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FINAL

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)

BACKGROUND DOCUMENT

FOR

ORGANIC TOXICITY CHARACTERISTIC WASTES

D018-D043

AND

ADDENDUM TO NONWASTEWATER FORMS OF PESTICIDE

TOXICITY CHARACTERISTIC WASTES

D012-D017

Richard Kinch
Chief, Waste Treatment Branch

Lisa Jones
Project Manager

U.S. Environmental Protection Agency
Office of Solid Waste
2800 Crystal Drive
Arlington, Virginia 22202

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1.0 INTRODUCTION

In accordance with the amendments to the Resource Conservation and Recovery Act (RCRA) enacted in the Hazardous and Solid Waste Amendments (HSWA) of November 8, 1984, the Environmental Protection Agency (EPA or the Agency) is establishing Best Demonstrated Available Technology (BDAT) treatment standards for organic Toxicity Characteristic (TC) wastes identified in Title 40, Code of Federal Regulations, Section 261.24 (40 CFR 261.24) as D018-D043. Compliance with these treatment standards is a prerequisite for land disposal of restricted wastes, as defined in 40 CFR Part 268. EPA may grant a variance from the applicable treatment standards under 40 CFR 268.44 and under 40 CFR 268.6. EPA may grant waste- and site-specific waivers from the applicable treatment standards in 268.41-268.43.

On May 19, 1980, under RCRA, the Agency instituted a framework for identifying hazardous waste (45 FR 33084). Under this framework, the Agency defines which solid wastes are hazardous by either identifying the characteristics of hazardous waste or listing particular hazardous wastes. EPA's approach for defining hazardous waste characteristics was to determine which properties of a waste would result in harm to human health or to the environment when improperly managed, and then to establish test methods and regulatory levels for each characteristic property. The Extraction Procedure (EP) Toxicity Characteristic was one of four hazardous waste characteristics that EPA identified and promulgated in May 1980 (40 CFR 261.24). A solid waste was classified as EP toxic if the liquid waste extract obtained using the EP contained any of 14 specified toxic constituents at concentrations equal to or greater than the corresponding regulatory level. These constituents consisted of eight metals, four insecticides, and two herbicides, which were assigned the hazardous waste codes D004-D017. A list of constituents regulated in D004-D017 wastes and their corresponding regulatory levels are presented in Table 1-1 at the end of this section.

On March 29, 1990, EPA promulgated the Toxicity Characteristic (TC) rule, which replaced the EP with the Toxicity Characteristic Leaching Procedure (TCLP) and added 26 organic chemicals (corresponding to hazardous waste codes D018-D043) to the 14 existing toxic constituents of concern (55 FR 11798). The TC rule established that a solid waste is considered a hazardous waste if the waste leachate generated using the TCLP contains any of these 40 (26 + 14 = 40) constituents at concentrations equal to or greater than the regulatory levels. The list of the constituents regulated in the final TC rule and their corresponding regulatory levels are also included in Table 1-1.

Treatment standards based on BDAT for D004-D017 wastes were promulgated in the Land Disposal Restrictions (LDR) for the Third Third scheduled wastes on June 1, 1990 (55 FR 22520).

This Background Document provides the Agency's rationale and technical support for developing BDAT treatment standards for both nonwastewater and wastewater forms of the 26 organic TC wastes (D018-D043). The BDAT treatment standards for wastewater forms of D018-D043 wastes discussed in this document are applicable to wastes managed in systems other than those regulated under the Clean Water Act (CWA), those regulated under the Safe Drinking Water Act (SDWA) that inject TC wastewaters into Class I injection wells, and those zero discharge facilities that engage in CWA equivalent treatment prior to land disposal. This document also provides revisions to the nonwastewater BDAT treatment standard for D015 and treatment standards for newly identified D012-D017 wastes. Newly identified D012-D017 wastes are defined as those D012-D017 wastes identified as hazardous by the TCLP but not by the EP leaching procedure. These wastes are not currently subject to the existing treatment standards for D012-D017 wastes.

The Agency's legal authority and the petition process necessary for requesting a variance from BDAT treatment standards are summarized in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for Quality

Assurance, Quality Control Procedures, and Methodologies (Methodology Background Document) (4). The methodology used for establishing BDAT treatment standards for the TC wastes is summarized in Appendix A and Appendix B of this Background Document.

Section 1.1, below, provides a discussion on the regulatory background for D004-D043 wastes. Section 1.2 presents a summary of the D012-D043 wastes BDAT treatment standards, and Section 1.3 briefly summarizes the contents of this document.

1.1 Regulatory Background

This section presents the regulatory background for the Toxicity Characteristic wastes (D004-D043). The TC regulatory levels and leachate procedure, as well as the BDAT treatment standards for these wastes, are discussed in this section. A list of the Federal Register notices related to the development of the Toxicity Characteristic regulations is presented in Table 1-2, several of which are described below.

1.1.1 Toxicity Characteristic Regulatory Levels

On May 19, 1980 (45 FR 33084), the Agency instituted the Extraction Procedure (EP) leaching procedure to identify wastes which pose a hazard to human health and the environment due to their potential to leach significant concentrations of a hazardous constituent. The Agency identified eight metal (D004-D011) and six pesticide TC constituents (D012-D017) that, if present in the EP waste extract in excess of specified concentrations, caused the waste to be identified as hazardous. The regulatory concentration levels were determined by the multiplication of constituent-specific *chronic* toxicity levels (the National Interim Primary Drinking Water Standards (DWS)) by a generic dilution/attenuation factor of 100, to reflect both the concentration at which the constituent is harmful to human health and the environment and the fate of the constituent in the environment.

On January 14, 1986, the Agency proposed a framework for a regulatory program to implement the Congressionally mandated Land Disposal Restrictions (51 FR 1602). This framework required a leaching test, known as the Toxicity Characteristic Leaching Procedure (TCLP), for use in the LDR program in developing hazardous waste treatment standards and determining whether these standards have been achieved. The TCLP was intended to serve as an improved leaching method that would be suitable for use in evaluating wastes containing both organic and inorganic constituents.

On June 13, 1986 (51 FR 21648), the Agency proposed to revise the existing hazardous waste identification regulations by (1) expanding the list of Toxicity Characteristic constituents, (2) replacing the EP leaching method with the TCLP, and (3) applying constituent-specific dilution/attenuation factors (DAFs) for each organic constituent included on the TC list, while retaining the 100-fold DAF for the metal and pesticide constituents (D004-D017). The proposal specifically identified regulatory concentration levels for 52 TC constituents, including the existing 14 metal and pesticide constituents and 38 additional organic constituents. The Agency used a subsurface fate and transport model to develop the constituent-specific DAFs for the organic TC constituents. The subsurface fate and transport model, named EPASMOD, was a modification of the model used to develop the regulatory levels for solvents and dioxins in the January 14, 1986 proposed rule. This model was based on a mismanagement scenario of co-disposal of TC wastes with municipal wastes in a Subtitle D sanitary landfill. The Agency also identified chronic toxicity reference levels for these 38 additional compounds, which, when multiplied by the DAF, determined the regulatory concentration level. EPA promulgated the TCLP for use in developing BDAT treatment standards and monitoring BDAT compliance for certain spent solvent wastes and dioxin-contaminated wastes (51 FR 40572, November 7, 1986). The Agency chose not to amend the Toxicity Characteristic rule by replacing the EP with the TCLP and including additional constituents in that final rule.

Three additional notices published concerning this proposed rule are described below. On May 18, 1987, the Agency published a Supplemental Notice of Proposed Rulemaking (52 FR 18583) in response to numerous comments on the June, 1986 proposal concerning the application of the revised Toxicity Characteristic rule to wastewaters. The main concern of the commenters was that it may be inappropriate to apply the TC mismanagement scenario (co-disposal of hazardous wastes with municipal wastes in an unlined landfill) to wastewaters managed in surface impoundments. The Supplemental Notice outlined several alternatives for the application of the TC to wastewaters that would result in a separate set of regulatory levels for these wastes. The alternative scenario for wastewaters assumed that the subject wastes would be managed in an unlined impoundment instead of being co-disposed in a municipal landfill.

The Agency then published a Notice of Data Availability and Request for Comments on May 19, 1988 (53 FR 18024) as a result of commenters' concern about uncertainties and technical difficulties associated with developing sufficiently representative DAFs for the 38 organic constituents. The Agency proposed two alternative approaches for establishing DAFs for these constituents. The first alternative involved setting the DAFs in two phases that would initially bring into the hazardous waste regulatory system the wastes with the highest concentrations of hazardous constituents. In the first phase, the Agency would use generic DAFs for all 38 new organic TC constituents while the development of the constituent-specific DAFs proceeded; once the development of these constituent-specific DAFs was completed, they would be implemented as the second phase. The Agency also considered, as the second alternative, to promulgate the 38 organic TC constituents in one phase, using a generic DAF. The Agency specifically requested comment on the use of a generic DAF for the two-phased approach. The Agency also updated the chronic toxicity reference levels for a number of constituents based on newly available information.

On August 1, 1988, the Agency published a Supplement to the Proposed Rule (53 FR 28892), introducing potential modifications to the subsurface fate and transport model used to calculate the constituent-specific DAFs. In addition, the Agency presented currently available hydrogeological data on municipal waste landfills and proposed to modify the subsurface fate and transport model to more accurately reflect conditions in municipal waste landfills.

The Agency promulgated the revisions to the Toxicity Characteristic rule on March 29, 1990 (55 FR 11798). The final rule retained many of the features of the June 13, 1986 proposal. The Agency replaced the EP leaching test with the TCLP, added 26 organic compounds to the list of TC constituents (identified as D018-D043 wastes), and established regulatory concentration levels for these organic constituents based on health-based concentration thresholds and a generic DAF that was developed using a subsurface fate and transport model. In response to the comments received on the proposed rule and related notices, the final rule incorporated a number of modifications to the leaching procedure, the list of TC constituents, the chronic toxicity reference levels, and the fate and transport model.

1.1.2 Treatment Standards for Toxicity Characteristic Wastes

The Agency first proposed treatment standards for the Toxicity Characteristic wastes under the LDR program in the Third Third proposed rule on November 22, 1989 (54 FR 48372). The proposed treatment standards were expressed as methods of treatment and concentration levels for wastewater and nonwastewater forms of the metal characteristic wastes (D004-D011), respectively. The Agency proposed two options for treatment standards for the pesticide TC wastes (D012-D017): the first option consisted of concentration-based treatment standards based on incineration treatment performance data, and the second option limited the treatment standards for D012-D017 wastes to their respective regulatory concentration, or characteristic, levels.

The Agency promulgated treatment standards for D004-D017 wastes in the Third Third final rule on June 1, 1990 (55 FR 22520). These treatment standards were applicable to only those wastes previously identified as hazardous by the EP leaching procedure and remaining hazardous by the new TCLP. The Agency did not identify treatment standards for wastewater forms of D004-D017 wastes at constituent concentrations below the corresponding characteristic level. The Agency determined that treatment standards promulgated below the characteristic level would cause significant disruption to the existing regulatory programs adopted pursuant to the Clean Water Act and Safe Drinking Water Act. Treatment standards were established as concentrations equivalent to the characteristic level for wastewater forms of D004-D011 wastes and as methods of treatment for wastewater forms of D012-D017 wastes.

The Agency determined that BDAT for nonwastewater forms of the metal TC wastes (D004-D011) was vitrification or stabilization, and promulgated treatment standards as concentrations equivalent to the characteristic level except for selenium wastes (D010). The Agency promulgated the treatment standard for D010 wastes, based on the performance of stabilization, at a concentration greater than the characteristic level. The Agency believed, based on the matrix-dependent applicability of this technology, that D010 wastes could not consistently be treated to concentrations less than the characteristic level. For nonwastewater forms of the pesticide TC wastes (D012-D017), the Agency promulgated treatment standards less than the characteristic levels based on the concentrations that could be achieved by incineration. The Agency determined that the applicability of incineration is not matrix-dependent and treatment by incineration can reduce hazardous constituent concentrations to concentrations that are orders of magnitude below the characteristic level.

On October 24, 1991 (56 FR 55160), in an Advanced Notice of Proposed Rulemaking, the Agency discussed potential treatment standards for the newly identified TC organic wastes (D018-D043) and newly identified inorganic wastes (D012-D017). Newly identified D012-D017 wastes are defined as those wastes identified as hazardous by the TCLP but not by the EP leaching procedure and are not currently subject to the existing D012-D017 wastes treatment standards. The Agency introduced treatment standard options for these wastes, which are discussed in this document.

1.2 Summary of BDAT Treatment Standards

The Agency is establishing BDAT treatment standards for nonwastewater forms of newly identified pesticide TC wastes (D012-D017) and for both nonwastewater and wastewater forms of the organic TC wastes (D018-D043). This section discusses the BDAT treatment standards for these wastes.

As discussed above, in the final rule for the Third Third wastes (55 FR 22520), the Agency promulgated treatment standards for those D012-D017 wastes identified as hazardous using both the TCLP and EP leaching procedures. Wastes identified as hazardous by the TCLP but not by the EP leaching procedure are considered to be newly identified D012-D017 wastes and not currently subject to BDAT treatment standards. The Agency is establishing the existing treatment standards for D012-D017 wastes, except for nonwastewater forms of D015 wastes, as the treatment standards for all newly identified D012-D017 wastes. The Agency is changing the treatment standard for nonwastewater forms of D015 wastes to be based on treatment performance data that account for both isomers of the constituent from which the treatment performance data were transferred; chlordane. The treatment standards and constituents regulated in nonwastewater forms of D012-D017 wastes are presented in Table 1-3.

The Agency is establishing treatment standards for both wastewater and nonwastewater forms of D018-D043 wastes as numerically equivalent to the universal treatment standards (i.e., universal standards). A universal standard is a single treatment standard established for a specific constituent regardless of the waste matrix in which it is present, i.e., the same treatment standard applies to a particular constituent in each waste code in which it is regulated. The treatment standards for wastewater forms of D018-D043 wastes presented in this document are applicable to wastes managed in systems other than those regulated under the CWA, those regulated under the SDWA that inject TC wastewaters into Class I injection wells, and those zero discharge facilities that engage in CWA equivalent treatment prior to land disposal. The treatment standards and constituents regulated in nonwastewater and wastewater forms of D018-D043 wastes are presented in Tables 1-4 and 1-5, respectively.

The universal standards for nonwastewater forms of wastes were developed using BDAT treatment performance data from the First, Second, and Third Thirds and Phase I rulemaking efforts. A summary of the development of universal standards for the constituents regulated in nonwastewater forms of D018-D043 wastes is presented in Appendix A of this document. A more detailed discussion of the Agency's rationale and technical support for establishing universal standards for nonwastewater forms of wastes is provided in its Final Best Demonstrated Available Technology (BDAT) Background Document for Universal Standards, Volume A: Universal Standards for Nonwastewater Forms of Listed Hazardous Wastes (16).

The universal standards for wastewater forms of wastes are based on treatment performance data from several sources, including the BDAT database, the NPDES database, the WERL database, EPA-collected WAO/PACT® data, the EAD database, industry-submitted leachate treatment performance data, data submitted by the Chemical Manufacturers Association's Carbon Disulfide Task Force, data submitted by the California Toxic Substances Control Division. data in literature that were already not part of the WERL database; and data in literature submitted by industry on the WAO and PACT® treatment processes. These standards reflect the performance of numerous industrial wastewater treatment systems. A summary of the development of universal standards for the constituents regulated in wastewater forms of D018-D043 wastes is presented in Appendix B of this document. A more detailed discussion of the Agency's rationale and technical support for establishing universal standards for wastewater forms of wastes is provided in its Final Best Demonstrated Available Technology (BDAT) Background Document for Universal Standards, Volume B: Universal Standards for Wastewater Forms of Listed Hazardous Wastes (23).

1.3 Contents of This Document

Section 2.0 of this document describes the industry affected by the land disposal restrictions for D018-D043 wastes. This section also presents current treatment and management practices and information on environmental releases of constituents of concern. These data were acquired from a survey of facilities which manage TC wastes and from the Agency's Toxic Release Inventory (TRI) database. Sections 3.0 and 4.0 present the BDAT treatment standards for nonwastewater and wastewater forms, respectively, of D018-D043 wastes based upon universal treatment standards. These sections also discuss the treatment technologies that are applicable and demonstrated for treatment of nonwastewater and wastewater forms of D018-D043 wastes, the identification of BDAT, and the determination of the treatment standards for those newly identified wastes. Section 4.0 presents the determination of the treatment standards for nonwastewater forms of newly identified D012-D017 wastes. References are presented in Section 6.0 and acknowledgements are presented in Section 7.0.

All tables and figures are located at the end of each section. References used in preparation of this Background Document are cited throughout this document within parentheses, e.g., (1).

Table 1-1

Toxicity Characteristic Constituents and Regulatory Levels[a]

Waste Code	Regulated Constituent	CAS Number	Regulatory Level (mg/L)
D004	Arsenic	7440-38-2	5.0
D005	Barium	7440-39-3	100
D006	Cadmium	7440-43-9	1.0
D007	Chromium	7440-47-3	5.0
D008	Lead	7439-92-1	5.0
D009	Mercury	7439-97-6	0.2
D010	Selenium	7782-49-2	1.0
D011	Silver	7440-22-4	5.0
D012	Endrin	72-20-8	0.02
D013	Lindane	58-89-9	0.4
D014	Methoxychlor	72-43-5	10.0
D015	Toxaphene	8001-35-2	0.5
D016	2,4-Dichlorophenoxyacetic Acid (2,4-D)	94-75-7	10.0
D017	2,4,5-TP (Silvex)	93-72-1	1.0
D018	Benzene	71-43-2	0.5
D019	Carbon Tetrachloride	56-23-5	0.5
D020	Chlordane	57-74-9	0.03
D021	Chlorobenzene	108-90-7	100
D022	Chloroform	67-66-3	6.0
D023	o-Cresol	95-48-7	200[b]
D024	m-Cresol	108-39-4	200[b]
D025	p-Cresol	106-44-5	200[b]
D026	Cresols (total)	---	200[b]
D027	1,4-Dichlorobenzene	106-46-7	7.5
D028	1,2-Dichloroethane	107-06-2	0.5

Table 1-1

(Continued)

Waste Code	Regulated Constituent	CAS Number	Regulatory Level (mg/L)
D029	1,1-Dichloroethylene	75-35-4	0.7
D030	2,4-Dinitrotoluene	121-14-2	0.13
D031	Heptachlor	76-44-8	0.008
D031	Heptachlor Epoxide	1024-57-3	0.008
D032	Hexachlorobenzene	118-74-1	0.13
D033	Hexachlorobutadiene	87-68-3	0.5
D034	Hexachloroethane	67-72-1	3.0
D035	Methyl Ethyl Ketone	78-93-3	200
D036	Nitrobenzene	98-95-3	2.0
D037	Pentachlorophenol	87-86-5	100
D038	Pyridine	110-86-1	5.0
D039	Tetrachloroethylene	127-18-4	0.7
D040	Trichloroethylene	79-01-6	0.5
D041	2,4,5-Trichlorophenol	95-95-4	400
D042	2,4,6-Trichlorophenol	88-06-2	2.0
D043	Vinyl Chloride	75-01-4	0.2

[a]Source: USEPA. 55 FR 11798.

[b]If o-, m-, and p-cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used.

Table 1-2

Federal Register Notices Discussing Toxicity Characteristic Regulations

Federal Register Notice	Topic	Regulatory Component				
		CTRLs[a]	Model[b]	TCLP/EP[c]	Regulatory Levels	BDAT Treatment Standards
May 19, 1980, 45 FR 33084	Final Rule for Identification and Listing of Hazardous Waste: Use of EP Toxicity Test Procedure	X			X	
January 14, 1986, 51 FR 1602	Proposed Land Disposal Restrictions Framework: Use of TCLP for Compliance with Treatment Standards		X	X		
June 9, 1986, 51 FR 24856	Notice of Availability of Reports Which Support the TCLP			X		
June 13, 1986, 51 FR 21648	Proposed Revisions to the Identification and Listing of Hazardous Waste: Use of the TCLP and Addition of Constituents to the Toxicity Characteristic	X	X	X	X	
November 7, 1986, 51 FR 40572	Final Land Disposal Restrictions Approach: Use of the TCLP for Compliance with Treatment Standards			X		
May 18, 1987, 52 FR 18583	Supplemental Notice of Proposed Rulemaking: Consideration of Separate Wastewater TC		X	X	X	

Table 1-2

(Continued)

Federal Register Notice	Topic	Regulatory Component: CTRLs[a]	Model[b]	TCLP/EP[c]	Regulatory Levels	BDAT Treatment Standards
May 19, 1988, 53 FR 18024	Notice of Data Availability and Request for Comments; Supplement to Proposed Rule: Use of a Generic DAF and Chronic Toxicity Reference Level Revisions	X	X		X	
May 24, 1988, 53 FR 18792	Proposed Revisions to TCLP to Replace Particle Reduction Step			X		
August 1, 1988, 53 FR 28892	Proposed Modifications to Groundwater Model		X			
November 22, 1989, 54 FR 48372	Proposed Land Disposal Restrictions for Third Third Scheduled Wastes					X
March 29, 1990, 55 FR 11798	Identification and Listing of Hazardous Wastes: Toxicity Characteristic Revisions, Final Rule	X	X	X	X	
June 1, 1990, 55 FR 22520	Final Rule for Land Disposal Restrictions for Third Third Scheduled Wastes					X
June 29, 1990, 55 FR 26986	Corrections to March 29, 1990 Toxicity Characteristic Revisions			X		

Table 1-2

(Continued)

Federal Register Notice	Topic	Regulatory Component				
		CTRLs[a]	Model[b]	TCLP/EP[c]	Regulatory Levels	BDAT Treatment Standards
October 24, 1991, 56 FR 55160	ANPRM and Request for Comment and Data for the Approach for Establishing BDAT Treatment Standards for D004-D043					X

[a]CTRLs - Chronic Toxicity Reference Levels

[b]Model - Groundwater Fate and Transport Model.

[c]TCLP/EP - Toxicity Characteristic Leaching Procedure or Extraction Procedure Leaching Test.

Sources: References 1-3, 5-15.

Table 1-3

BDAT Treatment Standards for Nonwastewater Forms of D012-D017 Wastes

Waste Code	Regulated Constituent	Maximum For Any Single Grab Sample Total Composition (mg/kg)
D012	Endrin	0.13
D013	Lindane	0.066
D014	Methoxychlor	0.18
D015	Toxaphene	2.6
D016	2,4-Dichlorophenoxyacetic Acid (2,4-D)	10
D017	2,4,5-TP (Silvex)	7.9

Source: Reference 17.

Table 1-4

BDAT Treatment Standards for Nonwastewater Forms of D018-D043 Wastes

Waste Code	Regulated Constituent	Maximum for Any Single Grab Sample (Total Composition Concentration) (mg/kg)
D018	Benzene	10
D019	Carbon Tetrachloride	6.0
D020	Chlordane	0.26
D021	Chlorobenzene	6.0
D022	Chloroform	6.0
D023	o-Cresol	5.6
D024	m-Cresol	5.6
D025	p-Cresol	5.6
D026	Cresols (total)	5.6
D027	1,4-Dichlorobenzene	6.0
D028	1,2-Dichloroethane	6.0
D029	1,1-Dichloroethylene	6.0
D030	2,4-Dinitrotoluene	140
D031	Heptachlor	0.066
D031	Heptachlor Epoxide	0.066
D032	Hexachlorobenzene	10
D033	Hexachloro-1,3-butadiene	5.6
D034	Hexachloroethane	30
D035	Methyl Ethyl Ketone	36
D036	Nitrobenzene	14
D037	Pentachlorophenol	7.4
D038	Pyridine	16
D039	Tetrachloroethylene	6.0

Table 1-4

(Continued)

Waste Code	Regulated Constituent	Maximum for Any Single Grab Sample (Total Composition Concentration) (mg/kg)
D040	Trichloroethylene	6.0
D041	2,4,5-Trichlorophenol	7.4
D042	2,4,6-Trichlorophenol	7.4
D043	Vinyl Chloride	6.0

Table 1-5

BDAT Treatment Standards for Wastewater Forms of D018-D043 Wastes[a]

Waste Code	Regulated Constituent	Maximum for Any Single Grab Sample (Total Composition Concentration) (mg/L)
D018	Benzene	0.14
D019	Carbon Tetrachloride	0.057
D020	Chlordane	0.0033
D021	Chlorobenzene	0.057
D022	Chloroform	0.046
D023	o-Cresol	0.11
D024	m-Cresol	0.77
D025	p-Cresol	0.77
D026	Cresols (total)	0.88
D027	1,4-Dichlorobenzene	0.090
D028	1,2-Dichloroethane	0.21
D029	1,1-Dichloroethylene	0.025
D030	2,4-Dinitrotoluene	0.32
D031	Heptachlor	0.0012
D031	Heptachlor Epoxide	0.016
D032	Hexachlorobenzene	0.055
D033	Hexachloro-1,3-butadiene	0.055
D034	Hexachloroethane	0.055
D035	Methyl Ethyl Ketone	0.28
D036	Nitrobenzene	0.068
D037	Pentachlorophenol	0.089
D038	Pyridine	0.014
D039	Tetrachloroethylene	0.056

Table 1-5

(Continued)

Waste Code	Regulated Constituent	Maximum for Any Single Grab Sample (Total Composition Concentration) (mg/L)
D040	Trichloroethylene	0.054
D041	2,4,5-Trichlorophenol	0.18
D042	2,4,6-Trichlorophenol	0.035
D043	Vinyl Chloride	0.27

[a]These treatment standards for wastewater forms of D018-D043 wastes are applicable to those wastes managed in systems other than those regulated under the CWA, those regulated under the SDWA that inject TC wastewaters into Class I injection wells, and those zero discharge facilities that engage in CWA equivalent treatment prior to land disposal.

2.0 INDUSTRY AFFECTED AND WASTE CHARACTERIZATION

This section describes the industries potentially affected by the BDAT treatment standards for D018-D043 wastes and presents available characterization data for these newly identified organic TC wastes. This section also presents current waste management and treatment practices and information on the environmental releases of the constituents of concern from these wastes. These data were acquired from a survey of facilities which manage TC wastes and from the Toxic Release Inventory (TRI) database.

2.1 Industries Affected

The Agency obtained information on the facilities which generate and/or manage D018-D043 wastes from a survey, referred to as the TC survey, conducted by the Office of Solid Waste, Waste Management Division, Capacity Programs Branch in January 1992. The purpose of the survey was to evaluate the total national capacity available for use in complying with the Land Disposal Restrictions and meeting treatment standards for D018-D043 wastes. The Agency surveyed those facilities that it believed land disposed the newly identified organic TC wastes. These facilities included those which landfill hazardous wastes and those which filed permit modifications to include D018-D043 wastes after these wastes were listed as hazardous. Of the 135 surveys sent to industry, 131 were returned. Eleven of these surveys were returned as Confidential Business Information (CBI) and are not represented in the data included in this section.

From the TC survey, the Agency estimates that at least 75 facilities in the United States generate D018-D043 wastes. Table 2-1 presents the numbers and location of these 75 facilities which produce each organic TC waste, by waste code. Table 2-2 summarizes the numbers of these facilities by EPA region. The total number of facilities generating organic TC wastes differs between Tables 2-1 and 2-2 because some of these facilities produce more than one organic TC waste. The majority of the facilities identified in the TC survey were petroleum refineries that generate wastes that exhibit the characteristic of toxicity for benzene (D018).

Additional information on the facilities which potentially generate D018-D043 wastes was obtained from the Regulatory Impact Analysis (RIA) for the TC Rule (19). This analysis was conducted by EPA to evaluate the costs and benefits of developing the TC rule, in accordance with the requirements of Executive Order 12291. As part of the RIA, the Agency characterized the affected wastes and facilities to serve as a basis for estimating costs, economic impacts, and benefits of the TC Rule. EPA completed detailed profiles of 15 major industrial sectors which it identified as the most likely to generate large quantities of wastes potentially affected by the TC Rule.

In the RIA, the Agency estimated the number of facilities which generate wastes that would exhibit the TC based on constituent concentration data. EPA divided the facilities potentially generating each waste into large and small facility size categories, using a cutoff of 50 employees to separate large from small facilities. To estimate the number of facilities that may potentially generate a TC waste, the Agency multiplied the number of facilities that they believed may generate potentially hazardous waste streams by the percentage of the total waste stream quantity which would exhibit the TC for each facility size category. The results of this analysis were evaluated by industrial classification and are presented in ranges from minimum to maximum in Table 2-3. An evaluation of these data indicated that small wholesale petroleum marketing facilities represent the majority of the facilities potentially affected by the TC rule. All of the petroleum refineries and large wholesale petroleum marketing facilities may also be affected by the TC. Other industries with large facilities that may be affected include organic chemicals, textile mills (including wool dyeing and finishing, hosiery and knit fabric finishing, and woven fabric finishing), plastics and resins, miscellaneous petroleum and coal products, pulp and paper mills, and pharmaceuticals.

The Agency also estimated, based on constituent concentration data, the quantity of each waste stream type (i.e., wastewaters or nonwastewaters) that would exhibit the TC. The RIA indicated that wastewaters would account for over 99% of the total quantity of affected wastes. These data were further analyzed by industrial classification. The petroleum refining industry is expected to generate the largest quantity of affected wastewaters (69%); the majority of these wastes are expected to be classified as D018 wastes (benzene). A second industry identified as potentially generating a large quantity of TC wastewaters is the organic chemicals industry. The majority of these wastewaters are expected to be classified as D018 (benzene), D019 (carbon tetrachloride), D022 (chloroform), D030 (2,4-dinitrotoluene), D035 (methyl ethyl ketone), and D043 (vinyl chloride) wastes.

Finally, an analysis of the RIA indicated that the petroleum refining industry accounts for the largest quantity (44%) of nonwastewater forms of potential TC wastes. Most (88%) of the nonwastewater matrices in this industry that are expected to be impacted by the TC are sludges from primary wastewater treatment. The other industry identified as a significant potential generator of TC nonwastewaters was the pulp and paper mill industry.

2.2 Waste Management Practices

From the TC survey, the Agency identified facilities which manage newly identified D018-D043 wastes. Some of these facilities generate and manage the wastes on site while others receive the wastes from off site. Table 2-4 presents a summary of management practices at these facilities by waste management type (e.g., storage, disposal, or treatment) and land disposal unit type (i.e., landfill, land treatment unit, surface impoundment, or underground injection well). Results from the TC survey indicate that most organic TC wastes are currently managed by disposal in either landfills or underground injection wells.

Following the promulgation of treatment standards for D018-D043 wastes, some of the facilities identified by the TC survey indicated that they plan to treat, on-site, organic TC wastes that are currently managed in land disposal units. From the TC survey, the Agency also identified treatment or recovery systems presently used for D018-D043 wastes. The Agency, for the purpose of the TC Survey, defined treatment systems as each treatment or recovery system used or planned to be used by each facility for managing the newly identified organic TC wastes. Table 2-5 presents the types and numbers of treatment systems currently used to manage each of the organic TC wastes. The Agency identified 63 treatment systems that are currently used to treat D018-D043 wastes, some of which are used to treat more than one waste.

For each treatment system identified in the TC survey, the Agency requested information concerning the ability of the treatment system to reduce the concentration of the hazardous constituents in the waste(s). The Agency specifically requested information as to whether the treatment system, as currently operated, could treat D018-D043 wastes to concentrations equivalent to the characteristic level and to the F039 treatment standards for the corresponding constituents (i.e., to concentrations below the characteristic level). The responses to these requests from the facilities currently treating D018-D043 wastes are summarized in Table 2-6.

