



Development Document for Proposed Effluent Limitations Guidelines and Standards for the Centralized Waste Treatment Industry

Volume I

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BACKGROUND

This chapter provides background information on the development of this re-proposed rule. The first sections detail the legislative background while the later sections provide information on the 1995 CWT proposal and the 1996 CWT Notice of Data Availability.

LEGAL AUTHORITY

1.0

These regulations are proposed under the authority of Sections 301, 304, 306, 307, 308, 402, and 501 of the Clean Water Act, 33 U.S.C.1311, 1314, 1316, 1317, 1318, 1342, and 1361.

LEGISLATIVE BACKGROUND

1.1

Clean Water Act

1.1.1

Congress adopted the Clean Water Act (CWA) to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Section 101(a), 33 U.S.C. 1251(a)). To achieve this goal, the CWA prohibits the discharge of pollutants into navigable waters except in compliance with the statute. The Clean Water Act confronts the problem of water pollution on a number of different fronts. Its primary reliance, however, is on establishing restrictions on the types and amounts of pollutants discharged from various industrial, commercial, and public sources of wastewater.

Congress recognized that regulating only those sources that discharge effluent directly into the nation's waters would not be sufficient to achieve the CWA's goals. Consequently, the CWA requires EPA to promulgate nationally applicable pretreatment standards which restrict pollutant discharges for those who discharge

wastewater indirectly through sewers flowing to publicly-owned treatment works (POTWs) (Section 307(b) and (c), 33 U.S.C. 1317(b) & (c)). National pretreatment standards are established for those pollutants in wastewater from indirect dischargers which may pass through or interfere with POTW operations. Generally, pretreatment standards are designed to ensure that wastewater from direct and indirect industrial dischargers are subject to similar levels of treatment. In addition, POTWs are required to implement local treatment limits applicable to their industrial indirect dischargers to satisfy any local requirements (40 CFR 403.5).

Direct dischargers must comply with effluent limitations in National Pollutant Discharge Elimination System ("NPDES") permits; indirect dischargers must comply with pretreatment standards. These limitations and standards are established by regulation for categories of industrial dischargers and are based on the degree of control that can be achieved using various levels of pollution control technology.

Best Practicable Control Technology

Currently Available (BPT) --

Sec. 304(b)(1) of the CWA

1.1.1.1

In the guidelines, EPA defines BPT effluent limits for conventional, priority,¹ and

¹In the initial stages of EPA CWA regulation, EPA efforts emphasized the achievement of BPT limitations for control of the "classical" pollutants (for example, TSS, pH, BOD5). However, nothing on the face of the statute explicitly restricted BPT limitation to such pollutants. Following passage of the Clean Water Act of 1977 with its requirement for point sources to achieve best available (continued on next page)

non-conventional pollutants. In specifying BPT, EPA looks at a number of factors. EPA first considers the cost of achieving effluent reductions in relation to the effluent reduction benefits. The Agency also considers: the age of the equipment and facilities, the processes employed and any required process changes, engineering aspects of the control technologies, non-water quality environmental impacts (including energy requirements), and such other factors as the Agency deems appropriate (CWA 304(b)(1)(B)). Traditionally, EPA establishes BPT effluent limitations based on the average of the best performances of facilities within the industry of various ages, sizes, processes or other common characteristics. Where, however, existing performance is uniformly inadequate, EPA may require higher levels of control than currently in place in an industrial category if the Agency determines that the technology can be practically applied.

*Best Conventional Pollutant
Control Technology (BCT) --*

Sec. 304(b)(4) of the CWA 1.1.1.2

The 1977 amendments to the CWA required EPA to identify effluent reduction levels for conventional pollutants associated with BCT technology for discharges from existing industrial point sources. In addition to other factors specified in Section 304(b)(4)(B), the CWA requires that EPA establish BCT limitations after consideration of a two part "cost-reasonableness" test. EPA explained its methodology for the development of BCT limitations in July 1986 (51 FR 24974).

Section 304(a)(4) designates the following as conventional pollutants: biochemical

oxygen demand (BOD₅), total suspended solids (TSS), fecal coliform, pH, and any additional pollutants defined by the Administrator as conventional. The Administrator designated oil and grease as an additional conventional pollutant on July 30, 1979 (44 FR 44501).

*Best Available Technology
Economically Achievable (BAT) --*
Sec. 304(b)(2) of the CWA

1.1.1.3

In general, BAT effluent limitations guidelines represent the best economically achievable performance of plants in the industrial subcategory or category. The factors considered in assessing BAT include the cost of achieving BAT effluent reductions, the age of equipment and facilities involved, the process employed, potential process changes, and non-water quality environmental impacts, including energy requirements. The Agency retains considerable discretion in assigning the weight to be accorded these factors. Unlike BPT limitations, BAT limitations may be based on effluent reductions attainable through changes in a facility's processes and operations. As with BPT, where existing performance is uniformly inadequate, BAT may require a higher level of performance than is currently being achieved based on technology transferred from a different subcategory or category. BAT may be based upon process changes or internal controls, even when these technologies are not common industry practice.

*New Source Performance Standards
(NSPS) -- Sec. 306 of the CWA*

1.1.1.4

NSPS reflect effluent reductions that are achievable based on the best available demonstrated control technology. New facilities have the opportunity to install the best and most efficient production processes and wastewater treatment technologies. As a result, NSPS should represent the most stringent controls attainable through the application of the best available

technology limitations to control discharges of toxic pollutants, EPA shifted the focus of the guidelines program to address the listed priority pollutants. BPT guidelines continue to include limitations to address all pollutants.

control technology for all pollutants (that is, conventional, nonconventional, and priority pollutants). In establishing NSPS, EPA is directed to take into consideration the cost of achieving the effluent reduction and any non-water quality environmental impacts and energy requirements.

Pretreatment Standards for Existing Sources (PSES) --

Sec. 307(b) of the CWA 1.1.1.5

PSES are designed to prevent the discharge of pollutants that pass-through, interfere-with, or are otherwise incompatible with the operation of publicly-owned treatment works (POTW). The CWA authorizes EPA to establish pretreatment standards for pollutants that pass-through POTWs or interfere with treatment processes or sludge disposal methods at POTWs. Pretreatment standards are technology-based and analogous to BAT effluent limitations guidelines.

The General Pretreatment Regulations, which set forth the framework for the implementation of categorical pretreatment standards, are found at 40 CFR Part 403. Those regulations contain a definition of pass-through that addresses localized rather than national instances of pass-through and establish pretreatment standards that apply to all non-domestic dischargers. See 52 FR 1586, January 14, 1987.

Pretreatment Standards for New

Sources (PSNS) --

Sec. 307(b) of the CWA 1.1.1.6

Like PSES, PSNS are designed to prevent the discharges of pollutants that pass-through, interfere-with, or are otherwise incompatible with the operation of POTWs. PSNS are to be issued at the same time as NSPS. New indirect dischargers have the opportunity to incorporate into their plants the best available demonstrated technologies. The Agency considers the same factors in promulgating PSNS

as it considers in promulgating NSPS.

Section 304(m) Requirements and Litigation

1.1.2

Section 304(m) of the CWA, added by the Water Quality Act of 1987, requires EPA to establish schedules for (1) reviewing and revising existing effluent limitations guidelines and standards ("effluent guidelines") and (2) promulgating new effluent guidelines. On January 2, 1990, EPA published an Effluent Guidelines Plan (55 FR 80) that established schedules for developing new and revised effluent guidelines for several industry categories. One of the industries for which the Agency established a schedule was the Centralized Waste Treatment Industry.

The Natural Resources Defense Council (NRDC) and Public Citizen, Inc. filed suit against the Agency, alleging violation of Section 304(m) and other statutory authorities requiring promulgation of effluent guidelines (*NRDC et al. v. Browner*, Civ. No. 89-2980 (D.D.C.)). Under the terms of a consent decree dated January 31, 1992, which settled the litigation, EPA agreed, among other things, to propose effluent guidelines for the "Centralized Waste Treatment Industry Category by April 31, 1994 and take final action on these effluent guidelines by January 31, 1996. On February 4, 1997, the court approved modifications to the Decree which revised the deadline to August 1999 for final action. EPA provided notice of these modifications on February 26, 1997 at 62 FR 8726.

The Land Disposal

Restrictions Program: ***1.1.3***

Introduction to RCRA Land

Disposal Restrictions (LDR) *1.1.3.1*

The Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act (RCRA), enacted

on November 8, 1984, largely prohibit the land disposal of untreated hazardous wastes. Once a hazardous waste is prohibited from land disposal, the statute provides only two options for legal land disposal: meet the treatment standard for the waste prior to land disposal, or dispose of the waste in a land disposal unit that has been found to satisfy the statutory no migration test. A no migration unit is one from which there will be no migration of hazardous constituents for as long as the waste remains hazardous (RCRA Sections 3004 (d),(e),(g)(5)).

Under section 3004, the treatment standards that EPA develops may be expressed as either constituent concentration levels or as specific methods of treatment. The criteria for these standards is that they must substantially diminish the toxicity of the waste or substantially reduce the likelihood of migration of hazardous constituents from the waste so that short-term and long-term threats to human health and the environment are minimized (RCRA Section 3004(m)(1)). For purposes of the restrictions, the RCRA program defines land disposal to include any placement of hazardous waste in a landfill, surface impoundment, waste pile, injection well, land treatment facility, salt dome formation, salt bed formation, or underground mine or cave. Land disposal restrictions are published in 40 CFR Part 268.

EPA has used hazardous waste treatability data as the basis for land disposal restrictions standards. First, EPA has identified Best Demonstrated Available Treatment Technology (BDAT) for each listed hazardous waste. BDAT is that treatment technology that EPA finds to be the most effective for a waste which is also readily available to generators and treaters. In some cases, EPA has designated, for a particular waste stream, a treatment technology which has been shown to successfully treat a similar, but more difficult to treat, waste stream. This ensured that the land disposal restrictions

standards for a listed waste stream were achievable since they always reflected the actual treatability of the waste itself or of a more refractory waste.

As part of the Land Disposal Restrictions (LDR), Universal Treatment Standards (UTS) were promulgated as part of the RCRA phase two final rule (July 27, 1994). The UTS are a series of concentrations for wastewaters and non-wastewaters that provide a single treatment standard for each constituent. Previously, the LDR regulated constituents according to the identity of the original waste; thus, several numerical treatment standards might exist for each constituent. The UTS simplified the standards by having only one treatment standard for each constituent in any waste residue.

The LDR treatment standards established under RCRA may differ from the Clean Water Act effluent guidelines proposed here today both in their format and in the numerical values set for each constituent. The differences result from the use of different legal criteria for developing the limits and resulting differences in the technical and economic criteria and data sets used for establishing the respective limits.

The differences in format of the LDR and effluent guidelines is that LDR establishes a single daily limit for each pollutant parameter whereas the effluent guidelines establish monthly and daily limits. Additionally, the effluent guidelines provide for several types of discharge, including new vs. existing sources, and indirect vs. direct discharge.

The differences in numerical limits established under the Clean Water Act may differ, not only from LDR and UTS, but also from point-source category to point-source category (for example, Electroplating, 40 CFR Part 413; and Metal Finishing, 40 CFR Part 433). The effluent guidelines limitations and standards are industry-specific, subcategory-specific, and

technology-based. The numerical limits are typically based on different data sets that reflect the performance of specific wastewater management and treatment practices. Differences in the limits reflect differences in the statutory factors that the Administrator is required to consider in developing technically and economically achievable limitations and standards -- manufacturing products and processes (which, for CWTs involves types of waste received for treatment), raw materials, wastewater characteristics, treatability, facility size, geographic location, age of facility and equipment, non-water quality environmental impacts, and energy requirements. A consequence of these differing approaches is that similar waste streams can be regulated at different levels.

Overlap Between LDR Standards and the Centralized Waste Treatment

Industry Effluent Guidelines 1.1.3.2

EPA's survey for this guideline identified no facilities discharging wastewater effluent to land disposal units. There is consequently no overlap between the proposed regulations for the CWT Industry and the Universal Treatment Standards.

**CENTRALIZED WASTE TREATMENT
INDUSTRY EFFLUENT GUIDELINE**

**RULEMAKING HISTORY 1.2
January 27, 1995 Proposal 1.2.1**

On January 27, 1995 (60 FR 5464), EPA proposed regulations to reduce discharges to navigable waters of toxic, conventional, and non-conventional pollutants in treated wastewater from facilities defined in the proposal as "centralized waste treatment facilities." As proposed, these effluent limitations guidelines and pretreatment standards would have applied to "any facility that treats any hazardous or non-hazardous industrial waste received from off-site

by tanker truck, trailer/roll-off bins, drums, barge or other forms of shipment." Facilities which received waste from off-site solely from via pipeline were excluded from the proposed rule. Facilities proposed for regulation included both stand-alone waste treatment and recovery facilities that treat waste received from off-site as well as those facilities that treat on-site generated process wastewater with wastes received from off-site.

The Agency proposed limitations and standards for an estimated 85 facilities in three subcategories. The subcategories for the centralized waste treatment (CWT) industry were metal-bearing waste treatment and recovery, oily waste treatment and recovery, and organic waste treatment and recovery. EPA based the BPT effluent limitations proposed in 1995 on the technologies listed in Table 1.1 below. EPA based BCT, BAT, NSPS, PSES, and PSNS on the same technologies as BPT.

Table 1.1 Technology Basis for 1995 BPT Effluent Limitations

Proposed Subpart	Name of Subcategory	Technology Basis
A	Metal-Bearing Waste Treatment and Recovery	Selective Metals Precipitation, Pressure Filtration, Secondary Precipitation, Solid-Liquid Separation, and Tertiary Precipitation For Metal-Bearing Waste Which Includes Concentrated Cyanide Streams: Pretreatment by Alkaline Chlorination at Elevated Operating Conditions
B	Oily Waste Treatment and Recovery	Ultrafiltration or Ultrafiltration, Carbon Adsorption, and Reverse Osmosis
C	Organic Waste Treatment and Recovery	Equalization, Air Stripping, Biological Treatment, and Multimedia Filtration

September 16, 1996 Notice of Data Availability

1.2.2

Based on comments received on the 1995 proposal and new information, EPA reexamined its conclusions about the Oily Waste Treatment and Recovery subcategory, or “oils subcategory”. (The 1995 proposal had defined facilities in this subcategory as “facilities that treat, and/or recover oil from oily waste received from off-site.”) Subsequently, in 1996 EPA noticed the availability of the new data on this subcategory. EPA explained that it had underestimated the size of the oils subcategory, and that the data used to develop the original proposal may have mischaracterized this portion of the CWT industry. EPA had based its original estimates on the size of this segment of the industry on information obtained from the 1991 Waste Treatment Industry Questionnaire. The basis year for the questionnaire was 1989. Many of the new oils facilities discussed in this notice began operation after 1989. EPA concluded that many of these facilities may have started up or modified their existing operations in response to requirements in EPA regulations, specifically, the

provisions of 40 CFR 279, promulgated on September 10, 1992 (Standards for the Management of Used Oil). These regulations govern the handling of used oils under the Solid Waste Disposal Act and CERCLA. EPA’s 1996 notice discussed the additional facilities, provided a revised description of the subcategory and described how the 1995 proposal limitations and standards, if promulgated, would have affected such facilities. The notice, among other items, also solicited comments on the use of dissolved air flotation in this subcategory.

DATA COLLECTION

EPA gathered and evaluated technical and economic data from various sources in the course of developing the effluent limitations guidelines and standards for the centralized waste treatment industry. These data sources include:

- EPA's *Preliminary Data Summary for the Hazardous Waste Treatment Industry*;
- Responses to EPA's "1991 Waste Treatment Industry Questionnaire";
- Responses to EPA's "Detailed Monitoring Questionnaire";
- EPA's 1990 - 1997 sampling of selected Centralized waste treatment facilities;
- Public comments to EPA's 1995 Proposed Rule;
- Public comments to EPA's 1996 Notice of Data Availability;
- Contact with members of the industry, environmental groups, pretreatment coordinators, Association of Municipal Sewage Authorities (AMSA), regional, state, and other government representatives; and
- Other literature data, commercial publications, and EPA data bases.

EPA used data from these sources to profile the industry with respect to: wastes received for treatment and/or recovery; treatment/recovery processes; geographical distribution; and wastewater and solid waste disposal practices. EPA then characterized the wastewater generated by treatment/recovery operations through an evaluation of water usage, type of discharge or disposal, and the occurrence of conventional, non-conventional, and priority pollutants.

The remainder of this chapter details the data sources utilized in the development of this reproposal.

PRELIMINARY DATA SUMMARY**2.1**

EPA began an effort to develop effluent limitations guidelines and pretreatment standards for waste treatment operations in 1986. In this initial study, EPA looked at a range of facilities, including centralized waste treatment facilities, landfills, and industrial waste combustors, that received hazardous waste from off-site for treatment, recovery, or disposal. The purpose of the study was to characterize the hazardous waste treatment industry, its operations, and pollutant discharges into national waters. EPA published the results of this study in the *Preliminary Data Summary for the Hazardous Waste Treatment Industry* in 1989 (EPA 440/1-89/100). During the same time period, EPA conducted two similar, but separate, studies of the solvent recycling industry and the used oil reclamation and re-refining industry. In 1989, EPA also published the results of these studies in two reports entitled the *Preliminary Data Summary for the Solvent Recycling Industry* (EPA 440/1-89/102) and the *Preliminary Data Summary for Used Oil Reclamation and Re-refining Industry* (EPA 440/1-89/014).

Based on a thorough analysis of the data presented in the *Preliminary Data Summary for the Hazardous Waste Treatment Industry*, EPA decided it should develop effluent limitations guidelines and standards for the centralized waste treatment industry. EPA also decided to develop standards for landfills and industrial waste combustors which were proposed on February 6, 1998 in the Federal Register (63 FR 6426 and 63 FR 6392, respectively). In addition to centralized waste treatment facilities, EPA also studied fuel blending operations and waste solidification/

stabilization facilities. As detailed and defined in the applicability section of the preamble, EPA has decided not to propose nationally applicable effluent limitations guidelines and standards for fuel blending and stabilization operations.

CLEAN WATER ACT

SECTION 308 QUESTIONNAIRES **2.2** ***Development of Questionnaires*** **2.2.1**

A major source of information and data used in developing the proposed effluent limitations guidelines and standards for the CWT category is industry responses to questionnaires distributed by EPA under the authority of Section 308 of the CWA. EPA developed two questionnaires, the 1991 Waste Treatment Industry Questionnaire and the Detailed Monitoring Questionnaire, for this study. The 1991 Waste Treatment Industry Questionnaire was designed to request 1989 technical, economic, and financial data from, what EPA believed to be, a census of the industry. The Detailed Monitoring Questionnaire was designed to elicit daily analytical data from a limited number of facilities which would be chosen after receipt and review of the 1991 Waste Treatment Industry Questionnaire responses.

In order to minimize the burden to centralized waste treatment facilities, EPA designed the 1991 Waste Treatment Industry Questionnaire such that recipients could use information reported in their 1989 Hazardous Waste Biennial Report as well as any other readily accessible data. The technical portion of the questionnaire, Part A, specifically requested information on:

- Treatment/recovery processes;
- Types and quantities of waste received for treatment;
- The industrial waste management practices used;
- Ancillary waste management operations;
- The quantity treatment, and disposal of

wastewater generated during industrial waste management;

- Summary analytical monitoring data;
- The degree of co-treatment (treatment of CWT wastewater with wastewater from other industrial operations at the facility);
- Cost of the waste treatment/recovery processes; and
- The extent of wastewater recycling or reuse at facilities.

Since the summary monitoring information requested in the 1991 Waste Treatment Industry Questionnaire was not sufficient for determination of limitations and industry variability, EPA designed a follow-up questionnaire, the Detailed Monitoring Questionnaire (DMQ), to collect daily analytical data from a limited number of facilities. EPA requested all DMQ facilities to submit effluent wastewater monitoring data in the form of individual data points rather than monthly aggregates, generally for the 1990 calendar year. Some facilities were also requested to submit monitoring data for intermediate waste treatment points in an effort to obtain pollutant removal information across specified treatment technologies.

Since most CWT facilities do not have analytical data for their wastewater treatment system influent, EPA additionally requested DMQ facilities to submit copies of their waste receipts for a six week period. Waste receipts are detailed logs of individual waste shipments sent to a CWT for treatment. EPA selected a six week period to minimize the burden to recipients and to create a manageable database.

EPA sent draft questionnaires to industry trade associations, treatment facilities who had expressed interest, and environmental groups for review and comment. EPA also conducted a pre-test of the 1991 Waste Treatment Industry Questionnaire at nine centralized waste treatment

facilities to determine if the type of information necessary would be received from the questions posed as well as to determine if questions were designed to minimize the burden to facilities. EPA did not conduct a pre-test of the Detailed Monitoring Questionnaire due to the project schedule limitations.

Based on comments from the reviewers, EPA determined the draft questionnaire required minor adjustments in the technical section and substantial revisions for both the economic and financial sections. EPA anticipated extensive comments, since this was EPA's first attempt at requesting detailed information from a service industry as opposed to a manufacturing-based industry.

As required by the Paperwork Reduction Act, 44 U.S.C. 3501 et seq., EPA submitted the questionnaire package (including the revised 1991 Waste Treatment Industry Questionnaire and the Detailed Monitoring Questionnaire) to the Office of Management and Budget (OMB) for review, and published a notice in the *Federal Register* to announce the questionnaire was available for review and comment (55 FR 45161). EPA also redistributed the questionnaire package to industry trade associations, centralized waste treatment industry facilities, and environmental groups that had provided comments on the previous draft and to any others who requested a copy of the questionnaire package.

No additional comments were received and OMB cleared the entire questionnaire package for distribution on April 10, 1991.

Distribution of Questionnaires **2.2.2**

In 1991, under the authority of Section 308 of the CWA, EPA sent the Waste Treatment Industry Questionnaire to 455 facilities that the Agency had identified as possible CWT facilities. Because there is no specific centralized waste

treatment industry Standard Industrial Code (SIC), identification of facilities was difficult. EPA looked to directories of treatment facilities, other Agency information sources, and even telephone directories to identify the 455 facilities which received the questionnaires. EPA received responses from 413 facilities indicating that 89 treated or recovered material from off-site industrial waste in 1989. The remaining 324 facilities did not treat, or recover materials from industrial waste from off-site. Four of the 89 facilities only received waste via a pipeline (fixed delivery system) from the original source of wastewater generation.

EPA obtained additional information from the 1991 Waste Treatment Industry Questionnaire recipients through follow-up phone calls and written requests for clarification of questionnaire responses.

After evaluation of the 1991 Waste Treatment Industry Questionnaire responses, EPA selected 20 in-scope facilities from the 1991 Waste Treatment Industry Questionnaire mailing list to complete the Detailed Monitoring Questionnaire. These facilities were selected based on: the types and quantities of wastes received for treatment; the quantity of on-site generated wastewater not resulting from treatment or recovery of off-site generated waste; the treatment/recovery technologies and practices; and the facility's wastewater discharge permit requirements. All 20 DMQ recipients responded.

WASTEWATER SAMPLING AND SITE VISITS 2.3 Pre-1989 Sampling Program 2.3.1

From 1986 to 1987, EPA conducted site visits and sampled at twelve facilities to characterize the waste streams and on-site treatment technology performance at hazardous waste incinerators, Subtitle C and D landfills, and hazardous waste treatment facilities as part of the Hazardous Waste Treatment Industry Study. All

of the facilities in this sampling program had multiple operations, such as incineration and commercial wastewater treatment. The sampling program did not focus on characterizing the individual waste streams from individual operations. Therefore, the data collected cannot be used for the characterization of centralized waste treatment wastewater, the assessment of treatment performance, or the development of limitations and standards. Information collected in the study is presented in the *Preliminary Data Summary for the Hazardous Waste Treatment Industry* (EPA 440/1-89/100).

1989 - 1997 Site Visits

2.3.2

Between 1989 and 1993, EPA visited 27 centralized waste treatment facilities. The purpose of these visits was to collect various information about the operation of CWTs, and, in most cases, to evaluate each facility as a potential week-long sampling candidate. EPA selected these facilities based on the information gathered by EPA during the selection of the Waste Treatment Industry Questionnaire recipients and the subsequent questionnaire responses.

In late 1994, EPA visited an additional four facilities which specialize in the treatment of bilge waters and other dilute oily wastes. These facilities were not in operation at the time the questionnaire was mailed, but were identified by EPA through contact with the industry and AMSA. EPA visited these facilities to evaluate them as potential sampling candidates and to determine if CWT operations at facilities which accept dilute oily wastes or used material were significantly different than CWT operations at facilities that accept concentrated oily wastes.

Following the 1995 proposal, EPA visited nine centralized waste treatment facilities, including eight additional oils facilities and one metals facility which had also been visited prior to the proposal. EPA selected these facilities

based on information obtained by EPA through proposal public comments, industry contacts, and EPA regional staff. In late 1997, EPA visited two pipeline facilities identified prior to the proposal (one via the questionnaire and the second through review of the OCPSF database and follow-up phone calls) in order to characterize operations at pipeline facilities.

During each facility site visit, EPA gathered the following information:

- The process for accepting waste for treatment or recovery;
- The types of waste accepted for treatment;
- Design and operating procedures for treatment technologies;
- The location of potential sampling points;
- Site specific sampling requirements;
- Wastewater generated on-site and its sources;
- Wastewater discharge option and limitations;
- Solid waste disposal practices;
- General facility management practices; and
- Other facility operations.

Site visit reports were prepared for all visits and are located in the regulatory record for this proposal.

Sampling Episodes

2.3.3

Facility Selection

2.3.3.1

EPA selected facilities to be sampled by reviewing the information received during site visits and assessing whether the wastewater treatment system (1) was theoretically effective in removing pollutants, (2) treated wastes received from a variety of sources, (3) was operated in such a way as to optimize the performance of the treatment technologies, and (4) applied waste management practices that increased the effectiveness of the treatment unit.

EPA also evaluated whether the CWT portion of each facility flow was adequate to assess the treatment system performance for the

centralized waste treatment waste stream. At some facilities, the centralized waste treatment operations were minor portions of the overall site operation. In such cases, where the centralized waste treatment waste stream is commingled with non-centralized waste treatment streams prior to treatment, characterization of this waste stream and assessment of treatment performance is difficult. Therefore, data from these commingled systems could not be used to establish effluent limitations guidelines and standards for the centralized waste treatment industry.

Another important consideration in the sampling facility selection process was the commingling of wastes from more than one centralized waste treatment subcategory. For example, many facilities treated metal-bearing and oily waste in the same treatment system. In such cases, EPA did not select these facilities for treatment technology sampling since EPA could not determine whether a decrease in pollutant concentrations in the commingled stream would be due to an efficient treatment system or dilution.

Using the criteria detailed above, EPA selected 14 facilities to sample in order to collect wastewater treatment efficiency data to be used to establish effluent limitations guidelines and standards for the centralized waste treatment industry. Twelve facilities were sampled prior to the 1995 proposal and four facilities (two additional and two resampled) were sampled after the proposal.

Sampling Episodes

2.3.3.2

After EPA selected a facility to sample, EPA prepared a draft sampling plan which described the location of sample points, the analysis to be performed at specified sample points, and the procedures to be followed during the sampling episode. Prior to sampling, EPA provided a copy of the draft sampling plan to the facility for review and comment to ensure EPA properly

described and understood facility operations. All comments were incorporated into the final sampling plan.

During the sampling episode, EPA collected samples of influent, intermediate, and effluent streams, preserved the samples, and sent them to EPA-approved laboratories. Facilities were given the option to split samples with EPA, but most facilities declined. Sampling episodes were generally conducted over a five-day period during which EPA obtained 24-hour composite samples for continuous systems and grab samples for batch systems.

Following the sampling episode, EPA prepared a draft sampling report that included descriptions of the treatment/recovery processes, sampling procedures, and analytical results. EPA provided draft reports to facilities for comment and review. All corrections were incorporated into the final report. Both final sampling plans and reports for all episodes are located in the regulatory record for this reproposal.

The specific constituents analyzed at each episode and sampling point varied and depended on the waste type being treated and the treatment technology being evaluated. At the initial two sampling episodes, the entire spectrum of chemical compounds for which there are EPA-approved analytical methods were analyzed (more than 480 compounds). Table 2-1 provides a complete list of these pollutants. After a review of the initial analytical data, the number of constituents analyzed was decreased by omitting analyses for dioxins/furans, pesticides/herbicides, methanol, ethanol, and formaldehyde. Pesticides/herbicides were analyzed on a limited basis depending on the treatment chemicals used at facilities. Dioxin/furan analysis was only performed on a limited basis for solid/filter cake samples to assess possible environmental impacts.

Data resulting from the influent samples contributed to the characterization of this

industry, development of the list of pollutants of concern, and development of raw waste characteristics. EPA used the influent, intermediate, and effluent points to analyze the efficacy of treatment at the facilities and to develop current discharge concentrations, loadings, and treatment technology options for the centralized waste treatment industry. Finally, EPA used data collected from the effluent points to calculate the long term averages (LTAs) for each of the proposed regulatory options. The use of this data is discussed in detail in subsequent chapters.

