# FINAL

# AMENDMENT TO THE

# FINAL BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)

# BACKGROUND DOCUMENT

# FOR

# WASTES FROM THE PRODUCTION OF

# 1,1,1-TRICHLOROETHANE

# K028, K029, K095, AND K096

Richard Kinch
Acting Chief, Waste Treatment Branch

Elaine Eby
Project Manager

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Solid Waste
401 M Street, S.W.
Washington, D.C. 20460

May 1990

TABLE OF CONTENTS


| | | Page |
|---|---|---|
| 1.0 | INTRODUCTION | 1-1 |
| 2.0 | AMENDMENT TO SECTION 3.0 (APPLICABLE AND DEMONSTRATED TREATMENT TECHNOLOGIES) OF THE FINAL BDAT BACKGROUND DOCUMENT FOR K028, K029, K095, AND K096 | 2-1 |
| | 2.1 Applicable Treatment Technologies for K028 Nonwastewater Metals | 2-1 |
| | 2.2 Demonstrated Treatment Technologies for K028 Nonwastewater Metals | 2-1 |
| | 2.3 Applicable Treatment Technologies for K029, K095, and K096 Wastewaters | 2-2 |
| | 2.4 Demonstrated Treatment Technologies for K029, K095, and K096 Wastewaters | 2-2 |
| 3.0 | AMENDMENT TO SECTION 4.0 (TREATMENT PERFORMANCE DATABASE) OF THE FINAL BDAT BACKGROUND DOCUMENT FOR K028, K029, K095, AND K096 | 3-1 |
| | 3.1 Treatment of Metal Constituents | 3-1 |
| | 3.2 Treatment of Organic Constituents | 3-3 |
| 4.0 | AMENDMENT TO SECTION 5.0 (IDENTIFICATION OF BEST DEMONSTRATED AND AVAILABLE TECHNOLOGY (BDAT)) OF THE FINAL BDAT BACKGROUND DOCUMENT FOR K028, K029, K095, AND K096 | 4-1 |
| | 4.1 Review of Treatment Performance Data | 4-2 |
| | 4.2 Statistical Comparison of Treatment Performance Data | 4-3 |
| | 4.3 Demonstrated Treatment Technologies | 4-3 |
| | 4.4 Available Treatment Technologies | 4-4 |
| 5.0 | AMENDMENT TO SECTION 6.0 (SELECTION OF REGULATED CONSTITUENTS) OF THE FINAL BDAT BACKGROUND DOCUMENT FOR K028, K029, K095, AND K096 | 5-1 |
| | 5.1 K028 Nonwastewater Metals | 5-2 |
| | 5.1.1 BDAT List Metal Constituents Deleted From Further Consideration for Regulation | 5-2 |
| | 5.1.2 BDAT List Metal Constituents Selected For Regulation | 5-3 |
| | 5.2 K029, K095, and K096 Wastewaters | 5-3 |
| | 5.2.1 BDAT List Constituents Deleted From Further Consideration for Regulation | 5-3 |
| | 5.2.2 BDAT List Constituents Selected For Regulation | 5-4 |
| 6.0 | AMENDMENT TO SECTION 7.0 (CALCULATION OF BDAT TREATMENT STANDARDS) OF THE FINAL BDAT BACKGROUND DOCUMENT FOR K028, K029, K095, AND K096 | 6-1 |

TABLE OF CONTENTS (Continued)


| | | Page |
|---|---|---|
| 7.0 | ACKNOWLEDGEMENTS . . . . . | 7-1 |
| 8.0 | REFERENCES . . . . . | 8-1 |

APPENDIX A - Treatment Performance Data For K029, K095, And K096 Wastewater Constituents

APPENDIX B - Quality Assurance/Quality Control Data

LIST OF TABLES


| | | Page |
|---|---|---|
| 1-1 | BDAT TREATMENT STANDARDS FOR K028 - NONWASTEWATER METALS | 1-5 |
| 1-2 | BDAT TREATMENT STANDARDS FOR K029, K095, AND K096 WASTEWATER ORGANICS | 1-6 |
| 3-1 | TCLP ANALYTICAL RESULTS FOR THE STABILIZED F024 INCINERATOR ASH SAMPLES - CEMENT BINDER | 3-5 |
| 5-1 | BDAT LIST CONSTITUENTS SELECTED FOR REGULATION IN K029, K095, AND K096 WASTEWATERS | 5-5 |
| 6-1 | CORRECTED CONCENTRATION DATA FOR METAL CONSTITUENTS IN STABILIZED F024 INCINERATOR ASH USED FOR TRANSFER TO K028 NONWASTEWATERS | 6-3 |
| 6-2 | CALCULATION OF TREATMENT STANDARDS FOR METAL CONSTITUENTS IN K028 NONWASTEWATERS | 6-4 |

# 1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA or Agency) is establishing best demonstrated available technology (BDAT) treatment standards for metals in nonwastewater forms of the listed hazardous waste K028 and for organics in wastewater forms of the listed hazardous wastes K029, K095, and K096. The listed hazardous wastes K028, K029, K095, and K096 were identified in Title 40, Code of Federal Regulations, Section 261.32 (40 CFR 261.32) as wastes from the production of 1,1,1-trichloroethane. These BDAT treatment standards are being established in accordance with the amendments to the Resource Conservation and Recovery Act (RCRA) of 1976, enacted by the Hazardous and Solid Waste Amendments (HSWA) of November 8, 1984. BDAT treatment standards will be effective no later than May 8, 1990, and on and after the effective date, compliance with these BDAT treatment standards will be a prerequisite under 40 CFR Part 268 for placement of the waste in land disposal units.

This background document ("amendment document") will amend the Final Best Demonstrated Available Technology (BDAT) Background Document for Wastes from the Production of 1,1,1-Trichloroethane - K028, K029, K095, and K096 ("the K028 Final BDAT Background Document" (Reference 1)). At the time of promulgation of K028 nonwastewater and wastewater standards and K029, K095, and K096 nonwastewater standards, the Agency reserved treatment standards for metal constituents in K028 nonwastewaters and decided to delay promulgation of K029, K095, and K096 wastewater standards. At that time, the Agency was evaluating treatment performance data from stabilization of ash from the incineration of F024. Thus, the Agency planned to modify the treatment standards for metals in K028 nonwastewaters at a later date based on this data. Treatment standards for K029, K095, and K096 wastewaters were not promulgated at that time due to insufficient treatment performance data available for use in determining those standards. This amendment document provides the Agency's rationale and technical support for selecting metal constituents for regulation in K028 nonwastewaters, for selecting organic

constituents for regulation in K029, K095, and K096 wastewaters, and for developing treatment standards for these constituents.

The Agency's legal authority and promulgated methodology for establishing treatment standards and the petition process necessary for requesting a variance from the treatment standards are summarized in EPA's Methodology for Developing BDAT Treatment Standards (Reference 2).

This amendment document describes the technologies used to treat K028 nonwastewater metals and K029, K095, and K096 wastewaters (or similar wastes) and presents the treatment performance data on which the treatment standards for these wastes are based. This document also explains how EPA determined BDAT, selected constituents for regulation, and calculated treatment standards for metals in nonwastewater forms of K028 and organics in wastewater forms of K029, K095, and K096.

The Agency is regulating three metal constituents in K028 nonwastewaters, five organic constituents in K029 wastewaters, seven organic constituents in K095 wastewaters, and eight organic constituents in K096 wastewaters. No metal constituents are currently being regulated in K029, K095, or K096 wastewaters. To determine the applicability of the treatment standards, wastewaters are defined as wastes containing less than 1% (weight basis) total suspended solids[1] (TSS) and less than 1% (weight basis) total organic carbon (TOC). Wastes not meeting this definition are classified as nonwastewaters and must comply with the nonwastewater treatment standards.

The Agency does not have any performance data for treatment of K028, K029, K095, and K096. Treatment performance tests for these wastes have not been pursued because the Agency believes that adequate treatment performance

---

[1]The term "total suspended solids" (TSS) clarifies EPA's previously used terminology of "total solids" and "filterable solids." Specifically, total suspended solids is measured by Method 209C (total suspended solids dried at 103-105°C) in Standard Methods for the Examination of Water and Wastewater, Sixteenth Edition (Reference 8).

data are available from similar wastes, including wastes previously tested by the BDAT Land Disposal Restrictions program. Therefore, treatment performance data were transferred for metal constituents in K028 nonwastewaters and for organic constituents in K029, K095, and K096 wastewaters.

For K028 nonwastewaters, BDAT treatment standards for metal constituents are based on treatment performance data transferred from stabilization of F024 incinerator ash. Table 1-1 (at the end of this section) lists the specific BDAT treatment standards being promulgated for K028 nonwastewater metals. Treatment standards for metal constituents regulated in K028 nonwastewaters are based on Toxicity Characteristic Leaching Procedure (TCLP) extracts after stabilization using a cement binder.

The units used for TCLP leachate concentration of metal constituents in K028 nonwastewaters is mg/l (parts per million on a weight-by-volume basis). If the concentrations of the constituents regulated in K028 TCLP extracts are lower than or are equal to the treatment standards, then treatment of the waste is not required prior to placement in a land disposal unit.

For K029, K095, and K096 wastewaters, BDAT treatment standards for organic constituents are based on treatment performance data transferred from multi-source leachate (F039) data as presented in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A: Wastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F039) For Which There Are Concentration-Based Treatment Standards (Reference 4). Table 1-2 (at the end of this section) lists the specific BDAT treatment standards being promulgated for K029, K095, and K096 wastewater organics. Treatment standards for organic constituents regulated in K029, K095, and K096 wastewaters are based on the total concentration of each constituent in the waste.

The units used for total constituent concentration of organic constituents in K029, K095, and K096 wastewaters are mg/l (parts per million

on a weight-by-volume basis). If the concentrations of the constituents regulated in K029, K095, and K096 wastewaters, as generated, are lower than or are equal to the treatment standards, then treatment of the waste is not required prior to placement in a land disposal unit.