Of the 63 treatment systems identified by the TC survey, facilities indicated that 52 of the systems could treat D018-D043 wastes to concentrations equivalent to the characteristic level, 7 could not treat to the characteristic level, and 4 were unsure. In response to the survey request regarding the ability of the system to treat D018-D043 wastes to concentrations below the characteristic level, facilities indicated that 36 of the systems could treat D018-D043 wastes to concentrations below the characteristic level, 12 could not treat to below the characteristic level, and 15 were unsure. Since some of these treatment systems treat more than one organic TC waste, these numbers do not correspond to the sum of the responses for the individual wastes as presented in Table 2-6.

2.3 Waste Characterization

Wastes exhibiting the characteristic of toxicity are identified as waste codes D004-D043. A waste is considered to exhibit the Toxicity Characteristic if the leachate generated using the TCLP contains constituents at concentrations equal to or greater than the regulatory levels listed in Table 1-1. Available waste characterization data for D018-D043 wastes were obtained from the TC survey. These data are presented in Table 2-7. These data indicate that D018-D043 wastes represent a wide range of waste matrices and that concentrations of the regulated constituents vary considerably.

2.4 Releases and Transfers of D018-D043 Wastes Reported in the TRI

The Toxic Release Inventory (TRI) database contains data on the environmental releases and transfers of chemicals reported annually by facilities with Standard Industrial Classification (SIC) codes 20 through 39 to EPA, as required by Section 313 of Title III to the Superfund Amendments and Reauthorization Act (SARA) (Title III is also known as the Emergency Planning and Community Right-to-Know Act). The chemicals for which these data must be submitted are specified in 40 CFR 372. These data are subsequently incorporated into a database of releases and transfers of chemicals, known as the Toxic Release Inventory (TRI) database. Most of the organic TC constituents regulated in D018-D043 wastes are included in this database. While the TRI data do not reflect the generation and release of the specific TC wastes, the data represent the releases and transfers of the specific chemical constituents selected for regulation in D018-D043 wastes.

The 1990 TRI data for total environmental releases were available for 25 of the 27 constituents regulated in D018-D043 wastes; these data indicated that approximately 248 million pounds of these constituents were released to the environment. Most (97%) of the total releases involved seven volatile organic constituents. In descending order of total quantities released, these seven constituents were: methyl ethyl ketone, trichloroethylene, benzene, chloroform, tetrachloroethylene, 1,2-dichloroethane, and chlorobenzene. While the releases of these seven chemicals to the environment were relatively large, the TRI data indicate that the majority of these releases (98%) were to air. This is supported by other EPA estimates indicating a rate of 85% loss of volatile organics to air. An analysis of the TRI data indicated that the magnitude of the generation of solid wastes containing these chemicals is expected to be significantly lower than that implied by the TRI data.

The TRI database classified environmental releases into the following six groups: air emissions, surface water discharges, underground injection, releases to land, transfers to POTWs, and transfers to other off-site facilities. In evaluating the releases of the TC constituents, the Agency categorized the constituents regulated in D018-D043 wastes as non-halogenated solvents, halogenated solvents, and chlorinated phenolics and pesticides based on similarities in chemical structure and usage. A list of the constituents within each of these three groups is presented in Table 2-8. Figures 2-1, 2-2, and 2-3 present the 1990 TRI estimates of releases and transfers for the non-halogenated solvents, halogenated solvents, and chlorinated phenolics and pesticides groups, respectively. The data for these groups indicate that the majority of releases and transfers for the two solvent groups consisted of air emissions and transfers to off-site facilities. A larger percentage of the non-halogenated solvents than the halogenated solvents were disposed of by underground injection and releases to land, while a higher percentage of the halogenated solvents than the non-halogenated solvents were discharged to surface water. The TRI data for the chlorinated phenolics and pesticides indicate that the majority of these constituents are transferred for management off site. The data also indicate that a large percentage of the releases for this group are to the air.

The TRI data also provided the total amounts of chemicals transferred to off-site facilities for management and to Publicly-Owned Treatment Works (POTWs). The 1990 data for total releases indicated that approximately 44 million pounds of the constituents regulated in D018-D043 wastes were transferred off-site to management facilities and POTWs. Most (91%) consisted of transfers to off-site management facilities.

The Agency also evaluated the data on releases and transfers of TC constituents in the TRI for calendar years 1987-1990. These data are presented in Figures 2-4, 2-5, and 2-6. The data for the halogenated solvents, non-halogenated solvents, and chlorinated phenolics and pesticides groups from 1987-1990 also indicate that most of the environmental releases of these constituents represent air emissions and transfers to off-site facilities. Additionally, the data indicate a reduction in the environmental releases of these constituents over this four year period.

Constituent-specific TRI data for the releases of the newly identified organic TC constituents are presented in Appendix C.

Table 2-1

Numbers and Locations of Generators of D018-D043 Wastes by Waste Code

Constituent	Waste Code	Number of Facilities	States (Number of Facilities Where the Waste is Generated)	EPA Regions (Number of Facilities Where the Waste is Generated)
Benzene	D018	69	CA (2), CO (1), DE (1), HI (1), IL (2), IN (1), LA (7), MI (3), MT (2), NJ (2), NM (1), NV (1), NY (1), OH (3), OK (3), OR (1), PA (2), PR (3), TX (27), VA (2), WA (2), WY (1).	II (6), III (5), V (9), VI (38), VIII (4), IX (4), X (3)
Carbon Tetrachloride	D019	7	LA (2), NJ (1), OH (1), TX (3)	II (1), V (1), VI (5)
Chlordane	D020	1	OH (1)	V (1)
Chlorobenzene	D021	3	LA (1), NJ (1), OH (1)	II (1), V (1), VI (1)
Chloroform	D022	3	LA (1), OH (1), TX (1)	V (1), VI (2)
o-Cresol	D023	2	OH (1), TX (1)	V (1), VI (1)
m-Cresol	D024	1	OH (1)	V (1)
p-Cresol	D025	1	OH (1)	V (1)
Cresol	D026	3	OH (1), OR (1), TX (1)	V (1), VI (1), X (1)
1,4-Dichlorobenzene	D027	1	OH (1)	V (1)
1,2-Dichloroethane	D028	4	LA (1), NJ (1), OH (1), TX (1)	II (1), V (1), VI (2)
1,1-Dichloroethylene	D029	1	OH (1)	V (1)
2,4-Dinitrotoluene	D030	2	NJ (1), OH (1)	II (1), V (1)
Heptachlor/Heptachlor Epoxide	D031	1	OH (1)	V (1)

Table 2-1

(Continued)

Constituent	Waste Code	Number of Facilities	States (Number of Facilities Where the Waste is Generated)	EPA Regions (Number of Facilities Where the Waste is Generated)
Hexachlorobenzene	D032	2	OH (1), TX (1)	V (1), VI (1)
Hexachlorobutadiene	D033	1	OH (1)	V (1)
Hexachloroethane	D034	1	OH (1)	V (1)
Methyl Ethyl Ketone	D035	4	OH (1), OR (1), TX (2)	V (1), VI (2), X (1)
Nitrobenzene	D036	4	NJ (1), OH (1), OR (1), TX (1)	II (1), V (1), VI (1), X (1)
Pentachlorophenol	D037	3	OH (1), OR (1), TX (1)	V (1), VI (1), X (1)
Pyridine	D038	1	OH (1)	V (1)
Tetrachloroethylene	D039	6	NJ (1), OH (1), OR (1), SC (1), TX (2)	II (1), IV (1), V (1), VI (2), X (1)
Trichloroethylene	D040	3	OH (1), OR (1), TX (1)	V (1), VI (1), X (1)
2,4,5-Trichlorophenol	D041	2	OR (1), TX (1)	VI (1), X (1)
Vinyl Chloride	D043	3	LA (1), OH (1), PA (1)	III (1), V (1), VI (1)

Source: USEPA Survey for Facilities that Land Dispose Newly Identified Organic TC Wastes (Reference 22).

Note: Data from the TC survey did not identify any facilities which generate D042 wastes.

Table 2-2

Numbers of Generators of D018-D043 Wastes by EPA Region

EPA Region	Number of Facilities[a]	Waste Codes (Number of Facilities Where the Waste is Generated)
II	7	D018 (6), D019 (1), D021 (1), D028 (1), D030 (1), D036 (1), D039 (1)
III	6	D018 (5), D043 (1)
IV	1	D039 (1)
V	9	D018 (9), D019 (1), D020 (1), D021 (1), D022 (1), D023 (1), D024 (1), D025 (1), D026 (1), D027 (1), D028 (1), D029 (1), D030 (1), D031 (1), D032 (1), D033 (1), D034 (1), D035 (1), D036 (1), D037 (1), D038 (1), D039 (1), D040 (1), D043 (1)
VI	41	D018 (38), D019 (5), D021 (1), D022 (2), D023 (1), D026 (1), D028 (2), D032 (1), D035 (2), D036 (1), D037 (1), D039 (2), D040 (1), D041 (1), D043 (1)
VIII	4	D018 (4)
IX	4	D018 (4)
X	3	D018 (3), D026 (1), D035 (1), D036 (1), D037 (1), D039 (1), D040 (1), D041 (1)

[a]Some facilities produce more than one organic TC waste.

Source: USEPA Survey for Facilities that Land Dispose Newly Identified Organic TC Wastes (Reference 22).

Note: Data from the TC survey did not indicate that there are any facilities in EPA Regions I and VII which generate D018-D043 wastes.

Table 2-3

Estimated Number of Facilities Which May Generate D018-D043 Wastes by Industrial Classification

Industrial Classification	Large Facilities[a]		Small Facilities[a]		All Facilities[b]	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Wool Dyeing and Finishing	39	48	0	0	39	48
Hosiery and Knit Fabric Finishing	170	440	330	830	500	1,300
Woven Fabric Finishing	58	59	150	150	210	210
Sawmill and Planing Mills	18	18	59	59	77	77
Pulp and Paper Mills	49	49	8	8	57	57
Plastic Materials and Resins	62	200	83	270	150	470
Synthetic Rubber	6	6	9	9	15	15
Synthetic Fibers, Cellulosic	16	16	0	0	16	16
Synthetic Fibers, Non-Cellulosic	4	4	1	3	5	7
Pharmaceuticals	54	54	170	170	220	220
Organic Chemicals	62	260	88	340	150	600
Petroleum Refining	220	220	0	0	220	220
Miscellaneous Petroleum and Coal Products	34	61	210	370	240	430
Petroleum Pipelines	29	29	200	200	230	230
Wholesale Petroleum Marketing	310	310	13,000	13,000	13,000	13,000
TOTAL[a]	**1,100**	**1,800**	**14,000**	**16,000**	**15,000**	**17,000**

[a]Large and small facilities are differentiated based on a cutoff of 50 employees.
[b]Totals may not be equivalent to the sum of facilities due to rounding.
Source: Reference 19.

Table 2-4

Waste Management Practices Reported for D018-D043 Wastes

Constituent	Waste Code	Land Disposal Unit Type	Waste Management Type	Number of Facilities
Benzene	D018	Landfill	Disposal	16
		Land Treatment Unit	Disposal	2
			Treatment	9
		Surface Impoundment	Disposal	3
			Storage	18
			Treatment	22
			Unspecified	5
		Underground Injection Well	Disposal	10
			Treatment	2
Carbon Tetrachloride	D019	Landfill	Disposal	6
		Land Treatment Unit	Treatment	1
		Surface Impoundment	Treatment	2
			Unspecified	2
		Underground Injection Well	Disposal	3
			Treatment	1
Chlordane	D020	Landfill	Disposal	5
		Underground Injection Well	Disposal	2

Table 2-4

(Continued)

Constituent	Waste Code	Land Disposal Unit Type	Waste Management Type	Number of Facilities
Chlorobenzene	D021	Landfill	Disposal	3
		Surface Impoundment	Disposal	2
		Underground Injection Well	Disposal	2
Chloroform	D022	Landfill	Disposal	3
		Surface Impoundment	Disposal	1
		Underground Injection Well	Disposal	5
			Treatment	1
o-Cresol	D023	Landfill	Disposal	2
		Underground Injection Well	Disposal	4
m-Cresol	D024	Landfill	Disposal	1
		Underground Injection Well	Disposal	1
p-Cresol	D025	Landfill	Disposal	1
		Underground Injection Well	Disposal	2
Cresol	D026	Landfill	Disposal	5
		Underground Injection Well	Disposal	3
1,4-Dichlorobenzene	D027	Landfill	Disposal	3
		Underground Injection Well	Disposal	2
			Treatment	1

Table 2-4

(Continued)

Constituent	Waste Code	Land Disposal Unit Type	Waste Management Type	Number of Facilities
1,2-Dichloroethane	D028	Landfill	Disposal	10
		Surface Impoundment	Disposal	1
			Storage	1
			Treatment	1
		Underground Injection Well	Disposal	3
1,1-Dichloroethylene	D029	Landfill	Disposal	3
		Underground Injection Well	Disposal	2
2,4-Dinitrotoluene	D030	Landfill	Disposal	3
		Underground Injection Well	Disposal	2
			Treatment	1
Heptachlor/Heptachlor Epoxide	D031	Landfill	Disposal	1
		Underground Injection Well	Disposal	2
Hexachlorobenzene	D032	Landfill	Disposal	4
		Underground Injection Well	Disposal	2
Hexachlorobutadiene	D033	Landfill	Disposal	1
		Underground Injection Well	Disposal	2
Hexachloroethane	D034	Landfill	Disposal	1
		Underground Injection Well	Disposal	2

Table 2-4

(Continued)

Constituent	Waste Code	Land Disposal Unit Type	Waste Management Type	Number of Facilities
Methyl Ethyl Ketone	D035	Landfill	Disposal	8
		Surface Impoundment	Disposal	1
			Treatment	1
		Underground Injection Well	Disposal	6
			Treatment	1
Nitrobenzene	D036	Landfill	Disposal	5
		Underground Injection Well	Disposal	4
Pentachlorophenol	D037	Landfill	Disposal	4
		Underground Injection Well	Disposal	3
Pyridine	D038	Landfill	Disposal	4
		Surface Impoundment	Disposal	1
		Underground Injection Well	Disposal	3
Tetrachloroethylene	D039	Landfill	Disposal	10
		Land Treatment Unit	Treatment	1
		Surface Impoundment	Disposal	1
			Treatment	1
		Underground Injection Well	Disposal	4
			Treatment	1

Table 2-4

(Continued)

Constituent	Waste Code	Land Disposal Unit Type	Waste Management Type	Number of Facilities
Trichloroethylene	D040	Landfill	Disposal	8
		Surface Impoundment	Disposal	1
		Underground Injection Well	Disposal	3
2,4,5-Trichlorophenol	D041	Landfill	Disposal	2
		Underground Injection Well	Disposal	2
2,4,6-Trichlorophenol	D042	Landfill	Disposal	2
		Underground Injection Well	Disposal	1
Vinyl Chloride	D043	Landfill	Disposal	6
		Surface Impoundment	Storage	2
		Underground Injection Well	Disposal	2

Source: USEPA Survey for Facilities that Land Dispose Newly Identified Organic TC Wastes (Reference 22).

Table 2-5

Treatment Technologies Used to Manage D018-D043 Wastes

Constituent	Waste Code	Treatment Technology	Number of Treatment Systems
Benzene	D018	Air Flotation	1
		Air Stripping	2
		API Separator	2
		Biological Treatment	21
		Biological Treatment/Carbon Adsorption	1
		Boiler	2
		Equalization	1
		Filtration/Underground Injection Well	1
		Incineration	2
		Land Treatment Unit	3
		PACT®	1
		Recovery	1
		Sludge Dewatering	3
		Soil Bioremediation	1
		Stabilization	1
		Steam Stripping	4
		UV Oxidation	1
		Wastewater Treatment (API, Biological Treatment, Air Flotation)	2
Carbon Tetrachloride	D019	Air Stripping	1
		Biological Treatment	2
		Filtration/Underground Injection Well	1
		Incineration	1
		Industrial Furnace	1
		Steam Stripping	1

Table 2-5

(Continued)

Constituent	Waste Code	Treatment Technology	Number of Treatment Systems
Chlorobenzene	D021	Biological Treatment	2
		Incineration	2
Chloroform	D022	Air Stripping	1
		Biological Treatment	1
		Filtration/Underground Injection Well	1
		Incineration	1
		Industrial Furnace	1
		Steam Stripping	1
o-Cresol	D023	Biological Treatment	1
		Incineration	1
m-Cresol	D024	Biological Treatment	1
p-Cresol	D025	Biological Treatment	1
Cresol	D026	Biological Treatment	1
		Biological Treatment/Carbon Adsorption	1
		Boiler	1
		Soil Bioremediation	1
1,4-Dichlorobenzene	D027	Biological Treatment	1
		Incineration	1
		Filtration/Underground Injection Well	1
		Steam Stripping	1
1,2-Dichloroethane	D028	Air Stripping	2
		Biological Treatment	1
		Carbon Adsorption	1
		Incineration	2
		Industrial Furnace	1
		Steam Stripping	1

Table 2-5

(Continued)

Constituent	Waste Code	Treatment Technology	Numoer of Treatment Systems
1,1-Dichloroethylene	D029	Air Stripping	1
		Biological Treatment	1
		Carbon Adsorption	1
		Incineration	1
		Steam Stripping	1
2,4-Dinitrotoluene	D030	Biological Treatment/Sludge Dewatering	1
		Incineration	1
Hexachlorobenzene	D032	Biological Treatment	2
		Incineration	1
		Industrial Furnace	1
		Steam Stripping	1
Hexachlorobutadiene	D033	Biological Treatment	1
		Incineration	1
		Steam Stripping	1
Hexachloroethane	D034	Biological Treatment	1
		Incineration	1
		Industrial Furnace	1
Methyl Ethyl Ketone	D035	Biological Treatment	1
		Boiler	1
		Incinerator	1
		Steam Stripping	1
Nitrobenzene	D036	Incineration	2
		Steam Stripping	1
Pentachlorophenol	D037	Biological Treatment	1
		Incineration	1
		Land Treatment Unit	1

Table 2-5

(Continued)

Constituent	Waste Code	Treatment Technology	Number of Treatment Systems
Pyridine	D038	Incineration	1
		Steam Stripping	1
Tetrachloroethylene	D039	Biological Treatment	1
		Incineration	2
		Industrial Furnace	1
		Steam Stripping	1
Trichloroethylene	D040	Air Stripping	1
		Biological Treatment	1
		Carbon Adsorption	1
		Incineration	3
		Steam Stripping	1
Vinyl Chloride	D043	Air Stripping	1
		Incineration	1
		Industrial Furnace	1
		Sludge Dewatering	1

Source: USEPA Survey for Facilities That Land Dispose Newly Identified Organic TC Wastes (Reference 22).

PACT® = Powdered Activated Carbon Treatment

Note: Data from the TC survey did not indicate treatment systems currently used to treat D020, D031, D041, and D042 wastes.

Some treatment systems identified by the TC Survey treat more than one organic TC waste.

Table 2-6

Levels Facilities Reported as Achievable for Treatment of D018-D043 Wastes

Constituent	Waste Code	Number of Treatment Systems Reportedly Able to Treat Waste to TC Regulatory Level			Number of Treatment Systems Reportedly Able to Treat Waste to Below TC Regulatory Level		
		Yes	No	Unsure	Yes	No	Unsure
Benzene	D018	33	6	2	23	8	10
Carbon Tetrachloride	D019	4	1	0	2	2	1
Chlorobenzene	D021	3	0	0	2	1	0
Chloroform	D022	2	1	0	0	2	1
o-Cresol	D023	1	0	0	0	1	0
m-Cresol	D024	1	0	0	0	1	0
p-Cresol	D025	1	0	0	0	1	0
Cresol	D026	2	0	0	0	1	1
1,4-Dichlorobenzene	D027	1	1	0	0	2	0
1,2-Dichloroethane	D028	3	0	1	1	2	1
1,1-Dichloroethylene	D029	1	0	1	0	1	1
2,4-Dinitrotoluene	D030	2	0	0	2	0	0
Hexachlorobenzene	D032	2	0	0	1	1	0
Hexachlorobutadiene	D033	1	0	0	0	1	0
Hexachloroethane	D034	1	0	0	0	1	0
Methyl Ethyl Ketone	D035	3	0	0	2	1	0
Nitrobenzene	D036	2	1	0	1	1	1
Pentachlorophenol	D037	2	0	0	0	1	1
Pyridine	D038	2	0	0	1	1	0
Tetrachloroethylene	D039	3	0	0	1	1	1
Trichloroethylene	D040	3	0	1	2	1	1
Vinyl Chloride	D043	2	0	0	2	0	0

Source: USEPA Questionnaire for Facilities that Land Dispose Newly Identified Organic TC Wastes (Reference 22).

Note: Data from the TC survey did not indicate treatment systems currently used to treat D020, D031, D041, and D042 wastes.
Some treatment systems identified by the TC Survey treat more than one organic TC waste.

Table 2-7

Waste Characterization Data for D018-D043 Wastes

Waste Code	Constituent Selected for Regulation	Concentration Range[a] (ppm)
D018	Benzene	0.5-200,000
D019	Carbon Tetrachloride	0.5-100,000
D020	Chlordane	4.38-1,000
D021	Chlorobenzene	100-5,000
D022	Chloroform	6-10,000
D023	o-Cresol	200-10,000
D024	m-Cresol	200-10,000
D025	p-Cresol	200-540
D026	Cresols (total)	250-10,000
D027	1,4-Dichlorobenzene	7.5-10,000
D028	1,2-Dichloroethane	0.5-64,000
D029	1,1-Dichloroethylene	0.7-20,000
D030	2,4-Dinitrotoluene	0.47-2,000
D031	Heptachlor/Heptachlor Epoxide	0.1-0.352
D032	Hexachlorobenzene	0.13-200
D033	Hexachlorobutadiene	>0.5
D034	Hexachloroethane	3-10
D035	Methyl Ethyl Ketone	200-350,000
D036	Nitrobenzene	2-14,000
D037	Pentachlorophenol	100-950,000
D038	Pyridine	5-16,000
D039	Tetrachloroethylene	0.7-10,000
D040	Trichloroethylene	0.5-500,000
D041	2,4,5-Trichlorophenol	>400
D042	2,4,6-Trichlorophenol	>2
D043	Vinyl Chloride	0.2-1,000

[a]The TC Survey did not clearly identify whether these analytical results were based on total composition or TCLP waste extract analysis.

Source: USEPA Survey for Facilities that Land Dispose Newly Identified Organic TC Wastes (Reference 22).

Table 2-8

TC Constituents Which Comprise the Non-Halogenated Solvents, Halogenated Solvents, and Chlorinated Phenolics and Pesticides Groups

Non-Halogenated Solvents

D018 - Benzene
D023 - o-Cresol
D024 - m-Cresol
D025 - p-Cresol
D026 - Cresol (mixed isomers)
D030 - 2,4-Dinitrotoluene
D035 - Methyl Ethyl Ketone
D036 - Nitrobenzene
D038 - Pyridine

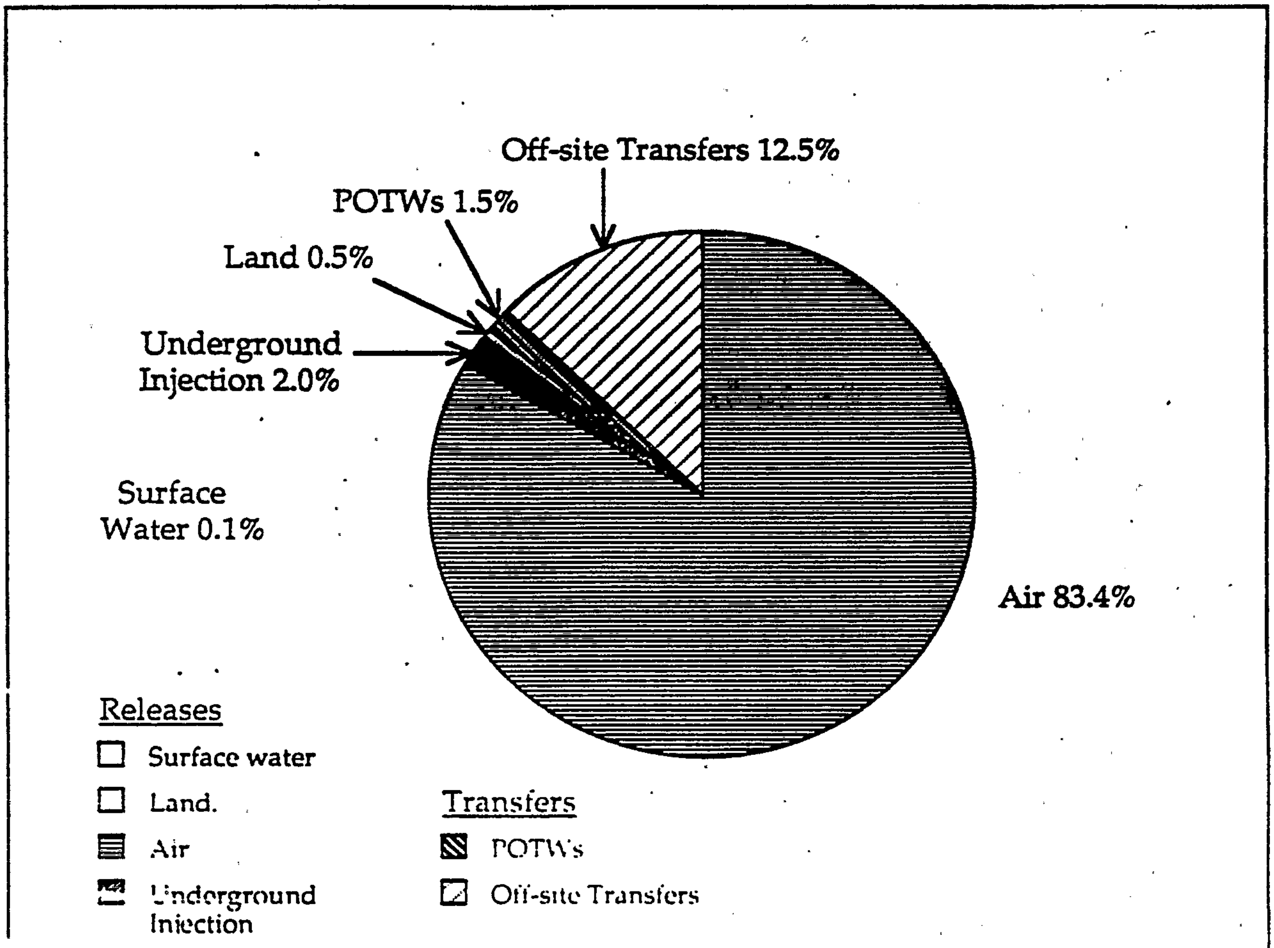
Halogenated Solvents

D019 - Carbon Tetrachloride
D021 - Chlorobenzene
D022 - Chloroform
D027 - 1,4-Dichlorobenzene
D028 - 1,2-Dichloroethane
D029 - 1,1-Dichloroethylene
D032 - Hexachlorobenzene
D033 - Hexachlorobutadiene
D034 - Hexachloroethane
D039 - Tetrachloroethylene
D040 - Trichloroethylene
D043 - Vinyl Chloride

Chlorinated Phenolics and Pesticides

D020 - Chlordane
D031 - Heptachlor
D031 - Heptachlor Epoxide
D037 - Pentachlorophenol
D041 - 2,4,5-Trichlorophenol
D042 - 2,4,6-Trichlorophenol

1990 Releases	152 Million Pounds	**1990 Transfers**	24.8 Million Pounds
Air Emissions	147 million	Transfers to POTWs	2.68 million
Surface Water Discharges	107,000	Transfers to Other Off-site Locations	22.1 million
Underground Injection	3.60 million		
Releases to Land	816,000		

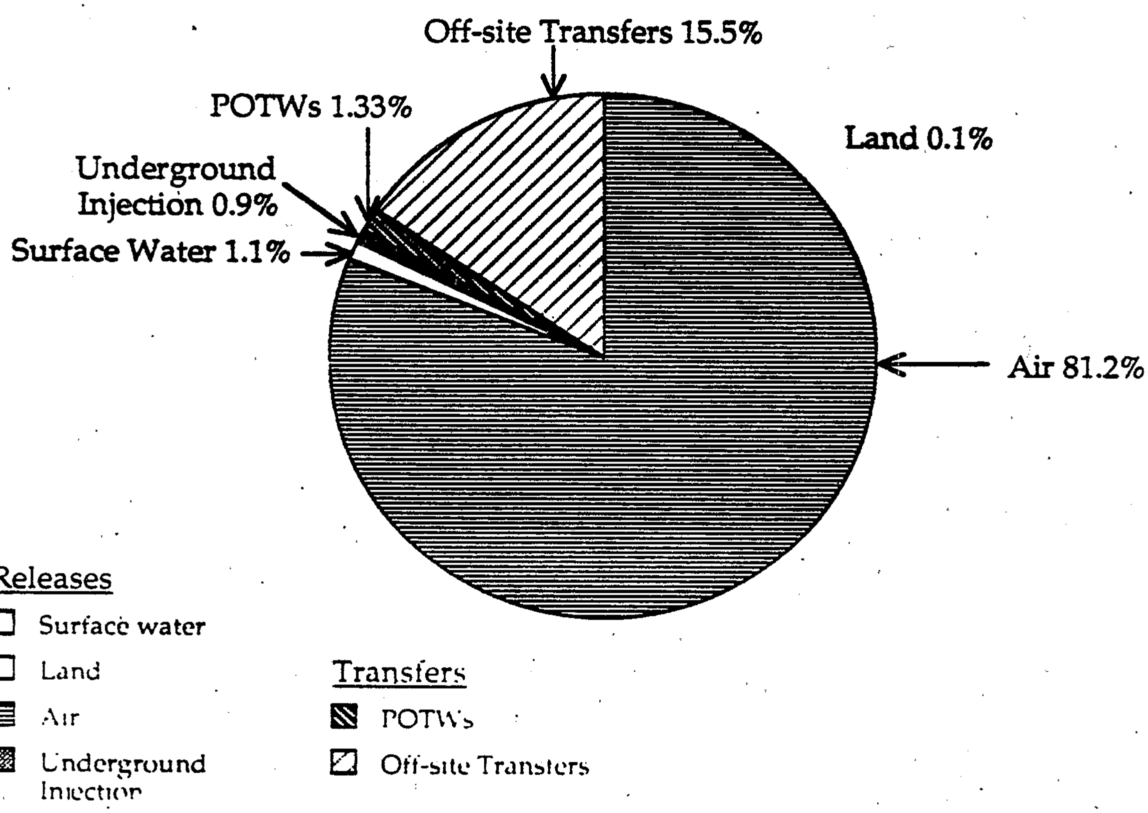


Source: Reference 18

Figure 2-1

1990 TRI Releases and Transfers of Non-Halogenated Solvents

1990 Releases	96.9 Million Pounds	1990 Transfers	19.6 Million Pounds
Air Emissions	94.6 million	Transfers to POTWs	1.55 million
Surface Water Discharges	1.18 million	Transfers to Other Off-site Locations	18.0 million
Underground Injection	1.01 million		
Releases to Land	87,500		