Table 2-1. Chemical Compounds Analyzed Under EPA Analytical Methods

Pollutant	Cas Num	Pollutant	Cas Num	Pollutant	Cas Num
<i>CLASSICAL WET CHEMISTRY</i>					
Amenable Cyanide	C-025	Disulfoton	298-04-4	Chloroneb	2675-77-6
Ammonia Nitrogen	7664-41-7	Epn	2104-64-5	Chloropropylate	5836-10-2
BOD	C-002	Ethion	563-12-2	Chlorothalonil	1897-45-6
Chloride	16887-00-6	Ethoprop	13194-48-8	Dibromochloropropane	96-12-8
COD	C-004	Famphur	52-85-7	Dacthal (Dcpa)	1861-32-1
Fluoride	16984-48-8	Fensulfothion	115-90-2	4,4'-ddd	72-54-8
Hexane Extractable Mater.	C-036	Fenthion	55-38-9	4,4'-dde	72-55-9
Hexavalent Chromium	18540-29-9	Hexamethylphosphoramide	680-31-9	4,4'-ddt	50-29-3
Nitrate/nitrite	C-005	Leptophos	21609-90-5	Diallate a	2303-16-4A
pH	C-006	Malathion	121-75-5	Diallate B	2303-16-4B
Recoverable Oil & Grease	C-007	Merphos	150-50-5	Dichlone	117-80-6
TDS	C-010	Methamidophos	10265-92-6	Dicofol	115-32-2
TOC	C-012	Methyl Chlorpyrifos	5598-13-0	Dieldrin	60-57-1
Total Cyanide	57-12-5	Methyl Parathion	298-00-0	Endosulfan I	959-98-8
Total Phenols	C-020	Methyl Trithion	953-17-3	Endosulfan Ii	33213-65-9
Total Phosphorus	14265-44-2	Mevinphos	7786-34-7	Endosulfan Sulfate	1031-07-8
Total Solids	C-008	Monocrotophos	6923-22-4	Endrin	72-20-8
Total Sulfide	18496-25-8	Naled	300-76-5	Endrin Aldehyde	7421-93-4
TSS	C-009	Parathion (Ethyl)	56-38-2	Endrin Ketone	53494-70-5
<i>1613: DIOXINS/FURANS</i>		Phorate	298-02-2	Ethalfuralin	55283-68-6
2378-TCDD	1746-01-6	Phosmet	732-11-6	Etriazazole	2593-15-9
2378-TCDF	51207-31-9	Phosphamidon E	297-99-4	Fenarimol	60168-88-9
12378-PECDD	40321-76-4	Phosphamidon Z	23783-98-4	Dicofol	115-32-2
12378-PECDF	57117-41-6	Ronnel	299-84-3	Dieldrin	60-57-1
23478-PECDF	57117-31-4	Sulfotepp	3689-24-5	Endosulfan I	959-98-8
123478-HXCDD	39227-28-6	Sulprofos	35400-43-2	Endosulfan Ii	33213-65-9
123678-HXCDD	57653-85-7	Tepp	107-49-3	Endosulfan Sulfate	1031-07-8
123789-HXCDD	19408-74-3	Terbufos	13071-79-9	Endrin	72-20-8
123478-HXCDF	70648-26-9	Tetrachlorvinphos	22248-79-9	Endrin Aldehyde	7421-93-4
123678-HXCDF	57117-44-9	Tokuthion	34643-46-4	Endrin Ketone	53494-70-5
123789-HXCDF	72918-21-9	Trichlorfon	52-68-6	Ethalfuralin	55283-68-6
234678-HXCDF	60851-34-5	Trichloronate	327-98-0	Etriazazole	2593-15-9
1234678-HPCDD	35822-46-9	Tricresylphosphate	78-30-8	Fenarimol	60168-88-9
1234678-HPCDF	67562-39-4	Trimethylphosphate	512-56-1	Dicofol	115-32-2
<i>1656: PESTICIDES/HERBICIDES</i>		<i>1656: PESTICIDES/HERBICIDES</i>			
1234789-HPCDF	55673-89-7	Acephate	30560-19-1	Dieldrin	60-57-1
Ocdd	3268-87-9	Acifluorfen	50594-66-6	Endosulfan I	959-98-8
Ocdf	39001-02-0	Alachlor	15972-60-8	Endosulfan Ii	33213-65-9
<i>1657: PESTICIDES/HERBICIDES</i>		Aldrin	309-00-2	Endosulfan Sulfate	1031-07-8
Azinphos Ethyl	2642-71-9	Atrazine	1912-24-9	Endrin	72-20-8
Azinphos Methyl	86-50-0	Benfluralin	1861-40-1	Endrin Aldehyde	7421-93-4
Chlorfevinphos	470-90-6	Alpha-bhc	319-84-6	Endrin Ketone	53494-70-5
Chlorpyrifos	2921-88-2	Beta-bhc	319-85-7	Ethalfuralin	55283-68-6
Coumaphos	56-72-4	Gamma-bhc	58-89-9	Etriazazole	2593-15-9
Crotoxyphos	7700-17-6	Delta-bhc	319-86-8	Fenarimol	60168-88-9
Def	78-48-8	Bromacil	314-40-9	Dicofol	115-32-2
Demeton a	8065-48-3A	Bromoxynil Octanoate	1689-99-2	Dieldrin	60-57-1
Demeton B	8065-48-3B	Butachlor	23184-66-9	Endosulfan I	959-98-8
Diazinon	333-41-5	Captafol	2425-06-1	Endosulfan Ii	33213-65-9
Dichlorfenthion	97-17-6	Captan	133-06-2	Endosulfan Sulfate	1031-07-8
Dichlorvos	62-73-7	Carbophenothion	786-19-6	Endrin	72-20-8
Dicrotophos	141-66-2	Alpha-chlordane	5103-71-9	Endrin Aldehyde	7421-93-4
Dimethoate	60-51-5	Gamma-chlordane	5103-74-2	Endrin Ketone	53494-70-5
Dioxathion	78-34-2	Chlorobenzilate	510-15-6	Ethalfuralin	55283-68-6

Table 2-1. Chemical Compounds Analyzed Under EPA Analytical Methods (continued)

Pollutant	Cas Num	Pollutant	Cas Num	Pollutant	Cas Num
Trifluralin	1582-09-8	Phosphorus	7723-14-0	Acrylonitrile	107-13-1
1658: PESTICIDES/HERBICIDES		Platinum	7440-06-4	Benzene	71-43-2
Dalapon	75-99-0	Potassium	7440-09-7	Bromodichloromethane	75-27-4
Dicamba	1918-00-9	Praseodymium	7440-10-0	Bromoform	75-25-2
Dichloroprop	120-36-5	Rhenium	7440-15-5	Bromomethane	74-83-9
Dinoseb	88-85-7	Rhodium	7440-16-6	Carbon Disulfide	75-15-0
Mcpa	94-74-6	Ruthenium	7440-18-8	Chloroacetonitrile	107-14-2
Mcpp	7085-19-0	Samarium	7440-19-9	Chlorobenzene	108-90-7
Picloram	1918-02-1	Scandium	7440-20-2	Chloroethane	75-00-3
2,4-d	94-75-7	Selenium	7782-49-2	Chloroform	67-66-3
2,4-db	94-82-6	Silicon	7440-21-3	Chloromethane	74-87-3
2,4,5-t	93-76-5	Silver	7440-22-4	Cis-1,3-dichloropropene	10061-01-5
2,4,5-tp	93-72-1	Sodium	7440-23-5	Crotonaldehyde	4170-30-3
1620: METALS		Strontium	7440-24-6	Dibromochloromethane	124-48-1
Aluminum	7429-90-5	Sulfur	7704-34-9	Dibromomethane	74-95-3
Antimony	7440-36-0	Tantalum	7440-25-7	Diethyl Ether	60-29-7
Arsenic	7440-38-2	Tellurium	13494-80-9	Ethyl Benzene	100-41-4
Barium	7440-39-3	Terbium	7440-27-9	Ethyl Cyanide	107-12-0
Beryllium	7440-41-7	Thallium	7440-28-0	Ethyl Methacrylate	97-63-2
Bismuth	7440-69-9	Thorium	7440-29-1	Iodomethane	74-88-4
Boron	7440-42-8	Thulium	7440-30-4	Isobutyl Alcohol	78-83-1
Cadmium	7440-43-9	Tin	7440-31-5	Methylene Chloride	75-09-2
Calcium	7440-70-2	Titanium	7440-32-6	M-xylene	108-38-3
Cerium	7440-45-1	Tungsten	7440-33-7	O+p Xylene	136777-61-2
Chromium	7440-47-3	Uranium	7440-61-1	Tetrachloroethene	127-18-4
Cobalt	7440-48-4	Vanadium	7440-62-2	Tetrachloromethane	56-23-5
Copper	7440-50-8	Ytterbium	7440-64-4	Toluene	108-88-3
Dysprosium	7429-91-6	Yttrium	7440-65-5	Trans-1,2-dichloroethene	156-60-5
Erbium	7440-52-0	Zinc	7440-66-6	Trans-1,3-dichloropropene	10061-02-6
Europium	7440-53-1	Zirconium	7440-67-7	Trans-1,4-dichloro-2-butene	110-57-6
Gadolinium	7440-54-2	1624: VOLATILE ORGANICS		Trichloroethene	79-01-6
Gallium	7440-55-3	1,1-dichloroethane	75-34-3	Trichlorofluoromethane	75-69-4
Germanium	7440-56-4	1,1-dichloroethene	75-35-4	Vinyl Acetate	108-05-4
Gold	7440-57-5	1,1,1-trichloroethane	71-55-6	Vinyl Chloride	75-01-4
Hafnium	7440-58-6	1,1,1,2-tetrachloroethane	630-20-6	1625: SEMIVOLATILE ORGANICS	
Holmium	7440-60-0	1,1,2-trichloroethane	79-00-5	1-methylfluorene	1730-37-6
Beryllium	7440-41-7	1,1,2,2-tetrachloroethane	79-34-5	1-methylphenanthrene	832-69-9
Bismuth	7440-69-9	1,2-dibromoethane	106-93-4	1-phenylnaphthalene	605-02-7
Boron	7440-42-8	1,2-dichloroethane	107-06-2	1,2-dibromo-3-chloropropane	96-12-8
Cadmium	7440-43-9	1,2-dichloropropane	78-87-5	1,2-dichlorobenzene	95-50-1
Calcium	7440-70-2	1,2,3-trichloropropane	96-18-4	1,2-diphenylhydrazine	122-66-7
Cerium	7440-45-1	1,3-dichloropropane	142-28-9	1,2,3-trichlorobenzene	87-61-6
Chromium	7440-47-3	1,4-dioxane	123-91-1	1,2,3-trimethoxybenzene	634-36-6
Cobalt	7440-48-4	2-butanone (Mek)	78-93-3	1,2,4-trichlorobenzene	120-82-1
Copper	7440-50-8	2-chloro-1,3-butadiene	126-99-8	1,2,4,5-tetrachlorobenzene	95-94-3
Dysprosium	7429-91-6	2-chloroethylvinyl Ether	110-75-8	1,2,3,4-diepoxybutane	1464-53-5
Erbium	7440-52-0	2-hexanone	591-78-6	1,3-benzenediol (Resorcinol)	108-46-3
Europium	7440-53-1	2-methyl-2-propenenitrile	126-98-7	1,3-dichloro-2-propanol	96-23-1
Gadolinium	7440-54-2	2-propanone (Acetone)	67-64-1	1,3-dichlorobenzene	541-73-1
Gallium	7440-55-3	2-propenal (Acrolein)	107-02-8	1,3,5-trithiane	291-21-4
Germanium	7440-56-4	Vanadium	7440-62-2	1,4-dichlorobenzene	106-46-7
Gold	7440-57-5	Ytterbium	7440-64-4	1,4-dinitrobenzene	100-25-4
Hafnium	7440-58-6	Yttrium	7440-65-5	1,4-naphthoquinone	130-15-4

Table 2-1. Chemical Compounds Analyzed Under EPA Analytical Methods (continued)

Pollutant	Cas Num	Pollutant	Cas Num	Pollutant	Cas Num
1,5-naphthalenediamine	2243-62-1	Acenaphthylene	208-96-8	Longifolene	475-20-7
2-bromochlorobenzene	694-80-4	Acetophenone	98-86-2	Malachite Green	569-64-2
2-chloronaphthalene	91-58-7	Alpha-naphthylamine	134-32-7	Methapyrilene	91-80-5
2-chlorophenol	95-57-8	Alpha-terpineol	98-55-5	Methyl Methanesulfonate	66-27-3
2-isopropyl-naphthalene	2027-17-0	Aniline	62-53-3	Naphthalene	91-20-3
2-methyl-4,6-dinitrophenol	534-52-1	Anthracene	120-12-7	N-C10 (N-decane)	124-18-5
2-methylbenzothiazole	120-75-2	Aramite	140-57-8	N-C12 (N-dodecane)	112-40-3
2-methylnaphthalene	91-57-6	Benzanthrone	82-05-3	N-C14 (N-tetradecane)	629-59-4
2-nitroaniline	88-74-4	Benzenethiol	108-98-5	N-C16 (N-hexadecane)	544-76-3
2-nitrophenol	88-75-5	Ben-zidine	92-87-5	N-C18 (N-octadecane)	593-45-3
2-phenylnaphthalene	612-94-2	Benzoic Acid	65-85-0	N-C20 (N-eicosane)	112-95-8
2-picoline	109-06-8	Benzo(a)anthracene	56-55-3	N-C22 (N-docosane)	629-97-0
2-(Methylthio)benzothiazole	615-22-5	Benzo(a)pyrene	50-32-8	N-C24 (N-tetracosane)	646-31-1
2,3-benzofluorene	243-17-4	Benzo(b)fluoranthene	205-99-2	N-C26 (N-hexacosane)	630-01-3
2,3-dichloroaniline	608-27-5	Benzo(ghi)perylene	191-24-2	N-C28 (N-octacosane)	630-02-4
2,3-dichloronitrobenzene	3209-22-1	Benzo(k)fluoranthene	207-08-9	N-C30 (N-triacontane)	638-68-6
2,3,4,6-tetrachlorophenol	58-90-2	Benzyl Alcohol	100-51-6	Nitrobenzene	98-95-3
2,3,6-trichlorophenol	933-75-5	<i>1625: SEMIVOLATILE ORGANICS</i>		N-nitrosodiethylamine	55-18-5
2,4-diaminotoluene	95-80-7	Beta-naphthylamine	91-59-8	N-nitrosodimethylamine	62-75-9
2,4-dichlorophenol	120-83-2	Biphenyl	92-52-4	N-nitrosodi-n-butylamine	924-16-3
2,4-dimethylphenol	105-67-9	Bis(2-chloroethoxy) Methane	111-91-1	N-nitrosodi-n-propylamine	621-64-7
2,4-dinitrophenol	51-28-5	Bis(2-chloroethyl) Ether	111-44-4	N-nitrosodiphenylamine	86-30-6
2,4-dinitrotoluene	121-14-2	Bis(2-chloroisopropyl) Ether	108-60-1	N-nitrosomethyl -Ethylamine	10595-95-6
2,4,5-trichlorophenol	95-95-4	Bis(2-ethylhexyl) Phthalate	117-81-7	N-nitrosomethyl-phenylamine	614-00-6
2,4,5-trimethylaniline	137-17-7	Butyl Benzyl Phthalate	85-68-7	N-nitrosomorpholine	59-89-2
2,4,6-trichlorophenol	88-06-2	Carbazole	86-74-8	N-nitrosopiperidine	100-75-4
2,6-dichloro-4-nitroaniline	99-30-9	Chrysene	218-01-9	N,n-dimethylformamide	68-12-2
2,6-dichlorophenol	87-65-0	Crotoxyphos	7700-17-6	O-anisidine	90-04-0
2,6-dinitrotoluene	606-20-2	Dibenzofuran	132-64-9	O-cresol	95-48-7
2,6-di-tert-butyl-p-benzoquinone	719-22-2	Dibenzothiophene	132-65-0	O-toluidine	95-53-4
3-bromochlorobenzene	108-37-2	Dibenzo(a,h)anthracene	53-70-3	P-cresol	106-44-5
3-chloronitrobenzene	121-73-3	Diethyl Phthalate	84-66-2	P-cymene	99-87-6
3-methylcholanthrene	56-49-5	Dimethyl Phthalate	131-11-3	P-dimethylamino-azobenzene	60-11-7
3-nitroaniline	99-09-2	Dimethyl Sulfone	67-71-0	Pentachlorobenzene	608-93-5
3,3-dichlorobenzidine	91-94-1	Di-n-butyl Phthalate	84-74-2	Pentachloroethane	76-01-7
3,3'-dimethoxybenzidine	119-90-4	Di-n-octyl Phthalate	117-84-0	Pentachlorophenol	87-86-5
3,5-dibromo-4-hydroxybenzonitrile	1689-84-5	Diphenyl Ether	101-84-8	Pentamethylbenzene	700-12-9
3,6-dimethylphenanthrene	1576-67-6	Diphenylamine	122-39-4	Perylene	198-55-0
4-aminobiphenyl	92-67-1	Diphenyldisulfide	882-33-7	Phenacetin	62-44-2
4-bromophenyl Phenyl Ether	101-55-3	Ethyl Methanesulfonate	62-50-0	Phenanthrene	85-01-8
4-chloro-2-nitroaniline	89-63-4	Ethylenethiourea	96-45-7	Phenol	108-95-2
4-chloro-3-methylphenol	59-50-7	Ethynylestradiol-3-methyl Ether	72-33-3	Phenothiazine	92-84-2
4-chloroaniline	106-47-8	Fluoranthene	206-44-0	Pronamide	23950-58-5
4-chlorophenyl Phenyl Ether	7005-72-3	Fluorene	86-73-7	Pyrene	129-00-0
4-nitroaniline	100-01-6	Hexachlorobenzene	118-74-1	Pyridine	110-86-1
4-nitrobiphenyl	92-93-3	Hexachlorobutadiene	87-68-3	Safrole	94-59-7
4-nitrophenol	100-02-7	Hexachlorocyclopentadiene	77-47-4	Squalene	7683-64-9
4,4-methylene-bis(2-chloroaniline)	101-14-4	Hexachloroethane	67-72-1	Styrene	100-42-5
4,5-methylene-phenanthrene	203-64-5	Hexachloropropene	1888-71-7	Thianaphthene (2,3-benzothiophene)	95-15-8
5-chloro-o-toluidine	95-79-4	Hexanoic Acid	142-62-1	Thioacetamide	62-55-5
5-nitro-o-toluidine	99-55-8	Indeno(1,2,3-cd)pyrene	193-39-5	Thioxanthone	492-22-8
7,12-dimethylbenz(a)anthracene	57-97-6	Isophorone	78-59-1	Triphenylene	217-59-4
Acenaphthene	83-32-9	Isosafrole	120-58-1	Tripropyleneglycolmethyl Ether	20324-33-8

Metal-Bearing Waste Treatment and Recovery Sampling 2.3.3.3

Between 1989 and 1994, EPA conducted six sampling episodes at facilities classified in the metals subcategory. Two of these facilities were re-sampled in 1996 following the proposal. Only one of those facilities sampled discharged to a surface water. The rest are indirect dischargers.

All of the facilities used metals precipitation as a means for treatment, but each of the systems was unique due to the treatment chemicals used and the system configuration and operation. Most facilities precipitated metals in batches. One facility segregated waste shipments into separate batches to optimize the precipitation of specific metals, then commingled the treated batches to precipitate additional metals. Another facility had a continuous system for precipitation in which the wastewater flowed through a series of treatment chambers, each using a different treatment chemical. EPA evaluated the following treatment technologies: primary, secondary, and tertiary precipitation, selective metals precipitation, gravity separation, multi-media filtration, clarification, liquid and sludge filtration, and treatment technologies for cyanide destruction.

EPA conducted sampling at metals facilities after the 1995 proposal to determine what effect total dissolved solids (TDS) concentrations had on the performance of metals precipitation processes. This issue was raised in public comments to the 1995 proposed rule. EPA resampled two facilities which had been sampled prior to the first proposal. The first facility formed the technology basis for the 1995 proposed metals subcategory regulatory option and the second was a facility with high levels of TDS in the influent waste stream. EPA was interested in obtaining additional data from the proposal option facility since they had altered their treatment systems from those previously sampled and because EPA failed to collect TDS

information during the original sampling episode. EPA was interested in collecting additional data from the second facility because the facility has high TDS values. EPA used data from both of the post-proposal sampling episodes to develop regulatory options considered for the re-proposal.

Oily Waste Treatment and Recovery Sampling 2.3.3.4

Between 1989 and 1994, EPA conducted four sampling episodes at oils subcategory facilities. Two additional oils facilities were sampled in 1996 following the proposal. All six are indirect dischargers and performed an initial gravity separation step with or without emulsion breaking to remove oil from the wastewater. At two facilities, however, the wastewater from the separation step was commingled with other non-oily wastewater prior to further treatment. As such, EPA could only use data from these facilities to characterize the waste streams after emulsion breaking. The other four facilities treated the wastewater from the initial separation step without commingling with non-oils subcategory wastewaters in systems specifically designed to treat oily wastewater. EPA evaluated the following treatment technologies for this subcategory: gravity separation, emulsion breaking, ultrafiltration, dissolved air flotation, biological treatment, reverse osmosis, carbon adsorption, and air stripping.

EPA conducted sampling at oils facilities in late 1994 (just before the proposal) and again after the proposal to address concerns raised at the 1994 public meeting and in the proposal public comments. Specifically, in regards to oils wastewater treatment, the commenters stated that (1) the facility which formed the technology basis for EPA's 1995 proposed option did not treat wastes which were representative of the wastes treated by many other oils facilities, and (2) EPA should evaluate dissolved air flotation as a basis for the regulatory option. All three of the

facilities sampled between 1994 and 1996 utilized dissolved air flotation and treated wastes which were generally more dilute than those treated by the 1995 proposal option facility. EPA used data from both of the post-proposal sampling episodes to develop regulatory options considered for this re-proposal. Data from the 1994 episode were not used to develop a regulatory option due to non-optimal performance and highly diluted influent streams; however, EPA used data from this facility to characterize the waste stream after emulsion breaking.

Organic-Bearing Waste Treatment and Recovery Sampling 2.3.3.5

EPA had difficulty identifying facilities that could be used to characterize waste streams and assess treatment technology performance in the organics subcategory. A large portion of the facilities, whose organic waste treatment operations EPA evaluated, had other industrial operations on-site. For these facilities, CWT waste streams represented a minor component of the overall facility flow.

Between 1989 and 1994, EPA did identify and sample three facilities that treated a significant volume of off-site generated organic waste relative to non-CWT flows. None of these facilities were direct discharging facilities. EPA evaluated treatment technologies including: air stripping, biological treatment in a sequential batch reactor, multi-media filtration, coagulation/flocculation, carbon adsorption, and CO₂ extraction. EPA chose not to use data from one of the three facilities in calculating effluent levels achievable with its in-place technologies because the facility was experiencing operational difficulties with the treatment system at the time of sampling. In addition, after reviewing the facility's waste receipts during the sampling episode, EPA determined that the facility accepted both oils subcategory and organics subcategory wastestreams and commingled them

for treatment. EPA has also not used data from a second facility in calculating effluent levels achievable with its in-place technologies because, after reviewing this facility's waste receipts during the sampling episode, EPA determined that this facility also accepted both oils subcategory and organics subcategory wastestreams and commingled them for treatment.

1998 Characterization Sampling of Oil Treatment and Recovery Facilities 2.3.4

EPA received many comments to the original proposal concerning the size and diversity of the oils treatment and recovery subcategory. Many suggested that the subcategory needed to be further subdivided in an effort to better depict the industry. As a result, in March and April 1998, EPA conducted site visits at eleven facilities which treat and/or recover non-hazardous oils wastes, oily wastewater, or used oil material from off-site. While the information collected at these facilities was similar to information collected during previous site visits, these facilities were selected based on waste receipts. The facilities represent a diverse mix of facility size, treatment processes, and geographical locations. EPA collected wastewater samples of their waste receipts and discharged effluent at 10 of these facilities. These samples were one-time grabs and were analyzed for metals, classicals, and semi-volatile organic compounds. The analytical results are located in Appendix B, but EPA has not incorporated the results into the analysis presented today. EPA plans to use this analytical data to supplement its wastewater characterization database prior to promulgation.

PUBLIC COMMENTS TO THE 1995 PROPOSAL AND THE 1996 NOTICE OF DATA AVAILABILITY 2.4

In addition to data obtained through the Waste Treatment Industry Questionnaire, DMQ,

site visits and sampling episodes, commenters on the January 27, 1995 proposal (55 FR 45161) and the September 16, 1996 Notice of Data Availability (61 FR 48805) also provided data to EPA. In fact, much of EPA's current characterization of the oily waste treatment and recovery subcategory is based on comments to the 1996 Notice of Data Availability.

As described earlier, following the 1995 proposal, EPA revised its estimate of the number of facilities in the oils subcategory and its description of the oils subcategory. Using new information provided by the industry during the 1995 proposal comment period in conjunction with questionnaire responses and sampling data used to develop the proposal, EPA recharacterized this subcategory of the industry. This recharacterization reflected new data on the wastes treated by the subcategory, the technology in-place, and the pollutants discharged. As part of this recharacterization, EPA developed individual profiles for each of the newly identified oils facilities by modeling current wastewater treatment performance and treated effluent discharge flow rates. In addition, assuming the same treatment technology options identified at proposal, EPA recalculated the projected costs of the proposed options under consideration, expected pollutant reductions associated with the options, and the projected economic impacts. EPA presented its recharacterization of the oils subcategory in the September 1996 Notice of Data Availability (61 FR 48806).

At the time of the 1995 proposal, EPA estimated there were 35 facilities in the oily waste treatment and recovery subcategory. Through comments received in response to the proposed rule, and communication with the industry, the National Oil Recyclers Association, and EPA Regional staff, EPA identified an additional 240 facilities that appeared to treat oily wastes from off-site. While attempting to confirm mailing addresses for each facility, EPA discovered that

20 of these facilities were either closed or could not be located. EPA then revised its profile of the oily waste treatment and recovery subcategory to include 220 newly-identified facilities. The information in the Notice of Data Availability was based on these 220 additional facilities.

In lieu of sending questionnaires out to the newly-identified oils facilities to collect technical and economic information, EPA used data from secondary sources to estimate facility characteristics such as wastewater flow. For most facilities, information about total facility revenue and employment were available from public sources (such as Dunn and Bradstreet). EPA then used statistical procedures to match the newly-identified facilities to similar facilities that had provided responses to the 1991 Waste Treatment Industry Questionnaire. This matching enabled EPA to estimate the flow of treated wastewater from each of the newly identified facilities. Where EPA had actual estimates for facility characteristics from the facility or public sources, EPA used the actual values. The estimated facility characteristics included the following:

- RCRA status;
- Waste volumes;
- Recovered oil volume;
- Wastewater volumes treated and discharged;
- Wastewater discharge option;
- Wastewater characteristics;
- Treatment technologies utilized; and
- Economic information.

EPA hoped to obtain information from each of the newly identified facilities through comments to the 1996 Notice of Data Availability. In order to facilitate that effort, copies of the Notice and the individual facility profile were mailed to each of the 220 newly identified facilities. Of these, EPA received comments and revised profiles from 100. Therefore, 120 facilities did not

provide comments to the Notice or revised facility profiles.

EPA determined the following about the list of newly identified oils facilities:

- 50 facilities were within the scope of the oily waste treatment and recovery subcategory;
- 16 facilities were fuel blenders;
- 31 facilities were out of scope of the oily waste treatment and recovery subcategory; and
- 3 facilities were closed.

EPA polled 9 of the 120 non-commenting facilities and determined that approximately half are within the scope of the industry. As a result, EPA estimates that half, or sixty, of the 120 non-commenting facilities are within the scope of the oily waste treatment and recovery subcategory. As to these sixty facilities that did not comment, EPA does not necessarily have facility specific information for them.

Finally, through comments to the Notice, EPA also obtained facility specific information on 19 facilities that EPA had not previously identified as possible CWT oils subcategory facilities.

Therefore, EPA's updated data base includes facility-specific information for a total of 104 facilities that are within the scope of the oily waste treatment and recovery subcategory. This total includes the 50 facilities for which EPA prepared facility information sheets, 19 new facilities identified through the Notice, and 35 facilities from the questionnaire data base. The number of in-scope facilities from the questionnaire data base has changed from the time of proposal due to other facility applicability issues, as discussed in Section 3.1. Finally, as described above, EPA estimates that the entire population of oils subcategory facilities includes an additional 60 facilities for which EPA does not have facility specific information. This brings the

total estimate of oils facilities to 164.

For this repoposal, EPA has again revised its characterization of the subcategory based on information provided prior to the 1995 proposal, during the proposal comment period, and during the Notice comment period. EPA has used the revised facility profiles and the earlier information to perform the technical and economic analyses presented for the oils subcategory. Unless noted otherwise, the final results of the analyses are scaled to represent the total population of oil facilities.

ADDITIONAL DATA SOURCES **2.5**

Additional Databases **2.5.1**

Several other data sources were used in developing effluent guidelines for the centralized waste treatment industry. EPA used the data included in the report entitled *Fate of Priority Pollutants in Publicly Owned Treatment Works* (EPA 440/1-82/303, September 1982), commonly referred to as the "50 POTW Study", in determining those pollutants that would pass through a POTW. EPA's National Risk Management Research Laboratory (NRMRL), formerly called the Risk Reduction Engineering Laboratory (RREL), treatability data base was used to supplement the information provided by the 50 POTW Study. A description of references is presented in Section 7.6.2.

Laboratory Study on the Effect of Total Dissolved Solids on Metals Precipitation **2.5.2**

During the comment period for the 1995 proposal, EPA received comments which asserted that high levels of total dissolved solids (TDS) in CWT wastewaters may compromise a CWT's ability to meet the proposed metal subcategory limitations. The data indicated that for some metal-contaminated wastewaters, as TDS levels increased, the solubility of the metal in

wastewater also increased. As such, the commenters claimed that metal-contaminated wastewaters with high TDS could not be treated to achieve the proposed limitations.

At the time of the original proposal, EPA had no data on TDS levels in CWT wastewaters. None of the facilities provided TDS data in their response to the Waste Treatment Industry Questionnaire or the Detailed Monitoring Questionnaire. Additionally, during the sampling episodes prior to the 1995 proposal, EPA did not collect TDS data. As such, EPA lacked the data to estimate TDS levels in wastewaters at the CWT facility which formed the technology basis for the 1995 proposed metals subcategory limitations.

In order to address the comment, EPA (1) collected additional information on TDS levels in metals subcategory wastewaters; (2) conducted additional sampling; (3) consulted literature sources; and (4) conducted bench scale studies.

First, EPA needed to determine the range of TDS levels in CWT metals subcategory wastewaters. As such, EPA contacted the metals subcategory Waste Treatment Industry Questionnaire respondents to determine the level of TDS in their wastewaters. Most CWT facilities do not collect information on the level of TDS in their wastewaters. Those facilities that provided information indicated that TDS levels in CWT metals subcategory wastewaters range from 10,000 ppm to 100,000 ppm (1 - 10 percent).

Second, EPA resampled the facility which formed the technology basis for the 1995 proposed metals subcategory limitations as well as one other metals subcategory facility, in part, to determine TDS levels in their wastewaters. EPA found TDS levels of 17,000 to 81,000 mg/L.

Third, EPA consulted various literature sources to obtain information about the effect of TDS levels on chemical precipitation. EPA found no data or information which related directly to

TDS effects on chemical precipitation.

Fourth, EPA conducted a laboratory study designed to determine the effect of TDS levels on chemical precipitation treatment performance. In this study, EPA conducted a series of bench-scale experiments on five metals: arsenic, chromium, copper, nickel and titanium. These metals were selected because (1) they are commonly found in CWT metals subcategory wastewaters, (2) their optimal precipitation is carried out in a range of pH levels; and/or (3) the data provided in the comments indicated that TDS may have a negative effect on the precipitation of these metals. The preliminary statistical analyses of the data from these studies show no consistent relationship among the five metals, pH levels, TDS concentrations and chemical precipitation effectiveness using hydroxide or a combination of hydroxide and sulfide. (DCN 23.32 describes the study and the statistical analyses in further detail.)

Therefore, because none of these four sources provided consistent and convincing evidence that TDS compromises a facility's ability to meet the proposed metal subcategory limitations, EPA has not incorporated the TDS levels into the development of limitations on metals discharges.

PUBLIC PARTICIPATION

2.6

EPA has strived to encourage the participation of all interested parties throughout the development of the CWT guidelines and standards. EPA has met with various industry representatives including the Environmental Technology Council (formerly the Hazardous Waste Treatment Council), the National Solid Waste Management Association (NSWMA), the National Oil Recyclers Association (NORA), and the Chemical Manufacturers Association (CMA). EPA has also participated in industry meetings as well as meetings with individual companies that may be affected by this regulation. EPA also met

with environmental groups including members of the Natural Resources Defense Council. Finally, EPA has made a concerted effort to consult with EPA regional staff, pretreatment coordinators, and other state and local entities that will be responsible for implementing this regulation.

EPA sponsored two public meetings, one prior to the original proposal on March 8, 1994 and one prior to this re-proposal on July 27, 1997. The purpose of the public meetings was to share information about the content and status of the proposed regulation. The public meetings also gave interested parties an opportunity to provide information and data on key issues.

On March 24, 1995, following the original proposal, EPA sponsored a workshop and public hearing. The purpose of the workshop was to provide information about the proposed regulation and to present topics on which EPA was soliciting comments. The public hearing gave interested parties the opportunity to present oral comments on the proposed regulation.

Finally, as detailed in the *Economic Analysis of Effluent Limitations Guidelines and Standards for the Centralized Waste Treatment Industry (EPA 821-R-98-019)*, on November 6, 1997, EPA convened a Small Business Regulatory Flexibility Act (SBREFA) Review Panel in preparing this reproposal. The review panel was composed of employees of the EPA program office developing this proposal, the Office of Information and Regulatory Affairs within the Office of Management and Budget and the Chief Counsel for Advocacy of the Small Business Administration (SBA). The panel met over the course of two months and collected the advice and recommendations of representatives of small entities that may be affected by this re-proposed rule and reported their comments as well as the Panel's findings on the following:

- Record keeping, reporting and other compliance requirements that the proposal would impose on small entities subject to the proposal, if promulgated.
- Identification of relevant Federal rules that may overlap or conflict with the proposed rule.
- Description of significant regulatory alternatives to the proposed rule which accomplish the stated objectives of the CWA and minimize any significant economic.

The small entity CWT population was represented by members of the National Oil Recyclers Association (NORA), the Environmental Technology Council, and a law firm representing a coalition of CWTs in Michigan. EPA provided each of the small entity representatives and panel members many materials related to the development of this reproposal. As such, the small entity representatives had the opportunity to comment on many aspects of this reproposal in addition to those specified above. All of the small entity comments and the panel findings are detailed in the "Final Report of the SBREFA Small Business Advocacy Review Panel on EPA's Planned Proposed Rule for Effluent Limitations Guidelines and Standards for the Waste Treatment Industry" which is located in the regulatory record accompanying this rule.

- The type and number of small entities that would be subject to the proposal.

SCOPE/APPLICABILITY OF THE PROPOSED REGULATION

Over half of the comments received on the original proposal and the notice of data availability related to the applicability of this rule. EPA has reviewed these comments and is proposing a revised scope for this rule. The vast majority of these issues are discussed in the following chapter.

APPLICABILITY

3.1

The universe of facilities which would be potentially subject to this guideline include the following. First, EPA is proposing to establish limitations and pretreatment standards for stand-alone waste treatment and recovery facilities receiving materials from off-site -- classic “centralized waste treaters.” These facilities may treat and/or recover or recycle hazardous or non-hazardous waste, hazardous or non-hazardous wastewater, and/or used material from off-site. Second, industrial facilities which process their own, on-site generated, process wastewater with hazardous or non-hazardous wastes, wastewaters, and/or used material received from off-site, in certain circumstances may be subject to this proposal with respect to a portion of their discharge.

The wastewater flows which EPA is proposing to regulate include some or all off-site waste receipts and on-site wastewater generated as a result of centralized waste treatment operations. The kinds of on-site wastewater generated at these facilities would include, for example, solubilization wastewater, emulsion breaking/gravity separation wastewater, used oil processing wastewater, treatment equipment washes, transport washes (tanker truck, drum, and roll-off boxes), laboratory-derived

wastewater, air pollution control wastewater, industrial waste combustor wastewater from on-site industrial waste combustors, landfill wastewater from on-site landfills, and contaminated stormwater. A detailed discussion of CWT wastewaters is provided in Chapter 4.

Facilities Subject to 40 CFR (Parts 400 to 471)

3.1.1

At the time of the original proposal, EPA defined a centralized waste treatment facility as any facility which received waste from off-site for treatment or recovery on a commercial or non-commercial basis. Non-commercial facilities were defined as facilities that accept off-site wastes from facilities under the same ownership. EPA received many comments concerning the applicability of the CWT rule to facilities that perform waste treatment and/or recovery of off-site generated wastes, but whose primary business is something other than waste treatment or recovery. These facilities are generally manufacturers who treat wastes generated as a result of their on-site manufacturing operations and whose wastewater discharges are already subject to existing effluent guidelines and standards. Many of these facilities also accept off-site generated wastes for treatment. In some instances, these off-site wastes received at these industrial facilities are generated by a facility under the same corporate ownership -- intracompany transfer -- and treated on a non-commercial basis. In other instances, the off-site waste streams originate from a company under a different ownership, an intercompany transfer.

In general, commenters urged that the scope of the guideline should be limited to facilities

whose sole purpose is the treatment of off-site wastes and wastewater. Reasons provided by commenters for limiting the scope of the guideline in this manner include:

- The wastes transferred from different locations within a company (and different companies) for treatment with on-site wastes are usually generated from the same categorical process as the on-site generated wastes. Since most of these facilities are already covered by an existing effluent guideline, coverage of these wastestreams is redundant. Monitoring, record keeping, etc. would be duplicative.
- This proposed rule will prevent effective waste management practices at many manufacturing facilities. Currently, many companies operate a single, central treatment plant and transport waste from “satellite” facilities to the central treatment facility. This allows for effective treatment while controlling costs. Additionally, many facilities transfer a specific wastestream to other company owned treatment systems (intracompany) that are designed for the most efficient treatment of that type of wastestream.
- Many of these types of facilities only accept wastestreams which are comparable and compatible with the on-site generated process wastestreams.
- These facilities are not primarily in the business of waste treatment. Only a small percentage of wastes treated are from off-site.
- EPA has not performed the technical analyses that are necessary to support application of the CWT rule to manufacturing facilities regulated by existing effluent guidelines and pretreatment standards.

