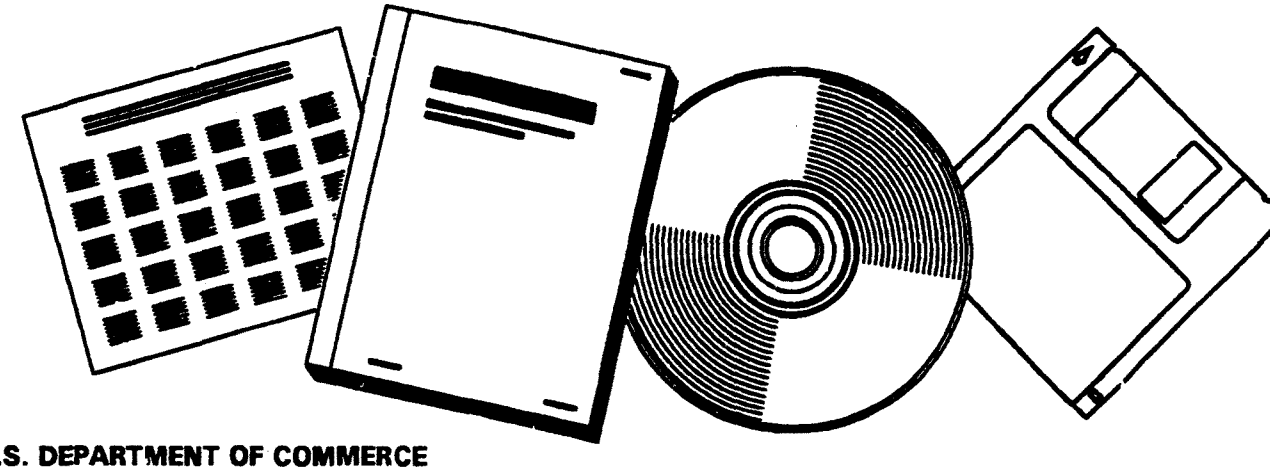
PB95-230876

NTIS
information is our business.

BEST DEMONSTRATED AVAILABLE TECHNOLOGY BACKGROUND DOCUMENT FOR F001-F005 SPENT SOLVENTS

(U.S.) ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC

JUN 92



U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

FINAL

BEST DEMONSTRATED AVAILABLE TECHNOLOGY

BACKGROUND DOCUMENT

FOR

F001-F005 SPENT SOLVENTS

Richard Kinch
Chief, Waste Treatment Branch

Anita Cummings
Project Manager

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

June 1992

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviation/Acronym	Definition
AC	Activated Carbon
ACF	Accuracy Correction Factor
AFF	Aerobic Fixed Film
AirS	Air Stripping
AL	Aerobic Lagoons
AnFF	Anaerobic Fixed Film
APCD	Air Pollution Control Devices
API	API Oil/Water Separator
API	American Petroleum Institute
ART	Articles not part of WERL database
AS	Activated Sludge Biological Treatment
BDAT	Best Demonstrated Available Technology
BGAC	Biological Granular Activated Carbon
BT	Biological Treatment
CAC	Chemically Assisted Clarification
CFR	Code of Federal Regulations
ChOx	Chemical Oxidation
Chred	Chemical Reduction
CWA	Clean Water Act
DAF	Dissolved Air Flotation
DNT	Dinitrotoluene
EAD	Engineering and Analysis Division
EPA	Environmental Protection Agency (United States)
FIL	Filtration
FR	Federal Register

LIST OF ABBREVIATIONS AND ACRONYMS (Continued)

Abbreviation/Acronym	Definition
FWPCA	Federal Water Pollution Control Act
GAC	Activated Carbon (Granular)
HSWA	Hazardous and Solid Waste Amendments
ITD	Industrial Technology Division
LDR	Land Disposal Restrictions
Leachate	Industry Submitted Leachate Data
LL	Liquid-Liquid Extraction
NPDES	National Pollutant Discharge Elimination System
OCPSF	Organic Chemicals, Plastics, and Synthetic Fibers
OER	On-site Engineering Report
OSW	Office of Solid Waste
PACT®	Powdered Activated Carbon Addition to Activated Sludge
RBC	Rotating Biological Contactor
RCRA	Resource Conservation and Recovery Act
RO	Reverse Osmosis
SCOx	Super Critical Oxidation
SExt	Solvent Extraction
SS	Steam Stripping
TCLP	Toxic Characteristic Leaching Procedure
TF	Trickling Filter
TOC	Total Organic Carbon
TSS	Total Suspended Solids
UF	Ultrafiltration
UV	Ultraviolet Radiation

LIST OF ABBREVIATIONS AND ACRONYMS (Continued)

Abbreviation/Acronym	Definition
VF	Variability Factor
WAO	Wet Air Oxidation
WERL	Water Engineering Research Laboratory
WOx	Wet Air Oxidation

1.0 INTRODUCTION

This background document provides technical support for revisions to the best demonstrated available technology (BDAT) treatment standards for the original 26 listed solvent constituents of F001-F005. This document presents:

(1) EPA's rationale and technical support for revising the F001-F005 treatment standards promulgated on November 7, 1986 and August 17, 1988;

(2) EPA's approach to and technical support for the treatment standards for nonwastewater and wastewater forms of F001-F005[1]; and

(3) The revised F001-F005 treatment standards.

The revised treatment standards for nonwastewater and wastewater forms of F001-F005 spent solvents are presented in Table 1-1. These treatment standards supersede those presented in the original F001-F005 Background Document, November 1986, and the Amendment to the F001-F005 Background Document, May 1988. The revised treatment standards for nonwastewater and wastewater forms of F001-F005 are based on the results of EPA-conducted incineration tests and on treatment performance data available to EPA from wastewater treatment units. These treatment standards are applicable to the wastes as listed, or to any wastes generated by the management or treatment of the listed wastes.

---

[1]Wastewaters are defined as wastes containing less than 1% (weight basis) total suspended solids[2] (TSS) and less than 1% (weight basis) total organic carbon (TOC). Wastes not meeting this definition are classified as nonwastewaters and must comply with the nonwastewater treatment standard.

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

Table 1-1

Revised F001-F005 Treatment Standards

	Wastewater		Nonwastewater
Constituents of F001-F005 Spent Solvent Wastes	Treatment Technology[a]	Treatment Standard (mg/l)	Treatment Standard[b] (mg/kg)
Acetone	BT	0.28	160
Benzene[c]	BT, SS, CA, or LL	0.140	36.0
n-Butyl Alcohol	BT	5.6	2.6
Carbon Disulfide	BT	0.014	[e]
Carbon Tetrachloride	BT	0.057	5.6
Chlorobenzene	BT	0.057	5.7
Cresol (m- and p-isomers)	AS	0.77	3.2
O-Cresol	BT	0.11	5.6
Cyclohexanone	BT	0.36	[e]
1,2-Dichlorobenzene	BT	0.088	6.2
Ethyl Acetate	AS	0.34	33
Ethyl Benzene	BT	0.057	6.0
Ethyl Ether	RO	0.12	160
2-Ethoxyethanol[c]	IN or BT	MOT	MOT
Isobutyl Alcohol	BT	5.6	170
Methanol	BT	5.6	[e]
Methylene Chloride	SS	0.089	33
	SS	0.44[d]	33
Methyl Ethyl Ketone	BT	0.28	36
Methyl Isobutyl Ketone	BT	0.14	33
Nitrobenzene	SS+AC	0.068	14
2-Nitropropane[c]	IN, ChOx+CA, or WETOx+CA	MOT	MOT
Pyridine	ANFF	0.014	16
Tetrachloroethylene	SS	0.056	5.6
Toluene	SS	0.08	28
1,1,1-Trichloroethane	SS	0.054	5.6
1,1,2-Trichloroethane[c]	BT, SS, CA, or LL	0.054	5.6
Trichloroethylene	SS	0.054	5.6
Trichloromonofluoromethane	LL+SS+AC	0.02	33
1,1,2-Trichloro-1,2,2-trifluoroethane	AS+Fil	0.057	28
Xylene	WOx	0.32	28

[a] Wastewater treatment technologies on which the treatment standards were based are indicated in this column.
[b] All of the nonwastewater treatment standards were based on incineration.
[c] These treatment standards were promulgated in the Third Third Final Rule and are not being revised.
[d] The treatment standard for wastewaters from the pharmaceutical industry.
[e] The treatment of these constituents is controlled by the regulation of other organic compounds in the waste, unless the constituent is the only hazardous constituent in the waste. In such cases, treatment standards for carbon disulfide, cyclohexanone, and methanol will be 4.81, 0.75, and 0.75 mg/L, respectively, as measured by analysis of TCLP extracts, and promulgated in the Second Third Final Rule.

MOT - Method of treatment.

Key to Treatment Technologies:

AC - Activated carbon.
ANFF - Anaerobic fixed film biological treatment.
AS - Activated sludge biological treatment.
BT - Biological treatment.
CA - Carbon adsorption.
ChOx - Chemical oxidation.
Fil - Filtration.
IN - Incineration.
LL - Liquid-liquid extraction.
RO - Reverse osmosis.
SS - Steam stripping.
WOx - Wet air oxidation.

___+___ is the first process unit followed in process train by the second.

This section briefly presents the background of regulation of F001-F005 solvent wastes, an overview of the revisions to the F001-F005 treatment standards, and a guide to the remaining sections in this document.

1.1 Regulatory Background

On May 19, 1980, under the authority of the Resource Conservation and Recovery Act (RCRA), the Environmental Protection Agency listed 26 commonly used organic solvents as hazardous wastes when spent or discarded. The solvents were listed as EPA hazardous wastes F001, F002, F003, F004, and F005. These listed wastes included certain spent halogenated and non-halogenated solvents and still bottoms from the recovery of these solvents.

The Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act were enacted on November 8, 1984. These amendments restricted all currently listed hazardous wastes from land disposal and required EPA to evaluate and determine maximum concentration levels or required methods of treatment which substantially diminish the toxicity of the wastes or substantially reduce the likelihood of migration of the hazardous constituent from the waste. The Land Disposal Restrictions program was established by EPA to facilitate the development of these treatment standards. The treatment standards were developed based on a best demonstrated available technology (BDAT) methodology as described in Section 2.0.

HSWA required EPA to prepare a schedule by November 8, 1986 for restricting the land disposal of all hazardous wastes listed or identified in 40 CFR Part 261 as of November 8, 1984. Solvent- and dioxin-containing wastes and California List

wastes were covered under a separate schedule set by Congress. The five groups of regulated wastes and their respective dates for promulgation of treatment standards are:

- Solvent and dioxin wastes — November 7, 1986;
- "California List" wastes — July 8, 1987;
- "First Third" wastes — August 17, 1988;
- "Second Third" wastes — June 23, 1989; and
- "Third Third" wastes — June 1, 1990.

After the specified promulgation date (referred to as the "hammer date" for that group), restricted wastes which did not meet the treatment standards were prohibited from land disposal. In addition, HSWA mandated that a particular waste automatically would be prohibited from land disposal if EPA failed to set treatment standards for that waste by these hammer dates (51 FR 40573).

The Agency received numerous comments regarding the interpretation of the spent solvents listings. As a result of the comments in the December 31, 1985 Federal Register (50 FR 53315), EPA clarified that the spent solvents listings cover only those solvents that are used for their "solvent" properties, i.e., to solubilize (dissolve) or mobilize other constituents. A solvent is considered "spent" when it has been used and is no longer fit for use without being regenerated, reclaimed, or otherwise reprocessed. Where solvents are used as reactants or ingredients in the formulation of commercial chemical products, manufacturing process wastes are not covered by the spent solvents listing.

As originally written, the spent solvents listing included only the pure form or the commercial grade of the solvents, and overlooked solvent mixtures. To eliminate this regulatory loophole, the Agency amended the listings by adding the "10 percent rule" (proposed on April 30, 1985 (50 FR 18378)). This rule expands the category of spent solvents considered to be hazardous wastes by including solvent mixtures which contained at least 10 percent (by volume) of total listed solvents before use. The Agency

believed that establishing a threshold level well below the minimum solvent concentration (10 percent) typically used in solvent formulations, would bring the majority of commercial solvent mixtures into the hazardous waste management system while excluding dilute mixtures. The Agency also has data indicating that mixtures with solvent concentrations above 10 percent have been demonstrated to cause substantial harm to human health. The proposed "10 percent rule" became a Final Rule on December 31, 1985 (50 FR 53315).

The final definition of spent solvents did not include four solvents that were added to the F001-F005 listing on February 25, 1986: benzene, 2-ethoxyethanol, 2-nitropropane, and 1,1,2-trichloroethane (51 FR 40607). The current definitions of F001-F005 are given in 40 CFR 261.31 as follows:

- F001 - The following spent halogenated solvents used in degreasing: tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; all spent solvent mixtures/blends used in degreasing containing, before use, a total of 10 percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

- F002 - The following spent halogenated solvents: tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, ortho-dichlorobenzene, and trichlorofluoromethane, and 1,1,2-trichloroethane; all spent solvent mixtures/blends containing, before use, a total of 10 percent or more (by volume) of one or more of the above halogenated solvents or those listed in F001, F004, or F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

- F003 - The following spent non-halogenated solvents: xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, only the above non-halogenated solvents, and, a total of 10 percent or more (by volume) of one or more of those solvents listed in F001, F002, F004, and

F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

- F004 - The following spent non-halogenated solvents: cresols and cresylic acid, and nitrobenzene; all spent solvent mixtures/blends containing, before use, a total of 10 percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

- F005 - The following spent non-halogenated solvents: toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of 10 percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, or F004; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

On November 7, 1986, the Agency promulgated treatment standards for the 26 original F001-F005 solvent constituents. Lab packs containing these solvents were also subject to these treatment standards. The November 7, 1986 rule did not include treatment standards for commercial chemical products, manufacturing chemical intermediates, and off-specification commercial chemical products (U and P wastes) that corresponded to the F001-F005 spent solvent wastes. This final rule also did not include treatment standards for the four solvents that were added to the F001-F005 listing on February 25, 1986: benzene, 2-ethoxyethanol, 2-nitropropane, and 1,1,2-trichloroethane (51 FR 40607); treatment standards for these constituents were promulgated in the Third Third Final Rule (1).

Compliance with these BDAT treatment standards is a prerequisite under 40 CFR Part 268 for placement of F001-F005 spent solvents in land disposal units. The Agency's legal authority and promulgated methodology for establishing treatment standards, and the petition process necessary for requesting a variance from the treatment standards are summarized in EPA's Methodology for Developing BDAT Treatment Standards (2).

The first amendment to the F001-F005 Background Document revised the treatment standard for methylene chloride in wastewaters from pharmaceutical facilities. The revised treatment standard for methylene chloride, based on steam stripping data for wastewaters similar to F001-F005 wastewaters from the pharmaceutical industry, was 0.44 mg/l (51 FR 31152). The First Third final rule, August 17, 1988, promulgated this treatment standard for wastewater forms of methylene chloride from the pharmaceutical industry (3).

This background document supports the second amendment to the Final Best Demonstrated Available Technology (BDAT) Background Document for F001-F005 (November 1986). Although this is an amendment to the original solvents background document, it has not been prepared in amendment form because of the magnitude of change involved. For completeness, this document discusses the determination of BDAT, the treatment performance database, the regulated constituents, and the calculation of the revised BDAT treatment standards. This document does not include discussions regarding the four solvents added to the F001-F005 listing on February 25, 1986: benzene, 2-ethoxyethanol, 2-nitropropane, and 1,1,2-trichloroethane, because the treatment standards for these constituents were promulgated in the Third Third Final Rule in accordance with the current BDAT methodology, and are not being revised at this time.

1.2 Revisions to the F001-F005 Treatment Standards

The treatment standards for the F001-F005 spent solvent wastes, which became effective on November 8, 1986, are being revised to reflect changes in the methodology used to develop the BDAT treatment standards since these treatment standards were originally developed. The revised treatment standards are based on total composition analysis for nonwastewater and wastewater constituents of these wastes with three exceptions.

For reasons discussed in Section 4.0 of this background document, non-wastewater wastes containing carbon disulfide, cyclohexanone, and methanol were not selected for revision of treatment standards.

The revisions to the F001-F005 treatment standards also do not include the four solvents that were added to the solvents listing on February 25, 1986 (benzene, 2-ethoxyethanol, 2-nitropropane, and 1,1,2-trichloroethane) because treatment standards for these constituents were promulgated in the Third Third Final Rule and were developed following the current methodology.

There are four differences between the methodology used to develop the F001-F005 treatment standards in 1986 and the current BDAT methodology. These differences include the measure of performance used; the transfer of treatment performance data; the determination of variability factors; and the use of quantitation limits.

First, during the proposal and promulgation of the original F001-F005 spent solvent treatment standards, performance measurements based on constituent concentrations in the toxicity characteristic leaching procedure (TCLP) extract of incinerator ash were used to determine treatment standards for nonwastewater forms of F001-F005. Under current BDAT methodology, total constituent concentrations in the incinerator ash are used to measure performance.

Second, during the development of the original F001-F005 spent solvent treatment standards, only data for regulated constituents were considered for transfer to constituents for which no treatment performance data were available. Using current BDAT methodology, treatment performance data for any constituent (including constituents not regulated) may be considered for transfer provided that the data represent substantial treatment and are not indicative of upset operating conditions in the treatment system.

Third, during the development of the original F001-F005 spent solvent standards, an average variability factor (used to account for variability in treatment system performance, treatment residual collection, and analysis of the treated waste samples) was calculated for each treatment technology; this average was used in treatment standard calculations when a variability factor could not be calculated. Additionally, in the 1986 treatment standards, some data were used in the average variability factor calculation that were not used in the treatment standard calculations. It is not clear why these data were included in the variability factor calculation since they were excluded from the treatment standard calculation. Since promulgation of the F001-F005 rule, the factor 2.8 has been determined to represent the variability inherent in treatment system operation and sample collection. This value is currently used when a variability factor cannot be determined. See Section 5.2.2 for more detail.

Finally, during the development of the 1986 treatment standards, each standard was compared with the quantitation limit for that corresponding constituent. In cases where the treatment standard represented a lower concentration than the quantitation limit, the treatment standard was set at the quantitation limit. This comparison with the constituent quantification limit did not continue in later rulemakings. The preamble to the Third Third Final Rule (56 FR 22520) states that quantitation limits are intended as guidance for analytical laboratories and do not represent the lowest concentrations that can be detected. Treatment standards are now calculated based on the detection limits achieved for a constituent in a particular matrix. The detection limits achieved by analytical laboratories used in conjunction with EPA-sponsored treatment tests are considered to be representative of any laboratory's capability. Development of treatment standards that are at or above analytical detection limits is further supported by the use of accuracy correction factors, which account for analytical inteferences associated with the chemical matrices of the samples.

1.3 Document Summary

Section 2.0 addresses the determination of the Best Demonstrated Available Technology (BDAT), including: the definitions of applicable, demonstrated and available; descriptions of applicable treatment technologies for non-wastewater and wastewater containing F001-F005 spent solvents; and the procedure for identifying the best demonstrated available technology. Section 3.0 discusses the nonwastewater and wastewater treatment performance data used in determining the revised BDAT treatment standards for F001-F005 spent solvents. Section 4.0 presents the constituents selected for revised regulation. Section 5.0 discusses calculation of the revised BDAT treatment standards. Section 6.0 contains acknowledgements. Section 7.0 lists references.

2.0 DETERMINATION OF THE BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)

This section presents the Agency's determination of applicable and demonstrated technologies, as well as the procedure for identifying the best demonstrated available technology (BDAT) for the treatment of each F001-F005 spent solvent waste. In determining BDAT, the Agency first determines which technologies are applicable for treatment of the waste(s) of interest. The Agency then determines which of the applicable technologies are demonstrated for treatment of the wastes of interest. The next step is to determine which of the demonstrated technologies perform the best. Integral to this determination is the evaluation of all available treatment performance data for the waste(s) of interest. The treatment performance data that were evaluated to determine BDAT for the revision of treatment standards for F001-F005 solvent wastes are presented in Section 3.0. Finally, the Agency determines whether the best demonstrated technology is available for treatment of the waste(s) of interest.

2.1 Applicable Treatment Technologies

To be considered applicable, the theory of treatment for the technology must be usable to treat the waste. Detailed descriptions of technologies that are applicable to treat listed hazardous wastes are provided in EPA's Treatment Technology Background Document (4).

Because nonwastewater and wastewater forms of solvent wastes may contain organic constituents at treatable concentrations, applicable technologies include those that destroy or reduce the total amount of various organic compounds in the waste. Therefore, the Agency has identified the following treatment technologies as potentially applicable for treatment of these wastes:

- Biological treatment (including aerobic fixed film, aerobic lagoons, activated sludge, filtration, anaerobic fixed film, rotating biological contactors, 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);
- Incineration (including fluidized-bed, rotary kiln, and liquid injection incineration);
- 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).

Total recycle or reuse may also be applicable for certain wastes. These treatment technologies were identified based on current waste treatment practices and on engineering judgment.