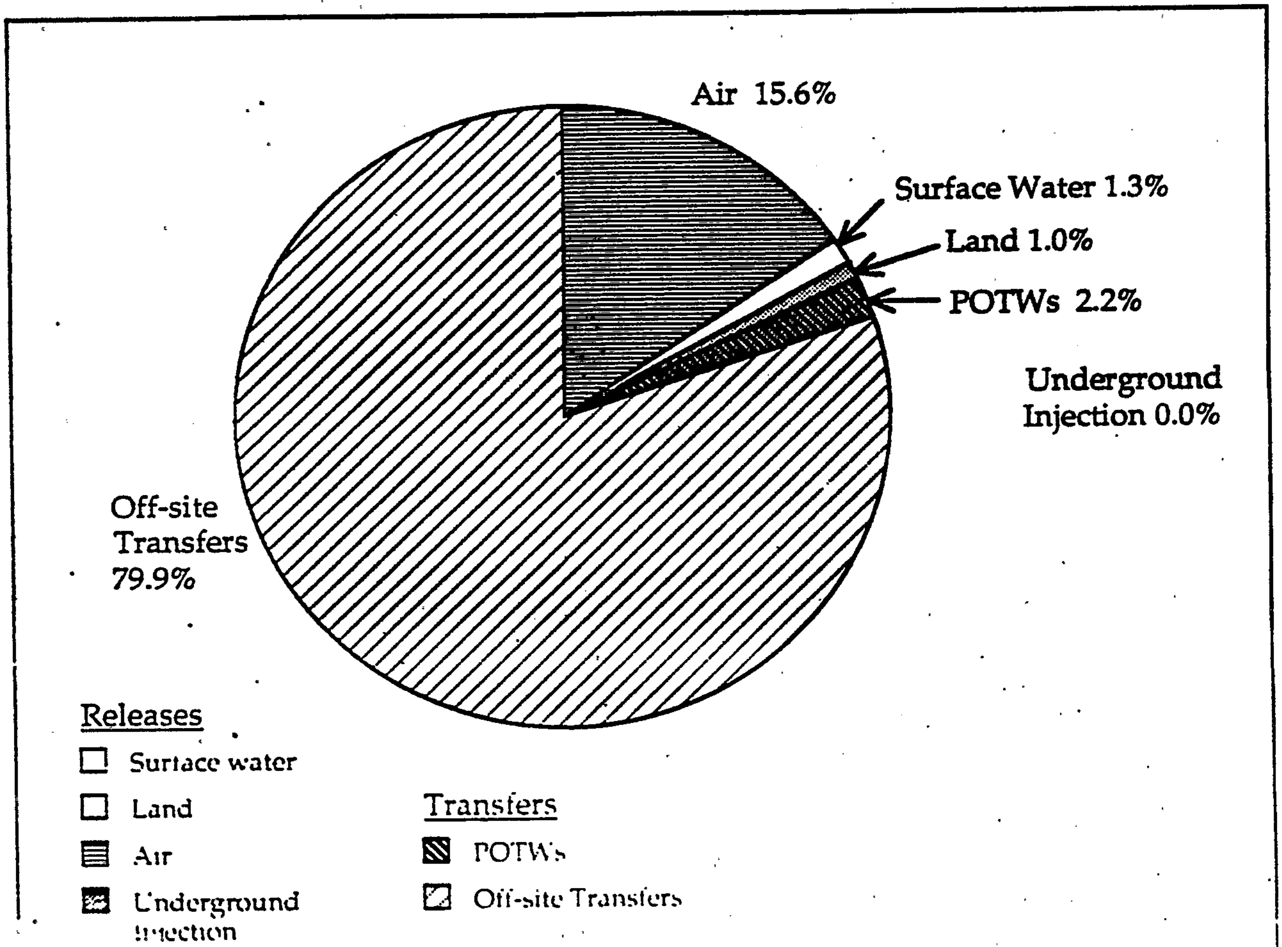


Source: Reference 18

Figure 2-2

1990 TRI Releases and Transfers of Halogenated Solvents

1990 Releases	36,100 Pounds	1990 Transfers	165,000 Pounds
Air Emissions	31,500	Transfers to POTWs	4,500
Surface Water Discharges	2,660	Transfers to Other Off-site Locations	161,000
Underground Injection	0		
Releases to Land	1,940		

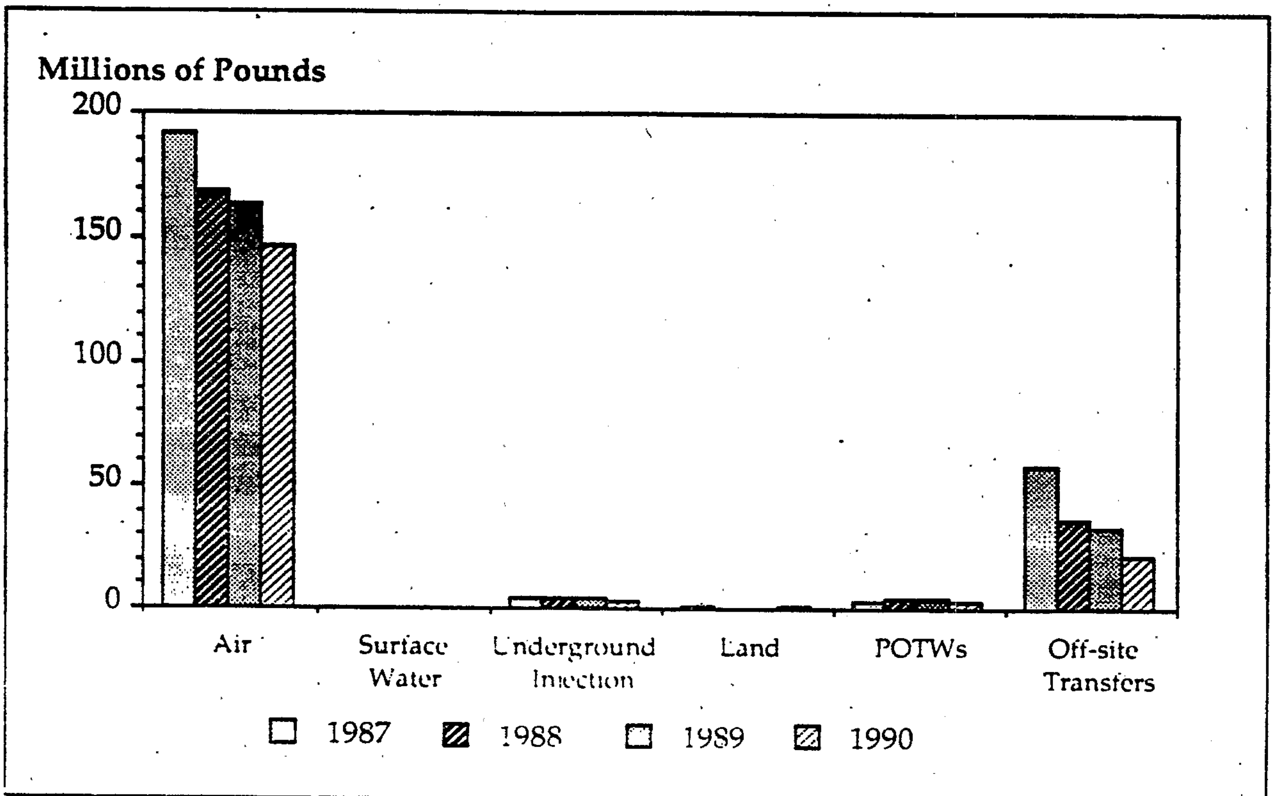


Source: Reference 18

Figure 2-3

1990 TRI Releases and Transfers of Chlorinated Phenolics and Pesticides

	1987 Pounds	1988 Pounds	1989 Pounds	1990 Pounds
Releases				
Air Emissions	191 million	169 million	163 million	147 million
Surface Water Discharges	412,000	154,000	265,000	107,000
Underground Injection	4.46 million	4.50 million	4.35 million	3.60 million
Releases to Land	1.08 million	387,000	305,000	816,000
Transfers				
Transfers to POTWs	2.91 million	4.21 million	4.65 million	2.68 million
Transfers to Other Off-site Locations	58.7 million	36.6 million	33.6 million	22.1 million

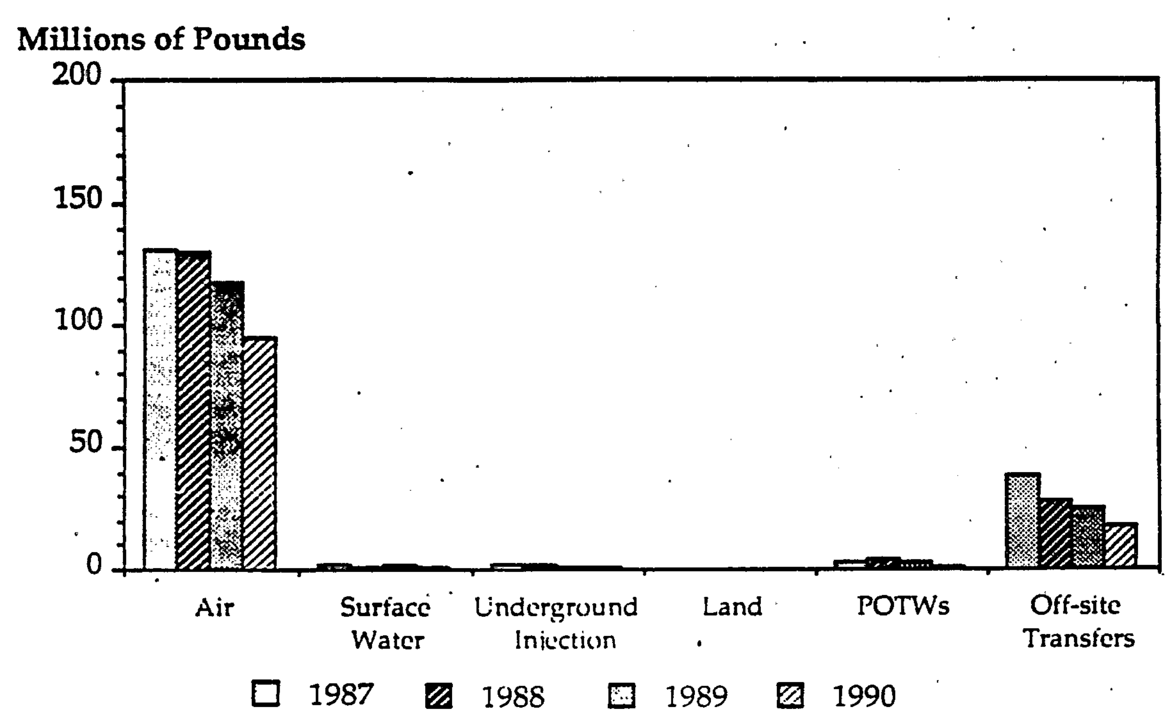


Source: Reference 18

Figure 2-4

1987-1990 TRI Releases and Transfers of Non-Halogenated Solvents

	1987 Pounds	1988 Pounds	1989 Pounds	1990 Pounds
Releases				
Air Emissions	132 million	130 million	118 million	94.6 million
Surface Water Discharges	1.57 million	1.33 million	1.60 million	1.18 million
Underground Injection	1.98 million	1.75 million	1.42 million	1.01 million
Releases to Land	147,000	223,000	103,000	87,600
Transfers				
Transfers to POTWs	3.59 million	4.01 million	3.32 million	1.55 million
Transfers to Other Off-site Locations	38.4 million	27.7 million	24.8 million	18.0 million

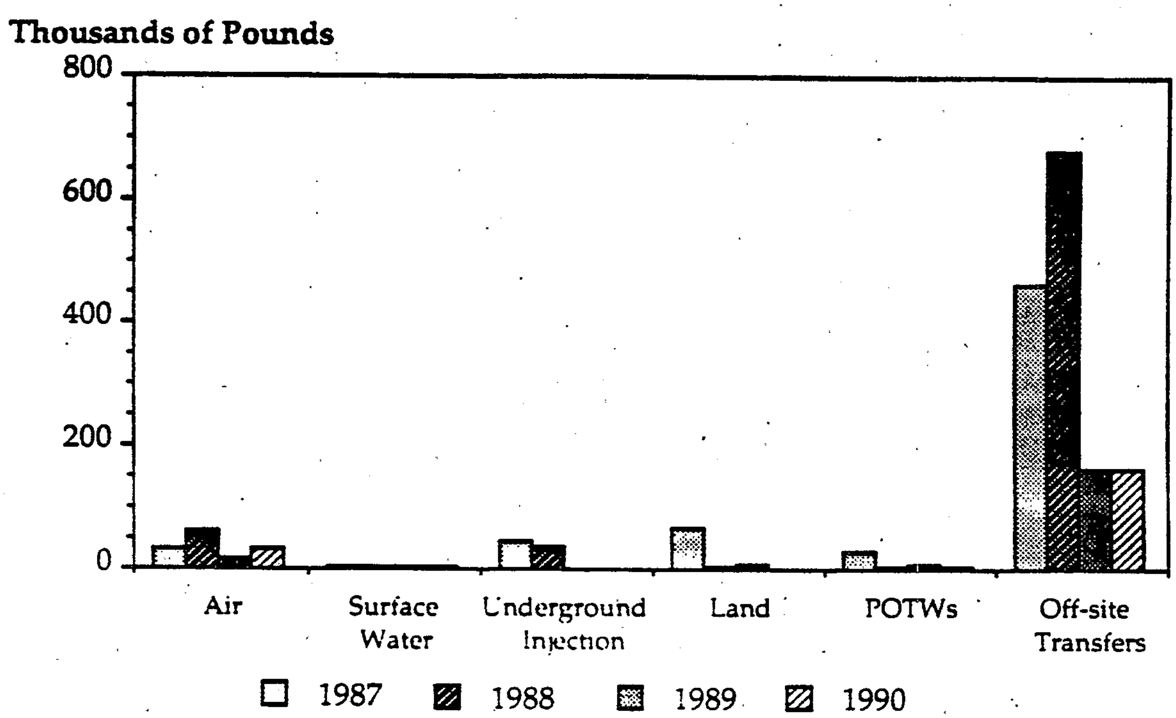


Source: Reference 18

Figure 2-5

1987-1990 TRI Releases and Transfers of Halogenated Solvents

	1987 Pounds	1988 Pounds	1989 Pounds	1990 Pounds
Releases				
Air Emissions	32,100	64,000	18,700	31,500
Surface Water Discharges	3,410	2,520	6,080	2,660
Underground Injection	43,800	36,300	0	0
Releases to Land	65,200	3,720	7,160	1,940
Transfers				
Transfers to POTWs	29,900	4,790	8,100	4,510
Transfers to Other Off-site Locations	460,000	678,000	164,000	161,000



Source: Reference 18

Figure 2-6

1987-1990 TRI Releases and Transfers of Chlorinated Phenolics and Pesticides

3.0 BDAT TREATMENT STANDARDS FOR NONWASTEWATER FORMS OF D018-D043 WASTES

This section discusses the identification of the Best Demonstrated Available Technology (BDAT) for treatment of nonwastewater forms of D018-D043 wastes and presents development of the BDAT treatment standards for the regulated constituents.

3.1 Identification of BDAT

This section discusses the Agency's determination of applicable and demonstrated technologies and BDAT for treatment of nonwastewater forms of D018-D043 wastes.

In order to establish BDAT, the Agency first identifies which technologies are applicable for treatment of the waste of interest. To be applicable, a technology must be usable, in theory, to treat the waste in question or a waste that is judged to be similar in terms of parameters that affect treatment selection. Detailed descriptions of technologies that are applicable for the treatment of listed hazardous wastes are provided in EPA's Treatment Technology Background Document (20). The identification of treatment technologies as applicable for treating listed hazardous wastes is based on current waste management practices, current literature sources, field testing, data submitted by equipment manufacturers and industrial concerns, plus the engineering judgement of EPA technical staff personnel.

The Agency next determines which of the applicable technologies are demonstrated for treatment of the wastes. To be demonstrated, a technology must be used in a full-scale operation for treatment of the waste of interest or a similar waste. Technologies that are available only at pilot- or bench-scale operations are not considered in identifying demonstrated technologies.

The Agency determines which of the demonstrated technologies is "best" based on treatment performance data for the constituents of interest, and determines whether this "best" demonstrated technology is also commercially "available." If the "best" demonstrated technology is considered to be "available," then that technology is determined to represent BDAT.

3.1.1 Applicable Treatment Technologies

Because nonwastewater forms of D018-D043 wastes contain organic constituents at treatable concentrations, 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 technologies as being applicable for treatment of nonwastewater forms of these wastes:

- Critical fluid extraction;
- Fuel substitution;
- High temperature thermal distillation;
- Incineration;
- Pressure filtration;
- Solvent extraction;
- Thermal desorption; and
- Total recycle or reuse.

The concentrations and type(s) of constituents present in the waste generally determine which technology is most applicable for treatment of that waste. A brief discussion of each of the technologies identified as applicable for treatment of the constituents in nonwastewater forms of D018-D043 wastes is given below (20).

<u>Critical Fluid Extraction</u>

Critical fluid extraction is a separation and recovery technology in which a solvent is brought to its critical state (liquefied gas) to extract organic constituents from a waste. The solvents used are usually gases when at ambient conditions. For the extraction procedure, the solvent is pressurized, which converts it from a gas to a liquid. As a liquid, it dissolves the organic constituents and removes them from the waste matrix. After the extraction, the solvent is returned to its gaseous state; a small volume of extract remains which contains high concentrations of organic constituents. This technology generates two residuals: a treated waste residual and an extract. The extract is often recycled or treated by incineration.

Fuel Substitution

Fuel substitution is a destruction technology in which heat is transferred to a waste to destabilize chemical bonds and destroy organic constituents. Fuel substitution involves using hazardous waste as fuel in industrial furnaces and boilers. The hazardous waste may be blended with other nonhazardous wastes (e.g., municipal sludge) and/or fossil fuels. Fuel substitution has been used in the treatment of industrial waste solvents, refinery wastes, synthetic fibers/petrochemical wastes, waste oils, and wastes produced during the manufacture of pharmaceuticals, pulp and paper, and pesticides. Fuel substitution generates two residuals: ash and scrubber water.

High Temperature Thermal Distillation

High temperature thermal distillation is a separation and recovery technology that subjects hydrocarbon-bearing wastewaters to indirect, electrically-generated heat in an inert atmosphere. The process removes all toxic volatilized hydrocarbon constituents from a waste; the constituents can be recovered subsequently in a reusable form by cooling the hydrocarbon-bearing inert gases at high pressure. This process generates two residuals: a treated waste residual and an extract.

Incineration

Incineration is a destruction technology in which heat is transferred to the waste to destabilize chemical bonds and destroy hazardous organic constituents. Three incineration technologies are applicable for organics in nonwastewaters: liquid injection, rotary kiln, and fluidized bed.

In a liquid injection incinerator, liquid wastes are atomized and injected into the incinerator, where additional heat is supplied to destabilize chemical bonds in the presence of air or oxygen. Once the chemical bonds are broken, these constituents react with oxygen to form carbon dioxide and water vapor. Liquid injection is applicable to wastes with low viscosity values, small particle size, and low suspended solids content. Since only wastes with low or negligible ash contents are amenable to liquid injection incineration, this technology does not normally generate an ash residual, but does generate a scrubber water residual.

In a rotary kiln incinerator, solid and/or semi-solid wastes are fed into the elevated slope end of the kiln. The rotation of the kiln mixes the waste with hot gases. Eventually, the waste reaches its ignition temperature, and the waste is converted to gas and ash through volatilization and combustion reactions. Ash is removed from the lower slope-end of the kiln. Combustion gases from the kiln, containing volatilized and partially combusted waste constituents, enter an afterburner for further combustion to complete the destruction of the organic waste constituents. Other wastes are often injected into the afterburner.

In a fluidized-bed incinerator, solid and/or semi-solid wastes are injected into a fluidized material (generally sand and/or incinerator ash), where they are heated to their ignition temperature. In the incinerator, the waste is converted to gas and ash through volatilization and combustion reactions. Heat energy from the combustion reaction is then transferred back to the fluidized-bed. The velocity of the combustion gases is reduced in a wider space above the bed, known as the "freeboard," allowing larger ash and unburned waste particles to fall back into the bed. Ash is removed periodically both during operation and during bed change-outs.

Combustion gases from all three types of incineration are fed into a scrubber system for cooling and removal of any entrained particles and acid gases. In general, with the exception of liquid injection incineration, two residuals are generated by the incineration process: ash and scrubber water.

Pressure Filtration

Pressure filtration, also known as sludge filtration, sludge dewatering, or cake-formation filtration, is a separation and recovery technology used for wastes that contain high concentrations (>1%) of suspended solids. Filtration separates particles from a fluid/particle mixture by passing the fluid through a medium that permits the flow of the fluid but retains the particles. Sludge filtration is commonly applied to waste sludges such as clarifier sludges; typically, these sludges can be dewatered to 20 to 50% solids concentration using this technology. Pressure filtration generates two residuals: dewatered sludge and water.

Solvent Extraction

Solvent extraction is a separation and recovery technology that removes organic constituents from a waste by mixing the waste with a solvent that preferentially dissolves and removes the constituents of concern from the waste. Wastes commonly treated by this technology have a broad range of total organic content; selection of an appropriate solvent is dependent on the relative solubilities of the constituents to be removed and the other organic compounds in the waste. Organics are removed from the waste due to greater constituent solubility in the solvent phase than in the waste phase.

Solvent extraction generates two residuals: a treated residual and an extract. The extract is often recycled or treated by incineration.

Thermal Desorption

Thermal desorption is a separation and recovery technology in which heat is used to volatilize organic constituents from wastes. Thermal desorption has been defined as a thermal treatment that uses direct or indirect heat exchange to elevate the temperature of a waste, thereby volatilizing the organic constituents. Thermal desorption differs from thermal destruction (incineration) in the way in which the organic constituents are treated. The objective of thermal desorption is to sufficiently elevate the temperature of the organic constituents to effect a phase separation to a gaseous state without combustion; the objective of incineration is to combust the organic constituents. Thermal desorption units function by creating steam from the volatilization of the moisture in the waste from heating. The steam tends to strip organic compounds from the waste and aids in the volatilization of organic compounds. Generally, this technology generates two residuals: a treated waste residual and an extract.

Total Recycle or Reuse

Total recycle or reuse of a waste within the same process or an external process eliminates the generation of the waste and subsequently generates no treatment residuals.

3.1.2 Demonstrated Treatment Technologies

Demonstrated technologies are those which have been demonstrated on a full-scale basis for treatment of the waste of interest or a similar waste. The Agency has no available data for the treatment of nonwastewater forms of D018-D043 wastes as generated. The Agency, however, has identified incineration as a demonstrated treatment technology for treatment of a similar waste, F039.

The Agency believes that F039 wastes are similar to D018-D043 wastes. F039 wastes are generated from many different sources and vary in concentration levels much like the TC wastes. Additionally, the F039 treatment performance database represents most of the BDAT treatment performance data available to the Agency for treatment of the organic Toxicity Characteristic constituents. The Agency believes that since both F039 and D018-D043 wastes represent a wide range of waste matrices and concentrations of the constituents selected for regulation in D018-D043 wastes, the demonstrated technologies for F039 wastes should also be considered demonstrated for D018-D043 wastes.

Since the Agency has no indication that any of the other applicable technologies are demonstrated in full-scale operation for treatment of the wastes of interest or similar wastes, incineration is the only technology identified as demonstrated for treatment of nonwastewater forms of D018-D043 wastes.

3.1.3 Identification of BDAT

The Agency determines BDAT based on a thorough review of all data on the treatment of the waste of concern or wastes judged to be similar. Once identified, the "best" performing demonstrated technology is evaluated to determine whether this treatment technology is available. To be "available," a technology (1) must provide substantial treatment and (2) must be commercially available. If the "best" demonstrated technology is "available," then the technology is determined to represent BDAT.

The Agency has determined that incineration, the only technology demonstrated, provides substantial treatment of a similar waste, F039, based on the reduction of all organic constituents of interest to nondetectable concentrations. In addition to providing substantial treatment, incineration is commercially available, meeting the second criterion of "availability." Therefore, incineration represents BDAT for nonwastewater forms of D018-D043 wastes.

The Agency notes, however, that when it establishes concentration-based treatment standards, the regulated community may use any non-prohibited technology to treat the waste to meet the treatment standards. Compliance with a concentration-based treatment standard requires only that the effluent concentration be achieved; once achieved, the waste may be land disposed. The waste need not be treated by the technology identified as BDAT; in fact, concentration-based treatment standards provide flexibility in the choice of a treatment technology. Any treatment, including recycling or any combination of treatment technologies, unless prohibited (e.g., impermissible dilution) or defined as land disposal (e.g., land treatment), may be used to achieve these standards.

3.2 Identification of BDAT Treatment Standards

The Agency is transferring universal standards to the constituents regulated in nonwastewater forms of D018-D043 wastes. A universal standard is a concentration limit established for a specific constituent regardless of the waste matrix in which it is present. Table 3-1 presents the specific treatment performance data used to determine the universal standards for the constituents regulated in these wastes.

Universal standards for the constituents regulated in nonwastewater forms of D018-D043 wastes were based upon incineration treatment performance data. These data represent BDAT for wastes included in previous rulemakings, and, therefore, have been judged to meet the Agency's requirements of BDAT. Thus, incineration was determined to be BDAT for the constituents of interest in universal standards. Because incineration has been identified as BDAT for D018-D043 wastes, the Agency feels it is appropriate to transfer universal standards to the constituents selected for regulation in nonwastewater forms of D018-D043 wastes.

The treatment standards database and methodology for identifying universal standards for constituents in nonwastewater forms of toxicity characteristic wastes are presented in Appendix A of this document. A more detailed discussion concerning the determination of universal standards for nonwastewater forms of listed hazardous wastes is provided in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for Universal Standards, Volume A: Universal Standards for Nonwastewater Forms of Listed Hazardous Wastes (16).

Table 3-1

Determination of BDAT Treatment Standards for Nonwastewater Forms of D018-D043 Wastes Based on Universal Standards

Waste Code and Regulated Constituent	Waste Code from Which the Universal Treatment Standard Data Were Transferred	Treatment Test from Which Performance Data[a] Were Transferred	Constituent from Which the Concentration in Treated Waste Was Transferred	Concentration in Treated Waste (mg/kg)	Constituent from Which the Accuracy Correction Data Were Transferred	Accuracy Correction Factor (Matrix Spike % Recovery)	Variability Factor	BDAT Treatment Standard (mg/kg)
D018 - Benzene	K083	K019	Benzene	<2.0	Benzene	1.18 (85)	2.8	10
D019 - Carbon Tetrachloride	K021, K073	K019	Carbon Tetrachloride	<2.0	Carbon Tetrachloride	1.06 (94)[b]	2.8	6.0
D020 - Chlordane	K032, K097	John Zink[c] (Test 2)	Chlordane (alpha and gamma)	<0.026	Chlordane	3.57 (28)[b]	2.8	0.26
D021 - Chlorobenzene	K019, F039, U157	K019	Chlorobenzene	<2.0	Chlorobenzene	1.01 (99)	2.8	6.0
D022 - Chloroform	K009, K010, K019, K029, F025, K021, K073	K019	Chloroform	<2.0	Chloroform	1.06 (94)[b]	2.8	6.0
D023 - o-Cresol	F039, U052	K019	o-Cresol	<2.0	p-Chloro-m-cresol	1 (110)	2.8	5.6
D024 - m-Cresol	F039, U052	K019	m- and p-Cresol	<2.0	p-Chloro-m-cresol	1 (110)	2.8	5.6
D025 - p-Cresol	F039, U052	K019	m- and p-Cresol	<2.0	p-Chloro-m-cresol	1 (110)	2.8	5.6
D026 - Cresols (total)[d]	F039, U052	K019	o-Cresol	<2.0	p-Chloro-m-cresol	1 (110)	2.8	5.6
D027 - 1,4-Dichlorobenzene	F039, U072	K019	1,4-Dichlorobenzene	<2.0	1,4-Dichlorobenzene	1.11 (90)	2.8	6.0

< - indicates a detection limit value; the concentration value represents the detection limit.
[a]Performance data consist of the concentration in treated waste, accuracy correction factor, and variability factor.
[b]This number represents an average of matrix spike recovery values.
[c]This test represented the incineration of waste code U127 and P059.
[d]If m-, o-, and p-cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used.
Source: Reference 16.

Table 3-1

(Continued)

Waste Code and Regulated Constituent	Waste Code from Which the Universal Treatment Standard Data Were Transferred	Treatment Test from Which Performance Data[a] Were Transferred	Constituent from Which the Concentration in Treated Waste Was Transferred	Concentration in Treated Waste (mg/kg)	Constituent from Which the Accuracy Correction Data Were Transferred	Accuracy Correction Factor (Matrix Spike % Recovery)	Variability Factor	BDAT Treatment Standard (mg/kg)
D028 - 1,2-Dichloroethane	K018, K019, K020, K029, F025	K019	1,2-Dichloroethane	<2.0	1,2-Dichloroethane	1.06 (94)[b]	2.8	6.0
D029 - 1,1-Dichloroethylene	K029, F025	K019	1,1-Dichloroethane	<2.0	1,1-Dichloroethane	1.06 (94)[b]	2.8	6.0
D030 - 2,4 Dinitrotoluene	F039, U105	K019	2,4-Dinitrotoluene	<50	2,4-Dinitrotoluene	1 (107)	2.8	140
D031 - Heptachlor	F039, P059, K032, K097	John Zink[c] (Test 2)	Heptachlor	<0.0066	Heptachlor	3.57 (28)	2.8	0.066
D031 - Heptachlor Epoxide	F039, P059, K032, K097	John Zink[c] (Test 2)	Heptachlor	<0.0066	Heptachlor	3.57 (28)	2.8	0.066
D032 - Hexachlorobenzene	K085	John Zink[c] (Test 2)	Hexachlorobenzene	<0.33	Hexachlorobenzene	4.76 (21)	2.8	10
D033 - Hexachlorobutadiene	K016, K018, K028, K030	K019	Naphthalene	<2.0	Naphthalene	1 (103)[b]	2.8	5.6
D034 - Hexachloroethane	K016, K018, K073, K095	K019	Hexachloroethane	<10.0	Hexachloroethane	1 (103)[b]	2.8	30
D035 - Methyl ethyl ketone	F039, K086, U159	K019	Methyl ethyl ketone	<10.0	1,1-Dichloroethylene	1.28 (78)	2.8	36

< - indicates a detection limit value; the concentration value represents the detection limit.
[a]Performance data consist of the concentration in treated waste, accuracy correction factor, and variability factor.
[b]This number represents an average of matrix spike recovery values.
[c]This test represented the incineration of waste code U127 and P059.
[d]If m-, o-, and p-cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used.
Source: Reference 16.

Table 3-1

(Continued)

Waste Code and Regulated Constituent	Waste Code from Which the Universal Treatment Standard Data Were Transferred	Treatment Test from Which Performance Data[a] Were Transferred	Constituent from Which the Concentration in Treated Waste Was Transferred	Concentration in Treated Waste (mg/kg)	Constituent from Which the Accuracy Correction Data Were Transferred	Accuracy Correction Factor (Matrix Spike % Recovery)	Variability Factor	BDAT Treatment Standard (mg/kg)
D036 - Nitrobenzene	F039, K086, U169	K019	Nitrobenzene	<5.0	4-Nitrophenol	1.03 (97)	2.8	14
	K083	K019	Nitrobenzene	<5.0	Nitrobenzene	1 (103)[b]	2.8	
D037 - Pentachlorophenol	F039, K001, U051	K001-PCP	Pentachlorophenol	<2.5	Pentachlorophenol	1.05 (95)	2.8	7.4
D038 - Pyridine	F039, U196	K001-PCP	Pyridine	<5.0	Benzene	1.14 (88)	2.8	16
D039 - Tetrachloroethylene	K019, K020, K028, K030, K073, K095, K096	K019	Tetrachloroethylene	<2.0	Tetrachloroethylene	1.06 (94)[b]	2.8	6.0
D040 - Trichloroethylene	F025, F039, K086, U228, K095, K096	K019	Trichloroethylene	<2.0	Trichloroethylene	1 (107)	2.8	6.0
D041 - 2,4,5-Trichlorophenol	F039	K001-PCP	Pentachlorophenol	<12.5	Pentachlorophenol	1.05 (95)	2.8	7.4
D042 - 2,4,6-Trichlorophenol	F039	K001-PCP	Pentachlorophenol	<12.5	Pentachlorophenol	1.05 (95)	2.8	7.4
D043 - Vinyl Chloride	K029	K019	Chloroform	<2.0	Chloroform	1.06 (94)[b]	2.8	6.0

< - indicates a detection limit value; the concentration value represents the detection limit.
[a]Performance data consist of the concentration in treated waste, accuracy correction factor, and variability factor.
[b]This number represents an average of matrix spike recovery values.
[c]This test represented the incineration of waste code U127 and P059.
[d]If m-, o-, and p-cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used.
Source: Reference 16.

