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Best Demonstrated Available Technology (BDAT) Background Document for F001 - F005 Spent Solvents

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

VOLUME 2

U.S. ENVIRONMENTAL PROTECTION AGENCY

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BDAT BACKGROUND DOCUMENT FOR
F001-F005 SPENT SOLVENT WASTES

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5. TREATMENT PERFORMANCE

5.1 Introduction

This section explains how all of the treatment standards for F001-F005 spent solvents were derived. A summary of the sources of treatment performance data used to derive BDAT treatment standards for spent solvent wastes is presented in Section 5.2. Data editing procedures are discussed in Section 5.3. Statistical analyses, including calculation of variability factors, outlier determination, and analysis of variance are discussed in Section 5.4. Development of BDAT treatment standards for wastewaters containing the F001-F005 spent solvent constituents are presented in Section 5.5. Treatment standards for all other spent solvent wastes are presented in Section 5.6. Complete data sets characterizing wastes used in the derivation of the treatment standards are presented in Appendix I. This appendix should be consulted when determining whether to submit a petition for a variance from the treatment standard. To obtain a variance, a petitioner would have to show that their F001-F005 spent solvent waste is sufficiently different from the wastes considered in the development of the treatment standard, such that EPA's consideration of this waste during the rulemaking would have resulted in a separate treatability subgroup. All pertinent statistical parameters and results used to determine the treatment standards are presented in Appendix II.

5.2 Summary of Treatment Performance Data

EPA collected data on treatment of wastes containing the F001-F005 spent solvent constituents. Treatment data were examined by EPA from the following sources for use in development of BDAT treatment standards for F001-F005 spent solvents:

a) Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) Industries Data Base (Reference 13). EPA collected treatment performance data for the development of OCPSF effluent limitations regulations. For the F001-F005 spent solvents rule, we used data from 28 plants in the OCPSF category. Wastewater treatment technologies for which data were collected as part of this program include steam stripping, biological treatment, and systems which use these technologies in combination with activated carbon adsorption. These data do not necessarily represent treatment of spent solvent wastes, but rather treatment of wastes containing the constituents. The Agency may use treatment data from wastes that it believes to be similar and that contain constituents of concern even though the actual wastes may not fall within an EPA code.

b) Pharmaceuticals Industry Data Base (Reference 14). EPA collected data for the development of effluent guidelines for the pharmaceuticals industry. We are using data from one plant which operates a steam stripper for treatment of methylene chloride wastewater in this data base. These data were presented in EPA's Notice of Availability of Data (Reference 16).

c) Subsequent to proposal, EPA collected incinerator residue samples from the incineration of hazardous wastes, including spent solvents, from 10 incinerators at 9 sites (Reference 11). Analyses of TCLP extracts of the residue and total analyses of the residue were performed for these samples. Analyses were also performed on influent wastes fed to the incinerators at all sites. These data were presented in EPA's Notice of Availability of Data (Reference 16).

d) Data on pilot-scale steam stripping and air stripping of solvent-contaminated groundwater are presented in a paper by Stover and Kincannon, 1983 (Reference 2). These data do not necessarily represent treatment of spent solvent wastes, but rather treatment of similar wastes containing the constituents.

e) Data on full-scale powdered activated carbon and biological treatment (commercially available PACT® process) of organic chemical manufacturing wastewater are presented in a paper by Hutton, 1979 (Reference 4). These data do not necessarily represent treatment of spent solvent wastes, but rather treatment of similar wastes containing the constituents.

f) Data on pilot-scale air stripping of tap water spiked with tetrachloroethylene and trichloroethylene and groundwater contaminated by industrial discharge are presented in a paper by Love and Eilers, 1982 (Reference 6). These data do not necessarily represent treatment of spent solvent wastes, but rather treatment of similar wastes containing the constituents.

g) Data on pilot-scale granular activated carbon adsorption of runoff water from a waste disposal site's containment dikes are presented in a paper by Becker and Wilson, 1978 (Reference 7). These data do not necessarily represent treatment of spent solvent wastes, but rather treatment of similar wastes containing the constituents.

h) Data on full-scale granular activated carbon adsorption of pesticide wastewater are presented in a report by IT Enviroscience, 1983 (Reference 3). These data do not necessarily represent treatment of spent solvent wastes, but rather treatment of similar wastes containing the constituents.

i) Data on full-scale biological treatment of wastewaters from the synfuels industry are presented in a report by Torpy, Raphaelian, and Luthy, 1981 (Reference 5). These data do not necessarily represent treatment of spent solvent wastes, but rather treatment of similar wastes containing the constituents.

j) Data on full-scale granular activated carbon adsorption of cresol wastewater are presented in a paper by Baker, Clark, and Jeserig, 1973 (Reference 12). These data do not necessarily represent treatment of spent solvent wastes, but rather treatment of similar wastes containing the constituents.

k) Data on bench-scale wet air oxidation of F001-F005 spent solvent wastes and on a synthetic waste containing methylene chloride were submitted by Zimpro, Inc., 1986 (Reference 10). These data do not necessarily represent treatment of spent solvent wastes, but rather treatment of similar wastes containing the constituents.

l) Iron and Steel Manufacturing Point Source Category Data Base (Reference 9). EPA collected data for the development of effluent guidelines for the iron and steel manufacturing industry. We considered data for xylene and toluene from three combined treatment systems in this data base.

m) Data on pilot-scale granular activated carbon adsorption of organic contaminants in a drinking water supply are presented in a paper by Ruggiero and Ausubel, 1982 (Reference 8). These data do not necessarily represent treatment of spent solvent wastes, but rather treatment of similar wastes containing the constituents.

Performance data used to develop BDAT treatment standards are presented by constituent for each of the F001-F005 spent solvent wastes in Sections 5.5 and 5.6. Complete data sets displaying all constituent values and all pollutant parameters analyzed for each influent and effluent point within each plant are included in Appendix I. The reader should consult this appendix for information characterizing the wastes treated in development of BDAT treatment standards.

5.3 Data Editing Rules

The following editing rules were applied to all of the available data. Changes from proposal are also discussed here:

a) All sets of influent and effluent concentrations were considered to be paired data unless it was known that the samples were not collected so as to fully account for the retention time in the treatment system. Paired data sets were deleted if the influent concentration was less than the corresponding effluent concentration. This is a change from proposal in response to comments. At proposal, all sets of influent and effluent concentrations were considered to be paired data regardless of treatment system retention time.

b) For paired data sets, individual data pairs were deleted if the influent concentration was below the quantification level for a constituent. Entire data sets were deleted when the majority of the influent concentrations for a constituent were below the quantification level for that constituent. Quantification levels for the solvents of concern are shown in Table 5-1. This is a change from proposal. At proposal, the Agency used screening levels as an editing criteria in order to assess whether the effluent concentration level represented treatment or simply reflected a low influent concentration. In response to comments, the Agency is no longer using screening levels to develop land disposal restrictions standards. As a consequence, the Agency believes it to be more appropriate to use quantification levels as an editing criteria for deleting treatment data sets where influent concentrations are low.

c) Treatment concentration levels reported by the analytical laboratories as at or below the analytical detection limit were set equal to the detection limit for averaging and statistical analyses. Setting the concentration level equal to the detection limit reported with a data set is a conservative approach because the actual concentration of a constituent reported as "not detected" is between zero and the detection limit. Consequently, the mean value computed using the detection limit as an estimate of the actual value will be somewhat higher than the true mean of the data. This is the same procedure used at proposal when data were reported at or below the detection limit.

Table 5-1

QUANTIFICATION LEVELS FOR F001 - F005 SOLVENTS

Constituent	Quantification Level (mg/L)
Acetone	0.05
n-Butyl alcohol	5.0
Carbon disulfide	0.05
Carbon tetrachloride	0.05
Chlorobenzene	0.05
Cresols (Cresylic acid)	0.50
Cyclohexanone	0.125
1,2-Dichlorobenzene	0.125
Ethyl acetate	0.05
Ethyl benzene	0.05
Ethyl ether	0.05
Isobutanol	5.0
Methanol	0.25
Methylene chloride	0.125
Methyl ethyl ketone	0.05
Methyl isobutyl ketone	0.05
Nitrobenzene	0.125
Pyridine	0.05
Tetrachloroethylene	0.05
Toluene	0.05
1,1,1-Trichloroethane	0.05
1,1,2-Trichloro-1,2,2-trifluoroethane	0.05
Trichloroethylene	0.05
Trichlorofluoromethane	0.05
Xylene	0.05

5.4 Statistical Methods for Establishing BDAT

To develop BDAT treatment standards, the Agency used the following three statistical methods that were presented in EPA's Notice of Availability of Data on the land disposal restrictions (Reference 16):

1) Variability Factor Calculation - to account for variability in performance of well-designed and well-operated systems.

2) Outlier Test - to determine whether a data point within a data set is representative of that data set.

3) Analysis of Variance - to measure whether differences between data sets are statistically discernible.

More detailed discussions of these methods follow below.

5.4.1 Variability Factor Calculation

The Agency incorporated a variability factor in the development of BDAT treatment standards. To obtain the BDAT treatment standard, the Agency multiplied the long-term average treatment performance value by the variability factor. Variability in performance principally arises from inherent mechanical limitations in maintaining control parameters at the optimum setting.

An example would be an automatic pH control system used to maintain the proper pH range for precipitation of a toxic metal. In this system, a pH sensing device provides a signal to the controller that the pH is not at the set point (i.e., the optimum design point). The controller then changes (either pneumatically or electrically) the position of the valve that supplies the reagent(s) used to adjust pH. The Agency would consider such a system to be well-operated provided that it is properly designed, calibrated, and maintained. Nevertheless, this system cannot be operated without any variation in the level of performance. Control valves are not manufactured in such a way that they can precisely add the exact amount of reagent needed to be at the set point: either too much or too little reagent will be added. Also, there is a lag time between the time that the sensing device detects a problem and the time the controller adjusts the position of the valve to correct the problem. Additionally, there can be process upsets that require greater changes to the system with corresponding greater variations in performance. Another source of variability is the analysis of treatment samples; even EPA approved methods will have some variability in test results for the same samples. All of the above variations can occur even at well designed and operated treatment facilities.

The Agency used the statistical calculation described below to account for these changes. This analysis is the same as has been used for the development of numerous regulations in the Effluent Guidelines Program.

$$VF = \frac{C_{99}}{Mean}$$

where,

VF = Estimate of maximum variability factor determined from a sample population of data.

C_{99} = Estimate of performance values which 99 percent of the observations will be below. C_{99} is calculated using the following equation:

$$C_{99} = \exp(y + 2.33S_y)$$

where y and S_y are the mean and standard deviation, respectively, of the logtransformed data.

Mean = Arithmetic average of the individual performance values.

Setting standards based on such a variability factor should not be viewed as "relaxing" BDAT requirements. Rather, it accommodates the normal variability of the processes. A plant will have to be designed to meet the mean treatment level in order to be assured of not being out of compliance when the Agency samples the treatment residues.

5.4.2 Outlier Test

An outlier in a data set is an observation (or data point) that is significantly different from the other data. The measure of difference is determined by the statistical method known as a Z-score. Because the outlier test assumes data to be normally distributed, it is necessary to transform the data by computing the logarithm of each data point before performing the outlier test. The Z-score is calculated by dividing the difference between the data point and the average of the data set by the standard deviation. For data that is normally distributed, 99.5 percent (or two standard deviations) of the measurements will have a Z-score between -2.0 and 2.0. A data point outside this range is not considered to be representative of the population from which the data are drawn.

EPA used this statistical method to confirm that certain data do not represent treatment by a well-operated system. The Agency used this method only in cases where data on the design and operation of a treatment system were limited. This method is a commonly used technique for evaluating data sets.

5.4.3 Analysis of Variance

EPA used the statistical method known as analysis of variance in determining the level of performance that represents BDAT. This method provides a measure of the differences between data sets. If the differences are not statistically discernible, the data sets are said to be homogeneous.

This method was used in two cases. The first case was where more than one technology was used to treat the same waste. In this case, the analysis of variance method was used to determine whether BDAT represented a level of performance achieved by only one technology or represented a level of performance achievable by more than one or all of the technologies. The second case where the analysis of variance was used was where different wastes with common constituents were treated with the same technology. We used this statistical method to determine whether separate BDAT values should be established for each waste or whether the levels of performance were homogeneous and, therefore, amenable to a single concentration level for a given constituent.

To determine whether any or all of the treatment data sets were homogeneous using the analysis of variance method, it was necessary to compare a calculated "F value" to what is known as a "critical value." These critical values are available in most statistics texts.

Where the F value is less than the critical value, all treatment data sets are homogeneous. If the F value exceeds the critical value, it is necessary to perform a "pair wise F" test to determine if any of the sets are homogeneous. The "pair wise F" test would be done for all of the various combinations of data sets using the same method and equation as the general F test.

The F value is calculated as follows:

(1) All data points are logtransformed.

(2) The sum of the logtransformed data points (Ti) is computed for each data set.

(3) The statistical parameter known as the sum of the squares between data sets (SSB) is computed:

$$SSB = \sum_{i=1}^{k} \frac{T_i 2}{n_i} - \frac{T^2}{N}$$

where,

k = number of treatment technologies
n_i = number of data points for technology i
N = number of data points for all technologies
T = sum of logtransformed data points for all technologies

(4) The sum of the squares within data sets (SSW) is computed.

$$SSW = \sum_{i=1}^{k} \sum_{j=1}^{n_i} y_{i,j}^2 - \sum_{i=1}^{k} \frac{T_i^2}{n_i}$$

where,

$y_{i,j}$ = the logtransformed observation (j) for treatment technology (i)

(5) The degrees of freedom corresponding to SSB and SSW are calculated. For SSB, the number of degrees of freedom is given by k-1. For SSW, the number of degrees of freedom is given by N-k.

(6) Using the above parameters, the F value is calculated as follows:

$$F = \frac{MSB}{MSW}$$

where,

$$MSB = SSB/(k-1) \text{ and}$$
$$MSW = SSW/(N-k).$$

A computational table summarizing the above parameters is shown below.

COMPUTATIONAL TABLE FOR THE F VALUE

Source	Sum of Squares	Degrees of Freedom	Mean Square	F
Between	SSB	k-1	$MSB = \frac{SSB}{k-1}$	$\frac{MSB}{MSW}$
Within	SSW	N-k	$MSW = \frac{SSW}{N-k}$	

5.5 Development of BDAT Treatment Standards for Wastewaters Containing F001-F005 Spent Solvent Wastes

BDAT treatment standards for F001-F005 spent solvent wastes in wastewater are presented in Table 5-2. Descriptions of how the treatment standards were derived are presented in this section. Treatment performance data for each constituent are also presented in this section. Complete data sets including all constituents and pollutant parameters analyzed in the wastes treated at each plant are included in Appendix I. Where wastewater treatment data were not available to the Agency, data on which the treatment standards were based were transferred from other spent solvent wastes for which data were available. The basis for transfer of treatment standards for wastewaters is presented in Section 5.5.1, page 5-14.

The derivation of BDAT treatment standards includes a variability analysis as discussed in Section 5.4. For some data sets, data were insufficient to develop variability factors; in these cases the Agency used a variability factor that represented the average of the variability factors from available data sets. Calculation of the average variability factors is discussed in Section 5.5.2.

In some cases, the treatment standard derived from the data was below the EPA published analytical quantification level for a specific constituent because of the lower quantification levels associated with the treatment residuals actually tested. In these instances, the BDAT treatment standard was set at the published quantification level, which is the lowest level at which EPA can support analytical quantification over the range of wastes that will be subject to this rule.

Table 5-2

BDAT TREATMENT STANDARDS
(As Concentrations in the Treatment Residual Extract)

Constituent	Wastewaters Containing Spent Solvents (mg/L)	Non-Wastewater Spent Solent Wastes (mg/L)
Acetone	0.05	0.59
n-Butyl alcohol	5.0	5.0
Carbon disulfide	1.05	4.81
Carbon tetrachloride	0.05	0.96
Chlorobenzene	0.15	0.05
Cresols (cresylic acid)	2.82	0.75
Cyclohexanone	0.125	0.75
1,2-Dichlorobenzene	0.65	0.125
Ethyl acetate	0.05	0.75
Ethylbenzene	0.05	0.053
Ethyl ether	0.05	0.75
Isobutanol	5.0	5.0
Methanol	0.25	0.75
Methylene chloride	0.20	0.96
Methylene chloride generated at pharmaceuticals plants	12.7	0.96
Methyl ethyl ketone	0.05	0.75
Methyl isobutyl ketone	0.05	0.33
Nitrobenzene	0.66	0.125
Pyridine	1.12	0.33
Tetrachloroethylene	0.079	0.05
Toluene	1.12	0.33
1,1,1-Trichloroethane	1.05	0.41
1,1,2-Trichloro-1,2,2-trifluoroethane	1.05	0.96
Trichloroethylene	0.062	0.091
Trichlorofluoromethane	0.05	0.96
Xylene	0.05	0.15

5.5.1 Transfer of Treatment Data for Wastewaters Containing F001-F005 Spent Solvent Wastes

Where wastewater treatment data on spent solvents were not available, the Agency developed treatment standards based on the treatment of wastes (e.g. process wastes) containing the constituents listed in F001-F005. We believe these wastes to be similar to F001-F005 spent solvent wastewaters. We have not identified, nor are we aware of, any constituents in the F001-F005 spent solvent wastewaters that would cause these wastes to treat differently than the broad array of wastes for which we have data. EPA's data base for wastewaters includes wastes generated in the manufacture of over 200 products at over 30 different facilities.

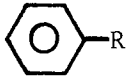
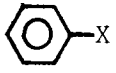
Where wastewater treatment data on a particular spent solvent waste or constituent were not available to the Agency, treatment data were transferred from other constituents for which data were available. For this rulemaking, treatment data were transferred based on similarity of chemical structure with the exception of carbon disulfide which is structurally dissimilar to the other listed F001-F005 hazardous wastes.

EPA's data transfer criteria represents a change from proposal. At proposal, the Agency relied primarily on the physical parameters of solubility and Henry's Law Constants. Solubility was used to predict the effectiveness of biological treatment; where biological treatment was the technology basis, the treatment standard was set at the level of detection. Henry's Law constants were used to predict the effectiveness of steam stripping.

Commenters stated that the Agency should base the transfer of data on average characteristics of wastes in a relatively large and diverse grouping. In consideration of the comments received, the Agency believes that, for the wide range of wastes covered for this particular rulemaking, a broader approach to transfer of data is warranted. Accordingly, in the final rule, we are using chemical structure as the basis for transfer of data. The Agency believes that chemical structure allows the consideration of a broader array of physical and chemical factors affecting treatment, while at the same time relating the transfer rationale to an indicator that is commonly used to predict how organic compounds will react with other compounds and under various conditions. Included in Table 5-3 are the structural groups upon which the transfer of treatment standards for wastewaters was based. One F001-F005 spent solvent constituent, carbon disulfide, was determined not to be

Table 5-3

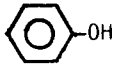
GROUPING OF SPENT SOLVENT CONSTITUENTS FOR TRANSFER OF BDAT WASTEWATER TREATMENT DATA

Name of Structural Group	Functional Group	Constituent	Treatment Value (mg/L)	Technology[b]	Constituent From Which Data Were Transferred
Halogenated Aliphatics	R-X	Carbon tetrachloride	0.05[c]	B	
		Methylene chloride			
		Pharmaceuticals Wastewater	12.7	SS	
		All Other Wastewaters	0.20	B	
		1,1,1-Trichloroethane	1.05	SS	
		1,1,2-Trichloro-1,2,2-trifluoroethane	1.05[a]	SS	1,1,1-Trichloroethane
		Trichlorofluoromethane	0.05[c]	B[d]	
Non-halogenated Aromatics		Ethylbenzene	0.05[c]	B	
		Toluene	1.12	B&AC	
		Xylene	0.05[c]	AC	
		Nitrobenzene	0.66	SS&AC	
		Pyridine	1.12[a]	B&AC	Toluene
Halogenated Alkenes	R=R'	Tetrachloroethylene	0.079	B	
		Trichloroethylene	0.062	B&AC	
Halogenated Aromatics		Chlorobenzene	0.15	B&AC	
		1,2-Dichlorobenzene	0.65	B&AC	
Ketones	R-C-R' ‖ O	Acetone	0.05[a,c]	SS	Methyl Isobutyl Ketone
		Cyclohexanone	0.125[a,c]	SS	Methyl Isobutyl Ketone
		Methyl ethyl ketone	0.05[a,c]	SS	Methyl Isobutyl Ketone
		Methyl isobutyl ketone	0.05[c]	SS	Methyl Isobutyl Ketone
Alcohols	R-OH	n-Butyl alcohol	5.0[a,c]	SS	Methyl Isobutyl Ketone
		Isobutanol	5.0[a,c]	SS	Methyl Isobutyl Ketone
		Methanol	0.25[a,c]	SS	Methyl Isobutyl Ketone

[a]Transferred treatment data.
[b]Treatment Technologies: B = Biological; SS = Steam Stripping; AC = Activated Carbon.
[c]Treatment standard shown is the quantification level for the constituent.
[d]Commercially available patented PACT® process.

Table 5-3 (Continued)

GROUPING OF SPENT SOLVENT CONSTITUENTS FOR TRANSFER OF BDAT WASTEWATER TREATMENT DATA

Name of Structural Group	Functional Group	Constituent	Treatment Value (mg/L)	Technology[b]	Constituent From Which Data Were Transferred
Ethers	R-O-R'	Ethyl ether	0.05[a,c]	SS	Methyl Isobutyl Ketone
Esters	R-C-OR' (O)	Ethyl acetate	0.05[a,c]	SS	Methyl Isobutyl Ketone
Phenols		Cresols	2.82	AC	
Organic Sulfur Compounds	R = S	Carbon disulfide	1.05[a]	SS	1,1,1-Trichloroethane

[a]Transferred treatment standards.
[b]Treatment Technologies: B = Biological; SS = Steam Stripping; AC = Activated Carbon.
[c]Treatment standard shown is the Quantification Level for the constituent.

structurally similar to any other F001-F005 constituents. For this reason, transfer of treatment data could not be based on chemical structure. However, carbon disulfide does have a large Henry's Law Constant, 1.2×10^{-2} atm m^3/mole (Reference 1), indicating that carbon disulfide is amenable to steam stripping. Henry's Law Constant was therefore used as the basis for transferring treatment data to carbon disulfide.

To best account for the range of physical and chemical properties within a structural group that affect treatment by a specific technology, the Agency transferred data from the compound with the least stringent treatment standard for any member of that structural group. If no treatment data were available for any member of the particular structural group, data representing the least stringent treatment standard from the next most similar structural group were transferred. For example, no treatment data were available for any member of the alcohols, esters, and ethers structural groups. The ketones were considered to be the next most similar structural group, based on the oxygen containing, electron-releasing functional groups present in all four structural groups. Therefore, data representing the least stringent treatment standard for constituents in the ketones group were transferred to the alcohols, ethers, and esters groups.

5.5.2 Derivation of Average Variability Factors for Wastewater Treatment

The derivation of BDAT treatment standards includes a variability analysis as discussed in Section 5.4.1. For some data sets, data were insufficient to develop variability factors; in these cases the Agency used a variability factor that represented the average of the variability factors from available data sets. Calculation of the average variability factors is shown in Table 5-4, page 5-18.

Table 5-4

VARIABILITY FACTORS FOR ALL FULL-SCALE WASTEWATER TREATMENT DATA SETS USED IN THE DERIVATION OF THE BDAT TREATMENT STANDARDS

BIOLOGICAL TREATMENT

Constituent	Plant	Variability Factor
1,2-Dichlorobenzene	202	2.11
Methylene Chloride	265	7.58
Tetrachloroethylene	225	3.65
Toluene	234	1.87
	257	1.89
	286	3.25
	AVERAGE	3.39

BIOLOGICAL TREATMENT FOLLOWED BY ACTIVATED CARBON

Constituent	Plant	Variability Factor
Chlorobenzene	246	4.93
1,2-Dichlorobenzene	246	3.68
Toluene	246	9.89
	AVERAGE	6.17

STEAM STRIPPING

Constituent	Plant	Variability Factor
Methylene Chloride	12003	3.76
Toluene	246	1.21
Trichloroethylene	284	1.81
	AVERAGE	2.26

STEAM STRIPPING FOLLOWED BY ACTIVATED CARBON

Constituent	Plant	Variability Factor
Nitrobenzene	297	2.65
Toluene	297	1.55
	AVERAGE	2.10

Average variability factor for all BDAT wastewater treatment = 3.56.

Table 5-4 (Continued)

VARIABILITY FACTORS FOR ALL FULL-SCALE WASTEWATER TREATMENT DATA SETS USED IN THE DERIVATION OF THE BDAT TREATMENT STANDARDS

ACTIVATED CARBON ADSORPTION* TREATMENT

Constituent	Plant	Variability Factor
Chlorobenzene	246	4.93
1,2-Dichlorobenzene	246	3.68
Toluene	246	9.89
Nitrobenzene	297	2.65
Toluene	297	1.55
	AVERAGE	4.54

*Includes data sets for biological treatment followed by activated carbon adsorption and steam stripping followed by activated carbon adsorption.

5.5.3 Acetone Wastewaters

The Agency has no data for wastewater treatment for the removal of acetone. For reasons presented in Section 5.5.1, EPA used chemical structure as the basis for transferring treatment data to acetone spent solvent wastewaters. Specifically, we transferred the treatment data from methyl isobutyl ketone because, like acetone, methyl isobutyl ketone contains the ketone functional group. Methyl isobutyl ketone was the only constituent for which we had data in the ketones structural group. Using performance data from methyl isobutyl ketone, the BDAT treatment standard for acetone is 0.05 mg/L. The technology basis for this treatment is steam stripping.

We believe the BDAT treatment standard for acetone spent solvent wastewaters represents substantial treatment. We would expect untreated acetone wastes to be similar to untreated methyl isobutyl ketone wastes, from which we transferred treatment data, since they are used in some of the same manufacturing processes as shown in Section 2 of this document. As discussed on page 5-73, in reference to methyl isobutyl ketone, we believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing acetone and substantially reduce the likelihood of migration of acetone from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for acetone was the same as the standard at promulgation although the derivation of the treatment standard has changed because of the change in the approach to data transfer. (See Section 5.5.1 for a more detailed discussion of the methodology for data transfer.)]

5.5.4 n-Butyl Alcohol Wastewaters

The Agency has no data for wastewater treatment for the removal of n-butyl alcohol. For reasons presented in Section 5.5.1, EPA used chemical structure as the basis for transferring treatment data to n-butyl alcohol spent solvent wastewaters. Specifically, we transferred the treatment data from methyl isobutyl ketone, which contains the ketone functional group, to n-butyl alcohol, which contains the hydroxyl functional group. The alcohols structural group is most structurally similar to the ketones group based upon their oxygen containing, electron-releasing functional groups. Methyl isobutyl ketone was the only constituent for which we had data in the ketones structural group. Using performance data from methyl isobutyl ketone, the transferred BDAT treatment standard for n-butyl alcohol is 0.05 mg/L. This transferred standard is below the quantification level and could not be used as the treatment standard; therefore, the BDAT treatment standard was set at the quantification level of 5.0 mg/L. The technology basis for this treatment standard is steam stripping.

We believe the BDAT treatment standard for n-butyl alcohol spent solvent wastewaters represents substantial treatment. We would expect untreated n-butyl alcohol wastes to be similar to untreated methyl isobutyl ketone wastes, from which we transferred treatment data, since they are used in some of the same manufacturing processes, as shown in Section 2 of this document. As discussed on page 5-73, in reference to methyl isobutyl ketone, we believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing n-butyl alcohol and substantially reduce the likelihood of migration of n-butyl alcohol from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for n-butyl alcohol was estimated at the detection limit of <0.100 mg/L based on biological treatment (see Table 13, 51 FR 1725). The principal difference between the proposed and promulgated treatment standards is EPA's consideration of quantification levels in setting the standard (see the discussion on the use of quantification levels in Section 5.5 on page 5-12). To a lesser extent, the Agency's change in the criteria for data transfer affected the treatment standard. (See Section 5.5.1, page 5-14, for a discussion of the Agency's methodology for data transfer.)]

5.5.5 Carbon Disulfide Wastewaters

The Agency has no data for wastewater treatment for the removal of carbon disulfide. For reasons presented in Section 5.5.1, in most cases EPA used chemical structure as the basis for transferring performance data where data are unavailable. However, carbon disulfide is structurally dissimilar to the other listed F001-F005 hazardous wastes. Therefore, transfer of treatment data could not be based on chemical structure.

