FINAL

BEST DEMONSTRATED AND AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR WASTES FROM THE PRODUCTION OF EPICHLOROHYDRIN K017

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1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) 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 K017, heavy ends (still bottoms) from the purification column in the production of epichlorohydrin. 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 and after the effective date, compliance with these BDAT treatment standards will be a prerequisite under 40 CFR Part 268 for placement of the wastes in land disposal units.

This background document provides the Agency's rationale and technical support for selecting the constituents for regulation in K017 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 K017 that is more difficult to treat than the wastes that were analyzed in developing the treatment standards for K017.

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 8).

This background document presents the following waste-specific information: the number and locations of facilities that may be affected by the land disposal restrictions for K017; the processes generating this waste; waste characterization data; the technologies used to treat this waste (or similar wastes, if any); and the treatment performance data on which the treatment standards are based. This document also explains how EPA determines BDAT, selects constituents for regulation, and calculates treatment standards.

Under 40 CFR 261.32, wastes identified as K017 are listed as follows:

K017 - Heavy ends (still bottoms) from the purification column in the production of epichlorohydrin.

The Agency believes that there are three facilities manufacturing epichlorohydrin in the United States that could potentially generate this listed waste.

The Agency is regulating three organic constituents in K017 nonwastewaters and wastewaters. No metal constituents are being regulated in K017. To determine the applicability of the treatment standards, wastewaters are defined as wastes containing less than 1% (weight basis) total suspended solids[1] and less than 1% (weight basis) total organic carbon (TOC). Wastes not meeting this definition are classified as nonwastewaters and must comply with the nonwastewater treatment standards.

The Agency does not have any performance data for treatment of K017. Treatment performance tests for these wastes have not been pursued since EPA-approved analytical methods are not available for some of the constituents of concern in K017. Additionally, the Agency believes that adequate treatment performance data are available for other constituents of concern (that do have EPA-approved analytical methods) from similar wastes. Therefore, the Agency is transferring such data from other sources to develop treatment standards for K017 nonwastewaters and wastewaters.

For K017 nonwastewaters, BDAT is incineration, based on treatment performance of this technology on the similar waste F024. The treatment standards for organic constituents are based on treatment performance data

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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 Standard Methods for the Examination of Water and Wastewater, Sixteenth Edition (Reference 10).

transferred from EPA's Final Best Demonstrated Available Technology (BDAT) Background Document For U and P Wastes and Multi-source Leachate (F039), Volume C: Nonwastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F034) For which There Are Concentration - Based Treatment Standards (Reference 19).

For K017 wastewaters, BDAT treatment standards for organic constituents are based on treatment performance data transferred from EPA's Final Best Demonstrated Available Technology (BDAT) Background Document For U and P Wastes and Multi-Source Leachate (F039), Volume A: Wastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F039) For Which There Are Concentration-Based Treatment Standards.

Table 1-1 at the end of this section lists the treatment standards for K017 nonwastewaters and wastewaters. Treatment standards for organic constituents regulated in K017 nonwastewaters and wastewaters are based on the total concentration of each constituent in the waste.

The units used for total constituent concentration of organic constituents in K017 nonwastewaters are mg/kg (parts per million on a weight-by-weight basis). The units used for total constituent concentration of organic constituents in K017 wastewaters are mg/l (parts per million on a weight-by-volume basis). If the concentrations of the constituents regulated in K017 nonwastewaters and wastewaters, as generated, are lower than or are equal to the promulgated treatment standards, then treatment of the waste is not required prior to land disposal.

Table 1-1

BDAT TREATMENT STANDARDS FOR K017

NONWASTEWATERS AND WASTEWATERS

Maximum for Any Single Grab Sample

BDAT List Constituent	Total Concentration Nonwastewaters (mg/kg)
26. 1,2-Dichloropropane	18
49. 1,2,3-Trichloropropane	28
68. Bis(2-chloroethyl)ether	7.2

Maximum for Any 24-Hour Composite Sample

BDAT List Constituent	Total Concentration Wastewaters (mg/l)
26. 1,2-Dichloropropane	0.85
49. 1,2,3-Trichloropropane	0.85
68. Bis(2-chloroethyl)ether	0.033

2.0 INDUSTRY AFFECTED AND WASTE CHARACTERIZATION

This section describes the industry affected by the land disposal restrictions for K017 and presents available characterization data for this waste.

Under 40 CFR 261.32 (hazardous wastes from specific sources), wastes identified as K017 are listed as heavy ends (still bottoms) from the purification column in the production of epichlorohydrin.

2.1 Industry Affected and Process Description

The Agency estimates that there are three domestic facilities that produce and purify epichlorohydrin and may potentially generate K017. Table 2-1 (presented at the end of this section) lists these facilities by state and EPA region. These facilities were identified using the updated TSDR survey database as well as data collected during EPA's listing efforts for K017 (Reference 6).

Epichlorohydrin is used mainly as an intermediate for the manufacture of glycerin and epoxy resins. It is also used in the manufacture of plasticizers, surfactants, stabilizers, and ion exchange resins.

Heavy ends (still bottoms) from the purification column in the production of epichlorohydrin is the waste stream addressed in this document. A simplified flow diagram illustrating the manufacturing process generating epichlorohydrin is presented in Figure 1.