EPA reexamined the database of facilities which form the basis of the CWT rule. EPA’s database contains information on 17 manufacturing facilities which commingle waste generated by on-site manufacturing activities for treatment with waste generated off-site and one manufacturing facility which does not commingle waste generated by on-site manufacturing activities for treatment with waste generated off-site. Nine of these facilities treat waste on a non-commercial basis only and nine treat waste on a commercial basis. Of the eighteen facilities, eight facilities only accept and treat off-site wastes which are from the same categorical process as the on-site generated wastestreams. Ten of the facilities, however, accept off-site wastes which are not subject to the same categorical standards as the on-site generated wastewater. The percentage of off-site wastewaters being commingled for treatment with on-site wastewater varies from 0.06% to 80% with the total volumes varying between 87,000 gallons per year to 381 million gallons per year.

The guidelines, as proposed in 1995, would have included both types of facilities within the scope of this rule. EPA included these facilities in the 1995 proposed CWT rule to ensure that all wastes receive adequate treatment -- even those shipped between facilities already subject to existing effluent limitations guidelines and standards (ELGs). EPA agrees that, for off-site wastes which are generated by the same categorical process as on-site generated wastes, intracompany and intercompany transfers are a viable and often preferable method to treat wastestreams efficiently at a reduced cost. EPA does not want to discourage these management practices. EPA is still concerned, however, that the effluent limitations and categorical standards currently in place may not ensure adequate treatment in circumstances where the off-site generated wastes are not from the same categorical group as the on-site generated wastes.

It is not duplicative to include within the scope of the CWT guideline, wastewater that results from the treatment of off-site wastes not subject to the guidelines and standards applicable to the treatment of wastewater generated on-site. Additionally, even though the primary business at these facilities is not the treatment of off-site wastes, EPA does not believe that the burden to these facilities exceeds that of the facilities whose primary business is the treatment of off-site wastes. EPA has included these facilities in all of its economic analyses.

Therefore, based on the Agency's evaluation of the comments submitted on its earlier proposal and consideration of additional information, EPA proposes to include within the scope of the CWT rule wastewater received from off-site (and commingled for treatment with on-site wastewater) at facilities subject to effluent limitations guidelines for existing source, standards of performance for new sources and pretreatment standards for new and existing sources unless all of the following conditions are met:

- The receiving facility is subject to national effluent limitations guidelines for existing sources, standards of performance for new sources, or pretreatment standards for new and existing sources; and
- The wastes received from off-site for treatment would be subject to the same national effluent limitations guidelines for existing sources, standards of performance for new sources, or pretreatment standards for new and existing sources as the on-site generated wastes.

For purposes of developing its effluent limitations and pretreatment standards, EPA has included manufacturing facilities which accept off-site waste for treatment in all of its analyses unless the above mentioned conditions were met.

EPA contemplates that this approach would be implemented in the following manner. A facility that is currently subject to an ELG receives wastewater from off-site for treatment. The wastewater is commingled for treatment with wastewater generated on-site. If the off-site wastewater is subject to the same ELG as the onsite wastewater (or would be if treated where generated), the CWT limitations would not apply to the discharge associated with the off-site wastewater flows. In that case, another guideline or standard applies. If, however, the off-site wastewater is not subject to the same ELG (or if none exist) or if the off-site wastewater is not commingled with on-site wastewater for treatment, that portion of the discharge associated with off-site flow would be subject to CWT requirements. The portion of the commingled or non-commingled wastewater associated with on-site generated wastewater remains subject to applicable limitations and standards for the facility. Alternatively, EPA is considering an option that requires manufacturing facilities that treat off-site wastes to meet all otherwise applicable categorical limitations and standards. This approach would determine limitations and standards for the off-site wastewater using the "combined waste stream formula" or "building block approach" (see Chapter 14). EPA envisions the second alternative would be preferable for facilities which only receive continuous flows of process wastewaters with relatively consistent pollutant profiles from no more than five customers. The decision to base limitations in this manner would be at the permit writers discretion only.

In addition, there are manufacturing facilities that may not currently be subject to any effluent limitations guidelines or pretreatment standards. Some of these may accept off-site wastewater that is commingled for treatment with on-site process wastewater. Under EPA regulations, the permit writer would develop Best Professional

Judgement (BPJ) local limits for indirect dischargers for the on-site generated wastewater flows. The portion of the discharge resulting from the treatment of off-site flows would be subject either to CWT limitations and standards or to the same BPJ requirements as on-site flows. CWT limitations would apply if the off-site wastes treated at the facility were different from those generated on-site, whether or not the wastes were subject to existing guidelines and standards (or would be, if treated at the site where generated). Alternatively, applying either a building block or combined wastestream formula approach, on-site wastewater would be subject to BPJ limits or standards and the off-site categorical wastewater subject to categorical limits for the industry generating the wastewater.

Pipeline Transfers

(Fixed Delivery Systems)

3.1.2

As previously noted, the scope of EPA's 1995 proposal did not extend to facilities which received off-site wastes for treatment solely via an open or enclosed conduit (for example, pipeline, channels, ditches, trenches, etc.). At that time, EPA had concluded that facilities which receive all their wastes through a pipeline or trench (fixed delivery systems) from the original source of waste generation are receiving continuous flows of process wastewater with relatively consistent pollutant profiles. As such, EPA concluded that these wastes differ fundamentally from those received at centralized waste treatment facilities it had studied as part of this rulemaking.

The Agency received many comments on the proposal to limit the applicability of the proposed limits to wastewaters received other than by pipelines or fixed delivery systems. Many commented that this approach is arbitrary and that the mode of transportation should not be the determining factor as to whether or not a facility is included in the scope of the rule. Commenters

asserted that the character of the waste remains unchanged regardless of whether it is trucked or piped to another facility for treatment. Many also questioned EPA's conclusion that piped waste is more consistent in strength and treatability from typical CWT wastewaters studied for this proposal.

EPA has reevaluated the database for this rule. EPA received questionnaire responses from four centralized waste treatment facilities which receive their wastestreams solely via pipeline. EPA also examined the database that was developed for the organic chemicals, plastics, and synthetic fibers (OCPSF) ELG to gather additional data on OCPSF facilities which also have centralized waste treatment operations. Based on the OCPSF database, 16 additional facilities are treating wastewater received solely via pipeline from off-site for treatment. A review of the CWT and OCPSF databases supplemented by telephone calls to selected facilities reveals that one facility no longer accepts wastes from off-site, one facility is now operating as a POTW, and 11 facilities only accept off-site wastes that were generated by a facility within the same category as on-site generated waste. (The latter facilities, under the criteria explained above, would no longer be within the scope of the proposed rule because they are already subject to existing effluent guidelines and standards.) Therefore, EPA identified 7 facilities which receive off-site wastes solely via pipeline which may be subject to this rulemaking.

Of these seven facilities, one is a dedicated treatment facility which is not located at a manufacturing site. The other six pipeline facilities are located at manufacturing facilities which are already covered by an existing ELG. All of the facilities are direct dischargers and all receive waste receipts from no more than five customers (many receive waste receipts from three or fewer customers).

Since the 1995 proposal, EPA conducted site

visits at two of these pipeline facilities. Information collected during these site visits confirmed EPA's original conclusion that wastes received by pipeline are more consistent in strength and treatability than "typical" CWT wastewaters. These wastewaters are traditional wastewaters from the applicable industrial category that generally remain relatively constant from day to day in terms of the concentration and type of pollutant parameters. Unlike traditional CWTs, their customers and wastewater sources do not change and are limited by the physical and monetary constraints associated with pipelines.

EPA has also reviewed the discharge permits for each of these pipeline facilities. EPA found that, in all cases, permit writers had carefully applied the "building block approach" in establishing the facility's discharge limitations. Therefore, in all cases, the treating facility was required to treat each of the piped wastewaters to comply with otherwise applicable effluent guidelines and standards.

Consequently, based on the information it has obtained to date, EPA continues to believe that (except as discussed below) wastes that are piped to waste treatment facilities should be excluded from the scope of the CWT rule and covered by otherwise applicable effluent guidelines and standards. The Agency has concluded that effluent limitations and pretreatment standards for centralized waste treatment facilities should not apply to pipeline treatment facilities. EPA believes that it is more appropriate for permit writers to develop limitations for treatment facilities that receive wastewater by pipeline on an individual basis by applying the "combined waste stream formula" or "building block" approach. The one exception to this approach is for facilities which receive waste via conduit (that is, pipeline, trenches, ditches, etc.) from facilities that are acting merely as waste collection or consolidation centers that are not the original source of the waste. These

wastewaters would be subject to CWT. EPA has not identified any pipeline facility that is receiving waste from waste consolidators, but has received public comment that these facilities exist.

EPA notes that 40 CFR §122.44(m) of the Agency's NPDES permitting regulations require that an NPDES permit for a private treatment works must include conditions expressly applicable to any user, as a limited co-permittee, necessary to ensure compliance with applicable NPDES requirements. In the case of a pipeline treatment system, this may require that the permit writer include conditions in a permit issued to the pipeline treatment system and its users, as co-permittee, if necessary for the pipeline facility to comply with the applicable limitations. Alternatively, EPA may need to issue permits both to the private treatment works and to the users or require the user to file a permit application.

Product Stewardship

3.1.3

Many members of the manufacturing community have adopted "product stewardship" programs as an additional service for their customers to promote recycling and reuse of products and to reduce the potential for adverse environmental impacts from chemical products. Many commenters on the proposal have defined "product stewardship" in this way: "taking back spent, used, or unused products, shipping and storage containers with product residues, off-specification products and waste materials from use of products." Generally, whenever possible, these manufacturing plants recover and reuse materials in chemical processes at their operations. Manufacturing companies that cannot reuse the spent, used, or unused materials returned to them treat these materials in their wastewater treatment plant. In industry's view, such materials are inherently compatible with the

treatment system. EPA received no specific information on these product stewardship activities in the responses to the 308 Waste Treatment Industry Questionnaire. EPA obtained information on this program from comment responses to the 1995 CWT proposal and in discussions with industry since the 1995 proposal. As part of their comment to the 1995 proposal, the Chemical Manufacturer's Association (CMA) provided results of a survey of their members on product stewardship activities. Based on these survey results, which are shown in Table 3.1 and Table 3-2, the vast

majority of materials received under the product stewardship programs are materials received for product rework. A small amount is classified as residual recycling and an even smaller amount is classified as drum take backs. Of the materials received, the vast majority is reused in the manufacturing process. With few exceptions, all of the materials (which are not reused in the manufacturing process) that are treated in the on-site wastewater treatment systems, appear to be from the same categorical group as the on-site manufactured materials.

Table 3-1 Summary of the Frequency of the Types of Activities and Dispositions Reported

	Item	Number	% of Total ¹
Activity	Drum Returns	3	5%
	Residual Recycling	7	12%
	Product Rework	50	86%
	Other	2	3%
Disposition	Rework/Reuse	53	91%
	On-site Wastewater Treatment	22	38%
	Off-site Disposal	29	50%

¹Based on information submitted by 33 CMA member facilities. Of these 33 members, 13 reported information concerning more than one product type, or activity. Therefore, the percentage of the total is based on 58 separate entries on the survey.

Table 3-2 Summary of Frequency of Each Product Class Reported by Facilities

Product Class	Number of Facilities	Percent of Total ¹
Polymers, Plastics, and Resins	17	52%
Organic Chemicals	6	18%
Solvents and Petroleum Products	3	9%
Inorganic Chemicals	4	12%
Pesticides	2	6%
Unspecified	4	12%

¹Based on Responses from 33 CMA facilities.

EPA has decided that wastewater generated from materials which are taken back for recycling or reuse should be subject to the CWT regulation (except as discussed elsewhere). EPA applauds the efforts of manufacturing facilities to reduce pollution and the environmental impacts of their products and does not want to discourage these practices. In most of the instances stated in the product stewardship definition, manufacturing facilities are essentially taking back product which has not been utilized or has not been chemically altered. In these cases where the treatment of these wastes would be subject to current guidelines or pretreatment standards, under the approach discussed in Section 3.1.1, these wastewater flows would not be subject to CWT requirements.

EPA remains concerned, however, that there are circumstances in which used materials or waste products may not be compatible with the otherwise existing treatment system. Therefore, EPA is not proposing to remove all product stewardship activities from the scope of this rulemaking. Those activities that involve used products or waste materials that are not subject to effluent guidelines or standards from the same category as the on-site generated wastes are subject to today's proposal. Based on the information provided by manufacturing facilities, EPA believes that very few product stewardship activities would be subject to this rule. EPA's approach will not curtail product stewardship activities, in general, but will ensure that all wastes are treated effectively.

Solids, Soils, and Sludges

3.1.4

EPA did not distinguish in its information gathering efforts between those waste treatment and recovery facilities treating aqueous waste and those treating non-aqueous wastes or a combination of both. Thus, EPA's 308 Waste Treatment Industry Questionnaire and related CWT Detailed Monitoring Questionnaire (DMQ) asked for information on CWT operations without regard to the type of waste treated. EPA's sampling program also included facilities which accepted both aqueous and solid wastes for treatment. In fact, the facility which formed the technology basis for the metals subcategory limitations selected at the time of the original proposal treats both liquid and solid wastes. As such, a facility that accepts wastes from off-site for treatment and/or recovery and which generates a wastewater is subject to the CWT rule regardless of whether the wastes are aqueous or non-aqueous. Therefore, wastewater generated in the treatment of solids received from off-site would be subject to the CWT rule.

As a further point of clarification, the main concern in the treatment or recycling of off-site "solid wastes" is that pollutants contained in the solid waste may be transferred to a process or contact water resulting in a wastewater that may require treatment. Examples of such wastewaters are:

- entrained water directly removed through dewatering operations (for example, sludge dewatering);
- contact water added to wash or leach contaminants from the waste material;
- stormwater that comes in direct contact with waste material; and
- solvent contaminated wastewater removed from scrap metal recycling.

The treatment or recovery of solids that remain in

solid form when contacted with water and which do not leach any chemicals into the water are necessarily not subject to this rule. Examples of excluded solids recovery operations are the recycling of aluminum cans, glass and plastic bottles.

Sanitary Wastes

3.1.5

The CWT proposal would regulate facilities which treat, or recover materials from, off-site industrial wastes and wastewaters. Sanitary wastes such as chemical toilet wastes and septage are not covered by the provisions of the proposed CWT rule. EPA would expect that, permit writers would develop Best Professional Judgment limitations or local limits to establish site-specific permit requirements for any commercial sanitary waste treatment facility.

Similarly, sanitary wastes received from off-site and treated at an industrial facility or a centralized waste treatment facility are not covered by provisions of the CWT rule. If these wastes are mixed with industrial wastes, EPA would expect that, as is the case now with ancillary sanitary waste flows mixed for treatment at categorical facilities, the permit writer would establish Best Professional Judgment, site-specific permit requirements.

Transporters and/or Transportation Equipment Cleaners

3.1.6

As proposed, the transportation equipment cleaning (TEC) regulation only applies to facilities that solely accept tanks which have been previously emptied or that contain a small amount of product, called a “heel”, typically accounting for less than one percent of the volume of the tank. A facility which accepts a tank truck, rail tank car, or barge not considered to be empty for cleaning or treatment is not subject to the TEC Point Source Category, and may be subject to the provisions established for

this rule.

There are some facilities which are engaged in traditional CWT activities and also engaged in traditional TEC activities. If the wastewaters from the two operations are commingled, under the approach adopted for the TEC proposal, the commingled TEC wastewater flow would be subject to CWT limits when promulgated. Therefore, a facility performing transportation equipment cleaning as well as other centralized waste treatment services that commingles these wastes is a centralized waste treatment facility. All of the wastewater discharges are subject to provisions of this rule. If, however, a facility is performing both operations and the wastestreams are not commingled (that is, transportation equipment cleaning wastewater is treated in one system and CWT wastes are treated in a second, separate system), both the TEC rule and CWT rules apply to the respective wastewaters.

As a further point of clarification, the CWT proposal would subject transportation equipment cleaning wastes received from off-site to its provisions. Transportation equipment cleaning wastes received from off-site that are treated at CWTs along with other off-site wastes *are* subject to provisions of this rule.

Publicly Owned Treatment Works (POTWs)

3.1.7

The repropoed CWT pretreatment regulations would not themselves establish any requirements that apply directly to local POTWs that receive off-site wastes. In the case of categorical wastes (subject to pretreatment standards in 40 CFR parts 400 to 471), the generator of the wastes must comply with any applicable standards before introducing the waste to the POTW regardless of whether the wastewater is discharged directly to the sewer or otherwise hauled to the POTW. Similarly, for non-categorical wastes, the generator would need to meet any applicable local limits regardless of

the mode of transportation to the POTW. As such, therefore, the proposed centralized waste treatment rule does not apply to POTWs.

EPA is aware of a POTW which plans to open a wastewater treatment system to operate in conjunction with their POTW operations. This CWT facility at a POTW will accept categorical wastewaters, treat them, and then discharge them to the POTW. As such, the CWT operation may be subject to provisions of this rule. It is not a POTW itself (even if the facility is located at the same site). In this case, the facility is operating as a centralized waste treatment facility and all discharges are subject to provisions of this rule.

Silver Recovery Operations from Used Photographic and X-Ray Materials 3.1.8

The proposal does not include electrolytic plating/ metallic replacement silver recovery operations of used photographic and x-ray materials within the scope of this rule. Based on the fundamental difference in technology used to recover silver at facilities devoted exclusively to treatment of photographic and x-ray wastes, the Agency has decided to defer proposing regulations for these facilities. The precipitation processes to recover silver used as the basis for its metal limits (including silver) is different from that most widely used to recover silver at facilities that treat only silver bearing wastes -- electrolytic plating followed by metallic replacement. Facilities which only perform centralized waste treatment silver recovery operations (electrolytic plating followed by metallic replacement) would not fall within the scope of today's proposal. Permit writers would use Best Professional Judgement or local limits to establish site-specific permit requirements. However, off-site wastes which are treated/recovered at these facilities through any other process and/or waste generated at these facilities as a result of any other CWT treatment/recovery process are subject to

provisions of this rule.

Many commenters to the 1995 CWT proposal expressed concern over the inclusion in the metals subcategory of CWT operations that recover metals from used photographic materials and solutions and x-ray materials and solutions. Commenters were particularly concerned that they would be unable to meet the limitations established for silver in the metals subcategory. In general, commenters stated that the scope of the proposed rule should not include these operations. Reasons provided include:

- The metals subcategory limitations proposed for the CWT rule are not based on technologies typically used in silver recovery operations. Silver recovery facilities typically use electrolytic plating followed by metallic replacement with iron.
- The facility used to calculate the BAT silver limitation is engaged in a variety of recovery operations. This BAT treatment system does not reflect performance of facilities which solely treat silver-bearing wastes.
- Existing effluent guidelines should be sufficient. Many facility discharge permits are based on Part 421, effluent guidelines for non-ferrous metals manufacturing, Subpart L secondary silver subcategory. In addition, an effluent guideline also exists for the industry which is the primary source of the recovered materials -- Part 459 photographic point source subcategory.
- The Silver Coalition and the Association of Metropolitan Sewerage Agencies (AMSA) have prepared and issued recommendations on technology, equipment and management practices for controlling discharges from facilities that process photographic materials.
- It is not economical or efficient for these waste streams to be recovered on-site due to their small volume. If this rule were enacted, many of the CWTs processing used

photographic materials would discontinue this operation and silver recovery operations would decrease greatly.

Based on information provided by the industry, EPA estimates that there are 360,000 photographic and image processing facilities which generate silver bearing wastes. Many of these facilities generate very small volumes of silver bearing waste which would not be economical or efficient to recover on site. Thus, there exists a large potential for facilities to consolidate and treat silver bearing photographic waste from various sources.

EPA believes that the off-site shipment of silver bearing photographic wastestreams for the purpose of consolidation and recovery is beneficial and does not wish to discourage this practice. EPA encourages the segregation of wastestreams as this leads to more efficient recovery. EPA is aware that some of these consolidated wastestreams are treated at typical CWTs and some are treated at facilities which treat photographic wastestreams only. While EPA has promulgated effluent guidelines for non-ferrous metals manufacturing and the photographic point source categories (40 CFR 421, Subpart L and 40 CFR 459, respectively), the majority of these centralized silver recovery facilities are not currently subject to any effluent guideline.

EPA agrees with proposal commenters that the BAT system selected at the time of the original proposal does not reflect performance of facilities which solely treat silver-bearing wastes. Although the facility which formed the technology basis for the 1995 proposed BAT limitations was engaged in recovering silver from photographic wastestreams, EPA does not have information in its database on facilities which perform centralized waste treatment of photographic wastestreams only.

High Temperature Metals Recovery 3.1.9

During the development of the 1995 proposal, EPA did not include facilities which perform high temperature metals recovery (HTMR) within the scope of this rule. EPA is aware of three facilities in the U.S. which utilize the HTMR process. High temperature metals recovery facilities generally take solid forms of various metal containing materials and produce a remelt alloy which is then sold as feed materials in the production of metals. These facilities utilize heat-based pyrometallurgical technologies, not the water-based precipitation/filtration technologies used throughout the CWT industry. Based on questionnaire responses and industry comments, the HTMR process does not generate wastewater.

For these reasons, the high temperature metals recovery operations have been excluded from provisions of the CWT rule. Facilities which only perform high temperature metals recovery are not subject to this rule. However, off-site wastes which are treated/recovered at these facilities through any other process and/or wastes generated at these facilities as a result of any other CWT treatment/ recovery process are subject to the provisions of this rule.

As noted, EPA's data show that HTMR operations generate no process wastewater. Accordingly, EPA is also considering whether this rule, when promulgated, should include a subcategory for HTMR operations with a zero discharge requirement.

Landfill Wastewaters**3.1.10**

EPA proposed effluent guidelines and pretreatment standards for Landfills, 40 CFR Part 445, on February 6, 1998 (63 FR 6426-6463). There, EPA explains how it proposed to treat categorical facilities that mix and treat categorical wastewater with wastewater from on-site landfills. EPA proposed to subject the mixed wastewater to the applicable categorical limits and not the proposed landfill limits. In the CWT industry, there are some facilities which are engaged both in CWT activities and in operating an on-site landfill(s). EPA is proposing to evaluate the mixture of CWT wastewater and landfill wastewater in the same way considered for the proposed landfill guidelines. Therefore, a facility performing landfill activities as well as other centralized waste treatment services that commingles the wastewaters would be a centralized waste treatment facility and all of the wastewater discharges would be subject to the provisions of this rule when promulgated. If a facility is performing both operations and the wastestreams are not commingled (that is, landfill wastewaters are treated in one treatment system and CWT wastewaters are treated in a second, separate, treatment system), the provisions of the Landfill rule and CWT rule would apply to their respective wastewaters.

Additionally, under the approach proposed for the Landfills rulemaking, centralized waste treatment facilities which are dedicated to landfill wastewaters only, whether they are located at a landfill site or not, would be subject to the effluent guidelines limitations and pretreatment standards for landfills when promulgated. These dedicated landfill centralized waste treatment facilities would not be subject to provisions of the centralized waste treatment rulemaking.

As a further point of clarification, landfill wastewaters are not specifically excluded from provisions of this rule. Landfill wastewaters that

are treated at CWTs along with other off-site wastestreams *are* subject to provisions of this rule. Furthermore, a landfill that treats its own landfill wastewater and off-site landfill wastewater would be subject to the proposed Landfill limits when promulgated in the circumstance described in 3.1.1 above.

Industrial Waste Combustors**3.1.11**

EPA proposed effluent guidelines and pretreatment standards for Industrial Waste Combustors, 40 CFR Part 444 on February 6, 1998 (63 FR 6392-6423). There, EPA explains how it proposed to treat categorical facilities that mix and treat categorical wastewater with wastewater from on-site industrial waste combustion. EPA proposed to subject the mixed wastewater to the applicable categorical limits and not the proposed industrial waste combustors limits. In the CWT industry, there are some facilities which are engaged both in CWT activities and in industrial waste combustion. EPA is proposing to evaluate the mixture of CWT wastewater and industrial waste combustion wastewater in the same way considered for the proposed industrial waste combustors guidelines. Therefore, a facility performing industrial waste combustion activities as well as other centralized waste treatment services that commingles the wastewaters would be a centralized waste treatment facility and all of the wastewater discharges would be subject to the provisions of this rule when promulgated. If a facility is performing both operations and the wastestreams are not commingled (that is, industrial waste combustion wastewaters are treated in one treatment system and CWT wastewaters are treated in a second, separate, treatment system), the provisions of the Industrial Waste Combustor rule and CWT rule would apply to their respective wastewaters

As a further point of clarification, industrial

waste combustor wastewaters are not specifically excluded from provisions of this rule. Industrial waste combustor wastewaters that are treated at CWTs along with other off-site wastestreams *are* subject to provisions of this rule. Furthermore, an industrial waste combustor that treats off-site industrial waste combustor wastewater would be subject to the proposed Industrial Waste Combustor limits when promulgated in the circumstances described in 3.1.1 above.

Solvent Recycling/Fuel Blending 3.1.12

The solvent recycling industry was studied by the EPA in the 1980s. EPA published the “Preliminary Data Summary for the Solvent Recycling Industry” (EPA 440/1-89/102) in September 1989 which describes this industry and the processes utilized. This document defines solvent recovery as “the recycling of spent solvents that are not the byproduct or waste product of a manufacturing process or cleaning operation located on the same site.” Spent solvents are generally recycled in two main operations. Traditional solvent recovery involves pretreatment of the wastestream (in some cases) and separation of the solvent mixtures by specially constructed distillation columns. Wastewater discharges resulting from this process are subject to effluent limitations guidelines and standards for the organic chemicals industry (40 CFR 414). As such, wastewaters resulting from traditional solvent recovery operations as defined above are not subject to this effluent guideline.

Fuel blending is the second main operation which falls under the definition of solvent recovery. Fuel blending is the process of mixing wastes for the purpose of regenerating a fuel for reuse. At the time of the 1995 proposal, fuel blending operations were excluded from the CWT rule since EPA believed the fuel blending process was “dry” (that is, no wastewaters were

produced). Based on comments to the original proposal and the Notice of Data Availability, EPA has concluded that this is valid and that true fuel blenders do not generate any process wastewaters and are therefore zero dischargers. EPA is concerned, however, that the term “fuel blending” may be loosely applied to any process where recovered hydrocarbons are combined as a fuel product. Such operations occur at nearly all used oil and fuel recovery facilities. Therefore, fuel blending operations as defined above would be excluded from the CWT rule providing that the operations do not generate a wastewater. In the event that wastewater is generated at a fuel blending facility, the facility is most likely performing some pretreatment operations (usually to remove water). These pretreatment wastewaters would be subject to this rule.

Re-refining 3.1.13

When EPA initially proposed guidelines and standards for CWTs, the regulations would have limited discharges from used oil reprocessors/reclaimers but did not specifically exclude discharges from used oil re-refiners. During review of information received on the proposal and assessment of the information collected, the Agency, at one point, considered limiting the scope of this regulation to reprocessors/reclaimers only. However, further data gathering efforts have revealed that the principal sources of re-refining wastewaters are essentially the same for reprocessors/reclaimers and re-refiners. Consequently, the re-refining wastewater is included within the scope of this proposal.

The used oil reclamation and re-refining industry was studied by EPA in the 1980s. EPA published the “Preliminary Data Summary for the Used Oil Reclamation and Re-Refining Industry” (EPA 440/1-89/014) in September 1989 which describes this industry and the processes utilized.

This document generally characterizes the industry in terms of the types of equipment used to process the used oil. Minor processors (reclaimers) generally separate water and solids from the used oil using simple settling technology, primarily in-line filtering and gravity settling with or without heat addition. Major processors (reclaimers) generally use various combinations of more sophisticated technology including screen filtration, heated settling, centrifugation, and light fraction distillation primarily to remove water. Re-refiners generally use the most sophisticated systems which generally include, in addition to the previous technology, a vacuum distillation step to separate the oil into different components.

This proposal applies to the process wastewater discharges from used oil re-refining operations. The principal sources of wastewater include oil-water gravity separation (often accompanied by chemical/thermal emulsion breaking) and dehydration unit operations (including light distillation and the first stage of vacuum distillation).

Used Oil Filter Recycling

3.1.14

EPA did not obtain information on used oil filter recycling through the Waste Treatment Industry Questionnaire. However, in response to the September 1996 Notice of Data Availability, EPA received comments from facilities which recycle used oil filters. In addition, EPA also visited several used oil reprocessors that recycle used oil filters as part of their operations.

Used oil filter recycling processes range from simple crushing and draining of entrained oil to more involved processes where filters are shredded and the metal and filter material are separated. In all cases, the oil is recycled, the crushed filters and separated metal are sent to smelters, and the separated filter material is recovered as solid fuel. Also, in all cases

observed, the operations generate no process wastewater. Therefore, based on this characterization, used oil filter recycling operations would not be subject to the provisions of the CWT rule as proposed today. EPA is also considering whether this rule, when promulgated, should include a subcategory for used oil filter recycling with a zero discharge requirement for such operation.

Marine Generated Wastes

3.1.15

EPA received many comments on the original proposal relating to marine generated wastes. Since these wastes are often generated while a ship is at sea and subsequently off-loaded at port for treatment, the treatment site could arguably be classified as a CWT due to its acceptance of “off” site wastes. Commenters, however, claimed that marine generated wastes should not be subject to the CWT rule for the following reasons:

- Unlike most CWT wastestreams, bilge and/or ballast water is generally dilute and not toxic; and
- Most of the bilge water is generated while the ship is docked. If only the small portion of bilge water contained in the ship upon docking is subject to regulation, it would be expensive and inefficient to monitor only that small portion for compliance with the CWT rule.

EPA reexamined its database concerning these wastes as well as additional data on the characteristics of these types of wastes provided through comments to the 1995 proposal. Based on data provided by industry on bilge and ballast water characteristics, bilge and ballast water can vary greatly in terms of the breadth of analytes and the concentration of the analytes from one ship to another. In most instances, the analytes and concentrations are similar to those found in

wastes typical of the oils subcategory. EPA found that while some shipyards have specialized treatment centers for bilge and/or ballast wastes, some of these wastes are being treated at traditional CWTs.

For purposes of this rule, EPA is defining a marine generated waste as waste generated as part of the normal maintenance and operation of a ship, boat, or barge operating on inland, coastal or open waters. Such wastes include wash water from equipment and tank cleaning, ballast water, bilge water, and other wastes generated as part of routine ship maintenance. EPA has determined that a waste off-loaded from a ship shall be considered as being generated on-site at the point where it is off-loaded provided that the waste is generated as part of the routine maintenance and operation of the ship on which it originated. The waste will not be considered an off-site generated waste as long as it is treated and discharged at the ship servicing facility where it is off-loaded. Therefore, these facilities would not be considered centralized waste treatment facilities. If, however, marine generated wastes are off-loaded and subsequently sent to a centralized waste treatment facility at a separate location, these facilities and their wastestreams would be subject to provisions of this rule.

Stabilization

3.1.16

In the original CWT proposal, waste solidification/stabilization operations were specifically not subject to the CWT rule. The reason stated for EPA's conclusion was that these operations are "dry" and do not generally produce a wastewater. EPA reexamined its database and concluded that this assessment remains valid. As such, stabilization/ solidification processes are not subject to the CWT rule as proposed today. If, however, the stabilization/solidification facility produces a wastewater from treatment and /or recovery of off-site wastes through any other

operation, those wastewaters would be subject to the CWT rule. EPA is also considering whether this rule, when promulgated, should include a subcategory for stabilization operations with a zero discharge requirement.

Grease Trap/Interceptor Wastes

3.1.17

EPA received comments on coverage of grease, sand, and oil interceptor wastes by the CWT rule during the comment period for the original proposal and 1996 Notice of Data Availability. Some of these wastes are from non-industrial sources and some are from industrial sources. Some are treated at central locations designed to exclusively treat grease trap/interceptor wastes and some of these wastes are treated at traditional CWTs with traditional CWT wastes.

Throughout the development of this rule, EPA has maintained that this rule is designed to cover the treatment and/or recovery of off-site *industrial* wastes. As such, as proposed today, grease/trap interceptor wastes do not fall within the scope of the proposal. Grease trap/interceptor wastes are defined as animal or vegetable fats/oils from grease traps or interceptors generated by facilities engaged in food service activities. Such facilities include restaurants, cafeterias, and caterers. Excluded grease trap/interceptor wastes should not contain any hazardous chemicals or materials that would prevent the fats/oils from being recovered and recycled. Wastewater discharges from the centralized treatment of wastes produced from oil interceptors, which are designed to collect petroleum-based oils, sand, etc. from industrial type processes, would be subject to this rule.

DESCRIPTION OF THE INDUSTRY

The adoption of the increased pollution control measures required by CWA and RCRA requirements had a number of ancillary effects, one of which has been the formation and development of a waste treatment industry. Several factors have contributed to the growth of this industry. These include: (a) the manner in which manufacturing facilities have elected to comply with CWA and RCRA requirements; (b) EPA's distinction for regulatory purposes between on- and off-site treatment of wastewater in the CWA guidelines program; and (c) the RCRA 1992 used oil management requirements.

A manufacturing facility's options for managing wastes include on-site treatment or sending them off-site. Because a large number of operations (both large and small) have chosen to send their wastes off-site, specialized facilities have developed whose sole commercial operation is the handling of wastewater treatment residuals and industrial process by-products.