Carbon disulfide has a large Henry's Law Constant, 1.2×10^{-2} atm m^3/mole (Reference 1), indicating that carbon disulfide is amenable to steam stripping. Therefore, the data used to determine the treatment standard were transferred from the constituent with the closest Henry's Law Constant and for which BDAT was based on steam stripping. The data on which the treatment standard for 1,1,1-trichloroethane was based, 1.05 mg/L, were transferred to carbon disulfide.

We believe the BDAT treatment standard for carbon disulfide spent solvent wastewaters represents substantial treatment. We would expect untreated carbon disulfide wastes to be similar to untreated 1,1,1-trichloroethane wastes from which we transferred treatment data. As discussed on page 5-110, in reference to 1,1,1-trichloroethane, we believe these constituent reductions to substantially diminish the toxicity of the spent solvent wastes containing carbon disulfide and substantially reduce the likelihood of migration of carbon disulfide from spent solvent wastes.

[A technology-based BDAT treatment standard was not developed for carbon disulfide wastewaters at proposal. The promulgated treatment standard was based on data transferred from treatment of 1,1,1-trichloroethane. (See Section 5.5.1, page 5-14 for a discussion of the Agency's methodology for data transfer.)]

5.5.6 Carbon Tetrachloride Wastewaters

The Agency has biological treatment data for carbon tetrachloride at plant 225 in the OCPSF data base. The Agency also has data from full-scale biological treatment of wastewater from organic chemicals manufacturing (commercially available patented PACT® process, Reference 4). The data are summarized in Table 5-5 and calculation of the BDAT treatment standard is shown in Table 5-6.

The following steps were taken to derive the BDAT treatment standard for carbon tetrachloride:

1. We evaluated each data set to determine whether any of the data represent poor design or operation of the treatment systems. The available data and information did not show any of the data to represent poor design and operation. Accordingly, none of the data were deleted on this basis.

2. We calculated the arithmetic average treatment concentration and the variability factor for each data set as shown in Table 5-6. Process variability could not be calculated for biological treatment by the PACT® process because there is only one data pair available from this process. Therefore, the average variability factor for BDAT biological treatment, 3.39, was used (calculation of the average variability factor is shown in Table 5-4, page 5-18).

   Process variability could not be calculated for biological treatment at plant 225 because all effluent values were reported as less than or equal to the detection limit of 10 ug/L. We would expect some variability in the data because the actual concentrations would range from 0 to the detection limit of 10 ug/L. To estimate the variability, the Agency used the average variability factor for BDAT biological treatment, 3.39. (Calculation of the average variability factor is shown in Table 5-4, page 5-18.)

3. The analysis of variance method was not used to compare different treatments of the same waste because data are available for only one type of treatment for each waste.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-6 could be associated with separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all

sources of wastewaters containing carbon tetrachloride spent solvents. The least stringent treatment level within the treatability subgroup was selected for BDAT (0.034 mg/L from plant 206) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. This calculated concentration level is below the quantification level and could not be used as the treatment standard; therefore, the treatment standard was set at the quantification level of 0.05 mg/L. The technology basis was biological treatment.

5. The BDAT treatment standard for carbon tetrachloride represents treatment of a variety of waste matrices generated by process streams from the manufacture of at least seven different products. The untreated waste concentration of carbon tetrachloride ranged from 0.050 mg/L to 44 mg/L in these waste matrices. All of these wastes can be treated to the BDAT treatment standard or below (0.050 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing carbon tetrachloride and substantially reduce the likelihood of migration of carbon tetrachloride from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for carbon tetrachloride was <0.010 mg/L based on biological treatment (see Table 13, 51 FR 1725). The difference between the proposed and promulgated treatment standards is primarily due to EPA's consideration of quantification levels in setting the promulgated standard (see the discussion on the use of quantification levels in Section 5.5, page 5-12) and the incorporation of a variability factor in derivation of the promulgated treatment standard. (See Section 5.4 for a discussion of the variability factor.) The changes in data editing also contributed to the change in the treatment standard (data editing rules are presented in Section 5.3).]

Table 5-5

TREATMENT PERFORMANCE DATA FOR CARBON TETRACHLORIDE

Plant 225 Biological Treatment[a]		Plant 225 Products Manufactured
Influent (ug/L)	Effluent (ug/L)	
		Polyvinyl chloride
		Perchloroethylene
1,890	10	Chlorinated paraffins
543	10	Chlorine
411	10	Hydrogen chloride
942	10	Sodium methylate
1,730	10	
1,054	10	
1,676	10	
1,813	10	
874	10	
832	10	
896	10	
842	10	
2,306	10	
1,340	10	
51	10	
210	10[b]	
44,000	10[b]	

D.G. Hutton, 1979 Biological Treatment[a,c]		Description of Waste Treated
Influent (ug/L)	Effluent (ug/L)	
95	5.5	Wastewater from organic chemicals manufacturing.

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

[b]In the data base from which this data was taken, the sampling data was designated using a different code, plant 227, because it represented a different sampling episode.

[c]Commercially available patented PACT® process.

Table 5-6

CALCULATION OF BDAT FOR CARBON TETRACHLORIDE

Plant No.	Technology	Average Treatment Concentration (ug/L)	Variability Factor	Treatment Concentration Level Avg. x VF (ug/L)
225	Biological	10	3.39[a]	34
1[b]	Biological	5.5	3.39[a]	19

[a]Average variability factor of all BDAT biological treatment data (see Table 5-4 and the discussion on page 5-17).

[b]Commercially available patented PACT® process.

5.5.7 Chlorobenzene Wastewaters

The Agency has biological treatment data for chlorobenzene at plants 202, 206, 246, and 263 in the OCPSF data base. Also available from the OCPSF data base are data for biological treatment followed by activated carbon adsorption at plant 246. The Agency also has data from full-scale biological treatment of wastewater from organic chemicals manufacturing (commercially available patented PACT® process, Reference 4). The data are summarized in Table 5-7 and calculation of the BDAT treatment standard is shown in Table 5-8.

The following steps were taken to derive the BDAT treatment standard for chlorobenzene:

1. We evaluated each data set to determine whether any of the data represent poor design or operation of the treatment systems. Data for biological treatment at plant 263 (consisting of three data points) were deleted on the basis of poor design and performance. Based on the disproportionately low removals relative to other biological treatment systems for wastes containing chlorobenzene, EPA judged this system to be poorly designed and operated. This system achieved a reduction of only 15.5 percent as compared with 85 to 99 percent for other biological systems treating wastes containing chlorobenzene.

   Data for biological treatment at plant 206 were deleted because the treatment system at this plant was shown to be poorly designed and/or operated based on the wide variation in influent concentrations. The nature of biological treatment systems requires sufficient control of influent concentrations through the use of equalization to prevent "shock loading" of the biomass.

2. We calculated the arithmetic average treatment concentration and the variability factor for each data set as shown in Table 5-8. Process variability could not be calculated for biological treatment by the PACT® process because there is only one data pair available from this process. Therefore, the average variability factor for BDAT biological treatment, 3.39, was used. (Calculation of the average variability factor is shown in Table 5-4, page 5-18.)

   Process variability could not be calculated for biological treatment at plant 202 because all effluent values were reported as less than or equal to the detection limit of 10 ug/L. We would expect some variability in the data because the actual concentrations would range from 0 to the detection limit of 10

ug/L. To estimate the variability, the Agency used the average variability factor for BDAT biological treatment, 3.39. (Calculation of the average variability factor is shown in Table 5-4, page 5-18.)

3. Biological treatment and biological treatment followed by activated carbon adsorption of chlorobenzene at plant 246 were compared with the analysis of variance method to determine whether the performance of one technology was significantly better than the other for treatment of the same waste. It was shown that the addition of activated carbon adsorption to biological treatment significantly improved treatment performance. Therefore, the treatment concentration level for plant 246 is 149 ug/L based upon biological treatment followed by activated carbon adsorption. (Refer to the statistical calculations and results in Table II-1, Appendix II.) The analysis of variance method could not be used to compare treatments on any other wastes because data were not available for more than one treatment for other wastes.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-8 could be associated with separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastewaters containing chlorobenzene spent solvents. The least stringent treatment level within the treatability subgroup was selected for BDAT (0.15 mg/L from plant 246) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. The technology basis was biological treatment followed by activated carbon adsorption.

5. The BDAT treatment standard for chlorobenzene represents treatment of a variety of waste matrices generated by process streams from the manufacture of 31 or more different products. The untreated waste concentration of chlorobenzene ranged from 0.010 mg/L to 7.2 mg/L in these waste matrices. All of these wastes can be treated to a level of 0.15 mg/L or below; in all cases we were able to treat to the BDAT treatment standard. We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing chlorobenzene and substantially reduce the likelihood of migration of chlorobenzene from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for chlorobenzene was 0.062 mg/L based on biological treatment followed by activated carbon adsorption (see Table 13, 51 FR 1725). The difference between the proposed and promulgated treatment standards is primarily due to the incorporation of a variability factor in derivation of the promulgated treatment standard. (See Section 5.4 for a discussion of the variability factor.) Other less significant factors affecting the change in the treatment standard are the changes in data editing (data editing rules are presented in Section 5.3), and deletion of some of the data points used at proposal because they represented poor operation of the treatment systems at the time of sampling.]

Table 5-7

TREATMENT PERFORMANCE DATA FOR CHLOROBENZENE

Plant 202 Biological Treatment[a]		Plant 202
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Disperse dye coupler
		Disperse dyes
135	10	Naphthalene sulfonic acid
160	10	Organic pigments
140	10	p-Phenylene diamine
99	10	Sulfur dyes
79	10	Vat dyes
284	10	Xylenesulfonic acid, sodium salt
404	10	
429	10	2-Bromo-4,6-dinitroaniline
361	10	2,4-Dinitroaniline
401	10	2,4-Dinitrochlorobenzene
163	10	2,4-Dinitrophenol
152	10	2,4,6-Trinitrophenol
161	10	4-Chloro-2,6-dinitrobenzene sulfonic acid, potassium salt
188	10	
304	10	
225	10	
302	10	
214	10	
159	10	
116	10	

Plant 206 Biological Treatment[a]		Plant 206
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		3,3-Dichlorobenzidine
		Polyurethane resins
9,206	1,083	Orthochloroaniline
16,646	710	Benzophenone
49,775	460	2-Sulfophthalic acid
1,414	2,781	2,6-Dichloronitroaniline
14,731	142	
3,159	603	
6,756	153	
929	794	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-7 (Continued)

TREATMENT PERFORMANCE DATA FOR CHLOROBENZENE

Plant 246 Biological Treatment[a]		Plant 246
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Aniline
		Dinitrotoluene (mixed)
343	115	Methylene diphenyl diisocyanate
19	36	Nitrobenzene
729	44	Polymeric methylene diphenyl diisocyanate
856	151	
10	19	Polyoxypropylene glycol
1,564	111	Toluene diamine (mixture)
10	229	Toluene diisocyanates (mixture)
10	233	Polymeric methylene dianiline
1,258	298	Polyurethane resins
355	10	
287	38	
409	14	
3,040	17	

Plant 246 Biological Treatment[a] Followed by Activated Carbon Adsorption		Plant 246
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Same as Plant 246 - Biological Treatment
343	21	
19	10	
729	10	
856	10	
10	19	
1,564	33	
10	30	
10	56	
836	68	
1,258	10	
287	10	
409	10	
3,040	10	
7,200	80[b]	
6,500	70[b]	
6,075	35[b]	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

[b]In the data base from which this data was taken, the sampling data was designated using a different code, plant 219, because it represented a different sampling episode.

Table 5-7 (Continued)

TREATMENT PERFORMANCE DATA FOR CHLOROBENZENE

Plant 263 Biological Treatment[a]		Plant 263 Products Manufactured
Influent (ug/L)	Effluent (ug/L)	
515	788	Methylene diphenyl diisocyanate
832	404	Polymeric methylene diphenyl diisocyanate
443	320	Polyurethane resins
		Polyurethane component
		Polyurethane prepolymer
		Propoxylates, alkylamines

D.G. Hutton, 1979 Biological Treatment[a,b]		Description of Waste Treated
Influent (ug/L)	Effluent (ug/L)	
1,900	12	Wastewater from organic chemicals manufacturing.

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).
[b]Commercially available patented PACT® process.

Table 5-8

CALCULATION OF BDAT FOR CHLOROBENZENE

Plant No.	Technology	Average Treatment Concentration (ug/L)	Variability Factor	Treatment Concentration Level Avg. x VF (ug/L)
202	Biological	10	3.39[a]	34
246	Biological	101	8.96	906
246	Biological followed by Activated Carbon	30	4.93	149
1[b]	Biological	12	3.39[a]	41

[a]Average variability factor of all BDAT biological treatment data (see Table 5-4 and the discussion on page 5-17).
[b]Commercially available patented PACT® process.

5.5.8 Cresols (Cresylic Acid) Wastewaters

The Agency has full-scale granular activated carbon adsorption data for cresols (cresylic acid) (References 3 and 12). The Agency also has biological treatment data (Reference 5). The data are summarized in Table 5-9.

The following steps were taken to derive the BDAT treatment standard for cresols (cresylic acid):

1. We evaluated each data set to determine whether any of the data represent poor design or operation of the treatment systems. The available data and information did not show any of the data to represent poor design and operation. Accordingly, none of the data were deleted on this basis.

   The biological treatment data set shown in Table 5-9 was deleted because the data were considered unreliable for use in developing treatment standards. The confidence of identification of the compounds present in the samples is questionable since the identifications were reported as "tentative." One activated carbon data set (Baker, et. al.) was deleted because the influent and effluent concentrations were not reported individually, but in ranges. The average effluent concentration and treatment concentration level could not be determined from the data.

2. We calculated the arithmetic average treatment concentration level and the variability factor for the data set. Process variability could not be calculated for activated carbon adsorption because there is only one data pair available from this process. Therefore, the average variability factor for BDAT activated carbon adsorption, 4.54, was used (calculation of the average variability factor is shown in Table 5-4, page 5-19).

3. The analysis of variance method was not used to compare different treatments of the same waste because data are available for only one type of treatment for each waste.

4. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastewaters containing cresols (cresylic acid) spent solvents. The treatment level within the treatability subgroup was selected for BDAT (2.82 mg/L from Torpy, Raphaelian, and Luthy, 1981) by multiplying the process effluent concentration, 0.620 mg/L, by the average variability factor for BDAT activated carbon adsorption, 4.54. The technology basis was activated carbon treatment.

5. The BDAT treatment standard for cresols (cresylic acid) represents treatment of a waste matrix generated by a process stream from the manufacture of pesticides. The untreated waste concentration of cresols (cresylic acid) was as high as 16.5 mg/L in this waste matrix. This waste was treated to a concentration below the BDAT treatment standard (2.82 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing cresols (cresylic acid) and substantially reduce the likelihood of migration of cresols (cresylic acid) from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for cresols (cresylic acid) was estimated at the detection limit of <0.100 mg/L based on biological treatment (see Table 13, 51 FR 1725). The principal difference between the proposed and promulgated treatment standards is EPA's use of performance data for activated carbon adsorption treatment of cresols and the incorporation of a variability factor in derivation of the promulgated treatment standard. (See Section 5.4 for a discussion of the variability factor.)]

Table 5-9

TREATMENT PERFORMANCE DATA FOR CRESOLS (CRESYLIC ACID)

IT Enviroscience, 1983 Full-Scale Granular Activated Carbon		Description of Waste Treated
Influent (ug/L)	Effluent (ug/L)	
16,500	620[a]	Pesticide wastewater

Torpy, Raphaelian & Luthy, 1981 Biological Treatment[b]		Description of Waste Treated
Influent (ug/L)	Effluent (ug/L)	
1,886	15.3[c]	Wastewater from the synfuels industry
2,536	36.8[c]	

Baker et. al., 1973 Full-Scale Granular Activated Carbon		Description of Waste Treated
Influent (ug/L)	Effluent (ug/L)	
3,500,000-6,500,000	0-7,000,000[d]	Cresol wastewater

[a]Reference did not specifically identify constituent as o-, m-, or p-cresol.
[b]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).
[c]o-Cresol.
[d]p-Cresol.

5.5.9 Cyclohexanone Wastewaters

The Agency has no data for wastewater treatment for the removal of cyclohexanone. For reasons presented in Section 5.5.1, EPA used chemical structure as the basis for transferring treatment data to cyclohexanone spent solvent wastewaters. Specifically, we transferred the treatment data from methyl isobutyl ketone because, like cyclohexanone, methyl isobutyl ketone contains the ketone functional group. Methyl isobutyl ketone was the only constituent for which we had data in the ketones structural group. Using performance data from methyl isobutyl ketone, the transferred standard for cyclohexanone is 0.05 mg/L. The standard derived from the transferred data is below the quantification level and could not be used as the treatment standard. Therefore, the BDAT treatment standard was set at the quantification level of 0.125 mg/L. The technology basis for this treatment standard is steam stripping.

We believe the BDAT treatment standard for cyclohexanone spent solvent wastewaters represents substantial treatment. We would expect untreated cyclohexanone wastes to be similar to untreated methyl isobutyl ketone wastes, from which we transferred treatment data, since they are used in some of the same manufacturing processes, as shown in Section 2 of this document. As discussed on page 5-73, in reference to methyl isobutyl ketone, we believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing cyclohexanone and substantially reduce the likelihood of migration of cyclohexanone from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for cyclohexanone was estimated at the detection limit of <0.100 mg/L based on biological treatment (see Table 13, 51 FR 1725). The principal difference between the proposed and promulgated treatment standards is EPA's consideration of quantification levels in setting the standard (see the discussion on the use of quantification levels in Section 5.5 on page 5-12). To a lesser extent, the Agency's change in the criteria for data transfer affected the treatment standard. (See Section 5.5.1, page 5-14, for a discussion of the Agency's methodology for data transfer.)]

5.5.10 1,2-Dichlorobenzene Wastewaters

The Agency has biological treatment data for 1,2-dichlorobenzene at plants 202, 206, and 246 in the OCPSF data base. The Agency also has data for biological treatment followed by activated carbon adsorption at plant 246 in the OCPSF data base. The data are summarized in Table 5-10 and calculation of the BDAT treatment standard is shown in Table 5-11.

The following steps were taken to derive the BDAT treatment standard for 1,2-dichlorobenzene:

1. We evaluated each data set to determine whether any of the data represent poor design or operation of the treatment systems. In EPA's judgment, one data point in the data set for biological treatment at plant 246 represented poor design and operation. We confirmed this judgment using the the outlier test (refer to Table II-3, Appendix II). The outlying data point was deleted.

2. We calculated the arithmetic average treatment concentration and the variability factor for each data set as shown in Table 5-11.

3. Biological treatment and biological treatment followed by activated carbon adsorption of 1,2-dichlorobenzene at plant 246 were compared with the analysis of variance method to determine whether the performance of one technology was significantly better than the other for treatment of the same waste. It was shown that the addition of activated carbon adsorption to biological treatment significantly improved treatment performance. Therefore, the treatment concentration level for plant 246 is 0.65 mg/L based upon biological treatment followed by activated carbon adsorption. (Refer to the statistical calculations and results in Appendix II.) The analysis of variance method could not be used to compare treatments on any other wastes because data were not available for more than one treatment for other wastes.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-11 could be associated with separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastewaters containing 1,2-dichlorobenzene spent solvents. The least stringent treatment level within the treatability subgroup was selected for BDAT (0.65 mg/L from plant 246) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. The technology basis was biological treatment followed by activated carbon adsorption.

5. The BDAT treatment standard for 1,2-dichlorobenzene represents treatment of a variety of waste matrices generated by process streams from the manufacture of 30 different products. The untreated waste concentration of 1,2-dichlorobenzene ranged from 0.233 mg/L to 4.4 mg/L in these waste matrices. All of these wastes were treated to the BDAT treatment standard or below (0.65 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing 1,2-dichlorobenzene and substantially reduce the likelihood of migration of 1,2-dichlorobenzene from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for 1,2-dichlorobenzene was 0.053 mg/L based on biological treatment followed by activated carbon adsorption (see Table 13, 51 FR 1725). The difference between the proposed and promulgated treatment standards is primarily due to the incorporation of a variability factor in derivation of the promulgated treatment standard. Other less significant factors affecting the change in the treatment standard are the changes in data editing (data editing rules are presented in Section 5.3) and deletion of some data points used at proposal because they represented poor operation of the treatment systems (see the discussion of the outlier analysis in Section 5.4).]

Table 5-10

TREATMENT PERFORMANCE DATA FOR 1,2-DICHLOROBENZENE

Plant 202 Biological Treatment[a]		Plant 202
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Disperse dye coupler
		Disperse dyes
1,350	21	Naphthalene sulfonic acid
1,554	20	Organic pigments
4,387	15	p-Phenylene diamine
2,444	10	Sulfur dyes
		Vat dyes
		Xylenesulfonic acid, sodium salt
		2-Bromo-4,6-dinitroaniline
		2,4-Dinitroaniline
		2,4-Dinitrochlorobenzene
		2,4-Dinitrophenol
		2,4,6-Trinitrophenol
		4-Chloro-2,6-dinitrobenzene sulfonic acid, potassium salt

Plant 206 Biological Treatment[a]		Plant 206
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		3,3-Dichlorobenzidine
		Polyurethane resins
806	125	Orthochloroaniline
437	175	Benzophenone
396	121	2-Sulfophthalic acid
381	89	2,6-Dichloronitroaniline
233	77	
2,333	55	
649	63	
1,247	61	
555	72	
847	44	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-10 (Continued)

TREATMENT PERFORMANCE DATA FOR 1,2-DICHLOROBENZENE

Plant 246 Biological Treatment[a]		Plant 246
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Aniline
		Dinitrotoluene (mixed)
2,081	1,153[b]	Methylene diphenyl diisocyanate
820	681	Nitrobenzene
914	830	Polymeric methylene diphenyl diisocyanate
1,558	612	
2,801	516	Polyoxypropylene glycol
1,620	529	Toluene diamine (mixture)
1,198	626	Toluene diisocyanates (mixture)
1,182	603	Polymeric methylene dianiline
1,338	506	Polyurethane resins
1,157	449	
1,412	470	
768	394	
1,894	512	
1,243	468	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

[b]In EPA's judgment, this data point represented poor design and operation. We confirmed this judgment using the outlier test (refer to Table II-3, Appendix II) and this data point was deleted.

Table 5-10 (Continued)

TREATMENT PERFORMANCE DATA FOR 1,2-DICHLOROBENZENE

Plant 246 Biological Treatment[a] Followed by Activated Carbon Adsorption		Plant 246
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Aniline
		Dinitrotoluene (mixed)
		Methylene diphenyl diisocyanate
2,081	368	Nitrobenzene
820	481	Polymeric methylene diphenyl diisocyanate
914	126	
1,558	225	Polyoxypropylene glycol
2,801	157	Toluene diamine (mixture)
1,620	158	Toluene diisocyanates (mixture)
1,198	177	Polymeric methylene dianiline
1,182	186	Polyurethane resins
1,338	191	
1,157	178	
1,412	158	
768	136	
1,894	150	
1,243	149	
3,000	50[b]	
2,187	72[b]	
3,275	35[b]	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

[b]In the data base from which this data was taken, the sampling data was designated using a different code, plant 219, because it represented a different sampling episode.

Table 5-11

CALCULATION OF BDAT FOR 1,2-DICHLOROBENZENE

Plant No.	Technology	Average Treatment Concentration (ug/L)	Variability Factor	Treatment Concentration Level Avg. x VF (ug/L)
202	Biological	16.5	2.11	35
206	Biological	88.2	2.48	219
246	Biological	554	1.56	862
246	Biological followed by Activated Carbon	176	3.68	648

5.5.11 Ethyl Acetate Wastewaters

The Agency has no data for wastewater treatment for the removal of ethyl acetate. For reasons presented in Section 5.5.1, EPA used chemical structure as the basis for transferring treatment data to ethyl acetate spent solvent wastewaters. Specifically, we transferred the treatment data from methyl isobutyl ketone, which contains the ketone functional group, to ethyl acetate, which contains the ester functional group. The esters structural group is most structurally similar to the ketones group based upon their oxygen containing, electron-releasing functional groups. Methyl isobutyl ketone was the only constituent for which we had data in the ketones structural group. Using performance data from methyl isobutyl ketone, the BDAT treatment standard for ethyl acetate is 0.05 mg/L. The technology basis for this treatment standard is steam stripping.

We believe the BDAT treatment standard for ethyl acetate spent solvent wastewaters represents substantial treatment. We would expect untreated ethyl acetate wastes to be similar to untreated methyl isobutyl ketone wastes, from which we transferred treatment data, since they are used in some of the same manufacturing processes, as shown in Section 2 of this document. As discussed on page 5-73, in reference to methyl isobutyl ketone, we believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing ethyl acetate and substantially reduce the likelihood of migration of ethyl acetate from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for ethyl acetate was estimated at the detection limit of <0.100 mg/L based on biological treatment (see Table 13, 51 FR 1725). The difference between the proposed and promulgated treatment standards is primarily due to the Agency's change in the criteria for data transfer. (See Section 5.5.1, page 5-14, for a discussion of the Agency's methodology for data transfer.)]

5.5.12 Ethylbenzene Wastewaters

The Agency has biological treatment data for ethylbenzene at plants 202, 211, 215, 221, 230, 234, 238, 242, 244, 251, 253, 257, 293, and 299 in the OCPSF data base. The Agency also has data from pilot-scale steam stripping and pilot-scale air stripping of solvent contaminated groundwater (Reference 2). The data are summarized in Table 5-12 and calculation of the BDAT treatment standard is shown in Table 5-13.

The following steps were taken to derive the BDAT treatment standard for ethylbenzene:

1. We evaluated each data set to determine whether any of the data represent poor design or operation of the treatment systems. The available data and information did not show any of the data to represent poor design and operation. Accordingly, none of the data were deleted on this basis.

   In consideration of the amount of full-scale data available for ethylbenzene, we believe it is appropriate to exclude data for pilot-scale air stripping and pilot-scale steam stripping.

2. We calculated the arithmetic average treatment concentration and the variability factor for each data set as shown in Table 5-13. Process variability could not be calculated for biological treatment at plants 202, 211, 215, 221, 230, 234, 238, 242, 244, 251, 253, 293, and 299 because all effluent values were reported as less than or equal to the detection limit of 10 ug/L. We would expect some variability in the data because the actual concentrations would range from 0 to the detection limit of 10 ug/L. To estimate the variability, the Agency used the average variability factor for BDAT biological treatment, 3.39. (Calculation of the average variability factor is shown in Table 5-4, page 5-18.)

3. The analysis of variance method was not used to compare different treatments of the same waste because data are available for only one type of treatment for each waste.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-13 could be associated with separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastewaters containing ethylbenzene spent solvents. The least stringent level within the treatability subgroup was

selected for BDAT (0.034 mg/L from plants 202, 211, 215, 221, 230, 234, 238, 242, 244, 251, 253, 293, and 299) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. This calculated concentration level is below the quantification level for ethylbenzene and could not be used as the treatment standard; therefore, the treatment standard was set at the quantification level of 0.05 mg/L. The technology basis was biological treatment.

5. The BDAT treatment standard for ethylbenzene represents treatment of a variety of waste matrices generated by process streams from the manufacture of at least 160 different products. The untreated waste concentration of ethylbenzene ranged from 0.010 mg/L to 80.0 mg/L in these waste matrices. All of these wastes were treated to the BDAT treatment standard or below (0.050 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing ethylbenzene and substantially reduce the likelihood of migration of ethylbenzene from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for ethylbenzene was <0.010 mg/L based on biological treatment (see Table 13, 15 FR 1725). The principal differences between the proposed and promulgated treatment standards are EPA's consideration of quantification levels in setting the standard (see the discussion on the use of quantification levels in Section 5.5 on page 5-12) and the incorporation of a variability factor in derivation of the promulgated treatment standard. Another less significant factor affecting the change in the treatment standard is the change in data editing (data editing rules are presented in Section 5.3).]