4.0 BDAT TREATMENT STANDARDS FOR WASTEWATER FORMS OF D018-D043 WASTES

This section discusses the identification of Best Demonstrated Available Technology (BDAT) for treatment of wastewater forms of D018-D043 wastes and presents the development of the BDAT treatment standards for the regulated constituents. The treatment standards for wastewater forms of wastes are applicable to wastes managed in systems other than those regulated under the CWA, those regulated under the SDWA that inject TC wastewater into Class I injection wells, and those zero discharge facilities that engage in CWA equivalent treatment prior to land disposal.

4.1 Identification of BDAT

This section discusses the Agency's determination of applicable and demonstrated technologies and BDAT for treatment of wastewater forms of D018-D043 wastes. However, any treatment technology which reduces the concentration of regulated constituents to the level of the treatment standards and is not considered impermissible dilution is also acceptable.

In order to establish BDAT, the Agency first identifies which technologies are "applicable" for treatment of the constituents of interest. An applicable technology is one which, in theory, can treat the waste in question or a waste similar to the waste in question in terms of parameters that affect treatment selection. Detailed descriptions of the technologies identified as applicable for the treatment of listed hazardous wastes are provided in EPA's Treatment Technology Background Document (20). The basis of identifying treatment technologies as applicable for treating BDAT List constituents is evaluation of current waste management practices, current literature sources, field testing, data submitted by equipment manufacturers and industrial concerns, plus engineering judgement of EPA technical staff personnel.

The Agency next determines which of the applicable technologies are "demonstrated" for treatment of the wastes. To be designated as demonstrated, a technology must be used in a full-scale operation for treatment of the waste of interest or a similar waste. Technologies that are available only at pilot- or bench-scale operations are not considered demonstrated technologies.

The Agency determines which of the demonstrated technologies is "best" by comparing available treatment performance data from as many systems as possible for the constituents of interest, and determines whether this "best" demonstrated technology is also commercially "available." If the "best" demonstrated technology is "available," then the technology is determined to represent BDAT.

4.1.1 Applicable Treatment Technologies

Because wastewater forms of D018-D043 wastes contain organic constituents at treatable concentrations, applicable treatment technologies include those that destroy or reduce the total amount of organic constituents in the waste. The technologies listed below are applicable for treatment of organic constituents in wastewater forms of D018-D043 wastes:

- Biological treatment (including aerobic fixed film, aerobic lagoon, activated sludge, filtration, anaerobic fixed film, rotating biological contactor, sequential batch reactor, and trickling filter technologies);
- Carbon adsorption (including activated carbon and granular activated carbon technologies);
- Chemical oxidation;
- Chemically assisted clarification (including chemical precipitation technology);
- PACT® treatment (including powdered activated carbon addition to activated sludge and biological granular activated carbon technologies);

- Reverse osmosis;
- Solvent extraction (including liquid-liquid extraction technology);
- Stripping treatment (including steam stripping and air stripping technologies); and
- Wet air oxidation (including supercritical oxidation technology).

The concentration and type(s) of waste constituents present in the waste generally determine which technology is most applicable. A brief discussion of each of the technologies identified as applicable for the treatment of constituents in wastewater forms of D018-D043 wastes is given below (20).

Biological Treatment

Biological treatment includes aerobic fixed film, aerobic lagoons, activated sludge, anaerobic fixed film, rotating biological contactor, sequential batch reactor, and trickling filter technologies. Biological treatment is a destruction technology in which organic constituents in wastewaters are biodegraded. This technology generates two treatment residuals: a treated effluent and a waste biosludge.

Carbon Adsorption

Carbon adsorption is a separation technology in which hazardous organic constituents in wastewaters are selectively adsorbed onto activated carbon. This technology generates two treatment residuals: a treated effluent and spent activated carbon. The spent activated carbon is often reactivated, recycled, or incinerated.

Chemical Oxidation

Chemical oxidation is a destruction technology in which inorganic cyanide, some dissolved organic compounds, and sulfides are chemically oxidized to yield carbon dioxide, water, salts, simple organic acids, and, in the case of sulfides, sulfur. This technology generates one treatment residual: treated effluent.

Chemically Assisted Clarification

Chemically assisted clarification, including chemical precipitation, is a separation technology in which coagulating and flocculating chemicals are added to form insoluble solid precipitates with the organics or inorganics in the wastewater. The solids formed are then separated from the wastewater by settling, clarification, and/or polishing filtration. This technology generates two treatment residuals: treated wastewater effluent and separated solid precipitate. The solid precipitate may require additional treatment to meet the nonwastewater BDAT treatment standards.

PACT® Treatment

PACT® treatment is a combination of carbon adsorption and biological treatment in which hazardous organic constituents are biodegraded or selectively adsorbed onto powdered-activated carbon. This technology generates two treatment residuals: a treated effluent and spent carbon/biosludge. The spent carbon is often regenerated and recycled to the process or may be incinerated.

Reverse Osmosis

Reverse osmosis is a separation technology in which dissolved organics (usually salts) are removed from a wastewater by filtering the wastewater through a semipermeable membrane at a pressure greater than the osmotic pressure caused by the dissolved organics in the wastewater. This technology generates two treatment residuals: the treated effluent wastewater and the concentrated organic salt materials which do not pass through the membrane.

Solvent Extraction

Solvent extraction is a separation technology in which organics are removed from a waste due to greater constituent solubility in the solvent phase than in the waste phase. This technology generates two residuals: a treated waste residual and an extract.

Stripping Treatment

Stripping treatment is a separation technology. Steam stripping is a technology in which wastewaters containing volatile organics have the organics removed by application of heat using steam as the heat source. Air stripping is a technology in which wastewaters containing volatile organics have the organics removed by volatilization. This technology generates one treatment residual: treated effluent. Emissions from stripping treatment may require further treatment.

Wet Air Oxidation

Wet air oxidation is a destruction technology in which organic constituents in wastes are oxidized and destroyed under pressure at elevated temperatures in the presence of dissolved oxygen. This technology is applicable for wastes comprised primarily of water and up to 10% total organic constituents. Wet air oxidation generates one treatment residual: treated effluent. The treated effluent may require further treatment for organic constituents by carbon adsorption or PACT® treatment. Emissions from wet air oxidation may also require further treatment.

4.1.2 Demonstrated Treatment Technologies

Demonstrated treatment technologies are those which have been demonstrated in full-scale operation for treatment of the wastes of interest or a similar waste. The Agency has identified all of the applicable treatment technologies for wastewater forms of D018-D043 wastes listed in Section 4.1.1 to be demonstrated technologies, from an analysis of the available treatment performance data presented in Appendix B. Treatment performance data for the constituents regulated in wastewater forms of D018-D043 wastes, presented in Appendix B, include data from bench-, pilot-, and full-scale treatment using these technologies.

4.1.3 Identification of BDAT

The procedure used to identify BDAT for the wastewater forms of D018-D043 wastes follows the methodology described in EPA's Methodology Background Document (4). All applicable and demonstrated treatment technologies are identified for the wastes of interest, and treatment performance data are examined to identify the technologies that perform "best." The treatment performance data are evaluated to determine:

- Whether the data represent operation of a well-designed and well-operated treatment system;
- Whether sufficient analytical quality assurance/quality control measures were used to ensure the accuracy of the data; and
- Whether the appropriate measure of performance was used to assess the performance of the particular treatment technology.

The Agency then determines whether the best demonstrated technology is "available." To be "available," a technology (1) must provide substantial treatment and (2) must be commercially available.

The Agency determined the best demonstrated technology for each constituent selected for regulation in D018-D043 wastes based on a thorough review of all of the treatment performance data available for each constituent. Appendix B presents the treatment performance data evaluated by EPA for these constituents.

The demonstrated technologies identified and determined to be "best" for each constituent are all commercially available. In addition, treatment performance data included in Appendix B show substantial treatment of each constituent by the corresponding technology identified as best. Therefore, the technologies selected as best and demonstrated for each constituent are also considered to be available, and therefore, BDAT for that constituent. The BDATs for the constituents regulated in the wastewater forms of D018-D043 wastes are shown in Table 4-1.

4.2 Identification of BDAT Treatment Standards

The Agency is transferring universal standards to the constituents regulated in nonwastewater and wastewater forms of D018-D043 wastes. A universal standard is a concentration limit established for a specific constituent regardless of the waste matrix in which it is present. Table 4-2 presents the specific treatment performance data used as the basis of the universal standards for the constituents regulated in these wastes.

Universal standards in wastewater forms of wastes are based on treatment performance data from several sources including the BDAT database, the NPDES database, the WERL database, EPA-collected WAO/PACT® data, the EAD database, industry-submitted leachate treatment performance data, data submitted by the Chemical Manufacturers Association's Carbon Disulfide Task Force, data submitted by the California Toxic Substances Control Division, data in literature that were not already part of the WERL database, and data in literature submitted by industry on the WAO and PACT® treatment processes. Since these standards reflect the performance of numerous industrial wastewater treatment systems, the Agency believes it is appropriate to transfer the universal standards for wastewaters to the constituents regulated in wastewater forms of D018-D043 wastes.

The treatment performance database and methodology for identifying universal standards for constituent in wastewater forms of toxicity characteristic wastes are presented in Appendix B of this document. A more detailed discussion concerning the determination of the universal standards for nonwastewater forms of listed hazardous wastes is provided in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for Universal Standards, Volume B: Universal Standards for Wastewater Forms of Listed Hazardous Wastes (23).

Table 4-1

Best Demonstrated Available Technology (BDAT) for Constituents Regulated in Wastewater Forms of D018-D043 Wastes

Waste Code	Regulated Constituent	BDAT
D018	Benzene	Steam Stripping (SS)
D019	Carbon tetrachloride	Biological Treatment (BT)
D020	Chlordane	Biological Treatment (BT)
D021	Chlorobenzene	Biological Treatment (BT)
D022	Chloroform	Steam Stripping (SS)
D023	o-Cresol	Biological Treatment (BT)
D024	m-Cresol	Activated Sludge (AS)
D025	p-Cresol	Activated Sludge (AS)
D026	Cresols (total)	Activated Sludge and Biological Treatment (AS and BT)
D027	1,4-Dichlorobenzene	Activated Sludge Biological Treatment (AS)
D028	1,2-Dichloroethane	Steam Stripping (SS)
D029	1,1-Dichloroethylene	Steam Stripping (SS)
D030	2,4-Dinitrotoluene	Powdered Activated Carbon Addition to Activated Sludge (PACT®)
D031	Heptachlor	Granular Activated Carbon (GAC)
D031	Heptachlor epoxide	Biological Treatment (BT)
D032	Hexachlorobenzene	Activated Sludge and Filtration (AS+Fil)
D033	Hexachloro-1,3-butadiene	Activated Sludge and Filtration (AS+Fil)
D034	Hexachloroethane	Activated Sludge and Filtration (AS+Fil)
D035	Methyl ethyl ketone	Biological Treatment (BT)
D036	Nitrobenzene	Steam Stripping and Activated Carbon (SS+AC)
D037	Pentachlorophenol	Filtration and Granular Activated Carbon (Fil+GAC)
D038	Pyridine	Anaerobic Fixed Film (AnFF)
D039	Tetrachloroethylene	Steam Stripping (SS)
D040	Trichloroethylene	Steam Stripping (SS)

Table 4-1

(Continued)

Waste Code	Regulated Constituent	BDAT
D041	2,4,5-Trichlorophenol	Biological Treatment (BT)
D042	2,4,6-Trichlorophenol	Biological Treatment (BT)
D043	Vinyl chloride	Steam Stripping (SS)

Source: Reference 23.

Table 4-2

Determination of BDAT Treatment Standards for Constituents in Wastewater Forms of D018-D043 Wastes Based on Universal Standards

Waste Code	Regulated Constituent	Treatment Technology	Database Reference	Average Effluent Concentration (mg/L)	Accuracy Correction Factor	Variability Factor	BDAT Treatment Standard (mg/L)
D018	Benzene	SS	EAD-OCPSF	0.010	-	14	0.14
D019	Carbon tetrachloride	BT	EAD-OCPSF	0.010	-	5.7	0.057
D020	Chlordane	BT	NPDES	0.00023	5.0	2.8	0.0033
D021	Chlorobenzene	BT	EAD-OCPSF	0.010	-	5.7	0.057
D022	Chloroform	SS	EAD-OCPSF	0.012	-	3.7	0.046
D023	o-Cresol	BT	BDAT (F001-F005)	0.025	-	4.4	0.11
D024	m-Cresol	AS	WERL	0.17	-	4.4	0.77
D025	p-Cresol	AS	WERL	0.17	-	4.4	0.77
D026	Cresols (total)	AS/BT	BDAT (F001-F005)/WERL	0.20	-	4.4	0.88[a]
D027	1,4-Dichlorobenzene	AS	WERL	0.016	-	5.5	0.090
D028	1,2-Dichloroethane	SS	EAD-OCPSF	0.026	-	8.2	0.21
D029	1,1-Dichloroethylene	SS	EAD-OCPSF	0.010	-	2.5	0.025
D030	2,4-Dinitrotoluene	PACT®	WERL	0.058	-	5.5	0.32

Table 4-2

(Continued)

Waste Code	Regulated Constituent	Treatment Technology	Database Reference	Average Effluent Concentration (mg/L)	Accuracy Correction Factor	Variability Factor	BDAT Treatment Standard (mg/L)
D031	Heptachlor	GAC	WERL	<0.000083	5.0	2.8	0.0012
D031	Heptachlor epoxide	BT	NPDES	0.0011	5.0	2.8	0.016
D032	Hexachlorobenzene	AS+Fil	WERL	0.010	-	5.5	0.055
D033	Hexachloro-1,3-butadiene	AS+Fil	WERL	0.010	-	5.5	0.055
D034	Hexachloroethane	AS+Fil	WERL	0.010	-	5.5	0.055
D035	Methyl ethyl ketone	BT	LEACHATE	<0.10	1.0	2.8	0.28
D036	Nitrobenzene	SS+AC	EAD-OCPSF	0.014	-	4.8	0.068
D037	Pentachlorophenol	Fil+GAC	WERL	0.020	-	4.4	0.089
D038	Pyridine	AnFF	WERL	<0.0024	-	5.7	0.014
D039	Tetrachloroethylene	SS	EAD-OCPSF	0.010	-	5.3	0.056
D040	Trichloroethylene	SS	EAD-OCPSF	0.010	-	5.3	0.054
D041	2,4,5-Trichlorophenol	BT	LEACHATE	<0.050	1.3	2.8	0.18

5.0 BDAT TREATMENT STANDARDS FOR NONWASTEWATER FORMS OF NEWLY IDENTIFIED PESTICIDE TC WASTES, D012-D017

This section discusses the BDAT treatment standards for nonwastewater forms of newly identified pesticide Toxicity Characteristic wastes (D012-D017). In the final rule for the Third Third wastes (55 FR 22520), the Agency promulgated treatment standards for only those D012-D017 wastes identified as hazardous by both the TCLP and EP leaching procedures. Wastes identified as hazardous by the TCLP but not by the EP are considered to be newly identified D012-D017 wastes and are currently not subject to the BDAT treatment standards. The Agency is establishing the existing treatment standards for nonwastewater forms of D012-D017 wastes as the treatment standards for all newly identified D012-D017 wastes except for nonwastewater forms of D015 wastes. The Agency is revising the D015 nonwastewater treatment standard as discussed below. These treatment standards are presented in Table 1-3.

5.1 Nonwastewaters

The Agency is establishing the existing treatment standards for nonwastewater forms of D012-D017 wastes as the treatment standards for all newly identified D012-D017 TC wastes, except for D015 wastes. The existing treatment standards for nonwastewater forms of D012-D014 and D016-D017 wastes were based on incineration, and since incineration treatment has been demonstrated to be relatively independent of matrix interferences, it is likely that any newly identified nonwastewater forms of these wastes can be treated to meet the existing treatment standards for nonwastewater forms of D012-D014 and D016-D017 wastes that were promulgated in the Third Third. These existing treatment standards are based on total composition analysis. The Agency is therefore establishing treatment standards for nonwastewater forms of newly identified D012-D017 wastes based on total composition analysis of the waste rather than on an analysis of the TCLP extract. Details regarding the development of the treatment standards for nonwastewater forms of D012-D014 and D016-D017 wastes

Table 4-2

(Continued)

Waste Code	Regulated Constituent	Treatment Technology	Database Reference	Average Effluent Concentration (mg/L)	Accuracy Correction Factor	Variability Factor	BDAT Treatment Standard (mg/L)
D042	2,4,6-Trichlorophenol	BT	LEACHATE	<0.010	1.3	2.8	0.035
D043	Vinyl chloride	SS	EAD-OCPSF	0.050	-	5.3	0.27

AnFF = Anaerobic Fixed Film
AS = Activated Sludge Biological Treatment
AS+Fil = Activated Sludge Biological Treatment and Filtration
BDAT = Best Demonstrated Available Technology
BT = Biological Treatment
EAD = Engineering and Analysis Division
Fil+GAC = Filtration and Granular Activated Carbon
GAC = Granular Activated Carbon
LEACHATE = Leachate Treatment Performance Data Submitted by Industry
NPDES = National Pollutant Discharge Elimination System
OCPSF = Organic Chemicals, Plastics, and Synthetic Fibers
PACT® = Powdered Activated Carbon Addition to Activated Sludge
SS = Steam Stripping
SS+AC = Steam Stripping and Activated Carbon
WERL = Water Engineering Research Lab

[a]As discussed in Appendix B, the wastewater treatment standard for D026 wastes (Cresols (total)) was determined based upon the sum of the m/p-cresol and o-cresol treatment standards.

< - Indicates a detection limit value.

Source: Reference 23.

Table 5-1

Determination of the BDAT Treatment Standard for Nonwastewater Forms of D015 Wastes

Constituent Regulated	Waste Code from Which the BDAT Treatment Standard Was Transferred	Treatment Test from Which Performance Data[a] Were Transferred	Constituent from Which the Concentration in Treated Waste Was Transferred	Concentration in Treated Waste (mg/kg)	Constituent from Which the Accuracy Correction Data Were Transferred	Accuracy Correction Factor (Matrix Spike % Recovery)	Variability Factor	BDAT Treatment Standard (mg/kg)
Toxaphene	K041, K098	John Zink (Test 2)	Chlordane (alpha and gamma)	<0.26[c]	Chlordane (alpha and gamma)	3.57 (28)[b]	2.8	2.6

< - indicates a detection limit value; the concentration value represents the detection limit.
[a]Performance data consist of the concentration in treated waste, accuracy correction factor, and variability factor.
[b]This number represents a constituent specific matrix spike.
[c]The concentration in the treated waste was doubled to account for both the alpha and gamma isomers of chlordane.

Sources: References 17 and 21.

are presented in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for Halogenated Pesticide and Chlorobenzene Wastes K031-K034, K041, K042, K085, K097, K098, K105, and D012-D017 (17).

The Agency is revising the nonwastewater treatment standard for D015 wastes, toxaphene. The existing treatment standard is 1.3 mg/kg, based upon the transfer of treatment performance data for chlordane from the Third Third Incineration Treatability Test at the John Zink Facility. However, the Agency believes that treatment standard data for toxaphene in nonwastewater forms of K041 and K098 wastes, which is also based on data from the John Zink treatability test, is more appropriate for transfer to D015 wastes. To account for the characteristic differences between toxaphene and chlordane (i.e., chemical structure differences), the toxaphene concentration is calculated by multiplying the chlordane concentration by ten. Both the alpha and gamma isomers of chlordane were accounted for in the development of the treatment standard by doubling the concentration of chlordane in the nonwastewater treatment residual. The Agency believes that the transfer of the K041 and K098 treatment standard of 2.6 mg/kg, which accounts for the two isomers of chlordane, is appropriate for D015 wastes. The Agency is establishing a treatment standard for nonwastewater forms of D015 wastes based on total composition analysis of the waste rather than on analysis of the TCLP extract. The treatment standard for nonwastewater forms of D015 wastes and the corresponding treatment performance data are presented in Table 5-1.

7.0 REFERENCES

1. USEPA. Office of Solid Waste. Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Final Rule, Interim Final Rule, and Request for Comments. Federal Register. (45 FR 33084). May 19, 1980.

2. USEPA. Office of Solid Waste. Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Toxicity Characteristics Revisions; Final Rule. Federal Register. (55 FR 11798). March 29, 1990.

3. USEPA. Office of Solid Waste. Land Disposal Restrictions for Third Third Scheduled Wastes; Final Rule. Federal Register. (55 FR 22520). June 1, 1990.

4. USEPA. 1988. U.S. Environmental Protection Agency, Office of Solid Waste. Final Best Demonstrated Available Technology (BDAT) Background Document for Quality Assurance, Quality Control Procedures, and Methodologies. Washington, D.C.: U.S. Environmental Protection Agency.

5. USEPA. Office of Solid Waste. Hazardous Waste Management System; Land Disposal Restrictions; Proposed Rule. Federal Register. (51 FR 1602). January 14, 1986.

6. USEPA. Office of Solid Waste. Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Notification Requirements; Reportable Quantity Adjustments; Proposed Rule. Federal Register. (51 FR 21648). June 13, 1986.

7. USEPA. Office of Solid Waste. Hazardous Waste Management System; Land Disposal Restrictions; Final Rule. Federal Register. (51 FR 40572). November 7, 1986.

8. USEPA. Office of Solid Waste. Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Supplemental Notice of Proposed Rulemaking. Federal Register. (52 FR 18583). May 18, 1987.

9. USEPA. Office of Solid Waste. Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Notice Of Data Availability and Request for Comments; Supplement to Proposed Rule. Federal Register. (53 FR 18024). May 19, 1988.

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20. USEPA. 1989. U.S. Environmental Protection Agency, Office of Solid Waste. Treatment Technology Background Document. U.S. Environmental Protection Agency, Office of Solid Waste. Washington, D.C.

21. USEPA. April, 1990. Onsite Engineering Report of the Third Thirds Incineration Treatability Test at the John Zink Company, Tulsa, OK. U.S. Environmental Protection Agency, Office of Solid Waste. Washington, D.C.

22. USEPA. Survey for Facilities That Land Dispose Newly Identified Organic TC Wastes.

23. USEPA. July, 1994. Final Best Demonstrated Available Technology (BDAT) Background Document for Universal Standards, Volume B: Universal Standards for Wastewater Forms of Listed Hazardous Wastes. U.S. Environmental Protection Agency, Office of Solid Waste. Washington, D.C.

10. USEPA. Office of Solid Waste. Hazardous Waste Management System; Identification and Listing of Hazardous Waste; New Data and Use of These Data Regarding the Establishment of Regulatory Levels for the Toxicity Characteristic; and Use of the Model for the Delisting Program; Notice Of Data Availability and Request for Comments; Supplement to Proposed Rule. Federal Register. (53 FR 28892). August 1, 1988.

11. USEPA. Office of Solid Waste. Land Disposal Restrictions for Third Third Scheduled Wastes; Proposed Rule. Federal Register. (54 FR 48372). November 22, 1989.

12. USEPA. Office of Solid Waste. Land Disposal Restrictions; Potential Treatment Standards for Newly Identified and Listed Wastes and Contaminated Soil; Proposed Rule. Federal Register. (56 FR 55160). October 24, 1991.

13. USEPA. Office of Solid Waste. Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Land Disposal Restrictions; Notice Of Availability of Reports. Federal Register. (51 FR 22856). July 9, 1986.

14. USEPA. Office of Solid Waste. Land Disposal Restrictions; Proposed Rule. Federal Register. (53 FR 18792). May 24, 1988.

15. USEPA. Office of Solid Waste. Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Toxicity Characteristics Revisions; Final Rule; Corrections. Federal Register. (55 FR 26986). June 29, 1990.

16. USEPA. July, 1994. Final Best Demonstrated Available Technology (BDAT) Background Document for Universal Standards, Volume A: Universal Standards for Nonwastewater Forms of Wastes. U.S. Environmental Protection Agency, Office of Solid Waste. Washington, D.C.

17. USEPA. May, 1990. Best Demonstrated Available Technology (BDAT) Background Document for Halogenated Pesticide and Chlorobenzene Wastes K032-K034, K041, K042, K085, K097, K109, D012-D017. U.S. Environmental Protection Agency, Office of Solid Waste. Washington, D.C.

18. USEPA. May, 1992. Toxic Release Inventory, Public Data Release. U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics. Washington, D.C.

19. USEPA. March 1990. Toxicity Characteristic Regulatory Impact Analysis. U.S. Environmental Protection Agency, Office of Solid Waste. Washington, D.C.

Appendix A

Treatment Performance Database and Methodology for Identifying Universal Standards for Constituents in Nonwastewater Forms of D018-D043 Wastes

(4) When evaluating the matrix spike recovery data, the Agency preferred to use a matrix spike recovery for a specific constituent instead of a value averaged over a group of constituents (e.g., volatile organics).

(5) The method detection limit was examined to determine if it could be met routinely by industry.

(6) The treatment performance data and standard corresponding to the "best" data was compared to the detection limits used to calculate other treatment standards to determine if the constituent could be treated to similar levels in similar waste codes.

A.2 Determination of Treatment Standards for Nonwastewater Forms of D018-D043 Wastes

Treatment standard data for the constituents regulated in nonwastewater forms of D018-D043 wastes are presented in Table A-1. A constituent-by-constituent discussion of the determination of the universal standard for each of these constituents is given below. The universal standards and corresponding performance data for each constituent regulated in D018-D043 wastes are also presented in Table 3-1. A more detailed discussion of the determination of the universal standards is provided in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for Universal Standards, Volume A: Universal Standards for Nonwastewater Forms of Listed Hazardous Wastes (16).

D018 - Benzene

The universal standard for benzene was determined to be 10 mg/kg, based upon the K083 treatment standard data. The Agency chose to use the K083 treatment standard data since these data represent the use of an accuracy correction factor and detection limit from the same constituent as the constituent of concern. The treatment standard was not based upon F039 and U019 treatment standard data because the detection limit was considered to be an outlier compared to the magnitude of the

This appendix presents the development of the universal treatment standards (i.e., universal standards) for the constituents regulated in nonwastewater forms of D018-D043 wastes. Section A.1 presents the methodology for determining nonwastewater universal standards and introduces the universal standards database. Section A.2 presents a constituent-by-constituent discussion of the determination of the universal standards for each constituent selected for regulation.

A.1 Methodology for Determining Nonwastewater Universal Standards

The performance data presented in Table A-1 represent the universal standards database for the constituents regulated in D018-D043 wastes. These data consist of the treatment performance data used to develop nonwastewater treatment standards in the First, Second, and Third Third, and Phase I Land Disposal Restrictions Program rulemaking efforts. In order to determine the universal standards, the Agency examined the treatment performance data used in calculating each treatment standard applicable to a specific constituent.

The Agency chose which treatment performance data to transfer as the universal standard on a constituent-by-constituent basis. Six factors were considered in selecting the "best" performance data and standard from the available treatment standard performance data:

(1) Where possible, the Agency preferred performance data (i.e., the matrix spike recovery data, detection limit, and variability factor (according to Table 3-1)) for the same constituent.

(2) The matrix spike recovery data were evaluated to determine whether acceptable recoveries were obtained according to EPA's quality assurance/quality control guidelines.

(3) When performance data from the same constituent were unavailable, the Agency used performance data from a constituent with similar composition and functional groups.

constituents. The Agency believes that a treatment standard of 6.0 mg/kg may be reasonably achieved based on the detection limits reported for chlorobenzene in other waste codes.

D022 - Chloroform

The universal standard for chloroform was determined to be 6.0 mg/kg, based upon the K019 treatment standard data. The Agency chose to use the K019 treatment standard data since these data represent the use of an accuracy correction factor and detection limit from the same constituent as the constituent of concern. The Agency believes that a treatment standard of 6.0 mg/kg may be reasonably achieved based on the detection limits reported for chloroform in other waste codes.

D023 - o-Cresol

The universal standard for o-cresol was determined to be 5.6 mg/kg, based upon the F039 and U052 treatment standards, which represent the only concentration-based treatment standards promulgated to date for this constituent based on the performance of incineration.

D024 - m-Cresol

The universal standard for m-cresol was determined to be 5.6 mg/kg based upon the F001-F005, F039, and U052 treatment standard data. The Agency chose to use the F001-F005, F039, and U052 data since these data represent the only concentration-based treatment standards promulgated to date for this constituent based upon the performance of incineration. The Agency believes that the detection limit reported for m-cresol in the K019 treatment test of 2.0 mg/kg is representative of the detection limits that may be reasonably achieved for m-cresol. In addition, a universal standard of 5.6

detection limits from other incineration tests. The treatment standard was established at 10 mg/kg in order that the treatment standard could be routinely met by industry, considering the detection limits reported for benzene in other waste codes.

D019 - Carbon Tetrachloride

The universal standard for carbon tetrachloride was determined to be 6.0 mg/kg, based on the K021 and K073 treatment standard data. The Agency chose to use the K021 and K073 treatment standard data since these data represent the use of an accuracy correction factor and detection limit from the same constituent as the constituent of concern. The Agency believes that a treatment standard of 6.0 mg/kg may be reasonably achieved based on the detection limits reported for carbon tetrachloride in other waste codes.

D020 - Chlordane

The universal standard for chlordane was determined to be 0.26 mg/kg, based upon the K032 and K097 treatment standard data. The Agency chose to use the K032 and K097 treatment standard data since these data represent the use of an accuracy correction factor and detection limit from the same constituent as the constituent of concern. The two isomers of chlordane, alpha and gamma, were also considered in calculating the K032 and K097 treatment standards.

D021 - Chlorobenzene

The universal standard for chlorobenzene was determined to be 6.0 mg/kg based upon the K019 treatment standard data. The Agency chose to use the K019 treatment standard data since these data represent the use of an accuracy correction factor and detection limit from the same constituent as the constituent of concern. The treatment standard was established at 6.0 mg/kg to maintain consistency with similar use the F039 and U072 treatment standard data since these data represent the use of an accuracy correction factor and detection limit from the same constituent as the constituent of concern. The treatment standard was established at 6.0 mg/kg to maintain consistency with similar constituents. The Agency believes that a treatment standard of 6.0 mg/kg may be reasonably achieved based on the detection limits reported for 1,4-dichlorobenzene in other waste codes.

D028 - 1,2-Dichloroethane

The universal standard for 1,2-dichloroethane was determined to be 6.0 mg/kg, based upon the K019 treatment standard data. The Agency chose to use the K019 treatment standard data since these data represent the use of an accuracy correction factor and detection limit from the same constituent as the constituent of concern. The Agency believes that a treatment standard of 6.0 mg/kg may be reasonably achieved based on the detection limits reported for 1,2-dichloroethane in other waste codes.

D029 - 1,1-Dichloroethylene

The universal standard for 1,1-dichloroethylene was determined to be 6.0 mg/kg, based on the K029 and F025 treatment standard data. The Agency chose to use the K029 and F025 treatment standard data rather than the F039 and U078 treatment standard data since the detection limit used in calculating the F039 and U078 treatment standard was considered to be an outlier compared to the magnitude of the detection limits from other incineration tests. The Agency believes that a treatment standard of 6.0 mg/kg may be reasonably achieved based on the detection limits reported for 1,1-dichloroethylene in other waste codes.

mg/kg is consistent with the universal standard established for a constituent similar in elemental composition and functional groups, o-cresol.

D025 - p-Cresol

The universal standard for p-cresol was determined to be 5.6 mg/kg based upon the F001-F005, F039, and U052 treatment standard data. The Agency chose to use the F001-F005, F039, and U052 data since these data represent the only concentration-based treatment standards promulgated to date for this constituent based upon the performance of incineration. The Agency believes that the detection limit reported for p-cresol in the K019 treatment test of 2.0 mg/kg is representative of the detection limits that may be reasonably achieved for p-cresol. In addition, a universal standard of 5.6 mg/kg is consistent with the universal standard established for a constituent similar in elemental composition and functional groups, o-cresol.