Many promulgated effluent guidelines also encouraged the creation of these central treatment centers. Inconsistent treatment of facilities which send their waste off-site to CWTs in the guidelines program has resulted in wastewater that is treated off-site being subject to inconsistent standards. EPA acknowledges that this may have created a loop-hole for dischargers to avoid treating their wastewater to standards comparable to categorical standards before discharge. Additionally, RCRA regulations, such as the 1992 used oil management requirements (40 CFR 279) significantly influenced the size and service provided by this industry.

INDUSTRY SIZE

4.1

Based upon responses to EPA's data gathering efforts, the Agency now estimates that there are approximately 205 centralized waste treatment facilities in 38 States. As shown below in Table 4-1, the major concentration of centralized waste treatment facilities is in EPA Regions 4, 5 and 6 due to the proximity of the industries generating the wastes undergoing treatment. At the time of the original proposal, EPA estimated there were 85 centralized waste treatment facilities in the United States. EPA, however, greatly underestimated the number of facilities in the proposed oily waste and recovery subcategory. Through additional data gathering activities (see discussion in Chapter 2), EPA obtained information on additional oils facilities. Except for facilities that were included or excluded because of scope changes/clarifications, all of the facilities which have been added since the original proposal treat and/or recover oily waste and/or used oil. EPA is aware that facilities in the metals and organics subcategories have entered or left the centralized waste treatment market also. This is expected in a service industry. Even so, EPA believes its initial estimate of facilities in the other subcategories is reasonable and no adjustments, other than those resulting from the redefined scope of the industry, have been made.

As detailed in Chapter 2, while EPA estimates there are 205 CWT facilities, EPA only has facility-specific information for 145 of these facilities. In preparing this reproposal, EPA conducted its analysis with the known facility specific information and then used the actual data to develop additional information to represent the

entire population. Unless otherwise stated, information presented in this document represents the entire population. Table 4-1 provides an example where data is only presented for the facilities for which EPA has facility-specific information.

GENERAL DESCRIPTION

4.2

Centralized waste treatment facilities do not fall into a single description and are as varied as the wastes they accept. Some treat wastes from a few generating facilities while others treat wastes from hundreds of generators. Some treat only certain types of waste while others accept many wastes. Some treat non-hazardous wastes exclusively while others treat hazardous and non-hazardous wastes. Some primarily treat concentrated wastes while others primarily treat more dilute wastes. For some, their primary business is the treatment of other company's wastes while, for others, centralized waste treatment is ancillary to their main business.

Centralized waste treatment facilities treat both hazardous and/or non-hazardous wastes. At the time of the original proposal, a few of the facilities in the industry database solely accepted wastes classified as non-hazardous under RCRA. The remaining facilities accepted either hazardous wastes only or a combination of hazardous and non-hazardous wastes. The vast majority of the newly identified oils facilities accept non-hazardous materials only. As such, EPA believes the market for centralized waste treatment of non-hazardous materials has increased during the 1990s.

EPA has detailed waste receipt information for the facilities in the 1991 Waste Treatment Industry Questionnaire data base. Of the 76 in-scope facilities from the proposal data base, 65 of them are RCRA-permitted treatment, storage, and disposal facilities (TSDFs). As such, most of these facilities were able to use information

reported in the 1989 Biennial Hazardous Waste Report to classify the waste accepted for treatment by the appropriate Waste Form and RCRA codes. The Waste Form and RCRA codes reported by the questionnaire respondents are listed in Table 4-2 and Table 4-3, respectively. (Table 14-2 in Chapter 14 lists these Waste Form and RCRA codes along with their associated property and/or pollutants). Some questionnaire respondents, especially those that treat non-hazardous waste, did not report the Waste Form Code information due to the variety and complexity of their operations.

EPA does not have detailed RCRA code and waste code information on waste receipts for the facilities identified after the original proposal. It is known that the majority of these facilities accept non-hazardous wastes. Of the 69 post-proposal oily waste facilities for which EPA has specific data, only 19 are RCRA-permitted TSDFs.

Centralized waste treatment facilities service a variety of customers. A CWT generally receives a variety of wastes daily from dozens of customers. Some customers routinely generate a particular wastestream and are unable to provide effective on-site treatment of that particular wastestream. Some customers utilize CWTs because they generate wastestreams only sporadically (for example tank removal, tank cleaning and remediation wastes) and are unable to economically provide effective on-site treatment of these wastes. Others, many which are small businesses, utilize CWTs as their primary source of wastewater treatment.

Table 4-1. Geographic Distribution of CWT Facilities (145 Facilities)

Region	State	# of CWTs	% of CWTs	Region	State	# of CWTs	% of CWTs
1	Connecticut	5	5.5	5	Illinois	6	26.2
	Maine	1			Indiana	4	
	Massachusetts	1			Michigan	10	
	Rhode Island	1			Minnesota	2	
2	New Jersey	6	6.8		Ohio	12	
	New York	4			Wisconsin	4	
3	Delaware	1	8.9	6	Louisiana	3	12.4
	Maryland	2			Oklahoma	2	
	Pennsylvania	6			Texas	13	
	Virginia	4			Iowa	1	2.8
4	Alabama	3	17.9		Kansas	2	
	Florida	8			Missouri	1	
	Georgia	3			Colorado	2	2.1
	Kentucky	2		8	Montana	1	
	Mississippi	1		9	Arizona	1	10.3
	North Carolina	1			California	12	
	South Carolina	2			Hawaii	1	
	Tennessee	6		10	Nevada	1	6.9
					Oregon	2	
					Washington	8	

Table 4-2. Waste Form Codes Reported by CWT Facilities in 1989¹

Waste Form Codes										
B001	B106	B112	B119	B206	B219	B310	B501	B507	B515	B604
B101	B107	B113	B201	B207	B305	B312	B502	B508	B518	B605
B102	B108	B114	B202	B208	B306	B313	B504	B510	B519	B607
B103	B109	B115	B203	B209	B307	B315	B505	B511	B601	B608
B104	B110	B116	B204	B210	B308	B316	B506	B513	B603	B609
B105	B111	B117	B205	B211	B309	B319				

¹Table 14-2 in Chapter 14 lists Waste Form Codes and their associated properties.Table 4-3. RCRA Codes Reported by Facilities in 1989²

RCRA Codes										
D001	D012	F009	K016	K063	P020	P069	U002	U052	U118	U161
D002	D017	F010	K031	K064	P022	P071	U003	U054	U122	U162
D003	D035	F011	K035	K086	P028	P074	U008	U057	U125	U188
D004	F001	F012	K044	K093	P029	P078	U009	U069	U134	U190
D005	F002	F019	K045	K094	P030	P087	U012	U080	U135	U205
D006	F003	F039	K048	K098	P040	P089	U013	U092	U139	U210
D007	F004	K001	K049	K103	P044	P098	U019	U098	U140	U213
D008	F005	K011	K050	K104	P048	P104	U020	U105	U150	U220
D009	F006	K013	K051	P011	P050	P106	U031	U106	U151	U226
D010	F007	K014	K052	P012	P063	P121	U044	U107	U154	U228
D011	F008	K015	K061	P013	P064	P123	U045	U113	U159	U239

²Table 14-2 in Chapter 14 lists Waste Form Codes and their associated properties.

Before a CWT accepts a waste for treatment, the waste generally undergoes rigorous screening for compatibility with other wastes being treated at the facility. Waste generators initially furnish the treatment facility with a sample of the waste stream to be treated. The sample is analyzed to characterize the level of pollutants in the sample and bench-scale treatability tests are performed to determine what treatment is necessary to treat the waste stream. After all analyses and tests are performed, the treatment facility determines the cost for treating the waste stream. If the waste generator accepts the cost of treatment, shipments of the waste stream to the treatment facility will begin. Generally, for each truck load of waste received for treatment, the treatment facility collects a sample from the shipment and analyzes the sample to determine if it is similar to the initial sample tested. If the sample is similar, the shipment of waste will be treated. If the sample is not similar but falls within an allowable range as determined by the treatment facility, the treatment facility will reevaluate the estimated cost of treatment for the shipment. Then, the waste generator decides if the waste will remain at the treatment facility for treatment. If the sample is not similar and does not fall within an allowable range, the treatment facility will decline the shipment for treatment.

Treatment facilities and waste generators complete extensive amounts of paperwork during the waste acceptance process. Most of the paperwork is required by Federal, State, and local regulations. The amount of paperwork necessary for accepting a waste stream emphasizes the difficulty of operating centralized waste treatment facilities.

WATER USE AND SOURCES OF WASTEWATER

4.3

Approximately 1.9 billion gallons of wastewater are generated annually at CWT facilities. It is difficult to determine the quantity

of wastes attributable to different sources because facilities generally mix the wastewater prior to treatment. EPA has, as a general matter, however, identified the sources described below as contributing to wastewater discharges at CWT operations that would be subject to the proposed effluent limitations and standards.

Waste Receipts. Most off-site waste received by CWT facilities is aqueous. These aqueous off-site waste receipts comprise the largest portion of the wastewater treated at CWTs. Typical waste receipts for the metals subcategory include but are not limited to: spent electroplating baths and sludges; spent anodizing solutions; metal finishing rinse water and sludges; and chromate wastes. Types of waste accepted for treatment in the oils subcategory include but are not limited to: lubricants, used petroleum products, used oils, oil spill clean-up, bilge water, tank clean out, off-specification fuels, and underground storage tank remediation waste. Types of wastes accepted for treatment in the organics subcategory include, but are not limited to: landfill leachate; groundwater clean-up; solvent-bearing waste; off-specification organic products; still bottoms; used antifreeze; and wastewater from chemical product operations and paint washes.

Solubilization Water. A portion of the off-site waste receipts is in a solid form. Water may be added to the waste to render it treatable.

Waste Oil Emulsion-Breaking Wastewater. The wastewater generated as a result of the emulsion breaking or gravity separation process from the processing of used oil constitutes a major portion of the wastewater treated at oils facilities. EPA estimates that, at a typical oils facility, half of the wastewater treated is a result of oil/water separation processes.

Tanker Truck/Drum/Roll-Off Box Washes. Water is used to clean the equipment used for transporting wastes. The amount of wastewater generated was difficult to assess because the wash water is normally added to the wastes or used as solubilization water.

Equipment Washes. Water is used to clean waste treatment equipment during unit shut downs or in between batches of waste.

Air Pollution Control Scrubber Blow-Down. Water or acidic or basic solution is used in air emission control scrubbers to control fumes from treatment tanks, storage tanks, and other treatment equipment.

Laboratory-Derived Wastewater. Water is used in on-site laboratories which characterize incoming waste streams and monitor on-site treatment performance.

Industrial Waste Combustor or Landfill Wastewater from On-Site Landfills. Wastewater is generated at some CWT facilities as a result of on-site landfilling or incineration activities.

Contaminated Stormwater. This is stormwater which comes in direct contact with the waste or waste handling and treatment areas. If this contaminated CWT stormwater is introduced to the treatment system, its discharge is subject to the proposed limitations. The Agency is proposing not to regulate under the CWT guideline non-contact stormwater or contaminated stormwater not introduced to the treatment system. Such flows may, in certain circumstances, require permitting under EPA's existing permitting program under 40 CFR 122.26(b)(14) and 40 CFR 403. CWTs that introduce non-contaminated stormwater into their treatment system will need to identify this as a source of non-CWT wastewater in their treatment

system in their permit applications. This is necessary in order that the permit writer may take account of these flows in developing permit limitations that reflect actual treatment.

VOLUME BY TYPE OF DISCHARGE **4.4**

In general, three basic options are available for disposal of wastewater treatment effluent: direct, indirect, and zero (or alternative) discharge. Some facilities utilize more than one option (for example, a portion of their wastewater is discharged to a surface water and a portion is evaporated). Direct dischargers are facilities which discharge effluent directly to a surface water. Indirect dischargers are facilities which discharge effluent to a publicly-owned treatment works (POTW). Zero or alternative dischargers do not generate a wastewater or do not discharge to a surface water or POTW. The types of zero or alternative discharge identified in the CWT industry are underground injection control (UIC), off-site transfer for further treatment or disposal, evaporation, and no wastewater generation. Table 4-4 lists the number of facilities utilizing each discharge option.

Average facility wastewater discharge information is presented in Table 4-5 for the indirect and direct discharge options. The proposed effluent limitations guidelines and standards for the CWT industry do not apply to facilities with a zero or alternative discharge.

Table 4-4 Facility Discharge Options

Discharge Option	No. of Facilities with Specific Data	No. of Scaled-Up Facilities
Direct	12	14
Indirect	101	144
Indirect and off-site transfer	1	1
Indirect and no wastewater generation	2	2
UIC	7	9
Off-site transfer	14	22
Evaporation	3	5
Off-site transfer and evaporation	1	1
Zero (not specified)	4	7
Total	145	205

Table 4-5 Quantity of Wastewater Discharged (205 Facilities)

Discharge Option	Quantity of Wastewater Discharged (Million gallons/year)			
	Total	Average	Minimum	Maximum
Direct	535	38.2	0.078	225
Indirect	1,370	9.3	0.0013	177

OFF-SITE TREATMENT INCENTIVES AND COMPARABLE TREATMENT

4.5

As noted before, the adoption of the increased pollution control measures required by the CWA and RCRA regulation was a significant factor in the formation and development of the centralized waste treatment industry. Major contributors to the growth of this industry include EPA decisions about how to structure its CWA effluent limitations guidelines program as well as the manner in which manufacturing facilities have elected to comply with CWA and RCRA requirements.

The CWA requires the establishment of limitations and standards for categories of point sources that discharge into surface waters or introduce pollutants into publicly owned treatment works. At present, facilities that do not discharge wastewater (or introduce pollutants to POTWs) may not be subject to the requirements

of 40 CFR Subchapter N Parts 400 to 471. Such facilities include manufacturing or service facilities that generate no process wastewater, facilities that recycle all contaminated waters, and facilities that use some kind of alternative disposal technology or practice (for example, deep well injection, incineration, evaporation, surface impoundment, land application, and transfer to a centralized waste treatment facility).

Thus, for example, in implementing CWA and RCRA requirements in the electroplating industry, many facilities made process modifications to conserve and recycle process wastewater, to extend the lives of plating baths, and to minimize the generation of wastewater treatment sludges. As the volumes of wastewater were reduced, it became economically attractive to transfer electroplating metal-bearing wastewater to off-site centralized waste treatment facilities for treatment or metals recovery rather

than to invest in on-site treatment systems. In the case of the organic chemicals, plastics, and synthetic fibers (OCPSF) industry, many facilities transferred selected process residuals and small volumes of process wastewater to off-site centralized waste treatment facilities. When estimating the engineering costs for the OCPSF industry to comply with the OCPSF regulation, the Agency assumed, based on economies of scale, in the case of facilities with wastewater flows less than 500 gallons per day, such plants would use off-site rather than on-site wastewater treatment.

The Agency believes that any wastes transferred to an off-site CWT facility should be treated to at least the same level as required for the same wastes if treated on-site at the manufacturing facility. In the absence of appropriate regulations to ensure at least comparable or adequate treatment, the CWT facility may inadvertently offer an economic incentive for increasing the pollutant load to the environment. One of the Agency's primary concerns is the potential for a discharger to reduce its wastewater pollutant concentrations through dilution rather than through appropriate treatment. This proposal is designed to ensure that wastes transferred to centralized waste treatment facilities would be treated to the same levels as on-site treatment or to adequate levels.

This is illustrated by the information the Agency obtained during the data gathering activities for the 1995 proposal. EPA visited 27 centralized waste treatment facilities in an effort to identify well-designed, well-operated candidate treatment systems for sampling. Two of the principal criteria for selecting plants for sampling were based on whether the plant applied waste management practices that increased the effectiveness of the treatment system and whether the treatment system was effective in removing pollutants. This effort was complicated by the level of dilution and co-dilution of one type of

waste with another. For example, many facilities treated metal-bearing and oily wastes in the same treatment system and many facilities mixed non-CWT wastewater with CWT wastewater. Mixing metal-bearing with non-metal-bearing oily wastewater and mixing CWT with non-CWT wastewater provides a dilution effect which generally reduces the efficiency of the wastewater treatment system. Of the 27 plants visited, many were not sampled because of the problems of assessing CWT treatment efficiencies due to dilution of one type of wastewater with another.

This proposal would ensure, to the extent possible, that metal-bearing wastes are treated with metals control technology, that oily wastes are treated with oils control technology, and that organic wastes are treated with organics control technology.

In developing this proposal, EPA identified a wide variation in the size of CWT facilities and the level of treatment provided by these facilities. Often, pollutant removals were poor, and, in some cases, significantly lower than would have been required had the wastewaters been treated at the site where generated. In particular, EPA's survey indicated that some facilities were employing only the most basic pollution control equipment and, as a result, achieved low pollutant removals relative to that easily obtained through the use of other, readily available pollutant control technology. Further, as explained below, EPA had difficulty in identifying more than a handful of facilities throughout the CWT industry that were achieving optimal removals.

During consideration of this proposal, EPA looked at whether it should limit the scope of national regulation to facilities above a certain size or flow level because of information before the Agency suggesting, that, in the case of certain smaller facilities, the costs of additional controls would represent a significant increase in their costs of operation. For the reasons explained

above, however, EPA has decided not to limit the scope of this proposal, based either on the size of a facility or the volume of wastewater flows. The effect of such an approach, given the structure of the industry and treatment level currently observed, would be effectively to encourage the movement of wastewater to some of the very facilities that are not providing treatment that is equivalent to that which would be expected (and required) if the wastewater were treated at the point of origin. Since this proposal would ensure adequate controls for wastewater discharges from CWT facilities that accept waste and wastewater that would otherwise be controlled by other guidelines, all members of the CWT industry should comply with the national CWT standards regardless of size or potential economic impacts.

INDUSTRY SUBCATEGORIZATION

*METHODOLOGY AND FACTORS
CONSIDERED AS THE BASIS
FOR SUBCATEGORIZATION*

5.1

The CWA requires EPA, in developing effluent limitations guidelines and pretreatment standards that represent the best available technology economically achievable for a particular industry category, to consider a number of different factors. Among others, these include the age of the equipment and facilities in the category, manufacturing processes employed, types of treatment technology to reduce effluent discharges, and the cost of effluent reductions (Section 304(b)(2)(b) of the CWA, 33 U.S.C. § 1314(b)(2)(B)). The statute also authorizes EPA to take into account other factors that the Agency deems appropriate.

One way in which the Agency has taken some of these factors into account is by breaking down categories of industries into separate classes of similar characteristics. This recognizes the major differences among companies within an industry that may reflect, for example, different manufacturing processes or other factors. One result of subdividing an industry by subcategories is to safeguard against overzealous regulatory standards, increase the confidence that the regulations are practicable, and diminish the need to address variations between facilities through a variance process (*Weyerhaeuser Co. v. Costle*, 590 F.2d 1011, 1053 (D.C. Cir. 1978)).

The centralized waste treatment industry, as previously explained, is not typical of many of the industries regulated under the CWA because it does not produce a product. Therefore, EPA considered certain additional factors that specifically apply to centralized waste treatment

operations in its evaluation of how to establish appropriate limitations and standards and whether further subcategorization was warranted. Additionally, EPA did not consider certain other factors typically appropriate when subcategorizing manufacturing facilities as relevant when evaluating this industry. The factors EPA considered in the subcategorization of the centralized waste treatment industry include:

- Facility age;
- Facility size;
- Facility location;
- Non-water quality impacts;
- Treatment technologies and costs;
- RCRA classification;
- Type of wastes received for treatment; and
- Nature of wastewater generated.

EPA concluded that certain of these factors did not support further subcategorization of this industry. The Agency concluded that the age of a facility is not a basis for subcategorization as many older facilities have unilaterally improved or modified their treatment process over time. EPA also decided that facility size was not an appropriate basis for subcategorizing. EPA identified three parameters as relative measures of facility size: number of employees, amount of waste receipts accepted, and wastewater flow. EPA found that CWTs of varying sizes generate similar wastewaters and use similar treatment technologies. Furthermore, wastes can be treated to the same level regardless of the facility size. Likewise, facility location is not a good basis for subcategorization. Based on the data collected,

no consistent differences in wastewater treatment technologies or performance exist because of geographical location. EPA recognizes, however, that geographic location may have an effect on the market for CWT services, the cost charged for these services, and the value of recovered product. These issues are addressed in the Economic Assessment Document.

While non-water quality characteristics (solid waste and air emission effects) are of concern to EPA, these characteristics did not constitute a basis for subcategorization. Environmental impacts from solid waste disposal and from the transport of potentially hazardous wastewater are a result of individual facility practices and EPA could not identify any common characteristics particular to a given segment of the industry. Treatment costs were not used as a basis for subcategorization because costs will vary and are dependent on the following waste stream variables: flow rates, wastewater quality, and pollutant loadings. Finally, EPA concluded that the RCRA classification was not an appropriate basis for subcategorization as the type of waste accepted for treatment appears to be more important than whether the waste was classified as hazardous or non-hazardous.

EPA identified only one factor with primary significance for subcategorizing the centralized waste treatment industry -- the type of waste received for treatment or recovery. This factor encompasses many of the other subcategorization factors. The type of treatment processes used, nature of wastewater generated, solids generated, and potential air emissions directly correlate to the type of wastes received for treatment or recovery. For today's proposal, EPA reviewed its earlier subcategorization approach and has decided to retain it. It is still EPA's conclusion that the type of waste received for treatment or recovery is the only appropriate basis for subcategorization of this industry.

PROPOSED SUBCATEGORIES

5.2

Based on the type of wastes accepted for treatment or recovery, EPA has determined that there are three subcategories appropriate for the centralized waste treatment industry:

- Subcategory A: Facilities which treat, recover, or treat and recover metal, from metal-bearing waste, wastewater, or used material from off-site (Metals Subcategory);
- Subcategory B: Facilities which treat, recover, or treat and recover oil, from oily waste, wastewater, or used material from off-site (Oils Subcategory); and
- Subcategory C: Facilities which treat, recover, or treat and recover organics, from other organic waste, wastewater, or used material from off-site (Organics Subcategory).

SUBCATEGORY DESCRIPTIONS

5.3

Metal-Bearing Waste Treatment and Recovery Subcategory

5.3.1

The facilities in this subcategory are those treating metal-bearing waste received from off-site and/or recover metals from off-site metal-bearing wastes. Currently, EPA has identified 59 facilities in this subcategory. Fifty-two facilities treat metal-bearing waste exclusively, while another six facilities recover metals from the wastes for sale in commerce or for return to industrial processes. One facility provides metal-bearing waste treatment in addition to conducting a metals recovery operation. The vast majority of these facilities have RCRA permits to accept hazardous waste. Types of wastes accepted for treatment include spent electroplating baths and sludges, spent anodizing solutions, metal finishing rinse water and sludge, and chromate wastes.

The typical treatment process used for metal-bearing waste is precipitation with lime or

caustic followed by filtration. The sludge generated is then landfilled in a RCRA Subtitle C or D landfill depending on its content. Most facilities that recover metals do not generate a sludge that requires disposal. Instead, the sludges are sold for metal content. In addition to treating metal bearing wastestreams, many facilities in this subcategory also treat cyanide wastestreams, many of which are highly-concentrated and complex. Since the presence of cyanide may interfere with the chemical precipitation process, these facilities generally pretreat to remove cyanide and then commingle the pretreated cyanide wastewaters with the other metal containing wastewaters. EPA estimates that nineteen of the metals facilities also treat cyanide wastestreams.

Oily Waste Treatment and Recovery Subcategory

5.3.2

The facilities in this subcategory are those that treat oily waste, wastewater, or used material received from off-site and/or recover oil from off-site oily materials. Currently, EPA estimates that there are 164 facilities in this subcategory. Among the types of waste accepted for treatment are lubricants, used petroleum products, used oils, oil spill clean-up, bilge water, tank clean-out, off-specification fuels, and underground storage tank remediation waste. Many facilities in this subcategory only provide treatment for oily wastewaters while others pretreat the oily wastes for contaminants such as water and then blend the resulting oil residual to form a product, usually fuel. Most facilities perform both types of operations. EPA estimates that 53 of these facilities only treat oily wastewaters and 36 facilities primarily recover oil for re-use. The remaining 75 facilities both treat oily waste and recover oil for re-use.

At the time of the original proposal, EPA believed that 85 percent of oils facilities were primarily accepting concentrated, difficult-

to-treat, stable, oil-water emulsions containing more than 10 percent oil. However, during post-proposal data collection, EPA learned that many of the wastes treated for oil content at these facilities were fairly dilute and consisted of less than 10 percent oils. EPA now believes that, while some facilities are accepting the more concentrated wastes, the majority of facilities in this subcategory are treating less concentrated wastes.

Further, at the time of the original proposal, only three of the facilities included in the data base for this subcategory were identified as solely accepting wastes classified as non-hazardous under RCRA. The remaining facilities accepted either hazardous wastes alone or a combination of hazardous and non-hazardous wastes. In contrast, based on more recent information, EPA believes that the majority of facilities in this subcategory only accept wastes that would be classified by RCRA as non-hazardous.

The most widely-used treatment technology in this subcategory is gravity separation and/or emulsion breaking. One-third of this industry only uses gravity separation and/or emulsion breaking to treat oily wastestreams. One-third of the industry also utilizes chemical precipitation and one-quarter also utilizes dissolved air flotation (DAF).

Organic Waste Treatment and Recovery Subcategory

5.3.3

The facilities in this subcategory are those that treat organic waste received from off-site and/or recover organics from off-site organic wastes. EPA estimates that there are 25 facilities in this subcategory. The majority of these facilities have RCRA permits to accept hazardous waste. Among the types of wastes accepted at these facilities are landfill leachate, groundwater cleanup, solvent-bearing waste, off-specification organic products, still bottoms, used antifreeze, and wastewater from chemical product operations

and paint washes.

All of the organics facilities which discharge to a surface water use equalization and some form of biological treatment to handle the wastewater. The vast majority of organics facilities which discharge to a POTW primarily use equalization. One third of all the organics facilities also use activated carbon adsorption. Most of the facilities in the organics subcategory have other industrial operations as well, and the centralized waste treatment wastes are mixed with these wastewaters prior to treatment. The relatively constant make-up of on-site wastewater can support the operation of conventional, continuous biological treatment processes, which otherwise could be upset by the variability of the off-site waste receipts.

MIXED WASTE SUBCATEGORY CONSIDERATION

5.4

EPA has received numerous comments from industry that the subcategorization scheme developed for this rule is impractical for CWT facilities which accept wastes in more than one subcategory. These commenters are primarily concerned about incoming waste receipts that may be classified in more than one subcategory. While CWTs can encourage their customers to segregate their wastes, they argue that CWTs can not require segregation of incoming waste receipts. Additionally, commenters have suggested that, for ease of implementation, mixed waste subcategory limitations should be developed for all facilities in multiple subcategories. These commenters are primarily concerned that permit writers may impose additional and substantial record keeping burden in order to classify wastes in each of the subcategories. Commenters have suggested that limitations for the mixed waste subcategory could combine pollutant limitations from all three subcategories, selecting the most stringent value where they overlap.

While facilities have suggested developing a mixed waste subcategory with limitations derived by combining pollutant limitations from all three subcategories (selecting the most stringent value where they overlap), EPA does not believe facilities have adequately considered the costs associated with such an option. Assuming facilities employ appropriate treatment rather than dilution to meet these mixed waste limitations, EPA compared the compliance cost for facilities in multiple subcategories with the mixed waste subcategory limitations as described above to compliance costs for facilities meeting the limitations for the three subcategories separately. Costs were greater for the mixed waste subcategory since EPA had to cost for larger flows, more chemical addition, etc. EPA chose nine representative facilities that treat wastes in more than one subcategory to conduct the comparison. EPA found that, in all cases, the costs of complying with the mixed waste subcategory limitations were two to three times higher than the costs associated with complying with each of the subcategory limitations separately. Since the market for these services is, generally, very competitive and since many of these facilities are small businesses, EPA believes that few facilities would choose to meet the limitations for the mixed waste subcategory.

The primary reason industry suggested the development of a mixed waste subcategory was their concern that waste receipts may be classified in more than one subcategory. As detailed in Chapter 13, EPA believes that the information currently collected is sufficient to classify wastes into each of the three subcategories. Using the recommended subcategory determination procedure, EPA is able to classify each waste receipt identified by the industry during the development of this rule in a single subcategory. Therefore, EPA believes that mixed waste receipt concern has been alleviated.

The second reason industry suggested the

development of a mixed waste subcategory was to simplify implementation for mixed subcategory facilities. EPA agrees with commenters that developing appropriate limitations for mixed waste facilities presents many challenges, but is concerned that mixed wastes receive adequate treatment. In many cases, facilities which accept wastes in multiple subcategories do not have treatment in place to provide effective treatment of all waste receipts. While these facilities meet their permit limitations, compliance is generally due to dilution rather than treatment. As an example, a facility may have a treatment system comprised of equalization and biological treatment and accepts wastes from the organics subcategory and the metals subcategory (high concentrations of metal pollutants). Only the organic subcategory waste receipts would be treated effectively. The “mixed waste subcategory” limitations described above would not prevent ineffective treatment and could actually encourage it. Therefore, based on economic considerations as well as concerns that EPA has about ensuring compliance with effective treatment, rather than dilution, EPA is not proposing a mixed waste subcategory.

POLLUTANTS OF CONCERN FOR THE CENTRALIZED WASTE TREATMENT INDUSTRY

As discussed previously, wastewater receipts treated at centralized waste treatment facilities may have significantly different pollutants and pollutant loads depending on the customer and the process generating the waste receipt. In fact, at many CWT facilities, the pollutants and pollutant loads may vary daily and from batch to batch. As a result, it is difficult to characterize "typical" CWT wastewaters. In fact, one of the distinguishing characteristics of CWT wastewaters (as compared to traditional categorical wastewaters) is that there is always the exception to the rule. For example, at one facility, EPA analyzed samples of wastewater received for treatment from a single facility that were obtained during three different, non-consecutive weeks. EPA found that the weekly waste receipts varied from the most concentrated (in terms of metal pollutants) to one of the least concentrated (in terms of metal pollutants).

METHODOLOGY

6.1

EPA determined pollutants of concern for the CWT industry by assessing EPA sampling data only. Industry has provided very little quantitative data on the concentrations of pollutants entering their wastewater treatment systems. For the metals and organics subcategory, EPA collected the data used to determine the pollutants of concern at influent points to the wastewater treatment systems. For the oils subcategory, EPA collected the data following emulsion breaking and/or gravity separation. The pollutant concentrations at these

points are lower than the original waste receipt concentrations as a result of the commingling of a variety of waste streams, and, in the case of the oils subcategory, as a result of pretreatment. In most cases, EPA could not collect samples from individual waste shipments because of physical constraints and excessive analytical costs.

EPA used two different analytical methods to analyze samples for oil and grease during the development of this guideline. EPA analyzed samples collected prior to the 1995 proposal using Method 413.1. This method uses freon and is being phased out. EPA analyzed oil and grease samples collected after the 1995 proposal using the newly proposed EPA Method 1664. Method 1664 is used to measure oil and grease as hexane extractable material (HEM) and to measure silica gel treated-hexane extractable material (SGT-HEM). EPA believes that oil and grease measurements from Method 413.1 and Method 1664 are comparable and has used the data interchangeably.

EPA collected influent sampling data over a limited time span (generally two to five days). The samples represent a snapshot of the receipts accepted for treatment during the time the samples were collected. Because waste receipts may vary significantly from day to day, EPA can't know if, in fact, the data are also representative of waste receipts during any other time period. If EPA had sampled at more facilities or over longer periods of time, EPA would expect to observe a wider range of flows, pollutants, and pollutant concentrations in CWT industry raw wastewater. This has complicated

the selection of pollutants of concern and regulated pollutants, and the estimation of current performance and removals associated with this rulemaking. Historically, in developing categorical limitations and standards, unlike the case for CWT waste receipts, influent wastestreams are generally consistent in strength and nature.

To establish the pollutants of concern, EPA reviewed the analytical data from influent wastewater samples to determine the number of times a pollutant was detected at treatable levels. EPA set treatable levels at ten times the method detection limit to ensure that pollutants detected as only trace amounts would not be selected. For most organic pollutants, the method detection limit is 10 ug/L. Therefore, for most organic parameters, EPA has defined treatable levels as 100 ug/L. For metals pollutants the method detection limits range from 0.2 ug/L to 1000 ug/L. EPA then obtained the initial pollutants of concern listing for each subcategory by establishing which parameters were detected at treatable levels in at least 10 percent of the influent wastewater samples. Ten percent was used to account for the variability of CWT wastewaters. As mentioned previously in Section 2.3.3.2, after the initial two sampling episodes EPA discontinued the analyses for dioxins/furans, pesticides/herbicides, methanol, ethanol, and formaldehyde, and as a result these parameters were not included in the pollutants of concern analysis. Figure 6-1 depicts the methodology EPA used to select pollutants of concern for each subcategory.

Tables 6-1 through 6-3 provide a listing of the pollutants that were determined to be pollutants of concern for each subcategory. These tables list the pollutant name, CAS number, the number of times the pollutant was analyzed, the number of detects, the method detection limit (MDL), the number of detects at treatable levels, and the minimum and maximum

concentration detected. Tables 6-4 through 6-6 provide a listing of the pollutants that were not considered to be pollutants of concern for each subcategory and the reason they were not selected. While EPA generally uses the parameters established as pollutants of concern to estimate pollutant loadings and pollutant removals, EPA only selected some of these parameters for regulation. The regulated pollutants are a subset of the pollutants of concern and are discussed in Chapter 7. Chapter 12 discusses pollutant loading and removal estimates.