Table 1-1

BDAT TREATMENT STANDARDS FOR K028

NONWASTEWATER METALS

| Maximum for Any Single Grab Sample | |
|---|---|
| BDAT List Constituent | Total Concentration (mg/l) |
| 159. Chromium (total) | 0.073 |
| 161. Lead | 0.021 |
| 162. Nickel | 0.088 |

Table 1-2

BDAT TREATMENT STANDARDS FOR K029, K095, AND K096
WASTEWATER ORGANICS

K029

Maximum for Any Single Grab Sample

| BDAT List Constituent | | Total Concentration (mg/l) |
|---|---|---|
| 14. | Chloroform | 0.046 |
| 23. | 1,2-Dichloroethane | 0.21 |
| 24. | 1,1-Dichloroethylene | 0.025 |
| 45. | 1,1,1-Trichloroethane | 0.054 |
| 50. | Vinyl chloride | 0.27 |

K095

Maximum for Any Single Grab Sample

| BDAT List Constituent | | Total Concentration (mg/l) |
|---|---|---|
| 40. | 1,1,1,2-Tetrachloroethane | 0.057 |
| 41. | 1,1,2,2-Tetrachloroethane | 0.057 |
| 42. | Tetrachloroethene | 0.056 |
| 46. | 1,1,2-Trichloroethane | 0.054 |
| 47. | Trichloroethene | 0.054 |
| 113. | Hexachloroethane | 0.055 |
| 137. | Pentachloroethane | 0.055 |

K096

Maximum for Any Single Grab Sample

| BDAT List Constituent | | Total Concentration (mg/l) |
|---|---|---|
| 40. | 1,1,1,2-Tetrachloroethane | 0.057 |
| 41. | 1,1,2,2-Tetrachloroethane | 0.057 |
| 42. | Tetrachloroethene | 0.056 |
| 46. | 1,1,2-Trichloroethane | 0.054 |
| 47. | Trichloroethene | 0.054 |
| 86. | 1,3-Dichlorobenzene | 0.036 |
| 137. | Pentachloroethane | 0.055 |
| 150. | 1,2,4-Trichlorobenzene | 0.055 |

## 2.0 AMENDMENT TO SECTION 3.0 (APPLICABLE AND DEMONSTRATED TREATMENT TECHNOLOGIES) OF THE FINAL BDAT BACKGROUND DOCUMENT FOR K028, K029, K095, AND K096

This section supplements the discussion in Section 3.0 (Applicable and Demonstrated Treatment Technologies) of the K028 Final BDAT Background Document (Reference 1). This section identifies the treatment technologies that are applicable for treatment of metals in K028 nonwastewaters and of organics in K029, K095, and K096 wastewaters, and determines which, if any, of the applicable technologies can be considered demonstrated for the purpose of establishing BDAT.

To be applicable, a technology must theoretically be usable to treat the waste in question or to treat a waste that is similar in terms of parameters that affect treatment selection. (Detailed descriptions of technologies that are applicable to listed hazardous wastes are provided in EPA's Treatment Technology Background Document (Reference 3)). To be demonstrated, a technology must be employed in full-scale operation for treatment of the waste in question or a similar waste. Technologies available only at pilot- or bench-scale operations are not considered in identifying demonstrated technologies.

### 2.1 Applicable Treatment Technologies for K028 Nonwastewater Metals

Applicable treatment technologies for K028 nonwastewaters were identified in the K028 Final BDAT Background Document (Section 3.1.1). The applicable technology for treatment of metals in K028 nonwastewaters is stabilization of the nonwastewater or nonwastewater residual.

### 2.2 Demonstrated Treatment Technologies for K028 Nonwastewater Metals

The Agency is not aware of any facilities that treat metal constituents in nonwastewater forms of K028 (such as ash from incineration) by stabilization or by any other technology. However, stabilization is demonstrated on wastes judged to be similar, such as F024. F024 is generated

from a similar industry and processing steps as K028, and these wastes are expected to contain similar metals. The Agency does not have treatment performance data for stabilization of nonwastewater forms of K028; however, for the BDAT program, the Agency has tested stabilization of F024 incinerator ash, as discussed in Section 3.0 of this amendment document.

## 2.3 Applicable Treatment Technologies for K029, K095, and K096 Wastewaters

The Agency recognizes that K029, K095, and K096 wastewaters may be generated by treatment technologies other than incineration. Since these wastewaters may contain hazardous organic constituents at treatable levels, applicable technologies include those that destroy or reduce the total amount of various organic compounds in the waste. All of the technologies identified as applicable for organics in Section 3.1.1 of EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A: Wastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F039) For Which There Are Concentration-Based Treatment Standards (Reference 4) are potentially applicable for treatment of K029, K095, and K096 wastewaters. Potentially applicable treatment technologies are not identified for hazardous metal and inorganic constituents because they are not expected to be present in K029, K095, and K096 wastewaters, nor does characterization data indicate that they are present.

## 2.4 Demonstrated Treatment Technologies for K029, K095, and K096 Wastewaters

All of the technologies identified as applicable for organics in Section 3.1.1 of EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A: Wastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F039) For Which There Are Concentration-Based Treatment Standards (Reference 4) are demonstrated for wastes containing the same organic constituents of concern as those in K029, K095, and K096.

## 3.0 AMENDMENT TO SECTION 4.0 (TREATMENT PERFORMANCE DATABASE) OF THE FINAL BDAT BACKGROUND DOCUMENT FOR K028, K029, K095, AND K096

This section supplements the discussion in Section 4.0 (Treatment Performance Data Base) of the K028 Final BDAT Background Document (Reference 1). Since the Agency does not have any treatment performance data for treatment of metals in K028 nonwastewaters or of organics in K029, K095, and K096 wastewaters, treatment performance data were transferred from other previously tested wastes as follows:

- Treatment performance data from stabilization of F024 were used to develop treatment standards for metal constituents in K028 nonwastewaters; and
- Multi-source leachate (F039) data, as presented in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A: Wastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F039) For Which There Are Concentration-Based Treatment Standards (Reference 4) were used to develop treatment standards for organic constituents in K029, K095, and K096 wastewaters.

The basis for data transfer and the sources of treatment performance data are discussed in the sections below. (All tables are presented at the end of this section.)

EPA's methodology for the transfer of treatment performance data is provided in EPA's Methodology for Developing BDAT Treatment Standards (Reference 2). Transfer of treatment performance data is technically valid in cases where the untested wastes are generated from similar industries or similar processing steps as the tested wastes, or the untested wastes have similar waste characteristics affecting treatment performance and treatment selection as the tested wastes.

### 3.1 Treatment of Metal Constituents

As discussed in Section 4.2 of the K028 Final BDAT Background Document, EPA has data for stabilization of metals in nonwastewaters in the

California List Notice of Data Availability (Reference 5), for stabilization of F006 and K062 at Plant J, for stabilization at Plant C of incinerator ash generated from fluidized-bed incineration of K048 and K051 at Plant B, and for stabilization at Plant C of incinerator ash generated from rotary kiln incineration of F024 at Plant I. (Plant codes are identified in Appendix A of the K028 Final BDAT Background Document.) EPA examined these wastes to identify the best data source(s), if any, for transfer of treatment performance data to K028 nonwastewater metals. Specifically, EPA examined whether K028 is (1) generated from similar industries or processing steps as the previously tested wastes, and (2) whether K028 has similar waste characteristics affecting treatment performance as the previously tested wastes.

Of the nonwastewaters previously tested by stabilization, F024, like K028, is generated from the chlorinated organic chemicals industry. Similar to K028, F024 is generated by filtration, or some other type of separation process from the product stream. F024, like K028, is generated from the production of chlorinated organic chemicals having carbon contents of one to five carbons. In addition, F024 contains metal constituents similar to those present in K028.

Waste characterization data for K028 indicate that the metal constituents present in K028 and K028 TCLP extracts include barium (2.13 ppm); chromium (total) (1.33 ppm); copper (4.21 ppm); lead (1.17 ppm); nickel (4.63 ppm); vanadium (0.353 ppm); and zinc (5.43 ppm). TCLP extract results for untreated F024 incinerator ash indicate that untreated F024 contains barium (1.67-1.99 ppm); chromium (total) (0.4-0.42 ppm); copper (5.54-9.59 ppm); lead (14.9-63.3 ppm); nickel (3.95-4.39 ppm); and zinc (2.06-2.07 ppm). Based on these similarities in metal constituents and in constituent concentrations, the Agency has determined that metal constituents in K028 nonwastewaters will closely resemble in type and concentration those present in untreated F024 incinerator ash.

Therefore, since F024 is generated from a similar industry and processing steps as K028, and the two wastes are expected to contain similar

metals, treatment standards for metals in K028 nonwastewaters were developed using treatment performance data transferred from stabilization of F024 incinerator ash.

As discussed in the F024 Background Document Amendment (Reference 6) and the F024 Stabilization Onsite Engineering Report (Reference 7), treatment performance data were collected from the stabilization of F024 incinerator ash using a cement binder, a lime/fly ash binder, and a kiln dust binder. The cement binder was judged best for treatment of F024 using analysis of variance (ANOVA) tests, as described in the F024 Background Document Amendment (Reference 6).

The treatment performance data from the stabilization of F024 incinerator ash using a cement binder are presented in Table 3-1.

## 3.2 Treatment of Organic Constituents

The treatment performance data that were used to develop treatment standards for organics in K029, K095, and K096 wastewaters are summarized in Appendix A of this document and are discussed in greater detail in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A: Wastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F039) For Which There Are Concentration-Based Treatment Standards (Reference 4). These treatment performance data are from wastewater treatment technologies and were used to develop treatment standards for organics in K029, K095, and K096 wastewaters. The Agency prefers, whenever possible, to use appropriate wastewater treatment performance data from well-designed and well-operated wastewater treatment units rather than scrubber water concentration data. Scrubber water concentrations represent the only other source of data available for transfer to K029, K095, and K096 wastewaters. The Agency believes that the wastewater treatment data presented in Appendix A represent the best source of treatment performance data for wastewater forms of K029, K095, and K096. The tested wastes represented by this wastewater treatment performance data have similar

waste characteristics affecting treatment performance and treatment selection as the untested K029, K095, and K096 wastewaters.