Epichlorohydrin is produced by the following reaction sequence:

Step 1:

Cl_2	+	H_2O	-------->	HOCl	+	HCl
(chlorine)		(water)		(hypochlorous acid)		(hydrochloric acid)

Step 2:

$$CH_2\text{-}CH\text{-}CH_2Cl + \underset{\text{(hypochlorous acid and hydrochloric acid)}}{HOCl\ HCl} \longrightarrow \underset{\text{(1,2-dichloropropanol-1)}}{CH_2OHCHClCH_2Cl\ (65\text{-}70\%)} + \underset{\text{(1,3-dichloropropanol-2)}}{CH_2ClCHOHCH_2Cl\ (30\text{-}55\%)}$$

(allyl chloride)

Step 3:

$$\underset{\text{(1,2-dichloropronanol-1)}}{CH_2OHCHClCH_2Cl} + \underset{\text{(1,3-dichloropropanol-2)}}{CH_2ClCHOHCH_2Cl} + 2NaOH \longrightarrow \underset{\text{(epichlorohydrin)}}{2CH_2\text{-}\overset{O}{\overset{/\ \backslash}{CH}}\text{-}CH_2Cl} + 2NaCl + 2H_2O$$

By-products produced in small quantities during the reaction sequence include 1,2,3-trichloropropane and chloro-ethers.

As shown in Figure 1, a mixture of hypochlorous acid and hydrochloric acid reactants is produced by absorbing chlorine in water in a chlorine absorber. The resulting acid reactant feed plus allyl chloride are then fed to the chlorination reactor. After chlorination, the reaction mixture (containing the dichloropropanols, some feed materials, and the reaction by-products) is sent to a separator. The top aqueous layer containing hydrochloric and hypochlorous acids is then recycled to the chlorine absorber, and the bottom organic phase is sent to the dehydrochlorination reactor, where the dichloropropanols are dehydrochlorinated using sodium hydroxide.

The crude epichlorohydrin and calcium chloride mixture from the dehydrochlorination reactor is sent to a steam stripper. In the steam stripper, an azeotropic mixture is formed consisting of water and crude epichlorohydrin. This mixture is taken overhead, condensed, and sent to a liquid/-liquid separator.

The wastewater from the bottom of the steam stripper is stripped in the aqueous phase stripper, where small amounts of epichlorohydrin are recovered overhead and recycled to the steam-stripper condenser. The bottom stream is discharged as wastewater.

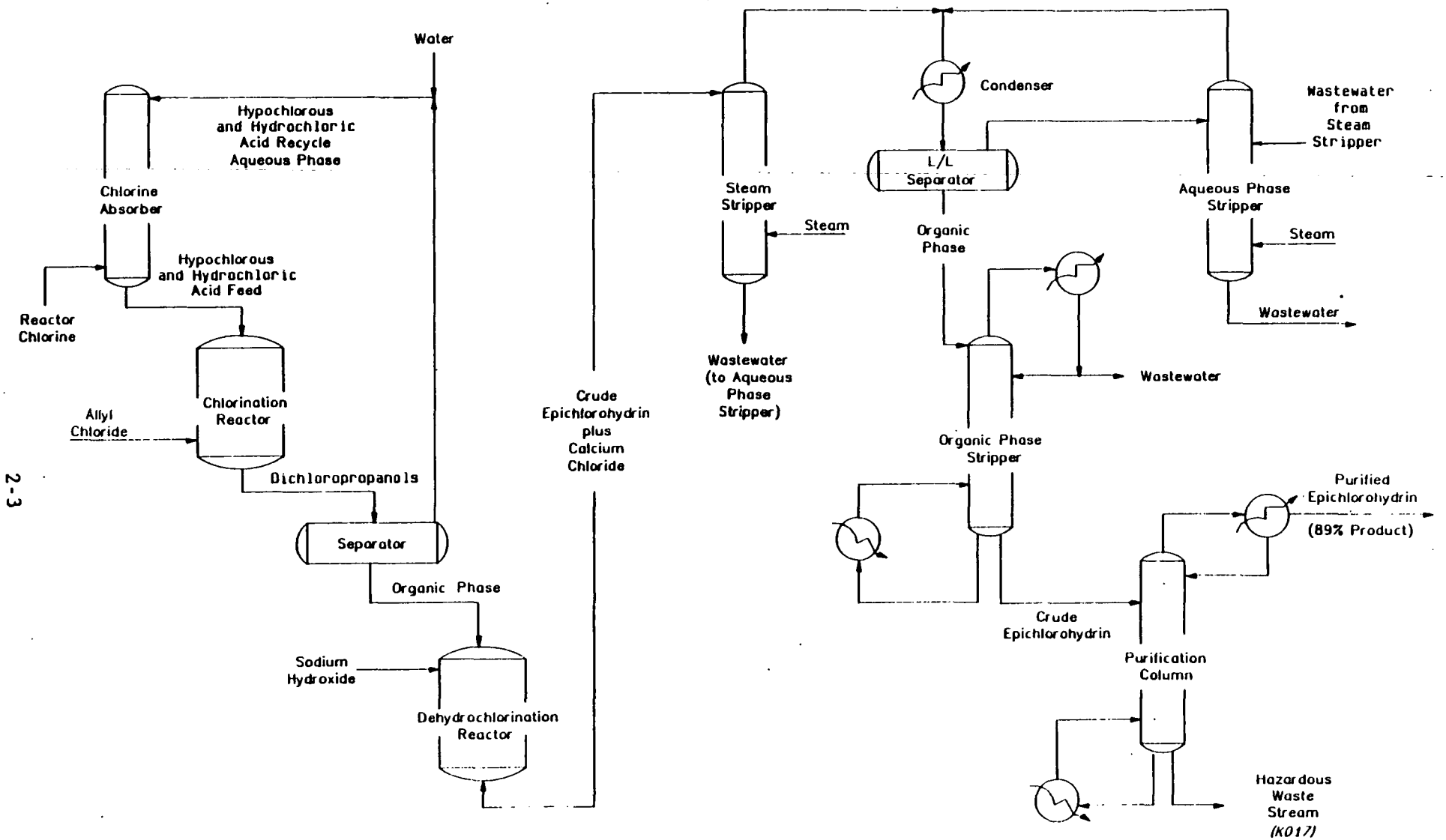

Figure 1. Production of Epichlorohydrin (K017)

The bottom organic phase from the liquid/liquid separator is fed to the organic phase stripper where residual water is removed overhead. The bottom stream of crude epichlorohydrin is fed to a purification column where it is purified by fractionation. Purified epichlorohydrin is distilled overhead. The bottom stream from the purification column forms the listed waste K017.