The concentrations and type(s) of waste constituents present in the waste generally determine which technology is most applicable. For example, wet air oxidation, PACT® treatment, biological treatment, and solvent extraction are applicable for treatment of wastewaters containing up to 1% total organic carbon. Carbon adsorption is applicable for treatment of wastewaters containing less than 0.1% total organic carbon

and is often used as a polishing step following primary treatment by biological treatment, solvent extraction, or wet air oxidation.

A brief discussion of each of the technologies identified as applicable for the treatment of F001-F005 constituents is given below.

Biological Treatment

Biological treatment is a destruction technology in which hazardous organic constituents in wastewaters are biodegraded. This technology generates two treatment residuals: a treated effluent and a waste biosludge. Waste biosludge may be land disposed without further treatment if it meets the applicable BDAT nonwastewater treatment standards for regulated constituents.

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 can be 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 sulfates. This technology generates one treatment residual: treated effluent.

Chemically-Assisted Clarification

Chemically-assisted clarification, including chemical precipitation, is a separation technology in which the addition of chemicals during treatment results in the formation of precipitates from the organic or inorganic constituents 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 be land disposed without further treatment if it meets the applicable BDAT nonwastewater treatment standards for regulated constituents.

Incineration

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

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

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

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

PACT® Treatment

PACT® treatment is a combination of carbon adsorption and biological treatment. It is a destruction technology in which hazardous organic constituents are biodegraded and selectively adsorbed onto powdered-activated carbon. This technology generates two treatment residuals: a treated effluent and spent carbon/biosludge. The spent carbon may be regenerated and recycled to the process or 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 organic constituents. This technology generates two treatment residuals: the treated effluent and the concentrated organic materials that do not pass through the membrane.

Solvent Extraction

Solvent extraction is a separation technology in which hazardous organic constituents are removed from the waste due to greater solubility in the solvent phase than in the waste phase. This technology generates two residuals: a treated waste residual and an extract. The extract may be recycled or incinerated.

Stripping Treatment

Stripping treatment is a separation technology in which volatile organic constituents in a liquid waste are physically transferred to a flowing gas or vapor. In steam stripping, steam contacts the waste, strips the volatile organics, and carries them to a condenser where the mixture of organic vapors and steam is condensed and collected in an accumulator tank. In air stripping, air contacts the waste and strips the volatile organic constituents. This technology generates one treatment residual, the treated effluent. Emissions from stripping treatment may require further treatment.

Wet Air Oxidation

Wet air oxidation is a destruction technology in which hazardous organic constituents in wastes are oxidized 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% organic carbon. Wet air oxidation generates one treatment residual: treated effluent. The treated effluent may require further treatment for hazardous organic constituents by carbon adsorption or PACT® treatment. Emissions from wet air oxidation may also require further treatment.

2.2 Demonstrated Treatment Technologies

To be considered "demonstrated," a technology must be employed in full-scale operation for treatment of the waste in question or a similar waste. Pilot- or bench-scale operations are not considered in identifying demonstrated technologies.

2.2.1 Nonwastewaters

The Agency has identified incineration as a demonstrated technology for treatment of organic constituents in nonwastewater forms of F001-F005. For the Land

Disposal Restrictions program, the Agency conducted full-scale incineration tests using rotary kiln incinerators. At least one incineration test was performed on waste constituents representing each of the basic functional groups believed to be present in organic constituents of F001-F005. The Agency believes that incineration is demonstrated for treatment of all waste constituents tested. Furthermore, the tested constituents represent all of the basic functional groups found in F001-F005. Therefore, the Agency believes that incineration can be considered demonstrated for all of the organic waste constituents found in F001-F005 wastes.

2.2.2 Wastewaters

The Agency has identified all of the technologies listed in Section 2.1 as demonstrated technologies for treatment of organic constituents in wastewater forms of F001-F005. These technologies have been demonstrated in full-scale operation for treatment of wastewaters containing these constituents or similar constituents. Performance data presented in Section 3.0 include data from bench-, pilot-, and full-scale treatment by these technologies.

2.3 Determination of BDAT

As described in EPA's Methodology Document (2), after all applicable and demonstrated treatment technologies are identified for the wastes of interest, 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 employed to ensure the accuracy of the data; and

- Whether the appropriate measure of performance was used to assess the particular treatment technology.

The Agency then determines whether the best demonstrated technology is "available." An available treatment technology is one that (1) is not a proprietary or patented process that cannot be purchased or licensed from the proprietor (i.e., it must be commercially available), and (2) substantially diminishes the toxicity of the waste or substantially reduces the likelihood of migration of hazardous constituents from the waste.

The Agency determined the "best" demonstrated technology for each constituent in F001-F005 by a thorough review of all of the treatment performance data available for each constituent. The treatment performance data that were evaluated are presented in Section 3.0.

2.3.1 Nonwastewaters

As previously stated, the Agency has identified incineration as a demonstrated technology for treatment of the organic constituents in nonwastewater forms of F001-F005. After reviewing the treatment performance data available to EPA, the Agency also believes incineration is the "best" technology for treatment of nonwastewater forms of these wastes. Finally, because commercially available treatment performance data (presented in Section 3.0) revealed substantial treatment from the use of incineration, it is considered available. Therefore, incineration is being identified as BDAT for nonwastewater forms of F001-F005.

2.3.2 Wastewaters

The performance data for demonstrated treatment technologies of F001-F005 came form a variety of sources, as identified in Section 3.2. To determine the best

demonstrated technology for specific constituents in wastewater forms of F001-F005, a hierarchy was established to evaluate the treatment performance data presented in Section 3.0. The Agency believes that data from the Industrial Technology Division (ITD), now the Engineering Analysis Division (EAD), and BDAT programs are superior to data from other sources. The EAD database, described in Section 3.2.3, is a comprehensive source of wastewater treatment performance data and usually represents longer term sampling with a greater number of sample sets than the other wastewater treatment databases, and data generated as part of the BDAT program follow EPA protocols for sampling and analysis procedures.

The following is an outline of the hierarchy for evaluation of treatment performance data which was used to determine the best demonstrated technology for wastewater constituents included in this document. All data used in determining BDAT for a constituent came from the highest performance data source available for that particular constituent.

(1) EAD treatment performance data were used to promulgate an EAD effluent-based limitation standard. The data representing EAD Option I were used in all cases (32).

(2) Agency-sponsored BDAT wastewater treatment test data.

(3) Industry-submitted multi-source leachate treatment performance data, where the data showed substantial treatment.

(4) Other available treatment performance data. Evaluation of these data was based on:

    (a) The treatment technology for which data were available;
    (b) Whether the data represented full-, pilot-, or bench-scale treatment;
    (c) The concentration of the constituent of interest in the influent to treatment;
    (d) The average concentration of the constituent of interest in the effluent from treatment; and
    (e) The removal efficiency of the treatment technology.

The demonstrated technologies identified in Section 2.2 and determined to be best for each constituent as identified in Section 3.0 are all commercially available, and treatment performance data included in Section 3.0 show substantial treatment of the constituent by the technologies. Therefore, the best demonstrated technology for each constituent is considered to be "available," and is BDAT for that constituent.

3.0 TREATMENT PERFORMANCE DATABASE

The revised treatment standards for nonwastewater and wastewater forms of F001-F005 are based on treatment performance data available to EPA from EPA-conducted incineration tests and from wastewater treatment units. The sources of treatment performance data and the basis for transfer of treatment performance data are discussed below.

The nonwastewater and wastewater treatment performance data available to EPA represent:

(1) Data from the organic chemical industries;

(2) Constituent concentrations in the influent that vary greatly; and

(3) Data from well-designed and well-operated wastewater treatment units and incineration tests.

Nonwastewater treatment performance data, based on total composition constituent concentrations in ash, were available from 14 incineration tests conducted by EPA to develop treatment standards for the First, Second, and Third Third Land Disposal Restrictions rulemakings and from 10 incineration tests (Acurex tests) conducted by EPA to characterize stack gas emissions from hazardous waste incinerators (5, 6). Scrubber water data were also collected from the Acurex incineration tests. However, quality assurance data were not collected for the Acurex test; therefore, the data were not used to develop the revised treatment standards for nonwastewater forms of F001-F005. The treatment performance data used to determine BDAT treatment standards for nonwastewater forms of F001-F005 were based solely on the 14 EPA-conducted incineration tests listed in Table 3-1 (6).

Table 3-1

Wastes Tested by Incineration as Part of the Land Disposal Restrictions Program

Test Number	Waste Code(s) Tested	Technology Used	On-Site Engineering Report Reference(s)	Background Document Reference
1	K001-Pentachlorophenol	Rotary Kiln	7	21
2	K001-Creosote	Rotary Kiln	8	21
3[b]	K011, K013, K014	Rotary Kiln	9	NA
4	K019	Rotary Kiln	10	22
5[b]	K024	Rotary Kiln	11	23
6[b]	K037	Rotary Kiln	12	24
7	K048, K051	Fluidized-Bed	13, 14	25
8	K087	Rotary Kiln	15	26
9	K101	Rotary Kiln	16	27
10	K102	Rotary Kiln	17	28
11	F024	Rotary Kiln	18	29
12	K015	Liquid Injection	19	30
13	D014, D016, P059[a], U127[a], U192[a]	Rotary Kiln	20	NA
14	U141[a], U028[a], P020[a], U122[a], U226[a], U239[a], U080[a], U220[a], U166[a], U161[a], U188[a]	Rotary Kiln	20	NA

NA - Not applicable.

[a]Commercial chemical products were used in these incineration tests as surrogates for these wastes.

[b]Data from Tests 3, 5, and 6 were not used in the F001-F005 treatment standard calculations.

Wastewater treatment performance data were available to the Agency from several sources, including literature studies, industry studies, and EPA-sponsored treatment tests. The Agency collected wastewater treatment performance data and developed a wastewater treatment database during the Third Third rule. This database was used to determine the F039 multi-source leachate wastewater treatment standards. Performance data from the treatment of wastewater forms of F001-F005 are included in the wastewater treatment performance database and the Agency used this database to calculate the revised treatment standards for these wastes. Accordingly, the wastewater treatment standards for F001-F005 are being revised based on the same data used to determine the F039 treatment standards; therefore, the treatment standards for wastewater forms of F001-F005 are the same as the treatment standards for wastewater forms of F039.

Section 3.1 discusses the nonwastewater treatment performance data. Section 3.2 gives a brief description of each data source examined for applicable wastewater treatment performance data. Section 3.3 presents the wastewater treatment performance data considered in determining BDAT and the treatment standard for each constituent.

3.1 Nonwastewater Treatment Performance Database

Incineration was determined to be BDAT for nonwastewater forms of F001-F005. Treatment performance data for F001-F005 subject to treatment standard revision were obtained from the 14 EPA-conducted incineration tests, and were used to determine BDAT and to develop treatment standards (Section 5.0) for F001-F005 solvent wastes.

Treatment performance data, to the extent that they were available to EPA, included the concentrations for a given constituent in the untreated and treated wastes, values of operating parameters measured at the time the waste was treated, and

values of relevant design parameters for the treatment technology. Only performance data for the waste constituents of interest are presented in this section. Values of design and operating parameters for each incineration treatment test can be found in the corresponding On-Site Engineering Report for each test (References 7 through 20).

After reviewing the treatment performance data from the 14 incineration tests, the Agency determined that the data from Tests 3, 5, and 6 were not suitable for use in developing treatment standards for the F001-F005 nonwastewaters. Data from Test 3 were not appropriate because the detection limits were significantly higher than the average detection limits for the other incineration tests. In addition, the wastes treated in Test 3 did not contain significant concentrations of the constituents of concern. Data from Tests 5 and 6 were not considered because the wastes treated were K024 (a phthalic anhydride waste) and K037 (a disulfoton waste). These wastes represent unique matrices that the Agency does not believe are representative of solvent waste matrices. Therefore, data from Tests 3, 5, and 6 were not considered further; development of treatment standards was based only on the treatment performance data from the remaining eleven tests.

In most cases, multiple sets of treatment performance data were used to develop treatment standards for the constituents in F001-F005. In cases where an individual waste constituent of concern was detected in the untreated or treated wastes from one or more treatment tests, data from only those tests were used to develop treatment standards for that constituent. If an individual constituent of concern was not detected in any of the untreated or treated wastes from the 11 incineration tests, the detection limits achieved for that constituent in ash from all the tests were used to develop treatment standards.

Table 3-2 presents the detection limits for the F001-F005 constituents in incinerator ash from all 11 incineration tests. More than one detection limit for a constituent in the ash from an incineration test may have been reported. To account for

Table 3-2
SUMMARY OF DETECTION LIMITS FOR WASTE CONSTITUENTS
FROM THE FOURTEEN EPA INCINERATION TESTS*

BDAT No.	Constituent	Test No.** ->	Detection Limit (ppm) 1	2	3	4	5	6	7	8	9	10	11	13	14
222	Acetone		50	50	0.05 a	10	50	50	10	0.05	0.01	3	0.01 a	0.02 a,b	0.02
223	n-Butyl alcohol		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.4	0.4
7	Carbon tetrachloride		2	10	2	2	2	2 a,c	2	0.025	0.005	1.5	0.005	0.01 a,b	0.01
9	Chlorobenzene		2	10	0.002	2	2	2	2	0.025	0.005	1.5	0.005	0.010 a	0.010
82	Cresol (m- and p- isomers)		0.5	0.67	0.01	2	0.5	0.4	0.2	1 a	0.42	1	0.351	0.36	0.36
81	o-Cresol		0.5	0.67	0.01	2	0.5	0.4	0.2	1	0.42	1	0.351	0.36	0.36
67	1,2-Dichlorobenzene		0.5	0.13	0.01	2	0.50	0.4	0.2	1.	0.42	1	0.351 a	0.36	0.36
225	Ethyl acetate		5	10	0.002	NA	2 c	2	NA	NA	NA	NA	NA	0.04	0.04
227	Ethyl ether		50	NA	NA	NA	50	NA	NA	NA	NA	NA	NA	0.01	0.01
33	Isobutyl alcohol		0.2	NA	NA	2	NA	NA	2	1	0.2	60	0.2	1	1
36	Methylene chloride		10	50	50	10	50	50	10	0.025	0.005	1.5	0.005	0.01 b	0.01 a,b
34	Methyl ethyl ketone		10	50	0.05	10	10 a,b	50 b	10	0.025 a,c	0.01	3	0.01 a	0.02	0.02
228	Methyl isobutyl ketone		10	100	0.01	10	10	10	10	0.025	0.01	3	0.01	0.02	0.02 a
126	Nitrobenzene		0.5	0.13	0.01	5	0.5	0.4	0.5	1	0.42	1	0.351	0.36	0.36
39	Pyridine		5	NA	NA	NA	NA	NA	2	2	0.4	120	0.4	0.5	0.5
42	Tetrachloroethylene		2	10	2 a	2	2 c	2	2	0.025	0.005	1.5	0.005 a	0.01 a	0.01
43	Creosote-Toluene		2	10	2 a	2	2 a,b,c	2 a	2 a,b	0.025 a,b,c	0.005	1.5 a	0.005	0.01 a	0.01 a
45	1,1,1-Trichloroethane		2	10	2	2	2	2	2	0.025	0.005	1.5	0.005	0.01	0.01 a
47	Trichloroethylene		2	10	2	2	2	2	2	0.025	0.005	1.5	0.005	0.01	0.01
48	Trichlorofluoromethane		2	10	0.002	2	2	2	2	0.025	0.005	1.5	0.005	0.01	0.01
215-217	Xylenes		2	10	2 a	2	2 c	2	2 a,b	0.025 a	0.005	1.5 a	0.005	0.01	0.01

* Incinerator ash samples were not collected for Test 12. Data from tests 3, 5, and 6 were not used to calculate F001-F005 treatment standards.
** Treatment test number is indicated in Table 3-1.
NA = Not Available
NR = Not Reported
a = Detected in untreated waste.
b = Detected in incinerator ash.
c = Detected in scrubber water.
NOTE: Carbon disulfide, cyclohexanone and methanol are not being regulated for nonwastewater forms of F001-F005.

Table 3-3

WASTE CONSTITUENTS DETECTED IN THE UNTREATED OR TREATED WASTES IN ONE OR MORE OF THE FOURTEEN INCINERATION TESTS

BOAT Number	Waste Constituent	Detected in Treatment Test Number*	Concentration in Untreated Waste (ppm)	Concentration in Ash (ppm)[# of sample sets]**	Concentration in Scrubber Water (ppm)[# of sample sets]**
222	Acetone	3	0.091 - 0.095	<0.05 [7]	<0.05 [6]
		9	<50 - 81	<0.01 [3]	<0.01 [4]
		11	<0.05 - 21,000	<0.01 [6]	<0.01 [6]
		13	0.065	<0.01 [3], 0.02 [1]	<0.01 [4]
7	Carbon tetrachloride	4	3,500 - 4,100	<2.0 [6]	<0.002 [6]
		6	<20	<2.0 [6]	<0.002 [7], 0.0073 [1]
		13	0.017	<0.005[1], 0.008[1], <0.010[1], 0.048[1]	<0.005 [4]
9	Chlorobenzene	4	<2,000 - 3,000	<2.0 [6]	<0.002[6]
		13	0.027	<0.005[1],<0.01[3]	<0.005[4]
82	Cresol (m- and p- isomers)	8	894 - 1,026	<1.0 [5]	<0.010 [6]
81	o-Cresol	4	20	<2.0 [6]	<0.002 [6]
87	1,2-Dichlorobenzene	4	250	<2.0 [6]	<0.002 [6]
		11	302	<0.333 [5], <0.351 [1]	<0.0121 [1], <0.0116 [1], <0.0108 [1], <0.0104 [1], <0.0108 [1], <0.0107 [1]
225	Ethyl acetate	5	<250	<2.0 [3]	<0.002 [7], 0.036 [1], 0.019 [1], 0.020 [1]
39	Methylene chloride	1	<10	<10 [3]	<0.010 [2], 0.061 [1]
		13	<6,300	<0.005[1], 0.090[1], 0.012[1], 0.015[1]	<0.005 [4]
		14	87,000	<0.010 [3], 0.016 [1]	<0.005 [4]
34	Methyl ethyl ketone	4	<1,000 - 10,000	<10 [6]	<0.01 [6]
		5	200 - 800	1100 [1], 780 [1], 460 [1]	<0.01 [10]
		6	<500	395[1],540[1],640[1],380[1],<50[1],<50[1]	<0.050 [6]
		8	<2.0 - 10	<0.025 [5]	<0.010 [5], 0.014 [1]
		11	2,200	<0.010 [6]	<0.01 [6]
229	Methyl isobutyl ketone	1	0.016	<10 [3]	<0.01 [6]
		14	82,000	<0.020 [4]	<0.01 [4]
128	Nitrobenzene	4	0.027 - 8.2	<5.0 [6]	<0.005 [6]

* - Treatment tests are identified by number in Table 3-1. Data from Tests 3,5, and 6 were not used to calculate treatment standards.
** - Number in brackets indicates the number of sample sets for which that value was reported.

Table 3-3 (Continued)

WASTE CONSTITUENTS DETECTED IN THE UNTREATED OR TREATED WASTES IN ONE OR MORE OF THE FOURTEEN INCINERATION TESTS

BDAT Number	Waste Constituent	Detected in Treatment Test Number*	Concentration in Untreated Waste (ppm)	Concentration in Ash (ppm) [# of sample sets]**	Concentration in Scrubber Water (ppm) [# of sample sets]**
39	Pyridine	1	<5.0	<5.0 [3]	<0.005 [5], 0.061 [1]
42	Tetrachloroethylene	3	2.3 - 3.9	<2.0 [7]	<0.002 [7]
		4	6,000 - 7,800	<2.0 [6]	<0.002 [6]
		5	<2.0	<2.0 [3]	<0.002 [5], 0.003 [1]
		11	0.39	<0.005 [6]	<0.005 [6]
		13	0.023	<0.005 [3], <0.01 [1]	<0.005 [4]
43	Toluene	1	10 - 41	<2.0 [3]	<0.002 [3]
		2	100 - 170	<10 [7]	<0.010 [7]
		3	2.3 - 3.6	<2.0 [7]	<0.002 [7]
		4	<2,000	<2.0 [6]	<0.002 [3], 0.0026 [1], 0.0032 [1], 0.0046 [1]
		5	<2.0 - 5.0	2.0 [2], 6.0 [1]	<0.002 [3], 0.002 [1], 0.003 [1], 0.004 [1]
		6	201 - 2,000	<2.0 [6]	<0.002 [6]
		7	22 - 120	<2.0 [5], 3.0 [1]	<0.004 [6]
		8	5.0 - 152	<0.025 [2], 0.085 [1], 0.15 [1], 0.19 [1]	<0.005 [5], 0.009 [2], 0.009 [1]
		9	<25 - 42	<0.005 [4]	<0.005 [4]
		10	5.4 - 23	<1.5 [4]	<0.005 [6]
		13	0.021	<0.005 [3], <0.01 [1]	<0.005 [3]
		14	69,000	<0.01 [4]	<0.005 [4]
45	1,1,1-Trichloroethane	4	33,000 - 81,000	<2.0 [6]	<0.002 [6]
		14	130,000	<0.01 [4]	<0.005 [4]
47	Trichloroethylene	4	2,200 - 3,210	<2.0 [6]	<0.002 [6]
215/ 216/ 217	Xylenes (total)	1	12 - 130	<2.0 [3]	<0.002 [3]
		2	120 - 170	<10 [7]	<0.010 [7]
		3	<2.0 - 7.2	<2.0 [7]	<0.002 [7]
		5	<2.0	<2.0 [3]	<0.002 [5], 0.004 [1]
		7	<14 - 120	<2.0 [5], 5.8 [1]	<0.004 [6]
		8	3.0 - 129	<0.025 [5]	<0.005 [6]
		10	<1.5 - 5.3	<1.5 [4]	<0.005 [6]

* - Treatment tests are identified by number in Table 3-1. Data from Tests 3,5, and 6 were not used to calculate treatment standards.
** - Number in brackets indicates the number of sample sets for which that value was reported.

have been collected to set BDAT standards for wastewater forms of specific hazardous waste codes. In establishing treatment standards for wastewater forms of listed wastes, the Agency prefers to use appropriate wastewater treatment data from well-designed and well-operated wastewater treatment units rather than scrubber water concentrations to develop wastewater treatment standards. (This does not, however, preclude the Agency from establishing treatment standards for other wastes based on constituent concentrations in incinerator scrubber waters.) Therefore, treatment performance data that represented a specific technology applicable to wastewater treatment, such as biological treatment or chemical precipitation, were the only data considered from the BDAT database.