Table 3-1

TCLP ANALYTICAL RESULTS FOR THE STABILIZED F024 INCINERATOR ASH SAMPLES - CEMENT BINDER

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

| BDAT List Constituent | | Detection Limit (mg/l) | Concentration in Untreated Waste (mg/l) Sample Set 1 | 2 | 3 | Concentration in the 28-Day Cure Treated Waste (mg/l) Sample Set 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|
| 154. | Antimony | 0.076 | ND | ND | ND | ND | ND | ND |
| 155. | Arsenic | 0.002 | 0.013 | 0.015 | 0.014 | 0.004 | 0.002 | 0.002 |
| 156. | Barium | 0.002 | 1.99 | 1.72 | 1.67 | 1.84 | 0.88 | 1.02 |
| 157. | Beryllium | 0.001 | 0.002 | 0.002 | 0.002 | ND | ND | ND |
| 158. | Cadmium | 0.003 | 0.021 | 0.021 | 0.021 | ND | ND | ND |
| 159. | Chromium (total) | 0.007 | 0.4 | 0.41 | 0.42 | 0.031 | 0.01 | 0.013 |
| 221. | Chromium (VI) | 0.006 | 0.34 | 0.075 | 0.049 | 0.19 | 0.15 | 0.14 |
| 160. | Copper | 0.018 | 5.54 | 6.71 | 9.59 | ND | ND | ND |
| 161. | Lead | 0.057 | 63.3 | 33.3 | 14.9 | 0.011 | 0.006 | 0.007 |
| 162. | Mercury | 0.0003 | 0.0006 | ND | ND | ND | ND | ND |
| 163. | Nickel | 0.025 | 4.39 | 3.96 | 3.93 | ND | ND | ND |
| 164. | Selenium | 0.002 | ND | ND | ND | ND | ND | ND |
| 165. | Silver | 0.004 | ND | ND | ND | ND | ND | ND |
| 166. | Thallium | 0.004 | ND | ND | ND | ND | ND | ND |
| 167. | Vanadium | 0.007 | ND | ND | ND | ND | ND | ND |
| 168. | Zinc | 0.003 | 2.06 | 2.07 | 2.06 | 0.041 | 0.05 | 0.173 |
| * | Aluminum | 0.023 | 15.8 | 16.9 | 16.4 | 0.45 | 0.28 | 0.26 |
| * | Calcium | 0.001 | 588 | 584 | 588 | 2,003 | 1,870 | 1,880 |
| * | Cobalt | 0.01 | 0.06 | 0.053 | 0.049 | ND | 0.012 | ND |
| * | Iron | 0.012 | 13.1 | 12.8 | 13.2 | 0.022 | 0.037 | 0.17 |
| * | Magnesium | 0.001 | 146 | 140 | 145 | 0.095 | 0.30 | 1.28 |
| * | Manganese | 0.001 | 1.98 | 2.19 | 2.21 | ND | ND | 0.001 |
| * | Molybdenum | 0.037 | ND | 0.041 | ND | 0.062 | 0.056 | 0.078 |
| * | Sodium | 0.021 | 45 | 44.8 | 45.1 | 37.4 | 37.2 | 37.4 |
| * | Tin | 0.105 | 1.04 | 0.43 | 0.32 | ND | ND | ND |

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

Source: Final Onsite Engineering Report of Treatment Technology Performance and Operation for Waterways Experiment Station, Vicksburg, Mississippi (Reference 7).

## 4.0 AMENDMENT TO SECTION 5.0 (IDENTIFICATION OF BEST DEMONSTRATED AND AVAILABLE TECHNOLOGY (BDAT)) OF THE FINAL BDAT BACKGROUND DOCUMENT FOR K028, K029, K095, AND K096

This section supplements the discussion in Section 5.0 (Identification of Best Demonstrated and Available Technology (BDAT)) of the K028 Final BDAT Background Document (Reference 1). This section discusses technologies that are available for treatment of metals in K028 nonwastewaters and of organics in K029, K095, and K096 wastewaters, and identifies BDAT for these wastes. The technologies that are available for treatment of the organic constituents found in K029, K095, and K096 wastewaters, along with identification of BDAT for these constituents, are discussed in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A: Wastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F039) For Which There Are Concentration-Based Treatment Standards (Reference 4).

To determine the best technology, the Agency examines all available treatment performance data on technologies that are identified as demonstrated for the waste of concern, or for a waste similar to the waste of concern, to evaluate whether one or more of the technologies performs significantly better than the others. If data are available for only one technology for treating a waste, then that technology is "best." When data are available for more than one treatment technology, the "best" performing treatment technology is usually determined by statistical methods as discussed in EPA's Methodology for Developing BDAT Treatment Standards (Reference 2). As described in this section, this was the case for the metals in nonwastewater forms of K028. In the case of the wastewater treatment data available to the Agency (and described in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A: Wastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F039) For Which There Are Concentration-Based Treatment Standards (Reference 4), a data hierarchy was established to determine the "best" technology for each constituent. This hierarchy is described in the Volume A document (Reference 4).

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

## 4.1 Review of Treatment Performance Data

The available treatment performance data presented in Section 3.0 were reviewed and assessed to determine whether they represent operation of a well-designed and well-operated system, whether sufficient quality assurance/quality control measures were employed to ensure the accuracy of the data, and whether the appropriate measures of performance were used to assess the performance of the treatment technology.

The treatment performance data and the design and operating data collected during the test of stabilization of F024 incinerator ash at Plant I were reviewed for the points described above. The appropriate measure of performance (TCLP extract concentration) was used to assess the treatment system (stabilization). Additionally, the Agency had no reason to believe that the treatment system at Plant I was not well-designed and well-operated, or that insufficient analytical quality assurance/quality control measures were employed in generating treatment performance data.

## 4.2 Statistical Comparison of Treatment Performance Data

As noted above, in cases where the Agency has treatment performance data from more than one technology, EPA uses the statistical method known as the analysis of variance (ANOVA) test (discussed in EPA's Methodology for Development BDAT Treatment Standards (Reference 2)) to determine if one technology performs significantly better than the rest. For F024 (the source of metal treatment performance data transferred to K028), the Agency has performance data on stabilization of F024 incinerator ash using three different binders. Statistical comparison of these data determined that stabilization using a cement binder performed better than the other binders. (Discussion of the analysis of variance (ANOVA) test results for the three binders is presented in the F024 Background Document Amendment (Reference 6)). Therefore, stabilization using a cement binder has been found to represent the best technology for treatment of metals in nonwastewater forms of K028.

## 4.3 Demonstrated Treatment Technologies

As discussed above, stabilization has been determined to be the demonstrated technology for treatment of metals in nonwastewater forms of K028. Because the Agency does not have treatment performance data for any other technologies for treating K028 metals or similar wastes, this treatment technology is considered to be the best. Therefore, the best demonstrated technology for metal constituents in K028 nonwastewaters has been determined to be stabilization.

The best demonstrated technology for K029, K095, and K096 wastewater constituents is presented in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A: Wastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F039) For Which There Are Concentration-Based Treatment Standards (Reference 4).

## 4.4 Available Treatment Technologies

The best technology for treatment of K028 nonwastewater metals, stabilization, is considered to be commercially available. Furthermore, the Agency has determined that this technology will provide substantial treatment of F024 metals, and therefore of K028 metals also. Consequently, this technology is considered to be available for treatment of K028 metal constituents, and has been determined to be BDAT.

The best technologies for treatment of K029, K095, and K096 wastewaters are also considered to be commercially available. Furthermore, the Agency has determined that these technologies will provide substantial treatment of the constituents of concern in the tested wastes, and therefore of K029, K095, and K096 also. Consequently, these technologies are considered to be available for treatment of K029, K095, and K096 wastewaters, and have been determined to be BDAT.

The identification of these technologies as BDAT for K028, K029, K095, and K096 does not preclude a facility from recycling or reuse operations in accordance with 40 CFR Part 261. In addition, the promulgated BDAT technologies do not preclude the use of other treatment technologies that can achieve the concentration-based treatment standards so long as those technologies do not constitute impermissible dilution or land disposal.

## 5.0 AMENDMENT TO SECTION 6.0 (SELECTION OF REGULATED CONSTITUENTS) OF THE FINAL BDAT BACKGROUND DOCUMENT FOR K028, K029, K095, AND K096

This section supplements the discussion in Section 6.0 (Selection of Regulated Constituents) of the K028 Final BDAT Background Document (Reference 1). This section presents a discussion of the selection of metal constituents being regulated in K028 nonwastewaters and of organic constituents being regulated in K029, K095, and K096 wastewaters.

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

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

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

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

The Agency initially considered all constituents on the BDAT List for regulation. Table 6-1 in the K028 Final BDAT Background Document summarizes available waste characterization data for K028, K029, K095, and K096 for the BDAT List constituents. If an analysis for a constituent was

performed but the constituent was not detected in the untreated or treated waste, the table indicates "ND" for that constituent. Constituents for which no analysis was performed are identified by "NA" (not analyzed). The constituents deleted from further consideration and the constituents selected for regulation in K028 nonwastewaters and in K029, K095, and K096 wastewaters are discussed in the sections below.

## 5.1 K028 Nonwastewater Metals

The Agency initially considered all metal constituents on the BDAT List for regulation in nonwastewater forms of K028. However, a BDAT List metal constituent was deleted from further consideration for regulation if (1) the constituent was not detected in the untreated waste, (2) the constituent was not analyzed for in the untreated waste, or (3) other reasons, as discussed in Section 5.1.1. Constituents that were selected for regulation are discussed in Section 5.1.2.

### 5.1.1 BDAT List Metal Constituents Deleted From Further Consideration for Regulation

A BDAT List metal constituent that was detected in untreated K028 was deleted from further consideration for regulation if (1) available treatment performance data for the constituent in F024 (from which data are being transferred) did not show effective treatment by BDAT, or (2) other reasons, as described below. BDAT List metal constituents that remained following the deletions described in this subsection were further considered for regulation. These constituents are total chromium, lead, and nickel.

Barium was deleted from further consideration for regulation in K028 nonwastewaters because the BDAT treatment performance data obtained from stabilization of F024 incinerator ash (from which data are being transferred) did not show effective treatment for this constituent.

Copper, vanadium, and zinc were further considered for regulation in K028 nonwastewaters but were not selected as regulated constituents. Although

the metal compounds copper cyanide, vanadium pentoxide, and zinc cyanide are listed in Appendix VIII of 40 CFR Part 261, the individual metals copper, vanadium, and zinc, are not listed. In this Third Third rulemaking, the Agency is only regulating copper, vanadium, and/or zinc in listed hazardous wastes if they cannot be controlled by regulation of other metal constituents. For K028, copper, vanadium, and zinc are believed to be controlled by the regulation of total chromium, lead, and nickel, and are therefore not being regulated.

### 5.1.2 BDAT List Metal Constituents Selected For Regulation

All of the metal constituents that were further considered for regulation in K028 nonwastewaters have been selected for regulation. The metal constituents being regulated are total chromium, lead, and nickel.

## 5.2 K029, K095, and K096 Wastewaters

The Agency initially considered all organic constituents on the BDAT List for regulation in wastewater forms of K029, K095, and K096. However, a BDAT List constituent was deleted from further consideration for regulation if: (1) the constituent was not detected in the untreated waste and is not suspected of being present in the waste; or (2) the constituent was not analyzed for in the untreated waste, as discussed in Section 5.2.1. Constituents that were selected for regulation are discussed in Section 5.2.2.