2.2 Waste Characterization

Table 2-2 (at the end of this section) presents a summary of the available characterization data for K017. Data are presented for BDAT List constituents and other compounds that are believed to be present or have been detected in K017.

As shown in Table 2-2, K017 contains several organic constituents that could be present at concentrations up to 70%. These constituents are 1,2-dichloropropane; 1,2,3-trichloropropane; bis(2-chloroethyl)ether; bis(2-chloromethyl)ether; epichlorohydrin; and dichloropropanol. K017 is not expected to contain metals, based on engineering judgment of the process generating the waste.

Table 2-1

FACILITIES THAT MAY GENERATE K017, BY STATE AND EPA REGION

Facility	Location	EPA Region
Dow Chemical	Freeport, TX	VI
Shell Oil Co.	Deer Park, TX	VI
Ciba-Geigy Corp.	Toms River, NJ	II

Table 2-2

SUMMARY OF AVAILABLE CHARACTERIZATION DATA FOR K017

BDAT List Constituents	Untreated Waste Concentration (%) Source[a]	Source[b]
26. 1,2-Dichloropropane	0.1-1	NA
49. 1,2,3-Trichloropropane	<0.01-70	70
68. Bis(2-chloroethyl)ether[c]	14	14
Other Constituents		
Bis(2-chloromethyl)ether[c]	14	14
Epichlorohydrin	<0.01-10	2
Dichloropropanol	0-10	10
Bis-dichloropropyl ether	<0.01-50	NA
Bis-tetrachloropropyl ether	10-50	NA
Chlorinated Aliphatics	4	4
Chloroallyl alcohol	<0.01-1	NA
1-Chloropropane	0.1-1	NA
2-Chloropropane	0.1-1	NA

NA - Not available.

[a]Waste Profiles (Reference 18).
[b]Listing Background Document for K017 (Reference 6).
[c]Untreated waste concentration for chloroethers including bis(2-chloroethyl)ether and bis(2-chloromethyl)ether combined is 14 percent.

3.0 APPLICABLE AND DEMONSTRATED TREATMENT TECHNOLOGIES

This section identifies the treatment technologies that are applicable for treatment of K017 and determines which 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 to treat 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 the treatment of the waste in question or of a similar waste. Technologies available only at pilot- or bench-scale operations are not considered in identifying demonstrated technologies.

3.1 Applicable Treatment Technologies

Since K017 contains high concentrations of organic compounds, applicable treatment technologies include those that destroy, reduce, or recover the total amount of various organic compounds in the waste.

3.1.1 Nonwastewaters

The Agency has identified the following treatment technologies as applicable for nonwastewater forms of K017: (1) incineration (fluidized-bed, rotary kiln, and liquid injection); (2) solvent extraction (including critical fluid extraction) followed by incineration or recycle of the extract; and (3) total recycle or reuse. These treatment technologies were identified based on current literature sources, field testing, and current waste treatment practices.

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 hazardous 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, waste is 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 waste constituents. Other waste may also be injected into the afterburner.

In a liquid injection incinerator, liquid wastes are atomized and injected into the incinerator. In general, only wastes with low or negligible ash contents are amenable to liquid injection incineration. Therefore, this technology generally does not result in the generation of an ash residual.

Combustion gases from the incinerator are then fed to a scrubber system for cooling and removal of entrained particulates and acid gases, if present. In general, with the exception of liquid injection incineration, two residuals are generated by incineration processes: ash and scrubber water.

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. The extract may be recycled or may be 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 hazardous organic constituents from the wastes. After the extraction step, the solvent (liquified gas at its critical state) is brought back to its normal condition in the gaseous state, generating 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 treated by incineration.

Total Recycle or Reuse. Total recycle or reuse of a waste in the same process or another process eliminates the generation of the waste and generates no treatment residuals.

3.1.2 Wastewaters

Applicable treatment technologies for organics in wastewaters are discussed in Section 3.0 of EPA's Final Best Demonstrated Available Technology (BDAT) Background Document For U and P Wastes and Multi-Source Leachate (F039), Volume A: Wastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F039) For Which There Are Concentration-Based Treatment Standards (Reference 20). The Agency has also identified these treatment technologies as applicable for wastewater forms of K017.

3.2 Demonstrated Treatment Technologies

3.2.1 Nonwastewaters

The Agency has identified incineration (including rotary kiln, liquid injection, and fluidized-bed incineration) and total recycle or reuse as the demonstrated treatment technologies for K017 nonwastewater and nonwastewater residuals. The Agency is not aware of any facilities that treat, on a full-scale operational basis, K017 or similar wastes using solvent extraction or critical fluid extraction; therefore, EPA believes that solvent extraction and critical fluid extraction are not currently demonstrated for K017.

Incineration. Rotary kiln incineration is demonstrated on a full-scale operational basis for treatment of K107 at at least one facility. Liquid injection incineration is demonstrated on a full-scale operational basis for treatment of a similar waste (F024) at at least four facilities. In

addition, fluidized-bed incineration is demonstrated on a full-scale operational basis for treatment of a similar waste (F024) at at least one facility.

Total Recycle or Reuse. EPA is aware of at least one facility that reuses K017 as feed to a thermal oxidation unit that produces acid and heat.

3.2.2 Wastewaters

The Agency is not aware of any facilities that treat wastewater forms of K017. However, the Agency believes that the technologies identified as applicable in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document For U and P Wastes and Multi-Source Leachate (F039), Volume A: Wastewater Forms of Organic U and P Wastes and Multi-source Leachate (K039) For Which There Are Concentration-Based Treatment Standards (Reference 20) are also demonstrated for treatment of the organic constituents of concern in K017. The Agency has identified the technologies identified in Volume A (Reference 20) as demonstrated for wastewater forms of K017.