BDAT wastewater treatment performance data were available from waste codes K103, K104, and K062 from the First and Second Third groups of wastes. The wastewater treatment technologies represented by these codes include liquid-liquid extraction, steam stripping, and activated carbon adsorption for organic constituents and chromium reduction followed by chemical precipitation and sedimentation for inorganic constituents.

Additionally, as part of the development of the original BDAT treatment standards for the F001-F005 solvent wastes, the Agency examined data from EAD sampling episodes; these data were presented in the Final BDAT Background Document for F001-F005 (31). The technologies examined included biological treatment, activated carbon adsorption, steam stripping, air stripping, and wet air oxidation. The wastewater treatment performance data presented for F001-F005 constituents have been incorporated into the tables of Section 3.3.

3.2.2 WAO/PACT® Data

For specific U and P waste codes that were regulated in the Third Third Final Rule, a wastewater treatment performance test was conducted on wet air oxidation

(WAO) and PACT® treatment technologies. The treatment performance data from this test are incorporated into the tables of Section 3.3.

3.2.3 EAD Database--Promulgated Limits

In response to the Federal Water Pollution Control Act (FWPCA) of 1972 and the Clean Water Act (CWA) of 1977, EPA promulgated regulations to reduce the level of pollutants in wastewater discharged from industrial point sources using the "Best Available Technology Economically Achievable." The responsibility for developing and promulgating effluent guidelines was assigned to the Industrial Technology Division (ITD), now the Engineering and Analysis Division (EAD) within EPA's Office of Water Regulations and Standards. To date, EAD has promulgated effluent regulations for 27 industrial categories.

The treatment performance data used for EAD's promulgation efforts have been summarized by category in specific effluent limitations guidelines and standards development documents. The treatment performance data from the Final Development Document for Effluent Limitations Guidelines and Standards for the Organic Chemicals, Plastics, and Synthetic Fibers Point Source Category for BDAT List solvent constituents for which EAD effluent limitations exist were incorporated into the tables of Section 3.3.

3.2.4 NPDES Database

Under the Clean Water Act, the discharge of pollutants into the waters of the United States is prohibited unless a permit is issued by the EPA or a state under the National Pollutant Discharge Elimination System (NPDES). An NPDES permit provides effluent limitations for specific pollutants that a facility discharges. The permit also requires monitoring and reporting to show that the effluent limitations are being met. The monitoring data submitted by facilities as part of the NPDES permit program have been summarized by the Agency in an NPDES database.

The NPDES database was searched for the F001-F005 solvent constituents to identify facilities that had monitoring data for these constituents. Constituent data from this search, representing concentrations of constituents in effluents from wastewater treatment, have been incorporated into the tables of Section 3.3. EPA was unable to evaluate whether substantial treatment occurred because the corresponding influent concentrations of the constituents were unavailable. Therefore, NPDES data were only used to calculate standards when other data were unavailable. The treatment technologies or treatment trains represented by the NPDES data were identified in some, but not all, cases. Where available, the treatment technology associated with the data has been specified in the tables of Section 3.3.

3.2.5 WERL Database

U.S. EPA's Risk Reduction Engineering Laboratory, which now includes the former Hazardous Waste Engineering Research Laboratory, has developed and is continuing to expand a database on the treatability of chemicals in various types of waters and wastewaters. This database (hereafter referred to as the WERL database) has been compiled from wastewater treatment performance data available in literature. The treatment performance data for F001-F005 solvent constituents in this database have been included in the tables of Section 3.3.

3.2.6 Leachate Treatment Performance Data

Performance data from the treatment of multi-source leachate were submitted to the Agency just prior to the proposal of the Third Third rule. The data were developed and compiled by a leachate committee composed of several major domestic corporations. This leachate committee was formed in April 1989 following the stay by the U.S. Court of Appeals, D.C. Circuit, of the Land Disposal Restrictions for the First Third group of wastes as it applied to hazardous waste leachate. (Waste Management Inc. v. EPA CADC, No. 88-1581, 8/9/88.)

is described in Section 2.3.2. The methodology used to develop the treatment standards is discussed in Section 5.0.

The tables in this section present the available treatment performance data for each F001-F005 constituent. The data used to determine the revised BDAT treatment standards are indicated with an asterisk. The discussion that precedes each data table specifies the BDAT technology identified and discusses the data that were considered in determining the revised concentration-based treatment standard. More information on the development of these wastewater treatment standards is found in Reference 6. Table 3-4 and Table 3-5 are database and treatment technology keys, respectively, for the data tables presented in Sections 3.3.1 to 3.3.26.

Table 3-4

Wastewater Treatment Performance Database Key

Code	Database
BDAT	Best Demonstrated Available Technology
EAD	Engineering and Analysis Division (formerly the Industrial Technology Division)
LEACHATE	Industry Submitted Leachate Data
NPDES	National Pollutant Discharge Elimination System
WAO	Wet Air Oxidation
WERL	Waste Engineering Research Laboratory
ART	Articles not part of WERL database

Table 3-5

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)
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
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, i.e., AS + Fil - Activated Sludge followed by Filtration.

"__w__" indicates that the two units are used together, i.e., UFwPAC - Ultrafiltration using Powdered Activated Carbon.

"__[B]" indicates batch instead of continuous flow.

3.3.1 Acetone

The data available for acetone were compiled from the WERL and NPDES databases, wet air oxidation (WOx) data from literature, and leachate treatment performance data submitted by industry. They are presented in Table 3-6. Technologies for which data are available include BT, AS, GAC, PACT®, RO, SS, and WOx. The treatment performance data represent bench-, pilot-, and full-scale studies. The resulting effluent concentrations ranged from 0.846 ppb to 10,000 ppb.

Based on industry-submitted leachate data available for acetone, BDAT for acetone was identified as BT. The BDAT treatment standard for acetone was calculated using the effluent concentration of 100 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for acetone (0.28 ppm) is described in Section 5.0 and is shown in Table 5-3.

TABLE 3-6
WASTEWATER TREATMENT PERFORMANCE DATA
FOR ACETONE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		NY0084859			8	126.000			NPDES
		NH0001376			10	620.560			NPDES
		MA0000442			10	806.000			NPDES
		NY0107760			14	296.429			NPDES
		CT0001341			23	420.000			NPDES
		AZ0000108			11	0.946			NPDES
		AZ0000108			11	1.000			NPDES
		AZ0000108			11	1.000			NPDES
		MA0000442			4	31.000			NPDES
		NY0081868			8	804.986			NPDES
		NY0107484			16	1010.760			NPDES
AS	Pilot	241B		1000-10000	5	28.000		98.5	WERL
AS	Full	116BE		10000-100000		1100.000		97.1	WERL
GAC	Full	245B		1000-10000	1	50.000		95.9	WERL
PACT	Bench	242E		100-1000		20.000		91.4	WERL
PACT	Bench	Zimpro		233	1	20.000		91	WAO
RO	Full	250B		1000-10000		200.000		81	WERL
RO	Full	250B		10000-100000		5800.000		78	WERL
SS	Pilot	1082E		10000-100000		10000.000		80	WERL
WOx	Full	242E		1000000		230.000		99.99	WERL
WOx [B]	Bench	78D		1000000		10000.000		99.4	WERL
* BT		CWM	100	1900-10000	3	100		97.92	LEACHATE
* BT	Bench	CWM	100	9133	3	100		98.91	LEACHATE

* Data used in developing the revised treatment standard.

3.3.2 n-Butyl Alcohol

The data available for n-butyl alcohol were compiled from the WERL database and leachate treatment performance data submitted by industry. These data are presented in Table 3-7. Technologies for which data are available include full-scale AS and BT. The resulting effluent concentrations ranged from 40 ppb to 2,000 ppb.

Based on industry-submitted leachate data available for n-butyl alcohol, BDAT for n-butyl alcohol was identified as BT. The BDAT treatment standard for n-butyl alcohol was calculated using an effluent concentration of 2,000 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for n-butyl alcohol (5.6 ppm) is described in Section 5.0 and is shown in Table 5-3.

TABLE 3-7
WASTEWATER TREATMENT PERFORMANE DATA
FOR n-BUTYL ALCOHOL

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AS	Full	1168E		10000-100000		40.000		99.79	WERL
* ST		CWM	2000	2800	1	2000		28.57	LEACHATE

* Data used in developing the revised treatment standard.

3.3.3 Carbon Disulfide

The data available for carbon disulfide were compiled from the NPDES data for one facility and leachate treatment performance data submitted by industry. These data are presented in Table 3-8. The technology for which data are available was BT; the resulting effluent concentration was 5 ppb.

Based on industry-submitted leachate data available for carbon disulfide, BDAT for carbon disulfide was identified as BT. The BDAT treatment standard for carbon disulfide was calculated using the effluent concentration of 5 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for carbon disulfide (0.014 ppm) is described in Section 5.0 and is shown in Table 5-3.

TABLE 3-8
WASTEWATER TREATMENT PERFORMANCE DATA
FOR CARBON DISULFIDE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		NY0000345			2	55.000			NPDES
* BT		EMELLE	5	10	1	5		50	LEACHATE
* BT		BFI	5	260	1	5		98.07	LEACHATE

* Data used in developing the revised treatment standard.

3.3.4 Carbon Tetrachloride

The data available for carbon tetrachloride were compiled from the WERL database, BDAT Solvents Rule data, and WOx and PACT® data from literature. These data are presented in Table 3-9. Technologies for which data are available include AL, AS+Fil, AirS, BT, CAC, GAC, PACT®, RO, SCOx, SS, TF, and WOx. The treatment performance data represent bench-, pilot, and full-scale studies. The resulting effluent concentrations ranged from 0.200 ppb to 12,000 ppb.

BDAT for carbon tetrachloride was identified as BT. BT was selected as BDAT because it represents full-scale data developed from EAD sampling and was used as part of the BDAT Solvents Rule. The effluent concentration achievable by this technology is supported by similar effluent concentrations from the SS and GAC treatment performance data. The BDAT treatment standard for carbon tetrachloride was calculated using the effluent concentration of 10 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for carbon tetrachloride (0.057 ppm) is described in Section 5.0 and is shown in Table 5-3.

TABLE 3-9
WASTEWATER TREATMENT PERFORMANCE DATA
FOR CARBON TETRACHLORIDE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AL	Pilot	203A		0-100	14	11.000		84	WERL
AL	Pilot	203A		0-100	14	15.000		78	WERL
AS	Pilot	203A		0-100	14	13.000		81	WERL
AS	Full	1B		100-1000	6	16.000		98	WERL
AS	Pilot	206B		0-100	20	0.200		99.87	WERL
AS	Full	975B		0-100		3.000		94.8	WERL
AS	Bench	202D		10000-100000		130.000		99.32	WERL
AS	Full	6B		100-1000	3	10.000		98.7	WERL
AS	Pilot	241B		100-1000	5	5.000		98.3	WERL
AS	Pilot	240A		0-100	12	4.000		90.7	WERL
AS+Fil	Full	6B		1000-10000	14	10.000		99.09	WERL
AS+Fil	Full	6B		10000-100000	2	10.000		99.96	WERL
AirS	Bench	1328E		10000-100000	5	7600.000		89	WERL
* BT	Full	P225		51-44000	17	10.000			BDAT # *
BT	Full	REF4		95	1	5.500			BDAT #
CAC	Pilot	203A		100-1000	14	101.000		0	WERL
GAC	Full	1264B		0-100		1.000		87	WERL
GAC	Full	237A		0-100	1	10.000		89	WERL
PACT	Bench	242E		1000-10000		30.000		96.5	WERL
PACT	Bench	Zimpro		880	1	1.000		99.9	WAO
PACT	Bench	Zimpro		2000	1	30.000		98.5	WAO
RO	Pilot	323B		100-1000	1	2.000		98	WERL
SCOx	Pilot	65D		100-1000		20.000		96.5	WERL
SS	Full	251B		10000-100000	10	5.000		99.99	WERL
SS	Full	251B		1000-10000	10	10.000		99.41	WERL
TF	Pilot	203A		0-100	14	28.000		62	WERL
TF	Pilot	240A		0-100	12	4.000		90.7	WERL
WOx	Bench	Zimpro		4330000	1	12000.000		99.7	WAO
WOx	Full	242E		1000000		2000.000		99.92	WERL

* Data used in developing the revised treatment standard.
# EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.

3.3.5 Chlorobenzene

The data available for chlorobenzene were compiled from the WERL database, BDAT Solvents Rule data, and PACT® and WOx data from literature. These data are presented in Table 3-10. Technologies for which data are available include AFF, AL, AS, AirS, BGAC, BT, BT + AC, GAC, PACT®, RO, SS, and WOx. The treatment performance data represent bench-, pilot-, and full-scale studies. The resulting effluent concentrations ranged from 0.200 ppb to 1,550,000 ppb.

BDAT for chlorobenzene was identified as BT. BT was selected as BDAT because it represents full-scale data developed from EAD sampling and was used as part of the BDAT Solvents Rule. The effluent concentration achievable by this technology is supported by similar effluent concentrations from the AS and PACT® treatment performance data. The BDAT treatment standard for chlorobenzene was calculated using the effluent concentration of 10 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for chlorobenzene (0.057 ppm) is described in Section 5.0 and is shown in Table 5-3.

TABLE 3-10
WASTEWATER TREATMENT PERFORMANCE DATA
FOR CHLOROBENZENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AFF	Bench	501A		0-100	9	1.000		90.7	WERL
AL	Bench	371D		1000-10000		160.000		94.7	WERL
AS	Bench	200B		100-1000	12	1.100		99.17	WERL
AS	Bench	200B		100-1000	6	1.300		99.81	WERL
AS	Full	975B		100-1000		6.000		94.6	WERL
AS	Full	6B		100-1000	4	10.000		98.9	WERL
AS	Bench	200B		0-100	8	0.200		99.23	WERL
AS	Full	975B		100-1000		10.000		94.6	WERL
AS	Full	975B		0-100		6.000		84	WERL
AS	Full	1B		100-1000	6	3.000		98.9	WERL
AS	Pilot	206B		100-1000	20	1.300		99.34	WERL
AS	Pilot	241B		100-1000	5	4.000		96.6	WERL
AS	Full	975B		100-1000		12.000		97.6	WERL
AirS	Bench	1328E		1000-10000	5	1600.000		77	WERL
AirS	Bench	1328E		10000-100000	5	3300.000		89	WERL
BGAC	Bench	501A		0-100	23	0.280		97.6	WERL
BT	Full	P208		929-49775	8	841.000			BDAT #
BT	Full	P246		10-3040	13	101.000			BDAT #
BT	Full	P263		443-832	3	504.000			BDAT #
BT	Full	REF4		1900	1	12.000			BDAT #
* BT	Full	P202		79-429	20	10.000			BDAT # *
BT+AC	Full	P246		10-7200	16	30.000			BDAT #
GAC	Full	245B		100-1000	1	10.000		96.6	WERL
GAC	Full	245B		1000-10000	1	10.000		99.7	WERL
GAC	Full	237A		1000-10000	1	10.000		99.17	WERL
GAC	Full	1421D		0-100		0.250		58	WERL
PACT	Full	6B		1000-10000	4	10.000		99.39	WERL
PACT	Bench	200B		100-1000	11	0.800		99.37	WERL
PACT	Bench	242E		0-100		5.000		84	WERL
PACT	Bench	Zimpro		31	1	5.000		84	WAO
RO	Pilot	323B		0-100	1	12.000		50	WERL
RC	Full	250B		0-100		4.000		53	WERL
RO	Full	250B		1000-10000		120.000		91.6	WERL
SS	Full	261B		100-1000	10	10.000		97.4	WERL
WOx	Bench	Zimpro		5535000	1	1550000.000		72	WAO
WOx	Bench	Zimpro		792000	1	61000.000		92.3	WAO

EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.
* Data used in developing the revised treatment standard.

3.3.6 meta/para-Cresol

Currently, reliable analytical methods for the separation and subsequent measurement of meta- and para-cresol do not exist. Therefore, the Agency feels it is appropriate to measure and regulate both isomers under one combined listing. The data available for meta/para-cresol were compiled from the WERL database and are presented in Table 3-11. Technologies for which data are available include API+DAF+AS, AS, AnFF, RO, and SExt. The treatment performance data represent bench-, pilot-, and full-scale studies. The resulting effluent concentrations ranged from 72 ppb to 17,000 ppb.

BDAT for meta/para-cresol was identified as AS. Activated sludge was selected as BDAT because it represents a demonstrated technology with a high removal efficiency, and was also the BDAT chosen for the ortho isomers of cresol. The BDAT treatment standard for meta/para-cresol was calculated using the effluent concentration of 174 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for meta/para-cresol (0.77 ppm) is described in Section 5.0 and is shown in Table 5-3.

TABLE 3-12
WASTEWATER TREATMENT PERFORMANCE DATA
FOR ortho-CRESOL

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRAION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AnFF	Bench	230A		100000-1000000		28000.000		78	WERL
AnFF	Pilot	235D		10000-100000		7800.000		95	WERL
AnFFwGAC	Pilot	249D		100000-1000000		8800.000		98.7	WERL
* BT	Full	REF5		1888-2536	2	25.000			BDAT * #
RO	Full	250B		100-1000		14.000		98.5	WERL

EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.
* Data used in developing the revised treatment standard.

3.3.8 Cyclohexanone

Wastewater treatment performance data were not available for cyclohexanone from any of the examined sources. Treatment performance data were therefore transferred to this constituent from methyl ethyl ketone, which was judged to be most similar to cyclohexanone in elemental composition and functional groups. The treatment performance data that were transferred from methyl ethyl ketone to cyclohexanone are presented in Table 3-20. BDAT for cyclohexanone was determined to be BT. A treatment standard of 0.36 ppm was calculated for cyclohexanone as described in Section 5.0 and shown in Table 5-3. The methyl ethyl ketone treatment performance data are discussed in more detail in Section 3.3.16 of this document.

3.3.9 1,2-Dichlorobenzene

The data available for 1,2-dichlorobenzene were compiled from the WERL database, BDAT Solvents Rule data, and WOx data from literature. These data are presented in Table 3-13. Technologies for which data are available include AFF, AL, AS, AirS, BGAC, BT, BT + AC, GAC, PACT®, RBC, RO, and WOx. The treatment performance data represent bench-scale, pilot-scale, and full-scale studies. The resulting effluent concentrations ranged from 0.090 ppb to 2,017,000 ppb.

BDAT for 1,2-dichlorobenzene was identified as BT. BT was selected as BDAT because it represents full-scale data developed from EAD sampling and was used as part of the BDAT Solvents Rule. The effluent concentration achievable by this technology is supported by similar effluent concentrations from the WERL activated sludge treatment performance data. The BDAT treatment standard for 1,2-dichlorobenzene was calculated using the effluent concentration of 16 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for 1,2-dichlorobenzene (0.088 ppm) is described in Section 5.0 and is shown in Table 5-3.