### 5.2.1 BDAT List Constituents Deleted From Further Consideration For Regulation

BDAT List Constituents Not Detected in the Untreated Waste. BDAT List constituents that were not detected in untreated K029, K095, and K096 (labeled "ND" in Table 6-1 of the K028 Final BDAT Background Document) were deleted from further consideration for regulation. Since detection limits vary according to the nature of the waste matrix being analyzed, the detection limits, if available, determined in the characterization of K029, K095, and K096, are included in Appendix D of the K028 Final BDAT Background Document.

BDAT List Constituents Not Analyzed For in the Untreated Waste. Some constituents on the BDAT List were deleted from further consideration for regulation because these constituents were not analyzed for in untreated K029, K095, and K096 (labeled "NA" in Table 6-1 of the K028 Final BDAT Background Document). Constituents such as organochlorine pesticides, phenoxyacetic acid herbicides, organophosphorus insecticides, polychlorinated biphenyls (PCBs), and dioxins and furans, were not analyzed for in the untreated waste because it was extremely unlikely that these constituents would be present in these waste.

### 5.2.2 BDAT List Constituents Selected For Regulation

All of the organic constituents that were further considered for regulation in K029, K095, and K096 wastewaters have been selected for regulation. The constituents being regulated are presented in Table 5-1, at the end of this section.

Table 5-1

BDAT LIST CONSTITUENTS SELECTED FOR REGULATION
IN K029, K095, AND K096 WASTEWATERS

K029

14. Chloroform
23. 1,2-Dichloroethane
24. 1,1-Dichloroethylene
45. 1,1,1-Trichloroethane
50. Vinyl chloride

K095

40. 1,1,1,2-Tetrachloroethane
41. 1,1,2,2-Tetrachloroethane
42. Tetrachloroethene
46. 1,1,2-Trichloroethane
47. Trichloroethane
113. Hexachloroethane
137. Pentachloroethane

K096

40. 1,1,1,2-Tetrachloroethane
41. 1,1,2,2-Tetrachloroethane
42. Tetrachloroethene
46. 1,1,2-Trichloroethane
47. Trichloroethane
86. 1,3-Dichlorobenzene
137. Pentachloroethane
150. 1,2,4-Trichlorobenzene

## 6.0 AMENDMENT TO SECTION 7.0 (CALCULATION OF BDAT TREATMENT STANDARDS) OF THE FINAL BDAT BACKGROUND DOCUMENT FOR K028, K029, K095, AND K096

This section supplements the discussion in Section 7.0 (Calculation of BDAT Treatment Standards) of the K028 Final BDAT Background Document (Reference 1).

The Agency bases numerical treatment standards for regulated constituents on the performance of well-designed and well-operated BDAT treatment systems. These standards must account for analytical limitations in available treatment performance data, and the data must be adjusted for variabilities related to treatment, sampling, and analytical techniques and procedures. This section discusses the calculation of treatment standards for K028 nonwastewater metals. Treatment standard calculations for the constituents selected for regulation in K029, K095, and K096 wastewaters are presented and discussed in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A: Wastewater Forms of Organic U and P Wastes and Multi-Source Leachate (F039) For Which There Are Concentration-Based Treatment Standards (Reference 4). The treatment standards being promulgated for organic constituents in wastewater forms of K029, K095, and K096 are presented in Table 1-2.

BDAT treatment standards for metal constituents in K028 nonwastewater residuals were calculated based on the transfer of three sample sets of treatment performance data from the stabilization of F024 incinerator ash using a cement binder. Before treatment standards were calculated, the treatment performance data were corrected to account for analytical interferences associated with the chemical matrices of the samples. A complete discussion of the accuracy correction of treatment data is provided in Appendix C of the K028 Final BDAT Background Document. Table 6-1 (at the end of this section) presents the corrected TCLP concentrations of metal constituents in the stabilized F024 rotary kiln incinerator ash. Concentration data are presented for only those constituents used to develop treatment standards for metal constituents in K028 nonwastewaters.

The treatment standards for K028 nonwastewater metals were calculated as shown in Table 6-2 (at the end of this section). The following three steps were used to calculate the treatment standards:

(1) The arithmetic average of the accuracy-corrected concentrations for each regulated constituent in the treated waste was calculated using the data presented in Table 6-1 of this document.

(2) Using the same data, a variability factor (discussed in EPA's Methodology for Developing BDAT Treatment Standards (Reference 2)) was calculated that represents the variability inherent in the performance of the treatment system, the collection of treated samples, and the analysis of samples. Where concentrations in the treated waste were reported as less than or equal to the detection limit for all the data points in the data set, variability is still expected, since the actual concentrations could range from zero to the detection limit. In these cases, the Agency assumed a log normal distribution of data points between the detection limit and a value one-tenth of the detection limit and then calculated a variability factor of 2.8.

(3) The treatment standard for each constituent to be regulated was calculated by multiplying the arithmetic average of the accuracy-corrected concentrations (step (1) above) by the variability factor (step (2) above).

The treatment standards being promulgated for metal constituents in nonwastewater forms of K028 are also presented in Table 1-1.

Table 6-1

CORRECTED CONCENTRATION DATA FOR METAL CONSTITUENTS IN STABILIZED F024 INCINERATOR ASH USED FOR TRANSFER TO K028 NONWASTEWATERS

| BDAT List Constituent | Corrected TCLP Concentration in the Treated Waste (mg/l) Sample Set 1 | 2 | 3 |
|---|---|---|---|
| 159. Chromium (total) | 0.036 | 0.011 | 0.015 |
| 161. Lead | 0.014 | 0.008 | 0.009 |
| 163. Nickel | <0.031 | <0.031 | <0.031 |

Table 6-2

CALCULATION OF TREATMENT STANDARDS FOR METAL CONSTITUENTS IN K028 NONWASTEWATERS

| Regulated BDAT List Constituent | Arithmetic Average of Corrected Treatment Values[a] (ppm) | Variability Factor (VF) (Average x VF) | Treatment Standard[a] (ppm) |
|---|---|---|---|
| 159. Chromium (total) | 0.021 | 3.5 | 0.073 |
| 161. Lead | 0.010 | 2.0 | 0.021 |
| 162. Nickel | 0.031 | 2.8 | 0.088 |

[a]The treatment standard values shown in this table have been rounded to show two significant figures.

## 7.0 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, Acting Chief, Waste Treatment Branch; Larry Rosengrant, Section Head, Treatment Technology Section; Jerry Vorbach, Project Officer; and Elaine Eby, Project Manager. Mr. Steve Silverman served as EPA legal advisor.

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

## 8.0 REFERENCES


1. U.S. EPA. 1989. U.S. Environmental Protection Agency, Office of Solid Waste. Final Best Demonstrated Available Technology (BDAT) Background Document for Wastes from the Production of 1,1,1-Trichloroethane - K028, K029, K095, and K096. May, 1989. Washington, D.C.: U.S. Environmental Protection Agency.

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

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

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

5. U.S. EPA. 1987. U.S. Environmental Protection Agency, Office of Solid Waste. California List Notice of Data Availability. 52 Federal Register 29992, August 12, 1987.

6. U.S. EPA. 1990. U.S. Environmental Protection Agency, Office of Solid Waste. Final Amendment to the Final Best Demonstrated Available Technology (BDAT) Background Document for Wastes From the Production of Chlorinated Aliphatic Hydrocarbons--F024. Washington, D.C.: U.S Environmental Protection Agency.

7. U.S. EPA. 1990. U.S. Environmental Protection Agency, Office of Solid Waste. Final Onsite Engineering Report of Stabilization of F024 Rotary-Kiln Incinerator Ash at U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS. Washington, D.C.: U.S. Environmental Protection Agency.

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

# APPENDIX A

# TREATMENT PERFORMANCE DATA

# FOR K029, K095, AND K096 WASTEWATER

# CONSTITUENTS

Chloroform (U044). Several sources of wastewater treatment performance data were available for chloroform including data from the ITD, and WERL databases and literature WAO and PACT[R] data. These data are presented in Table 4-15. Technologies for which data are available include AL, AS, AS+Fil, AirS, CAC, CAC+AirS, chemical oxidation (ChOx), GAC, PACT[R], RO, SS, TF, and WOx. The treatment performance data represent bench-, pilot-, and full-scale data.

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

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

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

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

BDAT for chloroform is being promulgated as proposed and is identified as steam stripping (SS). The BDAT treatment standard was calculated using the ITD median long-term average of 12.2 ppb and the ITD Option 1 variability factor. The calculation of the resulting BDAT treatment standard for chloroform (0.046 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-15
WASTEWATER TREATMENT PERFORMANCE DATA
FOR CHLOROFORM