4.0 TREATMENT PERFORMANCE DATA

The Agency does not have any treatment performance data for treatment of K017 nonwastewaters and wastewaters. Therefore, treatment performance data were transferred from other previously tested wastes to develop treatment standards for K017 nonwastewaters and wastewaters. The basis for data transfer and the sources of treatment performance data are discussed below.

EPA's methodology for transfer of treatment performance data is provided in EPA's Methodology for Developing BDAT Treatment Standards (Reference 8). Transfer of treatment performance data is technically valid in cases where the untested waste is generated from a similar industry or similar processing step, or has similar waste characteristics affecting treatment performance and treatment selection as the tested wastes. Sources of treatment performance data for potential transfer to K017 nonwastewaters include wastes previously tested by rotary kiln, fluidized-bed, or liquid injection incineration. Sources of treatment performance data for potential transfer to K017 wastewaters include those wastes and technologies identified in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document For U and P Wastes and Multi-Source Leachate (F039), Volume A: Wastewater Forms of Organic U and P Wastes and Multi-Source Leachate (K039) For Which There Are Concentration-Based Treatment Standards (Reference 20).

4.1 Treatment of Organic Constituents in Nonwastewaters

Wastes previously tested by the Agency by rotary kiln, fluidized-bed, or liquid injection incineration include: K001, K019, K024, K037, K086, K087, K101, K102, F024, K048, and K051. EPA examined these wastes to identify the best data source(s), if any, for transfer of treatment performance data to K017 nonwastewaters. Specifically, EPA examined whether the untested waste is (1) generated from similar industries or processing steps, and (2) whether the waste has similar waste characteristics affecting treatment performance as these previously tested wastes.

Of the wastes previously tested by incineration, two wastes, F024 and K019, are believed to be similar to K017. F024 and K019 are generated from the chlorinated organic chemicals industry and are also generated by distillation, filtration, or some other type of separation process from the product stream. K019 is generated from the production of chlorinated ethanes and contains high concentrations of these constituents. F024 is generated from the production of chlorinated organic chemicals having carbon contents of one to five carbons, and contains high concentrations of these types of compounds. In addition, F024 contains high concentrations of the three BDAT List constituents (1,2-dichloropropane; 1,2,3-trichloropropane; and bis(2-chloroethyl)ether) present in K017. K019 contains only one of the BDAT List constituents contained in K017, at a lower concentration than that in F024.

As discussed in the Treatment Technology Background Document (Reference 9), waste characteristics that affect treatment performance for rotary kiln, fluidized-bed, and liquid injection incineration include the thermal conductivity of the waste and the boiling points and bond dissociation energies of the constituents of concern. (Boiling points and bond dissociation energies of the constituents of concern in K017 are provided in Appendix A.) K017 is a sludge as generated and is expected to have a similar thermal conductivity to those of F024 and K019. The three BDAT List constituents present in K017 are also present in F024, and one BDAT List constituent is present in K019. Thus, the BDAT List constituents in K017 would have the same boiling points and bond dissociation energies as those constituents in F024 and K019. Therefore, based on thermal conductivity, boiling points, and bond dissociation energies, K017 is expected to be no more difficult to treat than either F024 or K019.

Characterization data for K017 shows that K017 nonwastewaters are comprised primarily of the organic constituents 1,2-dichloropropane; trichloropropane; bis(2-chloroethyl)ether; bis(2-chloromethyl)ether; epichlorohydrin; and dichloropropanol. The BDAT List constituents 1,2-dichloropropane; trichloropropane; and bis(2-chloroethyl)ether were also found in untreated F024 at concentrations of up to 23%, 0.9%, and 0.9%,

respectively. The only matching BDAT List constituent found in untreated K019 was bis(2-chloroethyl)ether at a concentration up to 340 ppm (0.034%).

Based on the similarities discussed above, the treatment performance of incineration for organic BDAT List constituents in K017 nonwastewaters was transferred from rotary kiln incineration of F024.

The treatment standards for organic BDAT List Constituents in K017 nonwastewaters were developed from incineration treatment performance data transferred from EPA's Final Best Demonstrated Available Technology (BDAT) Background Document For U and P Wastes and Multi-Source Leachate (F039), Volume C: Nonwastewater Forms of Organic U and P Waste and Multi-Source Leachate (K039) For Which There Are Concentration-Based Treatment Standards (Reference 19). These data were used for transfer to K017 nonwastewaters since the Agency believes that this incineration data best represents effluent concentrations achievable in analysis of organic constituents in incineration ash.

4.2 Treatment of Organic Constituents in Wastewaters

Treatment standards for organic BDAT List Constituents in K017 wastewaters were developed from treatment performance data transferred from EPA's Final Best Demonstrated Available Technology (BDAT) Background Document For U and P Wastes and Multi-Source Leachate (F039), Volume A: Wastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F039) For Which There Are Concentration-Based Treatment Standards (Reference 20).

Treatment performance data from Volume A (Reference 20) are presented in Appendix C. These data were used for transfer to K017 wastewaters because the Agency prefers, whenever possible, to use appropriate wastewater treatment data from well-designed and well-operated wastewater treatment units, rather than scrubber water concentration data, in setting BDAT treatment standards. Additionally, these data represent a specific wastewater treatment technology as opposed to incineration scrubber water.

5.0 IDENTIFICATION OF THE BEST DEMONSTRATED AND AVAILABLE TECHNOLOGY (BDAT)

This section presents the Agency's rationale for determining the best demonstrated available technology (BDAT) for K017 nonwastewaters and wastewaters. BDAT for K017 nonwastewaters has been determined to be incineration. BDAT for K017 wastewaters was determined on a constituent-by-constituent basis and 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: Wastewater Forms of Organic U and P Wastes and Multi-Source Leachate (K039) For Which There Are Concentration-Based Treatment Standards (Reference 20).