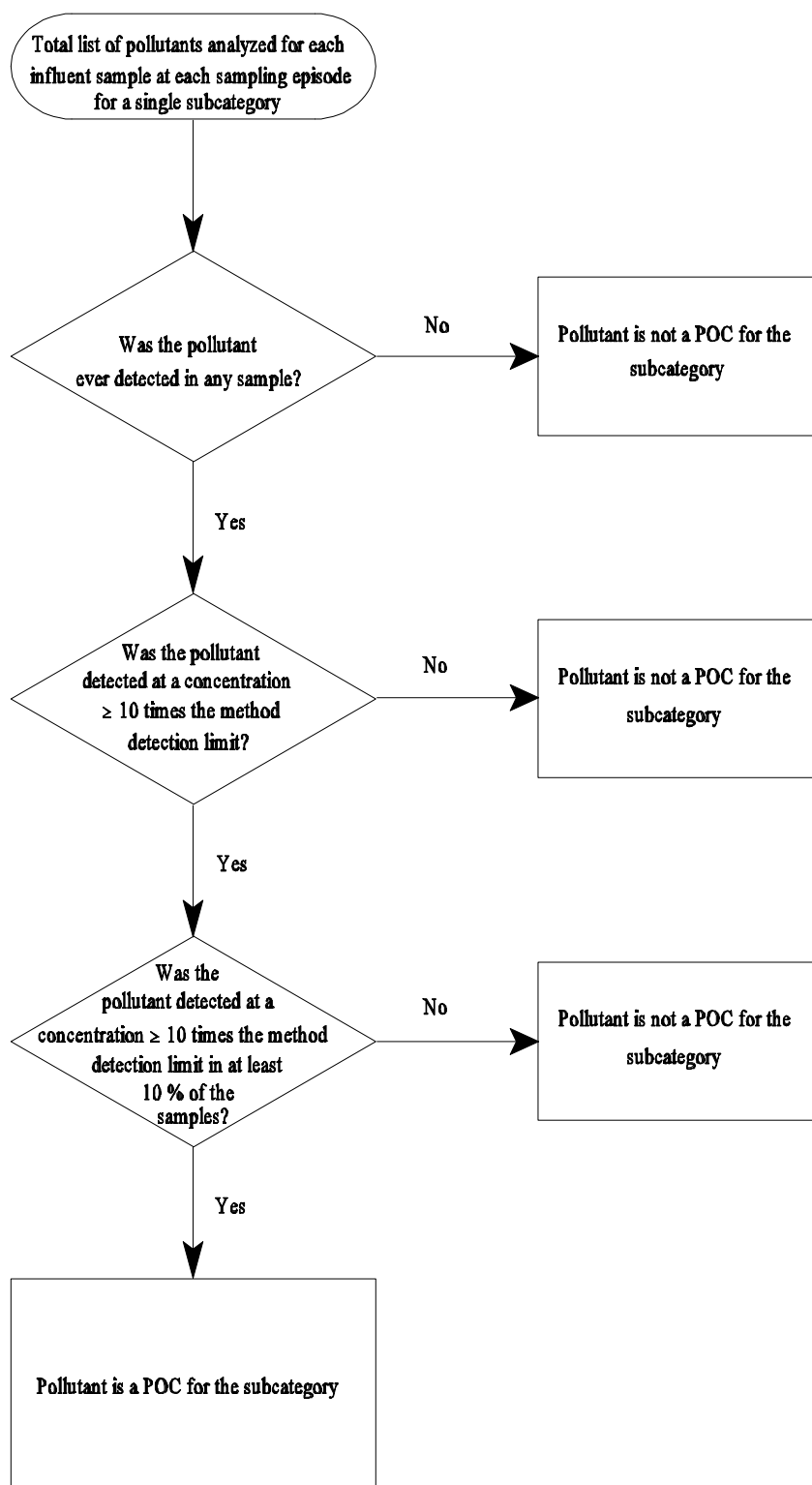


Figure 6-1. Pollutant of Concern Methodology

Table 6-1. Pollutants of Concern for the Metals Subcategory

		# Times		MDL	# Detects	Minimum	Maximum
Pollutant	Cas No.	Analyzed	# Detects	(ug/l)	>10xMDL	Conc.	Conc.
						(mg/l)	(mg/l)
CLASSICALS OR CONVENTIONALS							
Amenable Cyanide	C-025	21	15	20	15	0.00027	2.9000
Ammonia as Nitrogen	7664417	51	51	10	51	0.00040	1.0000
BOD 5-Day	C-002	49	42	2,000	37	0.00400	11.0000
COD	C-004	50	50	5,000	50	0.06800	86.0000
Chloride	16887006	12	12	1,000	12	0.26200	62.0000
Fluoride	16984488	51	51	100	48	0.00012	28.0000
Hexavalent Chromium	18540299	39	28	10	19	0.00000	40.0000
Nitrate/Nitrite	C-005	51	50	50	49	0.00030	40.0000
SGT-HEM	C-037	6	5	5,000	3	0.00630	0.0430
Total Cyanide	57125	26	22	20	22	0.00030	8.4000
TDS	C-010	12	12		12	13.00000	177.0000
TOC	C-012	51	49	1,000	49	0.05500	19.0000
Total Phenols	C-020	46	41	50	10	0.00001	0.0029
Total Phosphorus	14265442	46	45	10	45	0.00030	15.0000
Oil & Grease	C-007	43	37	5,000	15	0.00450	0.1430
Total Sulfide	18496258	46	16	1,000	9	0.00008	1.1000
TSS	C-009	51	51	4,000	50	0.01000	141.0000
METALS						(ug/l)	(ug/l)
Aluminum	7429905	51	48	200	47	723.0	2,080,000.0
Antimony	7440360	51	33	20	29	29.0	1,160,000.0
Arsenic	7440382	51	35	10	31	17.0	1,220,000.0
Barium	7440393	51	36	200	8	7.1	596,000.0
Beryllium	7440417	51	25	5	9	1.7	296.0
Boron	7440428	51	50	100	50	1,300.0	1,420,000.0
Cadmium	7440439	51	49	5	49	83.0	19,300,000.0
Calcium	7440702	51	51	5,000	46	6,630.0	9,100,000.0
Chromium	7440473	51	51	10	51	661.0	65,000,000.0
Cobalt	7440484	51	39	50	33	49.0	10,900,000.0
Copper	7440508	51	51	25	51	756.0	40,200,000.0
Gallium	7440553	26	9	500	5	1,125.0	36,350.0
Indium	7440746	25	10	1,000	6	800.0	61,200.0
Iodine	7553562	25	10	1,000	10	23,800.0	537,000.0
Iridium	7439885	25	13	1,000	11	400.0	253,000.0
Iron	7439896	51	51	100	51	3,140.0	7,745,000.0
Lead	7439921	51	50	50	49	208.0	3,220,000.0
Lithium	7439932	26	16	100	12	129.0	795,000.0
Magnesium	7439954	51	44	5,000	27	9,330.0	2,980,000.0
Manganese	7439965	51	50	15	49	84.0	6,480,000.0
Mercury	7439976	51	39	0	31	1.3	3,100.0
Molybdenum	7439987	51	51	10	50	14.0	1,390,000.0
Neodymium	7440008	24	7	500	3	480.0	58,400.0
Nickel	7440020	51	51	40	51	6,190.0	2,460,000.0
Niobium	7440031	26	6	1,000	3	600.0	57,300.0
Osmium	7440042	24	11	100	4	149.0	21,800.0
Phosphorus	7723140	25	21	1,000	19	1,730.0	2,550,000.0
Potassium	7440097	26	25	1,000	25	15,100.0	9,720,000.0
Selenium	7782492	51	24	5	18	10.0	11,800.0
Silicon	7440213	26	24	100	22	111.0	1,330,000.0
Silver	7440224	51	42	10	39	13.0	130,000.0
Sodium	7440235	51	51	5,000	51	469,500.0	77,700,000.0

Table 6-1. Pollutants of Concern for the Metals Subcategory

Pollutant	Cas No.	# Times		MDL (ug/l)	# Detects >10xMDL	Minimum	Maximum
		Analyzed	# Detects			Conc.	Conc.
Strontium	7440246	26	17	100	12	202.0	16,300.0
Sulfur	7704349	25	25	1,000	25	157,000.0	33,300,000.0
Tantalum	7440257	24	7	500	3	1,270.0	20,000.0
Tellurium	13494809	24	4	1,000	3	11,700.0	182,000.0
Thallium	7440280	51	17	10	11	14.0	275,000.0
Tin	7440315	51	44	30	43	145.0	15,100,000.0
Titanium	7440326	51	42	5	40	36.0	7,500,000.0
Vanadium	7440622	51	31	50	22	22.0	364,000.0
Yttrium	7440655	51	38	5	29	3.0	900.0
Zinc	7440666	51	50	20	50	2,512.0	16,400,000.0
Zirconium	7440677	26	11	100	5	200.0	4,860.0
ORGANICS						(ug/l)	(ug/l)
Benzoic Acid	65850	13	13	50	12	193.0	36,756.0
Benzyl Alcohol	100516	13	5	10	4	13.0	7,929.0
Bis(2-Ethylhexyl)Phthalate	117817	13	7	10	6	18.0	1,063.0
Bromodichloromethane	75274	13	3	10	2	90.0	704.0
Carbon Disulfide	75150	13	2	10	2	186.0	449.0
Chloroform	67663	13	5	10	3	161.0	731.0
Dibromochloromethane	124481	13	3	10	3	105.0	723.0
Hexanoic Acid	142621	13	7	10	6	99.0	1,256.0
Methylene Chloride	75092	13	11	10	8	11.0	734.0
N-Nitrosomorpholine	59892	13	3	10	2	50.0	167.0
N,N-Dimethylformamide	68122	13	5	10	3	126.0	301.0
Pyridine	110861	13	5	10	3	140.0	1,684.0
Tribromomethane	75252	13	3	10	2	72.0	338.0
Trichloroethene	79016	13	4	10	3	122.0	360.0
Tripropyleneglycol Methyl Ether	20324338	13	3	99	2	147.0	3,212.0
2-Butanone	78933	13	4	50	3	65.0	7,826.0
2-Propanone	67641	13	13	50	11	105.0	54,083.0

Table 6-2. Pollutants of Concern for the Oils Subcategory

Pollutant	Cas No.	# Times Analyzed	# Detects	MDL (ug/l)	# Detects >10 x MDL	Minimum Conc.	Maximum Conc.
CLASSICALS OR CONVENTIONALS						(mg/l)	(mg/l)
Amenable Cyanide	C-025	3	3	20	1	0.00003	0.00025
Ammonia as Nitrogen	7664417	24	24	10	24	0.02000	1.90000
BOD 5-Day	C-002	19	19	2,000	19	0.50000	26.00000
BOD	C-003	9	9	2,000	9	3.60000	20.00000
COD	C-004	28	28	5,000	28	0.00140	120.00000
Chloride	16887006	14	14	1,000	14	0.01900	6.20000
Fluoride	16984488	24	23	100	19	0.00012	0.33000
Nitrate/Nitrite	C-005	24	23	50	23	0.00050	0.10300
SGT-HEM	C-037	14	14	5,000	14	0.35400	3.70000
Total Cyanide	57125	13	12	20	5	0.00002	0.00098
TDS	C-010	18	18		18	1.30000	33.00000
TOC	C-012	28	28	1,000	28	0.29800	157.00000
Total Phenols	C-020	24	24	50	24	0.00280	0.18500
Total Phosphorus	14265442	24	24	10	24	0.00065	19.00000
Oil & Grease	C-007	28	28	5,000	28	0.03800	180.00000
TSS	C-009	28	28	4,000	26	0.03400	22.00000
METALS						(ug/l)	(ug/l)
Aluminum	7429905	28	26	200	22	213.0	192,580.0
Antimony	7440360	28	20	20	7	27.0	1,670.0
Arsenic	7440382	28	26	10	18	46.0	9,170.0
Barium	7440393	28	28	200	11	33.0	7,049.0
Beryllium	7440417	28	7	5	3	0.8	113.0
Boron	7440428	28	28	100	28	2,170.0	1,710,000.0
Cadmium	7440439	28	22	5	19	8.6	498.0
Calcium	7440702	28	28	5,000	23	27,700.0	572,750.0
Chromium	7440473	28	28	10	19	9.2	7,178.0
Cobalt	7440484	28	18	50	14	8.5	116,000.0
Copper	7440508	28	27	25	21	11.0	80,482.0
Germanium	7440564	19	2	500	2	10,250.0	12,360.0
Iron	7439896	28	28	100	27	494.0	630,000.0
Lead	7439921	28	27	50	18	34.0	21,725.0
Lutetium	7439943	19	3	100	3	1,165.0	1,315.0
Magnesium	7439954	28	28	5,000	17	4,910.0	753,000.0
Manganese	7439965	28	28	15	28	535.0	44,500.0
Mercury	7439976	28	20	0	14	0.3	56.0
Molybdenum	7439987	28	24	10	23	15.0	12,400.0
Nickel	7440020	28	27	40	18	77.0	62,800.0
Phosphorus	7723140	17	17	1,000	16	4,033.0	239,000.0
Potassium	7440097	19	19	1,000	19	23,550.0	2,880,000.0
Selenium	7782492	28	15	5	12	11.0	1,000.0
Silicon	7440213	19	19	100	19	1,862.0	87,920.0
Silver	7440224	28	15	10	3	8.0	7,740.0
Sodium	7440235	28	27	5,000	27	219,000.0	11,100,000.0
Strontium	7440246	19	13	100	8	128.0	3,470.0
Sulfur	7704349	17	17	1,000	17	90,600.0	3,712,000.0
Tin	7440315	28	16	30	13	127.0	6,216.0
Titanium	7440326	28	16	5	14	29.0	1,407.0
Vanadium	7440622	28	17	50	3	14.0	2,000.0
Zinc	7440666	28	28	20	25	34.0	94,543.0
ORGANICS						(ug/l)	(ug/l)
Acenaphthene	83329	28	6	10	6	105.0	13,418.0

Table 6-2. Pollutants of Concern for the Oils Subcategory

Pollutant	Cas No.	# Times Analyzed	# Detects	MDL (ug/l)	# Detects >10 x MDL	Minimum Conc.	Maximum Conc.
Alpha-Terpineol	98555	28	10	10	8	57.0	2,245.0
Aniline	62533	28	5	10	4	142.0	367.0
Anthracene	120127	28	10	10	10	110.0	18,951.0
Benzene	71432	28	28	10	24	70.0	20,425.0
Benzo(a)anthracene	56553	28	11	10	8	67.0	6,303.0
Benzo(a)pyrene	50328	28	4	10	3	65.0	6,670.0
Benzo(b)fluoranthene	205992	28	6	10	5	38.0	5,752.0
Benzo(k)fluoranthene	207089	28	4	10	3	38.0	5,752.0
Benzoic Acid	65850	28	24	50	24	3,458.0	163,050.0
Benzyl Alcohol	100516	28	7	10	3	40.0	783.0
Biphenyl	92524	28	15	10	11	36.0	10,171.0
Bis(2-Ethylhexyl)Phthalate	117817	28	13	10	9	33.0	838,450.0
Butyl Benzyl Phthalate	85687	28	6	10	4	118.0	49,069.0
Carbazole	86748	28	8	20	5	48.0	1,459.0
Carbon Disulfide	75150	28	14	10	6	11.0	2,335.0
Chlorobenzene	108907	28	11	10	6	12.0	326.0
Chloroform	67663	28	12	10	12	160.0	1,828.0
Chrysene	218019	28	11	10	9	88.0	8,879.0
Di-N-Butyl Phthalate	84742	28	4	10	3	104.0	1,262.0
Dibenzofuran	132649	28	5	10	4	117.0	13,786.0
Dibenzothiophene	132650	28	9	10	9	128.0	5,448.0
Diethyl Phthalate	84662	28	10	10	10	145.0	9,309.0
Diphenyl Ether	101848	28	7	10	5	149.0	13,751.0
Ethylbenzene	100414	28	28	10	25	14.0	18,579.0
Fluoranthene	206440	28	13	10	12	47.0	28,873.0
Fluorene	86737	28	9	10	6	73.0	15,756.0
Hexanoic Acid	142621	28	22	10	21	56.0	90,080.0
M-Xylene	108383	28	23	10	22	24.0	32,639.0
Methylene Chloride	75092	28	25	10	16	13.0	10,524.0
N-Decane	124185	28	24	10	22	62.0	579,220.0
N-Docosane	629970	28	18	10	14	17.0	15,354.0
N-Dodecane	112403	28	24	10	24	125.0	472,570.0
N-Eicosane	112958	28	26	10	23	58.0	319,080.0
N-Hexacosane	630013	28	9	10	6	16.0	9,561.0
N-Hexadecane	544763	28	26	10	26	160.0	1,367,970.0
N-Octadecane	593453	28	25	10	22	47.0	901,920.0
N-Tetracosane	646311	28	10	10	4	18.0	10,289.0
N-Tetradecane	629594	28	26	10	24	78.0	2,560,460.0
N,N-Dimethylformamide	68122	28	5	10	3	83.0	803.0
Naphthalene	91203	28	25	10	23	152.0	53,949.0
O+P Xylene	136777612	28	23	10	18	14.0	16,584.0
O-Cresol	95487	28	11	10	10	142.0	8,273.0
P-Cresol	106445	28	18	10	18	220.0	2,382.0
P-Cymene	99876	28	6	10	6	232.0	4,452.0
Pentamethylbenzene	700129	28	7	10	4	116.0	11,186.0
Phenanthrene	85018	28	18	10	14	12.0	49,016.0
Phenol	108952	28	25	10	23	1,351.0	48,640.0
Pyrene	129000	28	12	10	12	113.0	22,763.0
Pyridine	110861	28	9	10	6	14.0	1,280.0
Styrene	100425	28	5	10	5	289.0	843.0
Tetrachloroethene	127184	28	19	10	18	24.0	12,789.0
Toluene	108883	28	28	10	26	51.0	99,209.0

Table 6-2. Pollutants of Concern for the Oils Subcategory

Pollutant	Cas No.	# Times Analyzed	# Detects	MDL (ug/l)	# Detects >10 x MDL	Minimum Conc.	Maximum Conc.
Trichloroethene	79016	28	15	10	9	18.0	7,125.0
Tripropyleneglycol Methyl Ether	20324338	28	11	99	9	1,495.0	383,151.0
1-Methylfluorene	1730376	28	8	10	6	42.0	5,803.0
1-Methylphenanthrene	832699	28	10	10	8	92.0	7,111.0
1,1-Dichloroethene	75354	28	7	10	6	11.0	1,968.0
1,1,1-Trichloroethane	71556	28	23	10	19	10.0	14,455.0
1,2-Dichloroethane	107062	28	12	10	9	14.0	713.0
1,2,4-Trichlorobenzene	120821	28	8	10	8	359.0	18,899.0
1,4-Dichlorobenzene	106467	28	7	10	7	454.0	2,334.0
1,4-Dioxane	123911	28	3	10	3	189.0	1,323.0
2-Butanone	78933	28	26	50	24	57.0	178,748.0
2-Methylnaphthalene	91576	28	22	10	16	80.0	46,108.0
2-Phenylnaphthalene	612942	28	4	10	3	30.0	543.0
2-Propanone	67641	28	27	50	27	974.0	2,099,340.0
2,3-Benzofluorene	243174	28	6	10	5	162.0	2,755.0
2,4-Dimethylphenol	105679	28	10	10	7	76.0	2,171.0
3,6-Dimethylphenanthrene	1576676	28	5	10	5	114.0	2,762.0
4-Chloro-3-Methylphenol	59507	28	16	10	14	460.0	83,825.0
4-Methyl-2-Pentanone	108101	28	22	50	14	199.0	20,489.0

Table 6-3. Pollutants of Concern for the Organics Subcategory

Pollutant	Cas No.	# Times Analyzed	# Detects	MDL (ug/L)	# Detects >10 x MDL	Minimum Conc.	Maximum Conc.
CLASSICALS OR CONVENTIONALS						(mg/l)	(mg/l)
Amenable Cyanide	C-025	5	4	20	3	0.00014	0.00620
Ammonia as Nitrogen	7664417	5	5	10	5	0.08300	2.40000
BOD 5-Day	C-002	5	5	2,000	5	0.79000	7.60000
COD	C-004	5	5	5,000	5	1.40000	11.00000
Fluoride	16984488	5	5	100	2	0.00060	0.00200
Nitrate/Nitrite	C-005	5	4	50	4	0.10000	0.34000
Total Cyanide	57125	5	5	20	5	0.00080	0.00780
TOC	C-012	5	5	1,000	5	0.51000	3.80000
Oil & Grease	C-007	5	5	5,000	1	0.00220	0.04800
Total Sulfide	18496258	5	3	1,000	2	0.00400	0.02400
TSS	C-009	5	5	4,000	4	0.03300	3.70000
METALS						(ug/l)	(ug/l)
Aluminum	7429905	5	5	200	4	148.0	7,660.0
Antimony	7440360	5	4	20	3	146.0	1,540.0
Arsenic	7440382	5	5	10	1	8.3	152.0
Barium	7440393	5	5	200	2	1,030.0	136,000.0
Boron	7440428	5	5	100	5	2,950.0	4,320.0
Calcium	7440702	5	5	5,000	5	1,025,000.0	1,410,000.0
Chromium	7440473	5	4	10	2	63.0	274.0
Cobalt	7440484	5	4	50	3	253.0	731.0
Copper	7440508	5	5	25	4	7.0	2,690.0
Iodine	7553562	4	4	1,000	1	3,800.0	15,100.0
Iron	7439896	5	5	100	5	2,360.0	6,430.0
Lead	7439921	5	4	50	1	109.0	687.0
Lithium	7439932	5	5	100	5	1,100.0	18,750.0
Manganese	7439965	5	5	15	5	179.0	513.0
Molybdenum	7439987	5	5	10	4	33.0	6,950.0
Nickel	7440020	5	5	40	4	55.0	2,610.0
Phosphorus	7723140	4	4	1,000	1	3,000.0	15,900.0
Potassium	7440097	5	5	1,000	5	383,000.0	1,240,000.0
Silicon	7440213	5	5	100	5	1,500.0	3,600.0
Sodium	7440235	5	5	5,000	5	2,470,000.0	6,390,000.0
Strontium	7440246	5	5	100	5	3,900.0	14,000.0
Sulfur	7704349	5	5	1,000	5	12,800.0	1,990,000.0
Tin	7440315	5	4	30	2	200.0	2,530.0
Titanium	7440326	5	5	5	1	9.0	64.0
Zinc	7440666	5	5	20	4	40.0	1,210.0
ORGANICS						(ug/l)	(ug/l)
Acetphenone	98862	5	4	10	4	336.0	739.0
Aniline	62533	5	2	10	2	178.0	392.0
Benzene	71432	5	5	10	3	31.0	179.0
Benzoic Acid	65850	5	2	50	2	5,649.0	15,760.0
Bromodichloromethane	75274	5	5	10	1	26.0	197.0
Carbon Disulfide	75150	5	4	10	1	14.0	1,147.0
Chlorobenzene	108907	5	4	10	1	70.0	101.0
Chloroform	67663	5	4	10	4	5,224.0	32,301.0
Diethyl Ether	60297	5	4		4	182.0	211.5
Dimethyl Sulfone	67710	5	3	10	3	315.0	892.0
Ethane, Pentachloro-	76017	5	2	20	1	79.0	135.0
Ethylenethiourea	96457	5	2	20	2	8,306.0	9,655.0
Hexachloroethane	67721	5	2	10	2	75.0	101.0
Hexanoic Acid	142621	5	3	10	3	1,111.0	4,963.0

Table 6-3. Pollutants of Concern for the Organics Subcategory

Pollutant	Cas No.	# Times Analyzed	# Detects	MDL (ug/L)	# Detects >10 x MDL	Minimum Conc.	Maximum Conc.
Isophorone	78591	5	2	10	1	60.0	141.0
M-Xylene	108383	5	5	10	1	45.0	310.0
Methylene Chloride	75092	5	4	10	4	2,596.0	87,256.0
N,N-Dimethylformamide	68122	5	3	10	2	23.0	225.0
O+P Xylene	136777612	5	5	10	1	13.0	113.0
O-Cresol	95487	5	4	10	4	7,162.0	14,313.0
P-Cresol	106445	5	4	10	4	220.0	911.0
Pentachlorophenol	87865	5	5	50	4	25.0	677.0
Phenol	108952	5	4	10	4	483.0	9,491.0
Pyridine	110861	5	5	10	4	29.0	444.0
Tetrachloroethene	127184	5	4	10	4	2,235.0	19,496.0
Tetrachloromethane	56235	5	5	10	5	1,862.0	16,126.0
Toluene	108883	5	5	10	5	148.0	2,053.0
Trans-1,2-Dichloroethene	156605	5	5	10	5	1,171.0	5,148.0
Trichloroethene	79016	5	4	10	4	3,551.0	23,649.0
Vinyl Chloride	75014	5	5	10	5	290.0	1,226.0
1,1-Dichloroethane	75343	5	5	10	2	23.0	108.0
1,1-Dichloroethene	75354	5	5	10	5	112.0	461.0
1,1,1-Trichloroethane	71556	5	5	10	4	74.0	320.0
1,1,1,2-Tetrachloroethane	630206	5	5	10	5	249.0	2,573.0
1,1,2-Trichloroethane	79005	5	5	10	5	776.0	6,781.0
1,1,2,2-Tetrachloroethane	79345	5	1	10	1	8,602.0	8,602.0
1,2-Dibromoethane	106934	5	5	10	5	297.0	6,094.0
1,2-Dichlorobenzene	95501	5	1	10	1	479.0	479.0
1,2-Dichloroethane	107062	5	4	10	4	855.0	5,748.0
1,2,3-Trichloropropane	96184	5	5	10	4	100.0	839.0
1,3-Dichloropropane	142289	5	1	10	1	286.0	286.0
2-Butanone	78933	5	5	50	5	894.0	5,063.0
2-Picoline	109068	5	3		2	54.0	187.0
2-Propanone	67641	5	5	50	5	1,215.0	12,435.0
2,3-Dichloroaniline	608275	5	3	10	3	109.0	636.0
2,3,4,6-Tetrachlorophenol	58902	5	5	20	5	594.0	2,698.0
2,4-Dimethylphenol	105679	5	1	10	1	683.0	683.0
2,4,5-Trichlorophenol	95954	5	5	10	4	50.0	289.0
2,4,6-Trichlorophenol	88062	5	5	10	4	50.0	546.0
3,4,5-Trichlorocatechol	56961207	5	2	1	1	0.002	0.050
3,4-Dichlorophenol	95772	5	4	1	4	0.070	0.470
3,4,6-Trichloroguaiacol	60712449	5	3	1	1	0.007	0.020
3,5-Dichlorophenol	591355	5	3	1	3	0.040	0.170
3,6-Dichlorocatechol	3938167	5	1	1	1	0.010	0.010
4-Chlorophenol	106489	5	1	1	1	7.800	7.800
4-Methyl-2-Pentanone	108101	5	5	50	4	290.000	4,038.000
4,5-Dichloroguaiacol	2460493	5	1	1	1	0.010	0.010
4,5,6-Trichloroguaiacol	2668248	5	2	1	1	0.004	0.060
5-Chloroguaiacol	3743235	5	1	1	1	2.400	2.400
6-Chlorovanillin	18268763	5	1	1	1	0.040	0.040

Table 6-4. Pollutants Not Selected as Pollutants of Concern for the Metals Subcategory

Pollutant	Cas No.	Never Detected	Detected <10 x MDL	Detected in <10% of influent samples
METALS				
Bismuth	7440699		X	
Cerium	7440451		X	
Erbium	7440520			X
Europium	7440531		X	
Gadolinium	7440542			X
Germanium	7440564		X	
Gold	7440575			X
Hafnium	7440586		X	
Holmium	7440600	X		
Lanthanum	7439910			X
Lutetium	7439943		X	
Palladium	7440053			X
Platinum	7440064		X	
Praseodymium	7440100			X
Rhenium	7440155		X	
Rhodium	7440166	X		
Ruthenium	7440188			X
Samarium	7440199		X	
Scandium	7440202		X	
Terbium	7440279	X		
Thorium	7440291		X	
Thulium	7440304	X		
Tungsten	7440337			X
Uranium	7440611		X	
Ytterbium	7440644		X	
Organics				
Acenaphthene	83329	X		
Acenaphthylene	208968	X		
Acetophenone	98862		X	
Acrylonitrile	107131	X		
Adsorbable Organic Halides	59473040		X	
Alpha-Terpineol	98555		X	
Aniline	62533		X	
Aniline, 2,4,5-Trimethyl	137177	X		
Anthracene	120127	X		
Aramite	140578	X		
Benzathrone	82053	X		
Benzene	71432	X		
Benzenethiol	108985	X		
Benzidine	92875	X		
Benzo(a)anthracene	56553	X		
Benzo(a)pyrene	50328	X		
Benzo(b)fluoranthene	205992	X		
Benzo(ghi)perylene	191242	X		
Benzo(k)fluoranthene	207089	X		
Benzonitrile, 3,5-Dibromo-4-Hydroxy-	1689845	X		
Beta-Naphthylamine	91598	X		
Biphenyl	92524		X	
Biphenyl, 4-Nitro	92933	X		
Bis(2-Chloroethoxy) Methane	111911	X		
Bis(2-Chloroethyl) Ether	111444	X		
Bis(2-Chloroisopropyl) Ether	108601	X		
Bromomethane	74839	X		
Butyl Benzyl Phthalate	85687	X		
Carbazole	86748	X		
Chloroacetonitrile	107142	X		

Table 6-4. Pollutants Not Selected as Pollutants of Concern for the Metals Subcategory

Pollutant	Cas No.	Never Detected	Detected <10 x MDL	Detected in <10% of influent samples
Chlorobenzene	108907	X		
Chloroethane	75003	X		
Chloromethane	74873	X		
Chrysene	218019		X	
Cis-1,3-Dichloropropene	10061015	X		
Crotonaldehyde	4170303	X		
Crotoxypheos	7700176	X		
Di-N-Butyl Phthalate	84742	X		
Di-N-Octyl Phthalate	117840	X		
Di-N-Propylnitrosamine	621647	X		
Dibenzo(a,h)anthracene	53703	X		
Dibenzofuran	132649		X	
Dibenzothiophene	132650	X		
Dibromomethane	74953	X		
Diethyl Ether	60297		X	
Diethyl Phthalate	84662	X		
Dimethyl Phthalate	131113	X		
Dimethyl Sulfone	67710		X	
Diphenyl Ether	101848	X		
Diphenylamine	122394	X		
Diphenyldisulfide	882337	X		
Ethane, Pentachloro-	76017	X		
Ethyl Cyanide	107120	X		
Ethyl Methacrylate	97632	X		
Ethyl Methanesulfonate	62500	X		
Ethylbenzene	100414		X	
Ethylenethiourea	96457	X		
Fluoranthene	206440		X	
Fluorene	86737		X	
Hexachlorobenzene	118741	X		
Hexachlorobutadiene	87683	X		
Hexachlorocyclopentadiene	77474	X		
Hexachloroethane	67721	X		
Hexachloropropene	1888717	X		
Indeno(1,2,3-CD)pyrene	193395	X		
Iodomethane	74884	X		
Isobutyl Alcohol	78831	X		
Isophorone	78591		X	
Isosafrole	120581	X		
Longifolene	475207	X		
M-Xylene	108383		X	
Malachite Green	569642	X		
Mestranol	72333	X		
Methapyrilene	91805	X		
Methyl Methacrylate	80626	X		
Methyl Methanesulfonate	66273	X		
N-Decane	124185		X	
N-Docosane	629970		X	
N-Dodecane	112403		X	
N-Eicosane	112958		X	
N-Hexacosane	630013		X	
N-Hexadecane	544763		X	
N-Nitrosodi-N-Butylamine	924163	X		
N-Nitrosodiethylamine	55185		X	
N-Nitrosodimethylamine	62759		X	
N-Nitrosodiphenylamine	86306	X		
N-Nitrosomethylethylamine	10595956	X		

Table 6-4. Pollutants Not Selected as Pollutants of Concern for the Metals Subcategory

Pollutant	Cas No.	Never Detected	Detected <10 x MDL	Detected in <10% of influent samples
N-Nitrosomethylphenylamine	614006	X		
N-Nitrosopiperidine	100754	X		
N-Octacosane	630024		X	
N-Octadecane	593453		X	
N-Tetracosane	646311		X	
N-Tetradecane	629594		X	
N-Triacontane	638686		X	
Naphthalene	91203		X	
Nitrobenzene	98953		X	
O+P Xylene	136777612		X	
O-Anisidine	90040	X		
O-Cresol	95487	X		
O-Toluidine	95534	X		
O-Toluidine, 5-Chloro-	95794	X		
P-Chloroaniline	106478	X		
P-Cresol	106445	X		
P-Cymene	99876	X		
P-Dimethylaminoazobenzene	60117	X		
P-Nitroaniline	100016	X		
Pentachlorobenzene	608935	X		
Pentachlorophenol	87865			X
Pentamethylbenzene	700129	X		
Perylene	198550	X		
Phenacetin	62442	X		
Phenanthrene	85018		X	
Phenol	108952		X	
Phenol, 2-Methyl-4,6-Dinitro-	534521	X		
Phenothiazine	92842	X		
Pronamide	23950585	X		
Pyrene	129000	X		
Resorcinol	108463	X		
Safrole	94597	X		
Squalene	7683649	X		
Styrene	100425	X		
Tetrachloroethene	127184	X		
Tetrachloromethane	56235	X		
Thianaphthene	95158	X		
Thioacetamide	62555	X		
Thioxanthene-9-One	492228	X		
Toluene	108883		X	
Toluene, 2,4-Diamino-	95807	X		
Trans-1,2-Dichloroethene	156605	X		
Trans-1,3-Dichloropropene	10061026	X		
Trans-1,4-Dichloro-2-Butene	110576	X		
Trichlorofluoromethane	75694	X		
Triphenylene	217594	X		
Vinyl Acetate	108054	X		
Vinyl Chloride	75014	X		
1-Bromo-2-Chlorobenzene	694804	X		
1-Bromo-3-Chlorobenzene	108372	X		
1-Chloro-3-Nitrobenzene	121733	X		
1-Methylfluorene	1730376	X		
1-Methylphenanthrene	832699	X		
1-Naphthylamine	134327	X		
1-Phenylnaphthalene	605027	X		
1,1-Dichloroethane	75343	X		
1,1-Dichloroethene	75354	X		