Table 5-12

TREATMENT PERFORMANCE DATA FOR ETHYLBENZENE

Plant 202 Biological Treatment[a]		Plant 202
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Disperse dye coupler
		Disperse dyes
507	10	Naphthalene sulfonic acid
512	10	Organic pigments
449	10	p-Phenylene diamine
398	10	Sulfur dyes
307	10	Vat dyes
367	10	Xylenesulfonic acid, sodium salt
390	10	
489	10	2-Bromo-4,6-dinitroaniline
546	10	2,4-Dinitroaniline
596	10	2,4-Dinitrochlorobenzene
292	10	2,4-Dinitrophenol
303	10	2,4,6-Trinitrophenol
280	10	4-Chloro-2,6-dinitrobenzene sulfonic acid, potassium salt
207	10	
171	10	
96	10	
176	10	
181	10	
146	10	
119	10	

Plant 211 Biological Treatment[a]		Plant 211
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Coal tar solvent
		Coatings
80,000	10	Cresols (mixed)
36,584	10	Ethylbenzene
43,171	10	Methyl naphthalene
17,902	10	Naphthalene
14,769	10	Pitch tar residue
12,923	10	Pyridines (tar bases)
64,154	10	2,4-Xylenol (dimethyl phenol)
		Phenol

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-12 (Continued)

TREATMENT PERFORMANCE DATA FOR ETHYLBENZENE

Plant 215 Biological Treatment[a]		Plant 215
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Benzene
		Toluene
1,150	10	Mixed xylenes
564	10	Cyclohexane
4,150	10	Isobutylene
		Propylene
		Polypropylene
		Butyl rubber
		Paraffins

Plant 221 Biological Treatment[a]		Plant 221
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Di-isodecyl phthalate ester
		Ethylene
64	10	Propylene
10	10	Isopropanol
140	10	Petroleum hydrocarbon resins
		1,3-Butadiene
		Butylenes
		Cyclopentadiene dimer
		Isobutylene
		Isoprene

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-12 (Continued)

TREATMENT PERFORMANCE DATA FOR ETHYLBENZENE

Plant 230 Biological Treatment[a]		Plant 230
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Benzene
		Ethylene
1,217	10	Hydrogen
893	10	Propylene
1,537	10	Pyrolysis gasoline
2,652	10	Polyethylene resin
3,040	10	Polypropylene
101	10	Polypropylene resin
107	10	1,3-Butadiene
483	10	Butylenes
628	10	
578	10	
521	10	
440	10	
699	10	
563	10	
389	10	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-12 (Continued)

TREATMENT PERFORMANCE DATA FOR ETHYLBENZENE

Plant 234 Biological Treatment[a]		Plant 234
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Acetic acid
		Acetic anhydride
168	10	Acetone
390	10	Acetaldehyde
108	10	Propionic acid
200	10	PET resins/fibers
157	10	Acetoacetanilide
480	10	Terephthalic acid
130	10	n-Propyl acetate
114	10	Diethyl phthalate
110	10	Dimethyl phthalate
585	10	di-n-Butyl phthalate
90	10	Bis(2-ethylhexyl)phthalate
150	10	Methyl isobutyl ketone
59	10	Isopropoacetate
90	10	Isobutyl acetate
608	10	Hydroquinone
220	10	
260	10	
490	10	
120	10	
228	10	
227	10	
10	10	
10	10	
10	10	
339	10	
10	10	
250	10	
3,850	10	
336	10	
378	10	
295	10	
640	10	
71	10	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-12 (Continued)

TREATMENT PERFORMANCE DATA FOR ETHYLBENZENE

Plant 238 Biological Treatment[a]		Plant 238
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Formaldehyde
		Polystyrene (crystal)
3,350	10	Polystyrene (impact)
220	10	Polystyrene latex
		Polystyrene oriented sheet
		ABS resin
		Phenolic resins
		Styrene-acrylonitrile resin
		Styrene maleic anhydride resins

Plant 242 Biological Treatment[a]		Plant 242
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Alkyd resins
		Epoxy resins
553	10	Glyoxal-urea formaldehyde
190	10	textile resin
		Unsaturated polyester resins
		Acrylic resins
		Melamine resins
		Urea resins

Plant 244 Biological Treatment[a]		Plant 244
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Cyclohexanol
		C4 Hydrocarbons
608	10	Ethylene
		Ethylene-methacrylic acid copolymer
		Polyethylene polyvinyl acetate copolymers
		Propylene
		Hexamethylenediamine
		Polyethylene resins
		Adiponitrile

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-12 (Continued)

TREATMENT PERFORMANCE DATA FOR ETHYLBENZENE

Plant 251 Biological Treatment[a]		Plant 251
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Acetone
		Acetonitrile
1,281	10	Acrylonitrile
1,235	10	Benzene
1,360	10	Butylenes (mixed)
		Dialkylbenzene, by-product
		Diphenyl oxide (diphenyl ether)
		Ethane
		Ethylbenzene
		Ethylene
		Formaldehyde
		Iminodiacetic acid
		Naphthalene
		Nitrilotriacetic acid
		o-Xylene
		Phenol
		Propylene
		Resin tars
		Sorbic acid, salts
		Toluene
		1,3-Pentadiene (piperylene)
		Phenolic resins
		Cumene
		1,3-Butadiene
		Cyclopentadiene dimer
		Isoprene
		Xylenes (mixed)

Plant 253 Biological Treatment[a]		Plant 253
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Polypropylene resins
144	10	
10	10	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-12 (Continued)

TREATMENT PERFORMANCE DATA FOR ETHYLBENZENE

Plant 257 Biological Treatment[a]		Plant 257
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Acetone
		Allyl chloride
63	10	Bisphenol-A
71	10	Butylenes (mixed)
67	10	Diacetone alcohol
75	10	Ethylene
355	10	Isobutylene
327	10	Phenol
239	10	Propylene
139	10	Vinyl chloride
179	10	Epichlorohydrin
149	10	Acetone
159	10	Epoxy resins
153	10	Isopropanol
94	10	Methyl ethyl ketone
124	10	Methyl isobutyl ketone
116	10	n-Butyl alcohol
85	10	Cumene
122	10	Ethanol
172	10	sec-Butyl alcohol
141	10	Butadiene
83	10	Isoprene
157	10	
231	10	
376	10	
608	10	
3,648	10[b]	
970	55[b]	
1,000	10[b]	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

[b]In the data base from which this data was taken, the sampling data was designated using a different code, plant 259, because it represented a different sampling episode.

Table 5-12 (Continued)

TREATMENT PERFORMANCE DATA FOR ETHYLBENZENE

Plant 293 Biological Treatment[a]		Plant 293 Products Manufactured
Influent (ug/L)	Effluent (ug/L)	
		Polystyrene (impact)
		Polystyrene & copolymers
3,565	10	Polystyrene oriented sheet
2,287	10	ABS resin
		SAN resin

Plant 299 Biological Treatment[a]		Plant 299 Products Manufactured
Influent (ug/L)	Effluent (ug/L)	
		ABS resin
114	10	
22	10	
230	10	
112	10	
82	10	
114	10	
85	10	
77	10	
79	10	
81	10	
132	10	
75	10	
124	10	
144	10	
99	10	
105	10	

Stover and Kincannon, 1983 Pilot-Scale Steam Stripper		Description of Waste Treated
Influent (ug/L)	Effluent (ug/L)	
		Pilot-scale study of ground-
		water near a waste disposal
23,500	10	dump site which contained
23,500	10	household refuse, demolition
23,500	10	materials, chemical sludges,
23,500	992	and hazardous liquid chemicals.
23,500	10	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-12 (Continued)

TREATMENT PERFORMANCE DATA FOR ETHYLBENZENE

Stover and Kincannon, 1983 Pilot-Scale Air Stripper		Description of Waste Treated
Influent (ug/L)	Effluent (ug/L)	
23,500	53	Pilot-scale study of ground-water near a waste disposal dump site which contained household refuse, demolition materials, chemical sludges, and hazardous liquid chemicals.
23,500	10	
23,500	528	
23,500	558	
23,500	10	
23,500	1,035	

Table 5-13

CALCULATION OF BDAT FOR ETHYLBENZENE

Plant No.	Technology	Average Treatment Concentration (ug/L)	Variability Factor	Treatment Concentration Level Avg. x VF (ug/L)
202	Biological	10	3.39[a]	34
211	Biological	10	3.39[a]	34
215	Biological	10	3.39[a]	34
221	Biological	10	3.39[a]	34
230	Biological	10	3.39[a]	34
234	Biological	10	3.39[a]	34
238	Biological	10	3.39[a]	34
242	Biological	10	3.39[a]	34
244	Biological	10	3.39[a]	34
251	Biological	10	3.39[a]	34
253	Biological	10	3.39[a]	34
257	Biological	11.7	1.98	23
293	Biological	10	3.39[a]	34
299	Biological	10	3.39[a]	34

[a]Average variability factor for BDAT Biological Treatment (see Table 5-4 and the discussion on page 5-17).

5.5.13 Ethyl Ether Wastewaters

The Agency has no data for wastewater treatment for the removal of ethyl ether. For reasons presented in Section 5.5.1, EPA used chemical structure as the basis for transferring treatment data to ethyl ether spent solvent wastewaters. Specifically, we transferred the treatment data from methyl isobutyl ketone, which contains the ketone functional group, to ethyl ether, which contains the ether functional group. The ethers structural group is most structurally similar to the ketones group based upon their oxygen containing, electron-releasing functional groups. Methyl isobutyl ketone was the only constituent for which we had data in the ketones structural group. Using performance data from methyl isobutyl ketone, the BDAT treatment standard for ethyl ether is 0.05 mg/L. The technology basis for this treatment standard is steam stripping.

We believe the BDAT treatment standard for ethyl ether spent solvent wastewaters represents substantial treatment. As discussed on page 5-73, in reference to methyl isobutyl ketone, we believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing ethyl ether and substantially reduce the likelihood of migration of ethyl ether from spent solvent wastes.

[The proposed technology-based treatment standard for ethyl ether was estimated at the detection limit of <0.100 mg/L based on biological treatment (see Table 13, 51 FR 1725). The principal difference between the proposed and promulgated treatment standards is the Agency's change in the criteria for transfer of treatment data (see Section 5.5.21 for a discussion of the Agency's methodology for data transfer).]

5.5.14 Isobutanol Wastewaters

The Agency has no data for wastewater treatment for the removal of isobutanol. For reasons presented in Section 5.5.1, EPA used chemical structure as the basis for transferring treatment data to isobutanol spent solvent wastewaters. Specifically, we transferred the treatment data from methyl isobutyl ketone, which contains the ketone functional group, to isobutanol, which contains the hydroxyl functional group. The alcohol structural group is most structurally similar to the ketones group based upon their oxygen containing, electron-releasing functional groups. Methyl isobutyl ketone was the only constituent for which we had data in the ketones structural group. Using performance data from methyl isobutyl ketone, the transferred standard for isobutanol is 0.05 mg/L. The standard derived from the transferred data is below the quantification level and could not be used as the treatment standard. Therefore, the BDAT treatment standard was set at the quantification level of 5.0 mg/L. The technology basis for this treatment standard is steam stripping.

We believe the BDAT treatment standard for isobutanol spent solvent wastewaters represents substantial treatment. We would expect untreated isobutanol wastes to be similar to untreated methyl isobutyl ketone wastes, from which we transferred treatment data, since they are used in some of the same manufacturing processes, as shown in Section 2 of this document. As discussed on page 5-73, in reference to methyl isobutyl ketone, we believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing isobutanol and substantially reduce the likelihood of migration of isobutanol from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for isobutanol was estimated at the detection limit of <0.050 mg/L based on biological treatment (see Table 13, 51 FR 1725). The primary difference between the proposed and promulgated treatment standards is EPA's consideration of quantification levels in setting the standard (see the discussion on the use of quantification levels in Section 5.5 on page 5-12). To a lesser extent, the Agency's change in the criteria for data transfer affected the treatment standard. (See Section 5.5.1, page 5-14, for a discussion of the Agency's methodology for data transfer.)]

5.5.15 Methanol Wastewaters

The Agency has wet air oxidation treatment data for methanol (Reference 10). The data are summarized in Table 5-14.

The following steps were taken to derive the BDAT treatment standard for methanol:

1. We evaluated the data set to determine whether any of the data represent poor design or operation of the treatment system. The data for wet air oxidation treatment of methanol were deleted because we did not believe the treatment to be substantial. By transferring data from another technology, a BDAT treatment standard over 10,000 times (four orders of magnitude) smaller could be obtained. We have no information to conclude, nor do we believe, that the wastes treated by the wet air oxidation unit are sufficiently different from the similarly-treated wastes on which the standard was based to account for this large difference in treatability. Taking the variability into account, the standard derived from wet air oxidation would also be over 200 times greater than any BDAT treatment standard. We therefore conclude that the treatment represented by this data set for wet air oxidation treatment of methanol does not represent substantial reductions in toxicity or likelihood of migration.

2. Because the Agency has no other data for treatment of methanol, treatment data for methanol were transferred from another compound. For reasons presented in Section 5.5.1, EPA used chemical structure as the basis for transferring treatment data to methanol spent solvent wastewaters. Specifically, we transferred the treatment data from methyl isobutyl ketone, which contains the ketone functional group, to methanol, which contains the hydroxyl functional group. The alcohols structural group is most structurally similar to the ketones group based upon their oxygen containing, electron-releasing functional groups. Methyl isobutyl ketone was the only constituent for which we had data in the ketones structural group. Using performance data from methyl isobutyl ketone, the transferred standard for methanol is 0.05 mg/L. The standard derived from the transferred data is below the quantification level and could not be used as the treatment standard. Therefore, the BDAT treatment standard was set at the quantification level of 0.25 mg/L. The technology basis for this treatment standard is steam stripping.

   We believe the BDAT treatment standard for methanol spent solvent wastewaters represents substantial treatment. We would expect untreated methanol wastes to be similar to untreated methyl

isobutyl ketone wastes, from which we transferred treatment performance, since they are used in some of the same manufacturing processes, as shown in Section 2 of this document. As discussed on page 5-73, in reference to methyl isobutyl ketone, we believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing methanol and substantially reduce the likelihood of migration of methanol from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for methanol was estimated at the detection limit of <0.100 mg/L based on biological treatment (see Table 13, 51 FR 1725). The principal difference between the proposed and promulgated treatment standards is EPA's consideration of quantification levels in setting the standard (see the discussion on the use of quantification levels in Section 5.5 on page 5-12). To a lesser extent, the Agency's change in the criteria for data transfer affected the treatment standard. (See Section 5.5.1, page 5-14, for a discussion of the Agency's methodology for data transfer.)]

Table 5-14

TREATMENT PERFORMANCE DATA FOR METHANOL

Data Submitted by Zimpro, Inc., 1986

Wet Air Oxidation			
Raw Waste (ug/L)	Diluted Feed (ug/L)	Oxidation Product (ug/L)	Description of Waste Treated
36,900,000	9,200,000	800,000	General organic

5.5.16 Methylene Chloride Wastewaters

The Agency has biological treatment data for methylene chloride at plants 246 and 265 in the OCPSF data base. Also from the OCPSF data base are steam stripping data at plant 284 and biological treatment followed by activated carbon adsorption data at plant 246. The Agency also has data from pilot-scale granular activated carbon adsorption (Reference 7) and data from wet air oxidation treatment (Reference 10). Data are also available for steam stripping of methylene chloride wastewater from the Pharmaceuticals Manufacturing Industry (plant 12003 of the Industrial Technology Division data base). The data are summarized in Table 5-15 and calculation of the BDAT treatment standard is shown in Table 5-16.

The following steps were taken to derive the BDAT treatment standard for methylene chloride:

1. We evaluated each data set to determine whether any of the data represent poor design or operation of the treatment systems. Data for steam stripping of methylene chloride wastewater at the Pharmaceuticals manufacturing facility (plant 12003) were evaluated to determine whether the steam stripper could be considered well-designed and operated. The steam stripper was designed to operate at 98°C in the overhead. However, many data points were obtained during operation at overhead temperatures below 98°C. Therefore, the data were examined to determine the minimum temperature representative of a well-operated system. As a method of evaluating the data, the effluent concentration was plotted as a function of overhead temperature. The data indicate that, as the overhead temperature drops below the design temperature, there is an increase in the variability in the effluent concentrations achieved at a given overhead temperature. This increased variability is an indication of increased instability or poor control of the steam stripping system. Since the variability in the effluent concentrations increased as the overhead temperature dropped below 90°C, the minimum overhead temperature for a system that was well-operated was estimated as 90°C. Twenty-one data points were deleted from the data set because the overhead temperature was below 90°C.

   In consideration of the amount of full-scale data available for methylene chloride, we believe it is appropriate to exclude data for pilot-scale activated carbon adsorption and bench-scale wet air oxidation treatment.

2. We calculated the arithmetic average treatment concentration and the variability factor for each data set as shown in Table 5-16. Process variability could not be calculated for biological treatment followed by activated carbon adsorption at plant 246 because all effluent values were reported as less than or equal to the detection limit of 10 ug/L. We would expect some variability in the data because the actual concentrations would range from 0 to the detection limit of 10 ug/L. To estimate the variability, the Agency used the average variability factor for BDAT biological treatment followed by activated carbon adsorption, 6.17. (Calculation of the average variability factor is shown in Table 5-4, page 5-18)

3. Biological treatment and biological treatment followed by activated carbon adsorption of methylene chloride at plant 246 were compared to determine whether the performance of one technology was significantly better than the other for treatment of the same waste. Since all effluent values in each data set were reported as less than or equal to the detection limit, the two data sets were considered statistically homogeneous. The combined biological treatment followed by activated carbon adsorption data set was not used to determine the BDAT treatment standard because the addition of activated carbon adsorption did not significantly improve treatment performance. Therefore, the treatment concentration level for plant 246 is 0.20 mg/L based upon biological treatment.

   Data were not available for more than one treatment for other wastes; therefore, the analysis of variance method could not be used to compare treatments on other wastes.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-16 could be associated with separate waste treatability subgroups. Methylene chloride spent solvent wastewater generated at a Pharmaceuticals Manufacturing facility was identified as a separate waste treatability subgroup. Data were insufficient to identify other waste treatability subgroups; therefore, a second waste treatability subgroup was established for all remaining sources of wastewater containing methylene chloride spent solvents. We then compared the treatment levels for the two waste treatability subgroups by the analysis of variance. The treatment levels are significantly different (see Table II-6, Appendix II). A separate BDAT treatment standard (12.7 mg/L from plant 12003) was developed for the pharmaceuticals manufacturing industry based on the data for steam stripping of methylene chloride. The least stringent

treatment level within the second treatability subgroup for all other methylene chloride wastewaters was selected for BDAT (0.20 mg/L from plant 265) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. The technology basis was biological treatment.

5. The BDAT treatment standard for methylene chloride represents treatment of a variety of waste matrices generated by process streams from the manufacture of over 39 different products. The untreated waste concentration of methylene chloride ranged from 7,000 mg/L to 10,000 mg/L in pharmaceuticals wastewater. This waste was treated to the BDAT treatment standard developed for methylene chloride wastewaters from pharmaceuticals manufacturing or below (12.7 mg/L). The untreated waste concentration of methylene chloride ranged from 0.027 mg/L to 12.1 mg/L in all other waste matrices. All of these wastes were treated to the BDAT treatment standard or below (0.20 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing methylene chloride and substantially reduce the likelihood of migration of methylene chloride from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for methylene chloride was 0.011 mg/L based on biological treatment (see Table 13, 51 FR 1725). The difference between the proposed and promulgated treatment standards is primarily due to the use of additional data on treatment of methylene chloride and the incorporation of a variability factor in derivation of the promulgated treatment standard. The additional data supported development of a separate waste treatability subgroup for methylene chloride spent solvent wastewaters from pharmaceuticals manufacturing as discussed above. The additional data were presented in EPA's Notice of Availability of Data (51 FR 31783). Another less significant factor affecting the change in the treatment standard is the change in data editing (data editing rules are presented in Section 5.3).]

Table 5-15

TREATMENT PERFORMANCE DATA FOR METHYLENE CHLORIDE

Plant 246 Biological Treatment[a]		Plant 246
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Aniline
		Dinitrotoluene (mixed)
27	10	Methylene diphenyl diisocyanate
94	10	Nitrobenzene
1,817	10	Polymeric methylene diphenyl diisocyanate
717	10	
154	10	Polyoxypropylene glycol
133	10	Toluene diamine (mixture)
501	10	Toluene diisocyanates (mixture)
135	10	Polymeric methylene dianiline
460	10	Polyurethane resins
1,640	26	
3,907	10	
969	10	
277	10	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-15 (Continued)

TREATMENT PERFORMANCE DATA FOR METHYLENE CHLORIDE

Plant 246 Biological Treatment[a] Followed by Activated Carbon Adsorption		Plant 246
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Aniline
		Dinitrotoluene (mixed)
27	10	Methylene diphenyl diisocyanate
94	10	Nitrobenzene
1,817	10	Polymeric methylene diphenyl diisocyanate
717	10	
154	10	Polyoxypropylene glycol
133	10	Toluene diamine (mixture)
501	10	Toluene diisocyanates (mixture)
135	10	Plymeric methylene dianiline
2,062	10	Polyurethane resins
460	10	
3,907	10	
969	10	
277	10	
10	10	
10	10	
10	10	
10	10	
10	10	
10	10	
10	10	
10	10	
10	10	
10	10	
10	10	
10	10	
10	10	
5,550	10[b]	
3,005	10[b]	
2,980	10[b]	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

[b]In the data base from which this data was taken, the sampling data was designated using a different code, plant 219, because it represented a different sampling episode.

Table 5-15 (Continued)

TREATMENT PERFORMANCE DATA FOR METHYLENE CHLORIDE

Plant 265 Biological Treatment[a]		Plant 265 Products Manufactured
Influent (ug/L)	Effluent (ug/L)	
760	60	Tar, tar crudes, and tar pitches
690	10	
500	10	

Plant 284 Steam Stripping		Plant 284 Products Manufactured
Influent (ug/L)	Effluent (ug/L)	
1,135	10	Benzene
4,600	10	1,3-Butadiene
1,140	10	Ethylene
1,760	10	Propylene
2,400	10	Methylene chloride
690	10	1,1,2-Trichloroethane
570	10	Vinylidine chloride
320	10	1,2,3-Trichloropropene
267	10	1,2-Dichloropropane
520	10	Propylene oxide
198	10	Ethylene oxide
641	10	Propylene glycol
4,800	10	Dipropylene glycol
12,100	10	Tripropylene glycol
469	18	Ethylene glycol
		Methyl chloride
		Diethylene glycol
		Triethylene glycol
		Tetraethylene glycol
		Ethanol amines
		Polypropylene
		Chloroform
		Carbon tetrachloride
		1,2-Dichloroethane
		Vinyl chloride

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-15 (Continued)

TREATMENT PERFORMANCE DATA FOR METHYLENE CHLORIDE

Plant 12003 Steam Stripping		Plant 12003
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Pharmaceuticals
8,250,000	926	
8,250,000	5,100	
8,250,000	4,940	
8,250,000	3,000[a]	
8,250,000	1,990[a]	
8,250,000	5,700[a]	
8,250,000	22,800[a]	
8,250,000	38,050[a]	
225,000	3,900[a,b]	
225,000	8,360[a,b]	
225,000	20,600[a,b]	
225,000	4,070[a,b]	
225,000	10,700[a,b]	
225,000	20,300[a,b]	
225,000	4,800[a,b]	
225,000	7,870[a,b]	
7,000,000	1,720	
7,000,000	1,630	
7,000,000	3,600[a]	
7,000,000	14,250[a]	
7,000,000	39,300[a]	
7,000,000	138,000[a]	
7,000,000	110,000[a]	
7,000,000	60,800[a]	
11,200,000	10,100[a]	
9,900,000	22,850[a]	
9,100,000	57,500[a]	
9,400,000	115,000[a]	
10,200,000	59,900[a]	
11,800,000	127,000[a]	
10,000,000	3,180	
12,000,000	3,730[a]	
9,500,000	7,200	
9,500,000	4,040	
9,500,000	4,270	
9,500,000	1,470	
9,500,000	1,620[a]	
9,500,000	2,630	
9,500,000	7,830[a]	
9,500,000	15,800[a]	

[a]Data point deleted in analysis - overhead temperature less than 90°C.

[b]These data were deleted because the document from which they were obtained (Reference 14) stated that the data set was suspect.

Table 5-15 (Continued)

TREATMENT PERFORMANCE DATA FOR METHYLENE CHLORIDE

Becker and Wilson, 1978

Pilot-Scale Granular Activated Carbon Column		
Influent (ug/L)	Effluent (ug/L)	Description of Waste Treated
190	51.0	Runoff water from a waste disposal site's containment dikes.

Data Submitted by Zimpro, Inc., 1986

Wet Air Oxidation			
Raw Waste (ug/L)	Diluted Feed (ug/L)	Oxidation Product (ug/L)	Description of Waste Treated
3,600,000	--	4,000	General organic
15,000	--	<1,000	
500,000	125,000	<10,000	

Table 5-16

CALCULATION OF BDAT FOR METHYLENE CHLORIDE

Plant No.	Technology	Average Treatment Concentration (ug/L)	Variability Factor	Treatment Concentration Level Avg. x VF (ug/L)
Pharmaceuticals Manufacturing Industry:				
12003	Steam Stripping	3,375	3.76	12,690
All Other Methylene Chloride Wastewaters:				
284	Steam Stripping	10.5	1.40	15
246	Biological	11.2	1.78	20
265	Biological	26.7	7.58	202
246	Biological followed by Activated Carbon	10	6.17a	62

[a]Average variability factor for BDAT biological treatment followed by activated carbon adsorption (see Table 5-4 and the discussion on page 5-17).

5.5.17 Methyl Ethyl Ketone Wastewaters

The Agency has wet air oxidation treatment data for methyl ethyl ketone (Reference 10). The data are summarized in Table 5-17.

The following steps were taken to derive the BDAT treatment standard for methyl ethyl ketone:

1. We evaluated the data set to determine whether any of the data represent poor design or operation of the treatment system. Data on bench-scale wet air oxidation treatment were deleted because the concentration of methyl ethyl ketone in the diluted feed to the wet air oxidation process was not reported and the detection limit was not reported with the data.

2. Because the Agency has no other data for treatment of methyl ethyl ketone, treatment data for methyl ethyl ketone were transferred from another compound. For reasons presented in Section 5.5.1, EPA used chemical structure as the basis for transferring treatment data to methyl ethyl ketone spent solvent wastewaters. Specifically, we transferred treatment data from methyl isobutyl ketone because, like methyl ethyl ketone, methyl isobutyl ketone contains the ketone functional group. Methyl isobutyl ketone was the only constituent for which we had data in the ketone structural group. Using performance data from methyl isobutyl ketone, the BDAT treatment standard for methyl ethyl ketone is 0.05 mg/L. The technology basis for this treatment is steam stripping.

   We believe the BDAT treatment standard for methyl ethyl ketone spent solvent wastewaters represents substantial treatment. We would expect untreated methyl ethyl ketone wastes to be similar to untreated methyl isobutyl ketone wastes, from which we transferred treatment performance, since they are used in some of the same manufacturing processes, as shown in Section 2 of this document. As discussed on page 5-73, in reference to methyl isobutyl ketone, we believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing methyl ethyl ketone and substantially reduce the likelihood of migration of methyl ethyl ketone from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for methyl ethyl ketone was estimated at the detection limit of <0.050 mg/L based on biological treatment (see Table 13, 51 FR 1725). The principal difference between the proposed and promulgated treatment standards is the Agency's change in the criteria for data transfer. (See Section 5.5.1, page 5-14, for a discussion of the Agency's methodology for data transfer.)]

Table 5-17

TREATMENT PERFORMANCE DATA FOR METHYL ETHYL KETONE

Data Submitted by Zimpro, Inc., 1986

Wet Air Oxidation		
Raw Waste (ug/L)	Oxidation Product (ug/L)	Description of Waste Treated
8,200,000	Not detected[a]	Solvent still bottom wastewater.

[a]The detection limit was not reported with the data.

5.5.18 Methyl Isobutyl Ketone Wastewaters

The Agency has treatment data for methyl isobutyl ketone from pilot-scale steam stripping and pilot-scale air stripping of solvent contaminated groundwater (Reference 2). The data are summarized in Table 5-18 and calculation of the BDAT treatment standard is shown in Table 5-19.

The following steps were taken to derive the BDAT treatment standard for methyl isobutyl ketone:

1. We evaluated each data set to determine whether any of the data represent poor design or operation of the treatment systems. The available data and information did not show any of the data to represent poor design and operation. Accordingly, none of the data were deleted on this basis.

