	50	60	120	50	46	92
150. 1,2,4-Trichlorobenzene	<5	50	37.5	75	50	40	80

[a]Percent recovery = 100 x $(C_i - C_o)/C_t$, where C_i = amount recovered, C_o = original amount found, and C_t = amount spiked.

Source: Non-confidential version of the Onsite Engineering Report of Treatment Technology Performance and Operation for Rollins Environmental Services (TX) Inc., Deer Park, TX (Reference 13).

Table B-1 (Continued)

MATRIX SPIKE RECOVERIES FOR NONWASTEWATER RESIDUALS

Spike Constituent	Original Amount Found (ppm)	Sample Results			Duplicate Sample Results		
		Amount Spiked (ppm)	Amount Recovered (ppm)	Percent Recovery[a] (%)	Amount Spiked (ppm)	Amount Recovered (ppm)	Percent Recovery[a] (%)
METALS							
163. Nickel	<0.0249	2	1.61	80.5	2	1.59	79.7

[a]Percent recovery = 100 x $(C_i - C_o)/C_t$, where C_i = amount recovered, C_o = original amount found, and C_t = amount spiked.

Source: Non-confidential version of the Onsite Engineering Report for Stabilization of F024 Rotary Kiln Incineration Ash at U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi (Reference 10).

Table B-2

MATRIX SPIKE RECOVERIES FOR THE METAL CONSTITUENT IN WASTEWATER RESIDUALS

Spike Constituent	Original Amount Found (ppm)	Sample Results			Duplicate Sample Results		
		Amount Spiked (ppm)	Amount Recovered (ppm)	Percent Recovery[a] (%)	Amount Spiked (ppm)	Amount Recovered (ppm)	Percent Recovery[a] (%)
METALS							
163. Nickel	0.203	1.00	1.14	94	1.00	1.123	93

[a]Percent recovery = 100 x $(C_i - C_o)/C_t$, where C_i = amount recovered, C_o = original amount found, and C_t = amount spiked.

Source: Onsite Engineering Report for Horsehead Resource Development Company for K061 (Reference 17).

Table B-3

SUMMARY OF ACCURACY CORRECTION FACTORS

BDAT List Constituent	Accuracy Correction Factor[a] Kiln Ash Residue Total Composition	Scrubber Water Total Composition
4. Benzene	1.18	NA
34. Methyl ethyl ketone	1.06	NA
38. Methylene chloride	1.06	NA
42. Tetrachloroethene	1.06	NA
43. Toluene	1.06	NA
45. 1,1,1-Trichloroethane	1.06	NA
47. Trichloroethene	1.00	NA
215-217. Xylenes (total)	1.06	NA
222. Acetone	1.06	NA
226. Ethyl benzene	1.06	NA
229. Methyl isobutyl ketone	1.06	NA
51. Acenaphthalene	1.00	NA
57. Anthracene	1.00	NA
65. Benzo(k)fluoranthene	1.00	NA
70. Bis(2-ethylhexyl)phthalate	1.00	NA
80. Chrysene	1.00	NA
87. o-Dichlorobenzene	1.00	NA
88. p-Dichlorobenzene	1.11	NA
98. Di-n-butyl phthalate	1.00	NA
108. Fluoranthene	1.00	NA
109. Fluorene	1.00	NA
111. Hexachlorobutadiene	1.00	NA
126. Nitrobenzene	1.00	NA
141. Phenanthrene	1.00	NA
142. Phenol	1.11	NA
145. Pyrene	1.09	NA
163. Nickel	1.255	1.075

NA - Not applicable.

[a]The accuracy correction factor is equal to 100 divided by the percent recovery. An accuracy correction factor of 1.00 was used when matrix spike and duplicate matrix spike recoveries both exceeded 100%, so that the data were not adjusted to concentrations below the detection limits.