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 using a statistical method as discussed in EPA's Methodology for Developing BDAT Treatment Standards (Reference 8). In the case of wastewater treatment data available to the Agency for multi-source leachate (F039) wastewaters, found in Volume A (Reference 20), a data hierarchy was established to determine the best treatment technology for each constituent.

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," and so on.

5.1 Review of Treatment Performance Data

The available treatment performance data referenced in Section 4.0 were reviewed and assessed to determine whether they represent operation of a well-designed and well-operated 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 treatment technology. The Agency had no reason to believe that the treatment systems represented by these data were not well-designed and well-operated, or that insufficient analytical quality assurance/quality control measures were employed in generating the treatment performance data. Additionally, the data referenced in Section 4.0 had the appropriate measures of performance used to assess the treatment performance.

5.2 Accuracy Correction of Treatment Performance Data

As part of the review of treatment performance data, the data are adjusted to take into account any analytical interferences associated with the chemical makeup of the samples. Generally, performance data are corrected for accuracy as follows: (1) a matrix spike recovery is determined, as explained below, for each BDAT List constituent detected in the untreated or treated waste; (2) an accuracy correction factor is determined for each of the above constituents by dividing 100 by the matrix spike recovery (expressed as a percentage) for that constituent; and (3) the reported concentration of each BDAT List constituent detected in the untreated or treated waste is corrected by multiplying the concentration by the corresponding accuracy correction factor.

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.

Accuracy correction of the nonwastewater treatment performance data is discussed in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document For U and P Wastes and Multi-Source Leachate (F039), Volume C: Nonwastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F039) For Which There Are Concentration-Based Treatment Standards (Reference 19).

Accuracy correction of the wastewater treatment performance data is discussed in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document For Wastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F039), Volume A: Wastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F039) For Which There Are Concentration-Based Treatment Standards (Reference 20).

5.3 Best Demonstrated Technologies for K017

As discussed above, incineration has been determined to be the demonstrated technology for treatment of organics in nonwastewater forms of K017. Because the Agency does not have treatment performance data for any other technologies for treating K017 nonwastewaters or similar wastes, this treatment is the best. Therefore, the best demonstrated technology for K017 nonwastewaters has been determined to be incineration.

The best demonstrated technologies for treatment of organics in K017 wastewaters are presented and discussed on a constituent-by-constituent basis in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for Wastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F039), Volume A: Wastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F039) For Which There Are Concentration-Based Treatment Standards (Reference 20).

5.4 Available Treatment Technologies

The best technology for treatment of organic constituents in K017 nonwastewaters, incineration, is considered to be commercially available. Furthermore, the Agency has determined that this technology will provide substantial treatment of F024, and therefore of K017 also. Consequently, this technology is considered to be available for treatment of K017 nonwastewaters and has been determined to be BDAT.

The best technologies for treatment of organic constituents in K017 wastewaters are also considered to be commercially available. Furthermore, the Agency has determined that these technologies will provide substantial treatment of the constituents of concern in the tested wastes, and therefore of K017 also. Consequently, these technologies are considered to be available for treatment of K017 wastewaters and have been determined to be BDAT.

The identification of these technologies as BDAT for K017 does not preclude a facility from utilizing recycle or reuse operations in accordance with 40 CFR Part 261. Also, since concentration-based standards are being set, the BDAT technologies do not preclude the use of other treatment technologies that can achieve the treatment standards as long as the other treatment technologies do not constitute impermissible dilution or land disposal.

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 8)) from which constituents are selected for regulation. EPA may revise this list as additional data and information became available. The list is divided into the following categories: volatile organics, semivolatile 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 methodology and rationale for selection of regulated constituents in K017 nonwastewaters and wastewaters. (All tables are presented at the end of this section.)

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

1. The constituent must be on the BDAT List of 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, analytical difficulties 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 represents 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. Table 6-1 summarizes available waste characterization data for the BDAT List constituents in K017 (as derived from Table 2-2). Ranges of concentrations for constituents detected in the waste are shown in the table. Constituents for which no analysis was performed are identified by "NA" (not analyzed).

Generally, a BDAT List constituent is deleted from further consideration for regulation if: (1) the constituent was not analyzed for in the untreated waste; (2) detection limits or analytical results were not obtained for the constituent due to analytical problems; or (3) available treatment performance data for the constituent did not show effective treatment by BDAT.

6.1 BDAT List Constituents Not Selected For Regulation

6.1.1 BDAT List Constituents Not Analyzed For in the Untreated Waste

Some constituents on the BDAT List were deleted from further consideration for regulation because these constituents were not analyzed for in the untreated waste (labeled "NA" in Table 6-1). These constituents were not analyzed for because it is extremely unlikely that they would be present in the untreated waste, based on the processes generating K017. These constituent types include metals, inorganics, organochlorine pesticides, phenoxyacetic acid herbicides, organophosphorus insecticides, polychlorinated biphenyls (PCBs), and dioxins and furans.

6.1.2 BDAT List Constituents For Which Detection Limits or Analytical Results Were Not Obtained Due to Analytical Problems

There were no BDAT List constituents that were deleted from further consideration for regulation based on this consideration.

6.1.3 BDAT List Constituents For Which Available Treatment Performance Data Did Not Show Effective Treatment by BDAT

There were no BDAT List constituents that were deleted from further consideration for regulation based on this consideration.

6.2 BDAT List Constituents Selected For Regulation

All of the BDAT List organic constituents that were further considered for regulation in K017 nonwastewaters and wastewaters were selected for regulation. Table 6-2 presents the three BDAT List constituents selected for regulation in K017 nonwastewaters and wastewaters.

6.3 Non-BDAT List Constituents

Of the six constituents of concern identified in the K017 characterization data, three are BDAT List constituents and three are non-BDAT List constituents. The three non-BDAT List constituents of concern are bis(2-chloromethyl)ether, epichlorohydrin, and dichloropropanol. While these non-BDAT List constituents are present in K017 at high concentrations, there are currently no EPA-approved methods for analysis of these constituents in the K017 matrix. Therefore, these constituents could not be considered for regulation.