Table 6-4. Pollutants Not Selected as Pollutants of Concern for the Metals Subcategory

Pollutant	Cas No.	Never Detected	Detected <10 x MDL	Detected in <10% of influent samples
1,1,1-Trichloroethane	71556	X		
1,1,1,2-Tetrachloroethane	630206	X		
1,1,2-Trichloroethane	79005	X		
1,1,2,2-Tetrachloroethane	79345	X		
1,2-Dibromo-3-Chloropropane	96128	X		
1,2-Dibromoethane	106934	X		
1,2-Dichlorobenzene	95501		X	
1,2-Dichloroethane	107062		X	
1,2-Dichloropropane	78875	X		
1,2-Diphenylhydrazine	122667	X		
1,2,3-Trichlorobenzene	87616	X		
1,2,3-Trichloropropane	96184	X		
1,2,3-Trimethoxybenzene	634366	X		
1,2,4-Trichlorobenzene	120821	X		
1,2,4,5-Tetrachlorobenzene	95943	X		
1,2:3,4-Diepoxybutane	1464535	X		
1,3-Butadiene, 2-Chloro	126998	X		
1,3-Dichloro-2-Propanol	96231	X		
1,3-Dichlorobenzene	541731	X		
1,3-Dichloropropane	142289	X		
1,3,5-Trithiane	291214	X		
1,4-Dichlorobenzene	106467	X		
1,4-Dinitrobenzene	100254	X		
1,4-Dioxane	123911	X		
1,4-Naphthoquinone	130154	X		
1,5-Naphthalenediamine	2243621	X		
2-(Methylthio)Benzothiazole	615225	X		
2-Chloroethylvinyl Ether	110758	X		
2-Chloronaphthalene	91587	X		
2-Chlorophenol	95578		X	
2-Hexanone	591786	X		
2-Isopropylatphthalene	2027170	X		
2-Methylbenzothioazole	120752	X		
2-Methylnaphthalene	91576	X		
2-Nitroaniline	88744	X		
2-Nitrophenol	88755		X	
2-Phenylnaphthalene	612942	X		
2-Picoline	109068		X	
2-Propen-1-ol	107186	X		
2-Propenal	107028	X		
2-Methyl-2-Propenenitrile	126987	X		
2,3-Benzofluorene	243174	X		
2,3-Dichloroaniline	608275	X		
2,3-Dichloronitrobenzene	3209221	X		
2,3,4,6-Tetrachlorophenol	58902	X		
2,3,6-Trichlorophenol	933755	X		
2,4-Dichlorophenol	120832	X		
2,4-Dimethylphenol	105679	X		
2,4-Dinitrophenol	51285			X
2,4-Dinitrotoluene	121142	X		
2,4,5-Trichlorophenol	95954	X		
2,4,6-Trichlorophenol	88062	X		
2,6-Di-Tert-Butyl-P-Benzoquinone	719222	X		
2,6-Dichloro-4-Nitroaniline	99309	X		
2,6-Dichlorophenol	87650		X	
2,6-Dinitrotoluene	606202	X		
3-Chloropropene	107051	X		

Table 6-4. Pollutants Not Selected as Pollutants of Concern for the Metals Subcategory

Pollutant	Cas No.	Never Detected	Detected <10 x MDL	Detected in <10% of influent samples
3-Methylcholanthrene	56495	X		
3-Nitroaniline	99092	X		
3,3'-Dichlorobenzidine	91941	X		
3,3'-Dimethoxybenzidine	119904	X		
3,6-Dimethylphenanthrene	1576676	X		
4-Aminobiphenyl	92671	X		
4-Bromophenyl Phenyl Ether	101553	X		
4-Chloro-2-Nitroaniline	89634	X		
4-Chloro-3-Methylphenol	59507	X		
4-Chlorophenylphenyl Ether	7005723	X		
4-Methyl-2-Pentanone	108101		X	
4-Nitrophenol	100027		X	
4,4-Methylene-Bis(2-Chloroaniline)	101144	X		
4,5-Methylene-Phenanthrene	203645	X		
5-Nitro-O-Toluidine	99558	X		
7,12-Dimethylbenz(a)anthracene	57976	X		

Table 6-5. Pollutants Not Selected as Pollutants of Concern for the Oils Subcategory

Pollutant	Cas No.	Never Detected	Detected <10 x MDL	Detected in <10% of influent samples
CLASSICALS OR CONVENTIONALS				
Hexavalent Chromium	18540299			X
Total Sulfide	18496258		X	
METALS				
Bismuth	7440699		X	
Cerium	7440451		X	
Dysprosium	7429916	X		
Erbium	7440520	X		
Europium	7440531	X		
Gadolinium	7440542	X		
Gallium	7440553	X		
Gold	7440575	X		
Hafnium	7440586	X		
Holmium	7440600	X		
Indium	7440746	X		
Iodine	7553562	X		
Iridium	7439885			X
Lanthanum	7439910	X		
Lithium	7439932			X
Neodymium	7440008	X		
Niobium	7440031	X		
Osmium	7440042	X		
Palladium	7440053	X		
Platinum	7440064		X	
Praseodymium	7440100	X		
Rhenium	7440155		X	
Rhodium	7440166	X		
Ruthenium	7440188	X		
Samarium	7440199	X		
Scandium	7440202	X		
Tantalum	7440257			X
Tellurium	13494809		X	
Terbium	7440279	X		
Thallium	7440280		X	
Thorium	7440291	X		
Thulium	7440304	X		
Tungsten	7440337		X	
Uranium	7440611	X		
Ytterbium	7440644		X	
Yttrium	7440655		X	
Zirconium	7440677		X	
ORGANICS				
Acenaphthylene	208968			X
Acetophenone	98862			X
Acrylonitrile	107131	X		
Aniline, 2,4,5-Trimethyl	137177	X		
Aramite	140578	X		
Benzathrone	82053	X		
Benzenethiol	108985	X		
Benzidine	92875	X		
Benzo(ghi)perylene	191242		X	
Benzonitrile, 3,5-Dibromo-4-Hydroxy-	1689845	X		
Beta-Naphthylamine	91598	X		
Biphenyl, 4-Nitro	92933	X		
Bis(2-Chloroethoxy) Methane	111911	X		
Bis(2-Chloroethyl) Ether	111444	X		

Table 6-5. Pollutants Not Selected as Pollutants of Concern for the Oils Subcategory

Pollutant	Cas No.	Never Detected	Detected <10 x MDL	Detected in <10% of influent samples
Bis(2-Chloroisopropyl) Ether	108601	X		
Bromodichloromethane	75274	X		
Bromomethane	74839	X		
Chloroacetonitrile	107142	X		
Chloroethane	75003	X		
Chloromethane	74873	X		
Cis-1,3-Dichloropropene	10061015	X		
Crotonaldehyde	4170303	X		
Crotylphosphine	7700176	X		
Di-N-Octyl Phthalate	117840			X
Di-N-Propylnitrosamine	621647	X		
Dibenzo(a,h)anthracene	53703	X		
Dibromochloromethane	124481	X		
Dibromomethane	74953	X		
Diethyl Ether	60297			X
Dimethyl Phthalate	131113			X
Dimethyl Sulfone	67710	X		
Diphenylamine	122394			X
Diphenyldisulfide	882337	X		
Ethane, Pentachloro-	76017	X		
Ethyl Cyanide	107120	X		
Ethyl Methacrylate	97632	X		
Ethyl Methanesulfonate	62500	X		
Ethylenethiourea	96457	X		
Hexachlorobenzene	118741	X		
Hexachlorobutadiene	87683		X	
Hexachlorocyclopentadiene	77474	X		
Hexachloroethane	67721	X		
Hexachloropropene	1888717	X		
Indeno(1,2,3-CD)pyrene	193395	X		
Iodomethane	74884	X		
Isobutyl Alcohol	78831		X	
Isophorone	78591			X
Isosafrole	120581	X		
Longifolene	475207	X		
M+P Xylene	179601231		X	
Malachite Green	569642	X		
Mestranol	72333	X		
Methapyrilene	91805	X		
Methyl Methacrylate	80626	X		
Methyl Methanesulfonate	66273	X		
N-Nitrosodi-N-Butylamine	924163		X	
N-Nitrosodiethylamine	55185	X		
N-Nitrosodimethylamine	62759			X
N-Nitrosodiphenylamine	86306		X	
N-Nitrosomethylethylamine	10595956	X		
N-Nitrosomethylphenylamine	614006	X		
N-Nitrosomorpholine	59892		X	
N-Nitrosopiperidine	100754		X	
N-Octacosane	630024			X
N-Triacontane	638686		X	
Nitrobenzene	98953	X		
O-Anisidine	90040	X		
O-Toluidine	95534			X
O-Toluidine, 5-Chloro-	95794	X		
O-Xylene	95476		X	

Table 6-5. Pollutants Not Selected as Pollutants of Concern for the Oils Subcategory

Pollutant	Cas No.	Never Detected	Detected <10 x MDL	Detected in <10% of influent samples
P-Chloroaniline	106478	X		
P-Dimethylaminoazobenzene	60117	X		
P-Nitroaniline	100016	X		
Pentachlorobenzene	608935	X		
Pentachlorophenol	87865		X	
Perylene	198550	X		
Phenacetin	62442	X		
Phenol, 2-Methyl-4,6-Dinitro-	534521	X		
Phenothiazine	92842	X		
Pronamide	23950585	X		
Resorcinol	108463	X		
Safrole	94597	X		
Squalene	7683649	X		
Tetrachloromethane	56235			X
Thianaphthene	95158		X	
Thioacetamide	62555	X		
Thioxanthone-9-One	492228	X		
Toluene, 2,4-Diamino-	95807	X		
Trans-1,2-Dichloroethene	156605		X	
Trans-1,3-Dichloropropene	10061026	X		
Trans-1,4-Dichloro-2-Butene	110576	X		
Tribromomethane	75252	X		
Trichlorofluoromethane	75694			X
Triphenylene	217594			X
Vinyl Acetate	108054		X	
Vinyl Chloride	75014			X
1-Bromo-2-Chlorobenzene	694804	X		
1-Bromo-3-Chlorobenzene	108372	X		
1-Chloro-3-Nitrobenzene	121733	X		
1-Naphthylamine	134327	X		
1-Phenylnaphthalene	605027		X	
1,1-Dichloroethane	75343			X
1,1,1,2-Tetrachloroethane	630206	X		
1,1,2-Trichloroethane	79005	X		
1,1,2,2-Tetrachloroethane	79345		X	
1,2-Dibromo-3-Chloropropane	96128	X		
1,2-Dibromoethane	106934	X		
1,2-Dichlorobenzene	95501			X
1,2-Dichloropropane	78875	X		
1,2-Diphenylhydrazine	122667	X		
1,2,3-Trichlorobenzene	87616			X
1,2,3-Trichloropropane	96184	X		
1,2,3-Trimethoxybenzene	634366	X		
1,2,4,5-Tetrachlorobenzene	95943	X		
1,2:3,4-Diepoxybutane	1464535	X		
1,3-Butadiene, 2-Chloro	126998	X		
1,3-Dichloro-2-Propanol	96231	X		
1,3-Dichlorobenzene	541731		X	
1,3-Dichloropropane	142289	X		
1,3,5-Trithiane	291214			X
1,4-Dinitrobenzene	100254	X		
1,4-Naphthoquinone	130154	X		
1,5-Naphthalenediamine	2243621	X		
2-(Methylthio)Benzothiazole	615225	X		
2-Chloroethylvinyl Ether	110758	X		
2-Chloronaphthalene	91587	X		

Table 6-5. Pollutants Not Selected as Pollutants of Concern for the Oils Subcategory

Pollutant	Cas No.	Never Detected	Detected <10 x MDL	Detected in <10% of influent samples
2-Chlorophenol	95578	X		
2-Hexanone	591786		X	
2-Isopropyl-naphthalene	2027170			X
2-Methylbenzothiazole	120752	X		
2-Nitroaniline	88744	X		
2-Nitrophenol	88755			X
2-Picoline	109068		X	
2-Propen-1-ol	107186	X		
2-Propenal	107028			X
2-Propenenitrile, 2-Methyl	126987	X		
2,3-Dichloroaniline	608275		X	
2,3-Dichloronitrobenzene	3209221	X		
2,3,4,6-Tetrachlorophenol	58902	X		
2,3,6-Trichlorophenol	933755	X		
2,4-Dichlorophenol	120832	X		
2,4-Dinitrophenol	51285	X		
2,4-Dinitrotoluene	121142	X		
2,4,5-Trichlorophenol	95954	X		
2,4,6-Trichlorophenol	88062	X		
2,6-Di-Tert-Butyl-P-Benzoquinone	719222	X		
2,6-Dichloro-4-Nitroaniline	99309	X		
2,6-Dichlorophenol	87650	X		
2,6-Dinitrotoluene	606202	X		
3-Chloropropene	107051	X		
3-Methylcholanthrene	56495	X		
3-Nitroaniline	99092	X		
3,3'-Dichlorobenzidine	91941	X		
3,3'-Dimethoxybenzidine	119904	X		
4-Aminobiphenyl	92671	X		
4-Bromophenyl Phenyl Ether	101553	X		
4-Chloro-2-Nitroaniline	89634	X		
4-Chlorophenylphenyl Ether	7005723	X		
4-Nitrophenol	100027	X		
4,4'-Methylene-Bis(2-Chloroaniline)	101144	X		
4,5-Methylene-Phenanthrene	203645			X
5-Nitro-O-Toluidine	99558	X		
7,12-Dimethylbenz(a)anthracene	57976	X		

Table 6-6. Pollutants Not Selected as Pollutants of Concern for the Organics Subcategory

Pollutant	Cas No.	Never Detected	Detected <10 x MDL	Detected in <10% of influent samples
CLASSICALS OR CONVENTIONALS				
Hexavalent Chromium	18540299	X		
Total Phenols	C-020	X		
Total Phosphorus	14265442	X		
METALS				
Beryllium	7440417	X		
Bismuth	7440699	X		
Cadmium	7440439		X	
Cerium	7440451	X		
Dysprosium	7429916	X		
Erbium	7440520	X		
Europium	7440531	X		
Gadolinium	7440542	X		
Gallium	7440553		X	
Germanium	7440564	X		
Gold	7440575	X		
Hafnium	7440586		X	
Holmium	7440600	X		
Indium	7440746		X	
Iridium	7439885		X	
Lanthanum	7439910	X		
Lutetium	7439943	X		
Magnesium	7439954		X	
Mercury	7439976	X		
Neodymium	7440008	X		
Niobium	7440031	X		
Palladium	7440053	X		
Platinum	7440064		X	
Praseodymium	7440100	X		
Rhenium	7440155	X		
Rhodium	7440166	X		
Ruthenium	7440188	X		
Samarium	7440199	X		
Scandium	7440202	X		
Selenium	7782492	X		
Silver	7440224	X		
Tantalum	7440257	X		
Tellurium	13494809	X		
Terbium	7440279	X		
Thallium	7440280	X		
Thorium	7440291	X		
Thulium	7440304	X		
Tungsten	7440337	X		
Uranium	7440611	X		
Vanadium	7440622		X	
Ytterbium	7440644	X		
Yttrium	7440655		X	
Zirconium	7440677	X		
ORGANICS				
Acenaphthene	83329	X		
Acenaphthylene	208968	X		
Acrylonitrile	107131	X		
Alpha-Terpineol	98555	X		
Aniline, 2,4,5-Trimethyl	137177	X		
Anthracene	120127	X		
Aramite	140578	X		

Table 6-6. Pollutants Not Selected as Pollutants of Concern for the Organics Subcategory

Pollutant	Cas No.	Never Detected	Detected <10 x MDL	Detected in <10% of influent samples
Benzathrone	82053	X		
Benzenethiol	108985	X		
Benzidine	92875	X		
Benzo(a)anthracene	56553	X		
Benzo(a)pyrene	50328	X		
Benzo(b)fluoranthene	205992	X		
Benzo(ghi)perylene	191242	X		
Benzo(k)fluoranthene	207089	X		
Benzonitrile, 3,5-Dibromo-4-Hydroxy-	1689845	X		
Benzyl Alcohol	100516	X		
Beta-Naphthylamine	91598	X		
Biphenyl	92524	X		
Biphenyl, 4-Nitro	92933	X		
Bis(2-Chloroethoxy) Methane	111911	X		
Bis(2-Chloroethyl) Ether	111444	X		
Bis(2-Chloroisopropyl) Ether	108601	X		
Bis(2-Ethylhexyl)Phthalate	117817	X		
Bromomethane	74839	X		
Butyl Benzyl Phthalate	85687	X		
Carbazole	86748	X		
Chloroacetonitrile	107142	X		
Chloroethane	75003	X		
Chloromethane	74873	X		
Chrysene	218019	X		
Cis-1,3-Dichloropropene	10061015	X		
Crotonaldehyde	4170303	X		
Crotoxyphos	7700176	X		
Di-N-Butyl Phthalate	84742	X		
Di-N-Octyl Phthalate	117840	X		
Di-N-Propylnitrosamine	621647	X		
Dibenzo(a,h)anthracene	53703	X		
Dibenzofuran	132649	X		
Dibenzothiophene	132650	X		
Dibromochloromethane	124481	X		
Dibromomethane	74953	X		
Diethyl Ether	60297		X	
Diethyl Phthalate	84662	X		
Dimethyl Phthalate	131113	X		
Diphenyl Ether	101848	X		
Diphenylamine	122394	X		
Diphenyldisulfide	882337	X		
Ethyl Cyanide	107120	X		
Ethyl Methacrylate	97632	X		
Ethyl Methanesulfonate	62500	X		
Ethylbenzene	100414		X	
Fluoranthene	206440	X		
Fluorene	86737	X		
Hexachlorobenzene	118741		X	
Hexachlorobutadiene	87683		X	
Hexachlorocyclopentadiene	77474	X		
Hexachloropropene	1888717	X		
Indeno(1,2,3-CD)pyrene	193395	X		
Iodomethane	74884	X		
Isobutyl Alcohol	78831	X		
Isosafrole	120581	X		
Longifolene	475207	X		

Table 6-6. Pollutants Not Selected as Pollutants of Concern for the Organics Subcategory

Pollutant	Cas No.	Never Detected	Detected <10 x MDL	Detected in <10% of influent samples
Malachite Green	569642	X		
Mestranol	72333	X		
Methapyrilene	91805	X		
Methyl Methacrylate	80626	X		
Methyl Methanesulfonate	66273	X		
N-Decane	124185	X		
N-Docosane	629970	X		
N-Dodecane	112403	X		
N-Eicosane	112958	X		
N-Hexacosane	630013	X		
N-Hexadecane	544763	X		
N-Nitrosodi-N-Butylamine	924163	X		
N-Nitrosodiethylamine	55185	X		
N-Nitrosodimethylamine	62759		X	
N-Nitrosodiphenylamine	86306	X		
N-Nitrosomethylethylamine	10595956	X		
N-Nitrosomethylphenylamine	614006	X		
N-Nitrosomorpholine	59892	X		
N-Nitrosopiperidine	100754	X		
N-Octacosane	630024	X		
N-Octadecane	593453	X		
N-Tetracosane	646311		X	
N-Tetradecane	629594	X		
N-Triacontane	638686	X		
Naphthalene	91203	X		
Nitrobenzene	98953	X		
O-Anisidine	90040	X		
O-Toluidine	95534	X		
O-Toluidine, 5-Chloro-	95794	X		
P-Chloroaniline	106478	X		
P-Cymene	99876	X		
P-Dimethylaminoazobenzene	60117	X		
P-Nitroaniline	100016	X		
Pentachlorobenzene	608935	X		
Pentamethylbenzene	700129	X		
Perylene	198550	X		
Phenacetin	62442	X		
Phenanthrene	85018	X		
Phenol, 2-Methyl-4,6-Dinitro-	534521	X		
Phenothiazine	92842	X		
Pronamide	23950585	X		
Pyrene	129000	X		
Resorcinol	108463	X		
Safrole	94597	X		
Squalene	7683649	X		
Styrene	100425	X		
Tetrachlorocatechol	1198556		X	
Tetrachloroguaiacol	2539175	X		
Thianaphthene	95158	X		
Thioacetamide	62555	X		
Thioxanthene-9-One	492228	X		
Toluene, 2,4-Diamino-	95807	X		
Trans-1,3-Dichloropropene	10061026	X		
Trans-1,4-Dichloro-2-Butene	110576	X		
Tribromomethane	75252		X	
Trichlorofluoromethane	75694		X	

Table 6-6. Pollutants Not Selected as Pollutants of Concern for the Organics Subcategory

Pollutant	Cas No.	Never Detected	Detected <10 x MDL	Detected in <10% of influent samples
Trichlorosyringol	2539266		X	
Triphenylene	217594	X		
Tripropyleneglycol Methyl Ether	20324338	X		
Vinyl Acetate	108054	X		
1-Bromo-2-Chlorobenzene	694804	X		
1-Bromo-3-Chlorobenzene	108372	X		
1-Chloro-3-Nitrobenzene	121733	X		
1-Methylfluorene	1730376	X		
1-Methylphenanthrene	832699	X		
1-Naphthylamine	134327	X		
1-Phenylnaphthalene	605027	X		
1,2-Dibromo-3-Chloropropane	96128	X		
1,2-Dichloropropane	78875		X	
1,2-Diphenylhydrazine	122667	X		
1,2,3-Trichlorobenzene	87616	X		
1,2,3-Trimethoxybenzene	634366	X		
1,2,4-Trichlorobenzene	120821	X		
1,2,4,5-Tetrachlorobenzene	95943	X		
1,2:3,4-Diepoxybutane	1464535	X		
1,3-Butadiene, 2-Chloro	126998	X		
1,3-Dichloro-2-Propanol	96231	X		
1,3-Dichlorobenzene	541731	X		
1,3,5-Trithiane	291214	X		
1,4-Dichlorobenzene	106467	X		
1,4-Dinitrobenzene	100254	X		
1,4-Dioxane	123911		X	
1,4-Naphthoquinone	130154	X		
1,5-Naphthalenediamine	2243621	X		
2-(Methylthio)Benzothiazole	615225	X		
2-Chloroethylvinyl Ether	110758	X		
2-Chloronaphthalene	91587	X		
2-Chlorophenol	95578	X		
2-Hexanone	591786	X		
2-Isopropyl-naphthalene	2027170	X		
2-Methylbenzothioazole	120752	X		
2-Methylnaphthalene	91576	X		
2-Nitroaniline	88744	X		
2-Nitrophenol	88755	X		
2-Phenylnaphthalene	612942	X		
2-Picoline	109068		X	
2-Propen-1-ol	107186	X		
2-Propenal	107028	X		
2-Propenenitrile, 2-Methyl	126987	X		
2-Syringaldehyde	134963	X		
2,3-Benzofluorene	243174	X		
2,3-Dichloronitrobenzene	3209221	X		
2,3,6-Trichlorophenol	933755		X	
2,4-Dichlorophenol	120832		X	
2,4-Dinitrophenol	51285	X		
2,4-Dinitrotoluene	121142	X		
2,6-Di-Tert-Butyl-P-Benzoquinone	719222	X		
2,6-Dichloro-4-Nitroaniline	99309	X		
2,6-Dichlorophenol	87650	X		
2,6-Dinitrotoluene	606202	X		
3-Chloropropene	107051	X		
3-Methylcholanthrene	56495	X		

Table 6-6. Pollutants Not Selected as Pollutants of Concern for the Organics Subcategory

Pollutant	Cas No.	Never Detected	Detected <10 x MDL	Detected in <10% of influent samples
3-Nitroaniline	99092	X		
3,3'-Dichlorobenzidine	91941	X		
3,3'-Dimethoxybenzidine	119904	X		
3,4,5-Trichloroguaiacol	57057837		X	
3,5-Dichlorocatechol	13673922	X		
3,6-Dimethylphenanthrene	1576676	X		
4-Aminobiphenyl	92671	X		
4-Bromophenyl Phenyl Ether	101553	X		
4-Chloro-2-Nitroaniline	89634	X		
4-Chloro-3-Methylphenol	59507		X	
4-Chloroguaiacol	16766306	X		
4-Chlorophenylphenyl Ether	7005723	X		
4-Nitrophenol	100027	X		
4,4'-Methylene-Bis(2-Chloroaniline)	101144	X		
4,5-Dichlorocatechol	3428248		X	
4,5-Methylene-Phenanthrene	203645	X		
4,6-Dichloroguaiacol	16766317	X		
5-Nitro-O-Toluidine	99558	X		
5,6-Dichlorovanillin	18268694	X		
7,12-Dimethylbenz(a)anthracene	57976	X		

POLLUTANTS OF CONCERN FOR THE METALS SUBCATEGORY

6.2

Wastewaters treated at CWT facilities in the metals subcategory contain a range of conventional, toxic, and non-conventional pollutants. EPA analyzed influent samples for 320 conventional, classical, metal, and organic pollutants. EPA identified 78 pollutants of concern, including 43 metals, 17 organics, and 3 conventional pollutants as presented in Table 6-1. EPA excluded 242 pollutants from further review because they did not pass the pollutant of concern criteria. Table 6-4 lists these pollutants, including 178 pollutants that were never detected at any sampling episode, 54 pollutants that were detected at a concentration less than ten times the method detection limit, and 10 pollutants that were present in less than ten percent of the influent samples. EPA selected only 25 percent of the list of pollutants analyzed as pollutants of concern, and as expected, the greatest number of pollutants of concern in the metals subcategory were found in the metals group.

Facilities in the metals subcategory had the highest occurrence and broadest range of metals detected in their raw wastewater. The sampling identified a total of 43 metals above treatable levels, compared to 32 metals in the oils subcategory, and 25 metals in the organics subcategory. Maximum metals concentrations in the metals subcategory were generally at least an order of magnitude higher than metals in the oils and organics subcategories, and were often two to three orders of magnitude greater. Wastewaters contained significant concentrations of common non-conventional metals such as aluminum, iron, and tin. In addition, given the processes generating these wastewaters, waste receipts in this subcategory generally contained toxic heavy metals. Toxic metals found in the highest concentrations were cadmium, chromium, cobalt, copper, nickel, and zinc.

EPA detected three conventional pollutants (BOD₅, TSS, oil and grease) and fifteen classical pollutants above treatable levels in the metals subcategory, including hexavalent chromium, which was not found in either the oils or organics

subcategories. Concentrations for total and amenable cyanide, chloride, fluoride, nitrate/nitrite, TDS, TSS, and total sulfide were significantly higher for metals facilities than for facilities in the other subcategories.

While sampling showed organic pollutants at selected facilities in the metals subcategory, these were not typically found in wastewaters resulting from this subcategory. Many metals facilities have placed acceptance restrictions on the concentration of organic pollutants allowed in the off-site wastestreams. Of the 217 organic pollutants analyzed in the metals subcategory, EPA only detected 17 above treatable levels, as compared to more than 72 in the oils subcategory and 60 in the organics subcategory. However, of the organic compounds detected in the metals subcategory, three, specifically, dibromochloromethane, tribromomethane, and n-nitrosomorpholine were not detected in any other subcategory. EPA sampling detected all other organic pollutants in the metals subcategory at relatively low concentrations, as compared to the oils and organics subcategories.

POLLUTANTS OF CONCERN FOR THE OILS SUBCATEGORY

6.3

As detailed in Chapters 2 and 12, EPA does not have data to characterize raw wastewater for the oils subcategory. Therefore, EPA based its influent wastewater characterization for this subcategory on an evaluation of samples obtained following the initial gravity separation/emulsion breaking step. EPA analyzed these samples for 322 conventional, classical, metal, and organic pollutants. EPA identified 120 pollutants of concern, including 72 organics, 32 metals, and 3 conventional pollutants presented in Table 6-2. EPA eliminated 202 pollutants after applying its traditional criteria for regulating pollutants. Table 6-5 lists these pollutants, including 145 pollutants that were never detected at any sampling episode, 31 pollutants that were

detected at a concentration less than ten times the method detection limit, and 26 pollutants that were present in less than ten percent of the influent samples. EPA selected nearly 40 percent of the list of pollutants analyzed as pollutants of concern, the majority of which were organic pollutants.

Facilities in the oils subcategory had the broadest spectrum of pollutants of concern in their raw wastewater with 3 conventional pollutants, 13 classical pollutants, and more than 100 organics and metals. As expected, oil and grease concentrations in this subcategory were significantly higher than for the other subcategories, and varied greatly from one facility to the next, ranging from 40 mg/L to 180,000 mg/L (see Table 6-2) after the first stage of treatment. The concentrations of ammonia, BOD₅, COD, TOC, total phenols, and total phosphorus were also higher for facilities in the oils subcategory.

Wastewaters contained significant concentrations of both non-conventional and toxic metals such as aluminum, boron, cobalt, iron, manganese, and zinc. EPA's sampling data show most pollutant of concern metals were detected at higher concentrations in the oils subcategory than those found in the organics subcategory, but at significantly lower concentrations than those found in the metals subcategory. Germanium was the only metal detected at a treatable level in the oils subcategory but not in the other two subcategories.

Of the 72 organic pollutants detected above treatable levels in the oils subcategory, 40 were not present in the other two subcategories. Twenty four pollutants of concern organics were common to both the oils and organics subcategories, but more than half of these organics were detected in oily wastewater at concentrations two to three orders of magnitude higher than those found in the organics

subcategory wastewaters. Organic pollutants found in the highest concentrations were straight chain hydrocarbons such as n-decane and n-tetradecane, and aromatics such as naphthalene and bis(2-ethylhexyl)phthalate. EPA also detected polyaromatic hydrocarbons, such as benzo(a)pyrene in the wastewaters of oils facilities.

Some industry representatives questioned EPA's sampling results and claimed that benzo(a)pyrene would only be found at oils facilities which treat hazardous wastes. EPA reviewed the literature which confirmed that benzo(a)pyrene may be present in any waste that comes in contact with oil, coal tar, or petroleum products. Tables 6-7 and 6-8 present concentrations of benzo(a)pyrene in various industrial products, some of which are likely to be encountered at oils subcategory CWTs.

Though the concentration of benzo(a)pyrene varies widely across the examined sources, the information in the tables indicates that carbonaceous combustion products are a source of benzo(a)pyrene. Because many of these used products are treated at both hazardous and non-hazardous CWT oils facilities, benzo(a)pyrene may be detected at either hazardous or non-hazardous CWT facilities.

Table 6-7. Concentration of Benzo(a)pyrene in Industrial Products (Osborne & Crosby, 1987)

Sample	Benzo(a)pyrene Content
Carbon black	2-40 µg/g
Coal-tar pitch	1.3-2.4 %
Asphalt	0.1-27 mg/kg
Creosote	22 mg/kg
Regular gasoline	0.21 mg/L
Premium gasoline	0.48 mg/L
API Reference oils	0.6-44 mg/kg
Diesel oil	0.03 mg/kg
Fuel oil	0.03 mg/kg
Heavy lubricating oils	1.2-4.2 mg/kg
Light lubricating oils	6.0-7.0 mg/kg

Table 6-8. Concentration of Benzo(a)pyrene in Japanese Diesel Oils (Osborne & Crosby, 1987)

Oil Type	Aromatic Carbon Content (%)	Boiling Range (°C)	Benzo(a)pyrene Content (mg/L)
Commercial gas oil	13.0	184-382	1.9
Aromatic-rich gas oil	36.0	181-331	6.7
Coal-liquified oil	64	205-382	64.5

**POLLUTANTS OF CONCERN FOR
THE ORGANICS SUBCATEGORY****6.4**

Wastewaters treated at CWT facilities in the organics subcategory contain a range of conventional, toxic, and non-conventional pollutants. EPA analyzed influent samples for 336 classical, metal, and organic pollutants. EPA identified 97 pollutants of concern, including 60 organic pollutants, 25 metals, and 3 conventional pollutants presented in Table 6-3. EPA excluded 241 pollutants because they did not pass the pollutant of concern criteria. Table 6-6 presents these pollutants, including 214 pollutants that were never detected at any sampling episode, and 27 pollutants that were detected at a concentration less than ten times the method detection limit. EPA determined that only 30 percent of the list of pollutants analyzed were pollutants of concern.

As expected, wastewaters contained significant concentrations of organic parameters, many of which were highly volatile. However, although EPA analyzed wastewater samples in the organics subcategory for a more extensive list of organics than samples in the metals or oils subcategories, EPA selected only 20 percent of those organic pollutants analyzed as pollutants of concern. EPA selected a total of 60 organics above treatable levels in the influent samples analyzed. Thirty-six of these organics were present in the organics subcategory but not in the oils subcategory. EPA determined the remaining 24 organics were pollutants of concern for both the organics and oils subcategories. EPA's sampling detected only six of these organic pollutants at higher concentrations at organics facilities, specifically, chloroform, methylene chloride, o-cresol, tetrachloroethene, trichloroethene, and 1,2-dichloroethane. EPA found only 9 classical pollutants were pollutants of concern in the organics subcategory, and most were detected at lower concentrations than those found in the metals and oils subcategories.

The sampling detected a total of 25 metals above treatable levels, but these were present at concentrations significantly lower than in the metals subcategory. EPA's assessment showed that only three pollutant of concern metals (barium, calcium, and strontium) were detected at concentrations above those found in the oils subcategory.

REFERENCES**6.5**

Osborne and Crosby, Cambridge Monographs on Cancer Research: Benzopyrenes, Cambridge University Press; New York, NY; 1987.