TABLE 3-13
WASTEWATER TREATMENT PERFORMANCE DATA
FOR 1,2-DICHLOROBENZENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRAION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AFF	Bench	501A		0-100	25	0.380		96	WERL
AL	Pilot	192D		100-1000		10.000		97.7	WERL
AL	Pilot	192D		1000-10000		100.000		94.6	WERL
AL	Bench	371D		1000-10000		72.000		97.6	WERL
AS	Full	1B		100-1000	4	6.000		96	WERL
AS	Full	6B		1000-10000	3	52.000		98.5	WERL
AS	Pilot	192D		1000-10000		110.000		94.3	WERL
AS	Pilot	192D		100-1000		270.000		37	WERL
AS	Full	6B		100-1000	330	35.000		96.2	WERL
AS	Full	1B		100-1000	2	5.000		96.2	WERL
AS	Full	1B		0-100	3	2.000		94.3	WERL
AS	Full	6B		1000-10000	4	16.000		99.33	WERL
AS	Bench	200B		100-1000	14	8.000		92.7	WERL
AS	Full	1B		100-1000	5	10.000		91.7	WERL
AS	Full	1587E		0-100		1.200		79	WERL
AS	Bench	202D		10000-100000		80.000		99.94	WERL
AS	Pilot	241B		100-1000	10	25.000		93.2	WERL
AS	Bench	1050E		100-1000	5	1.800		98.6	WERL
AS	Full	376E		0-100	7	5.000		67	WERL
AS	Full	6B		100-1000	3	10.000		92.9	WERL
AS	Bench	1054E		100-1000		8.000		98.4	WERL
AirS	Bench	1328E		10000-100000	5	6200.000		74	WERL
AirS	Pilot	222B		0-100	1	0.500		83	WERL
BGAC	Bench	501A		0-100	34	0.310		96.8	WERL
BT	Full	P246		766-2801	14	596.000			BDAT #
* BT	Full	P202		1350-4367	4	16.000			BDAT # *
BT	Full	P206		233-2333	10	88.000			BDAT #
BT+AC	Full	P246		766-3276	17	176.000			BDAT #
GAC	Full	245B		100-1000	1	10.000		98.9	WERL
GAC	Full	1421D		0-100		0.270		90	WERL
PACT	Bench	242E		0-100		5.000		83	WERL
PACT	Bench	200B		100-1000	14	2.900		97.5	WERL
PACT	Full	6B		1000-10000	10	68.000		98.5	WERL
PACT	Full	6B		100-1000	4	64.000		90	WERL
RBC	Pilot	192D		100-1000		10.000		97.7	WERL
RO	Pilot	323B		0-100	1	11.000		70	WERL
RO	Pilot	180A		0-100		0.090		82.5	WERL
WOx	Bench	Zimpro		590000	1	150000.000		74.6	WAO
WOx	Bench	Zimpro		6530000	1	2017000.000		69.1	WAO
WOx	Pilot	78D		>1000000		29000.000		98.7	WERL

EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.
* Data used in developing the revised treatment standard.

3.3.10 Ethyl Acetate

The data available for ethyl acetate were compiled from the WERL database and the EPA WAO test. These data are presented in Table 3-14. The technologies for which data are available include AS and WOX. The treatment performance data represent bench- and pilot-scale studies. The effluent concentrations ranged from 60 ppb to 580 ppb.

BDAT for ethyl acetate was identified as AS. AS was selected as BDAT because the data show a high influent concentration and a high removal efficiency. The AS data were preferred over the EPA WAO test data due to the lower effluent values achieved by activated sludge treatment. The BDAT treatment standard for ethyl acetate was calculated using the effluent concentration of 60 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for ethyl acetate (0.34 ppm) is described in Section 5.0 and is shown in Table 5-3.

TABLE 3-14
WASTEWATER TREATMENT PERFORMANE DATA
FOR ETHYL ACETATE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
* AS	Bench	2000		1000-10000		60,000		98.4	WEFL
WOx	Pilot	Zimpro	130	630000-770000	3	680,000			WAO

* Data used in developing the revised treatment standard.

3.3.11 Ethyl benzene

The data available for ethyl benzene were compiled from the WERL database, BDAT Solvents Rule data, and PACT® and WOx data from literature. These data are presented in Table 3-15. Technologies for which data are available include AL, AL + AS, AS, API + DAF + AS, AS + Fil, AirS, AirS + GAC, BT, CAC, GAC, PACT®, RO, SS, TF, UF, and WOx. The treatment performance data represent bench-, pilot-, and full-scale studies with resulting effluent concentrations ranging from 0.020 ppb to 30,000 ppb.

BDAT for ethyl benzene was identified as BT. BT was selected as BDAT because it represents full-scale data developed from EAD sampling and was used as part of the BDAT Solvents Rule. The effluent concentration achievable by this technology is supported by similar effluent concentrations from the WERL AS treatment performance data. The BDAT treatment standard for ethyl benzene was calculated using the effluent concentration of 10 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for ethyl benzene (0.057 ppm) is described in Section 5.0 and is shown in Table 5-3.

TABLE 3-15
WASTEWATER TREATMENT PERFORMANCE DATA
FOR ETHYL BENZENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AL	Pilot	203A		100-1000	14	12.000		89	WERL
AL	Pilot	203A		100-1000	14	27.000		76	WERL
AL	Full	1B		0-100	4	10.000		69	WERL
AL+AS	Full	233D		1000-10000	21	4.000		99.93	WERL
API+DAF+AS	Full	1482D		10000-100000	4	3.300		99.96	WERL
AS	Bench	200B		100-1000	6	0.700		99.89	WERL
AS	Full	201B		0-100	18	6.000		92.8	WERL
AS	Pilot	206B		0-100	20	0.200		99.76	WERL
AS	Full	6B		100-1000	3	10.000		98.2	WERL
AS	Full	238A		0-100	3	0.500		97.2	WERL
AS	Pilot	240A		0-100	14	1.000		98.4	WERL
AS	Full	6B		100-1000	24	10.000		94.4	WERL
AS	Full	234A		0-100		0.200		99 14	WERL
AS	Full	234A		0-100		0.200		99.22	WERL
AS	Bench	202D		10000-100000		80.000		99.87	WERL
AS	Full	6B		1000-10000	4	10.000		99.47	WERL
AS	Full	975B		1000-10000		8.000		99.8	WERL
AS	Full	1B		0-100	6	9.000		90.7	WERL
AS	Full	975B		100-1000		10.000		98.4	WERL
AS	Full	1B		0-100	4	3.000		89	WERL
AS	Pilot	241B		100-1000	5	5.000		57.8	WERL
AS	Full	1B		0-100	3	5.000		89	WERL
AS	Full	1B		0-100	5	1.000		98.1	WERL
AS	Full	1B		0-100	4	1.000		97.7	WERL
AS	Full	1B		0-100	5	5.000		79	WERL
AS	Full	6B		1000-10000	3	25.000		98.7	WERL
AS	Full	1B		0-100	3	3.000		93.4	WERL
AS	Full	975B		0-100		8.000		87	WERL
AS	Pilot	203A		100-1000	14	6.000		94.6	WERL
AS	Pilot	REF2		23600	6	388.000			BDAT #
AS	Full	1B		100-1000	6	4.000		97.5	WERL
AS	Full	1B		100-1000	3	2.000		99.28	WERL
AS	Full	1B		100-1000	4	1.000		99.17	WERL
AS	Bench	200B		0-100	9	0.500		99.5	WERL
AS	Full	6B		100-1000	7	10.000		97.9	WERL
AS	Full	6B		100-1000	15	10.000		98.9	WERL
AS	Full	6B		100-1000	29	10.000		97.4	WERL
AS	Full	1B		0-100	4	8.000		89	WERL
AS	Full	6B		10000-100000	7	10.000		99.97	WERL
AS	Bench	200B		100-1000	12	0.600		99.5	WERL

EAD Data presented in the BDAT Solvents Rule F001-F005 Background Document.

TABLE 3-15 (Continued)
WASTEWATER TREATMENT PERFORMANCE DATA
FOR ETHYL BENZENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AS+Fil	Full	6B		0-100	15	10.000		90	WERL
AirS	Pilot	224B		0-100	1	0.500		91.9	WERL
AirS	Full	69A		0-100		0.300		94.1	WERL
AirS+GAC	Full	229A		0-100	19	1.000		80	WERL
* BT	Full	P211		12923-80000	7	10.000			BDAT # *
* BT	Full	P234		10-3950	33	10.000			BDAT # *
* BT	Full	P221		10-140	3	10.000			BDAT # *
* BT	Full	P233		2287-3595	2	10.000			BDAT # *
* BT	Full	P236		220-3350	2	10.000			BDAT # *
* BT	Full	P215		564-4150	3	10.000			BDAT # *
* BT	Full	P242		190-553	2	10.000			BDAT # *
* BT	Full	P244		606	1	10.000			BDAT # *
BT	Full	P257		63-3645	27	12.000			BDAT #
* BT	Full	P202		96-596	20	10.000			BDAT # *
* BT	Full	P230		101-3040	15	10.000			BDAT # *
* BT	Full	P209		22-230	16	10.000			BDAT # *
* BT	Full	P251		1235-1360	3	10.000			BDAT # *
* BT	Full	P253		10-144	2	10.000			BDAT # *
CAC	Pilot	203A		100-1000	14	73.000		34	WERL
GAC	Full	1421D		0-100		0.100		37	WERL
PACT	Bench	242E		0-100		5.000		76	WERL
PACT	Bench	Zimpro		185	1	1.000		99.5	WAO
PACT	Bench	200B		0-100	11	0.400		99.57	WERL
PACT	Bench	Zimpro		21	1	5.000		76	WAO
RO	Pilot	180A		0-100		0.020		71	WERL
RO	Pilot	250B		0-100		5.000		92.9	WERL
RO	Full	250B		1000-10000		170.000		97	WERL
SS	Pilot	REF2		23500	5	208.000			BDAT #
TF	Pilot	240A		0-100	14	1.000		98.4	WERL
TF	Pilot	203A		100-1000	14	31.000		72	WERL
TF	Full	1B		100-1000	4	11.000		90.8	WERL
TF	Full	1B		0-100	4	4.000		90.9	WERL
UF	Pilot	250B		100-1000		70.000		89	WERL
WOx	Full	Zimpro	50	19000-27000	2	3550.000			WAO
WOx	Full	242E		1000-10000		21.000		99.65	WERL
WOx [B]	Bench	1054E		1000-10000		500.000		94.8	WERL
WOx [B]	Bench	1054E		100000-1000000		30000.000		97	WERL

* Data used in developing revised treatment standard.
# EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.

3.3.12 Ethyl Ether

The data available for ethyl ether were compiled from the WERL database and are presented in Table 3-16. The only technology for which data were available was full-scale RO treatment. The resulting effluent concentrations ranged from 17 ppb to 24 ppb.

BDAT for ethyl ether was identified as RO. RO was selected as BDAT because it represents full-scale demonstrated treatment with a high removal efficiency. The BDAT treatment standard for ethyl ether was calculated using an effluent concentration of 20.5 ppb (which represents the average of the data presented) and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for ethyl ether (0.12 ppm) is described in Section 5.0 and is shown in Table 5-3.

TABLE 3-16
WASTEWATER TREATMENT PERFORMANCE DATA
FOR ETHYL ETHER

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
* RO	Full	250B		100-1000		17.000		88	WERL *
* RO	Full	250B		100-1000		24.000		92.8	WERL *

* Data used in developing the revised treatment standard.

3.3.13 Isobutyl Alcohol

The data available for isobutyl alcohol include leachate treatment performance data submitted by industry. These data are presented in Table 3-17. BT was the only technology for which data were available. The resulting average effluent concentration was 2,000 ppb.

Based on industry-submitted leachate data available for isobutyl alcohol, BDAT for isobutyl alcohol was identified as BT. The BDAT treatment standard for isobutyl alcohol was calculated using the effluent concentration of 2000 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for isobutyl alcohol (5.6 ppm) is described in Section 5.0 and is shown in Table 5-3.

TABLE 3-17
INDUSTRY-SUBMITTED LEACHATE TREATMENT PERFORMANCE
DATA FOR ISOBUTYL ALCOHOL

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
* ST		CWM	2000	2500-21000	3	2000.000		77.81	LEACHATE

* Data used in developing the revised treatment standard.

3.3.14 Methanol

The data available for methanol were compiled from the WERL database, PACT® data from literature, and leachate treatment performance data submitted by industry. These data are presented in Table 3-18. Technologies for which data are available include PACT®, SS, WOx, and BT. The treatment performance data represent bench-, pilot-, and full-scale studies. The resulting effluent concentrations ranged from 10 ppb to 290,000 ppb.

Based on industry-submitted leachate data available for methanol, BDAT for methanol was identified as BT. The BDAT treatment standard for methanol was calculated using the effluent concentration of 2000 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for methanol (5.6 ppm) is described in Section 5.0 and is shown in Table 5-3.

TABLE 3-18
WASTEWATER TREATMENT PERFORMANCE DATA
FOR METHANOL

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
PACT	Bench	Zimpro		208000	1	10.000		99.99	WAO
SS	Pilot	1082E		1000000		230000.000		84	WERL
WOx	Full	242E		1000000		210000.000		89.8	WERL
WOx	Bench	78D		1000000		290000.000		91	WERL
* BT		CWM	2000	7600-3100	3	2000.00		87.23	LEACHATE

* Data used in developing the revised treatment standard.

3.3.15 Methylene Chloride

The data available for methylene chloride were compiled from the EAD and WERL databases, BDAT Solvents Rule data, and WOx and PACT® data from literature. Technologies for which data are available include AS, AS+Fil, AirS, AirS+GAC, BT, BT+AC, CAC+AirS, GAC, PACT®, RO, SS, TF, and WOx. These data are presented in Table 3-19. The treatment performance data represent bench-, pilot-, and full-scale studies.

The treatment performance data available from the EAD database were used to determine BDAT treatment standards for this constituent for the following reasons:

(1) The EAD data represent treatment performance data from the OCPSF sampling episodes. The data collected by EAD include long-term sampling of several industries, therefore, the Agency believes these data are representative of the total organic chemical industry and can adequately represent a wastewater of unknown characteristics.

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

(3) A promulgated EAD limit represents data that have undergone further review, and have received acceptance by both EPA and industry.

BDAT for methylene chloride was identified as SS (steam stripping). The BDAT treatment standard was calculated using the EAD median long-term average effluent concentration of 22.956 ppb and the EAD Option 1 variability factor (32). The calculation of the resulting BDAT treatment standard for methylene chloride (0.089 ppm) is described in Section 5.0 and is shown in Table 5-3.

The treatment standard for methylene chloride in the pharmaceutical industry wastes is not being revised. It will remain 0.44 mg/L.

TABLE 3-19
WASTEWATER TREATMENT PERFORMANCE DATA
FOR METHYLENE CHLORIDE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AS	Full	1B		0-100	3	23.000		64	WERL
AS	Full	1B		0-100	3	17.000		72	WERL
AS	Full	1B		0-100	4	31.000		31	WERL
AS	Full	234A		0-100		2.000		93.3	WERL
AS	Full	201B		0-100	27	45.000		51	WERL
AS	Full	975B		0-100		0.430		92	WERL
AS	Full	1B		0-100	3	9.000		75	WERL
AS	Full	1B		100-1000	6	46.000		69	WERL
AS	Full	1B		100-1000	6	130.000		54	WERL
AS	Full	1B		0-100	4	23.000		57	WERL
AS	Full	6B		0-100	3	10.000		77	WERL
AS	Full	1B		0-100	4	61.000		34	WERL
AS	Full	236A		0-100	3	11.000		78	WERL
AS	Full	234A		0-100		4.900		58	WERL
AS	Bench	202D		100000-1000000		510.000		99.72	WERL
AS	Full	375E		0-100	7	10.000		69	WERL
AS	Full	6B		1000-10000	40	54.000		98.6	WERL
AS	Full	1B		0-100	5	16.000		72	WERL
AS	Full	6B		1000-10000	10	31.000		99.53	WERL
AS	Full	1B		0-100	3	23.000		74	WERL
AS	Full	6B		1000-10000	3	10.000		99.74	WERL
AS	Full	1B		0-100	6	17.000		77	WERL
AS	Full	1B		1000-10000	5	56.000		97.8	WERL
AS	Full	6B		0-100	10	13.000		79	WERL
AS	Full	1B		100-1000	5	560.000		31	WERL
AS	Pilot	206B		100-1000	20	4.000		98.6	WERL
AS	Full	1166E		10000-100000		920.000		98.4	WERL
AS	Full	234A		100-1000		0.800		99.5	WERL
AS	Full	1B		10000-100000	5	12000.000		14	WERL
AS	Full	1B		0-100	4	17.000		64	WERL
AS	Pilot	241B		100-1000	5	110.000		78	WERL
AS	Full	375E		0-100	7	5.000		80	WERL
AS	Full	1B		0-100	6	61.000		34	WERL
AS	Full	375E		1000-10000	7	55.000		99.3	WERL
AS	Full	1B		1000-10000	5	2000.000		5	WERL
AS	Full	1B		0-100	5	62.000		35	WERL
AS	Full	375E		0-100	7	20.000		64	WERL
AS+Fil	Full	6B		0-100	9	29.000		28	WERL
AirS	Pilot	206E		100-1000		3.000		98.6	WERL
AirS	Pilot	1362E		100-1000	3	5.300		98	WERL
AirS+GAC	Full	229A		100-1000	19	1.000		99.8	WERL

TABLE 3-19 (Continued)
WASTEWATER TREATMENT PERFORMANCE DATA
FOR METHYLENE CHLORIDE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
BT	Full	P246		27-3607	13	11.000			BDAT #
BT	Full	P265		500-750	3	27.000			BDAT #
BT+AC	Full	P246		10-5550	28	10.000			BDAT #
CAC+AirS	Full	1833D		0-100	25	2.400		92.3	WERL
GAC	Full	245B		100-1000	1	10.000		99	WERL
GAC	Full	237A		100-1000	1	10.000		94.4	WERL
PACT	Bench	242E		0-100		20.000		76	WERL
PACT	Bench	Zimpro		84	1	20.000		76	WAO
RO	Full	250B		100-1000		80.000		66	WERL
RO	Full	250B		10000-100000		15000.000		44	WERL
* SS	Full	725	10	10-5100	13	217.300			EAD *
* SS	Full	913	10	200-10400	14	10.000			EAD *
* SS	Full	415T	10	198-12100	15	10.500			EAD *
SS	Full	6B		1000-10000	15	10.000		99.52	WERL
SS	Full	251B		1000-10000	10	10.000		99.17	WERL
SS	Full	251B		1000000	10	11.000		100	WERL
SS	Full	6B		1000-10000	9	78.000		95.1	WERL
SS	Full	P12003		225000-12000000	40	24413.000			BDAT #
SS	Full	6B		100-1000	2	10.000		99	WERL
SS	Full	P284		198-12100	15	10.000			BDAT #
TF	Full	1B		0-100	5	20.000		67	WERL
TF	Full	375E		0-100	7	12.000		8	WERL
TF	Full	1B		0-100	3	23.000		36	WERL
TF	Full	1B		0-100	5	58.000		40	WERL
TF	Full	1B		0-100	5	21.000		77	WERL
TF	Full	1B		100-1000	6	16.000		89	WERL
TF	Full	1B		100-1000	4	120.000		56	WERL
TF	Full	375E		100-1000	7	21.000		86	WERL
TF	Full	1B		100-1000	5	37.000		66	WERL
WOx		REF10		15000-3600000	3	5000.000			BDAT #
WOx	Pilot	Zimpro		60000	1	10.000		99.9	WAO
WOx	Pilot	78D		10-100		10.000		99.96	WERL
WOx	Full	242E		100000-1000000		84.000		99.99	WERL

EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.
* Data used in developing revised treatment standard.

3.3.16 Methyl Ethyl Ketone

The data available for methyl ethyl ketone were compiled from the NPDES and WERL databases, PACT® and WOx data from literature, EPA WAO test data, and leachate treatment performance data submitted by industry. These data are presented in Table 3-20. Technologies for which data were available include AS, PACT®, WOx, WOx+PACT®, and BT. The treatment performance data represent bench-, pilot-, and full-scale studies with resulting effluent concentrations ranging from 0.01 ppb to 27,000 ppb.

Based on industry-submitted leachate data available for methyl ethyl ketone, BDAT for methyl ethyl ketone was identified as BT. The BDAT treatment standard for methyl ethyl ketone was calculated using the effluent concentration of 100 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for methyl ethyl ketone (0.28 ppm) is described in Section 5.0 and is shown in Table 5-3.

TABLE 3-20
WASTEWATER TREATMENT PERFORMANCE DATA
FOR METHYL ETHYL KETONE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		NY0096792			8	3.400			NPDES
		NY0072231			10	39.400			NPDES
		IN0036072			14	779.360			NPDES
		NH0001503			1	27000.000			NPDES
AS	Pilot	241B		100-1000	5	9.000		96.6	WERL
AS	Pilot	252E		100000-1000000	6	900.000		99.7	WERL
AS	Pilot	252E		10000-100000	7	500.000		99	WERL
PACT	Bench	Zimpro		2300	1	14.000		99.39	WAO
PACT	Bench	Zimpro		268	1	1.000		99.6	WAO
PACT	Bench	Zimpro		300	1	0.010		99.9	WAO
WOx	Pilot	Zimpro		6000000	1	1000.000		99.9	WAO
WOx	Full	242E		1000000		2300.000		99.9	WERL
WOx + PACT	Pilot	Zimpro	100	130000-250000	3	100.000		99.9	WAO
WOx [B]	Bench	78D		1000000		1000.000		99.9	WERL
WOx [B]	Bench	78D		100000-1000000		1000.000		99.6	WERL
* BT		CWM	100	2000-19000	3	100.000		98.78	LEACHATE
* BT	Bench	CWM	100	~7067	3	100.000		98.58	LEACHATE

* Data used in developing the revised treatment standard.