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AL | Full | 1607B | | 0-100 | 3 | 9.000 | | 90.1 | WERL |
| AL | Full | 1B | | 100-1000 | 6 | 26.000 | | 96.8 | WERL |
| AL | Pilot | 203A | | 100-1000 | 14 | 53.000 | | 61 | WERL |
| AL | Full | 141A | | 100-1000 | | 16.000 | | 92.3 | WERL |
| AL | Full | 1607B | | 100-1000 | 2 | 10.000 | | 97.4 | WERL |
| AL | Full | 1607B | | 100-1000 | 3 | 130.000 | | 86 | WERL |
| AL | Pilot | 203A | | 100-1000 | 14 | 31.000 | | 77 | WERL |
| AS | Full | 1B | | 0-100 | 3 | 20.000 | | 80 | WERL |
| AS | Full | 6B | | 100-1000 | 7 | 30.000 | | 77 | WERL |
| AS | Full | 1B | | 0-100 | 5 | 6.000 | | 86 | WERL |
| AS | Full | 6B | | 100-1000 | 3 | 10.000 | | 97.7 | WERL |
| AS | Bench | 202D | | 10000-100000 | | 200.000 | | 99.43 | WERL |
| AS | Full | 234A | | 0-100 | | 1.200 | | 61 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 21.000 | | 62 | WERL |
| AS | Full | 375E | | 0-100 | 7 | 1.000 | | 75 | WERL |
| AS | Full | 1B | | 100-1000 | 6 | 59.000 | | 51 | WERL |
| AS | Full | 975B | | 0-100 | | 2.000 | | 93.8 | WERL |
| AS | Full | 234A | | 0-100 | | 2.300 | | 72 | WERL |
| AS | Full | 234A | | 0-100 | | 0.500 | | 98.4 | WERL |
| AS | Full | 6B | | 100-1000 | 3 | 10.000 | | 98.2 | WERL |
| AS | Full | 238A | | 0-100 | 3 | 2.400 | | 46 | WERL |
| AS | Full | 1607B | | 100-1000 | 3 | 50.000 | | 86 | WERL |
| AS | Full | 1607B | | 1000-10000 | 2 | 40.000 | | 96.9 | WERL |
| AS | Pilot | 206B | | 100-1000 | 20 | 3.600 | | 97.4 | WERL |
| AS | Full | 375E | | 0-100 | 7 | 20.000 | | 78 | WERL |
| AS | Full | 1587E | | 0-100 | | 1.600 | | 65 | WERL |
| AS | Pilot | 241B | | 100-1000 | 5 | 44.000 | | 85 | WERL |
| AS | Full | 234A | | 0-100 | | 1.300 | | 84 | WERL |
| AS | Pilot | 203A | | 100-1000 | 14 | 18.000 | | 87 | WERL |
| AS | Full | 6B | | 1000-10000 | 27 | 19.000 | | 98.7 | WERL |
| AS | Full | 201B | | 0-100 | 29 | 38.000 | | 53 | WERL |
| AS | Full | 234A | | 0-100 | | 1.300 | | 65 | WERL |
| AS | Pilot | 240A | | 0-100 | 14 | 2.000 | | 98 | WERL |
| AS+Fil | Full | 6B | | 1000-10000 | 3 | 10.000 | | 99.41 | WERL |
| AS+Fil | Full | 6B | | 100-1000 | 14 | 10.000 | | 95.8 | WERL |
| AirS | Bench | 1328E | | 100000-1000000 | 5 | 16000.000 | | 93.1 | WERL |
| AirS | Pilot | 369A | | 0-100 | | 1.400 | | 98.2 | WERL |
| AirS | Pilot | 213B | | 0-100 | 1 | 13.000 | | 77 | WERL |
| AirS | Bench | 1328E | | 10000-100000 | 5 | 4400.000 | | 83 | WERL |

TABLE 4-15 (Continued)
WASTEWATER TREATMENT PERFORMANCE DATA
FOR CHLOROFORM

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AirS | Pilot | 225B | | 0-100 | 1 | 0.130 | | 98.9 | WERL |
| AirS | Bench | 17A | | 0-100 | | 2.600 | | 96.9 | WERL |
| AirS | Bench | 17A | | 1000-10000 | | 110.000 | | 91.7 | WERL |
| AirS | Bench | 17A | | 0-100 | | 3.900 | | 88 | WERL |
| AirS | Bench | 17A | | 100-1000 | | 4.200 | | 98.6 | WERL |
| AirS | Pilot | 210B | | 100-1000 | 1 | 1.000 | | 99.2 | WERL |
| AirS | Bench | 17A | | 100-1000 | | 3.700 | | 98.6 | WERL |
| AirS | Bench | 1328E | | 100-1000 | 5 | 34.000 | | 84 | WERL |
| AirS | Pilot | 434B | | 1000-10000 | 4 | 41.000 | | 98 | WERL |
| CAC | Pilot | 203A | | 100-1000 | 14 | 106.000 | | 22 | WERL |
| CAC+AirS | Full | 1833D | | 0-100 | 25 | 0.200 | | 89 | WERL |
| ChOx | Bench | 640E | | 100-1000 | 2 | 7.000 | | 96 | WERL |
| ChOx | Bench | 640E | | 100-1000 | 1 | 3.000 | | 99 | WERL |
| ChOx ($O_2$) | Pilot | 331D | | 0-100 | | 46.000 | | 37 | WERL |
| ChOx ($O_2$) | Pilot | 331D | | 0-100 | | 2.800 | | 35 | WERL |
| GAC | Full | 1264B | | 0-100 | | 1.000 | | 87 | WERL |
| GAC | Pilot | 331D | | 0-100 | | 1.000 | | 98.6 | WERL |
| GAC | Full | 245B | | 100-1000 | 1 | 10.000 | | 97.6 | WERL |
| GAC | Full | 237A | | 100-1000 | 1 | 10.000 | | 98.1 | WERL |
| GAC | Full | 245B | | 100-1000 | 1 | 10.000 | | 96.2 | WERL |
| PACT | Bench | 242E | | 0-100 | | 20.000 | | 47 | WERL |
| PACT | Bench | Zimpro | | 1470 | 1 | 1.000 | | 99.9 | WAO |
| PACT | Bench | Zimpro | | 38 | 1 | 20.000 | | 47 | WAO |
| RO | Pilot | 180A | | 0-100 | | 0.890 | | 71 | WERL |
| RO | Full | 250B | | 1000-10000 | | 110.000 | | 94.5 | WERL |
| RO | Full | 250B | | 100-1000 | | 53.000 | | 87 | WERL |
| SCOx | Pilot | 65D | | 100-1000 | | 1.700 | | 99.83 | WERL |
| * SS | Full | 415T | 10 | 7330-1088000 | 15 | 10.500 | | | ITD-L * |
| * SS | Full | 913 | 10 | 28700-200000 | 14 | 129.200 | | | ITD-L * |
| SS | Full | 6B | | 100000-1000000 | 15 | 10.000 | | 99.99 | WERL |
| SS | Full | 6B | | 10000-100000 | 2 | 120.000 | | 99.88 | WERL |
| SS | Full | 251B | | 1000000 | 10 | 6000.000 | | 99.99 | WERL |
| SS | Full | 251B | | 100000-1000000 | 10 | 9600.000 | | 96.4 | WERL |
| TF | Pilot | 240A | | 0-100 | 14 | 11.000 | | 89 | WERL |
| TF | Full | 1B | | 0-100 | 4 | 14.000 | | 86 | WERL |
| TF | Pilot | 203A | | 100-1000 | 14 | 102.000 | | 24 | WERL |
| WOx | Bench | Zimpro | | 4450000 | 1 | 3000.000 | | 99.9 | WAO |
| WOx | Bench | Zimpro | | 270000 | 1 | 1000.000 | | 99 | WAO |

* Data used in developing proposed standard.

1,2-Dichloroethane (U077). Several sources of wastewater treatment performance data were available for 1,2-dichloroethane, including data from the ITD, and WERL databases and literature WAO data. These data are presented in Table 4-20. Technologies for which data are available include AL, AL+AS, AS, AS+Fil, AirS, CAC, PACT$^R$, RO, SS, TF, and WOx. The treatment performance data represent bench-, pilot-, and full-scale studies.

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

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

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

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

BDAT for 1,2-dichloroethane is being promulgated as proposed and is identified as steam stripping (SS). The BDAT treatment standard was calculated using the ITD median long-term average of 25.6 ppb and the ITD Option 1 variability factor. The calculation of the resulting BDAT treatment standard for 1,2-dichloroethane (0.21 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-20
WASTEWATER TREATMENT PERFORMANCE DATA
FOR 1,2-DICHLOROETHANE

| 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 | 15.000 | | 90.2 | WERL |
| AL | Full | 1B | | 1000-10000 | 6 | 10.000 | | 99.75 | WERL |
| AL | Pilot | 203A | | 100-1000 | 14 | 45.000 | | 71 | WERL |
| AL+AS | Full | 233D | | 1000-10000 | 21 | 8.000 | | 99.67 | WERL |
| AS | Pilot | 203A | | 100-1000 | 14 | 22.000 | | 86 | WERL |
| AS | Pilot | 241B | | 100-1000 | 3 | 140.000 | | 57 | WERL |
| AS | Full | 1B | | 1000-10000 | 6 | 4400.000 | | 33 | WERL |
| AS | Full | 6B | | 100-1000 | 3 | 12.000 | | 98.1 | WERL |
| AS | Pilot | 240A | | 0-100 | 13 | 5.000 | | 94.3 | WERL |
| AS | Full | 6B | | 1000-10000 | 25 | 29.000 | | 98.6 | WERL |
| AS | Full | 375E | | 100-1000 | 7 | 74.000 | | 82 | WERL |
| AS | Bench | 202D | | 100000-1000000 | | 3700.000 | | 98.6 | WERL |
| AS | Full | 1B | | 10000-100000 | 6 | 1800.000 | | 89 | WERL |
| AS | Full | 6B | | 100-1000 | 13 | 94.000 | | 84 | WERL |
| AS | Full | 6B | | 100-1000 | 12 | 15.000 | | 98.5 | WERL |
| AS+Fil | Full | 6B | | 10000-100000 | 3 | 1200.000 | | 98.5 | WERL |
| AirS | Full | 322B | | 100-1000 | 5 | 55.000 | | 89 | WERL |
| AirS | Full | 322B | | 1000-10000 | 5 | 189.000 | | 91.8 | WERL |
| CAC | Pilot | 203A | | 100-1000 | 14 | 109.000 | | 29 | WERL |
| PACT | Bench | Zimpro | | 210 | 1 | 1.000 | | 99.5 | WAO |
| RO | Full | 250B | | 1000-10000 | | 350.000 | | 84 | WERL |
| RO | Full | 250B | | 0-100 | | 13.000 | | 79 | WERL |
| RO | Pilot | 323B | | 0-100 | 1 | 32.000 | | 37 | WERL |
| RO | Full | 250B | | 100-1000 | | 43.000 | | 76 | WERL |
| * SS | Full | 415T | 10 | 2339900-2347600 | 15 | 56.100 | | | ITD-L * |
| * SS | Full | 913 | 10 | 172000-327000 | 14 | 73.300 | | | ITD-L * |
| SS | Full | 251B | | 1000000 | 10 | 97.000 | | 99.99 | WERL |
| SS | Full | 6B | | 1000000 | 15 | 56.000 | | 99.99 | WERL |
| SS | Full | 6B | | 100000-1000000 | 2 | 50.000 | | 99.98 | WERL |
| TF | Pilot | 240A | | 0-100 | 13 | 12.000 | | 86 | WERL |
| TF | Full | 375E | | 100-1000 | 7 | 45.000 | | 65 | WERL |
| TF | Pilot | 203A | | 100-1000 | 14 | 93.000 | | 39 | WERL |
| WOx | Bench | Zimpro | | 6280000 | 1 | 13000.000 | | 99.8 | WAO |
| WOx (B) | Bench | 1054E | | 1000000 | | 230000.000 | | 93.6 | WERL |

* Data used in developing proposed standard.