Table 6-1

STATUS OF BDAT LIST CONSTITUENTS IN UNTREATED K017

BDAT List Constituent	Concentration in Untreated Waste (%)
Volatiles	
222. Acetone	NA
1. Acetonitrile	NA
2. Acrolein	NA
3. Acrylonitrile	NA
4. Benzene	NA
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	0.1-1
27. trans-1,3-Dichloropropene	NA
28. cis-1,3-Dichloropropene	NA
29. 1,4-Dioxane	NA
224. 2-Ethoxyethanol	NA
225. Ethyl acetate	NA
226. Ethyl benzene	NA

NA - Not analyzed.

Table 6-1 (Continued)

STATUS OF BDAT LIST CONSTITUENTS IN UNTREATED K017

BDAT List Constituent	Concentration in Untreated Waste (%)
Volatiles (Continued)	
30. Ethyl cyanide	NA
227. Ethyl ether	NA
31. Ethyl methacrylate	NA
214. Ethylene oxide	NA
32. Iodomethane	NA
33. Isobutyl alcohol	NA
37. Methacrylonitrile	NA
228. Methanol	NA
34. Methyl ethyl ketone	NA
229. Methyl isobutyl ketone	NA
35. Methyl methacrylate	NA
38. Methylene chloride	NA
230. 2-Nitropropane	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	<0.01-70
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

NA - Not analyzed.

Table 6-1 (Continued)

STATUS OF BDAT LIST CONSTITUENTS IN UNTREATED K017

BDAT List Constituent	Concentration in Untreated Waste (%)
Semivolatiles	
51. Acenaphthalene	NA
52. Acenaphthene	NA
53. Acetophenone	NA
54. 2-Acetylaminofluorene	NA
55. 4-Aminobiphenyl	NA
56. Aniline	NA
57. Anthracene	NA
58. Aramite	NA
59. Benz(a)anthracene	NA
218. Benzal chloride	NA
60. Benzenethiol	NA
62. Benzo(a)pyrene	NA
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	14
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
79. 3-Chloropropionitrile	NA
80. Chrysene	NA
81. ortho-Cresol	NA
82. para-Cresol	NA
232. Cyclohexanone	NA
83. Dibenz(a,h)anthracene	NA
84. Dibenzo(a,e)pyrene	NA
85. Dibenzo(a,i)pyrene	NA

NA - Not analyzed.

Table 6-1 (Continued)

STATUS OF BDAT LIST CONSTITUENTS IN UNTREATED K017

BDAT List Constituent	Concentration in Untreated Waste (%)
Semivolatiles (Continued)	
86. m-Dichlorobenzene	NA
87. o-Dichlorobenzene	NA
88. p-Dichlorobenzene	NA
89. 3,3'-Dichlorobenzidine	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
102. 2,4-Dinitrotoluene	NA
103. 2,6-Dinitrotoluene	NA
104. Di-n-octyl phthalate	NA
105. Di-n-propylnitrosamine	NA
106. Diphenylamine	NA
219. Diphenylnitrosamine	NA
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

NA - Not analyzed.

Table 6-1 (Continued)

STATUS OF BDAT LIST CONSTITUENTS IN UNTREATED K017

BDAT List Constituent	Concentration in Untreated Waste (%)
Semivolatiles (Continued)	
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	NA
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
139. Pentachlorophenol	NA
141. Phenanthrene	NA
142. Phenol	NA
220. Phthalic anhydride	NA
143. 2-Picoline	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

NA - Not analyzed.

Table 6-1 (Continued)

STATUS OF BDAT LIST CONSTITUENTS IN UNTREATED K017

BDAT List Constituent	Concentration in Untreated Waste (%)
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	NA
161. Lead	NA
162. Mercury	NA
163. Nickel	NA
164. Selenium	NA
165. Silver	NA
166. Thallium	NA
167. Vanadium	NA
168. Zinc	NA
Inorganics	
169. Cyanide	NA
170. Fluoride	NA
171. Sulfide	NA
	NA
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
179. DDE	NA
180. DDT	NA
181. Dieldrin	NA
182. Endosulfan I	NA
183. Endosulfan II	NA

NA - Not analyzed.

Table 6-1 (Continued)

STATUS OF BDAT LIST CONSTITUENTS IN UNTREATED K017

BDAT List Constituent	Concentration in Untreated Waste (%)
Organochlorine Pesticides (Continued)	
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
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

NA - Not analyzed.

Table 6-1 (Continued)

STATUS OF BDAT LIST CONSTITUENTS IN UNTREATED K017

BDAT List Constituent	Concentration in Untreated Waste (%)
Dioxins and Furans	
207. Hexachlorodibenzo-p-dioxins	NA
208. Hexachlorodibenzofuran	NA
209. Pentachlorodibenzo-p-dioxins	NA
210. Pentachlorodibenzofuran	NA
211. Tetrachlorodibenzo-p-dioxins	NA
212. Tetrachlorodibenzofuran	NA
213. 2,3,7,8-Tetrachlorodibenzo-p-dioxin	NA

NA - Not analyzed.

Table 6-2

BDAT LIST CONSTITUENTS SELECTED FOR REGULATION IN K017
NONWASTEWATERS AND WASTEWATERS

Nonwastewaters	Wastewaters
26. 1,2-Dichloropropane	26. 1,2-Dichloropropane
49. 1,2,3-Trichloropropane	49. 1,2,3-Trichloropropane
68. Bis(2-chloroethyl)ether	68. Bis(2-chloroethyl)ether

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. This section discusses the calculation of treatment standards for K017 nonwastewaters and wastewaters for the constituents selected for regulation using the available treatment performance data from the BDAT treatment technology.