3.3.17 Methyl Isobutyl Ketone

The data available for methyl isobutyl ketone were compiled from the WERL and NPDES databases, BDAT Solvent Rule data, EPA WAO test data, and leachate treatment performance data submitted by industry. These data are presented in Table 3-21. Technologies for which data were available include AS, RO, SS, WOx, WOx+PACT®, and BT. The treatment performance data represent pilot- and full-scale studies. The resulting effluent concentrations ranged from 5 ppb to 70,900 ppb.

Based on industry-submitted leachate data available for methyl isobutyl ketone, BDAT for methyl isobutyl ketone was identified as BT. The BDAT treatment standard for methyl isobutyl ketone was calculated using the effluent concentration of 50 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for methyl isobutyl ketone (0.14 ppm) is described in Section 5.0 and is shown in Table 5-3.

TABLE 3-21
WASTEWATER TREATMENT PERFORMANCE DATA
FOR METHYL ISOBUTYL KETONE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		NH0001503			1	70800.000			NPDES
AS	Pilot	REF2		76400	6	41617.000			BDAT #
AS	Pilot	241B		100-1000	4	6.000		98.1	WERL
RO	Full	250B		100-1000		15.000		89.9	WERL
SS	Pilot	REF2		76400	5	10.000			BDAT #
WOx	Full	242E		100000-1000000		5.000		99.99	WERL
WOx + PACT	Pilot	Zimpro	50	620000-630000	3	50.000			WAO
* BT		CWM	50	1400-7800	3	50.000		96.61	LEACHATE
* BT	Bench	CWM	50	~2167	3	50.000		97.69	LEACHATE

EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.
* Data used in developing the revised treatment standard.

3.3.18 Nitrobenzene

The data for nitrobenzene were compiled from the EAD and WERL databases, BDAT Solvents Rule data, and WOx data from literature. These data are presented in Table 3-22. Technologies for which data are available include AL, AS, AirS, BT, BT+AC, chemical oxidation (ChOx), liquid-liquid extraction (LL), LL+SS, LL+SS+AC, PACT®, SCOx, SS, SS+AC, and WOx. The treatment performance data represent bench-, pilot-, and full-scale studies.

The treatment performance data available from the EAD database were used to determine the BDAT treatment standard for this constituent for the following reasons:

(1) The EAD data represent treatment performance data from the OCPSF sampling episodes. The data collected by EAD include long-term sampling of several industries; therefore, the Agency believes these data are representative of the total organic chemical industry and can adequately represent a wastewater of unknown characteristics.

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

(3) A promulgated EAD limit represents data that have undergone further review and have received acceptance by both EPA and industry.

BDAT for nitrobenzene was identified as steam stripping followed by activated carbon (SS+AC). The BDAT treatment standard was calculated using the EAD median long-term average effluent concentration of 14 ppb and the EAD Option 1 variability factor (32). The calculation of the resulting BDAT treatment standard for nitrobenzene (0.068 ppm) is described in Section 5.0 and is shown in Table 5-3.

TABLE 3-22
WASTEWATER TREATMENT PERFORMANCE DATA
FOR NITROBENZENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRAION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AL	Bench	371D		1000-10000		69.000		97.7	WERL
AS	Full	975B		100-1000		96.000		72	WERL
AS	Full	6B		1000-10000	330	120.000		98.1	WERL
AS	Full	6B		10000-100000	3	150.000		99.8	WERL
AS	Bench	202D		10000-100000		2200.000		97.8	WERL
AS	Bench	200B		100-1000	16	3.000		97.5	WERL
AS	Full	975B		100-1000		3.400		98.48	WERL
AS	Full	6B		1000-10000	28	14.000		99.78	WERL
AS	Pilot	241B		100-1000	4	10.000		92.3	WERL
AS	Full	1B		100-1000	1	23.000		9[illegible]	WERL
AS	Pilot	241B		100-1000	10	32.000		92.8	WERL
AirS	Bench	1328E		100000-1000000	5	98000.000		16	WERL
BT	Full	P246		821-5580	14	737.000			BDAT #
BT+AC	Full	P246		821-90500	18	297.000			BDAT #
ChOx	Bench	975B		0-100		2.000		95.9	WERL
LL	Full	K104	30	2200000-3900000	5	2420000.000	115		BDAT
LL	Full	K103	30	1500000-3000000	5	2200000.000	115		BDAT
LL+SS	Full	K103/K104	30	1500000-3900000	5	2400.000	115		BDAT
LL+SS+AC	Full	K103/K104	30	1500000-3900000	4	30.000	115		BDAT
PACT	Bench	190E		100-1000		21.000		98	WERL
PACT	Full	6B		1000-10000	4	14.000		99.8	WERL
PACT	Bench	975B		100-1000		2.000		98.3	WERL
PACT	Bench	200B		100-1000	12	3.700		96.7	WERL
SCOx	Pilot	65D		1000000		22.000		99.99	WERL
SS	Full	P297		87000-330000	10	11799.000			BDAT #
SS	Full	P246		91200-1985760	15	251325.000			BDAT #
* SS+AC	Full	500	14	14-5460000	37	520.300			EAD *
* SS+AC	Full	2000	14	87000-330000	10	712.600			EAD *
SS+AC	Full	P297		87000-330000	10	713.000			BDAT #
WOx	Bench	Zimpro		5125000	1	255000.000		95	WAO

EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.
* Data used in developing the revised treatment standard.

3.3.19 Pyridine

The data available for pyridine were compiled from the WERL database and EPA WAO test data. These data are presented in Table 3-23. Technologies for which data are available include AS, AnFF, and WOx + PACT®. The treatment performance data represent bench-, and pilot-scale studies. The resulting effluent concentrations ranged from 0.900 ppb to 1900 ppb.

BDAT for pyridine was identified as AnFF. AnFF was selected as BDAT since this demonstrated biological treatment technology showed substantial treatment to levels below pyridine's detection limit. The BDAT treatment standard for pyridine was calculated using an effluent concentration of 2.4 ppb (the detection limit for pyridine) and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for pyridine (0.014 ppm) is described in Section 5.0 and is shown in Table 5-3.

TABLE 3-23
WASTEWATER TREATMENT PERFORMANCE DATA
FOR PYRIDINE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AS	Bench	1054E		1000-10000		1900.000		37	WERL
* AnFF	Pilot	236D		1000-10000		0.900 **		99.9	WERL
WOx + PACT	Pilot	Zimpro		>160000	3	146.000		99.9	WAO

* Data used in developing the revised standard.
** Quantified below the detection limit (2.4 ppg).

3.3.20 Tetrachloroethylene

The data for tetrachloroethylene were compiled from the EAD and WERL databases, BDAT Solvents Rule data, and PACT® data from literature. These data are presented in Table 3-24. Technologies for which data are available include AL, AS, AS+Fil, AirS, AnFF, BT, CAC+AirS, ChOx, Chred, GAC, PACT®, RO, SS, TF, UV, and WOx. The treatment performance data represent bench-, pilot-, and full-scale studies.

The treatment performance data available from the EAD database were used to determine the BDAT treatment standard for this constituent for the following reasons:

(1) The EAD data represent treatment performance data from the OCPSF sampling episodes. The data collected by EAD include long-term sampling of several industries; therefore, the Agency believes these data are representative of the total organic chemical industry and can adequately represent a wastewater of unknown characteristics.

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

(3) A promulgated EAD limit represents data that have undergone further review, and have received acceptance by both EPA and industry.

BDAT for tetrachloroethylene was identified as SS (steam stripping). The BDAT treatment standard was calculated using the EAD median long-term average effluent concentration of 10.4 ppb and the EAD Option 1 variability factor (32). The calculation of the resulting BDAT treatment standard for tetrachloroethene (0.056 ppm) is described in Section 5.0 and is shown in Table 5-3.

TABLE 3-24
WASTEWATER TREATMENT PERFORMANCE DATA
FOR TETRACHLOROETHYLENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AL	Full	1B		0-100	6	10.000		80	WERL
AS	Full	1B		0-100	3	10.000		89	WERL
AS	Full	1B		0-100	5	2.000		97.5	WERL
AS	Full	1B		0-100	4	6.000		85	WERL
AS	Full	238A		0-100	3	2.100		87	WERL
AS	Full	1567E		0-100		0.870		97.8	WERL
AS	Full	234A		0-100		22.000		49	WERL
AS	Full	238A		0-100	3	1.800		87	WERL
AS	Full	1B		0-100	4	1.000		98	WERL
AS	Full	234A		100-1000		3.900		96.7	WERL
AS	Full	1B		0-100	5	9.000		75	WERL
AS	Full	1B		100-1000	5	5.000		96.7	WERL
AS	Full	1B		0-100	3	22.000		45	WERL
AS	Full	1B		0-100	6	28.000		71	WERL
AS	Pilot	241B		100-1000	5	11.000		96.9	WERL
AS	Full	1B		1000-10000	6	440.000		95	WERL
AS	Full	201B		0-100	22	8.000		88.5	WERL
AS	Full	1B		0-100	4	6.000		93	WERL
AS	Full	1B		100-1000	6	48.000		79	WERL
AS	Full	1B		100-1000	6	28.000		78	WERL
AS	Full	234A		0-100		0.800		95.9	WERL
AS	Full	1B		0-100	6	8.000		96	WERL
AS	Full	1B		0-100	5	14.000		74	WERL
AS	Full	1B		100-1000	4	100.000		83	WERL
AS+Fil	Full	6B		10000-100000	3	230.000		99.04	WERL
AS+Fil	Full	6B		100-1000	15	11.000		97.7	WERL
AirS	Pilot	221B		0-100	1	0.500		95.8	WERL
AirS	Pilot	71D		0-100	1	0.200		98.7	WERL
AirS	Full	223B		100-1000	1	0.800		99.43	WERL
AirS	Pilot	222B		0-100	1	0.200		94.3	WERL
AirS	Pilot	217B		100-1000	1	0.300		99.73	WERL
AirS	Pilot	207B		0-100	1	0.500		98.3	WERL
AirS	Full	69A		0-100		0.960		98.4	WERL
AirS	Pilot	220B		0-100	1	0.200		99.76	WERL
AirS	Pilot	208B		0-100	1	0.200		99.17	WERL
AirS	Pilot	1363E		0-100		0.200		97.1	WERL
AirS	Pilot	214B		100-1000	1	0.900		99.31	WERL
AirS	Full	1042E		100-1000		0.900		99.71	WERL
AirS	Full	322B		100-1000	9	1.200		99.75	WERL
AirS	Pilot	1362E		1000-10000	3	5.000		99.74	WERL
AnFF	Bench	724D		10000-100000		4.400		99.99	WERL

TABLE 3-24 (Continued)
WASTEWATER TREATMENT PERFORMANCE DATA
FOR TETRACHLOROETHYLENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
BT	Full	P225		95-31500	18	47.000			BDAT #
BT	Full	P280		110-1748	12	10.000			BDAT #
BT	Full	REF4		62	1	7.300			BDAT #
CAC+AirS	Full	1833D		0-100	7	0.100		99	WERL
ChOx	Pilot	2028A		0-100	4	2.000		96	WERL
ChOx	Pilot	2028A		0-100	4	1.700		94	WERL
Chred	Bench			250	1	5.000			ART
GAC	Full	1264B		0-100		1.000		95.2	WERL
GAC	Full	245B		1000-10000	1	10.000		99.13	WERL
GAC	Full	237A		100-1000	1	10.000		96.3	WERL
PACT	Bench	242E		100-1000		10.000		92.6	WERL
PACT	Bench	Zimpro		304		1.000		99.7	WAO
PACT	Bench	Zimpro		136	1	10.000		93	WAO
RO	Pilot	323B		0-100	1	30.000		68	WERL
RO	Pilot	180A		0-100		0.250		91	WERL
* SS	Full	913	10	10800-241000	14	18.400			EAD *
SS	Full	251B		1000-10000	10	10.000		99.29	WERL
SS	Full	6B		10000-100000	2	10.000		99.95	WERL
TF	Full	1B		0-100	5	12.000		81	WERL
TF	Full	1B		100-1000	5	26.000		83	WERL
TF	Full	1B		0-100	3	16.000		54	WERL
TF	Full	1B		0-100	4	1.000		98.9	WERL
TF	Full	1B		0-100	6	6.000		92.7	WERL
TF	Full	1B		0-100	5	3.000		94.3	WERL
UV [B]	Bench	1136E		0-100	1	7.500		85	WERL
WOx		REF10		41000	1	1000.000			BDAT #
WOx	Pilot	78D		1000000		900.000		99.99	WERL

EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.
* Data used in developing the revised treatment standard.

3.3.21 Toluene

The data available for toluene were compiled from the EAD and WERL databases, BDAT Solvents Rule data, WOx and PACT® data from literature, and EPA WAO test data. These data are presented in Table 3-25. Technologies for which data are available include AL, AL+AS, API+DAF+AS, AS, AS+Fil, AirS, AirS+GAC, BT, BT+AC, GAC, PACT®, RO, SS, SS+AC, TF, UF, WOx+PACT®, and WOx. The treatment performance data represent bench-, pilot-, and full-scale studies.

The treatment performance data available from the EAD database were used to determine the BDAT treatment standard for this constituent for the following reasons:

(1) The EAD data represent treatment performance data from the OCPSF sampling episodes. The data collected by EAD include long-term sampling of several industries; therefore, the Agency believes these data are representative of the total organic chemical industry and can adequately represent a wastewater of unknown characteristics.

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

(3) A promulgated EAD limit represents data that have undergone further review, and have received acceptance by both EPA and industry.

BDAT for toluene was identified as SS (steam stripping). The BDAT treatment standard was calculated using the EAD median long-term average of 10 ppb and the EAD Option 1 variability factor (32). The calculation of the resulting BDAT treatment standard for toluene (0.080 ppm) is described in Section 5.0 and is shown in Table 5-3.

TABLE 3-25
WASTEWATER TREATMENT PERFORMANCE DATA
FOR TOLUENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AL	Full	6B		100-1000	3	10.000		98.2	WERL
AL	Bench	371D		1000-10000		90.000		97	WERL
AL	Full	1B		100-1000	6	32.000		96.1	WERL
AL+AS	Full	233D		1000-10000	21	4.000		99.85	WERL
API+DAF+AS	Full	1462D		10000-100000	4	11.000		99.93	WERL
AS	Bench	202D		10000-100000		10.000		99.96	WERL
AS	Full	6B		10000-100000	3	73.000		99.84	WERL
AS	Full	6B		1000-10000	3	10.000		99.57	WERL
AS	Full	975B		1000-10000		12.000		99.68	WERL
AS	Full	6B		10000-100000	3	76.000		99.90	WERL
AS	Bench	200B		100-1000	10	0.800		99.3	WERL
AS	Full	6B		1000-10000	24	10.000		99.73	WERL
AS	Full	1B		1000-10000	6	9.000		99.81	WERL
AS	Full	6B		1000-10000	15	10.000		99.88	WERL
AS	Full	6B		1000-10000	3	24.000		99.76	WERL
AS	Full	975B		1000-10000		280.000		96.3	WERL
AS	Full	6B		1000-10000	7	10.000		99.5	WERL
AS	Full	975B		100-1000		23.000		88	WERL
AS	Full	6B		1000-10000	33	20.000		99.8	WERL
AS	Pilot	226B		100000-1000000	7	300.000		99.85	WERL
AS	Full	6B		100-1000	14	10.000		97.8	WERL
AS	Full	6B		100-1000	4	10.000		97.8	WERL
AS	Full	1B		0-100	5	4.000		88	WERL
AS	Full	975B		100-1000		7.600		99.04	WERL
AS	Full	1B		100-1000	6	4.000		99.48	WERL
AS	Full	234A		0-100		0.700		97.1	WERL
AS	Full	1B		0-100	4	3.000		90.8	WERL
AS	Full	1567E		0-100		0.100		99	WERL
AS	Full	201B		100-1000	32	57.000		87	WERL
AS	Full	1B		100-1000	5	12.000		98.8	WERL
AS	Full	1B		0-100	4	1.000		98	WERL
AS	Full	234A		0-100		0.200		96.2	WERL
AS	Full	1B		100-1000	4	4.000		96.4	WERL
AS	Full	1B		0-100	5	2.000		97.6	WERL
AS	Full	238A		0-100	3	6.200		92.7	WERL
AS	Full	6B		100-1000	3	10.000		94.4	WERL
AS	Full	1B		0-100	5	2.000		97.1	WERL
AS	Full	1B		0-100	4	4.000		88	WERL
AS	Pilot	241B		100-1000	5	4.000		98.6	WERL

TABLE 3-25 (Continued)
WASTEWATER TREATMENT PERFORMANCE DATA
FOR TOLUENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AS	Full	234A		0-100		0.200		96.9	WERL
AS	Full	1B		0-100	5	3.000		94	WERL
AS	Full	1B		100-1000	6	20.000		89	WERL
AS	Full	1B		0-100	6	1.000		97.3	WERL
AS	Full	1B		0-100	5	1.000		97.4	WERL
AS	Full	234A		0-100		0.200		97.7	WERL
AS	Full	1B		0-100	6	2.000		96.3	WERL
AS	Full	1B		100-1000	5	56.000		93.5	WERL
AS	Pilot	206B		100-1000	20	0.600		99.76	WERL
AS	Full	1B		100-1000	6	10.000		96.4	WERL
AS	Full	234A		100-1000		0.200		99.9	WERL
AS	Full	1B		100-1000	6	31.000		95.4	WERL
AS	Pilot	REF2		92000	6	23467.000			BDAT #
AS + Fil	Full	6B		10000-100000	3	10.000		99.98	WERL
AirS	Full	322B		100-1000	24	0.680		99.77	WERL
AirS	Pilot	1362E		0-100	3	1.700		95.3	WERL
AirS	Bench	1328E		10000-100000	5	2800.000		92.4	WERL
AirS	Full	69A		0-100		0.940		97	WERL
AirS	Full	322B		0-100	5	2.000		97.4	WERL
AirS	Pilot	224B		0-100	1	0.500		98.9	WERL
AirS	Full	322B		1000-10000	6	34.000		99.16	WERL
AirS	Full	322B		10000-100000	3	114.000		99.39	WERL
AirS+GAC	Full	228A		0-100	19	1.000		90	WERL
ST	Full	P208		634-57475	10	1491.000			BDAT #
ST	Full	P211		1154-4000	7	10.000			BDAT #
ST	Full	P202		60-155	20	10.000			BDAT #
ST	Full	P244		1109	1	10.000			BDAT #
ST	Full	P210		135-5805	2	10.000			BDAT #
ST	Full	P223		99-286	3	10.000			BDAT #
ST	Full	P217		34400-60000	3	73.000			BDAT #
ST	Full	P234		2350-36000	32	21.000			BDAT #
ST	Full	P242		1200-1539	2	10.000			BDAT #
ST	Full	P221		10-328	3	10.000			BDAT #
ST	Full	P206		140-640	14	10.000			BDAT #
ST	Full	P240		22700	1	10.000			BDAT #
ST	Full	P248		77-12938	9	630.000			BDAT #
ST	Full	P251		15840-26060	3	10.000			BDAT #
ST	Full	P259		66-230	3	103.000			BDAT #
ST	Full	P257		1730-12900	27	12.000			BDAT #
ST	Full	P255		37750-60000	3	10.000			BDAT #

EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.