1,1-Dichloroethylene (U078). Two sources of wastewater treatment performance data were available for 1,2-dichloroethylene, including data from the ITD, and WERL databases. These data are presented in Table 4-21. Technologies for which data are available include AL, AS, AirS, CAC, GAC, RO, SS, and TF. The treatment performance data represent pilot- and full-scale studies.

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

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

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

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

BDAT for 1,1-dichloroethylene is being promulgated as proposed and is identified as steam stripping (SS). The BDAT treatment standard was calculated using the ITD median long-term average of 10 ppb and the ITD Option 1 variability factor. The calculation of the resulting BDAT treatment standard for 1,1-dichloroethylene (0.025 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-21
WASTEWATER TREATMENT PERFORMANCE DATA
FOR 1,1-DICHLOROETHYLENE

| 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 | 83.000 | | 61 | WERL |
| AL | Pilot | 203A | | 100-1000 | 14 | 35.000 | | 84 | WERL |
| AS | Full | 6B | | 100-1000 | 3 | 10.000 | | 97.2 | WERL |
| AS | Pilot | 206B | | 0-100 | 20 | 0.200 | | 99.75 | WERL |
| AS | Full | 201B | | 0-100 | 2 | 1.000 | | 97.5 | WERL |
| AS | Pilot | 203A | | 100-1000 | 14 | 14.000 | | 93.4 | WERL |
| AS | Full | 1B | | 0-100 | 2 | 5.000 | | 86 | WERL |
| AS | Full | 6B | | 100-1000 | 22 | 10.000 | | 97 | WERL |
| AS | Full | 1B | | 0-100 | 2 | 6.000 | | 92.9 | WERL |
| AS | Pilot | 240A | | 0-100 | 12 | 1.000 | | 98.3 | WERL |
| AS | Full | 6B | | 100-1000 | 3 | 25.000 | | 97 | WERL |
| AirS | Pilot | 217B | | 0-100 | 1 | 0.300 | | 95.6 | WERL |
| AirS | Pilot | 222B | | 0-100 | 1 | 1.000 | | 92.3 | WERL |
| AirS | Pilot | 1362E | | 1000-10000 | 3 | 4.000 | | 99.82 | WERL |
| AirS | Full | 1344E | | 1000-10000 | | 2.000 | | 99.94 | WERL |
| AirS | Pilot | 1139E | | 100-1000 | 6 | 7.400 | | 92.7 | WERL |
| AirS | Pilot | 1139E | | 0-100 | 2 | 1.000 | | 98.6 | WERL |
| CAC | Pilot | 203A | | 100-1000 | 14 | 150.000 | | 29 | WERL |
| GAC | Full | 237A | | 0-100 | 1 | 10.000 | | 64 | WERL |
| GAC | Full | 1264B | | 0-100 | | 1.000 | | 70 | WERL |
| GAC | Pilot | 1139E | | 0-100 | | 1.000 | | 97 | WERL |
| RO | Full | 250B | | 0-100 | | 1.200 | | 98.4 | WERL |
| RO | Full | 250B | | 0-100 | | 3.100 | | 72 | WERL |
| RO | Full | 250B | | 1000-10000 | | 240.000 | | 78 | WERL |
| SS | Full | 251B | | 1000-10000 | 10 | 10.000 | | 99.79 | WERL |
| SS | Full | 6B | | 1000-10000 | 2 | 10.000 | | 99.87 | WERL |
| SS | Full | 6B | | 1000-10000 | 15 | 10.000 | | 99.77 | WERL |
| * SS | Full | 415T | 10 | 200-10800 | 15 | 10.200 | | | ITD-L * |
| * SS | Full | 913 | 10 | 2900-12300 | 14 | 10.000 | | | ITD-L * |
| TF | Pilot | 240A | | 0-100 | 12 | 1.000 | | 98.3 | WERL |
| TF | Pilot | 203A | | 100-1000 | 14 | 85.000 | | 60 | WERL |

* Data used in developing proposed standard.

1,1,1-Trichloroethane (U226). Several sources of wastewater treatment performance data were available for 1,1,1-trichloroethane, including data from the ITD and WERL databases, BDAT Solvents Rule data, and literature WAO data. These data are presented in Table 4-42. Technologies for which data are available include AL, AS, AirS, BT, GAC, PACT$^R$, RO, SS, TF, and WOx. The treatment performance data represent bench-, pilot-, and full-scale studies.

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

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

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

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

BDAT for 1,1,1-trichloroethane is being promulgated as proposed and is identified as steam stripping (SS). The BDAT treatment standard was calculated using the ITD median long-term average of 10 ppb and the ITD Option 1 variability factor. The calculation of the resulting BDAT treatment standard for 1,1,1-trichloroethane (0.054 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-42
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 | | 99.88 | 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 | | 96.2 | 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 | | 76 | WERL |
| AS | Full | 238A | | 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 | 238A | | 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 | 234A | | 0-100 | | 1.300 | | 88 | WERL |
| AS | Bench | 202D | | 100000-1000000 | | 1600.000 | | 98.6 | WERL |
| AS | Pilot | REF6 | | 237 | 1 | 23.000 | | | BDAT # |
| AS | Pilot | REF2 | | 150000 | 6 | 48683.000 | | | BDAT # |

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

TABLE 4-42 (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 | | 96.8 | WERL |
| AirS | Full | 1344E | | 100-1000 | | 0.200 | | 99.98 | WERL |
| AirS | Pilot | 219B | | 0-100 | 1 | 0.500 | | 96.7 | WERL |
| BT | Full | P240 | | 10-215 | 3 | 10.000 | | | BDAT ‡ |
| GAC | Bench | 1362E | | 10-100 | | 1.000 | | 99.99 | WERL |
| GAC | Full | 1264B | | 0-100 | | 1.000 | | 96.6 | WERL |
| GAC | Full | 1264B | | 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 | | | ITD-L * |
| 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 | 1138E | | 0-100 | | 30.000 | | 40 | WERL |
| WOx | | REF10 | | 370000 | 1 | 1000.000 | | | BDAT ‡ |
| WOx | Full | Zimpro | 50 | 6900-9600 | 2 | | | | WAO |
| WOx | Full | 242E | | 100000-1000000 | | 400.000 | | 99.96 | WERL |

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

Vinyl Chloride (U043). Two sources of wastewater treatment performance data were available for vinyl chloride, including data from the ITD and WERL databases. These data are presented in Table 4-47. Technologies for which data are available include AS, AS+Fil, AirS, and SS. The treatment performance data represent pilot- and full-scale data.

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

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

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

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

BDAT for vinyl chloride is being promulgated as proposed and is identified as steam stripping (SS). The BDAT treatment standard was calculated using the ITD median long-term average of 50 ppb and the ITD Option 1 variability factor. The calculation of the resulting BDAT treatment standard for vinyl chloride (0.27 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-47
WASTEWATER TREATMENT PERFORMANCE DATA
FOR VINYL 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 | 6B | | 100-1000 | 3 | 50.000 | | 94.9 | WERL |
| AS | Full | 1B | | 1000-10000 | 6 | 100.000 | | 94.1 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 20.000 | | 80 | WERL |
| AS | Full | 1B | | 10000-100000 | 6 | 3900.000 | | 92.9 | WERL |
| AS+Fil | Full | 6B | | 1000-10000 | 14 | 50.000 | | 98.3 | WERL |
| AirS | Pilot | 217B | | 0-100 | 1 | 0.500 | | 93.1 | WERL |
| AirS | Full | 1344E | | 100-1000 | | 0.100 | | 99.99 | WERL |
| AirS | Full | 69A | | 0-100 | | 0.300 | | 96.4 | WERL |
| SS | Full | 251B | | 1000-10000 | 10 | 10.000 | | 99.88 | WERL |
| * SS | Full | 913 | 50 | 50-3500 | 14 | 50.000 | | | ITD-L * |
| * SS | Full | 725 | 50 | 410000-2230000 | 13 | 37944.200 | | | ITD-L * |
| SS | Full | 6B | | 1000000 | 11 | 120.000 | | 99.99 | WERL |

* Data used in developing proposed standard.

Pyridine (U196). The data available for pyridine were compiled from the WERL database and EPA WAO test data and are presented in Table 4-36. Technologies for which data are available include AS, AnFF, and WOx + PACT$^R$. The treatment performance data represent bench-, and pilot-scale studies. The resulting effluent concentrations ranged from 0.9 ppb to 1900 ppb with a detection limit for pyridine established at 2.4 ppb (see Table C-1, Appendix C).

BDAT for pyridine is being promulgated as proposed and is identified as anaerobic fixed film biological treatment (ARFF). Anaerobic fixed film was selected as BDAT since this demonstrated biological treatment technology showed substantial treatment to levels below the detection limit. The BDAT treatment standard for pyridine was calculated using an effluent concentration of 2.4 ppb (which represents 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 6.0 and is shown in Table 6-10.

1,1,1,2-Tetrachloroethane (U208). The data available for 1,1,1,2-tetrachloroethane were compiled from literature WAO data and are presented in Table 4-37. The technology for which data were available was bench-scale PACT$^R$.

BDAT for 1,1,1,2-tetrachloroethane is being promulgated as proposed and is identified as PACT$^R$. PACT$^R$ was selected as BDAT because it represents data with a high removal efficiency and the lowest achievable effluent. The BDAT treatment standard for 1,1,1,2-tetrachloroethane 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 1,1,1,2-tetrachloroethane (0.057 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-36
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 | 235D | | 1000-10000 | | 0.900 | | 99.9 | WERL * |
| WOx + PACT | Pilot | Zimpro | | >180000 | 3 | 146.000 | | 99.9 | WAO |

* Data used in developing proposed standard.

TABLE 4-37
WASTEWATER TREATMENT PERFORMANCE DATA
FOR 1,1,1,2-TETRACHLOROETHANE

| 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 | | 36 | 1 | 10.000 | | 72 | WAO * |

* Data used in developing proposed standard.

1,1,2,2-Tetrachloroethane (U209). The data available for 1,1,2,2-tetrachloroethane were compiled from the WERL and NPDES databases and are presented in Table 4-38. Technologies for which data are available include AS, AirS, BT, and GAC. The treatment performance data represent bench-, pilot-, and full-scale studies. The resulting effluent concentrations ranged from 0.0005 ppb to 11,000 ppb.