2. We calculated the arithmetic average treatment concentration and the variability factor for each data set as shown in Table 5-19. Process variability could not be calculated for the pilot-scale steam stripper because all effluent values were reported as less than or equal to the detection limit of 10 ug/L. We would expect some variability in the data because the actual concentrations would range from 0 to the detection limit of 10 ug/L. To estimate the variability, the Agency used the average variability factor for BDAT full-scale steam stripping, 2.26. (Calculation of the average variability factor is shown in Table 5-4, page 5-18.)

3. Air stripping and steam stripping of methyl isobutyl ketone at the pilot-scale plant were compared with the analysis of variance method to determine whether the performance of one technology was significantly better than the other for treatment of the same waste. It was shown that steam stripping provided significantly better removal of methyl isobutyl ketone when compared with air stripping. Therefore, the treatment concentration level for the pilot-scale plant is 23 ug/L based upon steam stripping. (Refer to Table II-7, Appendix II.) The analysis of variance method could not be used to compare treatments on any other methyl isobutyl ketone spent solvent wastes because data were not available for more than one treatment for any other wastes.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-19 could be associated with separate waste treatability subgroups. Sufficient data did not

exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastewaters containing methyl isobutyl ketone spent solvents. The least stringent treatment level within the treatability subgroup was selected for BDAT (0.025 mg/L from pilot-scale steam stripping) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. This calculated concentration level is below the quantification level and could not be used as the treatment standard; therefore, the treatment standard was set at the quantification level of 0.05 mg/L.

5. The BDAT treatment standard for methyl isobutyl ketone represents treatment of a waste matrix generated from the manufacture of four different products. The untreated waste concentration of methyl isobutyl ketone was as high as 76.4 mg/L in this waste matrix. This waste was treated to a concentration below the BDAT treatment standard (0.050 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing methyl isobutyl ketone and substantially reduce the likelihood of migration of methyl isobutyl ketone from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for methyl isobutyl ketone was estimated at the detection limit of <0.100 mg/L based on biological treatment (see Table 13, 51 FR 1722). The principal differences between the proposed and promulgated treatment standards are EPA's consideration of quantification levels in setting the standard (see the discussion on the use of quantification levels in Section 5.5 on page 5-12) and the incorporation of a variability factor in derivation of the promulgated treatment standard. Another less significant factor affecting the change in the treatment standard is the change in data editing (data editing rules are presented in Section 5.3).]

Table 5-18

TREATMENT PERFORMANCE DATA FOR METHYL ISOBUTYL KETONE

Stover and Kincannon, 1983
Pilot-Scale Steam Stripper

Influent (ug/L)	Effluent (ug/L)
76,400	10
76,400	10
76,400	10
76,400	10
76,400	10

Description of Waste Treated

Pilot-scale study of groundwater near a waste disposal dump site which contained household refuse, demolition materials, chemical sludges, and hazardous liquid chemicals.

Stover and Kincannon, 1983
Pilot-Scale Air Stripper

Influent (ug/L)	Effluent (ug/L)
76,400	45,000
76,400	60,000
76,400	24,400
76,400	42,800
76,400	18,500
76,400	60,200

Description of Waste Treated

Pilot-scale study of groundwater near a waste disposal dump site which contained household refuse, demolition materials, chemical sludges, and hazardous liquid chemicals.

Table 5-19

CALCULATION OF BDAT FOR METHYL ISOBUTYL KETONE

Plant No.	Technology	Average Treatment Concentration (ug/L)	Variability Factor	Treatment Concentration Level Avg. x VF (ug/L)
PS	Air Stripping	41,817	2.83	118,342
PS	Steam Stripping	10	2.26[a]	23

[a]Average variability factor for BDAT full-scale steam stripping (see Table 5-4 and the discussion on page 5-17).

5.5.19 Nitrobenzene Wastewaters

The Agency has data for treatment of wastewaters containing nitrobenzene by biological treatment at plant 246, biological treatment followed by activated carbon adsorption at plant 246, steam stripping at plants 246 and 297, and steam stripping followed by activated carbon adsorption at plant 297 in the OCPSF data base. The data are summarized in Table 5-20 and calculation of the BDAT treatment standard is shown in Table 5-21.

The following steps were taken to derive the BDAT treatment standard for nitrobenzene:

1. We evaluated each data set to determine whether any of the data represent poor design or operation of the treatment systems. In EPA's judgment, one data point in the data set for steam stripping at plant 297 represented poor design and operation. We confirmed this judgment using the outlier test (refer to Table II-8, Appendix II). The outlying data point was deleted. Data for steam stripping at plant 246 were deleted on the basis of design and performance. Based on the disproportionately low removals relative to other treatment systems for wastes containing nitrobenzene, EPA judged this system to be poorly designed and operated. This system achieved a reduction of only 35.7 percent as compared with 93.8 to 99.9 percent for other systems treating wastes containing nitrobenzene.

   Data for biological treatment and biological treatment followed by activated carbon adsorption at plant 246 were also deleted. During the sampling episode, this plant experienced high discharges of polyoxypropylene glycol, or "polyol", a product at the plant, into the treatment system. The discharge of polyol is normally closely controlled at this plant since the polyol interferes with removals of nitrobenzene in the treatment system. The data for this plant were not considered in developing BDAT treatment standards since the treatment system was not well-operated at the time of sampling.

2. We calculated the arithmetic average treatment concentration and the variability factor for each data set as shown in Table 5-21.

3. Steam stripping and steam stripping followed by activated carbon adsorption of nitrobenzene at plant 297 were compared with the analysis of variance method to determine whether the performance of one technology was significantly better than the other for treatment of the same waste. It was shown that the addition of activated carbon adsorption to steam stripping significantly

improved treatment performance. Therefore, the treatment concentration level for plant 297 is 0.66 mg/L based on steam stripping followed by activated carbon adsorption. (Refer to the statistical calculations and results in Table II-9, Appendix II.) The analysis of variance method could not be used to compare treatments on any other wastes because data were not available for more than one treatment for any other waste.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-21 could be associated with separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastewaters containing nitrobenzene spent solvents. The highest treatment level within the treatability subgroup was selected for BDAT (0.66 mg/L from plant 297) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. The technology basis was steam stripping followed by activated carbon adsorption.

5. The BDAT treatment standard for nitrobenzene represents treatment of a waste matrix generated by process streams from the manufacture of at least four different products. The untreated waste concentration of nitrobenzene ranged from 87 mg/L to 330 mg/L in this waste matrix. This waste was treated to the BDAT treatment standard or below (0.66 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing nitrobenzene and substantially reduce the likelihood of migration of nitrobenzene from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for nitrobenzene was <0.010 mg/L based on biological treatment (see Table 13, 51 FR 1725). The difference between the proposed and promulgated treatment standards is primarily due to the incorporation of a variability factor in derivation of the promulgated treatment standard. Other lesser factors affecting the change in the treatment standard are the changes in data editing (data editing rules are presented in Section 5.3) and deletion of some data points in the final rule because they represent poor operation of the treatment system (see the discussion of the outlier test in Section 5.4.)]

Table 5-20

TREATMENT PERFORMANCE DATA FOR NITROBENZENE

Plant 246
Steam Stripping

Influent (ug/L)	Effluent (ug/L)
290,780	281,720
226,415	296,775
196,530	359,980
155,310	183,263
363,560	273,190
1,965,760	161,025
361,510	103,968
675,000	94,228
290,460	338,750
344,720	619,610
91,200	117,140
201,990	145,765
230,540	272,850
233,786	137,000
237,940	384,610

Plant 246
Products Manufactured

Aniline
Dinitrotoluene (mixed)
Methylene diphenyl diisocyanate
Nitrobenzene
Polymeric methylene diphenyl diisocyanate
Polyoxypropylene glycol
Toluene diamine (mixture)
Toluene diisocyanates (mixture)
Polymeric methylene dianiline
Polyurethane resins

Plant 246
Biological Treatment[a]

Influent (ug/L)	Effluent (ug/L)
5,559	4,174
2,779	1,927
2,405	696
3,796	344
4,400	166
2,838	664
3,656	1,595
1,214	10
2,319	10
1,420	186
2,062	169
821	358
1,145	10
876	11

Plant 246
Products Manufactured

Same as Plant 246 - Steam Stripping

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-20 (Continued)

TREATMENT PERFORMANCE DATA FOR NITROBENZENE

Plant 246 Biological Treatment[a] and Activated Carbon Adsorption		Plant 246 Products Manufactured
Influent (ug/L)	Effluent (ug/L)	
		Aniline
		Dinitrotoluene (mixed)
5,559	982	Methylene diphenyl diisocyanate
2,779	1,902	Nitrobenzene
3,405	141	Polymeric methylene diphenyl diisocyanate
3,796	538	
4,400	537	Polyoxypropylene glycol
2,838	79	Toluene diamine (mixture)
3,656	420	Toluene diisocyanates (mixture)
2,015	16	Polymeric methylene dianiline
1,214	10	Polyurethane resins
2,319	233	
1,420	10	
2,063	10	
821	10	
1,145	10	
876	10	
87,000	230[b]	
45,030	179[b]	
90,500	38[b]	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

[b]In the data base from which this data was taken, the sampling data was designated using a different code, plant 248, because it represented a different sampling episode.

Table 5-20 (Continued)

TREATMENT PERFORMANCE DATA FOR NITROBENZENE

Plant 297 Steam Stripping	
Influent (ug/L)	Effluent (ug/L)
330,000	14,377
190,000	10,545
267,160	8,752
309,920	4,600
106,995	6,098
144,860	11,072
139,530	21,992
87,000	17,065
139,340	12,264
189,054	11,163

Plant 297 Products Manufactured
Nitrobenzene
Nitrotoluene
Aniline
o-Toluidine

Plant 297 Steam Stripping Followed by Activated Carbon Adsorption	
Influent (ug/L)	Effluent (ug/L)
330,000	374
190,000	150
267,160	143
309,920	330
106,995	372
144,860	140
139,530	4,900[a]
87,000	135
139,340	331
189,054	251

Plant 297 Products Manufactured
Same as Plant 297 - Steam Stripping

[a]In EPA's judgment, this data point represented poor design and operation. We confirmed this judgment using the outlier test (refer to Table II-8, Appendix II) and this data point was deleted.

Table 5-21

CALCULATION OF BDAT FOR NITROBENZENE

Plant No.	Technology	Average Treatment Concentration (ug/L)	Variability Factor	Treatment Concentration Level Avg. x VF (ug/L)
297	Steam Stripping	11,793	2.68	31,605
297	Steam Stripping followed by Activated Carbon	247	2.65	655

5.5.20 Pyridine Wastewaters

The Agency has no data for wastewater treatment for the removal of pyridine. For reasons presented in Section 5.5.1, EPA used chemical structure as the basis for transferring treatment standards to pyridine spent solvent wastewaters. Specifically, we transferred the treatment data from toluene because, like pyridine, toluene contains the aromatic ring functional group. Toluene had the least stringent treatment standard in the non-halogenated aromatics structural group. Using performance data from toluene, the BDAT treatment standard for pyridine is 1.12 mg/L. The technology basis for this treatment is biological treatment followed by activated carbon adsorption.

We believe the BDAT treatment standard for pyridine spent solvent wastewaters represents substantial treatment. We would expect untreated pyridine wastes to be similar to untreated toluene wastes, from which we transferred treatment data. As discussed on page 5-91, in reference to toluene, we believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing pyridine and substantially reduce the likelihood of migration of pyridine from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for pyridine was estimated at the detection level of <0.500 mg/L based on biological treatment (see Table 13, 51 FR 1725). The principal difference between the proposed and promulgated treatment standards is the Agency's change in the criteria for data transfer. (See Section 5.5.1, page 5-14, for a discussion of the Agency's methodology for data transfer.)]

5.5.21 Tetrachloroethylene Wastewaters

The Agency has biological treatment data for tetrachloroethylene at plants 225 and 280 in the OCPSF data base. Wet air oxidation treatment data are also available for treatment of wastewater containing tetrachloroethylene (Reference 10). The Agency also has data from two pilot-scale air strippers treating solvent spiked tap water (Reference 6, Site 1) and industrial discharge contaminated groundwater (Reference 6, Site 2), and from full-scale biological treatment of wastewater from organic chemicals manufacturing (commercially available PACT® process, Reference 4). The data are summarized in Table 5-22 and calculation of the BDAT treatment standard is shown in Table 5-23.

The following steps were taken to derive the BDAT treatment standard for tetrachloroethylene:

1. We evaluated each data set to determine whether any of the data represent poor design or operation of the treatment systems. In EPA's judgment, one data point in the data set for biological treatment at plant 225 represented poor design and operation. We confirmed this judgment using the outlier test (refer to Table II-11, Appendix II). The outlying data point was deleted. Data for pilot-scale air stripping treatment at Sites 1 and 2 and for bench-scale wet air oxidation were deleted because, in consideration of the amount of full-scale data available for tetrachloroethylene, we believe it is appropriate to exclude pilot-scale data.

2. We calculated the arithmetic average treatment concentration and the variability factor for each data set as shown in Table 5-23. Process variability could not be calculated for biological treatment at plant 280 because all effluent values were reported as less than or equal to the detection limit of 10 ug/L. We would expect some variability in the data because the actual concentrations would range from 0 to the detection limit of 10 ug/L. To estimate the variability, the Agency used the average variability factor for BDAT biological treatment, 3.39. (Calculation of the average variability factor is shown in Table 5-4, page 5-18.)

   Process variability could not be calculated for biological treatment by the PACT® process because there is only one data pair available from this process. Therefore, the average variability factor for BDAT biological treatment, 3.39, was used. (Calculation of the average variability factor is shown in Table 5-4, page 5-18.)

3. The analysis of variance method was not used to compare different treatments of the same waste because data are available for only one type of treatment for each waste.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-23 could be associated with separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastewaters containing tetrachloroethylene spent solvents. The least stringent treatment level within the treatability subgroup was selected for BDAT (0.079 mg/L from plant 225) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. The technology basis was biological treatment.

5. The BDAT treatment standard for tetrachloroethylene represents treatment of a variety of waste matrices generated by process streams from the manufacture of over 17 different products. The untreated waste concentration of tetrachloroethylene ranged from 0.062 mg/L to 31.5 mg/L in these waste matrices. All of these wastes were treated to the BDAT treatment standard or below (0.079 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing tetrachloroethylene and substantially reduce the likelihood of migration of tetrachloroethylene from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for tetrachloroethylene was <0.010 mg/L based on biological treatment (see Table 13, 51 FR 1725). The difference between the proposed and promulgated treatment standards is primarily due to the incorporation of a variability factor in derivation of the promulgated treatment standard. Other lesser factors affecting the change in the treatment standard are the changes in data editing (data editing rules are presented in Section 5.3) and deletion of some data points in the final rule because they represent poor operation of the treatment system (see the discussion of outlier test in Section 5.4).]

Table 5-22

TREATMENT PERFORMANCE DATA FOR TETRACHLOROETHYLENE

Plant 225 Biological Treatment[a]		Plant 225 Products Manufactured
Influent (ug/L)	Effluent (ug/L)	
		Polyvinyl chloride
		Perchloroethylene
2,251	10	Chlorinated paraffins
95	10	Chlorine
132	10	Hydrogen chloride
482	19	Sodium methylate
169	10	
186	10	
288	10	
913	10	
1,617	10	
374	10	
746	10	
714	10	
470	10	
252	12	
302	10	
17,500	476[b,c]	
31,500	150[b]	
24,000	55[b]	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

[b]In the data base from which this data was taken, the sampling data was designated using a different code, plant 227, because it represented a different sampling episode.

[c]In EPA's judgment, this data point represented poor design and operation. We confirmed this judgment using the outlier test (refer to Table II-11, Appendix II) and this data point was deleted.

Table 5-22 (Continued)

TREATMENT PERFORMANCE DATA FOR TETRACHLOROETHYLENE

Plant 280 Biological Treatment[a]		Plant 280
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Adipic acid, di(2-ethylhexyl) ester
413	10	Alkylphenols (incl. p-t-butyl)
401	10	Fatty acid esters
858	10	Phosphate esters, mixed triaryl
998	10	Phosphate esters, tributyl
405	10	Phosphate esters, tricresyl
258	10	Phosphate esters, tris(b-chloroalkyl)
110	10	
1,270	10	Phosphate esters, trixylenyl
1,748	10	Phosphates, alkyl acid, pyro-phosphates & salts
572	10	
729	10	Phosphonates, diethyl bis(2-hydroxyethyl) aminomethyl
399	10	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-22 (Continued)

TREATMENT PERFORMANCE DATA FOR TETRACHLOROETHYLENE

D.G. Hutton, 1979. Biological Treatment[a,b]		Description of Waste Treated
Influent (ug/L)	Effluent (ug/L)	
62	7.3	Wastewater from organic chemical manufacturing.

Love and Eilers, 1982 Pilot-Scale Air Stripper, Site 1								Description of Waste Treated
Average Influent Concentration (ug/L)	Average Effluent Concentration at Various Air-to-Water Ratios (ug/L)							
	1:1	2:1	3:1	4:1	8:1	16:1	20:1	
1,025	698	416	304	156	16			Tap water was spiked with tetrachloroethylene and trichloroethylene.
636	161	177	46	34	8	<1	<1	
338	139	103	47	34	4	1	2	
114	32	17	7	4	<1	<1	<1	
107	32	17	7	4	<1	<1	<1	

Love and Eilers, 1982 Pilot-Scale Air Stripper, Site 2		Description of Waste Treated
Average Influent Concentration (ug/L)	Average Effluent Concentration for 4:1 Air-to-Water Ratio (ug/L)	
94	9	Ground water was contaminated by industrial discharge; pilot-scale column was run continuously for over one year.

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).
[b]Commercially available patented PACT® process.

Table 5-22 (Continued)

TREATMENT PERFORMANCE DATA FOR TETRACHLOROETHYLENE

Data Submitted by Zimpro, Inc., 1986 Wet Air Oxidation		Description of Waste Treated
Raw Waste (ug/L)	Oxidation Product (ug/L)	
41,000	<1,000	General organic.

Table 5-23

CALCULATION OF BDAT FOR TETRACHLOROETHYLENE

Plant No.	Technology	Average Treatment Concentration (ug/L)	Variability Factor	Treatment Concentration Level Avg. x VF (ug/L)
225	Biological	21.5	3.65	79
280	Biological	10	3.39[a]	34
1[b]	Biological	7.3	3.39[a]	25

[a]Average variability factor for all BDAT biological treatment data (see Table 5-4 and the discussion on page 5-17).
[b]Commercially available patented PACT® process.

5.5.22 Toluene Wastewaters

The Agency has biological treatment data for toluene at plants 202, 206, 208, 210, 211, 215, 217, 221, 223, 230, 234, 240, 242, 244, 246, 251, 257, 265, and 286 in the OCPSF data base. Also available from the OCPSF data base are data for biological treatment followed by activated carbon adsorption at plant 246, steam stripping data at plant 246, and data for steam stripping followed by activated carbon adsorption at plant 297. The Agency also has data from pilot-scale steam stripping and air stripping of solvent contaminated groundwater (Reference 2), full-scale biological treatment of wastewater from organic chemicals manufacturing (commercially available patented PACT® process, Reference 4), and pilot-scale activated carbon adsorption of runoff water from a waste disposal site's containment dikes (Reference 7). The Agency also has data from the Iron and Steel Manufacturing Development Document (Reference 9) and wet air oxidation data submitted by Zimpro, Inc. (Reference 10). The data are summarized in Table 5-24 and calculation of the BDAT treatment standard is shown in Table 5-25.

The following steps were taken to derive the BDAT treatment standard for toluene:

1. We evaluated each data set to determine whether any of the data represent poor design or operation of the treatment systems. In EPA's judgment, two data points in the data set for biological treatment at plant 234 represented poor design and operation. We confirmed this judgment using the outlier test (refer to Table II-12, Appendix II,). The outlying data point was deleted.

   Data for biological treatment at plant 253 (consisting of three data points) were deleted on the basis of poor design and performance. Based on the disproportionately low removals relative to other treatment systems for wastes containing toluene, EPA judged this system to be poorly designed and operated. This system achieved a reduction of only 34.6 percent as compared with 86.3 to 99.9 percent for other systems treating wastes containing toluene.

   Individual paired data points for steam stripping treatment at plant 246 were deleted when the influent concentrations were below the 0.05 mg/L quantification level for toluene.

   Data for biological treatment at plant 206 were deleted because the treatment system at this plant was shown to be poorly designed and/or operated based on the wide variation in influent concentrations. The nature of biological treatment systems requires sufficient control of influent concentrations through the use of equalization to prevent "shock loading" of the biomass.

Data on pilot-scale steam stripping, pilot-scale air stripping, pilot-scale carbon adsorption, and bench-scale wet air oxidation treatment were deleted because, in consideration of the amount of full-scale data available for toluene, we believe it is appropriate to exclude pilot-scale data. The data from the Iron and Steel Manufacturing Development Document were not used because insufficient information exists in some cases to determine the concentrations treated and, in other cases, which technology was achieving removal. Also, in some cases, the treated values represented significant dilution of the wastestream.

2. We calculated the arithmetic average treatment concentration and the variability factor for each data set as shown in Table 5-25. Process variability could not be calculated for biological treatment at plant 217 because there is an insufficient number of data points available from this process to allow a meaningful estimation of process variability for the plant. Therefore, the average variability factor for BDAT biological treatment, 3.39, was used (calculation of the average variability factor is shown in Table 5-4, page 5-18).

   Process variability could not be calculated for biological treatment at plants 202, 208, 210, 211, 215, 221, 223, 230, 240, 242, 244, 251, and 265 because all effluent values were reported as less than or equal to the detection limit of 10 ug/L. We would expect some variability in the data because the actual concentrations would range from 0 to the detection limit of 10 ug/L. To estimate the variability, the Agency used the average variability factor for BDAT biological treatment, 3.39. (Calculation of the average variability factor is shown in Table 5-4, page 5-18.)

   Process variability could not be calculated for full-scale biological treatment of wastewater from organic chemicals manufacturing (the Zimpro PACT® process) because there was only one data point available for this process. Therefore, the average variability factor for BDAT biological treatment, 3.39, was used (calculation of the average variability factor is shown in Table 5-4, page 5-18).

3. Biological treatment and biological treatment followed by activated carbon adsorption of toluene at plant 246 were compared with the analysis of variance method to determine whether the performance of one technology was significantly better than the other for treatment of the same waste. It was shown that the addition of activated carbon adsorption to biological treatment

significantly improved treatment performance. Therefore, the treatment concentration level for plant 246 is 1.12 mg/L based upon biological treatment followed by activated carbon adsorption. (Refer to the statistical calculations and results in Table II-13, Appendix II.) The analysis of variance method could not be used to compare treatments on other wastes because data were not available for more than one treatment for any other waste.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-25 could be associated with separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastewaters containing toluene spent solvents. The least stringent treatment level within the treatability subgroup was selected for BDAT (1.12 mg/L from plant 246) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. The technology basis was biological treatment followed by activated carbon adsorption.

5. The BDAT treatment standard for toluene represents treatment of a variety of waste matrices generated by process streams from the manufacture of 150 different products. The untreated waste concentration of toluene ranged from 0.010 mg/L to 160 mg/L in these waste matrices. All of these wastes were treated to the BDAT treatment standard or below (1.12 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing toluene and substantially reduce the likelihood of migration of toluene from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for toluene was 0.016 mg/L based on activated carbon adsorption (see Table 13, 51 FR 1725). The difference between the proposed and promulgated treatment standards is primarily due to the incorporation of a variability factor in derivation of the promulgated treatment standard. Other less significant factors affecting the change in the treatment standard are the changes in data editing (data editing rules are presented in Section 5.3) and deletion of some data points in the final rule because they represent poor operation of the treatment system (see the discussion of the outlier test in Section 5.4).]

Table 5-24

TREATMENT PERFORMANCE DATA FOR TOLUENE

Plant 202 Biological Treatment[a] Influent (ug/L)	Effluent (ug/L)	Plant 202 Products Manufactured
		Disperse dye coupler
		Disperse dyes
122	10	Naphthalene sulfonic acid
130	10	Organic pigments
144	10	p-Phenylene diamine
126	10	Sulfur dyes
107	10	Vat dyes
139	10	Xylenesulfonic acid, sodium salt
154	10	
150	10	2-Bromo-4,6-dinitroaniline
155	10	2,4-Dinitroaniline
148	10	2,4-Dinitrochlorobenzene
81	10	2,4-Dinitrophenol
95	10	2,4,6-Trinitrophenol
95	10	4-Chloro-2,6-dinitrobenzene sulfonic acid, potassium salt
73	10	
138	10	
94	10	
107	10	
87	10	
67	10	
60	10	

Plant 206 Biological Treatment[a] Influent (ug/L)	Effluent (ug/L)	Plant 206 Products Manufactured
		3,3-Dichlorobenzidine
		Polyurethane resins
3,486	231	Orthochloroaniline
19,707	212	Benzophenone
17,697	220	2-Sulfophthalic acid
4,001	7,411	2,6-Dichloronitroaniline
57,475	320	
8,327	6,087	
49,379	14	
834	344	
14,877	17	
24,264	52	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-24 (Continued)

TREATMENT PERFORMANCE DATA FOR TOLUENE

Plant 208 Biological Treatment[a]	
Influent (ug/L)	Effluent (ug/L)
370	10
285	10
251	10
283	10
140	10
345	10
514	10
587	10
472	10
449	10
635	10
724	10
593	10
640	10

Plant 208
Products Manufactured

Cyclic (coal tar) intermediates
Tar, tar crudes, and tar pitches

Plant 210 Biological Treatment[a]	
Influent (ug/L)	Effluent (ug/L)
5,805	10
135	10[b]

Plant 210
Products Manufactured

Acetic acid
Acetone cyanohydrin
Acrylic acid
Acrylic acid esters
Acrylic resins, oil additives
Alkyl amines
Ethoxylates
Methacrylic acid esters
Methyl methacrylate
Alkyl phenols
Acetylene
Methacrylic acid

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

[b]In the data base from which this data was taken, the sampling data was designated using a different code, plant 282, because it represented a different sampling episode.

Table 5-24 (Continued)

TREATMENT PERFORMANCE DATA FOR TOLUENE

Plant 211 Biological Treatment[a] Influent (ug/L)	Effluent (ug/L)	Plant 211 Products Manufactured
		Coal tar solvent
		Coatings
4,000	10	Cresols (mixed)
2,082	10	Ethylbenzene
3,024	10	Methyl naphthalene
1,220	10	Naphthalene
1,546	10	Pitch tar residue
1,154	10	Pyridines (tar bases)
1,315	10	2,4-Xylenol (dimethyl phenol)
		Phenol

Plant 215 Biological Treatment[a] Influent (ug/L)	Effluent (ug/L)	Plant 215 Products Manufactured
		Benzene
		Toluene
4,550	10	Xylenes (mixed)
3,300	10	Cyclohexane
3,700	10	Isobutylene
		Propylene
		Polypropylene
		Butyl rubber
		Paraffins

Plant 217 Biological Treatment[a] Influent (ug/L)	Effluent (ug/L)	Plant 217 Products Manufactured
		Phthalic anhydride
		Butyl benzyl phthalate
60,000	10	Benzyl chloride
47,300	108	Tetrachlorophthalic anhydride
34,400	102	Phosphate esters
		Phthalate esters
		Polybenzyl ethyl benzene

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-24 (Continued)

TREATMENT PERFORMANCE DATA FOR TOLUENE

Plant 221 Biological Treatment[a] Influent (ug/L)	Effluent (ug/L)	Plant 221 Products Manufactured
		Di-isodecyl phthalate ester
		Ethylene
323	10	Propylene
190	10	Isopropanol
10	10	Petroleum hydrocarbon resins
		1,3-Butadiene
		Butylenes
		Cyclopentadiene dimer
		Isobutylene
		Isoprene

Plant 223 Biological Treatment[a] Influent (ug/L)	Effluent (ug/L)	Plant 223 Products Manufactured
		Acrylic acid esters
		Caprolactam
265	10	Cyclohexanone
179	10	Isobutanol
99	10	n-Butyl alcohol
		2-Ethyl hexanol

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-24 (Continued)

TREATMENT PERFORMANCE DATA FOR TOLUENE

Plant 230 Biological Treatment[a]		Plant 230
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Benzene
		Ethylene
15,891	10	Hydrogen
4,649	10	Propylene
4,904	10	Pyrolysis gasoline
20,065	10	Polyethylene resin
4,534	10	Polypropylene
19,848	10	Polypropylene resin
3,867	10	1,3-Butadiene
30,347	10	Butylenes
4,426	10	
3,806	10	
3,942	10	
3,538	10	
3,882	10	
3,789	10	
3,503	10	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-24 (Continued)

TREATMENT PERFORMANCE DATA FOR TOLUENE

Plant 234 Biological Treatment[a] Influent (ug/L)	Plant 234 Biological Treatment[a] Effluent (ug/L)	Plant 234 Products Manufactured
		Acetic acid
		Acetic anhydride
16,000	10	Acetone
6,200	10	Acetaldehyde
3,750	10	Propionic acid
7,600	10	PET resins/fibers
8,700	10	Acetoacetanilide
5,750	10	Terephthalic acid
6,800	10	n-Propyl acetate
6,500	10	Diethyl phthalate
9,800	10	Dimethyl phthalate
5,300	10	di-n-Butyl phthalate
4,100	10	Bis(2-ethylhexyl)phthalate
26,000	21	Methyl isobutyl ketone
3,825	19	Isopropoacetate
3,400	37	Isobutyl acetate
6,450	10	Hydroquinone
13,000	10	
35,000	10	
5,950	10	
5,310	10	
5,476	11	
11,060	12	
4,700	15	
2,350	10	
4,806	10	
6,650	67[b]	
15,000	10	
32,500	235[b]	
7,700	12	
25,750	10	
6,150	10	
16,000	10	
4,487	10	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

[b]In EPA's judgment, this data point represented poor design and operation. We confirmed this judgment using the outlier test (refer to Table II-12, Appendix II) and this data point was deleted.