TABLE 3-25 (Continued)
WASTEWATER TREATMENT PERFORMANCE DATA
FOR TOLUENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
BT	Full	P286		24000-160000	3	76.000			BDAT #
BT	Full	P215		3300-4550	3	10.000			BDAT #
BT	Full	P230		3503-30347	15	10.000			BDAT #
BT	Full	REF4		680	1	4.000			BDAT #
BT+AC	Full	P246		77-12936	10	113.000			BDAT #
GAC	Pilot	435B		10000-100000		10.000		99.96	WERL
GAC	Full	245B		10000-100000	1	10.000		99.94	WERL
GAC	Pilot	REF7		120	1	0.300			BDAT #
PACT	Bench	200B		100-1000	13	0.300		99.75	WERL
PACT	Bench	242E		0-100		5.000		91.2	WERL
PACT	Bench	Zimpro		2730	1	1.000		99.9	WAO
PACT	Bench	Zimpro		57	1	5.000		91	WAO
RO	Full	250B		100-1000		20.000		92.5	WERL
RO	Pilot	250B		0-100		12.000		88	WERL
RO	Full	250B		1000-10000		420.000		94.7	WERL
* SS		0415**	10	19300-29000	3	12.000			EAD *
SS	Full	6B		1000-10000	2	10.000		99.71	WERL
SS	Full	6B		10000-100000	3	12.000		99.95	WERL
* SS		0415*	10	2570-4230	4	22.300			EAD *
SS	Pilot	REF4		92000	5	42.000			BDAT #
SS	Full	P246		57-98	4	10.000			BDAT #
SS+AC	Full	P297		640-8650	3	11.000			BDAT #
TF	Full	6B		100-1000	3	10.000		98.3	WERL
TF	Full	1B		0-100	5	10.000		88	WERL
TF	Full	1B		0-100	6	7.000		86	WERL
TF	Full	1B		0-100	5	2.000		97.2	WERL
TF	Full	1B		0-100	6	1.000		98.2	WERL
TF	Full	1B		100-1000	4	7.000		97.8	WERL
UF	Pilot	250B		100-1000		84.000		35	WERL
WOx		REF10		8500000	1	200000.000			BDAT #
WOx	Bench	Zimpro		4330000	1	12000.000		99.7	WAO
WOx	Bench	Zimpro		5000	1	500.000		90	WAO
WOx	Pilot	Zimpro		30000	1	500.000		98.3	WAO
WOx	Full	Zimpro	50	62000-82000	2	10960.000			WAO
WOx	Full	242E		100-1000		57.000		72	WERL
WOx	Pilot	78D		10000-100000		500.000		98.3	WERL
WOx + PACT	Pilot	Zimpro	5	130000-180000	3	5.000		99.9	WAO
WOx[B]	Bench	78D		1000-10000		500.000		90	WERL
WOx[B]	Bench	78D		10000-100000		1000.000		98.8	WERL
WOx[B]	Bench	1054E		10000-100000		500.000		98.9	WERL
WOx[B]	Bench	1054E		1000000		220000.000		98.7	WERL

EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.
* Data used in developing the revised treatment standard.

3.3.22 1,1,1-Trichloroethane

The data available for 1,1,1-trichloroethane were compiled from the EAD and WERL databases, BDAT Solvents Rule data, and WOx and PACT® data from literature. These data are presented in Table 3-26. Technologies for which data are available include AL, AS, AirS, BT, GAC, PACT®, RO, SS, TF, UV, and WOx. The treatment performance data represent bench-, pilot-, and full-scale studies.

The treatment performance data available from the EAD database were used to determine the BDAT treatment standard for this constituent for the following reasons:

(1) The EAD data represent treatment performance data from the OCPSF sampling episodes. The data collected by EAD include long-term sampling of several industries; therefore, the Agency believes these data are representative of the total organic chemical industry and can adequately represent a wastewater of unknown characteristics.

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

(3) A promulgated EAD limit represents data that have undergone further review, and have received acceptance by both EPA and industry.

BDAT for 1,1,1-trichloroethane was identified as SS (steam stripping). The BDAT treatment standard was calculated using the EAD median long-term average effluent concentration of 10 ppb and the EAD Option 1 variability factor (32). The calculation of the resulting BDAT treatment standard for 1,1,1-trichloroethane (0.054 ppm) is described in Section 5.0 and is shown in Table 5-3.

TABLE 3-28
WASTEWATER TREATMENT PERFORMANCE DATA
FOR 1,1,1-TRICHLOROETHANE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AL	Full	1B		0-100	5	10.000		90	WERL
AS	Full	201B		0-100	6	21.000		79	WERL
AS	Full	1B		0-100000	4	10.000		89	WERL
AS	Full	234A		1000-10000		1.300		99.86	WERL
AS	Full	1B		1000-10000	6	850.000		87	WERL
AS	Full	1B		0-100	5	9.000		84	WERL
AS	Full	1B		0-100	4	10.000		84	WERL
AS	Full	1B		0-100	5	10.000		81	WERL
AS	Full	1B		100-1000	6	12.000		90	WERL
AS	Full	6B		100-1000	3	10.000		98.9	WERL
AS	Full	375E		0-100	7	1.000		92.3	WERL
AS	Full	1B		0-100	4	12.000		87	WERL
AS	Full	975B		100-1000		4.000		98.1	WERL
AS	Full	234A		0-100		1.000		97.6	WERL
AS	Pilot	206B		100-1000	20	0.300		99.77	WERL
AS	Full	1B		100-1000	5	54.000		89	WERL
AS	Full	1B		100-1000	6	5.000		98.2	WERL
AS	Full	1B		0-100	6	30.000		39	WERL
AS	Full	1B		0-100	4	5.000		95	WERL
AS	Full	1B		100-1000	6	28.000		94.3	WERL
AS	Full	234A		0-100		1.300		78	WERL
AS	Full	236A		0-100	3	2.200		85	WERL
AS	Full	234A		0-100		1.300		73	WERL
AS	Full	1B		0-100	3	2.000		95.8	WERL
AS	Full	236A		0-100	3	2.900		77	WERL
AS	Full	1587E		100-1000		0.270		99.73	WERL
AS	Full	1B		100-1000	5	100.000		70	WERL
AS	Full	375E		0-100	7	1.000		92.3	WERL
AS	Full	1B		0-100	3	7.000		83	WERL
AS	Full	1B		0-100	3	8.000		84	WERL
AS	Full	1B		0-100	3	2.000		95.8	WERL
AS	Pilot	241B		100-1000	5	8.000		97.2	WERL
AS	Full	1B		0-100	5	1.000		98.4	WERL
AS	Full	1B		0-100	3	4.000		88	WERL
AS	Full	294A		0-100		1.300		88	WERL
AS	Bench	202D		100000-1000000		1600.000		98.6	WERL
AS	Pilot	REF8		237	1	23.000			BDAT #
AS	Pilot	REF2		150000	6	48883.000			BDAT #

EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.

TABLE 3-26 (Continued)
WASTEWATER TREATMENT PERFORMANCE DATA
FOR 1,1,1-TRICHLOROETHANE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AirS	Pilot	211B		0-100	1	1.000		98.8	WERL
AirS	Pilot	207B		0-100	1	0.500		97.5	WERL
AirS	Pilot	812E		1000-10000		49.000		95.9	WERL
AirS	Pilot	222B		100-1000	1	1.100		99.75	WERL
AirS	Pilot	812E		0-100		3.000		92.9	WERL
AirS	Pilot	211B		100-1000	1	1.700		99.5	WERL
AirS	Pilot	1362E		1000-10000	3	130.000		97.8	WERL
AirS	Pilot	812E		100-1000		12.000		89	WERL
AirS	Pilot	217B		0-100	1	0.300		97	WERL
AirS	Pilot	205E		100-1000		7.000		98.8	WERL
AirS	Full	1344E		103-1000		0.200		99.98	WERL
AirS	Pilot	219B		0-100	1	0.500		96.7	WERL
BT	Full	P240		10-215	3	10.000			WERL
GAC	Bench	1362E		10-100		1.000		99.99	WERL
GAC	Full	1284B		0-100		1.000		98.8	WERL
GAC	Full	1284B		100-1000		1.000		99.35	WERL
GAC	Pilot	812E		100-1000		1.000		99.05	WERL
PACT	Bench	242E		100-1000		25.000		93.8	WERL
PACT	Bench	Zimpro		4970	1	1.000		99.9	WAO
PACT	Bench	Zimpro		405	1	25.000		93.8	WAO
RO	Pilot	180A		0-100		0.050		98.2	WERL
RO	Full	250B		100-1000		36.000		95.6	WERL
RO	Pilot	323B		0-100	1	2.000		97.8	WERL
RO	Full	250B		100-1000		10.000		93.8	WERL
SS	Full	6B		10000-100000		10.000		99.94	WERL
* SS	Full	913	10	11900-35000	14	10.000			EAD *
SS	Pilot	REF2		150000	5	463.000			BDAT #
TF	Full	375E		0-100	7	1.000		50	WERL
TF	Full	1B		0-100	5	2.000		92.6	WERL
TF	Full	1B		100-1000	6	2.000		98.3	WERL
TF	Full	1B		0-100	5	5.000		92.2	WERL
UV [B]	Bench	1136E		0-100		30.000		40	WERL
WOx		REF10		370000	1	1000.000			BDAT #
WOx	Full	Zimpro	50	6900-6900	2				WAO
WOx	Full	242E		100000-1000000		400.000		99.96	WERL

* Data used in developing the revised treatment standard.
# EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.

3.3.23 Trichloroethylene

The data available for trichloroethylene were compiled from the EAD and WERL databases, BDAT Solvents Rule data, and PACT® and WOx data from literature. These data are presented in Table 3-27. Technologies for which data are available include Chred, AS, AirS, BT, BT+AC, CAC+AirS, ChOx, GAC, PACT®, RO, SS, TF, UV, and WOx. The treatment performance data represent bench-, pilot-, and full-scale studies.

The treatment performance data available from the EAD database were used to determine the BDAT treatment standard for this constituent for the following reasons:

(1) The EAD data represent treatment performance data from the OCPSF sampling episodes. The data collected by EAD include long-term sampling of several industries, therefore, the Agency believes these data are representative of the total organic chemical industry and can adequately represent a wastewater of unknown characteristics.

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

(3) A promulgated EAD limit represents data that have undergone further review, and have received acceptance by both EPA and industry.

BDAT for trichloroethylene was identified as SS (steam stripping). The BDAT treatment standard was calculated using the EAD median long-term average of 10 ppb and the EAD Option 1 variability factor (32). The calculation of the resulting BDAT treatment standard for trichloroethylene (0.054 ppm) is described in Section 5.0 and is shown in Table 5-3.

TABLE 3-27
WASTEWATER TREATMENT PERFORMANCE DATA
FOR TRICHLOROETHYLENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AS	Bench	202D		10000-100000		210.000		99.78	WERL
AS	Full	1B		0-100	4	5.000		89	WERL
AS	Full	1B		100-1000	6	2.000		99.23	WERL
AS	Full	6B		100-1000	3	10.000		94.1	WERL
AS	Full	1587E		0-100		0.100		95.7	WERL
AS	Full	375E		0-100	7	2.500		58	WERL
AS	Full	1B		0-100	6	1.000		96.7	WERL
AS	Pilot	206B		100-1000	20	1.500		96.6	WERL
AS	Full	236A		0-100	3	2.100		90.6	WERL
AS	Full	1B		100-1000	4	3.000		97.3	WERL
AS	Pilot	241B		100-1000	5	7.000		96.7	WERL
AS	Full	1B		100-1000	6	64.000		87	WERL
AS	Full	234A		0-100		0.700		71	WERL
AS	Full	201B		0-100	6	13.000		87	WERL
AS	Full	1B		0-100	6	2.000		97.6	WERL
AS	Full	1B		0-100	5	1.000		96.5	WERL
AS	Full	6B		0-100	5	10.000		89	WERL
AS	Full	236A		0-100	3	0.500		94.6	WERL
AS	Full	234A		0-100		0.700		92.3	WERL
AS	Full	1B		100-1000	5	31.000		74	WERL
AS	Full	1B		100-1000	6	87.000		87	WERL
AS	Full	1B		0-100	4	4.000		89.7	WERL
AS	Full	1B		100-1000	6	37.000		92.6	WERL
AS	Full	1B		0-100	5	16.000		72	WERL
AirS	Pilot	1362E		1000-10000	3	1.000		99.94	WERL
AirS	Pilot	206B		100-1000	1	0.800		99.58	WERL
AirS	Full	196B		100-1000		1.500		99.75	WERL
AirS	Pilot	28A		100-1000		27.000		87	WERL
AirS	Pilot	216B		100-1000	1	2.100		96.9	WERL
AirS	Pilot	219B		100-1000	1	0.800		99.58	WERL

TABLE 3-27 (Continued)
WASTEWATER TREATMENT PERFORMANCE DATA
FOR TRICHLOROETHYLENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AirS	Pilot	369A		0-100		0.300		99.44	WERL
AirS	Pilot	211B		100-1000	1	3.100		96.6	WERL
AirS	Pilot	205E		0-100		1.000		97.2	WERL
AirS	Pilot	220B		100-1000	1	0.200		99.92	WERL
AirS	Pilot	217B		100-1000	1	1.200		99.89	WERL
AirS	Full	322B		100-1000	10	0.439		99.91	WERL
AirS	Pilot	1327E		1000-10000		190.000		91.3	WERL
AirS	Pilot	212B		0-100	1	0.400		99.6	WERL
AirS	Full	223B		0-100	1	0.500		99.2	WERL
AirS	Full	69A		0-100		1.400		98.1	WERL
AirS	Pilot	369A		0-100		3.000		93.2	WERL
AirS	Pilot	221B		0-100	1	0.500		99.44	WERL
AirS	Pilot	1585E		0-100	1	4.300		87	WERL
AirS	Pilot	1363E		100-1000		5.000		97.1	WERL
AirS	Pilot	1327E		0-100		4.300		87	WERL
AirS	Pilot	211B		1000-10000	1	7.700		99.3	WERL
AirS	Full	1042E		0-100		0.300		99.88	WERL
AirS	Pilot	215B		0-100	1	0.500		98	WERL
AirS	Pilot	206B		0-100	1	0.700		99.03	WERL
AirS	Pilot	222B		0-100	1	0.300		99.21	WERL
AirS	Full	322B		1000-10000	7	11.000		99.77	WERL
AirS	Pilot	1585E		1000-10000	1	170.000		84	WERL
AirS	Pilot	71D		100-1000	1	5.000		96.5	WERL
AirS	Pilot	207B		0-100	1	0.500		99.7	WERL
BT	Full	REF4		60	1	5.800			BDAT #
BT	Full	P213		16-76	3	10.000			BDAT #
BT	Full	P217		98-224	3	10.000			BDAT #
BT	Full	P253		484	1	16.000			BDAT #
BT+AC	Full	P246		40-70	3	10.000			BDAT #
CAC+AirS	Full	1833D		0-100	20	0.200		90	WERL
ChOx	Pilot	202BA		0-100	4	3.700		96.2	WERL

EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.

TABLE 3-27 (Continued)
WASTEWATER TREATMENT PERFORMANCE DATA
FOR TRICHLOROETHYLENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
ChOx	Pilot	2026A		100-1000		7.100		94.4	WERL
Chred	Pilot			200	1	5.000			ART
Chred	Bench			280	1	3.900			ART
Chred	Bench			300	1	0.400			ART
GAC	Full	1264B		100-1000		1.000		99.36	WERL
GAC	Full	1264B		0-100		1.000		98.8	WERL
GAC	Full	245B		100-1000	1	10.000		97.8	WERL
GAC	Full	1264B		0-100		1.300		98.8	WERL
GAC	Full	245B		1000-10000	1	10.000		99.46	WERL
GAC	Full	237A		100-1000	1	10.000		95.8	WERL
GAC	Pilot	REF8		171	1	0.500			BDAT #
PACT	Bench	242E		0-100		10.000		89	WERL
PACT	Bench	Zimpro		328	1	1.000		99.7	WAO
PACT	Bench	Zimpro		90	1	10.000		89	WAO
PACT	Bench	Zimpro		32.8	1	0.005		99.98	WAO
RO	Full	250B		100-1000		110.000		78	WERL
RO	Full	250B		0-100		5.500		79	WERL
RO	Pilot	323B		0-100	1	66.000		30	WERL
* SS	Full	415	10	50-10300	15	16.100			EAD *
SS	Full	251B		1000-10000	10	5.000		99.91	WERL
SS	Full	6B		1000-10000	14	16.000		99.20	WERL
SS	Full	6B		10000-100000	2	10.000		99.97	WERL
SS	Full	251B		1000-10000	10	10.000		99.79	WERL
* SS	Full	913	10	22900-82700	14	10.000			EAD *
SS	Full	P284		10-10300	15	16.000			BDAT #
TF	Full	1B		0-100	6	1.000		98.8	WERL
TF	Full	1B		100-1000	5	1.000		99.33	WERL
TF	Full	1B		0-100	5	1.000		98.5	WERL
TF	Full	1B		0-100	5	1.000		98.4	WERL
TF	Full	1B		0-100	6	5.000		93.2	WERL
UV [B]	Bench	1136E		0-100		22.000		58	WERL
WOx	Bench	Zimpro		500000	1	1700.000		99.7	WAO
WOx	Bench	Zimpro		300000	1	2000.000		99.3	WAO
WOx [B]	Bench	78D		100000-1000000		1700.000		99.66	WERL

EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.
* Data used in developing the revised treatment standard.

3.3.24 Trichloromonofluoromethane

The data available for trichloromonofluoromethane were compiled from the WERL and NPDES databases, the BDAT database, and BDAT Solvents Rule data. These data are presented in Table 3-28. Technologies for which data are available include AS, AirS+GAC, BT, LL, LL+SS, LL+SS+AC. The treatment performance data represent full-scale treatment. The resulting effluent concentrations ranged from 1 ppb to 2,400 ppb.

BDAT for trichloromonofluoromethane was identified as LL + SS + AC. LL + SS + AC was selected as BDAT since this treatment train had the best removal for those data developed using BDAT guidelines. The BDAT treatment standard for trichloromonofluoromethane was calculated using the effluent concentration of 7 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for trichloromonofluoromethane (0.020 ppm) is described in Section 5.0 and is shown in Table 5-3.

TABLE 3-28
WASTEWATER TREATMENT PERFORMANCE DATA
FOR TRICHLOROMONOFLUOROMETHANE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		KY0003603			1	64.000			NPDES
		NY0157112			1	30.000			NPDES
		NY0157112			1	30.000			NPDES
		NJ0028291			2	1.000			NPDES
		NY0002101			8	8.750			NPDES
		NY0199371			19	2.000			NPDES
		NY0002101			8	6.125			NPDES
		LA0065501			6	10.000			NPDES
		AZ0000108			11	1.000			NPDES
		AZ0000108			11	1.009			NPDES
		LA0066436			13	4.846			NPDES
		AZ0000108			11	1.736			NPDES
		NY0005096			1	10.000			NPDES
		NY0005096			15	10.000			NPDES
		NY0007048			9	1.000			NPDES
		NY0177482			42	3.200			NPDES
AS	Full	1B		100-1000	1	4.000		97.9	WERL
AirS+GAC	Full	229A		0-100	19	1.000		98.6	WERL
BT	Full	LA0036245			37	16.541			NPDES
BT	Full	REF4		920	1	13.000			BDAT #
LL	Full	K104	5	250-20000	5	2400.000			BDAT
LL	Full	K103	5	2500-5000	5	1250.000			BDAT
LL+SS	Full	K103/K104	5	250-20000	5	105.000			BDAT
* LL+SS+AC	Full	K103/K104	5	250-20000	4	7.000			BDAT *

EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.
* Data used in developing the revised treatment standard.

3.3.25 1,1,2-Trichloro-1,2,2-trifluoroethane

The data available for 1,1,2-trichloro-1,2,2-trifluoroethane were compiled from the WERL and NPDES databases. These data are presented in Table 3-29. The technology for which data were available was WOx. The treatment performance data represent pilot-scale studies with data effluent concentrations ranging from 1 ppb to 2,000 ppb.

Upon further evaluation of this data, EPA does not believe that the effluent concentrations in the WOx test represent BDAT effluent values that are achievable. Treatment performance data were therefore transferred to 1,1,2-trichloro-1,2,2-trifluoroethane from hexachloroethane, which was judged to be most similar to 1,1,2-trichloro-1,2,2-trifluoromethane in elemental composition and functional groups. The treatment performance data that were transferred from hexachloroethane are presented in Table 3-30. BDAT for 1,1,2-trichloro-1,2,2-trifluoroethane was determined to be AS + FIL. A treatment standard of 0.057 ppm was calculated as described in Section 5.0 and shown in Table 5-3.

TABLE 3-29
WASTEWATER TREATMENT PERFORMANCE DATA
FOR 1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		NY0005096			14	10.000			NPDES
		NY0003395			3	5.000			NPDES
		NY0005860			6	10.000			NPDES
		NY0005860			1	1.000			NPDES
		NY0005860			17	1.000			NPDES
		NY0005860			9	3.100			NPDES
		NY0107409			2	1.000			NPDES
WOx	Pilot	78D		1000000		2000.000		99.93	WERL

3.3.26 Xylenes

The data available for xylenes were compiled from the NPDES and WERL databases, BDAT Solvents Rule data, and WOx and PACT® data from literature. These data are presented in Tables 3-30, 3-31, 3-32, and 3-33. Technologies for which data were available included AS, AirS, PACT®, RO, GAC, and WOx. The treatment performance data represent bench-, pilot-, and full-scale studies. The resulting effluent concentrations ranged from 0.40 ppb to 20,000 ppb.

The BDAT treatment standard for xylenes was determined using the combined data for the ortho and meta isomers. The hierarchy used to evaluate the data, as described in Section 2.3.2, deviates for xylenes because the BDAT Solvents Rule data represent pilot-scale data and the WERL database represents full-scale data. Therefore, data from the WERL database were used to determine the BDAT treatment standard for xylenes. WOx and an achievable effluent of 56 ppb (the average of the data available for WOx full-scale studies) were selected. WOx and RO were the only full-scale data available with higher influent concentrations. The RO technology was not able to achieve effluent concentrations as low as those achieved by the WOx technology. Therefore, WOx was selected as BDAT. The resulting BDAT treatment standard for xylenes is 0.32 ppm, as shown in Table 5-3.