D026 - Cresols (total)

The universal standard for cresols (total) was determined to be 5.6 mg/kg, based on the universal standards for o-cresol and cresol (m- and p-isomers). The total cresol standard (D026) accounts for o-, m-, and p-cresols when these isomers cannot be differentiated. The Agency chose to use the universal standard data since these data have already been determined to be the "best" treatment performance data for cresols in the development of universal standards. The Agency believes that a treatment standard of 5.6 mg/kg may be reasonably achieved based on the detection limits reported for o-, m-, and p-cresol in other waste codes.

D027 - 1,4-Dichlorobenzene

The universal standard for 1,4-dichlorobenzene was determined to be 6.0 mg/kg, based upon the F039 and U072 treatment standard data. The Agency chose to treatment standard could be routinely met by industry, considering the detection limits reported for hexachlorobenzene in other waste codes.

D033 - Hexachlorobutadiene

The universal standard for hexachlorobutadiene was determined to be 5.6 mg/kg, based upon the K016, K018, K028, and K030 treatment standard data. The Agency chose to use the K016, K018, K028, and K030 treatment standard data rather than the F025, F039, and U128 treatment standard data since the detection limit used in calculating the F025, F039, and U128 treatment standard was considered to be an outlier compared to the magnitude of the detection limits from other incineration tests. The Agency believes that a treatment standard of 5.6 mg/kg may be reasonably achieved based on the detection limits reported for hexachlorobutadiene in other waste codes.

D034 - Hexachloroethane

The universal standard for hexachloroethane was determined to be 30 mg/kg, based upon the F025, K016, K018, K095, and K073 treatment standard data. The Agency chose to use the F025, K016, K018, K095, and K073 treatment standard data since these data represent the use of an accuracy correction factor and detection limit from the same constituent as the constituent of concern. The treatment standard was established at 30 mg/kg to maintain consistency of treatment standards within the treatability group.

D035 - Methyl Ethyl Ketone

The universal standard for methyl ethyl ketone was determined to be 36 mg/kg, based upon the F039, K086, and U159 treatment standards, which represent the only concentration-based treatment standards promulgated to date for this constituent.

D030 - 2,4-Dinitrotoluene

The universal standard for 2,4-dinitrotoluene was determined to be 140 mg/kg, based upon the F039 and U105 treatment standards, which represent the only concentration-based treatment standards promulgated to date for this constituent.

D031 - Heptachlor

The universal standard for heptachlor was determined to be 0.066 mg/kg, based upon the F039, P059, K032, and K097 treatment standards, which represent the only concentration-based treatment standards promulgated to date for this constituent.

D031 - Heptachlor Epoxide

The universal standard for heptachlor epoxide was determined to be 0.066 mg/kg, based upon the F039, P059, K032, and K097 treatment standards, which represent the only concentration-based treatment standards promulgated to date for this constituent.

D032 - Hexachlorobenzene

The universal standard for hexachlorobenzene was determined to be 10 mg/kg, based upon the K085 treatment standard data. The Agency chose to use the K085 treatment standard data since these data represent the use of an accuracy correction factor and detection limit from the same constituent as the constituent of concern. The treatment standard for hexachlorobenzene was not based upon the K016, K018, F025, F039, and U127 treatment standard data because the detection limit was considered to be an outlier compared to the magnitude of the detection limits from other incineration tests; the treatment standard was established at 10 mg/kg so that the

Agency believes that a treatment standard of 6.0 mg/kg may be reasonably achieved based on the detection limits reported for tetrachloroethylene in other waste codes.

D040 - Trichloroethylene

The universal standard for trichloroethylene was determined to be 6.0 mg/kg, based upon the F025, F039, K086, U228, K095, and K096 treatment standards, which represent the only concentration-based treatment standards promulgated to date for this constituent. The treatment standard was established at 6.0 mg/kg to maintain consistency with treatment standards for similar constituents.

D041 - 2,4,5-Trichlorophenol

The universal standard for 2,4,5-trichlorophenol was determined to be 7.4 mg/kg, based upon the F039 treatment standard data. The Agency chose to use the F039 treatment standard data since these data represent the use of an accuracy correction factor and detection limit from a more similar constituent as the constituent of concern.

D042 - 2,4,6-Trichlorophenol

The universal standard for 2,4,6-trichlorophenol was determined to be 7.4 mg/kg, based upon the F039 treatment standard data. The Agency chose to use the F039 treatment standard data since these data represent the use of an accuracy correction factor and detection limit from a more similar constituent as the constituent of concern.

D036 - Nitrobenzene

The universal standard for nitrobenzene was determined to be 14 mg/kg, based upon the F039, U169, K086, and K083 treatment standard data. The Agency chose to use the F039, U169, K086, and K083 treatment standard data since these data represent the use of an accuracy correction factor and detection limit from the same or similar constituent. This treatment standard was also chosen to account for variability in treatment of wastes containing this constituent.

D037 - Pentachlorophenol

The universal standard for pentachlorophenol was determined to be 7.4 mg/kg, based upon the F039, K001, and U051 treatment standard data. The Agency chose to use the F039, K001, and U051 treatment standard data since these data represent the use of an accuracy correction factor and detection limit from the same constituent as the constituent of concern.

D038 - Pyridine

The universal standard for pyridine was determined to be 16 mg/kg, based upon the F039 and U196 treatment standards, which represent the only concentration-based treatment standards the Agency has promulgated to date for this constituent.

D039 - Tetrachloroethylene

The universal standard for tetrachloroethylene was determined to be 6.0 mg/kg. based on the K019 treatment standard data. The Agency chose to use the K019 treatment standard data since these data represent the use of an accuracy correction factor and detection limit from the same constituent as the constituent of concern. The

Table A-1

Treatment Standard Data for Constituents Selected for Regulation in Nonwastewater Forms of D018-D043 Wastes

Waste Code and Regulated Constituent	Treatment Standard (ppm)	Corresponding Waste Code(s)	Concentration in Treated Waste (mg/kg)	Treatment Test From Which the Performance Data[a] Were Transferred	Constituent From Which the Concentration in Treated Waste Was Transferred	Constituent From Which the Accuracy Correction Data Were Transferred	Accuracy Correction Factor (Matrix Spike % Recovery)	Variability Factor
D018 - Benzene	0.071	K060, K087	<0.025	K087	Benzene	Benzene	1.02 (98)	2.8
	4.4	K085, K105	<0.33	John Zink[d] (Test 2)	Hexachlorobenzene	Hexachlorobenzene	4.76 (21)	2.8
	6.0	K103, K104	<2.0	K019	1,2-Dichloroethane	1,2-Dichloroethane	1.06 (94)[b]	2.8
	6.6	K083	<2.0	K019	Benzene	Benzene	1.18 (85)	2.8
	36	F039, U019	<10.0	K001-C	Benzene	Benzene	1.28 (78)	2.8
D019 - Carbon Tetrachloride	5.6	F039, U211	<2.0	K019	Carbon Tetrachloride	Trichloroethylene	1 (107)	2.8
	6.2[c]	F025	<2.0	K019	1,1,1-Trichloroethane	1,1,1-Trichloroethane	1.1 (91)[b,c]	2.8
	6.2[c]	K021, K073	<2.0	K019	Carbon Tetrachloride	Carbon Tetrachloride	1.1 (91)[b,c]	2.8
D020 - Chlordane	0.13	F039, U036	<0.013	John Zink[d] (Test 2)	Chlordane	Heptachlor	3.57 (28)	2.8
	0.26[c]	K032, K097	<0.026	John Zink[d] (Test 2)	Chlordane (alpha and gamma)	Chlordane	3.57 (28)[b]	2.8

< - Indicates a detection limit value; the concentration value represents the detection limit.
[a]Performance data consist of the concentration in treated waste, accuracy correction factor, and variability factor.
[b]This number represents an average of matrix spike values.
[c]See the notes at the end of this table.
[d]This test represented the incineration of waste codes U127 and P059.

Source: Reference 16.

D043 - Vinyl Chloride

The universal standard for vinyl chloride was determined to be 6.0 mg/kg, based on the K029 treatment standard data. The treatment standard for vinyl chloride was not based upon the F025, F039, and U043 treatment standard data because the detection limit was considered to be an outlier compared to the magnitude of the detection limits from other incineration tests. The Agency believes that a treatment standard of 6.0 mg/kg may be reasonably achieved based on the detection limits reported for vinyl chloride in other waste codes.

Table A-1

(Continued)

Waste Code and Regulated Constituent	Treatment Standard (ppm)	Corresponding Waste Code(s)	Concentration in Treated Waste (mg/kg)	Treatment Test From Which the Performance Data[a] Were Transferred	Constituent From Which the Concentration in Treated Waste Was Transferred	Constituent From Which the Accuracy Correction Data Were Transferred	Accuracy Correction Factor (Matrix Spike % Recovery)	Variability Factor
D028 - 1,2-Dichloroethane	6.0	K018, K019, K020, K029	<2.0	K019	1,2-Dichloroethane	1,2-Dichloroethane	1.06 (94)[b]	2.8
	6.2[c]	F025	<2.0	K019	1,2-Dichloroethane	1,2-Dichloroethane	1.1 (91)[b,c]	2.8
	7.2	F039, U077	<2.0	K019	1,2-Dichloroethane	1,1-Dichloroethylene	1.28 (78)	2.8
D029 - 1,1-Dichloroethylene	6.0	K029	<2.0	K019	1,1-Dichloroethane	1,1-Dichloroethane	1.06 (94)[b]	2.8
	6.2[c]	F025	<2.0	K019	1,1-Dichloroethylene	1,1-Dichloroethane	1.1 (91)[b,c]	2.8
	33	F039, U078	<10.0	K001-C	1,1-Dichloroethylene	1,1-Dichloroethylene	1.16 (86)	2.8
D030 - 2,4-Dinitrotoluene	140	F039, U105	<50	K019	2,4-Dinitrotoluene	2,4-Dinitrotoluene	1 (107)	2.8
D031 - Heptachlor	0.066	F039, P059, K032, K097	<0.0066	John Zink[d] (Test 2)	Heptachlor	Heptachlor	3.57 (28)	2.8
D031 - Heptachlor Epoxide	0.066	F039, P059, K032, K097	<0.0066	John Zink[d] (Test 2)	Heptachlor	Heptachlor	3.57 (28)	2.8
D032 - Hexachlorobenzene	4.4	K085	<0.33	John Zink[d] (Test 2)	Hexachlorobenzene	Hexachlorobenzene	4.76 (21)	2.8
	28	K016, K018	<10.0	K019	Hexachlorobenzene	Hexachlorobenzene	1 (103)[b]	2.8
	37	F025, F039, U127	<10.0	K019	Hexachlorobenzene	1,2,4-Trichlorobenzene	1.33 (75)	2.8

< - Indicates a detection limit value; the concentration value represents the detection limit.
[a]Performance data consist of the concentration in treated waste, accuracy correction factor, and variability factor.
[b]This number represents an average of matrix spike values.
[c]See the notes at the end of this table.
[d]This test represented the incineration of waste codes U127 and P059.

Source: Reference 16.

Table A-1

(Continued)

Waste Code and Regulated Constituent	Treatment Standard (ppm)	Corresponding Waste Code(s)	Concentration in Treated Waste (mg/kg)	Treatment Test From Which the Performance Data[a] Were Transferred	Constituent From Which the Concentration in Treated Waste Was Transferred	Constituent From Which the Accuracy Correction Data Were Transferred	Accuracy Correction Factor (Matrix Spike % Recovery)	Variabili[ty] Factor
D021 - Chlorobenzene	4.4	K085, K105	<0.33	John Zink[d] (Test 2)	Hexachlorobenzene	Hexachlorobenzene	4.76 (21)	2.8
	5.7	F039, U037	<2.0	K019	Chlorobenzene	Chlorobenzene	1.01 (99)	2.8
	6.0[c]	K019	<2.0	K019	Chlorobenzene	Chlorobenzene	1.01 (99)	2.8
D022 - Chloroform	6.0	K009, K010, K019, K029	<2.0	K019	Chloroform	Chloroform	1.06 (94)[b]	2.8
	6.2[c]	F025, K021, K073	<2.0	K019	Chloroform	Chloroform	1.1 (91)[b,c]	2.8
D023 - o-Cresol	5.6	F039, U052	<2.0	K019	o-Cresol	p-Chloro-m-cresol	1 (110)	2.8
D024 - m-Cresol	3.2	F039, U052	<1.0	K087	Cresol (m- and p-)	p-Chloro-m-cresol	1.15 (87)	2.8
D025 - p-Cresol	3.2	F039, U052	<1.0	K087	Cresol (m- and p-)	p-Chloro-m-cresol	1.15 (87)	2.8
D027 - 1,4-Dichlorobenzene	4.4	K042, K085, K105	<0.33	John Zink[d] (Test 2)	Hexachlorobenzene	Hexachlorobenzene	4.76 (21)	2.8
	6.2	F039, U072	<2.0	K019	1,4-Dichlorobenzene	1,4-Dichlorobenzene	1.11 (90)	2.8

< - Indicates a detection limit value; the concentration value represents the detection limit.
[a]Performance data consist of the concentration in treated waste, accuracy correction factor, and variability factor.
[b]This number represents an average of matrix spike values.
[c]See the notes at the end of this table.
[d]This test represented the incineration of waste codes U127 and P059.

Source: Reference 16.

Table A-1

(Continued)

Waste Code and Regulated Constituent	Treatment Standard (ppm)	Corresponding Waste Code(s)	Concentration in Treated Waste (mg/kg)	Treatment Test From Which the Performance Data[a] Were Transferred	Constituent From Which the Concentration in Treated Waste Was Transferred	Constituent From Which the Accuracy Correction Data Were Transferred	Accuracy Correction Factor (Matrix Spike % Recovery)	Variability Factor
D033 - Hexachlorobutadiene	5.6	K016, K018, K028, K030	<2.0	K019	Naphthalene	Naphthalene	1 (103)[b]	2.8
	28	F025, F039, U128	<10.0	K019	Hexachlorobutadiene	Trichloroethylene	1 (107)	2.8
D034 - Hexachloroethane	28	F039, U131	<10.0	K019	Hexachloroethane	Trichloroethylene	1 (107)	2.8
	28	K016, K018, K095, K019, K028, K030	<10.0	K019	Hexachloroethane	Hexachloroethane	1 (103)[b]	2.8
	30	F025, K073	<10.0	K019	Hexachloroethane	Hexachloroethane	1 (103)[b]	2.8
D035 - Methyl Ethyl Ketone	36	F039, K086, U159	<10.0	K019	Methyl Ethyl Ketone	1,1-Dichloroethylene	1.28 (78)	2.8
D036 - Nitrobenzene	5.6	K103, K104	<2.0	K019	Naphthalene	Naphthalene	1 (103)[b]	2.8
	14	F039, K086, U169	<5.0	K019	Nitrobenzene	4-Nitrophenol	1.03 (97)	2.8
	14	K083	<5.0	K019	Nitrobenzene	Nitrobenzene	1 (103)[b]	2.8
D037 - Pentachlorophenol	7.4	F039, K001, U051	<2.5	K001-PCP	Pentachlorophenol	Pentachlorophenol	1.05 (95)	2.8
D038 - Pyridine	16	F039, U196	<5.0	K001-PCP	Pyridine	Benzene	1.14 (88)	2.8

< - Indicates a detection limit value; the concentration value represents the detection limit.
[a]Performance data consist of the concentration in treated waste, accuracy correction factor, and variability factor.
[b]This number represents an average of matrix spike values.
[c]See the notes at the end of this table.
[d]This test represented the incineration of waste codes U127 and P059.

Source: Reference 16.

Table A-1

(Continued)

Waste Code and Regulated Constituent	Treatment Standard (ppm)	Corresponding Waste Code(s)	Concentration in Treated Waste (mg/kg)	Treatment Test From Which the Performance Data[a] Were Transferred	Constituent From Which the Concentration in Treated Waste Was Transferred	Constituent From Which the Accuracy Correction Data Were Transferred	Accuracy Correction Factor (Matrix Spike % Recovery)	Variability Factor
D039 - Tetrachloroethylene	5.6	F039, U210	<2.0	K019	Tetrachloroethylene	Trichloroethylene	1 (107)	2.8
	6.0	K016, K019, K020, K028, K030, K095, K096	<2.0	K019	Tetrachloroethylene	Tetrachloroethylene	1.06 (94)[b]	2.8
	6.2[c]	K073	<2.0	K019	Tetrachloroethylene	Tetrachloroethylene	1.1 (91)[b,c]	2.8
D040 - Trichloroethylene	5.6	F025, F039, K086, U228, K095, K096	<2.0	K019	Trichloroethylene	Trichloroethylene	1 (107)	2.8
D041 - 2,4,5-Trichlorophenol	4.4	K105	<0.33	John Zink[d] (Test 2)	Hexachlorobenzene	Hexachlorobenzene	4.76 (21)	2.8
	37[c]	F039	<12.5	K001-PCP	Pentachlorophenol	Pentachlorophenol	1.05 (95)	2.8
D042 - 2,4,6-Trichlorophenol	4.4	K105	<0.33	John Zink[d] (Test 2)	Hexachlorobenzene	Hexachlorobenzene	4.76 (21)	2.8
	37[c]	F039	<12.5	K001-PCP	Pentachlorophenol	Pentachlorophenol	1.05 (95)	2.8
D043 - Vinyl Chloride	6.0	K029	<2.0	K019	Chloroform	Chloroform	1.06 (94)[b]	2.8
	33	F025, F039, U043	<10.0	K001-C	Vinyl Chloride	1,1-Dichloroethylene	1.16 (86)	2.8

< - Indicates a detection limit value; the concentration value represents the detection limit.
[a]Performance data consist of the concentration in treated waste, accuracy correction factor, and variability factor.
[b]This number represents an average of matrix spike values.
[c]See the notes at the end of this table.
[d]This test represented the incineration of waste codes U127 and P059.

Source: Reference 16.

Table A-1

(Continued)

Notes:

Carbon Tetrachloride	The accuracy correction factors used in the F025, K021, and K073 treatment standards were transferred incorrectly from the K019 treatment tes The accuracy correction factor for the average of the semivolatile organic constituents was incorrectly transferred as 1.1 instead of 1.06. The correct treatment standards is 6.0 mg/kg.
Chlordane	To account for both the alpha and gamma isomers of chlordane, the concentration in the treated waste was doubled in calculating the K032 and K097 treatment standards. This doubling accounts for the K032 and K097 treatment standards of 0.26 mg/kg as opposed to the F039 and U036 treatment standards of 0.13 mg/kg.
Chlorobenzene	In calculating the treatment standard for K019, the variability factor, accuracy correction factor, and concentration in treated waste were incorrec multiplied. The correct K019 treatment standard is 5.7 mg/kg.
Chloroform	The accuracy correction factors used in the F025, K021, and K073 treatment standards were transferred incorrectly from the K019 treatment tes The accuracy correction factor for the average of the semivolatile organic constituents was incorrectly transferred as 1.1 instead of 1.06. The correct treatment standard is 6.0 mg/kg.
1,2-Dichloroethane	The accuracy correction factor used in the F025 treatment standard was transferred incorrectly from the K019 treatment test. The accuracy correction factor for the average of the semivolatile organic constituents was incorrectly transferred as 1.1 instead of 1.06. The correct treatmen standard is 6.0 mg/kg.
1,1-Dichloroethylene	The accuracy correction factor used in the F025 treatment standard was transferred incorrectly from the K019 treatment test. The accuracy correction factor for the average of the semivolatile organic constituents was incorrectly transferred as 1.1 instead of 1.06. The correct treatment standard is 6.0 mg/kg.
Tetrachloroethylene	The accuracy correction factor used in the K073 treatment standard was transferred incorrectly from the K019 treatment test. The accuracy correction factor for the average of the semivolatile organic constituents was incorrectly transferred as 1.1 instead of 1.06. The correct treatmen standard is 6.0 mg/kg.
2,4,5-Trichlorophenol	In calculating the F039 treatment standard, the PQL was used instead of the method detection limit. Since the PQL is five times greater than tl detection limit, the F039 treatment standard is incorrect by a factor of five, and should be 7.4 mg/kg.
2,4,6-Trichlorophenol	In calculating the F039 treatment standard, the PQL was used instead of the method detection limit. Since the PQL is five times greater than th detection limit, the F039 treatment standard is incorrect by a factor of five, and should be 7.4 mg/kg.

Appendix B

Treatment Performance Database and Methodology for Identifying Universal Standards for Constituents in Wastewater Forms of D018-D043 Wastes

B.1 Methodology for Determining Wastewater Universal Standards

The universal standards for regulated constituents in wastewater forms of D018-D043 wastes are based on treatment performance data from several sources, including the BDAT treatment performance database, the NPDES database, the WERL database, WAO/PACT® data, the EAD database, industry-submitted leachate treatment performance data, data submitted by the Chemical Manufacturers Association's Carbon Disulfide Task Force, data submitted by the California Toxic Substances Control Division, data in literature that were not already part of the WERL database, and data in literature submitted by industry on the WAO and PACT® treatment process. This appendix presents the wastewater treatment performance database and discusses use of the data to determine BDAT and to calculate the universal treatment standards for the constituents regulated in wastewater forms of D018-D043 wastes.

Table B-1 and Table B-2 are database and treatment technology keys, respectively, for the data tables presented in this appendix. Tables B-3 through B-27 in this appendix present the available wastewater treatment performance data for each constituent regulated in D018-D043 wastes. The data used to determine the universal standards are indicated with a footnote. A discussion of the determination of the universal standards for each of the constituents regulated in D018-D043 wastes is presented in Section B.2.

The calculation of the universal standards involved three steps: (1) identification of best demonstrated technologies and treatment performance data; (2) determination of a variability factor specific to each constituent in a treatment performance data set to correct for normal variation in the performance of a particular technology over time; and (3) calculation of the treatment standard, which is equal to the average effluent concentration multiplied by the variability factor. The universal standards and specific treatment performance data used to determine the treatment standards for the constituents regulated in wastewater forms of D018-D043 wastes are presented in Table 4-2.

<u>Identification of Best Demonstrated Technologies and Treatment Performance Data</u>

To determine the best demonstrated technology for each BDAT List organic constituent, the Agency examined the universal wastewater treatment performance database. To determine "best," a hierarchy was established to evaluate the wastewater treatment performance data. The following outlines the methodology used to determine "best" for wastewater constituents that are included in this document:

(1) For any organics with EAD performance data and a promulgated EAD effluent limitation, the EAD data were used to calculate the BDAT treatment standard for that constituent. The data representing EAD Option 1 (see Reference 23 for a description of Option 1) were used in all cases.

(2) For any constituent for which promulgated EAD standards (based on actual treatment performance data) do not exist, data from an Agency-sponsored BDAT wastewater treatment test were used to determine the BDAT treatment standard.

(3) For any constituent with industry-submitted leachate treatment performance data, where the data showed substantial treatment and the data were considered better or more representative of treatment performance than Agency data, the Agency used the industry-submitted leachate data to calculate the BDAT concentration-based standard.

(4) For any constituent without EAD data, BDAT wastewater treatment test data, or industry-submitted leachate treatment performance data showing substantial treatment, other available treatment performance data were evaluated to determine BDAT and were used to calculate the BDAT concentration-based standard. Considered in this evaluation were the treatment technology for which data were available, whether the data represented a full-, pilot-, or bench-scale technology, the concentration of the constituent of interest in the influent to treatment, the average

concentration of the constituent of interest in the effluent from treatment, and the removal efficiency of the treatment technology. Full-scale treatment data with an influent concentration range greater than 100 micrograms per liter (μg/L) were preferred over pilot- or bench-scale data and preferred over data with a low (i.e., 0-100 μg/L) influent concentration range. If several sets of data met these criteria (i.e., full-scale available technologies with high influent concentrations), they were compared by examination of their average effluent values and percent removals to determine the data set(s) which had the lowest effluent values and the technology with the highest percent removal.

(5) For any constituent where treatment performance data were not available from any of the examined sources, data were transferred for calculation of a BDAT treatment standard from a similar constituent in a waste judged to be similar.

Details regarding the identification of BDAT for the constituents selected for regulation in wastewater forms of D018-D043 wastes are presented in Section B.2 and in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for Universal Standards, Volume B: Universal Standards for Wastewater Forms of Wastes (23).

For most constituents regulated in D018-D043 wastes, the Agency had treatment performance data from the Engineering and Analysis Division (formerly Industrial Technology Division (ITD)) database. The Agency believes that these data represent the best demonstrated treatment performance for the following reasons:

- The EAD database consists of treatment performance data from Organic Chemical Plastics and Synthetic Fiber (OCPSF) sampling episodes. These episodes included long-term sampling of several industries and the data are therefore a good reflection of the treatment of organics in industrial wastewaters.

- The EAD data were carefully screened prior to inclusion in the OCPSF database and were used in determining an EAD promulgated limit.

- A promulgated EAD limit represents data that have undergone both EPA and industry review and acceptance.

Accuracy Correction Factors

Accuracy correction factors account for analytical interferences associated with the chemical matrices of the treated effluent samples. In those cases where an EAD variability factor was used to calculate the treatment standard, the Agency chose not to use an accuracy correction factor. Since EAD variability factors were originally calculated to represent performance, analytical, and matrix variations, the use of an accuracy correction factor was not necessary for these data. In cases where an EAD variability factor was not used, an accuracy correction factor was determined and included in the calculation of the universal standard.

Accuracy correction factors are determined for each constituent by dividing 100 by the lowest matrix spike recovery (expressed as a percent) value for that constituent. Since matrix spike data were not available for most of the data examined, analytical matrix spike data were pooled from BDAT and leachate sources. Leachate matrix spike data were used to determine an accuracy correction factor in those cases where leachate treatment performance data were used to establish a treatment standard. The BDAT matrix spike data were used in all other cases.

In cases where matrix spike data were not available for a specific constituent, but were available for a similar class of constituents (e.g., volatile organics, acid-extractable semivolatile organics, base-neutral semivolatile organics, organochlorine pesticides, organophosphorus insecticides), matrix spike recovery data for the class of constituents were transferred to the constituent of interest. All recovery values greater than 20% were averaged; an accuracy correction factor was determined based on the averaged value. As stated in EPA's Methodology Background Document (4), matrix spike recovery values less than 20% were considered unacceptable, and were not used in developing treatment standards.

In cases where matrix spike data were not available for the specific constituent and an average accuracy correction factor could not be determined for a similar class of constituents, a worst case accuracy correction factor was used. The worst case accuracy correction factor was based on a matrix spike percent recovery of 20 percent (the lowest percent recovery that the BDAT methodology considers acceptable). The calculated accuracy correction factor in this worst case then equals 5 (100 divided by 20).

Accuracy correction factors used in calculating the universal standards for the constituents selected for regulation in wastewater forms of D018-D043 wastes are presented in Tables B-28 and B-29.

Variability Factors

A variability factor accounts for the variability inherent in the treatment system performance, treatment residual collection, and analysis of the treated waste samples. Variability factors are calculated as described in EPA's Methodology Background Document (4).

Due to the nature of the data gathered from various sources presented in this appendix, variability factors for all of the constituents selected for regulation in D018-D043 wastes are not calculated as described in Reference 4, since in many cases, original effluent points were not available.

The variability factor calculated during the EAD regulation effort was used for those constituents for which a treatment standard was based on an EAD effluent limitation (i.e., selected volatile and semivolatile organic constituents).

For constituents where a variability factor was unknown or could not be calculated, an average variability factor was used. The average variability factors were generated from the EAD variability factors and are specific to the type of constituent under consideration (i.e., volatile organic or semivolatile organic). The average variability factor for volatile organics is the average of the variability factors from EAD data, as shown in Table B-30. The average variability factor for semivolatile organics is the average of the variability factors shown in Table B-31. Determination of these average variability factors is similar to the procedure used by EPA in previous BDAT rulemakings to determine average accuracy correction factors.

For those constituents that are not a volatile or semivolatile organic constituent where a variability factor could not be calculated or an average variability factor could not be determined, a variability factor of 2.8 was used. Also, the Agency used a variability factor of 2.8 for those constituents for which a treatment standard was based upon industry-submitted leachate data and for those constituents where the average effluent concentration was based on all non-detect values. A variability factor of 2.8 represents EPA's generic variability factor calculated assuming a lognormal distribution of effluent concentrations and an order of magnitude difference between the highest and lowest effluent values.

Treatment Standard Calculation

A constituent-by-constituent discussion of the determination of the universal standards for wastewaters is presented in Section B.2.

B.2 Determination of Treatment Standards for Wastewater Forms of D018-D043 Wastes

Wastewater treatment performance data for the constituents regulated in D018-D043 wastes are presented in Tables B-3 through B-27. A constituent-by-constituent discussion of the data used to calculate the universal standards for the constituents regulated in wastewater forms of D018-D043 wastes is given below.

D018 - Benzene

BDAT for benzene was identified as steam stripping (SS). Steam stripping was selected as BDAT because it represents treatment performance data from the EAD database. The universal standard was calculated using the EAD median long-term average of 10 ppb and the EAD variability factor for benzene. The determination of the resulting universal standard for benzene in wastewaters (0.14 mg/L) is shown in Table 4-2.

D019 - Carbon Tetrachloride

BDAT for carbon tetrachloride was identified as biological treatment (BT). Biological treatment was selected as BDAT because it represents full-scale data developed from EAD sampling and was used as part of the BDAT Solvents (F001-F005) rule. The effluent concentration achievable by this technology is supported by similar effluent concentrations from the SS and GAC treatment performance data. The universal standard was calculated using an effluent concentration of 10 ppb and the appropriate variability factor and accuracy correction factor for carbon tetrachloride. The determination of the resulting universal standard for carbon tetrachloride in wastewaters (0.057 mg/L) is shown in Table 4-2.

D021 - Chlorobenzene

BDAT for chlorobenzene was identified as biological treatment (BT). Biological treatment was selected as BDAT because it represents full-scale data developed from EAD sampling and was used as part of the BDAT Solvents (F001-F005) Rule. The effluent concentration achievable by this technology is supported by similar effluent concentrations from the AS and PACT® treatment performance data. The universal standard was calculated using an effluent concentration of 10 ppb and the appropriate variability factor and accuracy correction factor for chlorobenzene. The determination of the resulting universal standard for chlorobenzene in wastewaters (0.057 mg/L) is shown in Table 4-2.

D020 - Chlordane

BDAT for chlordane was identified as biological treatment (BT). Biological treatment was selected as BDAT since the available treatment performance data represent full-scale treatment and no additional full-scale data were available. The universal standard was calculated using an effluent concentration of 0.2336 ppb (the average of biological treatment effluent concentration values with those effluent values less than the method detection limit for chlordane (0.014 ppb) based on EPA-approved methods set at detection limit) and the appropriate variability factor and accuracy correction factor for chlordane. The determination of the resulting universal standard for chlordane in wastewaters (0.0033 mg/L) is shown in Table 4-2.

D022 - Chloroform

BDAT for chloroform was identified as steam stripping (SS). Steam stripping was selected as BDAT because it represents treatment performance data from the EAD database. The universal standard was calculated using the EAD median long-term average of 12.2 ppb and the EAD variability factor for chloroform. The determination of the resulting universal standard for chloroform in wastewaters (0.046 mg/L) is shown in Table 4-2.

D023 - o-Cresol

BDAT for o-cresol was identified as biological treatment (BT). Biological treatment was selected as BDAT because it represents full-scale data developed from EAD sampling used as part of the BDAT Solvents (F001-F005) Rule. The universal standard was calculated using an effluent concentration of 25 ppb and the appropriate variability factor and accuracy correction factor for o-cresol. The determination of the resulting universal standard for o-cresol in wastewaters (0.11 mg/L) is shown in Table 4-2.