BDAT for 1,1,2,2-tetrachloroethane is being promulgated as proposed and is identified as carbon adsorption. Granular activated carbon (GAC) was selected as BDAT because of its full-scale treatment performance with high influent concentrations and a high removal efficiency. The BDAT treatment standard for 1,1,2,2-tetrachloroethane 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 1,1,2,2-tetrachloroethane (0.057 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-38
WASTEWATER TREATMENT PERFORMANCE DATA
FOR 1,1,2,2-TETRACHLOROETHANE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| | | NY0007048 | | | 9 | 1.560 | | | NPDES |
| | | NJ0028291 | | | 2 | 1.000 | | | NPDES |
| | | LA0066435 | | | 13 | 7.570 | | | NPDES |
| | | LA0066214 | | | 15 | 5.000 | | | NPDES |
| | | LA0065501 | | | 6 | 5.000 | | | NPDES |
| | | NJ0030392 | | | 4 | 0.005 | | | NPDES |
| AS | Bench | 202D | | 100000-1000000 | | 11000.000 | | 94.5 | WERL |
| AS | Full | 1B | | 0-100 | 2 | 3.000 | | 93.5 | WERL |
| AirS | Pilot | 1363E | | 100-1000 | | 4.600 | | 99 | WERL |
| AirS | Pilot | 71D | | 100-1000 | 1 | 41.000 | | 95.5 | WERL |
| BT | Full | LA0038245 | | | 38 | 5.313 | | | NPDES |
| * GAC | Full | 245B | | 1000-10000 | 1 | 10.000 | | 99.1 | WERL * |

* Data used in developing proposed standard.

Tetrachloroethene (U210). Several sources of wastewater treatment performance data were available for tetrachloroethene, including data from the ITD and WERL databases, BDAT Solvents Rule data, and literature PACT[R] data. These data are presented in Table 4-39. Technologies for which data are available include AL, AS, AS+Fil, Airs, AnFF, BT, CAC+AirS, ChOX, chemical reduction (Chred), GAC, PACT[R], RO, SS, TF, and WOx. The treatment performance data represent bench-, pilot-, and full-scale studies.

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

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

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

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

BDAT for tetrachloroethene is being promulgated as proposed and is identified as steam stripping (SS). The BDAT treatment standard was calculated using the ITD median long-term average of 10.4 ppb and the ITD Option 1 variability factor. The calculation of the resulting BDAT treatment standard for tetrachloroethene (0.056 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-39
WASTEWATER TREATMENT PERFORMANCE DATA
FOR TETRACHLOROETHENE

| 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 | | 83 | WERL |
| AS | Full | 1B | | 0-100 | 5 | 2.000 | | 97.5 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 8.000 | | 85 | WERL |
| AS | Full | 238A | | 0-100 | 3 | 2.100 | | 87 | WERL |
| AS | Full | 1587E | | 0-100 | | 0.870 | | 97.8 | WERL |
| AS | Full | 234A | | 0-100 | | 22.000 | | 49 | WERL |
| AS | Full | 238A | | 0-100 | 3 | 1.600 | | 87 | WERL |
| AS | Full | 1B | | 0-100 | 4 | 1.000 | | 96 | 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 | | 95.3 | WERL |
| AS | Full | 1B | | 1000-10000 | 6 | 440.000 | | 85 | WERL |
| AS | Full | 201B | | 0-100 | 22 | 8.000 | | 89.5 | 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 | 26.000 | | 78 | WERL |
| AS | Full | 234A | | 0-100 | | 0.600 | | 95.9 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 8.000 | | 85 | 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 | | 0.500 | | 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 4-39 (Continued)
WASTEWATER TREATMENT PERFORMANCE DATA
FOR TETRACHLOROETHENE

| 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 | | 89 | WERL |
| ChOx | Pilot | 2026A | | 0-100 | 4 | 2.000 | | 86 | WERL |
| ChOx | Pilot | 2026A | | 0-100 | 4 | 1.700 | | 84 | 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 | | 81 | WERL |
| * SS | Full | 913 | 10 | 10800-241000 | 14 | 18.400 | | | ITD-L * |
| 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 | 18.000 | | 54 | WERL |
| TF | Full | 1B | | 0-100 | 4 | 1.000 | | 96.9 | 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 | 1138E | | 0-100 | 1 | 7.500 | | 85 | WERL |
| WOx | | REF10 | | 41000 | 1 | 1000.000 | | | BDAT ‡ |
| WOx | Pilot | 78D | | 1000000 | | 900.000 | | 99.98 | WERL |

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

Trichloroethene (U228). Several sources of wastewater treatment performance data were available for trichloroethene, including data from the ITD and WERL databases, BDAT Solvents Rule data, BDAT test data, and additional literature data. These data are presented in Table 4-44. Technologies for which data are available include Chred, AS, AirS, BT, BT+AC, CAC+Air S, ChOx, GAC, PACT[a], RO, SS, TF, and WOx. The treatment performance data represent bench-, pilot-, and full-scale studies.

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

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

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

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

BDAT for trichloroethene is being promulgated as proposed and is identified as steam stripping (SS). The BDAT treatment standard was calculated using the ITD median long-term average of 10 ppb and the ITD Option 1 variability factor. The calculation of the resulting BDAT treatment standard for trichloroethene (0.054 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-44
WASTEWATER TREATMENT PERFORMANCE DATA
FOR TRICHLOROETHENE

| 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 | | 98.6 | WERL |
| AS | Full | 238A | | 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 | | 98.5 | WERL |
| AS | Full | 6B | | 0-100 | 5 | 10.000 | | 89 | WERL |
| AS | Full | 238A | | 0-100 | 3 | 0.500 | | 94.8 | 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 | 209B | | 100-1000 | 1 | 0.800 | | 99.58 | WERL |
| AirS | Full | 199B | | 100-1000 | | 1.500 | | 99.75 | WERL |
| AirS | Pilot | 26A | | 100-1000 | | 27.000 | | 87 | WERL |
| AirS | Pilot | 216B | | 100-1000 | 1 | 2.100 | | 98.9 | WERL |
| AirS | Pilot | 219B | | 100-1000 | 1 | 0.500 | | 99.58 | WERL |

TABLE 4-44 (Continued)
WASTEWATER TREATMENT PERFORMANCE DATA
FOR TRICHLOROETHENE

| 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 | | 98.6 | 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 | | 99.69 | WERL |
| AirS | Full | 322B | | 100-1000 | 10 | 0.460 | | 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 | | 98.2 | 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 | | 99.68 | WERL |
| AirS | Pilot | 215B | | 0-100 | 1 | 0.500 | | 98 | WERL |
| AirS | Pilot | 208B | | 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 | | 98.5 | WERL |
| AirS | Pilot | 207B | | 0-100 | 1 | 0.500 | | 98.7 | 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 | 2026A | | 0-100 | 4 | 3.700 | | 96.2 | WERL |

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

TABLE 4-44 (Continued)
WASTEWATER TREATMENT PERFORMANCE DATA
FOR TRICHLOROETHENE

| 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 | | 98.6 | 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 | 0.590 | | | BDAT ‡ |
| PACT | Bench | 242E | | 0-100 | | 10.000 | | 89 | WERL |
| PACT | Bench | Zimpro | | 326 | 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 | 68.000 | | 30 | WERL |
| * SS | Full | 415 | 10 | 59-10300 | 15 | 16.100 | | | ITD-L * |
| 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 | 22900-52700 | 14 | 10.000 | | | ITD-L * |
| 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 | 1138E | | 0-100 | | 22.000 | | 56 | 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 |

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

1,1,2-Trichloroethane (U227). Several sources of wastewater treatment performance data were available for 1,1,2-trichloroethane, including data from the ITD and WERL databases and literature PACT[R] data. These data are presented in Table 4-43. Technologies for which data are available include AS, PACT[R], SS, and WOx. The treatment performance data represent bench-, pilot-, and full-scale studies.

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

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

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

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

BDAT for 1,1,2-trichloroethane is being promulgated as proposed and is identified as steam stripping (SS). The BDAT treatment standard was calculated using the ITD median long-term average of 10 ppb and the ITD Option 1 variability factor. The calculation of the resulting BDAT treatment standard for 1,1,2-trichloroethane (0.054 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-43
WASTEWATER TREATMENT PERFORMANCE DATA
FOR 1,1,2-TRICHLOROETHANE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AS | Full | 6B | | 100-1000 | 3 | 18.000 | | 97.1 | WERL |
| AS | Pilot | 206B | | 100-1000 | 20 | 28.000 | | 79 | WERL |
| AS | Full | 6B | | 0-100 | 3 | 10.000 | | 60 | WERL |
| AS | Full | 1B | | 0-100 | 3 | 5.000 | | 88 | WERL |
| AS | Pilot | 241B | | 100-1000 | 5 | 110.000 | | 54 | WERL |
| PACT | Bench | 242E | | 0-100 | | 5.000 | | 83 | WERL |
| PACT | Bench | 190E | | 1000-10000 | | 4.200 | | 99.68 | WERL |
| PACT | Bench | Zimpro | | 30 | 1 | 5.000 | | 83 | WAO |
| SCOx | Pilot | 65D | | 100000-1000000 | | 36.000 | | 99.98 | WERL |
| * SS | Full | 913 | 10 | 416-26400 | 14 | 11.200 | | | ITD-L * |
| * SS | Full | 415T | 10 | 220-14500 | 15 | 10.000 | | | ITD-L * |
| SS | Full | 6B | | 10000-100000 | 2 | 10.000 | | 99.96 | WERL |
| SS | Full | 6B | | 1000-10000 | 8 | 10.000 | | 99.85 | WERL |
| SS | Full | 251B | | 1000-10000 | 10 | 10.000 | | 99.87 | WERL |
| SS | Full | 251B | | 1000-10000 | 10 | 5.000 | | 99.91 | WERL |
| WOx | Full | 242E | | 10000-100000 | | 30.000 | | 99.91 | WERL |

* Data used in developing proposed standard.

Hexachloroethane (U131). The data available for hexachloroethane were compiled from the WERL database and are presented in Table 4-97. Technologies for which data are available include AS and AS+Fil. Data are available from pilot and full-scale studies. The resulting effluent concentration for both studies was 10 ppb.

BDAT for hexachloroethane is being promulgated as proposed and is identified as activated sludge followed by filtration (AS+Fil). AS+Fil was selected as BDAT since it represents full-scale treatment performance with a high removal efficiency. The BDAT treatment standard for hexachloroethane 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 hexachloroethane (0.055 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-97
WASTEWATER TREATMENT PERFORMANCE DATA
FOR HEXACHLOROETHANE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| AS | Pilot | 241B | | 100-1000 | 11 | 10.000 | | 97.1 | WERL |
| * AS+Fil | Full | 6B | | 100-1000 | 14 | 10.000 | | 93.8 | WERL * |

* Data used in developing proposed standard.