TABLE 3-30
WASTEWATER TREATMENT PERFORMANCE DATA
FOR 1,2-XYLENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		NY0183628			3	198.330			NPDES
AS	Full	1587E		0-100		0.100		98.6	WERL
AS	Bench	2008		100-1000	15	0.900		99.2	WERL
AirS	Pilot	224B		0-100	1	0.500		93	WERL
PACT	Bench	242E		0-100		5.000		93.7	WERL
PACT	Bench	Zimpro		79	1	5.000		94	WAO
RO	Full	250B		10000-100000		300.000		97.8	WERL
* WOx	Full	242E		10000-100000		79.000		99.92	WERL *

* Data used in developing the revised treatment standard.

TABLE 3-31
WASTEWATER TREATMENT PERFORMANCE DATA
FOR 1,3-XYLENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		NY0183628			3	198.330			NPDES
AS	Full	1587E		0-100		0.100		98.8	WERL
AirS	Pilot	224B		0-100	1	0.500		72	WERL
GAC	Full	1421D		0-100		0.130		20	WERL
PACT	Bench	242E		0-100		10.000		70	WERL
PACT	Bench	Zimpro		33	1	10.000		70	WAO
* WOx	Full	242E		10000-100000		33.000		99.7	WERL *

* Data used in developing the revised treatment standard.

TABLE 3-32
WASTEWATER TREATMENT PERFORMANE DATA
FOR 1,4-XYLENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		NY0183628			3	198.330			NPDES
AirS	Pilot	224B		0-100	1	0.500		90	WERL
GAC	Full	1421D		0-100		0.040		37	WERL

TABLE 3-33
WASTEWATER TREATMENT PERFORMANCE DATA
FOR XYLENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
GAC	Pilot	REF7		140	1	0.100			BDAT #
WOx		REF10		21200	1	500.000			BDAT #
WOx	Pilot	Zimpro		6385000	1	20000.000		99.8	WAO

EAD data presented in the BDAT Solvents Rule F001-F005 Background Document.

4.0 SELECTION OF CONSTITUENTS FOR REVISED REGULATION

This section presents the methodology and rationale for the selection of organic constituents for revised regulation in nonwastewater and wastewater forms of F001-F005. The Agency selected all 26 constituents in F001-F005 for revised regulation of wastewater forms of these wastes, and all but carbon disulfide, cyclohexanone, nd methanol for revised regulation of nonwastewater forms. The 26 waste constituents selected for revised regulation are listed in Table 4-1.

Revised treatment standards based on F039 data are not being promulgated for carbon disulfide, cyclohexanone, and methanol in nonwastewater forms of F001-F005, primarily due to difficulties associated with the analyses of these constituents in nonwastewater matrices. The Agency believes that treatment of carbon disulfide is provided concurrently with treatment of halogenated aliphatic and aromatic solvents, including the following constituents that are being regulated in F001-F005: carbon tetrachloride, methylene chloride, tetrachloroethylene, 1,1,1-trichloroethane, and trichloroethylene. For cyclohexanone and methanol, the Agency believes that treatment is provided concurrently with treatment of oxygenated wastes, including the following constituents that are being regulated in F001-F005: acetone, n-butanol, ethyl acetate, ethyl ether, isobutanol, methyl ethyl ketone, and methyl isobutyl ketone.

Therefore, the Agency is neither setting concentration-based treatment standards, nor treatment standards expressed as method of treatment for these three constituents, with one exception. This exception applies when carbon disulfide, cyclohexanone, or methanol is the only hazardous constituent present in a nonwastewater form of F001-F005. In such instances, the constituent will retain its November 8, 1986 treatment standard as measured by analysis of the TCLP extract. The November 8, 1986 TCLP treatment standards for carbon disulfide, cyclohexanone, and methanol in nonwastewater forms of F001-F005 are: 4.8 mg/L, 0.75 mg/L, and 0.75 mg/L, respectively.

Table 4-1

Regulated Constituents

F001-F005 Spent Solvent Wastes

Acetone
n-Butyl Alcohol
Carbon Disulfide[a]
Carbon Tetrachloride
Chlorobenzene
Meta/Para-Cresol
Ortho-Cresol
Cyclohexanone[a]
1,2-Dichlorobenzene
Ethyl Acetate
Ethyl Benzene
Ethyl Ether
Isobutyl Alcohol
Methanol[a]
Methylene Chloride
Methyl Ethyl Ketone
Methyl Isobutyl Ketone
Nitrobenzene
Pyridine
Tetrachloroethylene
Toluene
1,1,1-Trichloroethane
Trichloroethylene
Trichloromonofluoromethane
1,1,2-Trichloro-1,2,2-trifluoroethane
Xylenes

---

[a]These constituents were not selected for regulation in nonwastewater forms of spent solvent wastes.

5.0 CALCULATION OF REVISED BDAT TREATMENT STANDARDS

The Agency based concentration-based treatment standards for regulated constituents on the performance of well-designed and well-operated BDAT treatment systems. Specifically, the calculation of BDAT treatment standards involved three steps: (1) accuracy correction of the treatment performance data to account for analytical interferences with the chemical make-up of the samples; (2) determination of a variability factor, specific to each constituent, to correct for normal variations in the performance of a treatment technology; and (3) calculation of the treatment standard, which is equal to the average effluent concentration multiplied by the accuracy correction factor and the variability factor. The revised treatment standards that were calculated for each BDAT List constituent being regulated in nonwastewater and wastewater forms of F001-F005 are presented in Table 5-1 and Table 5-3, respectively. The revised nonwastewater and wastewater treatment standards were calculated for the selected constituents using the available treatment performance data discussed in Section 3.0.

The Agency acknowledges that in certain instances, compliance with the BDAT treatment standards cannot be demonstrated due to analytical difficulties in the analysis of certain wastes. In such instances, if the waste has been treated with a combustion BDAT process and an analytical sensitivity (i.e., detection limit) within an order of magnitude of the treatment standard has been achieved, the Agency will consider that compliance with the treatment standard for the respective constituents in the waste has been demonstrated (33).

5.1 Calculation of Revised BDAT Treatment Standards for Nonwastewater Forms of F001-F005

The revised treatment standards for nonwastewater forms of F001-F005 are based on treatment performance data available to EPA from 11 of the 14 EPA-conducted incineration tests. Treatment standards for the majority of the regulated

constituents in nonwastewater forms of F001-F005 were calculated using the methodology summarized in Section 5.1.1. Treatment standards for the remaining regulated constituents in nonwastewater forms of F001-F005 were calculated using the methodology described in the Methodology for Developing Treatment Standards using data transferred from F, K, and D wastes. This methodology is described in Section 5.1.2.

5.1.1 Methodology for Calculation of Treatment Standards for Nonwastewater Forms of F001-F005

Treatment standards were calculated for constituents in F001-F005 that are amenable to quantification in hazardous waste matrices based on incineration performance data compiled from the BDAT database. Specifically, the Agency considered constituent concentrations in incinerator ash from 11 of the 14 incineration tests listed in Table 3-1. As discussed in Section 3.0, data from Tests 3, 5, and 6 were not used in calculating treatment standards for constituents in F001-F005.

Concentration-based treatment standards for waste constituents selected for regulation were calculated by multiplying the constituent detection limit in ash by an accuracy correction factor and a variability factor. The following section and Sections 5.2.1 and 5.2.2 discuss these three components of the treatment standard calculations. These calculations are summarized in Table 5-1.

Detection Limits

Detection limits from the analyses of the incinerator ash residuals from the 11 incinerator tests were used to calculate treatment standards for constituents regulated in nonwastewater forms of F001-F005. Table 3-2 presents the detection limits used in the calculation and Table 3-3 presents the treatment performance data for those tests where each constituent was detected.

The following hierarchy is a summary of the methodology used to determine which detection limit was used in the calculation of each treatment standard, with the noted exception regarding acetone (see Exceptions to the Methodology):

(1) If the constituent was detected in the untreated waste, the standard was calculated from the highest detection limit for that constituent of those incineration tests where the constituent was detected in the untreated waste.

(2) If the constituent was not detected in the untreated waste and was detected in the treated waste, the standard was calculated from the highest detection limit for that constituent of those incineration tests where the constituent was detected in the treated waste.

(3) If the constituent was not detected in either the untreated or the treated waste, the standard was calculated from the highest detection limit for that constituent of all 11 incineration tests.

For example, 1,1,1-trichloroethane was detected in the untreated waste of two treatment tests (4 and 14), as indicated in Table 3-3. The higher detection limit for 1,1,1-trichloroethane in the ash samples from those two tests was 2 ppm in Test 4. Therefore, 2 ppm is shown in Table 5-1 as the detection limit for 1,1,1-trichloroethane and was used to calculate the applicable nonwastewater treatment standard.

As a second example, isobutyl alcohol was not detected in the untreated or treated waste of any of the 11 incineration tests and, therefore, does not appear in Table 3-3. Detection limits for this constituent in ash ranged from 0.2 ppm to 60 ppm, as indicated in Table 3-2. Therefore, the detection limit of 60 ppm from Test 10 is shown in Table 5-1 as the detection limit for isobutyl alcohol and was used to calculate the applicable nonwastewater treatment standard.

Exceptions to the Methodology

With the exception of acetone, all treatment standards for constituents in nonwastewater forms of F001-F005 were calculated according to the methodology described above. These treatment standards are presented in Table 5-1. Acetone was detected in the untreated waste in 3 of the 11 incineration tests, Tests 9, 11, and 13. According to the methodology described above, the highest detection limit for acetone in the ash from Tests 9, 11, and 13 should have been used to calculate the treatment standard. However, the highest detection limit for acetone in Tests 9, 11, and 13 was 0.01 ppm. The Agency believes that this detection limit is too low to be achieved routinely in ash by analytical laboratories. Therefore, the highest detection limit for acetone from all 11 incineration tests, 50 ppm from Test 2, is shown in Table 5-1 and was used to calculate the treatment standard.

5.1.2 Treatment Standard Calculation Methodology Using Data Transferred from K Wastes

The treatment standards for F001-F005 solvent constituents that do not have a corresponding U or P waste code were calculated using the methodology described in the Methodology for Developing Treatment Standards (2). This includes 1,1,2-trichloro-1,2,2-trifluoroethane and ethyl benzene. The treated waste concentration data for each of these constituents were corrected for accuracy. The average of the accuracy-corrected treatment values was then multiplied by a variability factor to determine the treatment standard. The treatment standards calculated for these constituents are presented in Table 5-2.

Treatment performance data for these constituents were transferred from regulated K wastes, as indicated in Table 5-2. Detailed information on the treatment performance data and the methodology used to calculate the treatment standards for

these constituents can be found in the appropriate background document for each K waste.

5.2 Calculation of Revised BDAT Treatment Standards for Wastewater Forms of F001-F005

The revised treatment standards for wastewater forms of F001-F005 are based on treatment performance data available to EPA from wastewater treatment units. The long-term average effluent concentration for each constituent was multiplied by an accuracy correction factor and a variability factor to determine the treatment standard. The treatment standards calculated for wastewater forms of the constituents in F001-F005 are shown in Table 5-3.

5.2.1 Accuracy Correction Factors

Accuracy correction factors account for analytical interferences associated with the chemical matrices of the samples. The accuracy correction factor is incorporated into the determination of treatment standards by multiplying it (and a variability factor when appropriate) by the constituent's detection limit. An accuracy correction factor was determined for each of the constituents by dividing 100 by the matrix spike recovery (percent) for each constituent.

The matrix spike recoveries are developed by analyzing a sample of a treated waste for a constituent and then re-analyzing the sample after the addition of a known amount of the same constituent (i.e., spike) to the sample. The matrix spike recovery represents the total amount of constituent recovered after spiking, minus the initial concentration of the constituent in the sample, and the result divided by the spike concentration of the constituent. Duplicate matrix spikes were performed for some BDAT List constituents. If a duplicate matrix spike was performed for a constituent, the

matrix spike recovery used for that constituent was the lower of the two values between the first matrix spike and the duplicate spike.

An accuracy correction factor of 1.00 was used when both the matrix spike and duplicate matrix spike recoveries exceeded 100 percent, so that the data were not adjusted to concentrations below the detection limits. Matrix spike values of less than 20 percent are not acceptable and were not used to correct detection limits, nor included in calculating average matrix spike recoveries.

EAD variability factors already contain accuracy correction measures. Therefore, to avoid over-correcting the data, accuracy correction factors were not used in cases where EAD variability factors were used. In cases where an EAD variability factor was not used, an accuracy correction factor was determined as described above and included in the treatment standard calculation.

As described above, matrix spike recovery data are routinely used in determining accuracy correction factors; however, these data were not available for most of the treatment performance data examined. Consequently, matrix spike data were pooled from BDAT and leachate data sources. Leachate matrix spike data were used to determine an accuracy correction factor in cases where leachate treatment performance data were used to establish a treatment standard; BDAT matrix spike data were used in all other cases. Where an accuracy correction factor was not available for a specific constituent, an average accuracy correction factor was determined, as presented in Tables 5-6 through 5-9.

5.2.2 Variability Factors

A variability factor accounts for the variability inherent in treatment system performance, treatment residual collection, and analysis of the treated waste samples.

Variability factors are calculated as described in EPA's Methodology for Developing BDAT Treatment Standards (2) and are presented in Tables 5-4 and 5-5.

Original effluent data points were not always available. Therefore, variability factors for some constituents were not calculated as described in Reference 2. For example, effluent data in the WERL database were presented as averages; since actual effluent data points were not available, it was not possible to calculate a variability factor specific to each of these constituents.

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 organics).

One of two options was used for constituents where a variability factor was unknown or could not be calculated.

(1) Use of average variability factors that were generated from the EAD variability factors and were specific to the type of constituent under consideration.

(2) Use of a variability factor of 2.8 for constituents that were not volatile or semivolatile organics.

The average volatile organic variability factor is an average of the volatile organic variability factors from EAD data as presented in Table 6-2. The average semivolatile organic variability factors are averages of the semivolatile organic variability factors from EAD data as presented in Table 6-3. The procedure for determination of these average variability factors was similar to the procedures used by EPA in previous Land Disposal Restrictions rulemakings to determine average accuracy correction factors.

A variability factor of 2.8 was used to calculate treatment standards for constituents for which the long-term average effluent concentration was based on detection limits only. This variability factor has been used by EPA in past Land Disposal Restrictions rulemakings where variability factors could not be calculated.

Table 5-1

TREATMENT STANDARDS CALCULATIONS FOR NONWASTEWATER FORMS OF F001-F005

BDAT Number	Constituent***	Detected in either Untreated or Treated Waste (Y or N)	Detection Limit (ppm)	Detection Limit Taken From Test #(s)*	Recovery (%)	Recovery Data Transferred From (BDAT List #/Test #)*	Accuracy Correction Factor	Corrected Detection Limit (ppm)	x	Variability Factor	=	Treatment Standard (ppm)**
222	Acetone	Y	50	2	86	24/2	1.16	58.14		2.8		160
225	n-Butyl alcohol	N	0.4	13,14	43	229/14	2.33	0.93		2.8		2.6
7	Carbon tetrachloride	Y	2	4	100	47/4	1.00	2.00		2.8		5.6
9	Chlorobenzene	Y	2	4	99	9/4	1.01	2.02		2.8		5.7
52	Cresol (m- and p- isomers)	Y	1	8	87	76/8	1.15	1.15		2.8		3.2
51	o-Cresol	Y	2	4	100	76/4	1.00	2.00		2.8		5.6
57	1,2-Dichlorobenzene	Y	2	4	90	88/4	1.11	2.22		2.8		6.2
225	Ethyl acetate	Y	10	2	86	24/2	1.16	11.63		2.8		33
227	Ethyl ether	N	50	1	86	24/2	1.16	58.14		2.8		160
35	Isobutyl alcohol	N	60	10	100	24/10	1.00	60.00		2.8		170
36	Methylene chloride	Y	10	4	78	24/4	1.28	12.82		2.8		36
34	Methyl ethyl ketone	Y	10	1	84	47/1	1.19	11.90		2.8		33
228	Methyl isobutyl ketone	Y	10	1	84	47/1	1.19	11.90		2.8		33
126	Nitrobenzene	Y	5	4	97	127/4	1.03	5.15		2.8		14
38	Pyridine	Y	5	1	88	4/1	1.14	5.68		2.8		16
42	Tetrachloroethylene	Y	2	4	100	47/4	1.00	2.00		2.8		5.6
43	Creosote-Toluene	Y	10	2	99	43/2	1.01	10.1		2.8		28
45	1,1,1-Trichloroethane	Y	2	4	100	47/4	1.00	2.00		2.8		5.6
47	Trichloroethylene	Y	2	4	100	47/4	1.00	2.00		2.8		5.6
48	Trichlorofluoromethane	N	10	2	86	24/2	1.16	11.63		2.8		33
215-217	Xylenes	Y	10	2	100	9/2	1.00	10.00		2.8		28

* Treatment test number is indicated in Table 3-1.

** Treatment standards apply to F001-F005 constituents.

*** Carbon disulfide, cyclohexanone and methanol are not being regulated in nonwastewater forms of F001-F005.

Table 5-2

TREATMENT STANDARD CALCULATIONS FOR F001-F005 CONSTITUENTS THAT ARE BASED ON PERFORMANCE DATA OTHER THAN THE ELEVEN INCINERATION TESTS

BDAT List Constituent	Waste Code/BDAT List Constituent From Which Treatment Performance Data Were Transferred	Average Concentration in the Treatment Residual (ppm)	x	Accuracy Correction Factor	x	Variability Factor	=	Treatment Standard (ppm)
ORGANICS								
226 Ethyl benzene	K019 RCRA Blend 226	3.0		5.0		2.8		14
231 1,1,2-Trichloro-1,2,2-trifluoroethane	K019/113	10.0		1.0		2.8		5.6

TABLE 5-3
BDAT TREATMENT STANDARDS FOR WASTEWATER
FORMS OF FOO1-FOO5

CONSTITUENTS	LONG TERM AVERAGE EFFLUENT CONCENTRATION (ppm)	VF	ACF	BDAT TREATMENT STANDARD (ppm)
Acetone	0.10	2.8	1.01	0.28
n-Butyl alcohol	2.0	2.8	1.0	5.6
Carbon disulfide	0.0050	2.8	1.0	0.014
Carbon tetrachloride	0.010	5.7		0.057
Chlorobenzene	0.010	5.7		0.057
meta/para-Cresol	0.17	4.4		0.77
ortho-Cresol	0.025	4.4		0.11
Cyclohexanone	0.10	2.8	1.3	0.36
1,2-Dichlorobenzene	0.016	5.5		0.088
Ethyl acetate	0.060	5.7		0.34
Ethyl benzene	0.010	5.7		0.057
Ethyl ether	0.021	5.7		0.12
Isobutyl alcohol	2.0	2.8	1.0	5.6
Methanol	2.0	2.8	1.0	5.6
Methylene chloride	0.023	3.9		0.089
Methyl ethyl ketone	0.10	2.8	1.0	0.28
Methyl isobutyl ketone	0.050	2.8	1.0	0.14
Nitrobenzene	0.014	4.8		0.068
Pyridine	0.0024	5.7		0.014
Tetrachloroethylene	0.010	5.3		0.056
Toluene	0.010	8.0		0.080
1,1,1-Trichloroethane	0.010	5.3		0.054
Trichloroethylene	0.010	5.3		0.054
Trichloromonofluoromethane	0.0070	2.8	1.0	0.020
1,1,2-Trichloro-1,2,2-trifluoroethane	0.010	5.7		0.057
Xylene(s)	0.056	5.7		0.32

VF - Availability Factor
ACF - Accuracy Correction Factor

TABLE 5-4
VOLATILE ORGANIC VARIABILITY FACTOR CALCULATION

VOLATILES	EAD VARIABILITY FACTOR
Acrylonitrile	4.83045
Benzene	13.8252
Chloroethane	5.34908
Chloroform	3.71334
Chloromethane	3.79125
1,1-Dichloroethane	5.86368
1,2-Dichloroethane	8.22367
1,1-Dichloroethene	2.4723
Trans-1,2-Dichloroethene	5.34908
Methylene Chloride	3.86915
Tetrachloroethylene	5.34908
Toluene	7.9508
1,1,1-Trichloroethane	5.34908
1,1,2-Trichloroethane	5.34908
Trichloroethylene	5.34908
Vinyl Chloride	5.34908
AVERAGE =	5.7310

VOLATILES VF = 5.7310

TABLE 5-5
SEMIVOLATILE VARIABILITY FACTOR CALCULATION

VOLATILES	EAD VARIABILITY FACTOR
ACID EXTRACTABLES	
2,4-Dimethylphenol	3.2566
4,6-Dinitro-o-cresol	11.5417
2,4-Dinitrophenol	2.45842
4-Nitrophenol	2.47783
Phenol	2.49705
	AVERAGE = 4.4463
ACID-EXTRACTABLE SEMIVOLATILES VF = 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 (b) fluoranthene	5.89125
Bis(2-ethylhexyl) phthalate	5.81768
Chrysene	5.89125
Diethyl phthalate	4.75861
Dimethyl phthalate	4.63633
Di-n-butyl phthalate	3.23768
Fluoranthene	5.89125
Fluorene	5.89125
Naphthalene	5.89125
Nitrobenzene	4.53045
Phenanthrene	5.89125
Pyrene	5.89125
	5.5340
BASE NEUTRAL EXTRACTABLE SEMIVOLATILES VF = 5.534	

TABLE 5-6
VOLATILE ORGANIC ACCURACY CORRECTION FACTOR CALCULATIONS - EPA BDAT DATA

VOLATILES	PERCENT RECOVERY						LOWEST RECOVERY	ACF
	WAO TEST A		WAO TEST B		K103/K104			
	Matrix Spike	Matrix Spike Duplicate	Matrix Spike	Matrix Spike Duplicate	Matrix Spike	Matrix Spike Duplicate		
n-Butanol	82	94	84	93			82	1.2
Isobutanol	97	92	102	89			89	1.1
Methanol	93	88	89	85			85	1.2
3-Chloropropionitrile	159	171	162	162			159	1.0
1,4-Dioxane	152	153	155	153			152	1.0
2-Ethoxyethanol	157	172	161	161			157	1.0
Ethylene oxide	103	37	50	22			22	4.6
Methacrylonitrile	150	158	165	169			150	1.0
Trichloroethene	87	89	87	88			87	1.2
1,1-Dichloroethene	108	110	120	120			108	1.0
Benzene	165	190	110	120	76	94	76	1.3
Chlorobenzene	98	110	88	90			88	1.1
Toluene			87	90			87	1.2
					AVERAGE =		103.23	
					SET AT =		100	

AVERAGE ACF FOR VOLATILE ORGANICS = 1.0

NOTES: If Percent Recovery is less than 20% that value is not included in the ACF calculation because it does not meet the quality control criteria for the BDAT program (36).