D024 - m-Cresol

BDAT for m-cresol was identified as activated sludge biological treatment (AS). Activated sludge was selected as BDAT because it represents a demonstrated technology with a high removal efficiency and was the BDAT chosen for o-cresol, a constituent similar to m-cresol with respect to elemental composition and functional groups. The universal standard was calculated using an effluent concentration of 174 ppb and the appropriate variability factor and accuracy correction factor for m-cresol. The determination of the resulting universal standard for m-cresol in wastewaters (0.77 mg/L) is shown in Table 4-2.

D025 - p-Cresol

BDAT for p-cresol was identified as activated sludge biological treatment (AS). Activated sludge was selected as BDAT because it represents a demonstrated technology with a high removal efficiency and was the BDAT chosen for o-cresol, a constituent similar to p-cresol with respect to elemental composition and functional groups. The universal standard was calculated using an effluent concentration of 174 ppb and the appropriate variability factor and accuracy correction factor for p-cresol.

The determination of the resulting universal standard for p-cresol in wastewaters (0.77 mg/L) is shown in Table 4-2.

D026 - Cresols (total)

The Agency is establishing a treatment standard for D026 wastes (cresols (total)) based upon the sum of the universal standards for o-cresol and cresol (m- and p-isomers). Since the total cresol (D026) standard accounts for o-, m-, and p- isomers when these isomers cannot be differentiated, the Agency chose to base the treatment standard based on the sum of these isomers. BDAT for total cresol, therefore, was identified as activated sludge biological treatment (AS) and biological treatment (BT), based upon BDAT for o-cresol and cresol (m- and p- isomers). The universal standard was calculated using an effluent concentration of 199 ppb (representing the sum of the effluent concentrations for o-cresol and cresol (m- and p- isomers)) and the appropriate variability factor and accuracy correction factor. The determination of the resulting treatment standard for total cresol in wastewaters (0.88 mg/L) is shown in Table 4-2.

D027 - 1,4-Dichlorobenzene (p-Dichlorobenzene)

BDAT for 1,4-dichlorobenzene was identified as activated sludge biological treatment (AS). Activated sludge was selected as BDAT since the available treatment performance data represent full-scale treatment with high influent concentrations and high removal efficiencies. The universal standard was calculated using an effluent concentration of 16.33 ppb (the average of the full-scale data presented for the activated sludge technology in the high influent concentration ranges) and the appropriate variability factor and accuracy correction factor for 1,4-dichlorobenzene. The determination of the resulting universal standard for 1,4-dichlorobenzene in wastewaters (0.090 mg/L) is shown in Table 4-2.

D028 - 1,2-Dichloroethane

BDAT for 1,2-dichloroethane was identified as steam stripping (SS). Steam stripping was selected as BDAT because it represents treatment performance data from the EAD database. The universal standard was calculated using the EAD median long-term average of 25.6 ppb and the EAD variability factor for 1,2-dichloroethane. The determination of the resulting universal standard for 1,2-dichloroethane in wastewaters (0.21 mg/L) is shown in Table 4-2.

D029 - 1,1-Dichloroethylene

BDAT for 1,1-dichloroethylene was identified as steam stripping (SS). Steam stripping was selected as BDAT because it represents treatment performance data from the EAD database. The universal standard was calculated using the EAD median long-term average of 10 ppb and the EAD variability factor for 1,1-dichloroethylene. The determination of the resulting universal standard for 1,1-dichloroethylene in wastewaters (0.025 mg/L) is shown in Table 4-2.

D030 - 2,4-Dinitrotoluene

BDAT for 2,4-dinitrotoluene was identified as powdered activated carbon addition to activated sludge (PACT®). PACT® was selected as BDAT since the available treatment performance data represent full-scale treatment with a high influent concentration and the lowest effluent concentration. The universal standard was calculated using an effluent concentration of 58 ppb and the appropriate variability factor and accuracy correction factor for 2,4-dinitrotoluene. The determination of the resulting universal standard for 2,4-dinitrotoluene in wastewaters (0.32 mg/L) is shown in Table 4-2.

D031 - Heptachlor

BDAT for heptachlor was identified as granular activated carbon (GAC). Granular activated carbon was selected as BDAT since the available treatment performance data represent full-scale treatment with a high influent concentration and a high removal efficiency and show the ability to treat the wastewater to a level less than the method detection limit for heptachlor (0.083 ppb) based on EPA-approved methods. The universal standard was calculated using its detection limit of 0.083 ppb and the appropriate variability factor and accuracy correction factor for heptachlor. The Agency used the method detection limit value since the effluent concentration of heptachlor was below the detection level routinely achievable using EPA-approved methods. The determination of the resulting universal standard for heptachlor in wastewaters (0.0012 mg/L) is shown in Table 4-2.

D031 - Heptachlor Epoxide

BDAT for heptachlor epoxide was identified as biological treatment (BT). Biological treatment was selected as BDAT since the available treatment performance data represent full-scale treatment and no additional full-scale data were available. The Agency believes that these data are representative of effluent values that can be routinely achieved by industry. The universal standard was calculated using an effluent concentration of 1.1449 ppb and the appropriate variability factor and accuracy correction factor for heptachlor epoxide. The determination of the resulting universal standard for heptachlor epoxide in wastewaters (0.016 mg/L) is shown in Table 4-2.

D032 - Hexachlorobenzene

BDAT for hexachlorobenzene was identified as activated sludge followed by filtration (AS+Fil). Activated sludge followed by filtration was selected as BDAT since the available treatment performance data represent full-scale treatment with a high influent concentration and a high removal efficiency. The universal standard was calculated using an effluent concentration of 10 ppb and the appropriate variability factor and accuracy correction factor for hexachlorobenzene. The determination of the resulting universal standard for hexachlorobenzene in wastewaters (0.055 mg/L) is shown in Table 4-2.

D033 - Hexachloro-1,3-butadiene

BDAT for hexachlorobutadiene was identified as activated sludge followed by filtration (AS+Fil). Activated sludge followed by filtration was selected as BDAT since the available treatment performance data represent full-scale treatment with a high influent concentration and a high removal efficiency. The universal standard was calculated using an effluent concentration of 10 ppb and the appropriate variability factor and accuracy correction factor for hexachlorobutadiene. The determination of the resulting universal standard for hexachlorobutadiene in wastewaters (0.055 mg/L) is shown in Table 4-2.

D034 - Hexachloroethane

BDAT for hexachloroethane was identified as activated sludge followed by filtration (AS+Fil). Activated sludge followed by filtration was selected as BDAT since the available treatment performance data represent full-scale treatment performance with a high removal efficiency. The universal standard was calculated using an effluent concentration of 10 ppb and the appropriate variability factor and accuracy correction factor for hexachloroethane. The determination of the resulting universal standard for hexachloroethane in wastewaters (0.055 mg/L) is shown in Table 4-2.

D035 - Methyl Ethyl Ketone

BDAT for methyl ethyl ketone was identified as biological treatment (BT). Biological treatment was selected as BDAT for two reasons: (1) the industry-submitted leachate data for biological treatment showed substantial treatment of methyl ethyl ketone and (2) the Agency believes that these data are representative of effluent values that can be routinely achieved by industry. The universal standard was calculated using an effluent concentration of 100 ppb and the appropriate variability factor and accuracy correction factor for methyl ethyl ketone. The determination of the resulting universal standard for methyl ethyl ketone in wastewaters (0.28 mg/L) is shown in Table 4-2.

D036 - Nitrobenzene

BDAT for nitrobenzene was identified as steam stripping followed by activated carbon (SS+AC). Steam stripping followed by activated carbon was selected as BDAT because it represents treatment performance data from the EAD database. The universal standard was calculated using the EAD median long-term average of 14 ppb and the EAD variability factor for nitrobenzene. The determination of the resulting universal standard for nitrobenzene in wastewaters (0.068 mg/L) is shown in Table 4-2.

D037 - Pentachlorophenol

BDAT for pentachlorophenol was identified as filtration followed by granular activated carbon (Fil+GAC). Fil+GAC was selected as BDAT since this technology represents treatment performance data with a high influent concentration and a high removal efficiency. The effluent concentration achievable by Fil+GAC is supported by the effluent concentration data from the biological treatment technologies. The universal standard was calculated using an effluent concentration of 20 ppb and the appropriate variability factor and accuracy correction factor for pentachlorophenol. The determination of the resulting universal standard for pentachlorophenol in wastewaters (0.089 mg/L) is shown in Table 4-2.

D038 - Pyridine

BDAT for pyridine was identified as anaerobic fixed film biological treatment (ARFF). Anaerobic fixed film was selected as BDAT since this demonstrated biological treatment technology showed substantial treatment and ability to treat the wastewater to a level less than the method detection limit for pyridine (2.4 ppb) based on EPA-approved methods. The universal standard was calculated using its detection limit of 2.4 ppb and the appropriate variability factor and accuracy correction factor for pyridine. The Agency used the method detection limit value since the effluent concentration of pyridine was below the detection level routinely achievable using EPA-approved methods. The determination of the resulting universal standard for pyridine in wastewaters (0.014 mg/L) is shown in Table 4-2.

D039 - Tetrachloroethylene

BDAT for tetrachloroethylene was identified as steam stripping (SS). Steam stripping was selected as BDAT because it represents treatment performance data from the EAD database. The universal standard was calculated using the EAD median long-term average of 10.4 ppb and the EAD variability factor for tetrachloroethylene. The determination of the resulting universal standard for tetrachloroethylene in wastewaters (0.056 mg/L) is shown in Table 4-2.

D040 - Trichloroethylene

BDAT for trichloroethylene was identified as steam stripping (SS). Steam stripping was selected as BDAT because it represents treatment performance data from the EAD database.. The universal standard was calculated using the EAD median long-term average of 10 ppb and the EAD variability factor for trichloroethylene. The determination of the resulting universal standard for trichloroethylene in wastewaters (0.054 mg/L) is shown in Table 4-2.

D041 - 2,4,5-Trichlorophenol

BDAT for trichlorophenol was identified as biological treatment (BT). Biological treatment was selected as BDAT for two reasons: (1) the industry-submitted leachate data for biological treatment showed substantial treatment of 2,4,5-trichlorophenol and (2) the Agency believes that these data are representative of effluent values that can be routinely achieved by industry. The universal standard was calculated using the effluent concentration of 50 ppb and the appropriate variability factor and accuracy correction factor for 2,4,5-trichlorophenol. The determination of the resulting universal standard for 2,4,5-trichlorophenol in wastewaters (0.18 mg/L) is shown in Table 4-2.

D042 - 2,4,6-Trichlorophenol

BDAT for 2,4,6-trichlorophenol was identified as biological treatment (BT). Biological treatment was selected as BDAT for two reasons: (1) the industry-submitted leachate data for biological treatment showed substantial treatment of 2,4,6-trichlorophenol and (2) the Agency believes that these data are representative of effluent values that can be routinely achieved by industry. The universal standard was calculated using an effluent concentration of 10 ppb and the appropriate variability factor and accuracy correction factor for 2,4,6-trichlorophenol. The determination of the resulting universal standard for 2,4,6-trichlorophenol in wastewaters (0.035 mg/L) is shown in Table 4-2.

D043 - Vinyl Chloride

BDAT for vinyl chloride was identified as steam stripping (SS). Steam stripping was selected as BDAT because it represents treatment performance data from the EAD database. The universal standard was calculated using the EAD median long-term average of 50 ppb and the EAD variability factor for vinyl chloride. The determination of the resulting universal standard for vinyl chloride in wastewaters (0.27 mg/L) is shown in Table 4-2.

Table B-1

Database Key for Wastewaters

Code	Database
BDAT	Best Demonstrated Available Technology
EAD	Engineering Analysis Division
NPDES	National Pollutant Discharge Elimination System
WAO	Wet Air Oxidation
WERL	Water Engineering Research Laboratory
OCPSF	Organic Chemicals, Plastics, and Synthetic Fibers
LEACHATE	Leachate Treatment Performance Data Submitted by Industry

Table B-2

Key to Treatment Technologies

Code	Technology
AC	Activated Carbon
AFF	Aerobic Fixed Film
AL	Aerobic Lagoons
API	API Oil/Water Separator
AS	Activated Sludge
AirS	Air Stripping
AnFF	Anaerobic Fixed Film
BGAC	Biological Granular Activated Carbon
BT	Biological Treatment
CAC	Chemically Assisted Clarification
ChOx	Chemical Oxidation
Chred	Chemical Reduction
DAF	Dissolved Air Flotation
Fil	Filtration
GAC	Activated Carbon (Granular)
KPEG	Dechlorination Using Alkoxide
LL	Liquid-Liquid Extraction
PACT®	Powdered Activated Carbon Addition to Activated Sludge
RBC	Rotating Biological Contactor
RO	Reverse Osmosis
SCOx	Super Critical Oxidation
SExt	Solvent Extraction
SS	Steam Stripping

Table B-2

(Continued)

Code	Technology
TF	Trickling Filter
UF	Ultrafiltration
UV	Ultraviolet Radiation
WOx	Wet Air Oxidation

"__ + __" - Indicates that the first process unit is followed in the process train by the second (e.g., AS + Fil - Activated Sludge followed by Filtration).

"__w + __" - Indicates that the two units are used together (e.g., UFwPAC - Ultrafiltration using Powdered Activated Carbon).

"__[B]" - Indicates batch instead of continuous flow.

Table B-3

Treatment Performance Data for Benzene in Wastewaters

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Recovery (%)	Removal (%)	Reference
AL	Bench	371D	NR	1000-10000	NR	60.000	NR	98	WERL
AL	Full	6B	NR	100-1000	2	10.000	NR	98.9	WERL
AL	Full	1B	NR	100-1000	6	10.000	NR	94.4	WERL
AL	Full	6B	NR	100-1000	2	10.000	NR	92.3	WERL
AL+AS	Full	233D	NR	10000-100000	21	13.000	NR	99.9	WERL
API+DAF+AS	Full	1482D	NR	1000-10000	4	3.700	NR	99.96	WERL
AS	Full	6B	NR	100-1000	7	10.000	NR	98.8	WERL
AS	Bench	200B	NR	100-1000	16	0.800	NR	99.3	WERL
AS	Bench	200B	NR	100-1000	8	1.000	NR	99.83	WERL
AS	Full	1B	NR	100-1000	6	2.000	NR	99	WERL
AS	Full	6B	NR	100-1000	22	30.000	NR	91.7	WERL
AS	Full	1B	NR	100-1000	6	1.000	NR	99.55	WERL
AS	Full	6B	NR	100-1000	14	10.000	NR	95.7	WERL
AS	Full	6B	NR	100-1000	3	10.000	NR	95.6	WERL
AS	Full	1B	NR	100-1000	6	2.000	NR	98.9	WERL
AS	Bench	202D	NR	100000-1000000	NR	40.000	NR	99.97	WERL
AS	Full	6B	NR	1000-10000	3	10.000	NR	99.09	WERL
AS	Full	6B	NR	1000-10000	27	11.000	NR	99.8	WERL
AS	Full	6B	NR	1000-10000	3	10.000	NR	99.71	WERL
AS	Full	6B	NR	0-100	28	10.000	NR	89.6	WERL
AS	Bench	200B	NR	0-100	16	0.500	NR	97.8	WERL
AS	Full	6B	NR	10000-100000	15	10.000	NR	99.97	WERL
AS	Full	234A	NR	100-1000	NR	0.600	NR	99.83	WERL
AS	Full	201B	NR	0-100	10	6.000	NR	81	WERL
AS	Full	1B	NR	0-100	6	16.000	NR	84	WERL
AS	Pilot	206B	NR	0-100	20	0.200	NR	99.73	WERL
AS	Full	234A	NR	0-100	NR	0.700	NR	97.4	WERL
AS+Fil	Full	6B	NR	100000-1000000	3	20.000	NR	99.99	WERL

Table B-3

(Continued)

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Recovery (%)	Removal (%)	Reference
AirS	Bench	1328E	NR	10000-100000	5	9300.000	NR	90	WERL
AirS	Full	322B	NR	100-1000	22	0.440	NR	99.74	WERL
AirS	Pilot	224B	NR	100-1000[b]	1	0.500	NR	99.67	WERL
AirS	Full	322B	NR	1000-10000	19	52.000	NR	98.7	WERL
AirS	Pilot	1362E	NR	100-1000	3	1.000	NR	99.09	WERL
AirS+GAC	Full	229A	NR	0-100	19	1.000	NR	90.9	WERL
GAC	Full	245B	NR	1000-10000[b]	1	10.000	NR	99.28	WERL
LL	Full	K104	5	4500-320000	5	35600.000	76.0	NR	BDAT
LL	Full	K103	5	32000-81000	5	3560.000	76.0	NR	BDAT
LL+SS	Full	K103/ K104	5	4500-320000	5	5.600	76.0	NR	BDAT
LL+SS+AC	Full	K103/ K104	5	4500-320000	4	19.000	76.0	NR	BDAT
PACT®	Bench	242E	NR	0-100	NR	5.000	NR	83	WERL
PACT®	Bench	200B	NR	100-1000	12	0.700	NR	99.34	WERL
PACT®	Bench	Zimpro	NR	290	1	1.000	NR	99.7	WAO (LIT)
PACT®	Bench	Zimpro	NR	29	1	5.000	NR	83	WAO (LIT)
RO	Full	250B	NR	1000-10000	NR	140.000	NR	92.2	WERL
RO	Full	250B	NR	0-100	NR	3.800	NR	95.1	WERL
RO	Pilot	323B	NR	0-100[b]	1	32.000	NR	19	WERL
RO	Pilot	250B	NR	100-1000	NR	50.000	NR	78	WERL
RO	Full	250B	NR	100-1000	NR	67.000	NR	92.7	WERL
SS[a]	Full	0415	10	22300-48100	4	38.800	NR	NR	EAD-OPSCF[a]
SS[a]	Full	2680	10	34693-147212	10	10.000	NR	NR	EAD-OCPSF[a]
SS[a]	Full	1494	10	239-2008310	13	44.8000	NR	NR	EAD-OCPSF[a]
SS[a]	Full	0415	10	274000-412000	3	200.300	NR	NR	EAD-OCPSF[a]
SS	Full	6B	NR	100000-1000000	3	200.000	NR	99.94	WERL
SS	Full	6B	NR	100000-1000000	12	48.000	NR	99.99	WERL
SS	Full	6B	NR	10000-100000	2	10.000	NR	99.97	WERL

Table B-3

(Continued)

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Recovery (%)	Removal (%)	Reference
SS	Full	6B	NR	10000-100000	10	10.000	NR	99.99	WERL
SS	Full	251B	NR	100-1000	10	10.000	NR	96.3	WERL
TF	Full	1B	NR	0-100	5	1.000	NR	97.5	WERL
TF+AS	Full	6B	NR	10000-100000	3	10.000	NR	99.97	WERL
UF	Pilot	250B	NR	1000-10000	NR	230.000	NR	78	WERL
WOx	Full	242E	NR	1000-10000	NR	29.000	NR	99.64	WERL
WOx [B]	Bench	1054E	NR	1000-10000	NR	500.000	NR	53	WERL
WOx [B]	Bench	1054E	NR	100000-1000000	NR	180000.000	NR	82	WERL

[a]Data used in developing universal standard.
[b]The influent concentration was reported as between this range.
NR = Not Reported.
Source: Reference 23.

Table B-4

Treatment Performance Data for Carbon Tetrachloride in Wastewaters

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
AL	Pilot	203A	NR	0-100	14	11.000	84	WERL
AL	Pilot	203A	NR	0-100	14	15.000	78	WERL
AS	Pilot	203A	NR	0-100	14	13.000	81	WERL
AS	Full	1B	NR	100-1000	6	16.000	88	WERL
AS	Pilot	206B	NR	0-100	20	0.200	99.67	WERL
AS	Full	975B	NR	0-100	NR	3.000	94.8	WERL
AS	Bench	202D	NR	10000-100000	NR	130.000	99.32	WERL
AS	Full	6B	NR	100-1000	3	10.000	96.7	WERL
AS	Pilot	241B	NR	100-1000	5	5.000	98.3	WERL
AS	Pilot	240A	NR	0-100	12	4.000	90.7	WERL
AS+Fil	Full	6B	NR	1000-10000	14	10.000	99.09	WERL
AS+Fil	Full	6B	NR	10000-100000	2	10.000	99.96	WERL
AirS	Bench	1328E	NR	10000-100000	5	7600.000	89	WERL
BT[a]	Full	P225	NR	51-44000	17	10.000	NR	BDAT[a,b]
BT	Full	F001-F005	NR	95	1	5.500	94.2	BDAT[a]
CAC	Pilot	203A	NR	100-1000	14	101.000	0	WERL
GAC	Full	1264B	NR	0-100	NR	1.000	87	WERL
GAC	Full	237A	NR	0-100[c]	1	10.000	89	WERL
PACT	Bench	242E	NR	1000-10000	NR	30.000	98.5	WERL
PACT	Bench	Zimpro	NR	860	1	1.000	99.9	WAO (LIT)
PACT	Bench	Zimpro	NR	2000	1	30.000	98.5	WAO (LIT)
RO	Pilot	323B	NR	100-1000[c]	1	2.000	98	WERL
SCOx	Pilot	65D	NR	100-1000	NR	20.000	96.5	WERL
SS	Full	251B	NR	10000-100000	10	5.000	99.99	WERL
SS	Full	251B	NR	1000-10000	10	10.000	99.41	WERL
TF	Pilot	203A	NR	0-100	14	26.000	62	WERL
TF	Pilot	240A	NR	0-100	12	4.000	90.7	WERL

Table B-4

(Continued)

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
WOx	Bench	Zimpro	NR	4330000	1	12000.000	99.7	WAO (LIT)
WOx	Full	242E	NR	1000000	NR	2000.000	99.92	WERL

[a]Data used in developing universal standard.
[b]EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.
[c]The influent concentration was reported as between this range.
NR = Not Reported.
Source: Reference 23.

Table B-5

Treatment Performance Data for Chlordane in Wastewaters

Technology	Technology Size	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
NR	NR	CA0107611	NR	NR	1	0.1000	NR	NPDES
NR	NR	CA0048216	NR	NR	5	132.0000	NR	NPDES
NR	NR	CA0037681	NR	NR	13	0.1000	NR	NPDES
NR	NR	CA0037681	NR	NR	29	0.1000	NR	NPDES
NR	NR	OH0058874	NR	NR	5	0.0200	NR	NPDES
NR	NR	LA0058882	NR	NR	33	15.9000	NR	NPDES
NR	NR	LA0065501	NR	NR	6	0.5000	NR	NPDES
NR	NR	LA0058882	NR	NR	32	15.6000	NR	NPDES
NR	NR	PA0026531	NR	NR	29	483.4500	NR	NPDES
NR	NR	CA0038598	NR	NR	5	0.1000	NR	NPDES
NR	NR	CA0048194	NR	NR	5	0.3420	NR	NPDES
NR	NR	CA0107417	NR	NR	6	0.0802	NR	NPDES
BT[a]	Full	CA0108031	NR	NR	1	0.0100	NR	NPDES[a]
BT[a]	Full	LA0038245	NR	NR	38	1.6500	NR	NPDES[a]
BT[a]	Full	CA0107395	NR	NR	5	0.2360	NR	NPDES[a]
BT[a]	Full	CA0048160	NR	NR	3	0.0100	NR	NPDES[a]
BT[a]	Full	TN0020711	NR	NR	22	0.0400	NR	NPDES[a]
BT[a]	Full	CA0037737	NR	NR	4	0.0500	NR	NPDES[a]
BT[a]	Full	CA0048143	NR	NR	2	0.1600	NR	NPDES[a]
BT[a]	Full	CA0047996	NR	NR	1	0.0500	NR	NPDES[a]
BT[a]	Full	CA0037494	NR	NR	2	0.1250	NR	NPDES[a]
BT[a]	Full	CA0047881	NR	NR	1	0.0500	NR	NPDES[a]
BT[a]	Full	CA0047364	NR	NR	3	0.0502	NR	NPDES[a]
BT[a]	Full	CA0022756	NR	NR	1	0.5000	NR	NPDES[a]
BT[a]	Full	CA0110604	NR	NR	9	0.1000	NR	NPDES[a]
Chred	Pilot	NR	NR	30	6	0.1000	NR	ART

[a]Data used in developing universal standard.
NR = Not reported
Source: Reference 23.

Table B-6

Treatment Performance Data for Chlorobenzene in Wastewaters

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
AFF	Bench	501A	NR	0-100	9	1.000	90.7	WERL
AL	Bench	371D	NR	1000-10000	NR	160.000	94.7	WERL
AS	Bench	200B	NR	100-1000	12	1.100	99.17	WERL
AS	Bench	200B	NR	100-1000	6	1.300	99.81	WERL
AS	Full	975B	NR	100-1000	NR	6.000	94.6	WERL
AS	Full	6B	NR	100-1000	4	10.000	98.9	WERL
AS	Bench	200B	NR	0-100	8	0.200	99.23	WERL
AS	Full	975B	NR	100-1000	NR	10.000	94.6	WERL
AS	Full	975B	NR	0-100	NR	6.000	84	WERL
AS	Full	1B	NR	100-1000	6	3.000	98.9	WERL
AS	Pilot	206B	NR	100-1000	20	1.300	99.34	WERL
AS	Pilot	241B	NR	100-1000	5	4.000	98.6	WERL
AS	Full	975B	NR	100-1000	NR	12.000	97.8	WERL
AirS	Bench	1328E	NR	1000-10000	5	1800.000	77	WERL
AirS	Bench	1328E	NR	10000-100000	5	3300.000	89	WERL
BGAC	Bench	501A	NR	0-100	23	0.290	97.6	WERL
BT	Full	P206	NR	929-49775	8	841.000	NR	BDAT[a]
BT	Full	P246	NR	10-3040	13	101.000	NR	BDAT[a]
BT	Full	P263	NR	443-832	3	504.000	NR	BDAT[a]
BT	Full	F001-F005	NR	1900	1	12.000	NR	BDAT[a]
BT[a]	Full	P202	NR	79-429	20	10.000	NR	BDAT[a,b]
BT+AC	Full	P246	NR	10-7200	16	30.000	NR	BDAT[a]
GAC	Full	245B	NR	100-1000[c]	1	10.000	96.6	WERL
GAC	Full	245B	NR	1000-10000[c]	1	10.000	99.7	WERL
GAC	Full	237A	NR	1000-10000[c]	1	10.000	99.17	WERL
GAC	Full	1421D	NR	0-100	NR	0.250	56	WERL
PACT®	Full	6B	NR	1000-10000	4	10.000	99.38	WERL
PACT®	Bench	200B	NR	100-1000	11	0.800	99.37	WERL

Table B-6

(Continued)

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
PACT®	Bench	242E	NR	0-100	NR	5.000	84	WERL
PACT®	Bench	Zimpro	NR	31	1	5.000	84	WAO (LIT)
RO	Pilot	323B	NR	0-100[c]	1	12.000	50	WERL
RO	Full	250B	NR	0-100	NR	4.000	53	WERL
RO	Full	250B	NR	1000-10000	NR	120.000	91.6	WERL
SS	Full	251B	NR	100-1000	10	10.000	97.4	WERL
WOx	Bench	Zimpro	NR	5535000	1	1550000.000	72	WAO (LIT)
WOx	Bench	Zimpro	NR	792000	1	61000.000	92.3	WAO (LIT)

[a]Data used in developing universal standard.
[b]EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.
[c]The influent concentration was reported as between this range.
NR = Not reported
Source: Reference 23.

Table B-7

Treatment Performance Data for Chloroform in Wastewaters

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
AL	Full	1607B	NR	0-100	3	9.000	90.1	WERL
AL	Full	1B	NR	100-1000	6	26.000	96.8	WERL
AL	Pilot	203A	NR	100-1000	14	53.000	61	WERL
AL	Full	141A	NR	100-1000	NR	16.000	92.3	WERL
AL	Full	1607B	NR	100-1000	2	10.000	97.4	WERL
AL	Full	1607B	NR	100-1000	3	130.000	86	WERL
AL	Pilot	203A	NR	100-1000	14	31.000	77	WERL
AS	Full	1B	NR	0-100	3	20.000	80	WERL
AS	Full	6B	NR	100-1000	7	30.000	77	WERL
AS	Full	1B	NR	0-100	5	6.000	86	WERL
AS	Full	6B	NR	100-1000	3	10.000	97.7	WERL
AS	Bench	202D	NR	10000-100000	NR	200.000	99.43	WERL
AS	Full	234A	NR	0-100	NR	1.200	61	WERL
AS	Full	1B	NR	0-100	6	21.000	62	WERL
AS	Full	375E	NR	0-100	7	1.000	75	WERL
AS	Full	1B	NR	100-1000	6	59.000	51	WERL
AS	Full	975B	NR	0-100	NR	2.000	93.8	WERL
AS	Full	234A	NR	0-100	NR	2.300	72	WERL
AS	Full	234A	NR	0-100	NR	0.500	98.4	WERL
AS	Full	6B	NR	100-1000	3	10.000	98.2	WERL
AS	Full	238A	NR	0-100	3	2.400	46	WERL
AS	Full	1607B	NR	100-1000	3	50.000	86	WERL
AS	Full	1607B	NR	1000-10000	2	40.000	96.9	WERL
AS	Pilot	206B	NR	100-1000	20	3.600	97.4	WERL
AS	Full	375E	NR	0-100	7	20.000	78	WERL
AS	Full	1587E	NR	0-100	NR	1.600	65	WERL
AS	Pilot	241B	NR	100-1000	5	44.000	85	WERL
AS	Full	234A	NR	0-100	NR	1.300	84	WERL

Table B-7

(Continued)

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
AS	Pilot	203A	NR	100-1000	14	18.000	87	WERL
AS	Full	6B	NR	1000-10000	27	19.000	98.7	WERL
AS	Full	201B	NR	0-100	29	38.000	53	WERL
AS	Full	234A	NR	0-100	NR	1.300	65	WERL
AS	Pilot	240A	NR	0-100	14	2.000	98	WERL
AS+Fil	Full	6B	NR	1000-10000	3	10.000	99.41	WERL
AS+Fil	Full	6B	NR	100-1000	14	10.000	95.8	WERL
AirS	Bench	1328E	NR	100000-1000000	5	16000.000	93.1	WERL
AirS	Pilot	369A	NR	0-100	NR	1.400	98.2	WERL
AirS	Pilot	213B	NR	0-100[b]	1	13.000	77	WERL
AirS	Bench	1328E	NR	10000-100000	5	4400.000	83	WERL
AirS	Pilot	225B	NR	0-100[b]	1	0.130	98.9	WERL
AirS	Bench	17A	NR	0-100	NR	2.600	96.9	WERL
AirS	Bench	17A	NR	1000-10000	NR	110.000	91.7	WERL
AirS	Bench	17A	NR	0-100	NR	3.900	88	WERL
AirS	Bench	17A	NR	100-1000	NR	4.200	98.6	WERL
AirS	Pilot	210B	NR	100-1000[b]	1	1.000	99.2	WERL
AirS	Bench	17A	NR	100-1000	NR	3.700	98.6	WERL
AirS	Bench	1328E	NR	100-1000	5	34.000	84	WERL
AirS	Pilot	434B	NR	1000-10000	4	41.000	98	WERL
CAC	Pilot	203A	NR	100-1000	14	106.000	22	WERL
CAC+AirS	Full	1833D	NR	0-100	25	0.200	89	WERL
ChOx	Bench	640E	NR	100-1000	2	7.000	96	WERL
ChOx	Bench	640E	NR	100-1000[b]	1	3.000	99	WERL
ChOx (ozone)	Pilot	331D	NR	0-100	NR	46.000	37	WERL
ChOx (ozone)	Pilot	331D	NR	0-100	NR	2.800	35	WERL
GAC	Full	1264B	NR	0-100	NR	1.000	87	WERL

Table B-7

(Continued)

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
GAC	Pilot	331D	NR	0-100	NR	1.000	98.6	WERL
GAC	Full	245B	NR	100-1000[b]	1	10.000	97.6	WERL
GAC	Full	237A	NR	100-1000[b]	1	10.000	98.1	WERL
GAC	Full	245B	NR	100-1000[b]	1	10.000	96.2	WERL
PACT®	Bench	242E	NR	0-100	NR	20.000	47	WERL
PACT®	Bench	Zimpro	NR	1470	1	1.000	99.9	WAO (LIT)
PACT®	Bench	Zimpro	NR	38	1	20.000	47	WAO (LIT)
RO	Pilot	180A	NR	0-100	NR	0.890	71	WERL
RO	Full	250B	NR	1000-10000	NR	110.000	94.5	WERL
RO	Full	250B	NR	100-1000	NR	53.000	87	WERL
SCOx	Pilot	65D	NR	100-1000	NR	1.700	99.83	WERL
SS[a]	Full	415T	10	7330-1088000	15	10.500	NR	EAD-OCPSF[a]
SS[a]	Full	913	10	28700-200000	14	129.200	NR	EAD-OCPSF[a]
SS	Full	6B	NR	100000-1000000	15	10.000	99.99	WERL
SS	Full	6B	NR	10000-100000	2	120.000	99.88	WERL
SS	Full	251B	NR	1000000	10	6000.000	99.99	WERL
SS	Full	251B	NR	100000-1000000	10	9600.000	96.4	WERL
TF	Pilot	240A	NR	0-100	14	11.000	89	WERL
TF	Full	1B	NR	0-100	4	14.000	86	WERL
TF	Pilot	203A	NR	100-1000	14	102.000	24	WERL
WOx	Bench	Zimpro	NR	4450000	1	3000.000	99.9	WAO (LIT)
WOx	Bench	Zimpro	NR	270000	1	1000.000	99	WAO (LIT)

[a]Data used in developing universal standard.
[b]The influent concentration was reported as between this range.
NR = Not reported
Source: Reference 23.