As noted in Section 5.0, before treatment standards are calculated, the treatment performance data are corrected to account for analytical interferences associated with the chemical matrices of the samples. 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 above its detection limit, the detection limit is used to calculate the average constituent concentration in the treated waste. 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 8).) 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.

BDAT treatment standards for constituents being regulated in K017 nonwastewaters were calculated as shown in Section 6.0 of EPA's Final Best Demonstrated Available Technology (BDAT) Background Document For U and P Wastes and Multi-Source Leachate (F039), Volume C: Nonwastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F039) For Which There Are Concentration-Based Treatment Standards (Reference 19).

BDAT treatment standards for constituents being regulated in K017 wastewaters were calculated as shown in Section 6.0 of EPA's Final Best Demonstrated Available Technology (BDAT) Background Document For U and P Wastes and Multi-Source Leachate (F039), Volume A: Wastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F039) For Which There Are Concentration-Based Treatment Standards (Reference 20).

Treatment standards for the regulated constituents in nonwastewater and wastewater forms of K017 are presented in Table 1-1.

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

9.0 REFERENCES

1. U.S. EPA. 1981. U.S. Environmental Protection Agency, Office of Solid Waste. Identification and Listing of Hazardous Waste Under RCRA, Subtitle C, Section 3001, Background Document. Washington, D.C.: U.S. Environmental Protection Agency.

2. Hydroscience. 1978. Trip Report Emission Control Options for the Synthetic Organic Chemicals Manufacturing Industry, Trip report for the allyl chloride-epichlorohydrin-glycerin process at Dow Chemical Company, Freeport, Texas. Washington, D.C.: U.S. Environmental Protection Agency.

3. U.S. EPA. 1981. U.S. Environmental Protection Agency, Office of Water Regulations and Standards. Contractors Engineering Analysis of Organic Chemicals and Plastics/Synthetic Fibers Industries, Appendix S, Chapter 41. Washington, D.C.: U.S. Environmental Protection Agency.

4. SRI International. 1988. 1988 Directory of Chemical Producers-United States of America. Menlo Park, CA: SRI International.

5. U.S. EPA. 1980. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Glycerin and its intermediates epichlorohydrin, acrolein and allyl chloride. Washington, D.C.: U.S. Environmental Protection Agency.

6. U.S. EPA. U.S. Environmental Protection Agency, Office of Solid Waste. Listing Background Document - Epichlorohydrin Production. Washington, D.C.: U.S. Environmental Protection Agency.

7. U.S. EPA. 1989. U.S. Environmental Protection Agency, Office of Solid Waste. Final Best Demonstrated Available Technology (BDAT) Background Document for Wastes from the Production of Chlorinated Aliphatic Hydrocarbons - F024. Washington, D.C.: U.S. Environmental Protection Agency.

8. U.S. EPA. 1989. U.S. Environmental Protection Agency, Office of Solid Waste. Methodology for Developing BDAT Treatment Standards. June, 1989. Washington, D.C.: U.S. Environmental Protection Agency.

9. U.S. EPA. 1989. U.S. Environmental Protection Agency, Office of Solid Waste. Treatment Technology Background Document. June, 1989. Washington, D.C.: U.S. Environmental Protection Agency.

10. American Public Health Association, American Water Works Association, and Water Pollution Control Federation. 1985. Standard Methods for the Examination of Water and Wastewater. Sixteenth Edition. Washington, D.C.

11. U.S. EPA. 1988. U.S. Environmental Protection Agency, Office of Solid Waste. F024 Characterization Report for DuPont Chemical Company, LaPlace, LA. Washington, D.C.: U.S. Environmental Protection Agency.

12. U.S. EPA. 1988. U.S. Environmental Protection Agency, Office of Solid Waste. F024 Characterization Report for Shell Chemical Company, Norco, LA. Washington, D.C.: U.S. Environmental Protection Agency.

13. U.S. EPA. 1988. U.S. Environmental Protection Agency, Office of Solid Waste. F024 Characterization Report for Vista Chemical Company, Lake Charles, LA. Washington, D.C.: U.S. Environmental Protection Agency.

14. U.S. EPA. 1988. U.S. Environmental Protection Agency, Office of Solid Waste. F024 Characterization Report for Vulcan Chemicals, Wichita, KS. Washington, D.C.: U.S. Environmental Protection Agency.

15. U.S. EPA. 1988. U.S. Environmental Protection Agency, Office of Solid Waste. Onsite Engineering Report of Treatment Technology Performance and Operation for Incineration at ENSCO, El Dorado, AR. Washington, D.C.: U.S. Environmental Protection Agency.

16. Weast, R.C., editor. 1984. CRC Handbook of Chemistry and Physics, 65th Edition. Boca Raton, FL: CRC Press, Inc.

17. Windholz, M., editor. 1983. The Merck Index, 10th Edition. Rahway, NJ: Merck and Co.

18. U.S. EPA. 1985. U.S. Environmental Protection Agency, Office of Solid Waste. Characterization of Waste Streams Listed in 40 CFR Section 261 Waste Profiles. Volume I. Washington, D.C.: U.S. Environmental Protection Agency.

19. U.S.EPA. 1990. U.S. Environmental Protection Agency, Office of Solid Waste. Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume C: Nonwastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F039) For Which There Are Concentration-Based Treatment Standards. Washington, D.C.: U.S. Environmental Protection Agency.

20. U.S.EPA. 1990. U.S. Environmental Protection Agency, Office of Solid Waste. Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A: Wastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F039) For Which There Are Concentration-Based Treatment Standards. Washington, D.C.: U.S. Environmental Protection Agency.

APPENDIX A

WASTE CHARACTERISTICS AFFECTING TREATMENT PERFORMANCE

Table A-1

BOILING POINTS FOR CONSTITUENTS OF CONCERN IN K017

BDAT List Constituent	Boiling Point (°C)	Reference No.
26. 1,2-Dichloropropane	96.4	16
49. 1,2,3-Trichloropropane	156.8	16
68. Bis(2-chloroethyl)ether	178	17
Bis(2-chloromethyl)ether	104	16
Epichlorohydrin	-16.5	17
Dichloroporanol	28	17

Source: Merck Index (Reference 17).