If Percent Recovery is greater than 100% that recovery is set at 100% so that the data are not adjusted to below the detection limits.

To determine an Accuracy Correction Factor [ACF] for volatile organics, the average of the lowest recoveries for each volatile organic constituent is calculated ACF = 100/ avg. low value.

TABLE 5-7
SEMIVOLATILE ACCURACY CORRECTION FACTOR CALCULATIONS - EPA DATA

SEMIVOLATILES	PERCENT RECOVERY						LOW VALUE	ACF
	WAO A		WAO B		K103/K104			
ACID EXTRACTABLE	Matrix Spike	Matrix Spike Duplicate	Matrix Spike	Matrix Spike Duplicate	Matrix Spike	Matrix Spike Duplicate		
p-Chloro-m-cresol	21	12	58				21	4.8
2-Chlorophenol	55	55	55				55	1.8
Pentachlophenol	68	82	0				68	1.5
4-Nitrophenol	20	13	43				20	5.0
Phenol	94	82	42		21	28	21	4.8
					AVERAGE =		37	

AVERAGE ACF FOR ACID EXTRACTABLE SEMIVOLATILES = 100/37 = 2.7

BASE NEUTRAL EXTRACTABLES

Acenaphthene	72	86	79				72	1.4
1,4-Dichlorobenzene	65	74	82				82	1.9
2,4-Dinitrotoluene	78	112	69				69	1.5
N-nitroso-di-n-propylamine	79	92	51				51	2.0
Pyrene	86	87	84				87	1.5
1,2,4-Trichlorobenzene	73	87	61				61	1.6
Nitrobenzene					115	116	115	1.0
Aniline					91	97	91	1.1
					AVERAGE =		72.3	

AVERAGE ACF FOR BASE NEUTRAL SEMIVOLATILES = 100/72.3 = 1.38

NOTES: If Percent Recovery is less than 20% that value is not included in the ACF calculation because it does not meet the quality control criteria for the BDAT program (38).

If Percent Recovery is greater than 100% that recovery is set at 100% so that the data are not adjusted to below the detection limits.

To determine an Accuracy Correction Factor [ACF] for volatile organics, the average of the lowest recoveries for each volatile organic constituent is calculated. ACF = 100/ avg. low value.

TABLE 5-8
VOLATILE ORGANICS ACCURACY CORRECTION FACTOR CALCULATIONS
FOR DOW LEACHATE DATA

	PERCENT RECOVERY			
VOLATILES	Matrix Spike	Matrix Spike Duplicate	LOW VALUE	ACF
Methanol	100	100	100	1.0
Isobutyl alcohol	101	101	99	1.0
n-butyl alcohol	105	99	99	1.01
1,1-Dichloroethene	130	132	130	1.0
Trichloroethene	94	94	94	1.06
Chlorobenzene	98	98	98	1.04
Toluene	100	100	100	1.0
Benzene	94	94	94	1.06
		AVERAGE =	101.75	
		SET AT =	100	

AVERAGE ACF FOR VOLATILE ORGANICS = 100/100 = 1.00

NOTES: If Percent Recovery is less than 20% that value is not included in the ACF calculation because it does not meet the quality control criteria for the BDAT program (36).

If Percent Recovery is greater than 100% that recovery is set at 100% so that the data are not adjusted to below the detection limits.

To determine an Accuracy Correction Factor [ACF] for volatile organics, the average of the lowest recoveries for each volatile organic constituent is calculated. ACF = 100/ avg. low value.

TABLE 5-9
VOLATILE ORGANICS ACCURACY CORRECTION FACTOR CALCULATIONS
FOR CWM LEACHATE DATA

VOLATILES	PERCENT REMOVAL	ACF
Acetone	99	1.01
n-Butyl Alcohol	112	1.0
Isobutyl Alcohol	112	1.01
Methyl Ethyl Ketone	99	1.01
Methanol	112	1.0
Methyl Isobutyl Ketone	99	1.01
AVERAGE =	105.5	
SET AT =	100	

AVERAGE ACF FOR VOLATILE ORGANICS = 100/100 = 1.00

NOTES: If Percent Recovery is less than 20% that value is not included in the ACF calculation because it does not meet the quality control criteria for the SOAT program (36).

If Percent Recovery is greater than 100% that recovery is set at 100% so that the data are not adjusted to below the detection limits.

To determine an Accuracy Correction Factor [ACF] for volatile organics, the average of the lowest recoveries for each volatile organic constituent is calculated. ACF = 100/ avg. low value.

6.0 ACKNOWLEDGEMENTS

This background document was prepared for the U.S. Environmental Protection Agency, Office of Solid Waste, by Radian Corporation under Contract No. 68-W9-0072. This document was prepared under the direction of Richard Kinch, Chief, Waste Treatment Branch; Larry Rosengrant, Section Head, Treatment Technology Section; Angela Wilkes, Project Officer; and Anita Cummings, Project Manager. Steve Silverman served as EPA legal advisor.

The following personnel from Radian Corporation were involved in preparing this document: Thomas Ferguson, Program Manager; Mary Willett, Project Director; and the Radian Engineering Team: Kurt Rindfusz, Robert Shark, and Chrisanti Haretos.

7.0 REFERENCES

1. U.S. Environmental Protection Agency, Office of Solid Waste. Final Best Demonstrated Available Technology (BDAT) Background Document Addendum for F002 (1,1,2 Trichloroethane) and F005 (benzene, 2-ethoxyethanol and 2-nitropropane). U.S. Environmental Protection Agency. Washington, D.C.: May 1990.

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

3. U.S. Environmental Protection Agency, Office of Solid Waste. Amendment to the Best Demonstrated Available Technology (BDAT) Background Document, Volumes 1 and 2 for F001-F005: Spent Solvents (Vol 10). U.S. Environmental Protection Agency. Washington, D.C.: May 1988.

4. U.S. Environmental Protection Agency, Office of Solid Waste. Treatment Technology Background Document. U.S. Environmental Protection Agency. Washington, D.C.: 1990.

5. U.S. Environmental Protection Agency, Hazardous Waste Engineering Research Laboratory. Characterization of Hazardous Waste Incineration Residuals. June 1986.

6. U.S. Environmental Protection Agency, Office of Solid Waste. Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039) for Which There are Concentration-Based Treatment Standards (Volumes A and C). U.S. Environmental Protection Agency. Washington, D.C.: May 1990.

7. U.S. Environmental Protection Agency. Onsite Engineering Report of Treatment Technology Performance and Operation for Incineration of K001-Pentachlorophenol (PCP) Waste at the U.S. Environmental Protection Agency Combustion Research Facility. U.S. Environmental Protection Agency. Washington, D.C.: November 12, 1987.

8. U.S. Environmental Protection Agency. Onsite Engineering Report of Treatment Performance and Operation for Incineration of K001-Creosote Waste at the U.S. Environmental Protection Agency Combustion Research Facility. U.S. Environmental Protection Agency. Washington, D.C.: November 23, 1987.

9. U.S. Environmental Protection Agency. Onsite Engineering Report of Treatment Performance and Operation for Incineration of K011/K013/K014 Sludge at the John Zink Test Facility. U.S. Environmental Protection Agency. Washington, D.C.: November 2, 1987.

10. U.S. Environmental Protection Agency. Non-confidential Version of the Onsite Engineering Report of Treatment Technology Performance and Operation for Rollins Environmental Services (TX) Inc., Deer Park, Texas. U.S. Environmental Protection Agency. Washington, D.C.: March 11, 1988.

11. U.S. Environmental Protection Agency. Onsite Engineering Report of Treatment Technology Performance and Operation: Incineration of K024 Waste at the U.S. Environmental Protection Agency Combustion Research Facility. U.S. Environmental Protection Agency. Washington, D.C.: 1987.

12. U.S. Environmental Protection Agency. Onsite Engineering Report of Treatment Technology Performance and Operations for Incineration of K037 Waste at the Combustion Research Facility. U.S. Environmental Protection Agency. Washington, D.C.: November 16, 1987.

13. U.S. Environmental Protection Agency. Onsite Engineering Report of Treatment Technology Performance and Operation for Amoco Oil Company, Whiting, Indiana. U.S. Environmental Protection Agency. Washington, D.C.: February 29, 1988.

14. Onsite Engineering Report of Treatment Technology Performance and Operation for Amoco Oil Company, Whiting, Indiana. U.S. Environmental Protection Agency. Washington, D.C.: July 15, 1988.

15. U.S. Environmental Protection Agency. Onsite Engineering Report of Treatment Technology Performance and Operation for Incineration of K087 Waste at the Combustion Research Facility, Jefferson, Arkansas. U.S. Environmental Protection Agency. Washington, D.C.: February 22, 1988.

16. U.S. Environmental Protection Agency. Onsite Engineering Report for John Zink Company for K101. U.S. Environmental Protection Agency. Washington, D.C.: April 25, 1988.

17. U.S. Environmental Protection Agency. Onsite Engineering Report for John Zink Company for K102. U.S. Environmental Protection Agency. Washington, D.C.: April 25, 1988.

18. U.S. Environmental Protection Agency. Onsite Engineering Report of Treatment Performance and Operation for Incineration for ENSCO, El Dorado, Arkansas. U.S. Environmental Protection Agency. Washington, D.C.: December, 1988.

19. U.S. Environmental Protection Agency. Onsite Engineering Report of Treatment Performance and Operation for Incineration of K015 Waste at the John Zink Company Test Facility. U.S. Environmental Protection Agency. Washington, D.C.: December 4, 1987.

20. U.S. Environmental Protection Agency, Office of Solid Waste. Onsite Engineering report of Treatment Technology Performance and Operation for John Zink Company. U.S. Environmental Protection Agency. Washington, D.C.: 1990.

21. U.S. Environmental Protection Agency, Office of Solid Waste. Best Demonstrated Available Technology (BDAT) Background Document for K001 Waste. U.S. Environmental Protection Agency. Washington, D.C.: 1988.

22. U.S. Environmental Protection Agency, Office of Solid Waste. Best Demonstrated Available Technology (BDAT) Background Document for K016, K018, K019, K020 Wastes. U.S. Environmental Protection Agency. Washington, D.C.: 1988.

23. U.S. Environmental Protection Agency, Office of Solid Waste. Best Demonstrated Available Technology (BDAT) Background Document for K024 Waste. U.S. Environmental Protection Agency. Washington, D.C.: 1988.

24. U.S. Environmental Protection Agency, Office of Solid Waste. Best Demonstrated Available Technology (BDAT) Background Document for K037 Waste. U.S. Environmental Protection Agency. Washington, D.C.: 1988.

25. U.S. Environmental Protection Agency, Office of Solid Waste. Best Demonstrated Available Technology (BDAT) Background Document for K048-K052 Waste. U.S. Environmental Protection Agency. Washington, D.C.: 1988.

26. U.S. Environmental Protection Agency, Office of Solid Waste. Best Demonstrated Available Technology (BDAT) Background Document for K087 Waste. U.S. Environmental Protection Agency. Washington, D.C.: 1988.

27. U.S. Environmental Protection Agency, Office of Solid Waste. Best Demonstrated Available Technology (BDAT) Background Document for K101 and K102, Low Arsenic Subcategory. U.S. Environmental Protection Agency. Washington, D.C.: 1988.

28. U.S. Environmental Protection Agency, Office of Solid Waste. Best Demonstrated Available Technology (BDAT) Background Document for Cyanide Wastes. U.S. Environmental Protection Agency. Washington, D.C.: 1989.

29. U.S. Environmental Protection Agency, Office of Solid Waste. Best Demonstrated Available Technology (BDAT) Background Document for F024 Waste. U.S. Environmental Protection Agency. Washington, D.C.: 1989.

30. U.S. Environmental Protection Agency, Office of Solid Waste. Best Demonstrated Available Technology (BDAT) Background Document for K015 Waste. U.S. Environmental Protection Agency. Washington, D.C.: 1988.

31. U.S. Environmental Protection Agency, Office of Solid Waste. Best Demonstrated Available Technology (BDAT) Background Document for F001-F005 Spent Solvents (Vols. 1, 2, and 3). U.S. Environmental Protection Agency. Washington, D.C.: November 1986.

32. U.S. Environmental Protection Agency, Office of Water Regulations and Standards. Development Document for Effluent Limitations Guidelines New Source Performance Standards and Pretreatment Standards for the Organic Chemicals and the Plastics and Synthetic Fibers Point Source Category (Volumes I and II). U.S. Environmental Protection Agency, Washington, D.C., 1987.

33. U.S. Environmental Protection Agency. Federal Register (Volume 55). U.S. Environmental Protection Agency. Washington, D.C.: June 1, 1990. p. 22541.

APPENDIX A

ACCURACY CORRECTION OF DATA

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

Matrix spike recoveries are developed by analyzing a sample of a treated waste for a constituent and then re-analyzing the sample after the addition of a known amount of the same constituent (i.e., spike) to the sample. The matrix spike recovery represents the total amount of constituent recovered after spiking, minus the initial concentration of the constituent in the sample, and the result divided by the spike concentration of the constituent. Duplicate matrix spikes were performed for some BDAT List constituents. If a duplicate matrix spike was performed for a constituent, the matrix spike recovery used for that constituent was the lower of the recovery values from the first matrix spike and the duplicate spike.

In cases where a matrix spike was not performed for a waste constituent in the treatment test from which the detection limit was taken, the matrix spike recovery from a similar constituent from the treatment test was transferred to the constituent.

For some F001-F005 solvent constituents, treatment performance data were transferred from K wastes. In these cases, when a matrix spike was not performed for a

particular constituent, the matrix spike recovery for each constituent was derived from the average matrix spike recoveries of the appropriate analytical fraction (e.g., volatile or semivolatile organics) for which recovery data were available. First, the matrix spike recoveries for all volatile or semivolatiles from the first matrix spike were averaged. An average matrix spike recovery was then calculated for the duplicate matrix spike recoveries. The lower of the two average matrix spike recoveries was used to calculate the accuracy correction factor for the constituent.

An accuracy correction factor was determined for each constituent by dividing 100 by the matrix spike recovery (percent) for that constituent. An accuracy correction factor of 1.00 was used when both the matrix spike and duplicate matrix spike recoveries exceeded 100 percent, so that the data were not adjusted to concentrations below the detection limits. Matrix spike values of less than 20 percent are not acceptable and were not used to correct detection limits, nor included in calculating average matrix spike recoveries.

Table A-1 presents the matrix spike recoveries obtained in each of the 11 incineration tests. Matrix spike recoveries and accuracy correction factors used for each F001-F005 solvent constituent included in this document are presented in Tables 5-1 and 5-2.

Table A-1

MATRIX SPIKE PERCENT RECOVERIES IN ASH FROM BDAT INCINERATION TESTS*

BDAT Number	BDAT List Constituent	Test 1	Test 2	Test 4	Test 7	Test 8	Test 9	Test 10	Test 11	Test 13	Test 14
Volatile Organics:											
1	Acetonitrile										
2	Acrolein										
3	Acrylonitrile										
4	Benzene	88,88	78,88	90,95	88	100,98	102,106	104,106	128,130	117,158	103,97
9	Chlorobenzene	124,120	102,112	99,100	46	106,108	104,110	106,110	900,108	92,56	115,109
22	1,1-Dichloroethane					114,114	100,98	128,130			
24	1,1-Dichloroethylene		88,85	85,76	96	114,114	100,98	128,130	89,112	35,32	75,73
229	Methyl isobutyl ketone									88,117	48,43
38	Methylene Chloride									300,309	120,124
43	Toluene	108,108	98,110		80	106,104	106,116	112,114	170,222	246,153	109,98
45	1,1,1-Trichloroethane									539,866	109,110
47	Trichloroethylene	88,84	87,77	107,112	76	114,114	116,128	112,116	178,216	210,294	109,103
215-2	17 Total Xylenes									61,23	92,91
Semivolatile Organics:											
51	Acenaphthalene						41,39	73,74			
52	Acenaphthene	120,120	0,3.4	110,110	66,63	93,91			30,66	51,24	60,54
70	Bis(2-ethylhexyl)phthalate									86,76	78,71
73	2-sec-Butyl-4,6-dinitrophenol		113,66							65,13	41,41
76	p-Chloro-m-cresol	90,95	35,66	110,120	56,57	92,87	47,44	66,64	66,135	86,84	90,79
78	2-Chlorophenol	100,105	89,53	96,100	70,70	78,83	41,39	62,58	76,102	46,42	53,41
87	p-Dichlorobenzene				76,76						
88	o-Dichlorobenzene	94,94	48,46	90,90		78,89	40,39	76,70	72,90	28,23	29,17
102	2,4-Dinitrotoluene	120,120	0,0	107,110	54,52	121,108	46,47	58,56	38,100	73,56	71,63
105	Di-n-propylnitrosamine	81,82	67,62	120,130	70,70	82,84	46,45	64,61	110,118	58,50	53,46
110	Hexachlorobenzene									54,21	74,139
117	Isosafrole									34,28	44,39
127	4-Nitrophenol	100,90	1.2,2.6	97,110	32,31	37,35	33,32	22,21	50,90	91,48	77,64
130	Pentachlorophenol	95,105	0,0	88,86	34,34	7,11	30,25	38,35	27,64	74,0	77,69
142	Phenol	85,80	72,85	90,97	65,65	77,80	41,40	65,61	101,122	70,61	70,60
144	Pronamide									96,89	92,84
145	Pyrene	98,100	0,0	120,92	58,53	34,39	46,45	86,79	6,82	49,0	73,66
150	1,2,4-Trichlorobenzene	98,100	30,30	75,80	60,66	84,89	41,39	76,76	60,90	30,25	36,24

* No matrix spike recovery data were collected for the ash from incineration test 12.

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. EPA530-R95-027	2.	PB95-230876

4. Title and Subtitle
BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR F001-F005 SPENT SOLVENTS; FINAL

5. Report Date
JUNE 1992

6.

7. Author(s)

8. Performing Organization Rept. No

9. Performing Organization Name and Address

U.S. EPA
OFFICE OF SOLID WASTE
401 M STREET, SW
WASHINGTON, DC 20460

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.
(C)
(G)

12. Sponsoring Organization Name and Address

13. Type of Report & Period Covered
TECHNICAL REPORT

14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

PROVIDES TECHNICAL SUPPORT FOR REVISIONS TO THE BDAT TREATMENT STANDARDS FOR THE ORIGINAL LISTED SOLVENT CONSTITUENTS OF F001-F005. EXAMINES EPA'S RATIONALE AND TECHNICAL SUPPORT FOR REVISING THE F001-F005 TREATMENT STANDARDS PROMULGATED ON NOVEMBER 7, 1986, AND AUGUST 17, 1988. PRESENTS EPA'S APPROACH TO AND TECHNICAL SUPPORT FOR THE TREATMENT STANDARDS FOR NONWASTEWATER AND WASTEWATER FORMS OF F001-F005 AND THE REVISED TREATMENT STANDARDS. APPENDIX DISCUSSES ACCURACY CORRECTION OF DATA.

17. Document Analysis a. Descriptors

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
	UNCLASSIFIED	0
RELEASE UNLIMITED	20. Security Class (This Page)	22. Price
	UNCLASSIFIED	0

(See ANSI-Z39.18)

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)