Table 5-24 (Continued)

TREATMENT PERFORMANCE DATA FOR TOLUENE

Plant 240 Biological Treatment[a] Influent (ug/L)	Effluent (ug/L)	Plant 240 Products Manufactured
		Acetic acid
		Acetylene
22,700	10	Acrolein
		Acrylic acid esters
		Benzene
		Cyclohexanone
		Diethylene glycol
		Epoxidized esters
		Ethylamines (mono, di, tri)
		Ethylene
		Ethylene dimer
		Ethylene glycol
		Ethylene glycol monomethyl ether
		Ethylene oxide
		Isopropyl amines (mono, di)
		Peracetic acid
		Polyethylene glycol
		Polyethylene polyamines
		Propylene
		Toluene
		1,2-Dichloroethane
		Butylenes
		Xylenes (mixed)

Plant 242 Biological Treatment[a] Influent (ug/L)	Effluent (ug/L)	Plant 242 Products Manufactured
		Alkyd resins
		Epoxy resins
1,533	10	Glyoxal-urea formaldehyde textile resin
1,200	10	
		Unsaturated polyester resins
		Acrylic resins
		Melamine resins
		Urea resins

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-24 (Continued)

TREATMENT PERFORMANCE DATA FOR TOLUENE

Plant 244 Biological Treatment[a]	
Influent (ug/L)	Effluent (ug/L)
1,109	10

Plant 244 Products Manufactured
Cyclohexanol
C4 hydrocarbons
Ethylene
Ethylene-methacrylic acid copolymer
Polyethylene polyvinyl acetate copolymers
Propylene
Hexamethylenediamine
Polyethylene resins
Adiponitrile

Plant 246 Steam Stripping	
Influent (ug/L)	Effluent (ug/L)
98	12
80	10
57	10
72	10

Plant 246 Products Manufactured
Aniline
Dinitrotoluene (mixed)
Methylene diphenyl diisocyanate
Nitrobenzene
Polymeric methylene diphenyl diisocyanate
Polyoxypropylene glycol
Toluene diamine (mixture)
Toluene diisocyanates (mixture)
Polymeric methylene dianiline
Polyurethane resins

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-24 (Continued)

TREATMENT PERFORMANCE DATA FOR TOLUENE

Plant 246 Biological Treatment[a] Followed by Activated Carbon Adsorption		Plant 246
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Aniline
		Dinitrotoluene (mixed)
4,372	98	Methylene diphenyl diisocyanate
77	b	Nitrobenzene
4,881	b	Polymeric methylene diphenyl diisocyanate
2,273	b	
244	53	Polyoxypropylene glycol
12,938	30	Toluene diamine (mixture)
4,166	91	Toluene diisocyanates (mixture)
10,375	330	Polymeric methylene dianiline
12,864	437	Polyurethane resins
180	21	
5,397	b	
1,371	b	
3,899	b	
5,400	50[c]	
5,500	10[c]	
6,575	10[c]	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

[b]The treatment effluent was not sampled on this sampling day.

[c]In the data base from which this data was taken, the sampling data was designated using a different code, plant 219, because it represented a different sampling episode.

Table 5-24 (Continued)

TREATMENT PERFORMANCE DATA FOR TOLUENE

Plant 246 Biological Treatment[a]		Plant 246
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Aniline
		Dinitrotoluene (mixed)
4,372	736	Methylene diphenyl diisocyanate
77	168	Nitrobenzene
4,881	14	Polymeric methylene diphenyl diisocyanate
2,273	308	
244	b	Polyoxypropylene glycol
12,938	94	Toluene diamine (mixture)
4,166	661	Toluene diisocyanates (mixture)
10,375	1,453	Polymeric methylene dianiline
12,864	b	Polyurethane resins
180	2,136	
4,308	b	
5,397	102	
1,371	b	
3,899	b	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

[b]The treatment effluent was not sampled on this sampling day.

Table 5-24 (Continued)

TREATMENT PERFORMANCE DATA FOR TOLUENE

Plant 251 Biological Treatment[a]		Plant 251
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Acetone
		Acetonitrile
15,840	10	Acrylonitrile
26,060	10	Benzene
21,700	10	Butylenes (mixed)
		Dialkylbenzene, by-product
		Diphenyl oxide (diphenyl ether)
		Ethane
		Ethylbenzene
		Ethylene
		Formaldehyde
		Iminodiacetic acid
		Naphthalene
		Nitrilotriacetic acid
		o-Xylene
		Phenol
		Propylene
		Resin tars
		Sorbic acid, salts
		Toluene
		1,3-Pentadiene (piperylene)
		Phenolic resins
		Cumene
		1,3-Butadiene
		Cyclopentadiene dimer
		Isoprene
		Xylenes (mixed)

Plant 253 Biological Treatment[a]		Plant 253
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Polypropylene resins
175	38	
230	140	
66	130	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-24 (Continued)

TREATMENT PERFORMANCE DATA FOR TOLUENE

Plant 257 Biological Treatment[a]		Plant 257
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
		Acetone
		Allyl chloride
1,330	10	Bisphenol-A
1,800	10	Butylenes (mixed)
2,090	10	Diacetone alcohol
1,730	10	Ethylene
3,365	10	Isobutylene
3,720	10	Phenol
3,746	10	Propylene
2,660	10	Vinyl chloride
2,964	10	Epichlorohydrin
2,482	10	Acetone
5,040	10	Epoxy resins
5,510	10	Isopropanol
4,933	10	Methyl ethyl ketone
4,665	10	Methyl isobutyl ketone
4,707	10	n-Butyl alcohol
3,836	10	Cumene
3,160	10	Ethanol
2,627	10	sec-Butyl alcohol
3,450	10	Butadiene
2,684	10	Isoprene
7,600	10	
4,121	10	
5,290	10	
4,985	10	
7,417	16[b]	
12,900	45[b]	
11,400	10[b]	

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

[b]In the data base from which this data was taken, the sampling data was designated using a different code, plant 259, because it represented a different sampling episode.

Table 5-24 (Continued)

TREATMENT PERFORMANCE DATA FOR TOLUENE

Plant 265 Biological Treatment[a] Influent (ug/L)	Effluent (ug/L)	Plant 265 Products Manufactured
37,750	10	Tar, tar crudes, and tar pitches
44,000	10	
50,000	10	

Plant 286 Biological Treatment[a] Influent (ug/L)	Effluent (ug/L)	Plant 286 Products Manufactured
160,000	38	Formaldehyde
52,000	80	Phenolic resins
24,000	110	Urea resins

Plant 297 Steam Stripping Followed by Activated Carbon Adsorption Influent (ug/L)	Effluent (ug/L)	Plant 297 Products Manufactured
8,650	10[b]	Nitrobenzene
640	14[b]	Nitrotoluene
750	10[b]	Aniline
		Toluidine

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

[b]In the data base from which this data was taken, the sampling data was designated using a different code, plant 248, because it represented a different sampling episode.

Table 5-24 (Continued)

TREATMENT PERFORMANCE DATA FOR TOLUENE

Stover and Kincannon, 1983 Pilot-Scale Steam Stripper		Description of Waste Treated
Influent (ug/L)	Effluent (ug/L)	
92,000	126	Pilot-scale study of groundwater near a waste disposal dump site which contained household refuse, demolition materials, chemical sludges, and hazardous liquid chemicals
92,000	10	
92,000	10	
92,000	10	
92,000	53	

D.G. Hutton, 1979 Biological Treatment[a,b]		Description of Waste Treated
Influent (ug/L)	Effluent (ug/L)	
680	4.1	Wastewater from organic chemicals manufacturing.

Stover and Kincannon, 1983 Pilot-Scale Air Stripper		Description of Waste Treated
Influent (ug/L)	Effluent (ug/L)	
92,000	30,000	Pilot-scale study of groundwater near a waste disposal dump site which contained household refuse, demolition materials, chemical sludges, and hazardous liquid chemicals
92,000	23,300	
92,000	19,000	
92,000	17,100	
92,000	6,600	
92,000	44,800	

Becker and Wilson, 1978 Pilot-Scale Granular Activated Carbon Column		Description of Waste Treated
Influent (ug/L)	Effluent (ug/L)	
120	0.3	Runoff water from a waste disposal site's containment dikes

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).
[b]Commercially available patented PACT® process.

Table 5-24 (Continued)

TREATMENT PERFORMANCE DATA FOR TOLUENE

Iron and Steel Manufacturing
Development Document, 1980
Multiple Treatment Technologies

Average Influent (ug/L)	Average Effluent (ug/L)	Plant	Description of Waste Treated
8,920	40	003	Excess ammonia liquor and miscellaneous wastewaters
5,450	73	008	Excess ammonia liquor and benzol plant wastewaters
6,130	7	009	Excess ammonia liquor and benzol plant wastewaters

Data Submitted by Zimpro, Inc., 1986
Wet Air Oxidation

Raw Waste (ug/L)	Diluted Feed (ug/L)	Oxidation Product (ug/L)	Description of Waste Treated
34,100,000	8,500,000	200,000	General organic

Table 5-25

CALCULATION OF BDAT FOR TOLUENE

Plant No.	Technology	Average Treatment Concentration (ug/L)	Variability Factor	Treatment Concentration Level Avg. x VF (ug/L)
246	Steam Stripping	10.5	1.23	13
202	Biological	10	3.39[a]	34
208	Biological	10	3.39[a]	34
210	Biological	10	3.39[a]	34
211	Biological	10	3.39[a]	34
215	Biological	10	3.39[a]	34
217	Biological	73.3	3.39[a]	248
221	Biological	10	3.39[a]	34
223	Biological	10	3.39[a]	34
230	Biological	10	3.39[a]	34
234	Biological	11.9	1.87	22
240	Biological	10	3.39[a]	34
242	Biological	10	3.39[a]	34
244	Biological	10	3.39[a]	34
246	Biological	630	17.61	11,100
251	Biological	10	3.39[a]	34
257	Biological	11.6	1.89	22
265	Biological	10	3.39[a]	34
286	Biological	76	3.25	247
246	Biological followed by Activated Carbon	113	9.89	1,118
297	Steam Stripping followed by Activated Carbon	11.3	1.55	18
1[b]	Biological	4.1	3.39[a]	14

[a]Average variability factor for BDAT biological treatment data (see Table 5-4 and the discussion on page 5-17).
[b]Commercially available patented PACT® process.

5.5.23 1,1,1-Trichloroethane Wastewaters

The Agency has full-scale biological treatment data for 1,1,1-trichloroethane from plant 240 in the OCPSF data base. The Agency also has data from pilot-scale steam stripping and pilot-scale air stripping of solvent contaminated groundwater (Reference 2), pilot-scale air stripping of industrial discharge contaminated groundwater (Reference 6), and bench-scale wet air oxidation of a general organic waste (Reference 10). The data are summarized in Table 5-26 and calculation of the BDAT treatment standard is shown in Table 5-27.

The following steps were taken to derive the BDAT treatment standard for 1,1,1-trichloroethane:

1. We evaluated each data set to determine whether any of the data represent poor design or operation of the treatment systems. Data from pilot-scale wet air oxidation treatment were deleted because the concentration of 1,1,1-trichloroethane in the diluted feed to the wet air oxidation process was not reported and because the detection limit of 1,000 ug/L for 1,1,1-trichloroethane in the oxidation product is too high for the data to be meaningful with regard to how well the system will perform.

   Data on pilot-scale steam stripping and pilot-scale air stripping were not deleted because, in consideration of the amount of full-scale treatment data available for this constituent, we believe that it is appropriate to include this pilot-scale data in derivation of the BDAT treatment standard for 1,1,1-trichloroethane.

2. We calculated the arithmetic average treatment concentration and the variability factor for each data set as shown in Table 5-27. Process variability could not be calculated for biological treatment at plant 240 because all effluent values were reported as less than or equal to the detection limit of 10 ug/L. We would expect some variability in the data because the actual concentrations would range from 0 to the detection limit of 10 ug/L. To estimate the variability, the Agency used the average variability factor for BDAT biological treatment, 3.39. (Calculation of the average variability factor is shown in Table 5-4, page 5-18.)

   To account for full-scale process variability in the pilot-scale steam stripping data, the average variability factor for BDAT full-scale steam stripping, 2.26, was used. (Calculation of the average variability factor is shown in Table 5-4, page 5-18.)

Process variability could not be calculated for the pilot-scale air stripper at Site 2 because there is only one data pair available from this process. Therefore, the average variability factor for all BDAT wastewater treatment, 3.56, was used. (Calculation of the average variability factor is shown in Table 5-4, page 5-18.)

3. Steam stripping and air stripping of 1,1,1-trichloroethane at the pilot-plant (Reference 2) were compared with the analysis of variance method to determine whether the performance of one technology was significantly better than the other for treatment of the same waste. It was shown that steam stripping provided significantly better removals of 1,1,1-trichloroethane compared with air stripping (refer to Table II-15, Appendix II). Therefore, the treatment standard for the pilot-plant is 1,046 ug/L based upon steam stripping.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-26 could be associated with separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastewaters containing 1,1,1-trichloroethane spent solvents. The least stringent treatment level within the treatability subgroup was selected for BDAT (1.05 mg/L from pilot-scale steam stripping) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup.

5. The BDAT treatment standard for 1,1,1-trichloroethane represents treatment of a variety of waste matrices generated by process streams from the manufacture of over 28 different products. The untreated waste concentration of 1,1,1-trichloroethane ranged from 0.010 mg/L to 150 mg/L in these waste matrices. All of these wastes were treated to the BDAT treatment standard or below (1.05 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing 1,1,1-trichloroethane and substantially reduce the likelihood of migration of 1,1,1-trichloroethane from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for 1,1,1-trichloroethane was 0.457 based on steam stripping (see Table 13, 51 FR 1725). The difference between the proposed and promulgated treatment standards is primarily due to the incorporation of a variability factor in derivation of the promulgated treatment standard. Other less significant factors affecting the change in the treatment standard are the changes in data editing (data editing rules are presented in Section 5.3).]

Table 5-26

TREATMENT PERFORMANCE DATA FOR 1,1,1-TRICHLOROETHANE

Stover and Kincannon, 1983
Pilot-Scale Steam Stripper

Influent (ug/L)	Effluent (ug/L)
150,000	10
150,000	10
150,000	150
150,000	2,135
150,000	10

Description of Waste Treated

Pilot-scale study of groundwater near a waste disposal dump site which contained household refuse, demolition materials, chemical sludges, and hazardous liquid chemicals.

Plant 240
Biological Treatment[a]

Influent (mg/L)	Effluent (mg/L)
215	10
10	10
95	10

Plant 240
Products Manufactured

Acetic acid
Acetylene
Acrolein
Acrylic acid esters
Benzene
Cyclohexanone
Diethylene glycol
Epoxidized esters
Ethylamines (mono, di, tri)
Ethylene
Ethylene dimer
Ethylene glycol
Ethylene glycol monomethyl ether
Ethylene oxide
Isopropyl amines (mono, di)
Peracetic acid
Polyethylene glycol
Polyethylene polyamines
Propylene
Toluene
1,2-Dichloroethane
Butylenes
Xylenes (mixed)

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-26 (Continued)

TREATMENT PERFORMANCE DATA FOR 1,1,1-TRICHLOROETHANE

Stover and Kincannon, 1983. Pilot-Scale Air Stripper		Description of Waste Treated
Influent (ug/L)	Effluent (ug/L)	
150,000	53,000	Pilot-scale study of ground-water near a waste disposal dump site which contained household refuse, demolition materials, chemical sludges, and hazardous liquid chemicals.
150,000	66,000	
150,000	60,000	
150,000	39,200	
150,000	7,600	
150,000	66,300	

Love and Eilers, 1982 Pilot-Scale Air Stripper, Site 2		Description of Waste Treated
Average Influent Concentration (ug/L)	Average Effluent Concentration for 4:1 Air-to-Water Ratio (ug/L)	
237	23	Ground water was contaminated by industrial discharge; pilot-scale column was run continuously for over one year.

Data Submitted by Zimpro, Inc., 1986 Wet Air Oxidation		
Raw Waste (ug/L)	Oxidation Product (ug/L)	Description of Waste Treated
370,000	<1,000	General organic.

Table 5-27

CALCULATION OF BDAT FOR 1,1,1-TRICHLOROETHANE

Plant No.	Technology	Average Treatment Concentration (ug/L)	Variability Factor	Treatment Concentration Level Avg. x VF (ug/L)
PS	Air Stripping	48,683	5.80	282,361
PS	Steam Stripping	463	2.26[a]	1,046
240	Biological	10	3.39[b]	34
PS,2	Air Stripping	23	3.56[c]	82

[a]Average variability factor for BDAT full-scale steam stripping (see Table 5-4 and the discussion on page 5-17).
[b]Average variability factor for BDAT biological treatment (see Table 5-4 and the discussion on page 5-17).
[a]Average variability factor for all BDAT wastewater treatment (see Table 5-4 and the discussion on page 5-17).

5.5.24 1,1,2-Trichloro-1,2,2-trifluoroethane Wastewaters

The Agency has no data for wastewater treatment for the removal of 1,1,2-trichloro-1,2,2-trifluoroethane. For reasons presented in Section 5.5.1, EPA used chemical structure as the basis for transferring treatment data to 1,1,2-trichloro-1,2,2-trifluoroethane spent solvent wastewaters. Specifically, we transferred the treatment data from 1,1,1-trichloroethane because, like 1,1,2-trichloro-1,2,2-trifluoroethane, 1,1,1-trichloroethane contains the halogen functional group. 1,1,1-trichloroethane had the least stringent treatment standard in the halogenated aliphatics structural group. Using performance data from 1,1,1-trichloroethane, the BDAT treatment standard for 1,1,2-trichloro-1,2,2-trifluoroethane is 1.05 mg/L. The technology basis for this treatment is steam stripping.

We believe the BDAT treatment standard for 1,1,2-trichloro-1,2,2-trifluoroethane spent solvent wastewaters represents substantial treatment. We would expect untreated 1,1,2-trichloro-1,2,2-trifluoroethane wastes to be similar to untreated 1,1,1-trichloroethane wastes, from which we transferred treatment data. As discussed on page 5-110, in reference to 1,1,1-trichloroethane, we believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing 1,1,2-trichloro-1,2,2-trifluoroethane and substantially reduce the likelihood of migration of 1,1,2-trichloro-1,2,2-trifluoroethane from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for 1,1,2-trichloro-1,2,2-trifluoroethane was 0.457 mg/L based on steam stripping (see Table 13, 51 FR 1725). The principal difference between the proposed and promulgated treatment standards is the Agency's change in the criteria for data transfer. (See Section 5.5.1, page 5-14, for a discussion of the Agency's methodology for data transfer.)]

5.5.25 Trichloroethylene Wastewaters

The Agency has biological treatment data for trichloroethylene at plants 213, 217, and 253 in the OCPSF data base. The Agency also has data from steam stripping at plant 284 and biological treatment followed by activated carbon adsorption at plant 246 in the OCPSF data base. Data are available for pilot-scale activated carbon adsorption (Reference 8). Full-scale biological treatment data of wastewater from organic chemicals manufacturing (commercially available patented PACT® process, Reference 4) and data from pilot-scale air stripping of tap water spiked with the constituent (Reference 6) are also available. The data are summarized in Table 5-28 and calculation of the BDAT treatment standard is shown in Table 5-29.

The following steps were taken to derive the BDAT treatment standard for trichloroethylene:

1. We evaluated each data set to determine whether any of the data represent poor design or operation of the treatment systems. In EPA's judgment, one data point in the data set for steam stripping at plant 284 represented poor design and operation. We confirmed this judgment using the outlier test (refer to Table II-17, Appendix II). The outlying data point was deleted. Another data point was deleted because the influent was less than the quantification level (0.05 mg/L).

   In consideration of the amount of full-scale data available for trichloroethylene, we believe it is appropriate to exclude data on pilot-scale activated carbon adsorption and pilot-scale air stripping treatment.

2. We calculated the arithmetic average effluent concentration and the variability factor for each data set as shown in Table 5-29. Process variability could not be calculated for biological treatment at plant 253 and biological treatment by the PACT® process because there was only one data pair available for each process. Therefore, the average variability factor for BDAT biological treatment, 3.39, was used (calculation of the average variability factor is shown in Table 5-4, page 5-18).

   Process variability could not be calculated for biological treatment at plants 213 and 217 and for biological treatment followed by activated carbon adsorption at plant 246 because all effluent values were reported as less than or equal to the detection limit of 10 ug/L. We would expect some variability in

the data because the actual concentrations would range from 0 to the detection limit of 10 ug/L. To estimate the variability, the Agency used the average variability factor for BDAT biological treatment, 3.39, for plants 213 and 217 and the average variability factor for BDAT biological treatment followed by activated carbon adsorption, 6.17, for plant 246 (calculation of the average variability factors is shown in Table 5-4, page 5-18).

3. The analysis of variance method was not used to compare different treatments of the same waste because data are available for only one type of treatment for each waste.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-27 could be associated with separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastewaters containing trichloroethylene spent solvents. The least stringent treatment level within the treatability subgroup was selected for BDAT (0.062 mg/L from plant 246) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. The technology basis was biological treatment followed by activated carbon adsorption.

5. The BDAT treatment standard for trichloroethylene represents treatment of a variety of waste matrices generated by process streams from the manufacture of over 50 different products. The untreated waste concentration of trichloroethylene ranged from 0.010 mg/L to 10.3 mg/L in these waste matrices. All of these wastes were treated to the BDAT treatment standard or below (0.062 mg/L). We believe these constituent reductions to substantially diminish the toxicity of the spent solvent wastes containing trichloroethylene and substantially reduce the likelihood of migration of trichloroethylene from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for trichloroethylene was <0.019 mg/L based on steam stripping (see Table 13, 51 FR 1725). The difference between the proposed and promulgated treatment standards is primarily due to the incorporation of a variability factor in derivation of the promulgated treatment standard. Other less significant factors affecting the change in the treatment standard are the changes in data editing (data editing rules are presented in Section 5.3) and deletion of some data points in the final rule because they represent poor operation of the treatment system (see the discussion of the outlier test in Section 5.4).]

Table 5-28

TREATMENT PERFORMANCE DATA FOR TRICHLOROETHYLENE

Plant 213 Biological Treatment[a]		Plant 213
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
16	10	Acetylenic alcohols & diols Ethylene-vinyl acetate copolymer
67	10	Polyvinyl alcohol resin
76	10	PVC copolymers, ethylene-vinyl chloride Polyvinyl acetate resins Polyvinyl chloride

Plant 217 Biological Treatment[a]		Plant 217
Influent (ug/L)	Effluent (ug/L)	Products Manufactured
98	10	Phthalic anhydride Butyl benzyl phthalate Benzyl chloride
200	10	Tetrachlorophthalic anhydride
224	10	Phosphate esters Phthalate esters Polybenzyl ethyl benzene

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

Table 5-28 (Continued)

TREATMENT PERFORMANCE DATA FOR TRICHLOROETHYLENE

Plant 246 Biological Treatment[a] Followed by Activated Carbon Adsorption		Plant 246 Products Manufactured
Influent (ug/L)	Effluent (ug/L)	
		Aniline
		Dinitrotoluene (mixed)
50	10[b]	Methylene diphenyl diisocyanate
70	10[b]	Nitrobenzene
40	10[b]	Polymeric methylene diphenyl diisocyanate
		Polyoxypropylene glycol
		Toluene diamine (mixture)
		Toluene diisocyanates (mixture)
		Polymeric methylene dianiline
		Polyurethane resins

Plant 253 Biological Treatment[a]		Plant 253 Products Manufactured
Influent (ug/L)	Effluent (ug/L)	
484	16	Polypropylene resins

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

[b]In the data base from which this data was taken, the sampling data was designated using a different code, plant 219, because it represented a different sampling episode.

Table 5-28 (Continued)

TREATMENT PERFORMANCE DATA FOR TRICHLOROETHYLENE

Plant 284 Steam Stripping		Plant 284 Products Manufactured
Influent (ug/L)	Effluent (ug/L)	
		Benzene
		1,3-Butadiene
1,650	10	Ethylene
5,200	10	Propylene
5,000	10	Methylene chloride
1,720	10	1,1,2-Trichloroethane
1,560	10	Vinylidine chloride
59	10	1,2,3-Trichloropropene
10,300	10	1,2-Dichloropropane
90	10	Propylene oxide
84	10	Ethylene oxide
83	10	Propylene glycol
210	10	Dipropylene glycol
1,600	27	Tripropylene glycol
160	10	Ethylene glycol
204	85[a]	Methyl chloride
10	10[b]	Diethylene glycol
		Triethylene glycol
		Tetraethylene glycol
		Ethanol amines
		Polypropylene
		Chloroform
		Carbon tetrachloride
		1,2-Dichloroethane
		Vinyl chloride

D.G. Hutton, 1979 Biological Treatment[c,d]		Description of Waste Treated
Influent (ug/L)	Effluent (ug/L)	
60	5.8	Wastewater from organic chemicals manufacturing.

[a]In EPA's judgment, this data point represented poor design and operation. We confirmed this judgment using the outlier test (refer to Table II-17, Appendix II) and this data point was deleted.

[b]This data point was deleted from analyses because the influent is less than the quantification level (50 ug/L).

[c]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).

[d]Commercially available patented PACT® process.

Table 5-28 (Continued)

TREATMENT PERFORMANCE DATA FOR TRICHLOROETHYLENE

Love and Eilers, 1982 Pilot-Scale Air Stripper, Site 1								Description of Waste Treated
Average Influent Concentration (ug/L)	Average Effluent Concentration at Various Air-to-Water Ratios (ug/L)							
	1:1	2:1	3:1	4:1	8:1	16:1	20:1	
1,064	796	614	508	319	53			Tap water spiked with tetrachloroethylene and trichloroethylene.
397	223	273	102	82	22	<1	<1	
241	136	110	61	53	8	2	3	
110	40	28	18	9	3	<1	<1	
73	22	14	8	6	1	<1	<1	

Ruggiero and Ausubel, 1982 Pilot-Scale Granular Activated Carbon Column		Description of Waste Treated
Influent (ug/L)	Effluent (ug/L)	
171	0.59	Contaminated drinking water supply.

Table 5-29

CALCULATION OF BDAT FOR TRICHLOROETHYLENE

Plant No.	Technology	Average Treatment Concentration (ug/L)	Variability Factor	Treatment Concentration Level Avg. x VF (ug/L)
284	Steam Stripping	11.3	1.81	20
213	Biological	10	3.39[a]	34
217	Biological	10	3.39[a]	34
253	Biological	16	3.39[a]	54
246	Biological followed by Activated Carbon	10	6.17[b]	62
1[c]	Biological	5.8	3.39[a]	20

[a]Average variability factor for BDAT biological treatment (see Table 5-4 and the discussion on page 5-17).