Table B-8

Treatment Performance Data for o-Cresol in Wastewaters

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
AnFF	Bench	230A	NR	100000-1000000	NR	26000.000	78	WERL
AnFF	Pilot	235D	NR	10000-100000	NR	7800.000	85	WERL
AnFFwGAC	Pilot	249D	NR	100000-1000000	NR	8800.000	98.7	WERL
BT[a]	Full	REF17	NR	1886-2536	2	25.000	NR	BDAT[a,b]
RO	Full	250B	NR	100-1000	NR	14.000	98.5	WERL

[a]Data used in developing universal standard.
[b]EAD data presented in the BDAT Solvents Rule F001-F005 Background Document (25).
NR = Not reported
Source: Reference 23.

Table B-9

Treatment Performance Data for meta/para-Cresol in Wastewaters

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
API+DAF+AS	Full	1482D	NR	1000-10000	4	160.000	87	WERL
AS[a]	Pilot	241B	NR	100-1000	9	174.000	68	WERL[a]
AnFF	Bench	230A	NR	100000-1000000	NR	17000.000	90.7	WERL
RO	Full	250B	NR	1000-10000	NR	72.000	97.7	WERL
SExt	Pilot	1082E	NR	100000-1000000	NR	3000.000	99.66	WERL

[a]Data used in developing universal standard.
[b]EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.
NR = Not reported
Source: Reference 23.

Table B-10

Treatment Performance Data for p-Dichlorobenzene in Wastewaters

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
AFF	Bench	501A	NR	0-100	27	0.200	98.1	WERL
AL	Pilot	192D	NR	0-100	NR	10.000	88	WERL
AL	Pilot	203A	NR	0-100	11	31.000	67	WERL
AL	Pilot	203A	NR	0-100	11	12.000	87	WERL
AL	Pilot	192D	NR	100-1000	NR	10.000	90.5	WERL
AS	Full	1B	NR	0-100	2	10.000	76	WERL
AS	Full	234A	NR	0-100	NR	0.500	81	WERL
AS	Pilot	241B	NR	100-1000	4	10.000	90.7	WERL
AS[a]	Full	975B	NR	1000-10000	NR	12.000	99.63	WERL[a]
AS	Pilot	192D	NR	100-1000	NR	10.000	90.5	WERL
AS	Pilot	631D	NR	0-100	NR	0.004	99	WERL
AS	Pilot	631D	NR	0-100	NR	0.004	99	WERL
AS	Pilot	240A	NR	100-1000	12	8.000	93.8	WERL
AS	Pilot	192D	NR	0-100	NR	10.000	88	WERL
AS	Full	234A	NR	0-100	NR	0.500	90	WERL
AS	Pilot	241B	NR	100-1000	11	19.000	95.1	WERL
AS	Full	201B	NR	0-100	2	6.000	79	WERL
AS	Full	1B	NR	0-100[b]	1	5.000	93.1	WERL
AS	Full	1B	NR	0-100[b]	1	8.000	83	WERL
AS	Pilot	203A	NR	0-100	11	5.000	94.6	WERL
AS	Full	234A	NR	0-100	NR	0.500	91.7	WERL
AS[a]	Full	6B	NR	100-1000	4	10.000	97	WERL[a]
AS	Full	975B	NR	0-100	NR	4.900	92.8	WERL
AS[a]	Full	975B	NR	100-1000	NR	27.000	96.6	WERL[a]
AirS	Bench	1328E	NR	10000-100000	5	3600.000	90	WERL
BGAC	Bench	501A	NR	0-100	34	0.270	97.5	WERL
CAC	Pilot	203A	NR	0-100	11	66.000	29	WERL
ChOx	Bench	975B	NR	0-100	NR	5.000	91.1	WERL

Table B-10

(Continued)

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
GAC	Full	245B	NR	100-1000[b]	1	10.000	96	WERL
GAC	Full	1421D	NR	0-100	NR	0.200	92	WERL
PACT®	Bench	975B	NR	0-100	NR	5.000	93.5	WERL
PACT®	Bench	975B	NR	0-100	NR	5.000	92.3	WERL
PACT®	Bench	Zimpro	NR	36.6	1	0.015	99.96	WAO (LIT)
RBC	Pilot	192D	NR	0-100	NR	10.000	88	WERL
RO	Pilot	180A	NR	0-100	NR	0.670	61	WERL
TF	Pilot	240A	NR	100-1000	11	16.000	88	WERL
TF	Pilot	203A	NR	0-100	11	58.000	38	WERL

[a]Data used in developing universal standard.
[b]The influent concentration was reported as between this range.
NR = Not reported
Source: Reference 23.

Table B-11

Treatment Performance Data for 1,2-Dichloroethane in Wastewaters

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
AL	Pilot	203A	NR	100-1000	14	15.000	90.2	WERL
AL	Full	1B	NR	1000-10000	6	10.000	99.75	WERL
AL	Pilot	203A	NR	100-1000	14	45.000	71	WERL
AL+AS	Full	233D	NR	1000-10000	21	8.000	99.67	WERL
AS	Pilot	203A	NR	100-1000	14	22.000	86	WERL
AS	Pilot	241B	NR	100-1000	3	140.000	57	WERL
AS	Full	1B	NR	1000-10000	6	4400.000	33	WERL
AS	Full	6B	NR	100-1000	3	12.000	98.1	WERL
AS	Pilot	240A	NR	0-100	13	5.000	94.3	WERL
AS	Full	6B	NR	1000-10000	25	29.000	98.6	WERL
AS	Full	375E	NR	100-1000	7	74.000	82	WERL
AS	Bench	202D	NR	100000-1000000	NR	3700.000	98.6	WERL
AS	Full	1B	NR	10000-100000	6	1800.000	89	WERL
AS	Full	6B	NR	100-1000	13	94.000	84	WERL
AS	Full	6B	NR	100-1000	12	15.000	98.5	WERL
AS+Fil	Full	6B	NR	10000-100000	3	1200.000	98.5	WERL
AirS	Full	322B	NR	100-1000	5	55.000	89	WERL
AirS	Full	322B	NR	1000-10000	5	189.000	91.8	WERL
CAC	Pilot	203A	NR	100-1000	14	109.000	29	WERL
PACT[a]	Bench	Zimpro	NR	210	1	1.000	99.5	WAO (LIT)
RO	Full	250B	NR	1000-10000	NR	350.000	84	WERL
RO	Full	250B	NR	0-100	NR	13.000	79	WERL
RO	Pilot	323B	NR	0-100[b]	1	32.000	37	WERL
RO	Full	250B	NR	100-1000	NR	43.000	76	WERL
SS[c]	Full	415T	10	2339900-2347600	15	56.100	NR	EAD-OCPSF[d]
SS[c]	Full	913	10	172000-327000	14	73.300	NR	EAD-OCPSF[d]
SS	Full	251B	NR	1000000	10	97.000	99.99	WERL
SS	Full	6B	NR	1000000	15	56.000	99.99	WERL

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Table B-11

(Continued)

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
SS	Full	6B	NR	100000-1000000	2	50.000	99.98	WERL
TF	Pilot	240A	NR	0-100	13	12.000	86	WERL
TF	Full	375E	NR	100-1000	7	45.000	65	WERL
TF	Pilot	203A	NR	100-1000	14	93.000	39	WERL
WOx	Bench	Zimpro	NR	6280000	1	13000.000	99.8	WAO (LIT)
WOx [B]	Bench	1054E	NR	1000000	NR	230000.000	93.6	WERL

[a]Data used in developing universal standard.
[b]The influent concentration was reported as between this range.
NR = Not reported
Source: Reference 23.

Table B-12

Treatment Performance Data for 1,1-Dichloroethylene in Wastewaters

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
AL	Pilot	203A	NR	100-1000	14	83.000	61	WERL
AL	Pilot	203A	NR	100-1000	14	35.000	84	WERL
AS	Full	6B	NR	100-1000	3	10.000	97.2	WERL
AS	Pilot	206B	NR	0-100	20	0.200	99.75	WERL
AS	Full	201B	NR	0-100	2	1.000	97.5	WERL
AS	Pilot	203A	NR	100-1000	14	14.000	93.4	WERL
AS	Full	1B	NR	0-100	2	5.000	86	WERL
AS	Full	6B	NR	100-1000	22	10.000	97	WERL
AS	Full	1B	NR	0-100	2	6.000	92.9	WERL
AS	Pilot	240A	NR	0-100	12	1.000	98.3	WERL
AS	Full	6B	NR	100-1000	3	25.000	97	WERL
AirS	Pilot	217B	NR	0-100[b]	1	0.300	95.6	WERL
AirS	Pilot	222B	NR	0-100[b]	1	1.000	92.3	WERL
AirS	Pilot	1362E	NR	1000-10000	3	4.000	99.82	WERL
AirS	Full	1344E	NR	1000-10000	NR	2.000	99.94	WERL
AirS	Pilot	1139E	NR	100-1000	6	7.400	92.7	WERL
AirS	Pilot	1139E	NR	0-100	2	1.000	98.6	WERL
CAC	Pilot	203A	NR	100-1000	14	150.000	29	WERL
GAC	Full	237A	NR	0-100[b]	1	10.000	64	WERL
GAC	Full	1264B	NR	0-100	NR	1.000	70	WERL
GAC	Pilot	1139E	NR	0-100	NR	1.000	97	WERL
RO	Full	250B	NR	0-100	NR	1.200	98.4	WERL
RO	Full	250B	NR	0-100	NR	3.100	72	WERL
RO	Full	250B	NR	1000-10000	NR	240.000	78	WERL
SS	Full	251B	NR	1000-10000	10	10.000	99.79	WERL
SS	Full	6B	NR	1000-10000	2	10.000	99.87	WERL
SS	Full	6B	NR	1000-10000	15	10.000	99.77	WERL
SS[a]	Full	415T	10	200-10800	15	10.200	NR	EAD-OCPSF[a]

Table B-12

(Continued)

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
SS[a]	Full	913	10	2900-12300	14	10.000	NR	EAD-OCPSF[a]
TF	Pilot	240A	NR	0-100	12	1.000	98.3	WERL
TF	Pilot	203A	NR	100-1000	14	85.000	60	WERL

[a]Data used in developing universal standard.
[b]The influent concentration was reported as between this range.
NR = Not reported
Source: Reference 23.

Table B-13

Treatment Performance Data for 2,4-Dinitrotoluene in Wastewaters

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
AS	Full	6B	NR	10000-100000	3	110.000	99.15	WERL
PACT®[a]	Full	6B	NR	1000-10000	4	58.000	96.4	WERL[a]
WO_x	Bench	Zimpro	NR	10000000	1	26000.000	99.74	WAO (LIT)
WO_x [B]	Bench	236A	NR	>1000000	1	12000.000	99.88	WERL

[a]Data used in developing universal standard.
NR = Not reported
Source: Reference 23.

Table B-14

Treatment Performance Data for Heptachlor in Wastewaters

Technology	Technology Size	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
NR	NR	LA0058882	NR	NR	33	15.3000	NR	NPDES
NR	NR	LA0058882	NR	NR	32	15.0000	NR	NPDES
NR	NR	LA0065501	NR	NR	6	0.1000	NR	NPDES
NR	NR	PA0026531	NR	NR	29	22.4140	NR	NPDES
NR	NR	FL0021661	NR	NR	3	0.0430	NR	NPDES
AL	Pilot	203A	NR	0-100	11	13.0000	67	WERL
AL	Pilot	203A	NR	0-100	11	13.0000	67	WERL
AS	Pilot	240A	NR	0-100	13	25.0000	68	WERL
AS	Pilot	203A	NR	0-100	11	13.0000	67	WERL
AS	Pilot	204A	NR	0-100	8	2.3000	92.8	WERL
BT	Full	LA0038245	NR	NR	39	1.7590	NR	NPDES
BT	Full	PA0026247	NR	NR	25	0.8470	NR	NPDES
CAC	Pilot	203A	NR	0-100	11	14.0000	64	WERL
GAC[a]	Full	237A	NR	100-1000[b]	1	0.0100	99.99	WERL[a]
TF	Pilot	203A	NR	0-100	11	18.0000	54	WERL
TF	Pilot	240A	NR	0-100	12	26.0000	67	WERL

[a]Data used in developing universal standard.
[b]The influent concentration was reported as between this range.
NR = Not reported
Source: Reference 23.

Table B-15

Treatment Performance Data for Heptachlor Epoxide in Wastewaters

Technology	Technology Size	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
NR	NR	LA0065501	NR	NR	6	0.1000	NR	NPDES
NR	NR	LA0058882	NR	NR	32	15.9000	NR	NPDES
NR	NR	LA0058882	NR	NR	33	16.5000	NR	NPDES
BT[a]	Full	LA0038245	NR	NR	39	1.1449	NR	NPDES[a]

[a]Data used in developing universal standard.
NR = Not reported
Source: Reference 23.

Table B-16

Treatment Performance Data for Hexachlorobenzene in Wastewaters

Technology	Technology Size	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
AS	Full	375E	NR	0-100	7	0.010	83	WERL
AS	Full	375E	NR	0-100	7	0.010	94.4	WERL
AS+Fil[a]	Full	6B	NR	100-1000	14	10.000	96.7	WERL[a]
GAC	Full	237A	NR	0-100	1	20.000	38	WERL

[a]Data used in developing universal standard.
NR = Not reported
Source: Reference 23.

Table B-17

Treatment Performance Data for Hexachlorobutadiene in Wastewaters

Technology	Technology Size	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
AS	Pilot	241B	NR	100-1000	11	15.000	96.2	WERL
AS+Fil[a]	Full	6B	NR	100-1000	2	10.000	92.8	WERL[a]
AS+Fil[a]	Full	6B	NR	1000-10000	14	10.000	99.6	WERL[a]
GAC	Full	237A	NR	100-1000[b]	1	20.000	82	WERL

[a]Data used in developing universal standard.
[b]The influent concentration was reported as between this range.
NR = Not reported
Source: Reference 23.

Table B-18

Treatment Performance Data for Hexachloroethane in Wastewaters

Technology	Technology Size	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
AS	Pilot	241B	NR	100-1000	11	10.000	97.1	WERL
AS+Fil[a]	Full	6B	NR	100-1000	14	10.000	93.8	WERL[a]

[a]Data used in developing universal standard.
NR = Not reported
Source: Reference 23.

Table B-19

Treatment Performance Data – for Methyl Ethyl Ketone in Wastewaters

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
NR	NR	NY0096792	NR	NR	8	3.400	NR	NPDES
NR	NR	NY0072231	NR	NR	10	39.400	NR	NPDES
NR	NR	IN0036072	NR	NR	14	779.360	NR	NPDES
NR	NR	NH0001503	NR	NR	1	27000.000	NR	NPDES
AS	Pilot	241B	NR	100-1000	5	9.000	96.6	WERL
AS	Pilot	252E	NR	100000-1000000	6	900.000	99.7	WERL
AS	Pilot	252E	NR	10000-100000	7	500.000	99	WERL
BT*	NR	CWM	100	2000-19000	3	100.000	98.78	LEACHATE*
BT*	Bench	CWM	100	~7067	3	100.000	98.58	LEACHATE*
PACT®	Bench	Zimpro	NR	2300	1	14.000	99.39	WAO (LIT)
PACT®	Bench	Zimpro	NR	266	1	1.000	99.6	WAO (LIT)
PACT®	Bench	Zimpro	NR	300	1	0.010	99.9	WAO (LIT)
WOx	Pilot	Zimpro	NR	6000000	1	1000.000	99.9	WAO (LIT)
WOx	Full	242E	NR	1000000	NR	2300.000	99.9	WERL
WOx+PACT®	Pilot	Zimpro	100	130000-250000	3	100	99.9	WAO
WOx [B]	Bench	78D	NR	1000000	NR	1000.000	99.9	WERL
WOx [B]	Bench	78D	NR	100000-1000000	NR	1000.000	99.6	WERL

*Data used in developing universal standard.
NR = Not reported
Source: Reference 23.

Table B-20

Treatment Performance Data for Nitrobenzene in Wastewaters

Technology	Technology Size	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Recovery (%)	Removal (%)	Reference
AL	Bench	371D	NR	1000-10000	NR	69.000	NR	97.7	WERL
AS	Full	975B	NR	100-1000	NR	96.000	NR	72	WERL
AS	Full	6B	NR	1000-10000	330	120.000	NR	96.1	WERL
AS	Full	6B	NR	10000-100000	3	150.000	NR	99.8	WERL
AS	Bench	202D	NR	10000-100000	NR	2200.000	NR	97.8	WERL
AS	Bench	200B	NR	100-1000	16	3.000	NR	97.5	WERL
AS	Full	975B	NR	100-1000	NR	3.400	NR	99.48	WERL
AS	Full	6B	NR	1000-10000	28	14.000	NR	99.78	WERL
AS	Pilot	241B	NR	100-1000	4	10.000	NR	92.3	WERL
AS	Full	1B	NR	100-1000[a]	1	23.000	NR	90	WERL
AS	Pilot	241B	NR	100-1000	10	32.000	NR	92.8	WERL
AirS	Bench	1328E	NR	100000-1000000	5	96000.000	NR	16	WERL
BT	Full	P246	NR	821-5559	14	737.000	NR	NR	BDAT[a]
BT+AC	Full	P246	NR	821-90500	18	297.000	NR	NR	BDAT[a]
ChOx	Bench	975B	NR	0-100	NR	2.000	NR	95.9	WERL
LL	Full	K104	30	2200000-3900000	5	2420000.000	115	NR	BDAT
LL	Full.	K103	30	1500000-3000000	5	2200000.000	115	NR	BDAT
LL+SS	Full	K103/ K104	30	1500000-3900000	5	2400.000	115	NR	BDAT
LL+SS+AC	Full	K103/ K104	30	1500000-3900000	4	30.000	115	NR	BDAT
PACT[a]	Bench	190E	NR	100-1000	NR	21.000	NR	96	WERL
PACT[a]	Full	6B	NR	1000-10000	4	14.000	NR	98.8	WERL
PACT[a]	Bench	975B	NR	100-1000	NR	2.000	NR	98.3	WERL
PACT[a]	Bench	200B	NR	100-1000	12	3.700	NR	96.7	WERL
SCOx	Pilot	65D	NR	1000000	NR	22.000	NR	99.99	WERL
SS	Full	P297	NR	87000-330000	10	11793.000	NR	NR	BDAT[a]
SS	Full	P246	NR	91200-1965760	15	251325.000	NR	NR	BDAT[a]
SS+AC[b]	Full	500	14	14-5460000	37	520.300	NR	NR	EAD-OCPSF[b]

Table B-20

(Continued)

Technology	Technology Size	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Recovery (%)	Removal (%)	Reference
SS+AC[c]	Full	2680	14	87000-330000	10	712.600	NR	NR	EAD-OCPSF[a]
SS+AC	Full	P297	NR	87000-330000	10	713.000	NR	NR	BDAT[b]
WOx	Bench	Zimpro	NR	5125000	1	255000.000	NR	95	WAO (LIT)

[a]Data presented in the BDAT Solvents Rule F001-F005 Background Document.
[b]Data used in developing universal standard.
[c]The influent concentration was reported as between this range.
NR = Not reported
Source: Reference 23.

Table B-21

Treatment Performance Data for Pentachlorophenol in Wastewaters

Technology	Technology Size	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
NR	NR	LA0066214	NR	NR	15	10.000	NR	NPDES
NR	NR	TX0001201	NR	NR	9	29.400	NR	NPDES
NR	NR	OH0058874	NR	NR	5	7624.000	NR	NPDES
NR	NR	MS0044580	NR	NR	1	3.000	NR	NPDES
NR	NR	TX0001201	NR	NR	59	41.900	NR	NPDES
NR	NR	M00103349	NR	NR	14	3.700	NR	NPDES
NR	NR	MW0049786	NR	NR	40	3.148	NR	NPDES
NR	NR	NJ0050750	NR	NR	5	18.775	NR	NPDES
NR	NR	LA0065501	NR	NR	6	5.000	NR	NPDES
NR	NR	OH0004961	NR	NR	1	16200.000	NR	NPDES
NR	NR	CT0003751	NR	NR	1	10.000	NR	NPDES
NR	NR	WI0025739	NR	NR	1	40.000	NR	NPDES
NR	NR	WY0032590	NR	NR	34	1.000	NR	NPDES
NR	NR	PA0026531	NR	NR	29	23103.400	NR	NPDES
NR	NR	WY0032590	NR	NR	1	1.000	NR	NPDES
NR	NR	CT0001341	NR	NR	24	64.600	NR	NPDES
NR	NR	NY0001210	NR	NR	1	0.010	NR	NPDES
AL	Pilot	203A	NR	0-100	11	57.000	32	WERL
AL	Pilot	203A	NR	0-100	11	20.000	76	WERL
AL	Pilot	192D	NR	100-1000	NR	10.000	98	WERL
AS	Bench	1050E	NR	100-1000	5	2.800	99.3	WERL
AS	Pilot	192D	NR	100-1000	NR	70.000	86	WERL
AS	Pilot	240A	NR	0-100	9	20.000	60	WERL
AS	Full	673B	NR	1000-10000	29	3600.000	57	WERL
AS	Bench	1691A	NR	100-1000	NR	1.000	99.66	WERL
AS	Bench	202D	NR	1000-10000	NR	170.000	97.9	WERL

Table B-21

(Continued)

Technology	Technology Size	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
AS	Bench	960E	NR	10000-100000	4	5400.000	74	WERL
AS	Full	375E	NR	0-100	7	0.620	15	WERL
AS	Pilot	204A	NR	0-100	8	6.300	17	WERL
AS	Full	375E	NR	0-100	7	0.650	14	WERL
AS	Pilot	203A	NR	0-100	11	3.000	96.4	WERL
AS	Bench	1691A	NR	10000-100000	NR	2.000	99.98	WERL
AS	Full	375E	NR	0-100	7	0.190	63	WERL
AS	Bench	40D	NR	10000-100000	30	68.000	99.66	WERL
AS	Bench	1691A	NR	1000-10000	NR	2.000	99.94	WERL
AS	Full	375E	NR	0-100	7	0.410	39	WERL
BT	Full	PA0008800	NR	NR	6	585.200	NR	NPDES
BT	Full	PA0026247	NR	NR	25	28.600	NR	NPDES
BT	Full	LA0038245	NR	NR	41	44.624	NR	NPDES
CAC	Pilot	203A	NR	0-100	11	50.000	40	WERL
COAG + Sed + BT + Fil	Full	MI0024023	NR	NR	18	20.444	NR	NPDES
Fil	Pilot	673B	NR	1000-10000	28	3400.000	6	WERL
Fil + GAC[c]	Pilot	673B	NR	100-1000	9	20.000	95.6	WERL[a]
GAC	Pilot	673B	NR	1000-10000	28	30.000	99.12	WERL
RBC	Pilot	192D	NR	100-1000	NR	90.000	82	WERL
RO	Pilot	180A	NR	0-100	NR	0.100	86	WERL
TF	Pilot	240A	NR	0-100	10	25.000	39	WERL
TF	Full	375E	NR	0-100	7	0.430	6	WERL
TF	Full	1B	NR	100-1000	6	220.000	35	WERL
TF	Full	1B	NR	0-100	6	14.000	69	WERL
TF	Pilot	203A	NR	0-100	11	82.000	2	WERL
TF	Full	375E	NR	0-100	7	0.500	33	WERL
TF	Full	M00023264	NR	NR	10	12.100	NR	NPDES

Table B-21

(Continued)

Technology	Technology Size	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
WOx	Bench	Zimpro	NR	5000000	1	135000.000	97.3	WAO (LIT)
WOx [B]	Bench	236A	NR	>1000000	1	6000.000	99.88	WERL

*Data used in developing universal standard
NR = Not reported
Source: Reference 23.

Table B-22

Treatment Performance Data for Pyridine in Wastewaters

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
AS	Bench	1054E	NR	1000-10000	NR	1900.000	37	WERL
AnFF[a]	Pilot	235D	NR	1000-10000	NR	0.900	99.9	WERL[a]
WOx+PACT®	Pilot	Zimpro	NR	>180000	3	146.000	99.9	WAO

[a]Data used in developing universal standard.
NR = Not reported
Source: Reference 23.

Table B-23

Treatment Performance Data for Tetrachloroethylene in Wastewaters

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
AL	Full	1B	NR	0-100	6	10.000	80	WERL
AS	Full	1B	NR	0-100	3	10.000	83	WERL
AS	Full	1B	NR	0-100	5	2.000	97.5	WERL
AS	Full	1B	NR	0-100	4	8.000	85	WERL
AS	Full	238A	NR	0-100	3	2.100	87	WERL
AS	Full	1587E	NR	0-100	NR	0.870	97.8	WERL
AS	Full	234A	NR	0-100	NR	22.000	49	WERL
AS	Full	238A	NR	0-100	3	1.600	87	WERL
AS	Full	1B	NR	0-100	4	1.000	96	WERL
AS	Full	234A	NR	100-1000	NR	3.900	96.7	WERL
AS	Full	1B	NR	0-100	5	9.000	75	WERL
AS	Full	1B	NR	100-1000	5	5.000	96.7	WERL
AS	Full	1B	NR	0-100	3	22.000	45	WERL
AS	Full	1B	NR	0-100	6	28.000	71	WERL
AS	Pilot	241B	NR	100-1000	5	11.000	95.3	WERL
AS	Full	1B	NR	1000-10000	6	440.000	85	WERL
AS	Full	201B	NR	0-100	22	8.000	89.5	WERL
AS	Full	1B	NR	0-100	4	6.000	93	WERL
AS	Full	1B	NR	100-1000	6	48.000	79	WERL
AS	Full	1B	NR	100-1000	6	26.000	78	WERL
AS	Full	234A	NR	0-100	NR	0.600	95.9	WERL
AS	Full	1B	NR	0-100	6	8.000	85	WERL
AS	Full	1B	NR	0-100	5	14.000	74	WERL
AS	Full	1B	NR	100-1000	4	100.000	83	WERL
AS+Fil	Full	6B	NR	10000-100000	3	230.000	99.04	WERL
AS+Fil	Full	6B	NR	100-1000	15	11.000	97.7	WERL
AirS	Pilot	221B	NR	0-100[a]	1	0.500	95.8	WERL
AirS	Pilot	71D	NR	0-100[a]	1	0.200	98.7	WERL

Table B-23

(Continued)

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
AirS	Full	223B	NR	100-1000[a]	1	0.800	99.43	WERL
AirS	Pilot	222B	NR	0-100[a]	1	0.200	94.3	WERL
AirS	Pilot	217B	NR	100-1000[a]	1	0.300	99.73	WERL
AirS	Pilot	207B	NR	0-100[a]	1	0.500	98.3	WERL
AirS	Full	69A	NR	0-100	NR	0.960	98.4	WERL
AirS	Pilot	220B	NR	0-100[a]	1	0.200	99.76	WERL
AirS	Pilot	208B	NR	0-100[a]	1	0.200	99.17	WERL
AirS	Pilot	1363E	NR	0-100	NR	0.200	97.1	WERL
AirS	Pilot	214B	NR	100-1000[a]	1	0.900	99.31	WERL
AirS	Full	1042E	NR	100-1000	NR	0.500	99.71	WERL
AirS	Full	322B	NR	100-1000	9	1.200	99.75	WERL
AirS	Pilot	1362E	NR	1000-10000	3	5.000	99.74	WERL
AnFF	Bench	724D	NR	10000-100000	NR	4.400	99.99	WERL
BT	Full	P225	NR	95-31500	18	47.000	NR	BDAT[b]
BT	Full	P280	NR	110-1748	12	10.000	NR	BDAT[b]
BT	Full	F001-F005	NR	62	1	7.300	88.2	BDAT[b]
CAC+AirS	Full	1833D	NR	0-100	7	0.100	89	WERL
ChOx	Pilot	2026A	NR	0-100	4	2.000	86	WERL
ChOx	Pilot	2026A	NR	0-100	4	1.700	84	WERL
Chred	Bench	NR	NR	250	1	5.000	98	ART
GAC	Full	1264B	NR	0-100	NR	1.000	95.2	WERL
GAC	Full	245B	NR	1000-10000[a]	1	10.000	99.13	WERL
GAC	Full	237A	NR	100-1000[a]	1	10.000	96.3	WERL
PACT®	Bench	242E	NR	100-1000	NR	10.000	92.6	WERL
PACT®	Bench	Zimpro	NR	304	NR	1.000	99.7	WAO (LIT)
PACT®	Bench	Zimpro	NR	136	1	10.000	93	WAO (LIT)
RO	Pilot	323B	NR	0-100[a]	1	30.000	68	WERL
RO	Pilot	180A	NR	0-100	NR	0.250	81	WERL

Table B-23

(Continued)

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
SS[a]	Full	913	10	1080-241000	14	18.400	NR	EAD-OCPSF[b]
SS	Full	251B	NR	1000-10000	10	10.000	99.29	WERL
SS	Full	6B	NR	1000-10000	2	10.000	99.95	WERL
TF	Full	1B	NR	0-100	5	12.000	81	WERL
TF	Full	1B	NR	100-100000	5	26.000	83	WERL
TF	Full	1B	NR	0-100	3	18.000	54	WERL
TF	Full	1B	NR	0-100	4	1.000	96.9	WERL
TF	Full	1B	NR	0-100	6	6.000	92.7	WERL
TF	Full	1B	NR	0-100	5	3.000	94.3	WERL
UV(B)	Bench	1138E	NR	0-100[c]	1	7.500	85	WERL
WOx	NR	Zimpro	NR	41000	1	1000.000	97.6	BDAT[a]
WOx	Pilot	78D	NR	1000000	NR	900.000	99.98	WERL

[a]Data used in developing universal standard.
[b]EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.
[c]The influent concentration was reported as between this range.
NR = Not reported
Source: Reference 23.