Table A-2

BOND DISSOCIATION ENERGIES FOR CONSITUENTS OF CONCERN IN K017

BDAT List Constituent		Bond Dissociation Energy (kcal/mole)
26.	1,2-Dichloropropane	930
49.	1,2,3-Trichloropropane	910
68.	Bis(2-chloroethyl)ether	1,290
	Bis(2-chloromethyl)ether	720
	Epichlorohydrin	910
	Dichloropropanol	1,025

Source: CRC Handbook of Chemistry and Physics (Reference 16).

APPENDIX B

WASTEWATER TREATMENT PERFORMANCE DATA

1,2-Dichloropropane (U083). The data available for 1,2-dichloropropane were compiled from the WERL database and the EPA WAO test. These data are presented in Table 4-23. Technologies for which data are available include AS, AirS, ozonation (ChOx(Oz)), GAC, and WOX. The treatment performance data represent bench-, pilot-, and full-scale studies. The resulting effluent concentrations ranged from 0.500 ppb to 1,800 ppb.

BDAT for 1,2-dichloropropane is being promulgated as proposed and is identified as activated sludge biological treatment (AS). Activated sludge was selected as BDAT because it represents full-scale data with various high influent ranges and substantial treatment removals. The activated sludge data were used in preference to the EPA WAO test data due to the lower effluent values achievable by activated sludge treatment as well as the fact that it represents full-scale data over the WAO pilot-scale data. The BDAT treatment standard for 1,2-dichloropropane was calculated using an effluent concentration of 148.4 ppb (which represents an average of the AS effluent concentrations presented for full-scale treatment) and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for 1,2-dichloropropane (0.85 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-23
WASTEWATER TREATMENT PERFORMANCE DATA
FOR 1,2-DICHLOROPROPANE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
* AS	Full	6B		100-1000	15	490.000		37	WERL *
AS	Bench	202D		100000-1000000		1800.000		99.01	WERL
AS	Pilot	241B		100-1000	5	61.000		76	WERL
* AS	Full	1B		1000-10000	1	1.000		99.96	WERL *
* AS	Full	6B		1000-10000	3	180.000		98.2	WERL *
* AS	Full	6B		1000-10000	3	60.000		96.7	WERL *
AS	Pilot	206B		100-1000	20	6.000		98.1	WERL
* AS	Full	6B		100-1000	24	11.000		98.2	WERL *
AirS	Pilot	222B		0-100	1	0.500		75	WERL
AirS	Pilot	1362E		100-1000	3	2.700		99	WERL
ChOx (Oz)	Pilot	331D		0-100		3.000		33	WERL
ChOx (Oz)	Pilot	331D		0-100		4.800		21	WERL
GAC	Pilot	331D		0-100		1.000		84	WERL
WOx	Pilot	Zimpro	150	550000-630000	3	1607.000			WAO

* Data used in developing proposed standard.

1,2,3-Trichloropropane. No wastewater treatment performance data were available for 1,2,3-trichloropropane 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. 1,2,3-Trichloropropane is similar in structure to those constituents in treatability group II.A.2.b.(3) and the constituent used to transfer treatment performance data from was 1,2-dichloropropane. The treatment performance data for 1,2-dichloropropane is presented in Table 4-23. Using a transfer from this constituent results in a BDAT for 1,2,3-trichloropropane of activated sludge biological treatment and a BDAT treatment standard of 0.85 ppm as described in Section 6.0 and shown in Table 6-10.

Bis(2-chloroethyl)ether (U025). The data available for bis(2-chloroethyl)ether were compiled from the NPDES and WERL databases and are presented in Table 4-63. Technologies for which data are available include AL, AS, BT, CAC, ChOx, and TF. The treatment performance data represent bench-, pilot-, and full-scale studies. The resulting effluent concentrations ranged from 1 ppb to 430 ppb.

BDAT for bis(2-chloroethyl)ether is being promulgated as proposed and is identified as activated sludge biological treatment (AS). Activated sludge was selected as BDAT because the data represent full-scale treatment performance with a high influent concentration and high removal efficiency. The BDAT treatment standard for bis(2-chloroethyl)ether was calculated using the effluent concentration of 6 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for bis(2-chloroethyl)ether (0.033 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-63
WASTEWATER TREATMENT PERFORMANCE DATA
FOR BIS(2-CHLOROETHYL)ETHER

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		LA0065501			6	10.000			NPDES
		PA0012777			38	3.014			NPDES
		NY0107174			8	25.875			NPDES
		MI0000868			8	2.750			NPDES
		LA0066214			15	10.000			NPDES
AL	Pilot	203A		100-1000	11	102.000		29	WERL
AL	Pilot	203A		100-1000	11	78.000		46	WERL
AS	Full	1B		100-1000	11	13.000		98.3	WERL
AS	Pilot	240A		0-100	9	29.000		67	WERL
AS	Full	6B		1000-10000	3	430.000		73	WERL
AS	Pilot	203A		100-1000	11	30.000		79	WERL
* AS	Full	975B		1000-10000		6.000		99.87	WERL *
BT	Full	KY0002119			13	12.080			NPDES
BT	Full	LA0038245			38	12.492			NPDES
BT	Full	PA0026247			25	10.880			NPDES
BT	Full	PA0026689			2	2.500			NPDES
BT	Full	MI0029173			15	1.000			NPDES
BT	Full	MI0029173			15	1.000			NPDES
CAC	Pilot	203A		100-1000	11	114.000		20	WERL
ChOx	Bench	975B		1000-10000		6.000		99.74	WERL
TF	Pilot	203A		100-1000	11	132.000		8	WERL
TF	Pilot	240A		0-100	8	65.000		32	WERL

* Data used in developing proposed standard.