[b]Average variability factor for BDAT biological treatment followed by activated carbon adsorption (see Table 5-4 and the discussion on page 5-17).

[c]Commercially available patented PACT® process.

5.5.26 Trichlorofluoromethane Wastewaters

The Agency has trichlorofluoromethane treatment data from full-scale biological treatment of wastewater from organic chemicals manufacturing (commercially available patented PACT® process, Reference 4). The data are summarized in Table 5-30.

The following steps were taken to derive the BDAT treatment standard for trichlorofluoromethane:

1. We evaluated the data set to determine whether the data represent poor design or operation of the treatment system. The available data and information did not show any of the data to represent poor design and operation. Accordingly, none of the data were deleted on this basis.

2. We calculated the arithmetic average treatment concentration and the variability factor for the data set. The average effluent concentration is 13 ug/L. Process variability could not be calculated for this plant because there is only one data pair available from this process. Therefore, the average variability factor for BDAT biological treatment, 3.39, was used (calculation of the average variability factor is shown in Table 5-4, page 5-18).

3. The analysis of variance method was not used to compare different treatments of the same waste because data are available for only one type of treatment for each waste.

4. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastewaters containing trichlorofluoromethane spent solvents. The BDAT treatment level for trichlorofluoromethane was selected (0.044 mg/L from Hutton, 1979) by multiplying the process effluent concentration, 0.013 mg/L by the average variability factor from BDAT biological treatment, 3.39. This calculated treatment standard is below the quantification level and could not be used as the treatment standard; therefore, the treatment standard was set at the quantification level of 0.05 mg/L. The technology basis was biological treatment.

5. The BDAT treatment standard for trichlorofluoromethane represents treatment of a waste matrix generated by process streams from the manufacture of organic chemicals. The untreated waste

concentration of trichlorofluoromethane was as high as 0.920 mg/L in this waste matrix. This waste was treated to a concentration below the BDAT treatment standard (0.050 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing trichlorofluoromethane and substantially reduce the likelihood of migration of trichlorofluoromethane from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for trichlorofluoromethane was 0.457 mg/L based on steam stripping (see Table 13, 51 FR 1725). The principal differences between the proposed and promulgated treatment standards are EPA's consideration of quantification levels in setting the standard (see the discussion of the use of quantification levels in Section 5.5, page 5-12) and use of biological treatment performance data at promulgation that were not used at proposal. (The data were deleted at proposal because the influent concentration was below the screening level for trichlorofluoromethane.) The incorporation of a variability factor in derivation of the promulgated treatment standard also contributed to the change in the treatment standard since proposal.]

Table 5-30

TREATMENT PERFORMANCE DATA FOR TRICHLOROFLUOROMETHANE

D.G. Hutton, 1979		
Biological Treatment[a,b]		Description of Waste Treated
Influent (ug/L)	Effluent (ug/L)	
920	13	Wastewater from organic chemicals manufacturing.

[a]The data do not represent paired data (i.e., the samples were not collected so as to fully account for the retention time in the treatment system).
[b]Commercially available patented PACT® process.

5.5.27 Xylene Wastewaters

The Agency has wet air oxidation data (Reference 10), activated carbon adsorption followed by steam stripping data (Reference 9), and carbon adsorption data (Reference 7) for xylene. The data are summarized in Table 5-31.

The following steps were taken to derive the BDAT treatment standard for xylene:

1. We evaluated each data set to determine whether any of the data represent poor design or operation of the treatment systems. The data for wet air oxidation were deleted because the detection limit of 500 ug/L for xylene in the oxidation product is too high for the data to be meaningful with regard to how well the system will perform. The data from the Iron and Steel Manufacturing Development Document were not used because insufficient information exists in some cases to determine the concentrations treated and, in other cases, which technology was achieving removal. Also, in some cases, the treated values represented significant dilution of the wastestream.

2. We calculated the arithmetic average treatment concentration and the variability factor for the data set. Process variability could not be calculated for activated carbon adsorption at the pilot-scale plant because there is only one data pair available from this process. Therefore, the average variability factor for all BDAT activated carbon adsorption, 4.54, was used (calculation of the average variability factor is shown in Table 5-4).

3. The analysis of variance method was not used to compare different treatments of the same waste because data are available for only one type of treatment for each waste.

4. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastewaters containing xylene spent solvents. The BDAT treatment level for xylene was selected (0.0005 mg/L from Becker and Wilson, 1978) by multiplying the process effluent concentration, 0.0001 mg/L by the average variability factor from BDAT activated carbon adsorption, 4.54. This calculated standard is below the quantification level and could not be used as the treatment standard. Therefore, the treatment standard was set at the quantification level of 0.05 mg/L. The technology basis was activated carbon adsorption.

5. The BDAT treatment standard for xylene represents treatment of a waste matrix from a disposal site. The untreated waste concentration of xylene was as high as 0.140 mg/L in this waste matrix. This waste was treated to a concentration below the BDAT treatment standard (0.050 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing xylene and substantially reduce the likelihood of migration of xylene from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for xylene was <0.005 mg/L based on activated carbon adsorption followed by steam stripping (see Table 13, 51 FR 1725). The principal differences between the proposed and promulgated treatment standards are EPA's consideration of quantification levels in setting the standard (see the discussion on the use of quantification levels in Section 5.5 on page 5-12) and the incorporation of a variability factor in derivation of the promulgated treatment standard. Other less significant factors affecting the change in the treatment standard are the changes in data editing (data editing rules are presented in Section 5.3) and deletion of some data points in the final rule because they represent poor operation of the treatment system (see the discussion of the outlier test in Section 5.4).]

Table 5-31

TREATMENT PERFORMANCE DATA FOR XYLENE

Iron and Steel Manufacturing
Development Document, 1980
Multiple Treatment Technologies

Average Influent (ug/L)	Average Effluent (ug/L)	Plant	Description of Waste Treated
101,000	5	009	Excess ammonia liquor and benzol plant wastewaters

Data Submitted by Zimpro, Inc., 1986
Wet Air Oxidation

Raw Waste (ug/L)	Diluted Feed (ug/L)	Oxidation Product (ug/L)	Description of Waste Treated
212,000	21,200	<500	General organic

Becker and Wilson, 1978
Pilot-Scale Granular Activated Carbon Column

Influent (ug/L)	Effluent (ug/L)	Description of Waste Treated
140	<0.1	Runoff water from a waste disposal site's containment dikes

5.6 Development of BDAT Treatment Standards for F001-F005 Spent Solvent Wastes (Other Than Wastewater)

BDAT treatment standards for F001-F005 spent solvent wastes (other than wastewater) are presented in Table 5-2. BDAT treatment standards for spent solvent wastes other than wastewaters are based on incineration of the waste. Treatment standards were calculated from data on the analysis of the TCLP extract of incinerator residue. Descriptions of how the treatment standards were derived for spent solvent wastes other than wastewaters are presented in this section. Treatment performance data for each constituent are also presented in this section. Data sets including all constituents and all pollutant parameters analyzed in the wastes treated at each incinerator are included in Appendix I. Where data on the TCLP extract were not available, treatment data were transferred based on structural similarity. Transfer of incineration treatment data is discussed in Section 5.6.1.

The derivation of BDAT treatment standards includes a variability analysis as discussed in Section 5.4. For some data sets, we had insufficient data to develop variability factors. Therefore, to account for process variability, an average variability factor was calculated from data available from TCLP extracts of incinerator ash from the burning of waste containing acetone, methylene chloride, and toluene. Calculation of the average variability factor is discussed in Section 5.6.2.

In some cases, the treatment standard derived from the data was below the EPA published analytical quantification level for a specific constituent. In these instances, the BDAT treatment standard was set at the quantification level, which is the lowest level at which EPA can support analytical quantification over the range of wastes that will be subject to this rule.

5.6.1 Transfer of Incineration Treatment Data

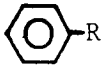
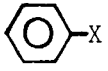
Where data on the TCLP extract of incinerator ash were not available to the Agency, treatment data were transferred from other constituents for which data were available. For this rulemaking, treatment data were transferred based on similarity of chemical structure. Chemical structure is commonly used to predict how organic compounds will react with other compounds and under various conditions. Constituents considered to be similar in chemical structure contain the same functional groups. Functional groups such as double bonds, hydroxyl groups, ketone groups, and amino groups, are the parts of the molecule where most chemical reactions occur (including combustion reactions which occur during incineration). A compound's chemical, physical, and thermodynamic properties are also dependent on chemical structure. Included in Table 5-32 are the structural groups upon which the transfer of treatment standards was based.

Although parameters such as the heat of combustion could be used to indicate the amenability of a compound to incineration, the Agency believes that for the wide range of wastes covered for this particular rulemaking, a broader approach to data transfer is warranted. Therefore, the Agency transferred treatment standards based on general chemical structure rather than on a single physical, chemical, or thermodynamic property specific to the treatment technology.

The F001-F005 hazardous wastes were grouped according to chemical structures as listed in Table 5-32. To best account for the range of physical and chemical properties within a structural group that affect treatment, the Agency transferred data from the compound with the least stringent treatment standard for any member of that structural group. If no treatment data were available for any member of a particular structural group, data representing the least stringent treatment standard from the next most similar structural group were transferred. For example, no treatment data were available for any member of the alcohols, esters, and ethers structural groups. The ketones were considered to be the next most similar structural group, based on the oxygen containing, electron-releasing functional groups present in all four structural groups. Therefore, data representing the least stringent treatment standard for constituents in the ketones group were transferred to the alcohols, ethers, and esters groups.

Table 5-32

GROUPING OF SPENT SOLVENT CONSTITUENTS FOR TRANSFER OF BDAT TREATMENT DATA FOR ALL OTHER F001 - F005 SPENT SOLVENTS

Name of Structural Group	Functional Group	Constituent	Treatment Standard (mg/L in TCLP Extract of Incinerator Ash)	Constituent From Which Data Were Transferred
Halogenated Aliphatics	R-X	Carbon tetrachloride	0.96[a]	Methylene Chloride
		Methylene chloride	0.96	
		1,1,1-Trichloroethane	0.41	
		1,1,2-Trichloro-1,2,2-trifluoroethane	0.96[a]	Methylene Chloride
		Trichlorofluoromethane	0.96[a]	Methylene Chloride
Non-Halogenated Aromatics		Ethylbenzene	0.053[b]	
		Toluene	0.33	
		Xylene	0.15	
		Nitrobenzene	0.125[b]	
		Pyridine	0.33a	Toluene
Halogenated Alkenes	R=R'	Tetrachloroethylene	0.05[b]	
		Trichloroethylene	0.091	
Halogenated Aromatics		Chlorobenzene	0.05[b]	
		1,2-Dichlorobenzene	0.125[b]	
Ketones	R-C-R' ‖ O	Acetone	0.59	
		Cyclohexanone	0.75[a]	Methyl ethyl ketone
		Methyl ethyl ketone	0.75	
		Methyl isobutyl ketone	0.33	

[a]Transferred treatment data.
[b]Treatment standard shown is the quantification level for the constituent.

Table 5-32 (Continued)

GROUPING OF SPENT SOLVENT CONSTITUENTS FOR TRANSFER OF
BDAT TREATMENT DATA FOR ALL OTHER F001 - F005
SPENT SOLVENTS

Name of Structural Group	Functional Group	Constituent	Treatment Standard (mg/L in TCLP Extract of Incinerator Ash)	Constituent From Which Data Were Transferred
Alcohols	R-OH	n-Butyl alcohol	5.0[a,b]	Methyl ethyl ketone
		Isobutanol	5.0[a,b]	Methyl ethyl ketone
		Methanol	0.75[a]	Methyl ethyl ketone
Ethers	R-O-R'	Ethyl ether	0.75[a]	Methyl ethyl ketone
Esters	R-C-OR' (O)	Ethyl acetate	0.75[a]	Methyl ethyl ketone
Phenols	-OH	Cresols	0.75[a]	Methyl ethyl ketone
Organic Sulfur Compounds	R = S	Carbon disulfide	4.81	

[a]Transferred treatment data.
[b]Treatment standard shown is the quantification level for the constitutent.

5.6.2 Derivation of An Average Variability Factor for Incineration

The derivation of BDAT treatment standards includes a variability analysis as discussed in Section 5.4.1. For some data sets, we had insufficient data to develop variability factors; in these cases we used a variability factor that represented the average of the variability factors from available data sets. Calculation of the average variability factors is shown in Table 5-33, page 5-134.

Table 5-33

VARIABILITY FACTORS FOR INCINERATION DATA*

Constituent	Site	Variability Factor
Methylene Chloride	2	9.05
Acetone	2	1.629
	AVERAGE	5.34

*The variability factors for methylene chloride and acetone shown in the above table are generated from a plant sampled subsequent to proposal. Analysis of the samples were completed after the Agency's September 5, 1986 Notice of Data Availability (51 FR 31783). The average variability factor calculated from these data is somewhat higher than the variability factor generated from data available at proposal and presented in the Notice of Data Availability (5.34 compared to 3.56). In addition, since this value is based on incineration data, it provides a better representation of the variability experienced in a full-scale incinerator than does the previous value derived from wastewater treatment technologies. The specific data used to generate the individual variability factors for methylene chloride and acetone has been claimed to be confidential.

5.6.3 Acetone (Other Than Wastewater)

The Agency has treatment data for the TCLP extract of incinerator ash from the treatment of acetone (Reference 11). The data are summarized in Table 5-34.

The following steps were taken to derive the BDAT treatment standard for acetone:

1. We evaluated the data to determine whether any of the data represented poor design or operation of the incineration system. Data from one facility (site 6) were deleted because the incineration system control devices were not properly designed and operated. The facility is under a Consent Decree to replace and improve the current incinerator control system. Data from another facility (site 2) were deleted because the Agency judged that the system was not properly operated at the time the data were collected. A follow-up sampling visit confirmed the Agency's judgment. The new data were not used in the determination of the long-term performance average for incineration of acetone; however, the data were used to develop a variability factor for incineration.

2. We determined an arithmetic average residue concentration level and a variability factor for each data set. Residue concentration levels reported as less than or equal to the reported detection limit were set equal to the detection limit for statistical analyses. This is a conservative approach since the actual concentration would be between zero and the detection limit. Two residue concentration levels were reported for site 5, one for each incinerator at the site. These were considered as two separate data points.

   Process variability could not be calculated from the incineration data because only one influent and effluent data pair was available for each data set. Therefore, to account for process variability, an average variability factor was calculated for incineration, 5.34 (calculation of the average variability factor is shown in Table 5-33).

3. The analysis of variance method was not used to compare different treatments of the same waste because data are available for only one type of treatment for each waste.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-34 could be associated with

separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastes (other than wastewater) containing acetone spent solvents. The least stringent treatment level within the treatability subgroup was selected for BDAT (0.59 mg/L for site 7 obtained by multiplying the variability factor by the highest average residue concentration level) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. The technology basis was incineration.

5. The BDAT treatment standard for acetone represents treatment of a variety of waste matrices incinerated at six different sites. The untreated waste concentration of acetone ranged from 36 mg/kg to 160,000 mg/kg in these waste matrices. All of these wastes were treated to the BDAT treatment standard or below (0.59 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing acetone and substantially reduce the likelihood of migration of acetone from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for acetone was estimated at the detection limit of <0.050 mg/L based on incineration (see Table 11, 51 FR 1722). The difference between the proposed and promulgated treatment standards is primarily a result of additional data gathering subsequent to proposal. The new data were presented in EPA's Notice of Availability of Data (51 FR 31783). In addition, a variability analysis was incorporated into the development of the treatment standards for promulgation.]

Table 5-34

INCINERATION DATA FOR ACETONE

Site	Type of Incinerator	Wastes Incinerated	Flow-Weighted Average Influent (mg/kg)	Incinerator Residue* Total (mg/kg)	Incinerator Residue* TCLP (ug/L)	Footnotes
1	Rotary Kiln with Secondary Combustor	PCB Contaminated Dirt	36	<5	<5	a
3	Rotary Kiln with Secondary Combustor	Drum Feed Solids Liquid Waste Fuel	160,000	<2.5	<5	a
5	Fixed Hearth (Two Separate Incineration Systems)	(From Furniture Manufacturing Industry) Solvent Wastes High-Btu Liquid Wastes Low-Btu Liquid Wastes Lacquer-Coated Cardboard	13,500 13,500	<500 <500	<5 <5	b b
7	Fixed Hearth with Secondary Combustor	High-Btu Liquids Low-Btu Liquids Solids Feed	3,120	<500	110	a
8	Rotary Kiln with Secondary Liquid Injection Combustor	Liquid Waste Fuel	86,000	<2.5	<5	a

*Values shown as "<" were reported as below the indicated detection limits.

(a) Influent concentration is flow-weighted average.
(b) Influent concentration is an arithmetic average.

Table 5-34 (Continued)

INCINERATION DATA FOR ACETONE

Site	Type of Incinerator	Wastes Incinerated	Flow-Weighted Average Influent (mg/kg)	Incinerator Residue* Total (mg/kg)	Incinerator Residue* TCLP (ug/L)	Footnotes
9	Rotary Kiln with Secondary Combustor	High-Btu Liquids Low-Btu Liquids Solids Feedb	223,335	<2.5	67	a

*Values shown as "<" were reported as below the indicated detection limits.

(a) Influent concentration is flow-weighted average.
(b) Gel and filter press residue.

5.6.4 n-Butyl Alcohol (Other Than Wastewater)

The Agency has no data on TCLP extracts of residue from incineration of n-butyl alcohol to use in the derivation of the BDAT treatment standard. For reasons presented in Section 5.6.1, EPA used chemical structure as the basis for transferring treatment data to n-butyl alcohol spent solvent wastes other than wastewaters. Specifically we transferred treatment data from methyl ethyl ketone, which contains the ketone functional group, to n-butyl alcohol, which contains the hydroxyl functional group. The alcohols structural group is most structurally similar to the ketones group based upon their oxygen-containing, electron-releasing functional groups.

The Agency has data on the analysis of the TCLP extract of incineration residue for three compounds in the ketones structural group: acetone, methyl ethyl ketone, and methyl isobutyl ketone. To best account for the range of physical and chemical properties within a structural group that affect treatment by a specific technology, the Agency transferred data representing the least stringent treatment standard from the compounds for which data were available in the ketones structural group. The data from which the treatment standard for incineration of methyl ethyl ketone was derived were transferred to n-butyl alcohol. The treatment standard is 0.75 mg/L based on the transferred data. The transferred value is below the quantification level for n-butyl alcohol and could not be used as the treatment standard. Therefore, the treatment standard is set at the quantification level of 5.0 mg/L.

We believe the BDAT treatment standard for n-butyl alcohol spent solvent wastes (other than wastewater) represents substantial treatment. We would expect untreated n-butyl alcohol wastes to be similar to untreated methyl ethyl ketone wastes from which we transferred treatment data since they are used in many similar manufacturing processes, as shown in Section 2 of this document. As discussed on page 5-163, in reference to methyl ethyl ketone, we believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing n-butyl alcohol and substantially reduce the likelihood of migration of n-butyl alcohol from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for n-butyl alcohol was estimated at the detection limit of <0.100 mg/L based on incineration (see Table 11, 51 FR 1722). The principal difference between the proposed and promulgated treatment standards is the Agency's change in the criteria for data transfer (see Section 5.6.1, page 5-130, for a discussion of the Agency's methodology for data transfer.)]

5.6.5 Carbon Disulfide (Other Than Wastewater)

The Agency has treatment data for the TCLP extract of incinerator ash from the treatment of carbon disulfide (Reference 11). The data are summarized in Table 5-35.

The following steps were taken to derive the BDAT treatment standard for carbon disulfide:

1. We evaluated the data to determine whether any of the data represented poor design or operation of the incineration system. The available data and information did not show any of the data to represent poor design and operation. Accordingly, none of the data were deleted on this basis.

2. We determined an arithmetic average residue concentration level and a variability factor for each data set. Residue concentration levels reported as less than or equal to the reported detection limit were set equal to the detection limit for statistical analyses. This is a conservative approach since the actual concentration would be between zero and the detection limit. Process variability could not be calculated from the incineration data because only one influent and effluent data pair was available for each data set. Therefore, to account for process variability, an average variability factor was calculated for incineration, 5.34 (calculation of the average variability factor is shown in Table 5-33).

3. The analysis of variance method was not used to compare different treatments of the same waste because data are available for only one type of treatment for each waste.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-35 could be associated with separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastes (other than wastewater) containing carbon disulfide spent solvents. The least stringent treatment level within the treatability subgroup was selected for BDAT (4.81 mg/L from site 3 obtained by multiplying the variability factor by the highest average residue concentration level) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. The technology basis was incineration.

5. The BDAT treatment standard for carbon disulfide represents treatment of a variety of waste matrices incinerated at two sites. The untreated waste concentration of carbon disulfide was as high as 400 mg/kg in these waste matrices. All of these wastes were treated to the BDAT treatment standard or below (4.81 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing carbon disulfide and substantially reduce the likelihood of migration of carbon disulfide from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for carbon disulfide was estimated at the detection limit of <0.010 mg/L based on incineration (see Table 11, 51 FR 1722). The difference between the proposed and promulgated treatment standards is primarily a result of additional data gathering subsequent to proposal. The new data were presented in EPA's Notice of Availability of Data (51 FR 31783). In addition, a variability analysis was incorporated into the development of the treatment standards for promulgation.]

Table 5-35

INCINERATION DATA FOR CARBON DISULFIDE

Site	Type of Incinerator	Wastes Incinerated	Flow-Weighted Average Influent* (mg/kg)	Incinerator Residue* Total (mg/kg)	Incinerator Residue* TCLP (ug/L)	Footnotes
3	Rotary Kiln with Secondary Combustor	Drum Feed Solids Liquid Waste Fuel	<400	2.8	900	a
8	Rotary Kiln with Secondary Liquid Combustor	Liquid Waste Fuel	<400	<2.0	4	a

*Values shown as "<" were reported as below the indicated detection limits.

(a) Influent concentration is flow-weighted average.

5.6.6 Carbon Tetrachloride (Other than Wastewater)

The Agency has no data on TCLP extracts of residue from incineration of carbon tetrachloride to use in the derivation of the BDAT treatment standard. For reasons presented in Section 5.6.1, EPA used chemical structure as the basis for transferring treatment data to carbon tetrachloride spent solvent wastes other than wastewaters. Specifically we transferred treatment data from methylene chloride to carbon tetrachloride; both contain the halogen functional group.

The Agency has data on the analysis of the TCLP extract of incineration residue for two compounds in the halogenated aliphatics structural group: methylene chloride and 1,1,1-trichloroethane. To best account for the range of physical and chemical properties within a structural group that affect treatment by a specific technology, the Agency transferred data representing the least stringent treatment standard from the compounds for which data were available in the halogenated aliphatics structural group. The data from which the treatment standard for incineration of methylene chloride was derived were transferred to carbon tetrachloride. The treatment standard is 0.96 mg/L based on the transferred data.

We believe the BDAT treatment standard for carbon tetrachloride spent solvent wastes (other than wastewater) represents substantial treatment. We would expect untreated carbon tetrachloride wastes to be similar to untreated methylene chloride wastes from which we transferred treatment data. As discussed on page 5-159, in reference to methylene chloride, we believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing carbon tetrachloride and subsequently reduce the likelihood of migration of carbon tetrachloride from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for carbon tetrachloride was estimated at the detection limit of <0.010 mg/L based on incineration (see Table 11, 51 FR 1722). The principal difference between the proposed and promulgated treatment standards is the Agency's change in the criteria for data transfer (see Section 5.6.1, page 5-130, for a discussion of the Agency's methodology for data transfer.)]

5.6.7 Chlorobenzene (Other Than Wastewater)

The Agency has treatment data for the TCLP extract of incinerator ash from the treatment of chlorobenzene (Reference 11). The data are summarized in Table 5-36.

The following steps were taken to derive the BDAT treatment standard for chlorobenzene:

1. We evaluated the data to determine whether any of the data represented poor design or operation of the incineration system. The available data and information did not show any of the data to represent poor design and operation. Accordingly, none of the data were deleted on this basis. Data were deleted from one site because chlorobenzene was reported as below the detection limits for both the influent and the TCLP extract of the ash.

2. We determined an arithmetic average residue concentration level and a variability factor for each data set. Residue concentration levels reported as less than or equal to the reported detection limit were set equal to the detection limit for statistical analyses. This is a conservative approach since the actual concentration would be between zero and the detection limit. Process variability could not be calculated from the incineration data because only one influent and effluent data pair was available for each data set. Therefore, to account for process variability, an average variability factor was calculated for incineration, 5.34 (calculation of the average variability factor is shown in Table 5-33).

3. The analysis of variance method was not used to compare different treatments of the same waste because data are available for only one type of treatment for each waste.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-36 could be associated with separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastes (other than wastewater) containing chlorobenzene spent solvents. The least stringent treatment level within the treatability subgroup was selected for BDAT (0.016 mg/L for sites 8 and 9 obtained by multiplying the variability factor by the highest average residue concentration level) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. This calculated standard is below the quantification level and could not be used as the treatment

standard; therefore, the treatment standard is set at the quantification level of 0.05 mg/L. The technology basis was incineration.

5. The BDAT treatment standard for chlorobenzene represents treatment of a variety of waste matrices incinerated at two sites. The untreated concentration of chlorobenzene was as high as 1,100 mg/kg in these waste matrices. All of these wastes were treated to the BDAT treatment standard or below (0.05 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing chlorobenzene and substantially reduce the likelihood of migration of chlorobenzene from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for chlorobenzene was estimated at the detection limit of <0.020 mg/L based on incineration (see Table 11, 51 FR 1722). The difference between the proposed and promulgated treatment standards is primarily a result of additional data gathering subsequent to proposal and use of the analytical quantification level as the treatment standard since the standard derived from the data is below the EPA published analytical quantification level for chlorobenzene (see Table 5-1 and the discussion on page 5-17). The new data were presented in EPA's Notice of Availability of Data (51 FR 31783). In addition, a variability analysis was incorporated into the development of the treatment standards for promulgation.]

Table 5-36

INCINERATION DATA FOR CHLOROBENZENE

Site	Type of Incinerator	Wastes Incinerated	Flow-Weighted Average Influent (mg/kg)	Incinerator Residue* Total (mg/kg)	Incinerator Residue* TCLP (ug/L)	Footnotes
8	Rotary Kiln with Secondary Liquid Injection Combustor	Liquid Waste Fuel	1,100	<1.5	<3	a
9	Rotary Kiln with Secondary Combustor	High-Btu Liquids Low-Btu Liquids Solids Feedc	1,034	<1.5	<3	b

*Values shown as "<" were reported as below the indicated detection limits.

(a) Influent concentration is flow-weighted average.
(b) Influent concentration is an arithmetic average.
(c) Gel and filter press residue.

5.6.8. Cresols (Cresylic Acid) (Other Than Wastewater)

The Agency has no data on TCLP extracts of residue from incineration of cresols (cresylic acid) to use in the derivation of the BDAT treatment standard. For reasons presented in Section 5.6.1, EPA used chemical structure as the basis for transferring treatment data to cresols (cresylic acid) spent solvent wastes other than wastewaters. Specifically we transferred treatment data from methyl ethyl ketone, which contains the ketone functional group, to cresol (cresylic acid), which contains the phenol functional group. The phenols structural group is most structurally similar to the ketones group based upon their oxygen-containing, electron-releasing functional groups.

The Agency has data on the analysis of the TCLP extract of incineration residue for three compounds in the ketones structural group: acetone, methyl ethyl ketone, and methyl isobutyl ketone. To best account for the range of physical and chemical properties within a structural group that affect treatment by a specific technology, the Agency transferred data representing the least stringent treatment standard from the compounds for which data were available in the ketones structural group. The data from which the treatment standard for incineration of methyl ethyl ketone was derived were transferred to cresols (cresylic acid). The treatment standard is 0.75 mg/L based on the transferred data.

We believe the BDAT treatment standard for cresols (cresylic acid) spent solvent wastes (other than wastewater) represents substantial treatment. We would expect untreated cresols (cresylic acid) wastes to be similar to untreated methyl ethyl ketone wastes from which we transferred treatment data. As discussed on page 5-163, in reference to methyl ethyl ketone, we believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing cresols (cresylic acid) and substantially reduce the likelihood of migration of cresols (cresylic acid) from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for methyl ethyl ketone was estimated at the detection limit of <0.100 mg/L based on incineration (see Table 11, 51 FR 1722). The principal difference between the proposed and promulgated treatment standards is the Agency's change in the criteria for data transfer (see section 5.6.1, page 5-130, for a discussion of the Agency's methodology for data transfer.)]