POLLUTANTS SELECTED FOR REGULATION

Chapter 6 details the pollutants of concern for each subcategory and the methodology used in selecting the pollutants. As expected for the CWT industry, these pollutants of concern lists contain a broad spectrum of pollutants. EPA has, however, chosen not to regulate all of these parameters. This chapter details the pollutants of concern which were not selected for regulation under the proposed options and provides a justification for eliminating these pollutants. (The proposed options are detailed in Chapter 9.) Additionally, Figures 7-1 and 7-2 illustrate the procedures used to select the regulated pollutants for direct and indirect dischargers.

TREATMENT CHEMICALS 7.1

EPA excluded all pollutants which may serve as treatment chemicals: aluminum, calcium, chloride, fluoride, iron, magnesium, phosphorus, potassium, sodium, and sulfur. EPA eliminated these pollutants because regulation of these pollutants could interfere with their beneficial use as wastewater treatment additives.

NON-CONVENTIONAL BULK PARAMETERS 7.2

EPA excluded many non-conventional bulk parameters such as total dissolved solids (TDS), chemical oxygen demand (COD), organic carbon (TOC), nitrate/nitrite, total phenols, total phosphorus, and total sulfide. EPA excluded these parameters because it is more appropriate to target specific compounds of interest rather than a parameter which measures a variety of pollutants for this industry. The specific pollutants which comprise the bulk parameter

may or may not be of concern to EPA. EPA also excluded amenable cyanide since the proposed total cyanide limit would also control amenable cyanide.

POLLUTANTS NOT DETECTED AT TREATABLE LEVELS 7.3

EPA eliminated pollutants that were present below treatable concentrations in wastewater influent to the treatment system(s) selected as the basis for effluent limitations. For a pollutant to be retained, the pollutant: a) had to be detected in the influent sample at treatable levels (ten times the minimum analytical detection limit) in at least fifty percent of the samples; or b) had to be detected at any level in the influent samples at least 50 percent of the time and the combined mean of the influent samples for the entire episode had to be greater than or equal to ten times the minimum analytical detection limit. EPA added the second condition to account for instances where a slug of pollutant was treated during the sampling episode. EPA added this condition since the CWT industry's waste receipts vary daily and EPA wanted to incorporate these variations in the calculations of long term averages and limitations. Pollutants excluded from regulation for the selected subcategory options because they were not detected at treatable levels are presented in Table 7-1.

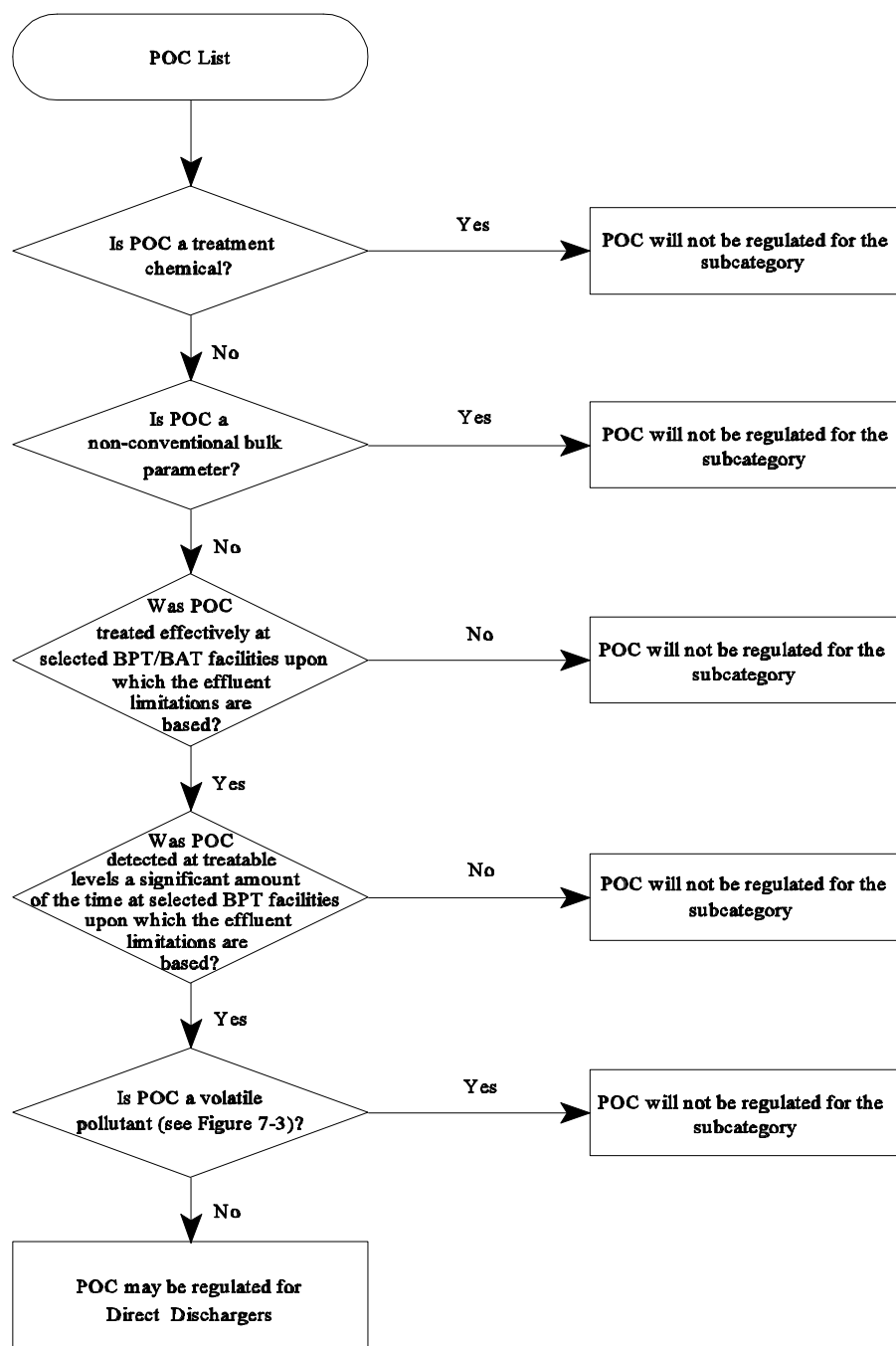


Figure 7-1. Selection of Pollutants That May Be Regulated for Direct Discharges for Each Subcategory

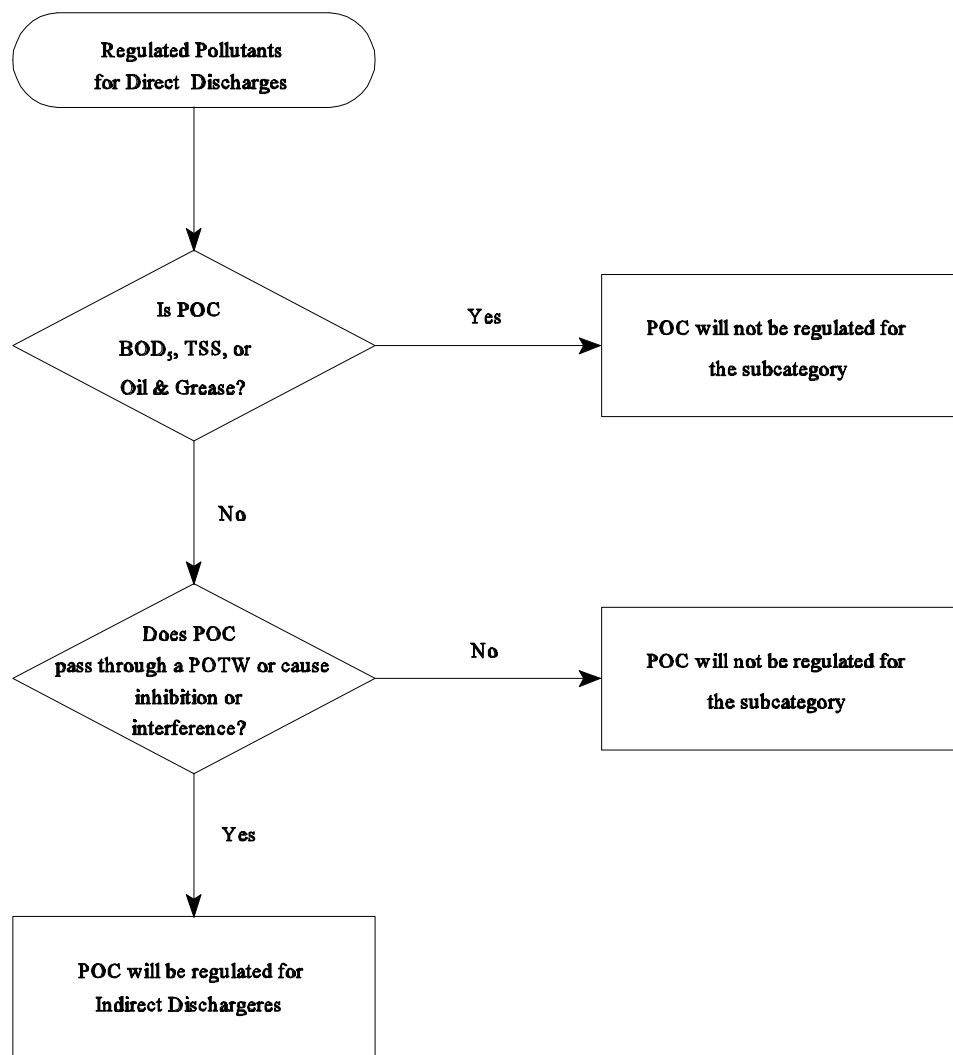


Figure 7-2. Selection of Pollutants to be Regulated for Indirect Discharges for Each Subcategory

Table 7.1 Pollutants Not Detected At Treatable Levels

Metals Option 3	Metals Option 4	Oils Option 8	Oils Option 9	Organics Option 3/4
Amenable cyanide	Amenable cyanide	Amenable cyanide	Amenable cyanide	Amenable cyanide
SGT-HEM	SGT-HEM	Beryllium	Beryllium	Oil & Grease
Total cyanide	Arsenic ¹	Germanium	Germanium	Arsenic
Oil & Grease ²	Barium	Lutetium	Lutetium	Barium
Barium	Beryllium	Silver	Silver	Iodine
Gallium	Gallium	Vanadium	Vanadium	Lead
Indium	Indium	Aniline	Aniline	Titanium
Iodine	Iodine	Benzyl alcohol	n-Hexacosane	Bromodichloromethane
Iridium	Neodymium	Diphenyl ether	n-Tetracosane	Carbon disulfide
Lithium	Niobium	n-Hexacosane	n,n-Dimethylformamide	Chlorobenzene
Neodymium	Osmium	n-Tetracosane	1,4-dioxane	Diethyl ether
Niobium	Tantalum	n,n-Dimethylformamide		Ethane, Pentachloro-
Osmium	Tellurium	o-Cresol		Hexachloroethane
Strontium	Thallium	1,4-dioxane		Isophorone
Tantalum	Benzyl alcohol	2-phenylnaphthalene		o+p-Xylene
Tellurium	Bis(2-ethylhexyl) phthalate	2,3-benzofluorene		1,1,2,2-tetrachloroethane
Zirconium	Carbon disulfide	2,4-dimethylphenol		1,2-dichlorobenzene
Benzoic acid	Hexanoic Acid	3,6-dimethylphenanthrene		1,3-dichloropropane
Benzyl alcohol	Methylene chloride	4-chloro-3-methylphenol		2-picoline
Bis(2-ethylhexyl) phthalate				2,4-dimethylphenol
Bromodichloromethane				3,4,5-trichlorocatechol
Carbon disulfide				3,4,6-trichloroguaiacol

Table 7.1 Pollutants Not Detected At Treatable Levels

Metals Option 3	Metals Option 4	Oils Option 8	Oils Option 9	Organics Option 3/4
Chloroform				3,6-dichlorocatechol
Dibromochloromethane				4-chlorophenol
Hexanoic Acid				4,5-dichloroguaiacol
Methylene chloride				4,5,6-trichloroguaiacol
n-Nitrosomorpholine				5-chloroguaiacol
n,n-Dimethylformamide				6-chlorovanillin
Pyridine				
Tribromomethane				
Trichloroethene				
Tripropyleneglycol methyl ether				
2-Butanone				
2-Propanone				

¹ While arsenic was not detected at treatable levels at the facility forming the basis of Metals Option 4, EPA is transferring data from single stage precipitation and regulating arsenic for Metals Option 4.

² While oil and grease was not detected at treatable levels at the facility forming the basis of Metals Option 3, EPA is transferring data from Metals Option 4 and proposing regulation of Oil & Grease for Metals Option 3.

POLLUTANTS NOT TREATED**7.4**

EPA excluded all pollutants for which the selected technology option was ineffective (i.e., pollutant concentrations remained the same or increased across the treatment system). For the oils subcategory option 8, phenol and 2-propanone were ineffectively treated, and for the oils subcategory option 9, 2-propanone and 2,4-dimethylphenol were not treated effectively. For the organics subcategory, the selected treatment technology did not effectively treat boron, chromium, lithium, nickel, and tin. For the metals subcategory options, with the exception of selenium (for Option 3), all pollutants of concern were effectively treated.

VOLATILE POLLUTANTS**7.5**

EPA detected volatile organic pollutants in the waste receipts of all three subcategories. For this rule, EPA defines a volatile pollutant as a pollutant which has a Henry's Law constant in excess of 10^{-4} atm m³ mol⁻¹. Table 7-2 lists the organic pollutants (those analyzed using method 1624 or 1625) by subcategory along with their Henry's Law constant. For pollutants in the oils subcategory, the solubility in water was reported in addition to the Henry's Law constant to determine whether volatile pollutants remained in the oil-phase or volatilized from the aqueous phase. If no data were available on the Henry's Law constant or solubility for a particular pollutant, then the pollutant was assigned an average pollutant group value. Pollutant groups were developed by combining pollutants with similar structures. If no data were available for any pollutant in the group, then all pollutants in the group were not considered volatile. The assignment of pollutant groups is discussed in more detail in Section 7.6.2.

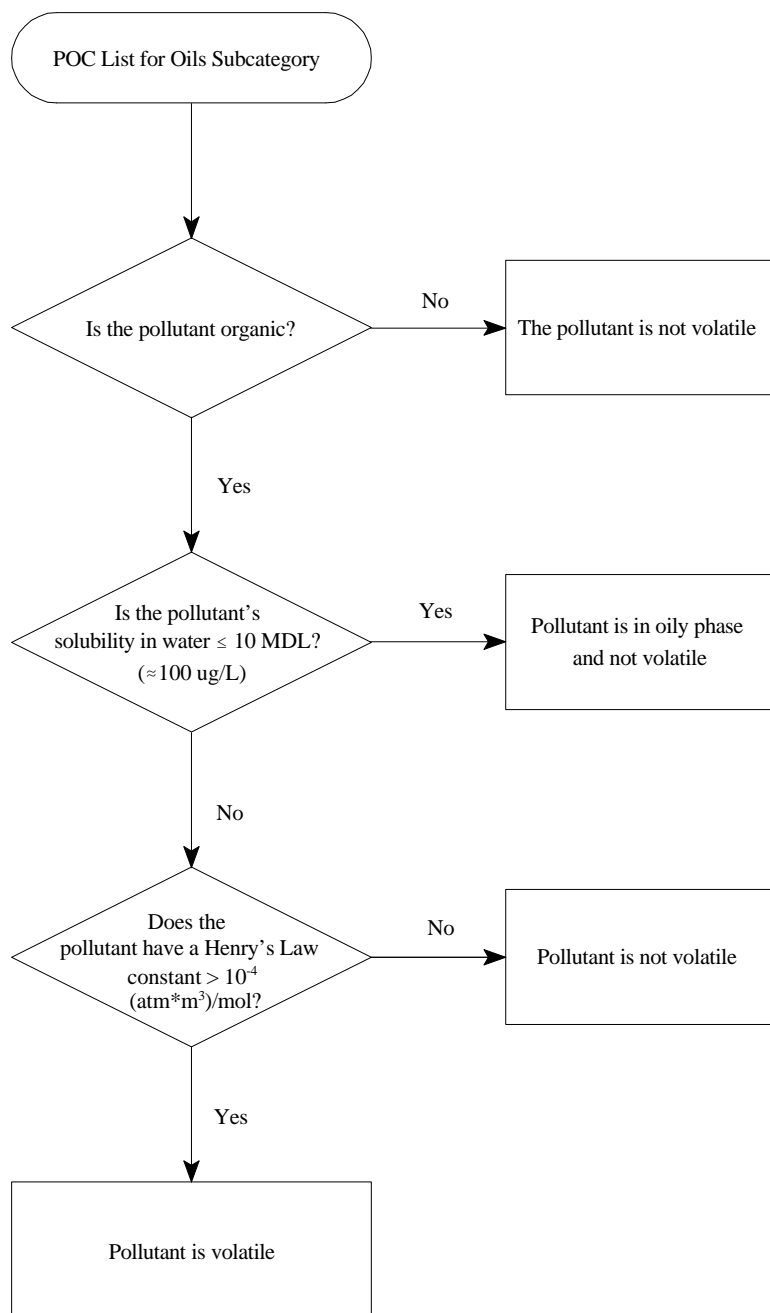


Figure 7-3. Determination of Volatile Pollutants for Oils Subcategory

Table 7.2. Volatile Organic Pollutant Properties By Subcategory

Organic Pollutant	CAS #	Method	Subcategory			Henry's Law Constant $\frac{atm * m^3}{mol}$	Solubility (mg/L)	Solubility Ref. and Temp.	Pollutant Group	Volatile ?	Volatile for Oils?
			Metals	Oils	Organics						
1-methylfluorene	1730376	1625		X		4.26E-03	1.81E+04			yes	yes
1-methylphenanthrene	832649	1625		X		>E-04	1.21E+03		Group DD	yes	yes
1,1-dichloroethane	75343	1624			X	5.50E-03				yes	
1,1-dichloroethene	75354	1624		X	X	1.90E-01	2.10E+02	25		yes	yes
1,1,1-trichloroethane	71556	1624		X	X	3.00E-02	4.40E+03	20		yes	yes
1,1,1,2-tetrachloroethane	630206	1624			X	3.00E-02				yes	
1,1,2-trichloroethane	79005	1624			X	1.20E-03				yes	
1,2-dibromoethane	106934	1624			X	2.00E-02				yes	
1,2-dichloroethane	107062	1624		X	X	9.14E-04	8.69E+03	20		yes	yes
1,2,3-trichloropropane	96184	1624			X	2.10E-04				yes	
1,2,4-trichlorobenzene	120821	1625		X		2.30E-03	1.90E+01	22		yes	yes
1,4-dichlorobenzene	106467	1625		X		3.10E-03	7.90E+01	25		yes	yes
2-butanone	78933	1624	X	X	X	2.70E-05	2.75E+05			no	no
2-methylnaphthalene	91576	1625		X		7.98E-04	2.60E+01	25		yes	yes
2-phenylnaphthalene	612902	1625		X		>E-04	1.21E+03		Group DD	yes	yes
2-propanone	67641	1624	X		X	2.10E-05				no	
2,3-benzofluorene	243174	1625		X		>E-04	1.21E+03		Group DD	yes	yes
2,3-dichloroaniline	608275	1625			X	<E-04				no	
2,3,4,6-tetrachlorophenol	58902	1625			X	3.00E-04				yes	
2,4,5-trichlorophenol	95954	1625			X	2.20E-04				yes	
2,4,6-trichlorophenol	88062	1625			X	4.00E-06				no	
3,4-dichlorophenol	95772	1625			X	>10E-4					

Table 7.2. Volatile Organic Pollutant Properties By Subcategory

Organic Pollutant	CAS #	Method	Subcategory			Henry's Law Constant $\frac{atm * m^3}{mol}$	Solubility (mg/L)	Solubility Ref. and Temp.	Pollutant Group	Volatile ?	Volatile for Oils?
			Metals	Oils	Organics						
3,5-dichlorophenol	591355	1625			X	>10E-4					
3,6-dimethylphenanthrene	1576676	1625		X		>E-04	1.21E+03		Group DD	yes	yes
4-chloro-3-methylphenol	59507	1625		X		2.50E-06	3.85E+03	20		no	no
4-methyl-2-pentanone	108101	1624		X	X	3.80E-04	1.91E+04			yes	yes
Acenaphthene	83329	1625		X		9.10E-05	3.42E+00	25		no	no
Acetophenone	98862	1625			X	<E-04	5.50E+03			no	
Alpha-terpineol	988555	1625		X		6.90E-05				no	no
Ammonia-N	7664417	350.2	X	X	X						
Aniline	62533	1625			X	<E-04			Group J	no	
Anthracene	120127	1625		X		8.60E-05	1.29E+00	25		no	no
Benzene	71432	1624		X	X	5.50E-03	1.78E+03	20		yes	yes
Benzo (a) anthracene	56553	1625		X		1.00E-06	1.00E-02	24		no	no
Benzo (a) pyrene	50328	1625		X		4.90E-07	3.80E-03	25		no	no
Benzo (b) fluoranthene	205992	1625		X		1.22E-05	1.37E-02			no	no
Benzo (k) fluoranthene	207089	1625		X		3.87E-05	1.37E-02			no	no
Benzoic acid	65850	1625	X	X	X	7.00E-08	2.90E+03	20		no	no
Benzyl alcohol	100516	1625		X		1.10E+00	3.50E+04	20		yes	yes
Biphenyl	92524	1625		X		4.80E-04	7.50E+00	25		yes	yes
Bis(2-ethylhexyl)phthalate	117817	1625		X		3.00E-07	1.30E+00	25		no	no
Bromodichloromethane	75274	1624	X			2.10E-03				yes	
Butyl benzyl phthalate	85687	1625		X		8.30E-06	2.90E+00			no	no
Carbazole	86748	1625		X		<E-04			Group J	no	no

Table 7.2. Volatile Organic Pollutant Properties By Subcategory

Organic Pollutant	CAS #	Method	Subcategory			Henry's Law Constant $\frac{atm * m^3}{mol}$	Solubility (mg/L)	Solubility Ref. and Temp.	Pollutant Group	Volatile ?	Volatile for Oils?
			Metals	Oils	Organics						
Carbon disulfide	75150	1624		X		1.20E-02	2.90E+03	20		yes	yes
Chlorobenzene	108907	1624		X		3.58E-03	4.88E+02	25		yes	yes
Chloroform	67663	1624	X	X	X	2.88E-03	9.30E+03	25		yes	yes
Chrysene	218019	1625		X		1.50E-06	6.00E-03	25		no	no
Dibenzofuran	132649	1625		X		>E-04	1.00E+01			no	no
Dibenzothiophene	132650	1625		X		4.40E-04	soluble		Group II	no	no
Dibromochloromethane	124481	1624	X			>E-04				yes	
Diethyl ether	60297	1624			X						
Diethyl phthalate	132650	1625		X		1.20E-06	8.96E+02			no	no
Dimethyl sulfone	67710	1625			X	>E-04	very soluble			no	
Di-n-butyl phthalate	84742	1625		X		2.80E-07	4.00E+02	25		no	no
Diphenyl ether	101848	1625		X		6.60E-03	2.10E+01	25		yes	yes
Ethyl benzene	100414	1624		X		6.60E-03	1.52E+02	20		yes	yes
Ethylenethiourea	96457	1625			X	>E-04			Group I	no	
Fluoranthene	206440	1625		X		6.50E-06	2.65E-01	25		no	no
Fluorene	86737	1625		X		6.40E-05	1.90E+00	25		no	no
Hexanoic Acid	142621	1625		X	X	1.90E+00	1.10E+04			yes	yes
Methylene chloride	75092	1624		X	X	2.30E-03	1.67E+04	25		yes	yes
m-Xylene	108383	1624		X	X	1.10E-02	2.00E+02			yes	yes
Naphthalene	91203	1625		X		4.60E-04	3.00E+01	25		yes	yes
N-decane	124185	1625		X		7.14E+00	9.00E-03			yes	no

Table 7.2. Volatile Organic Pollutant Properties By Subcategory

Organic Pollutant	CAS #	Method	Subcategory			Henry's Law Constant $\frac{atm * m^3}{mol}$	Solubility (mg/L)	Solubility Ref. and Temp.	Pollutant Group	Volatile ?	Volatile for Oils?
			Metals	Oils	Organics						
n-Docosane	629970	1625		X		>E-04	4.78E-03		Group CC	yes	no
n-Dodecane	112403	1625		X		>E-04	4.78E-03		Group CC	yes	no
n-Eicosane	112958	1625		X		>E-04	4.78E-03		Group CC	yes	no
n-Hexadecane	544763	1625		X		>E-04	9.00E-04	25		yes	no
n-Nitrosomorpholine	59892	1625	X			>E-04			Group I	no	
n-Octadecane	593453	1625		X		>E-04	7.00E-03	25		yes	no
n-Tetradecane	629594	1625		X		>E-04	2.20E-03	25		yes	no
n,n-Dimethylformamide	68122	1625	X		X	<E-04				no	
o-Cresol	95487	1625		X	X	1.60E-06	3.10E+04			no	no
o+p-Xylene	136777612	1624		X		7.00E-03	1.87E+02	20		yes	yes
p-Cresol	106445	1625		X	X	9.60E-07	2.40E+04	40		no	no
p-Cymene	99876	1625		X		>E-04	3.40E+02			yes	yes
Pentachlorophenol	87865	1625			X	2.80E-06				no	
Pentamethylbenzene	700129	1625		X		>E-04	4.96E+02		Group K	yes	yes
Phenanthrene	85018	1625		X		2.26E-04	8.16E-01	21		yes	yes
Phenol	108952	1625		X	X	4.54E-07	8.00E+04	25		no	no
Pyrene	129000	1625		X		5.10E-06	1.60E-01	26		no	no
Pyridine	110861	1625	X	X	X	2.10E-06	3.88E+05			no	no
Styrene	100425	1625		X		2.80E-03	3.00E+02	20		yes	yes
Tetrachloroethene	127184	1624		X	X	1.53E-03	1.50E+02	25		yes	yes
Tetrachloromethane	56235	1624			X	2.90E-02				yes	
Toluene	108883	1624		X	X	6.66E-03	5.15E+02	20		yes	yes

Table 7.2. Volatile Organic Pollutant Properties By Subcategory

Organic Pollutant	CAS #	Method	Subcategory			Henry's Law Constant $\frac{atm * m^3}{mol}$	Solubility (mg/L)	Solubility Ref. and Temp.	Pollutant Group	Volatile ?	Volatile for Oils?
			Metals	Oils	Organics						
Trans-1,2-dichloroethene	156605	1624			X	5.30E-03				yes	
Tribromomethane	75252	1624	X			5.30E-04				yes	
Trichloroethene	79016	1624	X	X	X	9.10E-03	1.10E+03	25		yes	yes
Tripropyleneglycol methyl ether	20324338	1625	X	X		>E-04			Group GG	no	no
Vinyl chloride	75014	1624			X	2.80E-02				yes	

As shown in Table 7-2, volatile pollutants were regularly detected at treatable levels in waste receipts from CWT facilities, particularly in the oils and organics subcategory. However, treatment technologies currently used at many of these facilities, while removing the pollutants from the wastewater, do not “treat” the volatiles. The volatile pollutants are simply transferred to the air. For example, in the metals subcategory, wastewater treatment technologies are generally based on chemical precipitation, and the removal of volatile pollutants from wastewater following treatment with chemical precipitation is due to volatilization. Some CWT facilities recognize that volatilization may be occurring and have installed air stripping systems equipped with emissions control to effectively remove the pollutants from both the water and the air.

EPA evaluated various wastewater treatment technologies during the development of this rule. These technologies were considered because of their efficacy in removing pollutants from wastewater. Since EPA is concerned about removing pollutants from all environmental media, EPA also evaluated wastewater treatment trains for the oils and organics subcategories which included air stripping with emissions control.

EPA is not proposing to regulate any predominantly volatile parameters. The non-regulated volatile parameters for the metals, organics, and oils subcategory options that were not already excluded as detailed in Sections 7.1, 7.2, 7.3, and 7.4 are presented in Table 7-3. Unlike the metals and the organics subcategories, for the oils subcategory, volatilization can not be predicted using the Henry’s Law constant only. Henry’s Law constants are established for pollutants in an aqueous phase only. For other non-aqueous single phase or two-phase systems (such as oil-water), other volatilization constants apply. Estimating these constants in oil-water mixtures can lead to engineering calculations

which are generally based on empirical data. EPA chose an approach which is depicted in Figure 7-3 and discussed below.

First, EPA reviewed water solubility data to estimate whether the organic pollutants would be primarily in an oil phase or aqueous phase. For pollutants which have a solubility less than ten times the minimum analytical detection limit (the same edit used to determine pollutants of concern and long term averages), EPA assumed that the amount of pollutants in the aqueous phase would be negligible and that all of the pollutant would be primarily in an oil phase. For pollutants which have a solubility greater than ten times the minimum analytical detection limit, EPA assumed that the amount of pollutant in the oil phase would be negligible and that all of the pollutant would be primarily in an aqueous phase. For pollutants determined to be in an aqueous phase, EPA then reviewed the Henry’s law constant in the same manner as the other two subcategories. For pollutants determined to be in an oil phase, EPA assumed that volatilization would be negligible (regardless of their volatility in the aqueous phase) and has not categorized them as volatile pollutants.

Even though EPA has not regulated volatile pollutants through this rulemaking, EPA encourages all facilities which accept waste receipts containing volatile pollutants to incorporate air stripping with overhead recovery into their wastewater treatment systems. EPA also notes that CWT facilities determined to be major sources of hazardous air pollutants are subject to maximum achievable control technology (MACT) as promulgated for off-site waste and recovery operations on July 1, 1996 (61FR34140) as 40 CFR Part 63.

Table 7-3. Non-Regulated Volatile Organic Pollutants by Subcategory and Option

Metals Option 3	Metals Option 4	Organics Option 3/4	Oils Option 8	Oils Option 9
Ammonia-N	Ammonia-N	1,1,1,2-tetrachloroethane	1-methylfluorene	1-methylfluorene
Carbon disulfide	Bromodichloromethane	1,1,1-trichloroethane	1-methylphenanthrene	1-methylphenanthrene
	Chloroform	1,1,2-trichloroethane	1,1,1-trichloroethane	1,1,1-trichloroethane
	Dibromochloromethane	1,1-dichloroethane	1,1-dichloroethene	1,1-dichloroethene
	n-Nitrosomorpholine	1,1-dichloroethene	1,2-dichloroethane	1,2-dichloroethane
	n,n-Dimethylformamide	1,2,3-trichloropropane	1,2,4-trichlorobenzene	1,2,4-trichlorobenzene
	Tribromomethane	1,2-dibromoethane	1,4-dichlorobenzene	1,4-dichlorobenzene
	Trichloroethene	1,2-dichloroethane	2-methylnaphthalene	2-methylnaphthalene
	Tripropyleneglycol methyl ether	2,3,4,6-tetrachlorophenol	4-methyl-2-pentanone	2-phenylnaphthalene
		2,4,5-trichlorophenol	Ammonia-N	2,3-benzofluorene
		3,4-dichlorophenol	Benzene	3,6-dimethylphenanthrene
		3,5-dichlorophenol	Biphenyl	4-methyl-2-pentanone
		4-methyl-2-pentanone	Carbon disulfide	Ammonia-N
		Ammonia-N	Chlorobenzene	Benzene
		Benzene	Chloroform	Benzyl alcohol
		Chloroform	Dibenzofuran	Biphenyl
		Dimethyl sulfone	Dibenzothiopene	Carbon disulfide
		Ethylenethiourea	Ethyl benzene	Chlorobenzene
		Hexanoic Acid	Hexanoic Acid	Chloroform
		Methylene chloride	Methylene chloride	Dibenzofuran
		m-Xylene	m-Xylene	Dibenzothiopene
		Tetrachloroethene	Naphthalene	Diphenyl ether
		Toluene	o+p-Xylene	Ethyl benzene
		Trans-1,2-dichloroethene	p-Cymene	Hexanoic Acid
		Trichloroethene	Pentamethylbenzene	Methylene chloride
		Vinyl chloride	Phenanthrene	m-Xylene
			Styrene	Naphthalene
			Tetrachloroethene	o+p-Xylene
			Toluene	p-Cymene
			Trichloroethene	Pentamethylbenzene
			Tripropyleneglycol methyl ether	Phenanthrene
				Styrene
				Tetrachloroethene
				Toluene
				Trichloroethene
				Tripropyleneglycol methyl ether

**POLLUTANTS SELECTED FOR
PRETREATMENT STANDARDS AND
PRETREATMENT STANDARDS FOR NEW
SOURCES (INDIRECT DISCHARGERS) 7.6
Background 7.6.1**

Unlike direct dischargers whose wastewater will receive no further treatment once it leaves the facility, indirect dischargers send their wastewater streams to a POTW for further treatment. Therefore, for indirect dischargers, before proposing pretreatment standards, EPA examines whether the pollutants discharged by the industry “pass through” a POTW to waters of the U.S. or interfere with the POTW operation or sludge disposal practices. Generally, to determine if pollutants pass through a POTW, EPA compares the percentage of the pollutant removed by well-operated POTWs achieving secondary treatment with the percentage of the pollutant removed by facilities meeting BAT effluent limitations. A pollutant is determined to “pass through” a POTW when the average percentage removed by a well-operated POTW is less than the percentage removed by direct dischargers complying with BPT/BAT effluent limitations. In this manner, EPA can ensure that the combined treatment at indirect discharging facilities and POTWs is at least equivalent to that obtained through treatment by a direct discharger.

This approach to the definition of pass-through satisfies two competing objectives set by Congress: (1) that standards for indirect dischargers be equivalent to standards for direct dischargers, and (2) that the treatment capability and performance of the POTW be recognized and taken into account in regulating the discharge of pollutants from indirect dischargers. Rather than compare the mass or concentration of pollutants discharged to the POTW with the mass or concentration of pollutants discharged by a BAT facility, EPA compares the percentage of the pollutants removed by the facility with the POTW removal. EPA takes this approach

because a comparison of the mass or concentration of pollutants in a POTW effluent with pollutants in a BAT facility’s effluent would not take into account the mass of pollutants discharged to the POTW from non-industrial sources, nor the dilution of the pollutants in the POTW effluent to lower concentrations from the addition of large amounts of non-industrial water.