**********
The pentachloroethane wastewater
treatment standard is based on a
transfer of hexachloroethane data.
**********

m-Dichlorobenzene (U071). The data available for m-dichlorobenzene were compiled from the WERL database and are presented in Table 4-77A. In addition, leachate treatment performance data submitted by industry just prior to proposal are presented in Table 4-77B. Technologies for which data are available include aerobic fixed film (AFF), AS, AirS, BGAC, GAC, PACT[a], RO, and BT. The treatment performance data represent bench-, pilot-, and full-scale studies. The resulting effluent concentrations ranged from 0.160 ppb to 3,300 ppb.

At proposal, BDAT for m-dichlorobenzene was identified as biological treatment and the treatment standard was based on an effluent concentration of 3.6 ppb from activated sludge (AS). Between proposal and promulgation, EPA evaluated the industry-submitted leachate data available for m-dichlorobenzene. Since this data for biological treatment (BT) showed substantial treatment of m-dichlorobenzene and showed average leachate effluent values greater than that of activated sludge, these data were used to calculate the promulgated standard. Therefore, BDAT for m-dichlorobenzene is biological treatment.

The BDAT treatment standard for m-dichlorobenzene 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 m-dichlorobenzene (0.036 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-77A
WASTEWATER TREATMENT PERFORMANCE DATA
FOR m-DICHLOROBENZENE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| APF | Bench | 501A | | 0-100 | 34 | 7.100 | | 28 | WERL |
| AS | Full | 1587E | | 0-100 | | 0.270 | | 77 | WERL |
| * AS | Full | 975B | | 100-1000 | | 3.600 | | 99.14 | WERL * |
| AS | Pilot | 241B | | 100-1000 | 11 | 41.000 | | 89 | WERL |
| AS | Full | 1B | | 100-1000 | 2 | 5.000 | | 98 | WERL |
| AS | Full | 975B | | 0-100 | | 1.200 | | 93.3 | WERL |
| AS | Bench | 202D | | 10000-100000 | | 340.000 | | 99.51 | WERL |
| AirS | Bench | 1328E | | 10000-100000 | 5 | 3300.000 | | 89 | WERL |
| BGAC | Bench | 501A | | 0-100 | 34 | 0.500 | | 94.9 | WERL |
| GAC | Full | 1421D | | 0-100 | | 0.290 | | 80 | WERL |
| PACT | Bench | 975B | | 0-100 | | 2.000 | | 83 | WERL |
| PACT | Full | 6B | | 100-1000 | 10 | 25.000 | | 96.9 | WERL |
| RO | Pilot | 323B | | 0-100 | 1 | 9.000 | | 66 | WERL |
| RO | Pilot | 180A | | 0-100 | | 0.160 | | 69 | WERL |

* Data used in developing proposed standard.

TABLE 4-77B
INDUSTRY-SUBMITTED TREATMENT PERFORMANCE
DATA FOR m-DICHLOROBENZENE

| TECHNOLOGY | TECHNOLOGY SIZE | FACILITY | DETECTION LIMIT (ppb) | RANGE INFLUENT CONCENTRATION (ppb) | NO. OF DATA POINTS | AVERAGE EFFLUENT CONCENTRATION (ppb) | RECOVERY (%) | REMOVAL (%) | REFERENCE |
|---|---|---|---|---|---|---|---|---|---|
| BT | | DOW | 10 | 46-205 | 3 | 10.000 | | 91.24 | LEACHATE |

1,2,4-Tricholorobenzene. The data available for 1,2,4-trichlorobenzene were compiled from the WERL database and are presented in Table 4-115. Technologies for which data are available include AFF, AS, BGAC, GAC, PACT$^R$, RO, and TF. The treatment performance data represent bench-, pilot-, and full-scale studies. The resulting effluent concentrations ranged from 0.02 ppb to 89 ppb.

BDAT for 1,2,4-trichlorobenzene is being promulgated as proposed and is identified as PACT$^R$. PACT$^R$ was selected as BDAT since this technology represents full-scale treatment with a high influent concentration and a high removal efficiency. The BDAT treatment standard for 1,2,4-trichlorobenzene 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 1,2,4-trichlorobenzene (0.055 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-115
WASTEWATER TREATMENT PERFORMANCE DATA
FOR 1,2,4-TRICHLOROBENZENE

| 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 | 23 | 0.870 | | 90.5 | WERL |
| AS | Full | 6B | | 100-1000 | 330 | 71.000 | | 88 | WERL |
| AS | Pilot | 241B | | 100-1000 | 9 | 89.000 | | 86 | WERL |
| AS | Full | 1B | | 0-100 | 6 | 8.000 | | 92 | WERL |
| AS | Full | 201B | | 0-100 | 13 | 14.000 | | 80 | WERL |
| AS | Full | 1B | | 1000-10000 | 4 | 89.000 | | 91.9 | WERL |
| AS | Full | 975B | | 100-1000 | | 36.000 | | 84 | WERL |
| AS | Bench | 200B | | 100-1000 | 14 | 12.000 | | 90 | WERL |
| BGAC | Bench | 501A | | 0-100 | 34 | 0.280 | | 96.9 | WERL |
| GAC | Full | 245B | | 1000-10000 | 1 | 10.000 | | 99.74 | WERL |
| GAC | Full | 1421D | | 0-100 | | 0.830 | | 90 | WERL |
| PACT | Bench | 200B | | 100-1000 | 12 | 2.100 | | 98 | WERL |
| * PACT | Full | 6B | | 100-1000 | 10 | 10.000 | | 96 | WERL * |
| RO | Pilot | 180A | | 0-100 | | 0.020 | | 95.7 | WERL |
| TF | Full | 1B | | 0-100 | 3 | 5.000 | | 91.7 | WERL |

* Data used in developing proposed standard.

# APPENDIX B

## QUALITY ASSURANCE/QUALITY CONTROL DATA

Table B-1

STABILIZED F024 INCINERATOR ASH MATRIX SPIKE RECOVERIES FOR METAL CONSTITUENTS

Cement Binder: Run #2

| BDAT List Constituent | | Original Amount Found[a] (ppm) | Amount Spiked (ppm) | Sample Results: Amount Recovered (ppm) | Sample Results: Percent Recovery[b] (%) | Duplicate Sample Results: Amount Recovered (ppm) | Duplicate Sample Results: Percent Recovery[b] (%) | Relative Percent Difference (%) |
|---|---|---|---|---|---|---|---|---|
| 155. | Arsenic | 0.0036 | 0.1 | 0.105 | 101.3 | 0.109 | 105 | 3.7 |
| 156. | Barium | 1.84 | 2 | 3.70 | 93.2 | 3.78 | 97.2 | 2.1 |
| 157. | Beryllium | <0.0009 | 2 | 1.74 | 87.1 | 1.75 | 87.6 | 0.6 |
| 158. | Cadmium | <0.0027 | 2 | 1.61 | 80.3 | 1.62 | 80.9 | 0.8 |
| 159. | Chromium (total) | 0.0311 | 2 | 1.77 | 87.2 | 1.79 | 88.0 | 0.9 |
| 221. | Chromium (VI) | 0.00944 | 0.010 | 0.0185 | 90.8 | 0.185 | 90.8 | 0.0 |
| 160. | Copper | <0.0179 | 2 | 1.71 | 85.6 | 1.71 | 85.6 | 0.0 |
| 161. | Lead | 0.0112 | 0.075 | 0.007 | 78.4 | 0.0735 | 83.1 | 4.9 |
| 162. | Mercury | 0 | 0.0005 | 0.000483 | 96.6 | 0.000497 | 99.4 | 2.9 |
| 163. | Nickel | <0.0249 | 2 | 1.61 | 80.5 | 1.59 | 79.7 | 1.0 |
| 168. | Zinc | 0.0406 | 2 | 1.61 | 78.3 | 1.66 | 81.2 | 3.5 |
| * | Aluminum | 0.4542 | 2 | 2.25 | 90.0 | 2.28 | 91.4 | 1.2 |
| * | Calcium | 2,000 | 1,000 | 3,020 | 102 | 3,060 | 106 | 1.3 |
| * | Cobalt | <0.0102 | 2 | 1.52 | 75.8 | 1.57 | 78.6 | 3.7 |
| * | Iron | 0.0219 | 2 | 1.66 | 81.8 | 1.66 | 82.1 | 0.3 |
| * | Magnesium | 0.0947 | 2 | 1.71 | 80.7 | 1.70 | 80.4 | 0.4 |
| * | Manganese | <0.0012 | 2 | 1.62 | 80.9 | 1.62 | 81.0 | 0.1 |
| * | Molybdenum | 0.0623 | 2 | 1.78 | 85.7 | 1.75 | 84.5 | 1.3 |
| * | Sodium | 37.4 | 24 | 62.2 | 103 | 63.7 | 110 | 2.3 |
| * | Tin | <0.105 | 4 | 4.01 | 100 | 4.05 | 101 | 0.8 |

* Non-BDAT List Constituent

[a]For constituents not detected in the treatment residual at or above the detection limit (DL), the original amount found is considered as zero in calculating percent recovery.
[b]Percent recovery = 100 x $(C_1-C_o)/C_t$, where $C_1$ is amount recovered, $C_o$ = original amount found, and $C_t$ = amount spiked.

Table B-2

SUMMARY OF ACCURACY CORRECTION FACTORS
FOR METAL CONSTITUENTS IN STABILIZED F024 INCINERATOR ASH

| BDAT List Constituent | | Accuracy Correction Factor[a] |
|---|---|---|
| 155. | Arsenic | 1.000 |
| 156. | Barium | 1.073 |
| 157. | Beryllium | 1.148 |
| 158. | Cadmium | 1.245 |
| 159. | Chromium (total) | 1.147 |
| 221. | Chromium (VI) | 1.101 |
| 160. | Copper | 1.168 |
| 161. | Lead | 1.276 |
| 162. | Mercury | 1.035 |
| 163. | Nickel | 1.255 |
| 168. | Zinc | 1.277 |
| * | Aluminum | 1.111 |
| * | Calcium | 1.000 |
| * | Cobalt | 1.319 |
| * | Iron | 1.222 |
| * | Magnesium | 1.244 |
| * | Molybdenum | 1.236 |
| * | Sodium | 1.183 |
| * | Tin | 1.000 |
| | | 1.000 |

*Non-BDAT List Constituent

[a]The accuracy correction factor is equal to 1.000 divided by the percent recovery correction factor.