5.6.9 Cyclohexanone (Other Than Wastewater)

The Agency has no data on TCLP extracts of residue from incineration of cyclohexanone to use in the derivation of the BDAT treatment standard. For reasons presented in Section 5.6.1, EPA used chemical structure as the basis for transferring treatment data to cyclohexanone spent solvent wastes other than wastewaters. Specifically we transferred treatment data from methyl ethyl ketone because, like cyclohexanone, methyl ethyl ketone contains the ketone functional group.

The Agency has data on the analysis of the TCLP extract of incineration residue for three compounds in the ketones structural group: acetone, methyl ethyl ketone, and methyl isobutyl ketone. To best account for the range of physical and chemical properties within a structural group that affect treatment by a specific technology, the Agency transferred data representing the least stringent treatment standard from the compounds for which data were available in the ketones structural group. The data from which the treatment standard for incineration of methyl ethyl ketone was derived were transferred to cyclohexanone. The treatment standard is 0.75 mg/L based on the transferred data.

We believe the BDAT treatment standard for cyclohexanone spent solvent wastes (other than wastewater) represents substantial treatment. We would expect untreated cyclohexanone wastes to be similar to untreated methyl ethyl ketone wastes from which we transferred treatment data since they are used in many similar manufacturing processes, as shown in Section 2 of this document. As discussed on page 5-163, in reference to methyl ethyl ketone, we believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing cyclohexanone and substantially reduce the likelihood of migration of cyclohexanone from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for cyclohexanone was estimated at the detection limit of <0.100 mg/L based on incineration (see Table 11, 51 FR 1722). The principal difference between the proposed and promulgated treatment standards is the Agency's change in the criteria for data transfer (see Section 5.6.1, page 5-130, for a discussion of the Agency's methodology for data transfer.)]

5.6.10 1,2-Dichlorobenzene (Other Than Wastewater)

The Agency has treatment data for the TCLP extract of incinerator ash from the treatment of 1,2-dichlorobenzene (Reference 11). The data are summarized in Table 5-37.

The following steps were taken to derive the BDAT treatment standard for 1,2-dichlorobenzene:

1. We evaluated the data to determine whether any of the data represented poor design or operation of the incineration system. Data from one facility (site 2) were deleted because the Agency judged that the system was not properly operated at the time the data were collected. A follow-up sampling visit confirmed the Agency's judgment. The new data were not used in the determination of the long-term performance average for incineration of 1,2-dichlorobenzene; however, the data were used to develop a variabiity factor for incineration. Data from another site were deleted because 1,2-dichlorobenzene was reported below the detection limits for both the influent and the TCLP extract of the ash.

2. We determined an arithmetic average residue concentration level and a variability factor for each data set. Residue concentration levels reported as less than or equal to the reported detection limit were set equal to the detection limit for statistical analyses. This is a conservative approach since the actual concentration would be between zero and the detection limit. Two residue concentration levels were reported for site 5, one for each incinerator at the site. These were considered as two separate data points.

   Process variability could not be calculated from the incineration data because only one influent and effluent data pair was available for each data set. Therefore, to account for process variability, an average variability factor was calculated for incineration, 5.34 (calculation of the average variability factor is shown in Table 5-33).

3. The analysis of variance method was not used to compare different treatments of the same waste because data are available for only one type of treatment for each waste.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-37 could be associated with separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all

sources of wastes (other than wastewater) containing 1,2-dichlorobenzene spent solvents. The least stringent treatment level within the treatability subgroup was selected for BDAT (0.011 mg/L for site 7 obtained by multiplying the variability factor by the highest average residue concentration level) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. This calculated standard is below the quantification level and could not be used as the treatment standard; therefore, the treatment standard is set at the quantification level of 0.125 mg/L. The technology basis was incineration.

5. The BDAT treatment standard for 1,2-dichlorobenzene represents treatment of a variety of waste matrices incinerated at two sites. The untreated waste concentration of 1,2-dichlorobenzene ranged from 92 mg/kg to 1,085 mg/kg in these waste matrices. All of these wastes were treated to the BDAT treatment standard or below (0.125 mg/L). We believe these constituent reductions substantially diminish the toxicity of spent solvent wastes containing 1,2-dichlorobenzene and substantially reduce the likelihood of migration of 1,2-dichlorobenzene from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for 1,2-dichlorobenzene was estimated at the detection limit of <0.010 mg/L based on incineration (see Table 11, 51 FR 1722). The difference between the proposed and promulgated treated standards is primarily a result of additional data gathering subsequent to proposal and use of the analytical quantification level as the treatment standard since the standard derived from the data is below the EPA published analytical quantification level for 1,2-dichlorobenzene (see Table 5-1 and the discussion on page 5-17). The new data were presented in EPA's Notice of Availability of Data (51 FR 31783). In addition, a variability analysis was incorporated into the development of the treatment standards for promulgation.]

Table 5-37

INCINERATION DATA FOR 1,2-DICHLOROBENZENE

Site	Type of Incinerator	Wastes Incinerated	Flow-Weighted Average Influent (mg/kg)	Incinerator Residue* Total (mg/kg)	Incinerator Residue* TCLP (ug/L)	Footnotes
5	Fixed Hearth (Two Separate Incineration Systems)	(From Furniture Manufacturing Industry)	1,085	<100	<1	a
			1,085	<100	<1	a
		Solvent Wastes				
		High-Btu Liquid Wastes				
		Low-Btu Liquid Wastes				
		Lacquer-Coated Cardboard				
7	Fixed Hearth with Secondary Combustor	High-Btu Liquids	92	<0.1	<2	b
		Low-Btu Liquids				
		Solids Feed				

*Values shown as "<" were reported as below indicated detection limits.

(a) The influent concentration is an arithmetic average.
(b) The influent concentration is flow-weighted average.

5.6.11 Ethyl Acetate (Other Than Wastewater)

The Agency has no data on TCLP extracts of residue from incineration of ethyl acetate to use in the derivation of the BDAT treatment standard. For reasons presented in Section 5.6.1, EPA used chemical structure as the basis for transferring treatment data to ethyl acetate spent solvent wastes other than wastewaters. Specifically we transferred treatment data from methyl ethyl ketone, which contains the ketone functional group, to ethyl acetate, which contains the ester functional group. The esters structural group is most structurally similar to the ketones group based upon their oxygen-containing, electron-releasing functional groups.

The Agency has data on the analysis of the TCLP extract of incineration residue for three compounds in the ketones structural group: acetone, methyl ethyl ketone, and methyl isobutyl ketone. To best account for the range of physical and chemical properties within a structural group that affect treatment by a specific technology, the Agency transferred data representing the least stringent treatment standard from the compounds for which data were available in the ketones structural group. The data from which the treatment standard for incineration of methyl ethyl ketone was derived were transferred to ethyl acetate. The treatment standard is 0.75 mg/L based on the transferred data.

We believe the BDAT treatment standard for ethyl acetate spent solvent wastes (other than wastewater) represents substantial treatment. We would expect untreated ethyl acetate wastes to be similar to untreated methyl ethyl ketone wastes from which we transferred treatment data since they are used in many similar manufacturing processes, as shown in Section 2 of this document. As discussed on page 5-163, in reference to methyl ethyl ketone, we believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing ethyl acetate and substantially reduce the likelihood of migration of ethyl acetate from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for ethyl acetate was estimated at the detection limit of <0.100 mg/L based on incineration (see Table 11, 51 FR 1722). The principal difference between the proposed and promulgated treatment standards is the Agency's change in the criteria for data transfer (see Section 5.6.1, page 5-130, for a discussion of the Agency's methodology for data transfer.)]

5.6.12 Ethylbenzene (Other Than Wastewater)

The Agency has treatment data for the TCLP extract of incinerator ash from the treatment of ethylbenzene (Reference 11). The data are summarized in Table 5-38.

The following steps were taken to derive the BDAT treatment standard for ethylbenzene:

1. We evaluated the data to determine whether any of the data represented poor design or operation of the incineration system. Data from one facility (site 6) were deleted because the incineration system control devices were not properly designed and operated. The facility is under a Consent Decree to replace and improve the current incinerator control system. Data from another facility (site 2) were deleted because the Agency judged that the system was not properly operated at the time the data were collected. A follow-up sampling visit confirmed the Agency's judgment. The new data were not used in the determination of the long-term performance average for incineration of ethylbenzene; however, the data were used to develop a variability factor for incineration. Data from a third site were deleted because ethylbenzene was reported as below the detection limits for both the influent and the TCLP extract of the ash.

2. We determined an arithmetic average residue concentration level and a variability factor for each data set. Residue concentration levels reported as less than or equal to the reported detection limit were set equal to the detection limit for statistical analyses. This is a conservative approach since the actual concentration would be between zero and the detection limit. Two residue concentration levels were reported for site 5, one for each incinerator at the site. These were considered as two separate data points.

   Process variability could not be calculated from the incineration data because only one influent and effluent data pair was available for each data set. Therefore, to account for process variability, an average variability factor was calculated for incineration, 5.34 (calculation of the average variability factor is shown in Table 5-33).

3. The analysis of variance method was not used to compare different treatments of the same waste because data are available for only one type of treatment for each waste.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-38 could be associated with separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastes (other than wastewater) containing ethylbenzene spent solvents. The least stringent treatment level within the treatability subgroup was selected for BDAT (0.053 mg/L for site 7 obtained by multiplying the variability factor by the highest average residue concentration level) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. The technology basis was incineration.

5. The BDAT treatment standard for ethylbenzene represents treatment of a variety of waste matrices incinerated at five sites. The untreated waste concentration of ethylbenzene ranged from 780 mg/kg to 43,000 mg/kg in these waste matrices. All of these wastes were treated to the BDAT treatment standard or below (0.053 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing ethylbenzene and substantially reduce the likelihood of migration of ethylbenzene from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for ethylbenzene was estimated at the detection limit of <0.010 mg/L based on incineration (see Table 11, 51 FR 1722). The difference between the proposed and promulgated treatment standards is primarily a result of additional data gathering subsequent to proposal. The new data were presented in EPA's Notice of Availability of Data (51 FR 31783). In addition, a variability analysis was incorporated into the development of the treatment standards for promulgation.]

Table 5-38

INCINERATION DATA FOR ETHYLBENZENE

Site	Type of Incinerator	Wastes Incinerated	Flow-Weighted Average Influent (mg/kg)	Incinerator Residue* Total (mg/kg)	Incinerator Residue* TCLP (ug/L)	Footnotes
3	Rotary Kiln with Secondary Combustor	Drum Feed Solids Liquid Waste Fuel	4,048	0.5	2	a
5	Fixed Hearth (Two Separate Incineration Systems)	(From Furniture Manufacturing Industry) Solvent Wastes High-Btu Liquid Wastes Low-Btu Liquid Wastes Lacquer-Coated Cardboard	780 780	<300 <300	<3 <3	b b
7	Fixed Hearth with Secondary Combustor	High-Btu Liquids Low-Btu Solids Solids Feed	14,642	<300	10	a
8	Rotary Kiln with Secondary Liquid Injection Combustor	Liquid Waste Fuel	43,000	<1.5	<3	a
9	Rotary Kiln with Secondary Combustor	High-Btu Liquids Low-Btu Liquids Solids Feedc	8,591	<1.5	<3	a

*Values shown as "<" were reported as below indicated detection limits.

(a) The influent concentration is flow-weighted average.
(b) The influent concentration is an arithmetic average.
(c) Gel and filter press residue.

5.6.13 Ethyl Ether (Other Than Wastewater)

The Agency has no data on TCLP extracts of residue from incineration of ethyl ether to use in the derivation of the BDAT treatment standard. For reasons presented in Section 5.6.1, EPA used chemical structure as the basis for transferring treatment data to ethyl ether spent solvent wastes other than wastewaters. Specifically we transferred treatment data from methyl ethyl ketone, which contains the ketone functional group, to ethyl ether, which contains the ether functional group. The ethers structural group is most structurally similar to the ketones group based upon their oxygen-containing, electron-releasing functional groups.

The Agency has data on the analysis of the TCLP extract of incineration residue for three compounds in the ketones structural group: acetone, methyl ethyl ketone, and methyl isobutyl ketone. To best account for the range of physical and chemical properties within a structural group that affect treatment by a specific technology, the Agency transferred data representing the least stringent treatment standard from the compounds for which data were available in the ketones structural group. The data from which the treatment standard for incineration of methyl ethyl ketone was derived were transferred to ethyl ether. The treatment standard is 0.75 mg/L based on the transferred data.

We believe the BDAT treatment standard for ethyl ether spent solvent wastes (other than wastewater) represents substantial treatment. We would expect untreated ethyl ether wastes to be similar to untreated methyl ethyl ketone wastes from which we transferred treatment data. As discussed on page 5-163, in reference to methyl ethyl ketone, we believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing ethyl ether and substantially reduce the likelihood of migration of ethyl ether from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for ethyl ether was estimated from the detection limit of <0.100 mg/L based on incineration (see Table 11, 51 FR 1722). The principal difference between the proposed and promulgated treatment standards is the Agency's change in the criteria for data transfer (see Section 5.6.1, page 5-130, for a discussion of the Agency's methodology for data transfer.)]

5.6.14 Isobutanol (Other Than Wastewater)

The Agency has no data on TCLP extracts of residue from incineration of isobutanol to use in the derivation of the BDAT treatment standard. For reasons presented in Section 5.6.1, EPA used chemical structure as the basis for transferring treatment data to isobutanol spent solvent wastes other than wastewaters. Specifically we transferred treatment data from methyl ethyl ketone, which contains the ketone functional group, to isobutanol, which contains the hydroxyl functional group. The alcohols structural group is most structurally similar to the ketones group based upon their oxygen-containing, electron-releasing functional groups.

The Agency has data on the analysis of the TCLP extract of incineration residue for three compounds in the ketones structural group: acetone, methyl ethyl ketone, and methyl isobutyl ketone. To best account for the range of physical and chemical properties within a structural group that affect treatment by a specific technology, the Agency transferred data representing the least stringent treatment standard from the compounds for which data were available in the ketones structural group. The data from which the treatment standard for incineration of methyl ethyl ketone was derived were transferred to isobutanol. The treatment standard is 0.75 mg/L based on the transferred data. The transferred value is below the quantification level for isobutanol and could not be used as the treatment standard. Therefore, the treatment standard is set at the quantification level of 5.0 mg/L.

We believe the BDAT treatment standard for isobutanol spent solvent wastes (other than wastewater) represents substantial treatment. We would expect untreated isobutanol wastes to be similar to untreated methyl ethyl ketone wastes from which we transferred treatment data. As discussed on page 5-163, in reference to methyl ethyl ketone, we believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing isobutanol and substantially reduce the likelihood of migration of isobutanol from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for isobutanol was estimated at the detection limit of <0.050 mg/L based on incineration (see Table 11, 51 FR 1722). The principal difference between the proposed and promulgated treatment standards is the Agency's change in the criteria for data transfer (see Section 5.6.1, page 5-130, for a discussion of the Agency's methodology for data transfer.)]

5.6.15 Methanol (Other Than Wastewater)

The Agency has no data on TCLP extracts of residue from incineration of methanol to use in the derivation of the BDAT treatment standard. For reasons presented in in Section 5.6.1, EPA used chemical structure as the basis for transferring treatment data to methanol spent solvent wastes other than wastewaters. Specifically we transferred treatment data from methyl ethyl ketone, which contains the ketone functional group, to methanol, which contains the hydroxyl functional group. The alcohols structural group is most structurally similar to the ketones group based upon their oxygen-containing, electron-releasing functional groups.

The Agency has data on the analysis of the TCLP extract of incineration residue for three compounds in the ketones structural group: acetone, methyl ethyl ketone, and methyl isobutyl ketone. To best account for the range of physical and chemical properties within a structural group that affect treatment by a specific technology, the Agency transferred data representing the least stringent treatment standard from the compounds for which data were available in the ketones structural group. The data from which the treatment standard for incineration of methyl ethyl ketone was derived were transferred to methanol. The treatment standard is 0.75 mg/L based on the transferred data.

We believe the BDAT treatment standard for methanol spent solvent wastes (other than wastewater) represents substantial treatment. We would expect untreated methanol wastes to be similar to untreated methyl ethyl ketone wastes from which we transferred treatment data since they are used in many similar manufacturing processes, as shown in Section 2 of this document. As discussed on page 5-163, in reference to methyl ethyl ketone, we believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing methanol and substantially reduce the likelihood of migration of methanol from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for methanol was estimated at the detection limit of <0.100 mg/L based on incineration (see Table 11, 51 FR 1722). The principal difference between the proposed and promulgated treatment standards is the Agency's change in the criteria for data transfer (see Section 5.6.1, page 5-130, for a discussion of the Agency's methodology for data transfer.)]

5.6.16 Methylene Chloride (Other Than Wastewater)

The Agency has treatment data for the TCLP extract of incinerator ash from the treatment of methylene chloride (Reference 11). The data are summarized in Table 5-39.

The following steps were taken to derive the BDAT treatment standard for methylene chloride:

1. We evaluated the data to determine whether any of the data represented poor design or operation of the incineration system. Data from one facility (site 6) were deleted because the incineration system control devices were not properly designed and operated. The facility is under a Consent Decree to replace and improve the current incinerator control system. Data from another facility (site 2) were deleted because the Agency judged that the system was not properly operated at the time the data were collected. A follow-up sampling visit confirmed the Agency's judgment. The new data were not used in the determination of the long-term performance average for incineration of methylene chloride; however, the data were used to develop a variability factor for incineration.

2. We determined an arithmetic average residue concentration level and a variability factor for each data set. Residue concentration levels reported as less than or equal to the reported detection limit were set equal to the detection limit for statistical analyses. This is a conservative approach since the actual concentration would be between zero and the detection limit. Two residue concentration levels were reported for site 5, one for each incinerator at the site. These were considered as two separate data points.

   Process variability could not be calculated from the incineration data because only one influent and effluent data pair was available for each data set. Therefore, to account for process variability, an average variability factor was calculated for incineration, 5.34 (calculation of the average variability factor is showing in Table 5-33).

3. The analysis of variance method was not used to compare different treatments of the same waste because data are available for only one type of treatment for each waste.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-39 could be associated with separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all

sources of wastes (other than wastewater) containing methylene chloride spent solvents. The least stringent treatment level within the treatability subgroup was selected for BDAT (0.96 mg/L for site 5 obtained by multiplying the variability factor by the highest average residue concentration level) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. The technology basis was incineration.

5. The BDAT treatment standard for methylene chloride represents treatment of a variety of waste matrices incinerated at six sites. The untreated waste concentration of methylene chloride ranged from 22 mg/kg to 14,875 mg/kg in these waste matrices. All of these wastes were treated to the BDAT treatment standard or below (0.96 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing methylene chloride and substantially reduce the likelihood of migration of methylene chloride from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for methylene chloride was estimated at the detection limit of <0.010 mg/L based on incineration (see Table 11, 51 FR 1722). The difference between the proposed and promulgated treatment standards is primarily a result of additional data gathering subsequent to proposal. The new data were presented in EPA's Notice of Availability of Data (51 FR 31783). In addition, a variability analysis was incorporated into the development of the treatment standards for promulgation.]

Table 5-39

INCINERATION DATA FOR METHYLENE CHLORIDE

Site	Type of Incinerator	Wastes Incinerated	Flow-Weighted Average Influent* (mg/kg)	Incinerator Residue* Total (mg/kg)	Incinerator Residue* TCLP (ug/L)	Footnotes
1	Rotary Kiln with Secondary Combustor	PCB Contaminated Dirt	22	<3	20	a
3	Rotary Kiln with Secondary Combustor	Drum Feed Solids Liquid Waste Fuel	9,808	<1.5	23	a
5	Fixed Hearth (Two Separate Incineration Systems)	(From Furniture Manufacturing Industry) Solvent Wastes High-Btu Liquid Wastes Low-Btu Liquid Wastes Lacquer-Coated Cardboard	5,690 5,690	<300 <300	<3 180	b b
7	Fixed Hearth with Secondary Combustor	High-Btu Liquids Low-Btu Liquids Solids Feed	<300	<300	150	a
8	Rotary Kiln with Secondary Liquid Injection Combustor	Liquid Waste Fuel	6,600	<1.5	26	a

*Values shown as "<" were reported as below indicated detection limits.

(a) Influent is flow-weighted average.
(b) Influent is an arithmetic average.

Table 5-39 (Continued)

INCINERATION DATA FOR METHYLENE CHLORIDE

Site	Type of Incinerator	Wastes Incinerated	Flow-Weighted Average Influent (mg/kg)	Incinerator Residue* Total (mg/kg)	Incinerator Residue* TCLP (ug/L)	Footnotes
9	Rotary Kiln with Secondary Combustor	High-Btu Liquids Low-Btu Liquids Solids Feedb	14,875	<1.5	100	a

*Values shown as "<" were reported as below indicated detection limits.

NA - Not Analyzed

(a) Influent is flow-weighted average.
(b) Gel and filter press residue.

5.6.17 Methyl Ethyl Ketone (Other Than Wastewater)

The Agency has treatment data for the TCLP extract of incinerator ash from the treatment of methyl ethyl ketone (Reference 11). The data are summarized in Table 5-40.

The following steps were taken to derive the BDAT treatment standard for methyl ethyl ketone:

1. We evaluated the data to determine whether any of the data represented poor design or operation of the incineration system. Data from one facility (site 6) were deleted because the incineration system control devices were not properly designed and operated. The facility is under a Consent Decree to replace and improve the current incinerator control system. Data from another facility (site 2) were deleted because the Agency judged that the system was not properly operated at the time the data were collected. A follow-up sampling visit confirmed the Agency's judgment. The new data were not used in the determination of the long-term performance average for incineration of methyl ethyl ketone; however, the data were used to develop a variability factor for incineration. Data from a third site were deleted because methyl ethyl ketone was reported as below the detection limits for both the influent and the TCLP extract of the ash.

2. We determined an arithmetic average residue concentration level and a variability factor for each data set. Residue concentration levels reported as less than or equal to the reported detection limit were set equal to the detection limit for statistical analyses. This is a conservative approach since the actual concentration would be between zero and the detection limit. Two residue concentration levels were reported for site 5, one for each incinerator at the site. These were considered as two separate data points.

   Process variability could not be calculated from the incineration data because only one influent and effluent data pair was available for each data set. Therefore, to account for process variability, an average variability factor was calculated for incineration, 5.34 (calculation of the average variability factor is shown in Table 5-33).

3. The analysis of variance method was not used to compare different treatments of the same waste because data are available for only one type of treatment for each waste.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-40 could be associated with separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastes (other than wastewater) containing methyl ethyl ketone spent solvents. The least stringent treatment level within the treatability subgroup was selected for BDAT (0.59 mg/L for site 7 obtained by multiplying the variability factor by the highest average residue concentration level) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. The technology basis was incineration.

5. The BDAT treatment standard for methyl ethyl ketone represents treatment of a variety of waste matrices incinerated at four sites. The untreated waste concentration of methyl ethyl ketone ranged from 28,165 mg/kg to 110,000 mg/kg in these waste matrices. All of these wastes were treated to the BDAT treatment standard or below (0.75 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing methyl ethyl ketone and substantially reduce the likelihood of migration of methyl ethyl ketone from spent solvent wastes.

[The proposed BDAT technology-based treatment standard for methyl ethyl ketone was estimated at the detection limit of <0.050 mg/L based on incineration (see Table 11, 51 FR 1722). The difference between the proposed and promulgated treatment standards is primarily a result of additional data gathering subsequent to proposal. The new data were presented in EPA's Notice of Availability of Data (51 FR 31783). In addition, a variability analysis was incorporated into the development of the treatment standards for promulgation.]

Table 5-40

INCINERATION DATA FOR METHYL ETHYL KETONE

Site	Type of Incinerator	Wastes Incinerated	Flow-Weighted Average Influent (mg/kg)	Incinerator Residue* Total (mg/kg)	Incinerator Residue* TCLP (ug/L)	Footnotes
3	Rotary Kiln with Secondary Combustor	Drum Feed Solids Liquid Waste Fuel	100,000	<1.5	<3	a
5	Fixed Hearth (Two Separate Incineration Systems)	(From Furniture Manufacturing Industry) Solvent Wastes High-Btu Liquid Wastes Low-Btu Liquid Wastes Lacquer-Coated Cardboard	28,165 28,165	<300 <300	<3 25	b b
7	Fixed Hearth with Secondary Combustor	High-Btu Liquids Low-Btu Liquids Solids Feed	35,000	<300	140	a
8	Rotary Kiln with Secondary Liquid Injection Combustor	Liquid Waste Fuel	110,000	<1.5	<3	a

*Values shown as "<" were reported as below indicated detection limits.

(a) The influent concentration is flow-weighted average.
(b) The influent concentration is an arithmetic average.

5.7.18 Methyl Isobutyl Ketone (Other Than Wastewater)

The Agency has treatment data for the TCLP extract of incinerator ash from the treatment of methyl isobutyl ketone (Reference 11). The data are summarized in Table 5-41.

The following steps were taken to derive the BDAT treatment standard for methyl isobutyl ketone:

1. We evaluated the data to determine whether any of the data represented poor design or operation of the incineration system. Data from one facility (site 6) were deleted because the incineration system control devices were not properly designed and operated. The facility is under a Consent Decree to replace and improve the current incinerator control system. Data from another facility (site 2) were deleted because the Agency judged that the system was not properly operated at the time the data were collected. A follow-up sampling visit confirmed the Agency's judgment. The new data were not used in the determination of the long-term performance average for incineration of methyl isobutyl ketone; however, the data were used to develop a variability factor for incineration.

2. We determined an arithmetic average residue concentration level and a variability factor for each data set. Residue concentration levels reported as less than or equal to the reported detection limit were set equal to the detection limit for statistical analyses. This is a conservative approach since the actual concentration would be between zero and the detection limit. Two residue concentration levels were reported for site 5, one for each incinerator at the site. These were considered as two separate data points.

   Process variability could not be calculated from the incineration data because only one influent and effluent data pair was available for each data set. Therefore, to account for process variability, an average variability factor was calculated for incineration, 5.34 (calculation of the average variability factor is shown in Table 5-33).

3. The analysis of variance method was not used to compare different treatments of the same waste because the data are available for only one type of treatment for each waste.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-41 could be associated with separate waste treatability subgroups. Sufficient data did not

exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastes (other than wastewater) containing methyl isobutyl ketone spent solvents. The least stringent treatment level within the treatability subgroup was selected for BDAT (0.33 mg/L for site 7 obtained by multiplying the variability factor by the highest average residue concentration level) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. The technology basis was incineration.

5. The BDAT treatment standard for methyl isobutyl ketone represents treatment of a variety of waste matrices incinerated at six sites. The untreated waste concentration of methyl isobutyl ketone ranged from 15 mg/kg to 32,000 mg/kg in these waste matrices. All of these wastes were treated to the BDAT treatment standard or below (0.33 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing methyl isobutyl ketone and substantially reduce the likelihood of migration of methyl isobutyl ketone from spent solvent wastes.

[The proposed BDAT technology-based treatment standard for methyl isobutyl ketone was estimated at the detection limit of <0.010 mg/L based on incineration (see Table 11, 51 FR 1722). The difference between the proposed and promulgated treatment standards is primarily a result of additional data gathering subsequent to proposal. The new data were presented in EPA's Notice of Availability of Data (51 FR 31783). In addition, a variability analysis was incorporated into the development of the treatment standards for promulgation.]

Table 5-41

INCINERATION DATA FOR METHYL ISOBUTYL KETONE

Site	Type of Incinerator	Wastes Incinerated	Flow-Weighted Average Influent (mg/kg)	Incinerator Residue* Total (mg/kg)	Incinerator Residue* TCLP (ug/L)	Footnotes
1	Rotary Kiln with Secondary Combustor	PCB Contaminated Dirt	15	<2	<2	a
3	Rotary Kiln with Secondary Combustor	Drum Feed Solids Liquid Waste Fuel	30,000	<1.0	<2	a
5	Fixed Hearth (Two Separate Incineration Systems)	(From Furniture Manufacturing Industry) Solvent Wastes High-Btu Liquid Wastes Low-Btu Liquid Wastes Lacquer-Coated Cardboard	315 315	<200 <200 ..	<2 <2	b b
7	Fixed Hearth with Secondary Combustor	High-Btu Liquids Low-Btu Liquids Solids Feed	10,818	<200	62	a
8	Rotary Kiln with Secondary Liquid Injection Combustor	Liquid Waste Fuel	32,000	<1.0	<2	a

*Values shown as "<" were reported as below indicated detection limits.