Table B-24

Treatment Performance Data for Trichloroethylene in Wastewaters

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
AS	Bench	202D	NR	10000-100000	NR	210.000	99.78	WERL
AS	Full	1B	NR	0-100	4	5.000	89	WERL
AS	Full	1B	NR	100-1000	6	2.000	99.23	WERL
AS	Full	6B	NR	100-1000	3	10.000	94.1	WERL
AS	Full	1587E	NR	0-100	NR	0.100	95.7	WERL
AS	Full	375E	NR	0-100	7	2.500	58	WERL
AS	Full	1B	NR	0-100	6	1.000	96.7	WERL
AS	Pilot	206B	NR	100-1000	20	1.500	98.6	WERL
AS	Full	238A	NR	0-100	3	2.100	90.6	WERL
AS	Full	1B	NR	100-1000	4	3.000	97.3	WERL
AS	Pilot	241B	NR	100-1000	5	7.000	96.7	WERL
AS	Full	1B	NR	100-1000	6	64.000	87	WERL
AS	Full	234A	NR	0-100	NR	0.700	71	WERL
AS	Full	201B	NR	0-100	6	13.000	87	WERL
AS	Full	1B	NR	0-100	6	2.000	97.6	WERL
AS	Full	1B	NR	0-100	5	1.000	98.5	WERL
AS	Full	6B	NR	0-100	5	10.000	89	WERL
AS	Full	238A	NR	0-100	3	0.500	94.8	WERL
AS	Full	234A	NR	0-100	NR	0.700	92.3	WERL
AS	Full	1B	NR	100-1000	5	31.000	74	WERL
AS	Full	1B	NR	100-1000	6	87.000	87	WERL
AS	Full	1B	NR	0-100	4	4.000	89.7	WERL
AS	Full	1B	NR	100-1000	6	37.000	92.6	WERL
AS	Full	1B	NR	0-100	5	16.000	72	WERL
AirS	Pilot	1362E	NR	1000-10000	3	1.000	99.94	WERL
AirS	Pilot	209B	NR	100-1000	1	0.800	99.58	WERL
AirS	Full	199B	NR	100-1000	NR	1.500	99.75	WERL
AirS	Pilot	26A	NR	100-1000	NR	27.000	87	WERL

Table B-24

(Continued)

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
AirS	Pilot	216B	NR	100-1000*	1	2.100	98.9	WERL
AirS	Pilot	219B	NR	100-1000*	1	0.500	99.58	WERL
AirS	Pilot	369A	NR	0-100	NR	0.300	99.44	WERL
AirS	Pilot	211B	NR	100-1000*	1	3.100	98.6	WERL
AirS	Pilot	205E	NR	0-100	NR	1.000	97.2	WERL
AirS	Pilot	220B	NR	100-1000*	1	0.200	99.92	WERL
AirS	Pilot	217B	NR	100-1000*	1	1.200	99.69	WERL
AirS	Full	322B	NR	100-1000	10	0.460	99.91	WERL
AirS	Pilot	1327E	NR	1000-10000	NR	190.000	91.3	WERL
AirS	Pilot	212B	NR	0-100*	1	0.400	99.6	WERL
AirS	Full	223B	NR	0-100*	1	0.500	98.2	WERL
AirS	Full	69A	NR	0-100	NR	1.400	98.1	WERL
AirS	Pilot	369A	NR	0-100	NR	3.000	93.2	WERL
AirS	Pilot	221B	NR	0-100*	1	0.500	99.44	WERL
AirS	Pilot	1585E	NR	0-100*	1	4.300	87	WERL
AirS	Pilot	1363E	NR	100-1000	NR	5.000	97.1	WERL
AirS	Pilot	1327E	NR	0-100	NR	4.300	87	WERL
AirS	Pilot	211B	NR	1000-10000*	1	7.700	99.3	WERL
AirS	Full	1042E	NR	0-100	NR	0.300	99.68	WERL
AirS	Pilot	215B	NR	0-100*	1	0.500	98	WERL
AirS	Pilot	208B	NR	0-100*	1	0.700	99.03	WERL
AirS	Pilot	222B	NR	0-100*	1	0.300	99.21	WERL
AirS	Full	322B	NR	1000-10000	7	11.000	99.77	WERL
AirS	Pilot	1585E	NR	1000-10000*	1	170.000	84	WERL
AirS	Pilot	71D	NR	100-1000*	1	5.000	98.5	WERL
AirS	Pilot	207B	NR	0-100*	1	0.500	98.7	WERL
BT	Full	F001-F005	NR	60	1	5.800	90.3	BDAT*
BT	Full	P213	NR	16-76	3	10.000	NR	BDAT*

Table B-24

(Continued)

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
BT	Full	P217	NR	98-224	3	10.000	NR	BDAT[a]
BT	Full	P253	NR	484	1	16.000	96.7	BDAT[a]
BT+AC	Full	P246	NR	40-70	3	10.000	NR	BDAT[a]
CAC+AirS	Full	1833D	NR	0-100	20	0.200	90	WERL
ChOx	Pilot	2026A	NR	0-100	4	3.700	96.2	WERL
ChOx	Pilot	2026A	NR	100-1000	NR	7.100	94.4	WERL
Chred	Pilot	NR	NR	200	1	5.000	97.5	ART
Chred	Bench	NR	NR	280	1	3.900	98.6	ART
Chred	Bench	NR	NR	300	1	0.400	99.9	ART
GAC	Full	1264B	NR	100-1000	NR	1.000	99.36	WERL
GAC	Full	1264B	NR	0-100	NR	1.000	98.8	WERL
GAC	Full	245B	NR	100-1000[c]	1	10.000	97.8	WERL
GAC	Full	1264B	NR	0-100	NR	1.300	98.6	WERL
GAC	Full	245B	NR	1000-10000[c]	1	10.000	99.46	WERL
GAC	Full	237A	NR	100-1000[c]	1	10.000	95.8	WERL
GAC	Pilot	REF20	NR	171	1	0.590	99.7	BDAT[a]
PACT®	Bench	242E	NR	0-100	NR	10.000	89	WERL
PACT®	Bench	Zimpro	NR	326	1	1.000	99.7	WAO (LIT)
PACT®	Bench	Zimpro	NR	90	1	10.000	89	WAO (LIT)
PACT®	Bench	Zimpro	NR	32.8	1	0.005	99.98	WAO (LIT)
RO	Full	250B	NR	100-1000	NR	110.000	78	WERL
RO	Full	250B	NR	0-100	NR	5.500	79	WERL
RO	Pilot	323B	NR	0-100[c]	1	68.000	30	WERL
SS[b]	Full	415	10	59-10300	15	16.100	NR	EAD-OCPSF[a]
SS	Full	251B	NR	1000-10000	10	5.000	99.91	WERL
SS	Full	6B	NR	1000-10000	14	16.000	99.20	WERL
SS	Full	6B	NR	10000-100000	2	10.000	99.97	WERL
SS	Full	251B	NR	1000-10000	10	10.000	99.79	WERL

Table B-24

(Continued)

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
SS[b]	Full	913	10	22900-52700	14	10.000	NR	EAD-OCPSF[a]
SS	Full	P284	NR	10-10300	15	16.000	NR	BDAT[c]
TF	Full	1B	NR	0-100	6	1.000	98.8	WERL
TF	Full	1B	NR	100-1000	5	1.000	99.33	WERL
TF	Full	1B	NR	0-100	5	1.000	98.5	WERL
TF	Full	1B	NR	0-100	5	1.000	98.4	WERL
TF	Full	1B	NR	0-100	6	5.000	93.2	WERL
UV [B]	Bench	1138E	NR	0-100	NR	22.000	56	WERL
WOx	Bench	Zimpro	NR	500000	1	1700.000	99.7	WAO (LIT)
WOx	Bench	Zimpro	NR	300000	1	2000.000	99.3	WAO (LIT)
WOx [B]	Bench	78D	NR	100000-1000000	NR	1700.000	99.66	WERL

[a]EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.
[b]Data used in developing universal standard.
[c]The influent concentration was reported as between this range.
NR = Not reported
Source: Reference 23.

Table B-25

Treatment Performance Data for 2,4,5-Trichlorophenol in Wastewaters

Technology	Technology Size	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
BT[a]	NR	DOW	50	25-1000	3	50.000	90.1	LEACHATE[a]
Gr/Rem	Full	WI0029149	NR	NR	4	8.000	NR	NPDES

[a]Data used in developing universal standard.
NR = Not reported
Source: Reference 23.

Table B-26

Treatment Performance Data for 2,4,6-Trichlorophenol in Wastewaters

Technology	Technology Size	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
NR	NR	PA0033367	NR	NR	1	10.000	NR	NPDES
NR	NR	PA0036650	NR	NR	6	5.170	NR	NPDES
NR	NR	AR0038512	NR	NR	25	3083.510	NR	NPDES
NR	NR	PA0008231	NR	NR	7	7150.000	NR	NPDES
NR	NR	LA0065501	NR	NR	6	10.000	NR	NPDES
NR	NR	AR0038512	NR	NR	20	1294.810	NR	NPDES
NR	NR	CT0001341	NR	NR	30	398.000	NR	NPDES
NR	NR	MI0000868	NR	NR	8	2.000	NR	NPDES
NR	NR	PA0008231	NR	NR	1	10.000	NR	NPDES
NR	NR	LA0066214	NR	NR	15	10.000	NR	NPDES
NR	NR	NJ0005134	NR	NR	18	37.647	NR	NPDES
AS	Full	375E	NR	0-100	7	0.070	42	WERL
AS	Full	375E	NR	0-100	7	0.040	60	WERL
BT*	NR	DOW	10	26-200	3	10.000	90.49	LEACHATE*
BT	Full	PA0026247	NR	NR	25	11.520	NR	NPDES
BT	Full	LA0038245	NR	NR	38	10.466	NR	NPDES
BT	Full	NY0026042	NR	NR	3	5.000	NR	NPDES
BT	Full	MI0022276	NR	NR	22	0.635	NR	NPDES
RO	Pilot	180A	NR	0-100		0.010	98	WERL

*Data used in developing universal standard.
NR = Not reported
Source: Reference 23.

Table B-27

Treatment Performance Data for Vinyl Chloride in Wastewaters

Technology	Technology Scale	Facility	Detection Limit (ppb)	Range of Influent Concentrations (ppb)	No. of Data Points	Average Effluent Concentration (ppb)	Removal (%)	Reference
AS	Full	6B	NR	100-1000	3	50.000	94.9	WERL
AS	Full	1B	NR	1000-10000	6	100.000	94.1	WERL
AS	Full	1B	NR	0-100	4	20.000	80	WERL
AS	Full	1B	NR	10000-100000	6	3900.000	92.9	WERL
AS+Fil	Full	6B	NR	1000-10000	14	50.000	98.3	WERL
AirS	Pilot	217B	NR	0-100[b]	1	0.500	93.1	WERL
AirS	Full	1344E	NR	100-1000	NR	0.100	99.99	WERL
AirS	Full	69A	NR	0-100	NR	0.300	96.4	WERL
SS	Full	251B	NR	1000-10000	10	10.000	99.88	WERL
SS[a]	Full	913	50	50-3500	14	50.000	NR	EAD-OCPSF[a]
SS[a]	Full	725	50	410000-2230000	13	37944.200	NR	EAD-OCPSF[a]
SS	Full	6B	NR	1000000	11	120.000	99.99	WERL

[a]Data used in developing universal standard.
[b]The influent concentration was reported as between this range.
NR = Not reported
Source: Reference 23.

Table B-28

Accuracy Correction Factors for Volatile Organic Constituents Using Industry-Submitted Leachate Data from CWM

Constituent	Matrix Spike Recovery	Accuracy Correction Factor[a]
Acetone	99	1.01
n-Butanol	112[b]	1.0
Isobutanol	112[b]	1.0
Methyl Ethyl Ketone	99	1.01
Methanol	112[b]	1.0
Methyl Isobutyl Ketone	99	1.01
Average = 105.5[b]		
Volatile Average Accuracy Correction Factor (ACF)[c] = 100/100 = 1.00		

[a]The accuracy correction factor is calculated from: ACF = 100/recovery value.
[b]Percent recoveries greater than 100% were set at 100% for the ACF calculation.
[c]The average accuracy correction factor for volatile organics was calculated using the average of the recovery values for each volatile organic constituent (ACF = 100/avg. low value).

Source: Reference 23.

Table B-29

Accuracy Correction Factors for Semivolatile Organic Constituents Using Industry-Submitted Leachate Data from Dow

Constituent	Percent Recovery			Accuracy Correction Factor[a]
	Matrix Spike	Matrix Spike Duplicate	Lowest Recovery Value	
ACID EXTRACTABLES				
Pentachlorophenol	79	83	79	1.3
Phenol	71	74	71	1.4
2-Chlorophenol	72	73	72	1.4
p-Chloro-m-cresol	79	84	79	1.3
4-Nitrophenol	109	100	100	1.0
			Average = 80.2	
Acid Semivolatile Organics Average Accuracy Correction Factor (ACF)[b] = 100/80.2 = 1.25				
BASE/NEUTRAL EXTRACTABLES				
1,2,4-Trichlorobenzene	80	89	80	1.3
Acenaphthene	81	86	81	1.2
2,4-Dinitrotoluene	84	83	83	1.2
Pyrene	87	105	87	1.1
N-Nitroso-n-propylamine	60	65	60	1.7
1,4-Dichlorobenzene	74	82	74	1.4
			Average = 77.5	
Base/Neutral Semivolatile Organics Average Accuracy Correction Factor (ACF)[b] = 100/77.5 = 1.29				

[a]The accuracy correction factor is calculated from ACF = 100/lowest recovery value.
[b]The average accuracy correction factor for semivolatile organics was calculated using the average of the lowest recovery values for each semivolatile organic constituent (ACF = 100/avg. low value).

Source: Reference 23.

Table B-30

EAD Variability Factors for Volatile Organic Constituents

Constituent	EAD Variability Factor
Acrylonitrile	4.83045
Benzene	13.5252
Chloroethane	5.34808
Chloroform	3.71334
Chloromethane	3.79125
1,1-Dichloroethane	5.88383
1,2-Dichloroethane	8.22387
1,1-Dichloroethylene	2.4723
trans-1,2-Dichloroethylene	5.34808
Methylene Chloride	3.86915
Tetrachloroethylene	5.34808
Toluene	7.9506
1,1,1-Trichloroethane	5.34808
1,1,2-Trichloroethane	5.34808
Trichloroethylene	5.34808
Vinyl Chloride	5.34808
	Average = 5.7310
Volatile Organics Average Variability Factor = 5.7310	

Source: Reference 23.

Table B-31

EAD Variability Factors for Semivolatile Organic Constituents

Constituent	EAD Variability Factor
ACID EXTRACTABLES	
2,4-Dimethylphenol	3.2565
4,6-Dinitro-o-cresol	11.5417
2,4-Dinitrophenol	2.45842
4-Nitrophenol	2.47783
Phenol	2.49705
	Average = 4.4463
Acid Semivolatile Organics Average Variability Factor = 4.4463	
BASE/NEUTRAL EXTRACTABLES	
Acenaphthalene	5.89125
Acenaphthene	5.89125
Anthracene	5.89125
Benzo(a)anthracene	5.89125
Benzo(a)pyrene	5.89125
Benzo(k)fluoranthene	5.89125
bis(2-Ethylhexyl)phthalate	5.91768
Chrysene	5.89125
Diethyl Phthalate	4.75961
Dimethyl Phthalate	4.63833
Di-n-butyl Phthalate	3.23768
Fluoranthene	5.89125
Fluorene	5.89125
Naphthalene	5.89125
Nitrobenzene	4.83045
Phenanthrene	5.89125
Pyrene	5.89125
	Average = 5.5340
Base/Neutral Semivolatile Organics Average Variability Factor = 5.5340	

Source: Reference 23.

Appendix C

TRI Release Data Corresponding to the Organic TC Constituents Regulated in D012-D043 Wastes for 1987-1990

This appendix presents the Toxic Release Inventory (TRI) data available to the Agency for the environmental releases of the constituents corresponding to the organic TC wastes (D012-D043). These constituent-specific data were used to develop the tables and figures presented and evaluated in Section 2.0. For the purpose of the evaluation of the TRI data, the Agency divided the TC constituents into five groups: halogenated solvents, non-halogenated solvents, chlorinated phenolics and pesticides, and pesticide TC constituents (D012-D017). A list of the constituents which comprise the non-halogenated solvents, halogenated solvents, and chlorinated phenolics and pesticides groups is presented in Table 2-8.

The constituent-specific TRI release and transfer data for each year from 1987-1990 are presented in this appendix. The TRI data are presented in Tables C-1, C-2, C-3, and C-4 for the halogenated solvents, Tables C-5, C-6, C-7, and C-8 for the non-halogenated solvents, Tables C-9, C-10, C-11, and C-12 for the chlorinated phenolics and pesticides. Since the TRI database provided only limited data on the releases of the pesticide TC wastes (D012-D017), these data are not included in this appendix. Figures 2-4, 2-5, and 2-6 present an evaluation of the TRI releases and transfers of the halogenated solvents, non-halogenated solvents, and chlorinated phenolics and pesticides for the period from 1987-1990.

Table C-1

1987 TRI Releases and Transfers of TC Halogenated Solvents

CAS Number	Chemical	Air Emissions (Pounds)	Surface Water Discharges (Pounds)	Underground Injection (Pounds)	Releases to Land (Pounds)	Transfers to POTWs (Pounds)	Off-site Transfers (Pounds)
56-23-5	Carbon Tetrachloride	4491609	11283	211000	3134	16551	1898593
108-90-7	Chlorobenzene	5173781	62744	56503	18878	559923	5290627
67-66-3	Chloroform	25253417	1216418	161000	39220	895936	2611979
106-46-7	1,4-Dichlorobenzene	1244833	11557	19000	740	87305	126308
107-06-2	1,2-Dichloroethane	6382086	75486	1162844	3173	1391536	4408848
75-35-4	1,1-Dichloroethylene	NA	NA	NA	NA	NA	NA
118-74-1	Hexachlorobenzene	3339	6	522	0	109	656847
87-68-3	Hexachloro-1,3-butadiene	3580	189	70	1	125	1984287
67-72-1	Hexachloroethane	5656	8	197	501	0	831291
127-18-4	Tetrachloroethylene	33207858	162021	354000	5220	468519	9380569
79-01-6	Trichloroethylene	53979996	31551	18720	73283	130836	10426948
75-01-4	Vinyl Chloride	1794472	3578	700	2833	38973	801165
	Total Release or Transfer	131540627	1574841	1984556	146983	3589813	38417462
	Percentage	74.21	0.89	1.12	0.08	2.03	21.67

NA - Data Not Available

Source: Reference 18

Table C-2

1988 TRI Releases and Transfers of TC Halogenated Solvents

CAS Number	Chemical	Air Emissions (Pounds)	Surface Water Discharges (Pounds)	Underground Injection (Pounds)	Releases to Land (Pounds)	Transfers to POTWs (Pounds)	Off-site Transfers (Pounds)
56-23-5	Carbon Tetrachloride	3767421	16447	98054	14759	5014	1349761
108-90-7	Chlorobenzene	4569513	98354	84457	4127	578774	5043055
67-66-3	Chloroform	23871504	1120702	36002	68498	1226573	1469422
106-46-7	1,4-Dichlorobenzene	1891419	6153	4000	1300	37997	138882
107-06-2	1,2-Dichloroethane	4524929	40517	1452084	2166	1476992	2013386
75-35-4	1,1-Dichloroethylene	NA	NA	NA	NA	NA	NA
118-74-1	Hexachlorobenzene	4994	4	410	0	160	965099
87-68-3	Hexachloro-1,3-butadiene	2556	153	220	0	300	3532941
67-72-1	Hexachloroethane	19187	11	520	1	260	649856
127-18-4	Tetrachloroethylene	35614502	33784	72250	106394	586994	5338846
79-01-6	Trichloroethylene	54623373	14050	390	21440	79652	6531916
75-01-4	Vinyl Chloride	1436427	2051	53	4409	17104	675787
	Total Release or Transfer	130325825	1332226	1748440	223094	4009820	27708951
	Percentage	78.82	0.81	1.06	0.13	2.43	16.76

NA - Data Not Available

Source: Reference 18

Table C-3

1989 TRI Releases and Transfers of TC Halogenated Solvents

CAS Number	Chemical	Air Emissions (Pounds)	Surface Water Discharges (Pounds)	Underground Injection (Pounds)	Releases to Land (Pounds)	Transfers to POTWs (Pounds)	Off-site Transfers (Pounds)
56-23-5	Carbon Tetrachloride	3443248	16396	122043	1616	3841	1716644
108-90-7	Chlorobenzene	4051149	62551	82969	6609	312398	4074606
67-66-3	Chloroform	25881082	1208450	114338	70145	1067436	876933
106-46-7	1,4-Dichlorobenzene	1592229	6621	250	250	33941	104091
107-06-2	1,2-Dichloroethane	4382066	227614	1046661	714	1399826	2623097
75-35-4	1,1-Dichloroethylene	NA	NA	NA	NA	NA	NA
118-74-1	Hexachlorobenzene	4591	338	710	0	30	1453803
87-68-3	Hexachloro-1,3-butadiene	3637	622	330	1	100	4213617
67-72-1	Hexachloroethane	22480	421	770	1	250	486536
127-18-4	Tetrachloroethylene	27238228	54940	50005	10791	467501	4230162
79-01-6	Trichloroethylene	49994455	16065	390	8690	31509	4914891
75-01-4	Vinyl Chloride	1269032	2969	391	3899	7925	105396
	Total Release or Transfer	117882197	1596987	1418857	102716	3324757	24799776
	Percentage	79.05	1.07	0.95	0.07	2.23	16.63

NA - Data Not Available

Source: Reference 18

Table C-4

1990 TRI Releases and Transfers of TC Halogenated Solvents

CAS Number	Chemical	Air Emissions (Pounds)	Surface Water Discharges (Pounds)	Underground Injection (Pounds)	Releases to Land (Pounds)	Transfers to POTWs (Pounds)	Off-site Transfers (Pounds)
56-23-5	Carbon Tetrachloride	1671092	4644	31557	1005	42049	1079478
108-90-7	Chlorobenzene	4046799	72893	49406	4267	148728	3747266
67-66-3	Chloroform	21762461	1001446	89560	57897	799120	1153889
106-46-7	1,4-Dichlorobenzene	818133	3912	255	38	12921	180756
107-06-2	1,2-Dichloroethane	5595973	48763	826672	7351	81514	3568409
75-35-4	1,1-Dichloroethylene	NA	NA	NA	NA	NA	NA
118-74-1	Hexachlorobenzene	1468	124	220	0	23	53010
87-68-3	Hexachloro-1,3-butadiene	4906	715	330	0	958	84345
67-72-1	Hexachloroethane	8041	1	1500	334	0	128241
127-18-4	Tetrachloroethylene	21644996	21505	11012	1017	450528	4266258
79-01-6	Trichloroethylene	37897948	14209	805	13154	11341	3619556
75-01-4	Vinyl Chloride	1135809	7291	593	2521	1897	130873
	Total Release or Transfer	94587626	1175503	1011910	87584	1549079	18012081
	Percentage	81.24	1.01	0.87	0.08	1.33	15.47

NA - Data Not Available

Source: Reference 18

Table C-5

1987 TRI Releases and Transfers of TC Non-Halogenated Solvents

CAS Number	Chemical	Air Emissions (Pounds)	Surface Water Discharges (Pounds)	Underground Injection (Pounds)	Releases to Land (Pounds)	Transfers to POTWs (Pounds)	Off-site Transfers (Pounds)
71-43-2	Benzene	31890120	289916	801733	129782	782392	2515590
1319-77-3	Cresols (mixed isomers)	797542	11475	2418718	845704	56210	2703567
108-39-4	m-Cresol	20450	0	0	250	7091	33508
95-48-7	o-Cresol	57382	721	0	3200	15118	116939
106-44-5	p-Cresol	86584	1000	96000	16912	339052	33711
121-14-2	2,4-Dinitrotoluene	99498	11270	203000	261	770000	3952902
78-93-3	Methyl Ethyl Ketone	157919555	76189	75250	59765	724166	48338190
98-95-3	Nitrobenzene	115893	17076	561000	250	8850	684006
110-86-1	Pyridine	298438	4630	303650	28656	209880	354556
	Total Release or Transfer	191285462	412277	4459351	1084780	2912759	58732969
	Percentage	73.89	0.16	1.72	0.42	1.13	22.69

Source: Reference 18

Table C-6

1988 TRI Releases and Transfers of TC Non-Halogenated Solvents

CAS Number	Chemical	Air Emissions (Pounds)	Surface Water Discharges (Pounds)	Underground Injection (Pounds)	Releases to Land (Pounds)	Transfers to POTWs (Pounds)	Off-site Transfers (Pounds)
71-43-2	Benzene	30787947	47763	825035	136691	1146116	2350382
1319-77-3	Cresols (mixed isomers)	769284	6516	1804060	4772	358242	1559595
108-39-4	m-Cresol	18932	283	0	455	7415	139240
95-48-7	o-Cresol	89797	448	1	1667	40703	90523
106-44-5	p-Cresol	640703	1143	152000	62291	744568	27270
121-14-2	2,4-Dinitrotoluene	93257	12055	106400	14961	700000	126336
78-93-3	Methyl Ethyl Ketone	136034011	77304	253762	162163	935896	30806197
98-95-3	Nitrobenzene	40373	5907	819024	2875	5671	1371395
110-86-1	Pyridine	228449	2158	537775	1125	275083	97428
	Total Release or Transfer	168702753	153577	4498057	387000	4213694	36568366
	Percentage	**78.64**	**0.07**	**2.10**	**0.18**	**1.96**	**17.05**

Source: Reference 18

Table C-7

1989 TRI Releases and Transfers of TC Non-Halogenated Solvents

CAS Number	Chemical	Air Emissions (Pounds)	Surface Water Discharges (Pounds)	Underground Injection (Pounds)	Releases to Land (Pounds)	Transfers to POTWs (Pounds)	Off-site Transfers (Pounds)
71-43-2	Benzene	27043080	169947	799132	122444	1178362	1881680
1319-77-3	Cresols (mixed isomers)	897744	7627	2069891	2437	78305	728393
108-39-4	m-Cresol	12601	45	0	0	15588	55715
95-48-7	o-Cresol	59666	311	2	3345	123923	73192
106-44-5	p-Cresol	255484	3421	1800	10000	1507037	745156
121-14-2	2,4-Dinitrotoluene	87293	12657	69000	341	600000	243455
78-93-3	Methyl Ethyl Ketone	134798789	67797	200698	163627	789574	29551913
98-95-3	Nitrobenzene	38791	1287	554025	2814	4750	108436
110-86-1	Pyridine	143003	2365	660281	251	354602	259117
	Total Release or Transfer	163336451	265457	4354829	305259	4652141	33647057
	Percentage	79.07	0.13	2.11	0.15	2.25	16.29

Source: Reference 18

Table C-8

1990 TRI Releases and Transfers of TC Non-Halogenated Solvents

CAS Number	Chemical	Air Emissions (Pounds)	Surface Water Discharges (Pounds)	Underground Injection (Pounds)	Releases to Land (Pounds)	Transfers to POTWs (Pounds)	Off-site Transfers (Pounds)
71-43-2	Benzene	24406849	24943	654068	724429	630669	2228781
1319-77-3	Cresols (mixed isomers)	732604	2336	1634529	3855	57073	649835
108-39-4	m-Cresol	7567	0	0	0	7439	14721
95-48-7	o-Cresol	39146	36	0	255	53066	66247
106-44-5	p-Cresol	239004	1955	1997	2873	879959	80741
121-14-2	2,4-Dinitrotoluene	57583	3735	74000	2153	12	120820
78-93-3	Methyl Ethyl Ketone	121327056	65213	117204	81940	787817	18640870
98-95-3	Nitrobenzene	66260	1419	608000	755	1372	108352
110-86-1	Pyridine	112490	7336	514955	25	264948	175476
	Total Release or Transfer	146988559	106973	3604753	816285	2682355	22085843
	Percentage	83.38	0.06	2.04	0.46	1.52	12.53

Source: Reference 18

Table C-9

1987 TRI Releases and Transfers of Chlorinated Phenolics and Pesticides

CAS Number	Chemical	Air Emissions (Pounds)	Surface Water Discharges (Pounds)	Underground Injection (Pounds)	Releases to Land (Pounds)	Transfers to POTWs (Pounds)	Off-site Transfers (Pounds)
57-74-9	Chlordane	7158	4	19825	0	4035	223695
76-44-8	Heptachlor	8178	2	0	0	57	118550
1024-57-3	Heptachlor Epoxide	NA	NA	NA	NA	NA	NA
87-86-5	Pentachlorophenol	16769	3153	8520	65176	25760	118190
95-95-4	2,4,5-Trichlorophenol	NA	NA	NA	NA	NA	NA
88-06-2	2,4,6-Trichlorophenol	0	250	15500	0	0	0
	Total Release or Transfer	32105	3409	43845	65176	29852	460435
	Percentage	**5.06**	**0.54**	**6.91**	**10.27**	**4.70**	**72.53**

NA - Data Not Available

Source: Reference 18

Table C-10

1988 TRI Releases and Transfers of Chlorinated Phenolics and Pesticides

CAS Number	Chemical	Air Emissions (Pounds)	Surface Water Discharges (Pounds)	Underground Injection (Pounds)	Releases to Land (Pounds)	Transfers to POTWs (Pounds)	Off-site Transfers (Pounds)
57-74-9	Chlordane	575	4	4262	0	23	80809
76-44-8	Heptachlor	49055	2	0	0	37	51935
1024-57-3	Heptachlor Epoxide	NA	NA	NA	NA	NA	NA
87-86-5	Pentachlorophenol	14029	2465	20000	3717	4728	545673
95-95-4	2,4,5-Trichlorophenol	91	0	0	0	0	20
88-06-2	2,4,6-Trichlorophenol	250	50	12000	0	0	10
	Total Release or Transfer	64000	2521	36262	3717	4788	678447
	Percentage	**8.10**	**0.32**	**4.59**	**0.47**	**0.61**	**85.91**

NA - Data Not Available

Source: Reference 18

Table C-11

1989 TRI Releases and Transfers of Chlorinated Phenolics and Pesticides

CAS Number	Chemical	Air Emissions (Pounds)	Surface Water Discharges (Pounds)	Underground Injection (Pounds)	Releases to Land (Pounds)	Transfers to POTWs (Pounds)	Off-site Transfers (Pounds)
57-74-9	Chlordane	3753	4	0	0	37	3099
76-44-8	Heptachlor	3411	2	0	0	51	73292
1024-57-3	Heptachlor Epoxide	NA	NA	NA	NA	NA	NA
87-86-5	Pentachlorophenol	11123	2559	0	6906	8013	87417
95-95-4	2,4,5-Trichlorophenol	250	0	0	0	0	250
88-06-2	2,4,6-Trichlorophenol	116	3515	0	250	0	0
	Total Release or Transfer	18653	6080	0	7156	8101	164058
	Percentage	9.14	2.98	0.00	3.51	3.97	80.40

NA - Data Not Available

Source: Reference 18

Table C-12

1990 TRI Releases and Transfers of Chlorinated Phenolics and Pesticides

CAS Number	Chemical	Air Emissions (Pounds)	Surface Water Discharges (Pounds)	Underground Injection (Pounds)	Releases to Land (Pounds)	Transfers to POTWs (Pounds)	Off-site Transfers (Pounds)
57-74-9	Chlordane	4422	1	0	0	99	523
76-44-8	Heptachlor	3797	1	0	0	58	85306
1024-57-3	Heptachlor Epoxide	NA	NA	NA	NA	NA	NA
87-86-5	Pentachlorophenol	23206	2577	0	1941	4349	75159
95-95-4	2,4,5-Trichlorophenol	NA	NA	NA	NA	NA	NA
88-06-2	2,4,6-Trichlorophenol	78	79	0	0	0	0
	Total Release or Transfer	31503	2658	0	1941	4506	160988
	Percentage	15.63	1.32	0.00	0.96	2.24	79.86

NA - Data Not Available

Source: Reference 18