Table B-4

ACCURACY-CORRECTED DATA USED TO CALCULATE TREATMENT STANDARDS FOR CONSTITUENTS REGULATED IN K083 NONWASTEWATERS

BDAT List Constituent	Sample Set:	Corrected Total Concentration in RCRA Blend Waste Incinerator Ash (ppm)[a]					
		1	2	3	4	5	6
VOLATILES							
4. Benzene		2.35	2.35	2.35	2.35	2.35	2.35
34. Methyl ethyl ketone		10.6	10.6	10.6	10.6	10.6	10.6
38. Methylene chloride		10.6	10.6	10.6	10.6	10.6	10.6
42. Tetrachloroethene		2.13	2.13	2.13	2.13	2.13	2.13
43. Toluene		2.13	2.13	2.13	2.13	2.13	2.13
45. 1,1,1-Trichloroethane		2.13	2.13	2.13	2.13	2.13	2.13
47. Trichloroethene		2.00	2.00	2.00	2.00	2.00	2.00
215.-217. Xylenes (total)		2.13	2.13	2.13	2.13	2.13	2.13
222. Acetone		10.6	10.6	10.6	10.6	10.6	10.6
226. Ethyl benzene		2.13	2.13	2.13	2.13	2.13	2.13
229. Methyl isobutyl ketone		10.6	10.6	10.6	10.6	10.6	10.6
SEMIVOLATILES							
51. Acenaphthalene		2.00	2.00	2.00	2.00	2.00	2.00
57. Anthracene		2.00	2.00	2.00	2.00	2.00	2.00
65. Benzo(k)fluoranthene		2.00	2.00	2.00	2.00	2.00	2.00
70. Bis(2-ethylhexyl)phthalate		2.00	2.00	2.00	12.00	2.00	2.00
80. Chrysene		2.00	2.00	2.00	2.00	2.00	2.00
87. o-Dichlorobenzene		2.00	2.00	2.00	2.00	2.00	2.00
88. p-Dichlorobenzene		2.22	2.22	2.22	2.22	2.22	2.22
98. Di-n-butyl phthalate		2.00	2.00	2.00	230	2.00	2.00
108. Fluoranthene		2.00	2.00	2.00	2.00	2.00	2.00
109. Fluorene		2.00	2.00	2.00	2.00	2.00	2.00
111. Hexachlorobutadiene		10.0	10.0	10.0	10.0	10.0	10.0
126. Nitrobenzene		5.00	5.00	5.00	5.00	5.00	5.00
141. Phenanthrene		2.00	2.00	2.00	2.00	2.00	2.00
142. Phenol		2.22	2.22	2.22	2.22	2.22	2.22
145. Pyrene		2.17	2.17	2.17	2.17	2.17	2.17

[a]Constituent concentrations have been corrected by multiplying the concentration by the accuracy correction factor (ACF) for each constituent.

Table B-4 (Continued)

ACCURACY-CORRECTED DATA USED TO CALCULATE TREATMENT STANDARDS FOR CONSTITUENTS REGULATED IN K083 NONWASTEWATERS

BDAT List Constituent	Sample Set:	Corrected Total Concentration in F024 Nonwastewater Treatment Residual (ppm)[a]					
		1	2	3	4	5	6
METALS							
163. Nickel		0.031	0.031	0.031	NA	NA	NA

NA - Not applicable.

[a]Constituent concentrations have been corrected by multiplying the concentration by the accuracy correction factor (ACF) for each constituent.

Table B-5

ACCURACY-CORRECTED DATA USED TO CALCULATE THE TREATMENT STANDARD FOR THE METAL CONSTITUENT REGULATED IN K083 WASTEWATERS

BDAT List Constituent	Sample Set:	Corrected Total Concentration in K062 Wastewater Treatment Residual (ppm)[a]					
		1	2	3	4	5	6
METALS							
163. Nickel		0.387	0.355	0.419	NA	NA	NA

NA - Not applicable.

[a]Constituent concentrations have been corrected by multiplying the concentration by the accuracy correction factor (ACF) for each constituent.