(a) Influent concentration is flow-weighted average.
(b) Influent concentration is an arithmetic average.

Table 5-41 (Continued)

INCINERATION DATA FOR METHYL ISOBUTYL KETONE

Site	Type of Incinerator	Wastes Incinerated	Flow-Weighted Average Influent (mg/kg)	Incinerator Residue* Total (mg/kg)	Incinerator Residue* TCLP (ug/L)	Footnotes
9	Rotary Kiln with Secondary Combustor	High-Btu Liquids Low-Btu Liquids Solids Feedb	24,905	<1.0	<2	a

*Values shown as "<" were reported as below indicated detection limits.

(a) Influent concentration is flow-weighted average.
(b) Gel and filter press residue.

5.6.19 Nitrobenzene (Other Than Wastewater)

The Agency has treatment data for the TCLP extract of incinerator ash from the treatment of nitrobenzene (Reference 11). The data are summarized in Table 5-42.

The following steps were taken to derive the BDAT treatment standard for nitrobenzene:

1. We evaluated the data to determine whether any of the data represented poor design or operation of the incineration system. The available data and information did not show any of the data to represent poor design and operation. Accordingly, none of the data were deleted on this basis.

2. We determined an arithmetic average residue concentration level and a variability factor for each data set. Residue concentration levels reported as less than or equal to the reported detection limit were set equal to the detection limit for statistical analyses. This is a conservative approach since the actual concentration would be between zero and the detection limit.

   Process variability could not be calculated from the incineration data because only one influent and effluent data pair was available for each data set. Therefore, to account for process variability, an average variability factor was calculated for incineration, 5.34 (calculation of the average variability factor is shown in Table 5-33).

3. The analysis of variance method was not used to compare different treatments of the same waste because data are available for only one type of treatment for each waste.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-42 could be associated with separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastes (other than wastewater) containing nitrobenzene spent solvents. The least stringent treatment level within the treatability subgroup was selected for BDAT (0.011 mg/L for site 7 obtained by multiplying the variability factor by the highest average residue concentration level) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. This calculated standard is below the quantification level and could not be used as the treatment standard; therefore, the treatment standard is set at the quantification level of 0.125 mg/L. The technology was incineration.

5. The BDAT treatment standard for nitrobenzene represents treatment of a variety of waste matrices incinerated at one site. The untreated waste concentration of nitrobenzene was as high as 79 mg/kg in these waste matrices. This waste was treated to a concentration below the BDAT treatment standard (0.125 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing nitrobenzene and substantially reduce the likelihood of migration of nitrobenzene from spent solvent wastes.

[The proposed BDAT technology-based treatment standard for nitrobenzene was estimated at the detection limit of <0.010 mg/L based on incineration (see Table 11, 51 FR 1722). The difference between the proposed and promulgated treatment standards is primarily a result of additional data gathering subsequent to proposal and use of the analytical quantification level as the treatment standard since the standard derived from the data is below the EPA published analytical quantification level for nitrobenzene (see Table 5-1 and the discussion on page 5-17). The new data were presented in EPA's Notice of Availability of Data (51 FR 31783). In addition, a variability analysis was incorporated into the development of the treatment standards for promulgation.]

Table 5-42

INCINERATION DATA FOR NITROBENZENE

Site	Type of Incinerator	Wastes Incinerated	Flow-Weighted Average Influent (mg/kg)	Incinerator Residue* Total (mg/kg)	Incinerator Residue* TCLP (ug/L)	Footnotes
7	Fixed Hearth with Secondary Combustor	High-Btu Liquids Low-Btu Liquids Solids Feed	79	<0.1	<2	a

*Value shown as "<" were reported as below indicated detection limits.

(a) The influent concentration is flow-weighted average.

5.6.20 Pyridine (Other Than Wastewater)

The Agency has no data on TCLP extracts of residue from incineration of pyridine to use in the derivation of the BDAT treatment standard. For reasons presented in Section 5.6.1, EPA used chemical structure as the basis for transferring treatment data to pyridine spent solvent wastes other than wastewaters. Specifically we transferred treatment data from toluene to pyridine; both which contain the aromatic ring functional group.

The Agency has data on the analysis of the TCLP extract of incineration residue for four compounds in the aromatics structural group: ethylbenzene, toluene, xylene, and nitrobenzene. To best account for the range of physical and chemical properties within a structural group that affect treatment by a specific technology, the Agency transferred data representing the least stringent treatment standard from the compounds for which data were available in the aromatics structural group. The data from which the treatment standard for incineration of toluene was derived were transferred to pyridine. The treatment standard is 0.33 mg/L based on the transferred data.

We believe the BDAT treatment standard for pyridine spent solvent wastes (other than wastewater) represents substantial treatment. We would expect untreated pyridine wastes to be similar to untreated toluene wastes from which we transferred treatment data since they are used in some of the same manufacturing processes, as shown in Section 2 of this document. As discussed on page 5-177 in reference to toluene, we believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing pyridine and substantially reduce the likelihood of migration of pyridine from spent solvent wastes.

[The proposed technology based BDAT treatment standard for pyridine was estimated at the detection limit of <0.500 mg/L based on incineration (see Table 11, 51 FR 1722). The principal difference between the proposed and promulgated treatment standards is the Agency's change in the criteria for data transfer (see Section 5.6.1, page 5-130, for a discussion of the Agency's methodology for data transfer.)]

5.6.21 Tetrachloroethylene (Other Than Wastewater)

The Agency has treatment data for the TCLP extract of incinerator ash from the treatment of tetrachloroethylene (Reference 11). The data are summarized in Table 5-43.

The following steps were taken to derive the BDAT treatment standard for tetrachloroethylene:

1. We evaluated the data to determine whether any of the data represented poor design or operation of the incineration system. Data from one facility (site 6) were deleted because the incineration system control devices were not properly designed and operated. The facility is under a Consent Decree to replace and improve the current incinerator control system. Data from another facility (site 2) were deleted because the Agency judged that the system was not properly operated at the time the data were collected. A follow-up sampling visit confirmed the Agency's judgment. The new data were not used in the determination of the long-term performance average for incineration of tetrachloroethylene; however, the data were used to develop a variability factor for incineration. Data from a third site were deleted because tetrachloroethylene was reported as below the detection limits for both the influent and the TCLP extract of the ash.

2. We determined an arithmetic average residue concentration level and a variability factor for each data set. Residue concentration levels reported as less than or equal to the reported detection limit were set equal to the detection limit for statistical analyses. This is a conservative approach since the actual concentration would be between zero and the detection limit.

   Process variability could not be calculated from the incineration data because only one influent and effluent data pair was available for each data set. Therefore, to account for process variability, an average variability factor was calculated for incineration, 5.34 (calculation of the average variability factor is shown in Table 5-33).

3. The analysis of variance method was not used to compare different treatments of the same waste because data are available for only one type of treatment for each waste.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-43 could be associated with separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all

sources of wastes (other than wastewater) containing tetrachloroethylene spent solvents. The least stringent treatment level within the treatability subgroup was selected for BDAT (0.016 mg/L for sites 1, 3, 8, and 9 obtained by multiplying the variability factor by the highest average residue concentration level) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. This calculated value is below the quantification level and could not be used as the treatment standard; therefore, the treatment standard is set at the quantification level of 0.05 mg/L. The technology basis was incineration.

5. The BDAT treatment standard for tetrachloroethylene represents treatment of a variety of waste matrices incinerated at four sites. The untreated waste concentration of tetrachloroethylene ranged from 4 mg/kg to 17,000 mg/kg in these waste matrices. All of these wastes were treated to the BDAT treatment standard or below (0.05 mg/kg). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing tetrachloroethylene and substantially reduce the likelihood of migration of tetrachloroethylene from spent solvent wastes.

[The proposed BDAT technology-based treatment standard for tetrachloroethylene was estimated at the detection limit of <0.010 mg/L based on incineration (see Table 11, 51 FR 1722). The difference between the proposed and promulgated treatment standards is primarily a result of additional data gathering subsequent to proposal and use of the analytical quantification level as the treatment standard since the standard derived from the data is below the EPA published analytical quantification level for tetrachloroethylene (see Table 5-1 and the discussion on page 5-17). The new data were presented in EPA's Notice of Availability of Data (51 FR 31783). In addition, a variability analysis was incorporated into the development of the treatment standards for promulgation.]

Table 5-43

INCINERATION DATA FOR TETRACHLOROETHYLENE

Site	Type of Incinerator	Wastes Incinerated	Flow-Weighted Average Influent (mg/kg)	Incinerator Residue* Total (mg/kg)	Incinerator Residue* TCLP (ug/L)	Footnotes
1	Rotary Kiln with Secondary Combustor	PCB Contaminated Dirt	4	<3	<3	a
3	Rotary Kiln with Secondary Combustor	Drum Feed Solids Liquid Waste Fuel	256	<1.5	<3	a
8	Rotary Kiln with Secondary Liquid Injection Combustor	Liquid Waste Fuel	17,000	<1.5	<3	a
9	Rotary Kiln with Secondary Combustor	High-Btu Liquids Low-Btu Liquids Solids Feedb	466	<1.5	<3	a

*Values shown as "<" were reported as below indicated detection limits.

(a) The influent concentration is flow-weighted average.
(b) Gel and filter press residue.

5.6.22 Toluene (Other Than Wastewater)

The Agency has treatment data for the TCLP extract of incinerator ash from the treatment of toluene (Reference 11). The data are summarized in Table 5-44.

The following steps were taken to derive the BDAT treatment standard for toluene:

1. We evaluated the data to determine whether any of the data represented poor design or operation of the incineration system. Data from one facility (site 6) were deleted because the incineration system control devices were not properly designed and operated. The facility is under a Consent Decree to replace and improve the current incinerator control system. Data from another facility (site 2) were deleted because the Agency judged that the system was not properly operated at the time the data were collected. A follow-up sampling visit confirmed the Agency's judgment. The new data were not used in the determination of the long-term performance average for incineration of toluene; however, the data were used to develop a variability factor for incineration. Data from a third site were deleted because toluene was reported as below the detection limits for both the influent and the TCLP extract of the ash.

2. We determined an arithmetic average residue concentration level and a variability factor for each data set. Residue concentration levels reported as less than or equal to the reported detection limit were set equal to the detection limit for statistical analyses. This is a conservative approach since the actual concentration would be between zero and the detection limit. Two residue concentration levels were reported for site 5, one for each incinerator at the site. These were considered as two separate data points.

   Process variability could not be calculated from the incineration data because only one influent and effluent data pair was available for each data set. Therefore, to account for process variability, an average variability factor was calculated for incineration, 5.34 (see Table 5-33).

3. The analysis of variance method was not used to compare different treatments of the same waste because data are available for only one type of treatment for each waste.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-44 could be associated with separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups;

therefore, one waste treatability subgroup was established for all sources of wastes (other than wastewater) containing toluene spent solvents. The least stringent treatment level within the treatability subgroup was selected for BDAT (0.33 mg/L for site 7 obtained by multiplying the variability factor by the highest average residue concentration level) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. The technology basis was incineration.

5. The BDAT treatment standard for toluene represents treatment of a variety of waste matrices incinerated at six sites. The untreated waste concentration of toluene ranged from 3 mg/kg to 100,357 mg/kg in these waste matrices. All of these wastes were treated to the BDAT treatment standard or below (0.33 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing toluene and substantially reduce the likelihood of migration of toluene from spent solvent wastes.

[The proposed BDAT technology-based treatment standard for toluene was estimated at the detection limit of <0.010 mg/L based on incineration (see Table 11, 51 FR 1722). The difference between the proposed and promulgated treatment standards is primarily a result of additional data gathering subsequent to proposal. The new data were presented in EPA's Notice of Availability of Data (51 FR 31783). In addition, a variability analysis was incorporated into the development of the treatment standards for promulgation.]

Table 5-44

INCINERATION DATA FOR TOLUENE

Site	Type of Incinerator	Wastes Incinerated	Flow-Weighted Average Influent (mg/kg)	Incinerator Residue* Total (mg/kg)	Incinerator Residue* TCLP (ug/L)	Footnotes
1	Rotary Kiln with Secondary Combustor	PCB Contaminated Dirt	3	<3	6	a
3	Rotary Kiln with Secondary Combustor	Drum Feed Solids Liquid Waste Fuel	38,057	2.5	27	a
5	Fixed Hearth (Two Separate Incineration Systems)	(From Furniture Manufacturing Industry) Solvent Wastes High-Btu Liquid Wastes Low-Btu Liquid Wastes Lacquer-Coated Cardboard	12,743 12,743	<300 <300	<3 7	b b
7	Fixed Hearth with Secondary Combustor	High-Btu Liquids Low-Btu Liquids Solids Feed	9,562	<300	61	a
8	Rotary Kiln with Secondary Liquid Injection Combustor	Liquid Waste Fuel	43,000	2.1	13	a

*Values shown as "<" were reported as below indicated detection limits.

(a) The influent concentration is flow-weighted average.
(b) The influent concentration is an arithmetic average.

Table 5-44 (Continued)

INCINERATION DATA FOR TOLUENE

Site	Type of Incinerator	Wastes Incinerated	Flow-Weighted Average Influent (mg/kg)	Incinerator Residue* Total (mg/kg)	Incinerator Residue* TCLP (ug/L)	Footnotes
9	Rotary Kiln with Secondary Combustor	High-Btu Liquids Low-Btu Liquids Solids Feedb	100,357	<1.5	<3	a

*Values shown as "<" were reported as below indicated detection limits.

(a) The influent concentration is flow-weighted average.
(b) Gel and filter press residue.

5.6.23 1,1,1-Trichloroethane (Other Than Wastewater)

The Agency has treatment data for the TCLP extract of incinerator ash from the treatment of 1,1,1-trichloroethane (Reference 11). The data are summarized in Table 5-45.

The following steps were taken to derive the BDAT treatment standard for 1,1,1-trichloroethane:

1. We evaluated the data to determine whether any of the data represented poor design or operation of the incineration system. Data from two sites were deleted because 1,1,1-trichloroethane was reported as below the detection limits for both the influent and the TCLP extract of the ash.

2. We determined an arithmetic average residue concentration level and a variability factor for each data set. Residue concentration levels reported as less than or equal to the reported detection limit were set equal to the detection limit for statistical analyses. This is a conservative approach since the actual concentration would be between zero and the detection limit. Two residue concentration levels were reported for site 5, one for each incinerator at the site. These were considered as two separate data points.

   Process variability could not be calculated from the incineration data because only one influent and effluent data pair was available for each data set. Therefore, to account for process variability, an average variability factor was calculated for incineration, 5.34 (calculation of the average variability factor is shown in Table 5-33).

3. The analysis of variance method was not used to compare different treatments of the same waste because data are available for only one type of treatment for each waste.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-45 could be associated with separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastes (other than wastewater) containing 1,1,1-trichloroethane spent solvents. The least stringent treatment level within the treatability subgroup was selected for

BDAT (0.41 mg/L for site 7 obtained by multiplying the variability factor by the highest average residue concentration level) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. The technology basis was incineration.

5. The BDAT treatment standard for 1,1,1-trichloroethane represents treatment of a variety of waste matrices incinerated at five sites. The untreated waste concentration of 1,1,1-trichloroethane ranged from 463 mg/kg to 29,000 mg/kg in these waste matrices. All of these wastes were treated to the BDAT treatment standard or below (0.41 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing 1,1,1-trichloroethane and substantially reduce the likelihood of migration of 1,1,1-trichloroethane from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for 1,1,1-trichloroethane was estimated at the detection limit of <0.010 mg/L based on incineration (see Table 11, 51 FR 1722). The difference between the proposed and promulgated treatment standards is primarily a result of additional data gathering subsequent to proposal. The new data were presented in EPA's Notice of Availability of Data (51 FR 31783). In addition, a variability analysis was incorporated into the development of the treatment standards for promulgation.]

Table 5-45

INCINERATION DATA FOR 1,1,1-TRICHLOROETHANE

Site	Type of Incinerator	Wastes Incinerated	Flow-Weighted Average Influent (mg/kg)	Incinerator Residue* Total (mg/kg)	Incinerator Residue* TCLP (ug/L)	Footnotes
3	Rotary Kiln with Secondary Combustor	Drum Feed Solids Liquid Waste Fuel	29,000	<1.5	<3	a
5	Fixed Hearth (Two Separate Incineration Systems)	(From Furniture Manufacturing Industry) Solvent Wastes High-Btu Liquid Wastes Low-Btu Liquid Wastes Lacquer-Coated Cardboard	463 463	<300 <300	<3 3	b b
7	Fixed Hearth with Secondary Combustor	High-Btu Liquids Low-Btu Liquids Solids Feed	1,920	<300	77	a
8	Rotary Kiln with Secondary Liquid Injection Combustor	Liquid Waste Fuel	10,000	<1.5	<3	a
9	Rotary Kiln with Secondary Combustor	High-Btu Liquids Low-Btu Liquids Solids Feedc	15,792	<1.5	<3	a

*Values shown as "<" were reported as below indicated detection limits.

(a) The influent concentration is flow-weighted average.
(b) The influent concentration is an arithmetic average.
(c) Gel and filter press residue.

5.6.24 1,1,2-Trichloro-1,2,2-trifluoroethane (Other Than Wastewater)

The Agency has no data on TCLP extracts of residue from incineration of 1,1,2-trichloro-1,2,2-trifluoroethane to use in the derivation of the BDAT treatment standard. For reasons presented in Section 5.6.1 EPA used chemical structure as the basis for transferring treatment data to 1,1,2-trichloro-1,2,2-trifluoroethane spent solvent wastes other than wastewaters. Specifically we transferred treatment data from methylene chloride to 1,1,2-trichloro-1,2,2-trifluoroethane; both contain the halogen functional group.

The Agency has data on the analysis of the TCLP extract of incineration residue for two compounds in the halogenated aliphatics structural group: methylene chloride and 1,1,1-trichloroethane. To best account for the range of physical and chemical properties within a structural group that affect treatment by a specific technology, the Agency transferred data representing the least stringent treatment standard from the compounds for which data were available in the halogenated aliphatics structural group. The data from which the treatment standard for incineration of methylene chloride was derived were transferred to 1,1,2-trichloro-1,2,2-trifluoroethane. The treatment standard is 0.96 mg/L based on the transferred data.

We believe the BDAT treatment standard for 1,1,2-trichloro-1,2,2-trifluoroethane spent solvent wastes (other than wastewater) represents substantial treatment. We would expect untreated 1,1,2-trichloro-1,2,2-trifluoroethane wastes to be similar to untreated methylene chloride wastes from which we transferred treatment data since they are used in many similar manufacturing processes, as shown in Section 2 of this document. As discussed on page 5-159, in reference to methylene chloride, we believe these constituent reductions to substantially diminish the toxicity of the spent solvent wastes containing 1,1,2-trichloro-1,2,2-trifluoroethane and substantially reduce the likelihood of migration of 1,1,2-trichloro-1,2,2-trifluoroethane from spent solvent wastes.

[The proposed BDAT technology-based treatment standard for 1,1,2-trichloro-1,2,2-trifluoroethane was estimated at the detection limit of <0.010 mg/L based on incineration (see Table 11, 51 FR 1722). The principal difference between the proposed and promulgated treatment standards is the Agency's change in the criteria for data transfer (see Section 5.6.1, page 5-130, for a discussion of the Agency's methodology for data transfer.)]

5.6.25 Trichloroethylene (Other Than Wastewater)

The Agency has treatment data for the TCLP extract of incinerator ash from the treatment of trichloroethylene (Reference 11). The data are summarized in Table 5-46.

The following steps were taken to derive the BDAT treatment standard for trichloroethylene:

1. We evaluated the data to determine whether any of the data represented poor design or operation of the incineration system. Data from one facility (site 2) were deleted because the Agency judged that the system was not properly operated at the time the data were collected. A follow-up sampling visit confirmed the Agency's judgment. The new data were not used in the determination of the long-term performance average for incineration of trichloroethylene; however, the data were used to develop a variability factor for incineration. Data from two other sites were deleted because trichloroethylene was reported as below the detection limits for both the influent and the TCLP extract of the ash.

2. We determined an arithmetic average residue concentration level and a variability factor for each data set. Residue concentration levels reported as less than or equal to the reported detection limit were set equal to the detection limit for statistical analyses. This is a conservative approach since the actual concentration would be between zero and the detection limit. Process variability could not be calculated from the incineration data because only one influent and effluent data pair was available for each data set. Therefore, to account for process variability, an average variability factor was calculated for incineration, 5.34 (calculation of the average variability factor is shown in Table 5-33).

3. The analysis of variance method was not used to compare different treatments of the same waste because data are available for only one type of treatment for each waste.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-46 could be associated with separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastes (other than wastewater) containing trichloroethylene spent solvents. The least stringent treatment

level within the treatability subgroup was selected for BDAT (0.091 mg/L for site 7 obtained by multiplying the variability factor by the highest average residue concentration level) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. The technology basis was incineration.

5. The BDAT treatment standard for trichloroethylene represents treatment of a variety of waste matrices incinerated at three sites. The untreated waste concentration of trichloroethylene ranged from 1,009 mg/kg to 4,700 mg/kg in these waste matrices. All of these wastes were treated to the BDAT treatment standard or below (0.091 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing trichloroethylene and substantially reduce the likelihood of migration of trichloroethylene from spent solvent wastes.

[The proposed BDAT technology-based treatment standard for trichloroethylene was estimated at the detection limit of <0.010 mg/L based on incineration (see Table 11, 51 FR 1722). The difference between the proposed and promulgated treatment standards is primarily a result of additional data gathering subsequent to proposal. The new data were presented in EPA's Notice of Availability of Data (51 FR 31783). In addition, a variability analysis was incorporated into the development of the treatment standards for promulgation.]

Table 5-46

INCINERATION DATA FOR TRICHLOROETHYLENE

Site	Type of Incinerator	Wastes Incinerated	Flow-Weighted Average Influent (mg/kg)	Incinerator Residue* Total (mg/kg)	Incinerator Residue* TCLP (ug/L)	Footnotes
7	Fixed Hearth with Secondary Combustor	High-Btu Liquids Low-Btu Liquids Solids Feed	1,009	<300	17	a
8	Rotary Kiln with Secondary Liquid Injection Combustor	Liquid Waste Fuel	4,700	<1.5	<3	a
9	Rotary Kiln with Secondary Combustor	High-Btu Liquids Low-Btu Liquids Solids Feedb	4,244	<1.5	<3	a

*Values shown as "<" were reported as below indicated detection limits.

(a) The influent concentration is flow-weighted average.
(b) Gel and filter press residue.

5.6.26 Trichlorofluoromethane (Other Than Wastewater)

The Agency has no data on TCLP extracts of residue from incineration of trichlorofluoromethane to use in the derivation of the BDAT treatment standard. For reasons presented in Section 5.6.1, EPA used chemical structure as the basis for transferring treatment data to trichlorofluoromethane spent solvent wastes other than wastewaters. Specifically we transferred treatment data for methylene chloride to trichlorofluoromethane; both contain the halogen functional group.

The Agency has data on the analysis of the TCLP extract of incineration residue for two compounds in the halogenated aliphatics structural group: methylene chloride and 1,1,1-trichloroethane. To best account for the range of physical and chemical properties within a structural group that affect treatment by a specific technology, the Agency transferred data representing the least stringent treatment standard from the compounds for which data were available in the halogenated aliphatics structural group. The data from which the treatment standard for incineration of methylene chloride was derived were transferred to trichlorofluoromethane. The treatment standard is 0.96 mg/L based on the transferred data.

We believe the BDAT treatment standard for trichlorofluoromethane spent solvent wastes (other than wastewater) represents substantial treatment. We would expect untreated trichlorofluoromethane wastes to be similar to untreated methylene chloride wastes from which we transferred treatment data since they are used in many similar manufacturing processes as shown in Section 2 of this document. As discussed on page 5-159, in reference to methylene chloride, we believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing trichlorofluoromethane and substantially reduce the likelihood of migration of trichlorofluoromethane from spent solvent wastes.

[The proposed technology-based BDAT treatment standard for trichlorofluoromethane was estimated at the detection limit of <0.010 mg/L based on incineration (see Table 11, 51 FR 1722). The principal difference between the proposed and promulgated treatment standards is the Agency's change in the criteria for data transfer (see Section 5.6.1, page 5-130, for a discussion of the Agency's methodology for data transfer.)]

5.6.27 Xylene (Other Than Wastewater)

The Agency has treatment data for the TCLP extract of incinerator ash from the treatment of xylene (Reference 11). The data are summarized in Table 5-47.

The following steps were taken to derive the BDAT treatment standard for xylene:

1. We evaluated the data to determine whether any of the data represented poor design or operation of the incineration system. Data from one facility (site 6) were deleted because the incineration system control devices were not properly designed and operated. The facility is under a Consent Decree to replace and improve the current incinerator control system. Data from another facility (site 2) were deleted because the Agency judged that the system was not properly operated at the time the data were collected. A follow-up sampling visit confirmed the Agency's judgment. The new data were not used in the determination of the long-term performance average for incineration of xylene; however, the data were used to develop a variability factor for incineration. Data from two other sites were deleted because xylene was reported as below the detection limits for both the influent and the TCLP extract of the ash.

2. We determined an arithmetic average residue concentration level and a variability factor for each data set. Residue concentration levels reported as less than or equal to the reported detection limit were set equal to the detection limit for statistical analyses. This is a conservative approach since the actual concentration would be between zero and the detection limit. Process variability could not be calculated from the incineration data because only one influent and effluent data pair was available for each data set. Therefore, to account for process variability, an average variability factor was calculated for incineration, 5.34 (calculation of the average variability factor is shown in Table 5-33).

3. The analysis of variance method was not used to compare different treatments of the same waste because data are available for only one type of treatment for each waste.

4. EPA then analyzed the data to determine if the various treatment concentration levels shown in Table 5-47 could be associated with separate waste treatability subgroups. Sufficient data did not exist to identify separate waste treatability subgroups; therefore, one waste treatability subgroup was established for all sources of wastes (other than wastewater) containing xylene spent

solvents. The least stringent treatment level within the treatability subgroup was selected for BDAT (0.15 mg/L for site 7 obtained by multiplying the variability factor by the highest average residue concentration level) to ensure that the standard could be achieved for all waste matrices within the waste treatability subgroup. The technology basis was incineration.

5. The BDAT treatment standard for xylene represents treatment of a variety of waste matrices incinerated at four sites. The untreated waste concentration of xylene ranged from 7,300 mg/kg to 46,393 mg/kg in these waste matrices. All of these wastes were treated to the BDAT treatment standard or below (0.15 mg/L). We believe these constituent reductions substantially diminish the toxicity of the spent solvent wastes containing xylene and substantially reduce the likelihood of migration of xylene from spent solvent wastes.

[The proposed BDAT technology-based treatment standard for xylene was estimated at the detection limit of <0.010 mg/L based on incineration (see Table 11, 51 FR 1722). The difference between the proposed and promulgated treatment standard is primarily a result of additional data gathering subsequent to proposal. The new data were presented in EPA's Notice of Availability of Data (51 FR 31783). In addition, a variability analysis was incorporated into the development of the treatment standards for promulgation.]

Table 5-47

INCINERATION DATA FOR XYLENE

Site	Type of Incinerator	Wastes Incinerated	Flow-Weighted Average Influent (mg/kg)	Incinerator Residue* Total (mg/kg)	Incinerator Residue* TCLP (ug/L)	Footnotes
3	Rotary Kiln with Secondary Combustor	Drum Feed Solids Liquid Waste Fuel	15,863	1.5	15	a
7	Fixed Hearth with Secondary Combustor	High-Btu Liquids Low-Btu Liquids Solids Feed	46,393	<300	28	a
8	Rotary Kiln with Secondary Liquid Injection Combustor	Liquid Waste Fuel	7,300	<1.5	<3	a
9	Rotary Kiln with Secondary Combustor	High-Btu Liquids Low-Btu Liquids Solids Feedb	22,039	<1.5	<3	a

*Values shown as "<" were reported as below indicated detection limits.

(a) The influent concentration is flow-weighted average.
(b) Gel and filter press residue.

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