For specific pollutants, such as volatile organic compounds, EPA may use other means to determine pass-through. Generally, for volatile compounds, a volatile override test based on the Henry’s Law constant is used to determine pass-through. The volatile override test is applied where the overall percent removal estimated for a well-operated POTW substantially includes emission of the pollutant to the air rather than actual treatment. Therefore, for volatile pollutants, even though the POTW percent removal data indicate that the pollutant would not pass through, regulation of the pollutant is warranted to ensure “treatment” of the pollutant.

As detailed in Section 7.5, for all three subcategories, EPA selected technology options which are not designed to control the emission of volatile pollutants. Therefore, for the selected options, removal of volatile pollutants from wastewater is largely due to the emission of the pollutant rather than treatment. As such, for this rulemaking, EPA believes the volatile override test is inappropriate and has determined pass-through solely by comparing percent removals.

In selecting the regulated pollutants under the pretreatment standards, EPA starts with the pollutants regulated for direct dischargers under BPT/BAT. For pretreatment standards, EPA then excludes three conventional parameters, BOD₅, total suspended solids (TSS), and oil and grease (measured as HEM) from further consideration without conducting the percent removal comparison because POTWs are designed to treat these parameters. Therefore, for this rulemaking, EPA evaluated 23 pollutants for

metals option 3, 31 pollutants for metals option 4, 51 pollutants for oils option 9, and 23 pollutants for Organics Option 4 for possible PSES and PSNS regulation. The following sections describe the methodology used in determining percent removals for the option technologies, percent removals for a “well-operated” POTW, and the results of EPA’s pass-through analysis.

Determination of Percent Removals for Well-Operated POTWs

7.6.2

The primary source of the POTW percent removal data was the “Fate of Priority Pollutants in Publicly Owned Treatment Works” (EPA 440/1-82/303, September 1982), commonly referred to as the “50-POTW Study”. However, the 50-POTW Study did not contain data for all pollutants for which the pass-through analysis was required. Therefore, EPA obtained additional data from EPA’s National Risk Management Research Laboratory’s (NRMRL) Treatability Database (formerly called the Risk Reduction Engineering Laboratory (RREL) Treatability Database). These sources and their uses are discussed below.

The 50-POTW Study presents data on the performance of 50 well-operated POTWs achieving secondary treatment in removing toxic pollutants. The work performed with this database included some data editing criteria. Because the data collected for evaluating POTW removals included influent levels that were close to the detection limit, EPA devised the data editing hierarchical rules to eliminate low influent concentration levels, thereby minimizing the possibility that low POTW removals might simply reflect low influent concentrations instead of being a true measure of treatment effectiveness. The hierarchical data editing rules for the 50-POTW Study were as follows: 1) detected pollutants must have at least three pairs (influent/effluent) of data points to be included,

2) average pollutant influent levels less than 10 times the pollutant minimum analytical detection limit were eliminated, along with the corresponding effluent values, and 3) if none of the average pollutant influent concentrations exceeded 10 times the minimum analytical detection limit, then the average influent values less than 20 ug/L were eliminated, along with the corresponding effluent values. EPA then calculated each POTW percent removal for each pollutant based on its average influent and its average effluent values. The POTW percent removal used for each pollutant in the pass-through test is the median value of all the POTW pollutant specific percent removals.

EPA’s NRMRL Treatability Database provides information, by pollutant, on removals obtained by various treatment technologies. The database provides the user with the specific data source and the industry from which the wastewater was generated. EPA used the NRMRL database to supplement the treatment information provided in the 50-POTW Study when there was insufficient information on specific pollutants. For each of the pollutants of concern not found in the 50-POTW database, EPA obtained data from portions of the NRMRL database. EPA then edited these files so that only treatment technologies representative of typical POTW secondary treatment operations (activated sludge, activated sludge with filtration, aerobic lagoons) were used. EPA further edited these files to include information pertaining only to domestic or industrial wastewater. EPA used pilot-scale and full-scale data only, and eliminated any bench-scale data. EPA retained data from papers in a peer-reviewed journal or government report, but edited out lesser quality references, such as reports which were not reviewed. Zero and negative percent removals were eliminated, as well as data with less than two pairs of influent/effluent data points. Finally, EPA calculated the average percent

removal for each pollutant from the remaining pollutant removal data.

EPA selected the final percent removal for each pollutant based on a data hierarchy, which was related to the quality of the data source. The following data source hierarchy was used for selecting a percent removal for a pollutant: 1) if available, the median percent removal from the 50-POTW Study was chosen using all POTWs data with influent levels greater than or equal to 10 times the pollutant minimum analytical detection limit, 2) if not available, the median percent removal from the 50-POTW Study was chosen using all POTWs data with influent levels greater than 20 ug/L, 3) if not available, the average percent removal from the NRMRL Treatability Database was chosen using only domestic wastewater, 4) if not available, the average percent removal from the NRMRL Treatability Database was chosen using domestic and industrial wastewater, and finally 5) a pollutant was assigned an average group percent removal, or “generic” removal if no other data was available. Pollutant groups were developed by combining pollutants with similar chemical structures. (A complete list of pollutants and pollutant groupings are available in Appendix A). EPA calculated the average group percent removal by using all pollutants in the group with selected percent removals from either the 50-POTW Study or the NRMRL Treatability Database. EPA then averaged percent removals together to determine the average group percent removal. Pollutant groups and generic removals used in the pass-through analysis are presented in Table 7-4. Only groups A, J, and CC are presented in Table 7-4 since these are the only groups for which EPA assigned a pollutant an average group percent removal in its pass-through analysis. The final POTW percent removal assigned to each pollutant is presented in Table 7-5, along with the source and data hierarchy of each removal.

Table 7.4 CWT Pass-Through Analysis Generic POTW Percent Removals

Pollutant	CAS NO.	% Removal	Source
Group A: Metals			
Barium	7440393	27.66	50 POTW - 10 X NOMDL
Beryllium	7440417	61.23	RREL 5 - (ALL WW)
Cadmium	7440439	90.05	50 POTW - 10 X NOMDL
Chromium	7440473	91.25	50 POTW - 10 X NOMDL
Cobalt	7440484	6.11	50 POTW - 10 X NOMDL
Copper	7440508	84.11	50 POTW - 10 X NOMDL
Iridium	7439885	74.00	RREL 5 - (ALL WW)
Lead	7439921	91.83	50 POTW - 10 X NOMDL
Lithium	7439932	26.00	RREL 5 (ALL WW)
Manganese	7439965	40.60	RREL 5 - (ALL WW)
Mercury	7439976	90.16	50 POTW - 10 X NOMDL
Molybdenum	7439987	52.17	RREL 5 - (DOM WW)
Nickel	7440020	51.44	50 POTW - 10 X NOMDL
Silver	7440224	92.42	50 POTW - 10 X NOMDL
Strontium	7440246	14.83	RREL 5 - (DOM WW)
Thallium	7440280	53.80	RREL 5 - (ALL WW)
Tin	7440315	65.20	RREL 5 - (ALL WW)
Titanium	7440326	68.77	RREL 5 - (ALL WW)
Vanadium	7440622	42.28	RREL 5 - (ALL WW)
Yttrium	7440655	57.93	RREL 5 - (ALL WW)
Zinc	7440666	77.97	50 POTW - 10 X NOMDL
Zirconium	7440177		Average Group Removal
Average Group Removal		60.00	

Pollutant	CAS NO.	% Removal	Source
Group J: Anilines			
Aniline	62533	62.00	RREL 5 - (ALL WW)
Carbazole	86748		Average Group Removal
Average Group Removal		62.00	

Pollutant	CAS NO.	% Removal	Source
Group CC: n-Paraffins			
n-Decane	124185	9.00	RREL 5 - (ALL WW)
n-Docosane	629970	88.00	RREL 5 - (ALL WW)
n-Dodecane	112403	95.05	RREL 5 - (ALL WW)
n-Eicosane	112958	92.40	RREL 5 - (ALL WW)
n-Hexacosane	630013		Average Group Removal
n-Hexadecane	544763		Average Group Removal
n-Octadecane	593453		Average Group Removal
n-Tetradecane	629594		Average Group Removal
Average Group Removal		71.11	

Table 7.5 Final POTW Percent Removals

Pollutant	Metals	Oils	Organics	CAS NO.	Percent Removal	Source
CLASSICAL						
Ammonia as N	X	X	X	766417	40.85	50 POTW - 10 X NOMDL
BOD ₅	X	X	X	C-002	91.32	50 POTW - 10 X NOMDL
Hexavalent Chromium	X			18540299	5.68	50 POTW - 10 X NOMDL
Oil + Grease	X	X		C-007	81.41	50 POTW - 10 X NOMDL
Total Cyanide	X	X	X	57125	70.44	50 POTW - 10 X NOMDL
Total Suspended Solids	X	X	X	C-009	90.29	50 POTW - 10 X NOMDL
METALS						
Antimony	X	X	X	7440360	71.13	50 POTW - 10 X NOMDL
Arsenic		X		7440382	90.89	50 POTW - 10 X NOMDL
Barium		X		7440393	27.66	50 POTW - 10 X NOMDL
Beryllium	X			7440417	61.23	RREL 5 - (ALL WW)
Boron	X	X		7440428	20.04	50 POTW - >20 PPB
Cadmium	X	X		7440439	90.05	50 POTW - 10 X NOMDL
Chromium	X	X		7440473	91.25	50 POTW - 10 X NOMDL
Cobalt	X	X	X	7440484	6.11	50 POTW - >20 PPB
Copper	X	X	X	7440508	84.11	50 POTW - 10 X NOMDL
Iridium	X			7439885	74.00	RREL 5 - (ALL WW)
Lead	X	X		7439921	91.83	50 POTW - 10 X NOMDL
Lithium	X			7439932	26.00	RREL 5 - (ALL WW)
Manganese	X	X	X	7439965	40.60	RREL 5 - (ALL WW)
Mercury	X	X		7439976	90.16	50 POTW - 10 X NOMDL
Molybdenum	X	X	X	7439987	52.17	RREL 5 - (DOM WW)
Nickel	X	X		7440020	51.44	50 POTW - 10 X NOMDL
Selenium	X	X		7782492	34.33	RREL 5 - (DOM WW)
Silicon	X	X	X	7440213	27.29	RREL 5 - (ALL WW)
Silver	X			7440224	92.42	50 POTW - 10 X NOMDL
Strontium	X	X	X	7440246	14.83	RREL 5 - (DOM WW)
Thallium	X			7440280	53.80	RREL 5 - (ALL WW)
Tin	X	X		7440315	65.20	RREL 5 - (ALL WW)
Titanium	X	X		7440326	68.77	RREL 5 - (ALL WW)
Vanadium	X			7440622	42.28	RREL 5 - (ALL WW)
Yttrium	X			7440655	57.93	RREL 5 - (ALL WW)
Zinc	X	X	X	7440666	77.97	50 POTW - 10 X NOMDL
Zirconium	X			7440677	60.00	Generic Removal-Group A
ORGANICS						
2-butanone	X	X	X	78933	96.60	RREL 5 - (DOM WW)
2-propanone	X		X	67641	83.75	RREL 5 - (ALL WW)
2,3-dichloroaniline			X	608275	41.00	RREL 5 - (ALL WW)

Table 7.5 Final POTW Percent Removals

Pollutant	Metals	Oils	Organics	CAS NO.	Percent Removal	Source
2,4,6-trichlorophenol			X	88062	65.00	RREL 5 - (ALL WW)
4-chloro-3-methylphenol		X		59507	63.00	RREL 5 - (ALL WW)
Acenaphthene		X		83329	98.29	50 POTW - 10 X NOMDL
Acetophenone			X	98862	95.34	RREL 5 - (ALL WW)
Alpha-terpineol		X		988555	94.40	RREL 5 - (ALL WW)
Aniline			X	62533	62.00	RREL 5 - (ALL WW)
Anthracene		X		120127	95.56	50 POTW - 10 X NOMDL
Benzo (a) anthracene		X		56553	97.50	RREL 5 - (DOM WW)
Benzo (a) pyrene		X		50328	95.20	RREL 5 - (ALL WW)
Benzo (b) fluoranthene		X		205992	95.40	RREL 5 - (ALL WW)
Benzo (k) fluoranthene		X		207089	94.70	RREL 5 - (ALL WW)
Benzoic Acid	X	X	X	65850	80.50	RREL 5 - (ALL WW)
Bis(2-ethylhexyl) phthalate		X		117817	59.78	50 POTW - 10 X NOMDL
Butyl benzyl phthalate		X		85687	94.33	50 POTW - 10 X NOMDL
Carbazole		X		86748	62.00	Generic Removal-Group J
Chrysene		X		218019	96.90	RREL 5 - (DOM WW)
Diethyl phthalate		X		84662	59.73	50 POTW - > 20 PPB
Di-n-butyl phthalate		X		84742	79.31	50 POTW - > 20 PPB
Fluoranthene		X		206440	42.46	50 POTW - > 20 PPB
Fluorene		X		86737	69.85	50 POTW - > 20 PPB
n-Decane		X		124185	9.00	RREL 5 - (ALL WW)
n-Docosane		X		629970	88.00	RREL 5 - (ALL WW)
n-Dodecane		X		112403	95.05	RREL 5 - (ALL WW)
n-Eicosane		X		112958	92.40	RREL 5 - (ALL WW)
n-Hexadecane		X		544763	71.11	Generic Removal-Group CC
n-Octadecane		X		593453	71.11	Generic Removal-Group CC
n-Tetradecane		X		629594	71.11	Generic Removal-Group CC
n,n-Dimethylformamide	X		X	68122	84.75	RREL 5 - (ALL WW)
o-Cresol		X	X	95487	52.50	RREL 5 - (ALL WW)
p-Cresol		X	X	106445	71.67	RREL 5 - (ALL WW)
Pentachlorophenol			X	87865	13.88	50 POTW - >20 PPB
Phenol		X	X	108952	95.25	50 POTW - 10 X NOMDL
Pyrene		X		129000	83.90	RREL 5 - (DOM WW)
Pyridine	X	X	X	110861	95.40	RREL 5 - (ALL WW)

**Methodology for Determining
Treatment Technology
Percent Removals**

7.6.3

EPA calculated treatment percent removals for each selected BAT option using the data used to determine the option long term averages and limitations. Therefore, the data used to calculate treatment option percent removals was subjected to the same data editing criteria as the data used in calculating the long-term averages and limitations as described in Section 10. This editing included excluding the influent and effluent data for pollutants that were not detected in the influent at treatable levels, excluding data for pollutants which were not treated by the technology, and excluding data that were associated with process upsets.

After the data were edited, EPA used the following methodology to calculate percent removal:

- 1) For each pollutant and each sampled facility, EPA averaged the remaining influent data and effluent data to give an average influent concentration and an average effluent concentration, respectively.
- 2) EPA calculated percent removals for each pollutant and each sampling episode from the average influent and average effluent concentrations using the following equation:

$$\% \text{ Removal} = \frac{(\text{Avg Influent} - \text{Avg Effluent})}{\text{Average Influent}} \times 100$$

- 3) EPA calculated the median percent removal for each pollutant for each option from the facility-specific percent removals.

Pass-Through Analysis Results 7.6.4

The results of the Pass-Through Analysis are presented in Tables 7-6 through 7-9 by subcategory and treatment option.

**Pass-Through Analysis Results
for the Metals Subcategory 7.6.4.1**

For metals subcategory option 3, pass-through results are presented in Table 7-6. All pollutants analyzed passed through and may be regulated under PSES and PSNS. For metals subcategory option 4, pass-through results are presented in Table 7-7. All non-conventional pollutants analyzed passed through, and all metals passed through with the exception of molybdenum and zirconium. However, for organic pollutants analyzed, only benzoic acid passed through. All pollutants that passed through are regulated under PSES and PSNS.

Table 7.6 Final Pass-Through Results For Metals Subcategory Option 3

Pollutant Parameter	Option 3 Removal (%)	POTW Removal (%)	Pass-Through
CLASSICALS			
Hexavalent Chromium	93.36	5.68	yes
METALS			
Antimony	99.71	71.13	yes
Arsenic	99.77	90.89	yes
Beryllium	99.00	61.23	yes
Boron	75.15	20.04	yes
Cadmium	99.96	90.05	yes
Chromium	99.98	91.25	yes
Cobalt	99.59	6.11	yes
Copper	100.00	84.11	yes
Lead	99.67	91.83	yes
Manganese	99.99	40.60	yes
Mercury	99.80	90.16	yes
Molybdenum	88.20	52.17	yes
Nickel	99.87	51.44	yes
Selenium	92.66	34.33	yes
Silicon	99.75	27.29	yes
Silver	99.32	92.42	yes
Thallium	95.99	53.80	yes
Tin	99.83	65.20	yes
Titanium	99.76	68.77	yes
Vanadium	99.48	42.28	yes
Yttrium	94.25	57.93	yes
Zinc	99.99	77.97	yes

Table 7.7 Final Pass-Through Results For Metals Subcategory Option 4

Pollutant Parameter	Option 4 Removal (%)	Median POTW Removal (%)	Pass-Through
CLASSICALS			
Hexavalent Chromium	98.01	5.68	yes
Total Cyanide	97.07	70.44	yes
METALS			
Antimony	94.30	71.13	yes
Arsenic	91.71	90.89	yes
Boron	54.70	20.04	yes
Cadmium	99.97	90.05	yes
Chromium	99.91	91.25	yes
Cobalt	98.47	6.11	yes
Copper	99.91	84.11	yes
Iridium	99.69	74.00	yes
Lead	99.95	91.83	yes
Lithium	66.83	26.00	yes
Manganese	99.87	40.60	yes
Mercury	98.38	90.16	yes
Molybdenum	26.40	52.17	no
Nickel	99.59	51.44	yes
Selenium	57.54	34.33	yes
Silicon	98.58	27.29	yes
Silver	99.62	92.42	yes
Strontium	95.89	14.83	yes
Tin	99.94	65.20	yes
Titanium	99.84	68.77	yes
Vanadium	99.46	42.28	yes
Yttrium	95.39	57.93	yes
Zinc	99.93	77.97	yes
Zirconium	42.13	61.00	no
ORGANICS			
2-Butanone	74.72	96.60	no
2-Propanone	65.62	83.75	no
Benzoic Acid	82.99	80.50	yes
n,n-Dimethylformamide	54.81	84.75	no
Pyridine	48.49	95.40	no

Pass-Through Analysis Results for the Oils Subcategory

7.6.4.2

The final pass-through analysis results for the oils subcategory option 9 are presented in Table 7-8. Several metals and organic pollutants passed through, and therefore may be regulated under PSES and PSNS.

Table 7.8 Final Pass-Through Results For Oils Subcategory Option 9

Pollutant Parameter	Option 9 Removal (%)	Median POTW Removal (%)	Pass-Through
CLASSICALS			
Total Cyanide	64.38	70.44	no
METALS			
Antimony	87.99	71.13	yes
Arsenic	57.64	90.89	no
Barium	91.91	27.66	yes
Boron	33.01	20.04	yes
Cadmium	88.08	90.05	no
Chromium	86.24	91.25	no
Cobalt	52.20	6.11	yes
Copper	93.85	84.11	yes
Lead	88.26	91.83	no
Manganese	46.03	40.60	yes
Mercury	77.43	90.16	no
Molybdenum	53.73	52.17	yes
Nickel	41.24	51.44	no
Selenium	36.94	34.33	yes
Silicon	42.07	27.29	yes
Strontium	50.68	14.83	yes
Tin	90.78	65.20	yes
Titanium	89.99	68.77	yes
Zinc	78.25	77.97	yes
ORGANICS			
2-Butanone	15.41	96.60	no
4-chloro-3-methylphenol	27.48	63.00	no
Acenaphthene	96.75	98.29	no
Alpha-terpineol	94.77	94.40	yes
Anthracene	96.67	95.56	yes
Benzo (a) anthracene	95.70	97.50	no
Benzo (a) pyrene	96.27	95.20	yes
Benzo (b) flouranthene	95.92	95.40	yes
Benzo (k) fluoranthene	95.89	94.70	yes

Benzoic acid	19.32	80.50	no
Bis (2-ethylhexyl) phthalate	94.09	59.78	yes
Butyl benzyl phthalate	92.60	94.33	no
Carbazole	81.09	62.00	yes
Chrysene	97.22	96.90	yes
Di-n-butyl phthalate	88.07	79.31	yes
Diethyl phthalate	63.97	59.73	yes
Fluoranthene	96.43	42.46	yes
Fluorene	92.86	69.85	yes
n-Decane	94.98	9.00	yes
n-Docosane	96.87	88.00	yes
n-Dodecane	96.50	95.05	yes
n-Eicosane	95.54	92.40	yes
n-Hexadecane	96.53	71.11	yes
n-Octadecane	97.20	71.11	yes
n-Tetradecane	96.85	71.11	yes
o-cresol	21.08	52.50	no
p-cresol	34.88	71.67	no
Phenol	14.88	95.25	no
Pyrene	97.63	83.90	yes
Pyridine	21.45	95.40	no

Pass-Through Analysis Results for the Organics Subcategory

7.6.4.3

The results of the pass-through analysis for the organics subcategory option 3/4 are presented in Table 7-9. Several metals and organic pollutants passed through, and therefore may be regulated under PSES and PSNS.

Table 7.9 Final Pass-Through Results For Organics Subcategory Option 3/4

Pollutant Parameter	Option 3/4 Removal (%)	Median POTW Removal (%)	Pass-Through
CLASSICALS			
Total Cyanide	33.46	70.44	no
METALS			
Antimony	33.27	71.13	no
Cobalt	17.31	6.11	yes
Copper	38.04	84.11	no
Manganese	4.22	40.60	no
Molybdenum	57.10	52.17	yes
Silicon	4.71	27.29	no
Strontium	59.51	14.83	yes
Zinc	60.51	77.97	no
ORGANICS			
2-butanone	69.20	96.60	no
2-propanone	68.57	83.75	no
2,3-dichloroaniline	80.45	41.00	yes
2,4,6-trichlorophenol	45.16	65.00	no
Acetophenone	92.44	95.34	no
Aniline	92.88	62.00	yes
Benzoic Acid	94.29	80.50	yes
n,n-Dimethylformamide	89.26	84.75	yes
o-Cresol	98.39	52.50	yes
p-Cresol	85.38	71.67	yes
Pentachlorophenol	23.19	13.88	yes
Phenol	87.08	95.25	no
Pyridine	61.69	95.40	no

FINAL LIST OF POLLUTANTS SELECTED FOR REGULATION**7.7****Direct Dischargers****7.7.1**

After EPA eliminated pollutants of concern which were treatment chemicals, non-conventional bulk parameters, not detected at treatable levels, not treated, or volatile, EPA still had a lengthy list of pollutants which could be regulated -- particularly in the oils subcategory. EPA further eliminated pollutants that were identified during screening, but not analyzed in a quantitative manner¹. These pollutants are iridium, lithium, silicon, and strontium. EPA also eliminated pollutants that are not toxic as quantified by their toxic weighting factor (TWF)². A single pollutant, yttrium, has a TWF of zero and was, therefore, eliminated. EPA also eliminated pollutants that were removed by the proposed treatment technologies, but whose removal was not optimal. EPA eliminated pollutants that were removed by less than 30% with the proposed technology options for the organics subcategory and by less than 50% with the proposed technology options for the metals and oils subcategories. These pollutants are listed in Table 7-10.

Table 7-10 Pollutants Eliminated Due to Non-Optimal Performance

Metals Option 4	Metals Option 3	Oils Option 8	Oils Option 9	Organics Option 3/4
BOD ₅	None	BOD ₅	BOD ₅	Cobalt
Molybdenum		Boron	Boron	Manganese
Pyridine		Manganese ³	Manganese	Pentachlorophenol
Zirconium		Nickel	Nickel	
		Selenium	Selenium	
		Benzoic Acid	Benzoic Acid	
		p-Cresol	o-Cresol	
		Phenol	p-Cresol	
		Pyridine	Phenol	
		2-butanone	Pyridine	
			2-butanone	
			4-methyl-2-pentanone	

Finally, EPA eliminated those pollutants for which the treatment technology forming the basis of the option is not a standard method of treatment. For example, chemical precipitation systems are not designed to remove BOD₅. Table 7-11 lists these pollutants for each subcategory and option.

¹Analyses for these pollutants were not subject to the quality assurance/quality control (QA/QC) procedures required by analytical Method 1620.

²Toxic weighting factors are derived from chronic aquatic life criteria and human health criteria established for the consumption of fish. Toxic weighting factors can be used to compare the toxicity of one pollutant relative to another and are normalized based on the toxicity of copper. TWFs are discussed in detail in the Cost Effectiveness Analysis Document.

³Removals for this pollutant for option 8 were not less than 50%. However, since removals for this pollutant for option 9 (the BAT selected option) were less than 50%, for consistency, they were similarly eliminated for option 8.

Table 7-11. Pollutants Eliminated Since Technology Basis is Not Standard Method of Treatment

Metals Option 4	Metals Option 3	Oils Option 8/9	Organics Option 3/4
BOD ₅ Boron	Benzoic Acid Boron 2-butanone 2-propanone	Total Cyanide	Total Cyanide

For the organics subcategory, EPA's final list of regulated pollutants for direct discharging CWT facilities was based on the previous edits. For the metals subcategory, three pollutants, beryllium, molybdenum, and thallium, remained for metals option 3, but had been eliminated for metals option 4. For consistency, EPA also eliminated these three pollutants for metals option 3. EPA's final list of regulated pollutants for direct discharges in the metals subcategory was based on these additional edits.

However, for the organic pollutants in the oils subcategory, EPA further reduced the number of regulated pollutants as detailed in the following paragraphs. EPA selected this approach based on comments to the 1995 proposal.

Therefore, EPA organized the remaining organic pollutants in the oils subcategory into pollutant groups. As detailed in Section 7.6.2, pollutant groups were developed by combining pollutants of similar structures. The remaining list of organics pollutants in the oils subcategory are in four pollutant groups: n-paraffins, polyaromatic hydrocarbons, phthalates, and aliphatic alcohols. EPA reviewed the influent characterization data from oils subcategory facilities (including the additional data collected at non-hazardous oils facilities) to determine which pollutants in each structural group are always detected together. If pollutants in a structural group are always detected together, then EPA can establish some (or one) pollutants in each group as indicator pollutants. Since the effectiveness of the treatment technologies which

form the basis of the proposed oils subcategory limitations is similar for pollutants in each group, EPA can be confident that regulation of the group indicator pollutant(s) will ensure control of all the group pollutants. This approach allows EPA to reduce the list of regulated pollutants for the oils subcategory substantially. Tables 7-12, 7-13, and 7-14 summarize the data for each structural group. In these tables, an "X" indicates the pollutant was detected at the sampled facility while a "blank" indicates the pollutant was not detected at the sampled facility.

Data for n-paraffins show that while n-decane is usually detected in combination with other n-paraffins, it was the sole n-paraffin detected at one facility. Therefore, no other n-paraffins in this group can be used as an indicator parameter for n-decane. Additionally, the data show that n-decane is not an acceptable indicator parameter for the other pollutants in this group. The data also show that n-hexadecane, n-octadecane and n-tetradecane were always detected together and vice versa. Finally, the data show that the other n-paraffins were also detected with n-hexadecane, n-octadecane and n-tetradecane, but that the reverse statement is not always true. Therefore, along with n-decane, EPA can select n-hexadecane, n-octadecane or n-tetradecane as an indicator parameter for the majority of the n-paraffins. EPA selected n-octadecane.

Data for the polyaromatic hydrocarbons show that fluoroanthene and pyrene were always detected together and vice-versa. Likewise, when the other polyaromatic hydrocarbons were detected, both fluoranthene and pyrene were

always detected. However, the reverse statement is not true. Therefore, EPA can select either fluoranthene or pyrene as an indicator parameter for all of the polyaromatic hydrocarbons. EPA selected fluoranthene since it was detected most often. Data for the phthalate group show that while bis-2-ethylhexylphthalate is usually detected with other phthalates, it is sometimes the only pollutant detected in this group. Therefore, no other n-pollutant in this group can be used as an indicator parameter for bis-2-ethylhexylphthalate. The data also show that butyl benzyl phthalate is usually detected with other phthalates, but that it was the only phthalate detected at one facility. Therefore, no other n-pollutant in this group can be used as an indicator parameter for butyl benzyl phthalate. Finally, the data show that diethylphthalate and di-n-butylphthalate are always detected with bis-2-ethylhexylphthalate. As a result, EPA selected bis-2-ethylhexylphthalate and butyl benzylphthalate for regulation in the phthalate group.

Table 7-15 shows the final list of pollutants selected for regulation for direct dischargers.

Table 7-12. Frequency of Detection⁴ of n-Paraffins in CWT Oils Subcategory Wastes

Pollutant	Facility																Total Number of Detects at Combined Facilities
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	
n-Decane	X		X	X	X	X	X	X	X	X		X	X				29/37
n-Docosane	X		X	X	X	X	X	X	X	X			X	X			23/37
n-Dodecane	X	X	X	X	X	X	X	X		X			X	X			28/37
n-Eicosane	X	X	X	X	X	X	X	X	X	X			X	X			31/37
n-Hexadecane	X	X	X	X	X	X	X	X	X	X			X	X		X	32/37
n-Octadecane	X	X	X	X	X	X	X	X	X	X			X	X		X	31/37
n-Tetradecane	X	X	X	X	X	X	X	X	X	X			X	X		X	32/37

X = Pollutant was detected at the sampled facility

“blank = Pollutant was not detected at the sampled facility

⁴For some facilities, the data represent composite samples collected over three to five days, while for other facilities the data represent grab samples collected once.

Table 7-13. Frequency of Detection⁵ of Polyaromatic Hydrocarbons in CWT Oils Subcategory Wastes

Pollutant	Facility																Total Number of Detects at Combined Facilities
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	
Acenaphthene						X	X	X	X								9/37
Anthracene					X	X	X	X	X								14/37
Benzo(a)anthracene					X	X	X	X									14/37
Benzo(a)pyrene						X	X	X									6/37
Benzo(b)fluoranthene					X	X	X										7/37
Benzo(k)fluoranthene						X	X										5/37
Chrysene					X	X	X	X	X								15/37
Fluoranthene					X	X	X	X	X					X			18/37
Fluorene					X	X	X	X	X								14/37
Pyrene					X	X	X	X	X					X			14/37

X = Pollutant was detected at the sampled facility

“blank = Pollutant was not detected at the sampled facility

⁵For some facilities, the data represent composite samples collected over three to five days, while for other facilities the data represent grab samples collected once.

Table 7-14. Frequency of Detection⁶ of Phthalates in CWT Oils Subcategory Wastes

Pollutant	Facility																Total Number of Detects at Combined Facilities
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	
Bis-2-ethylhexylphthalate	X		X		X	X	X	X		X			X	X	X	X	22/37
Butylbenzylphthalate		X				X	X	X									9/37
Diethylphthalate					X	X	X	X						X			15/37
Di-n-butylphthalate					X	X	X	X									6/37

X = Pollutant was detected at the sampled facility

“blank = Pollutant was not detected at the sampled facility

⁶For some facilities, the data represent composite samples collected over three to five days, while for other facilities the data represent grab samples collected once.

Table 7-15. Final List of Regulated Pollutants for Direct Discharging CWTs

Metals Subcategory Option 4 (BPT, BAT)	Metals Subcategory Option 3 (NSPS)	Oils Subcategory Option 9 BPT, BAT, NSPS	Organics Subcategory Option 3 BPT, BAT, NSPS
TSS	TSS	Oil and Grease	BOD ₅
Oil and Grease	Oil and Grease	TSS	TSS
Antimony	Antimony	Antimony	Antimony
Arsenic	Arsenic	Arsenic	Copper
Cadmium	Cadmium	Barium	Molybdenum
Chromium	Chromium	Cadmium	Zinc
Cobalt	Cobalt	Chromium	Acetophenone
Copper	Copper	Cobalt	Aniline
Hex chromium	Hex Chromium	Copper	Benzoic Acid
Lead	Lead	Lead	o-Cresol
Manganese	Manganese	Mercury	p-Cresol
Mercury	Mercury	Molybdenum	Phenol
Nickel	Nickel	Tin	Pyridine
Selenium	Silver	Titanium	2-butanone
Silver	Tin	Zinc	2-propanone
Tin	Titanium	Alpha-terpineol	2,3-dichloroaniline
Titanium	Total cyanide	Bis(2-ethylhexyl)	2,4,6-trichlorophenol
Total cyanide	Vanadium	phthalate	
Vanadium	Zinc	Butylbenzyl phthalate	
Zinc		Carbazole	
		Fluoranthene	
		N-decane	
		N-octadecane	
		SGT-HEM ⁷	

⁷EPA has not proposed regulating SGT-HEM. However, EPA has asked for comment on whether SGT-HEM should be used as an indicator parameter for the organic analytes in this subcategory.

Indirect Dischargers**7.7.2**

As detailed in Section 7.6, all pollutants regulated for direct dischargers which pass-through well-operated POTWs are regulated for indirect dischargers. Table 7-16 shows the final list of regulated pollutants for indirect dischargers selected by EPA.

Table 7-16. Final List of Regulated Pollutants for Indirect Discharging CWT Facilities

Metals Subcategory Option 4 PSES	Metals Subcategory Option 3 PSNS	Oils Subcategory Option 8 (PSES) Option 9 (PSNS)	Organics Subcategory Option 3 PSES, PSNS
Antimony	Antimony	Antimony	Molybdenum
Arsenic	Arsenic	Barium	Aniline
Cadmium	Cadmium	Cobalt	Benzoic Acid
Chromium	Chromium	Copper	o-Cresol
Cobalt	Cobalt	Molybdenum	p-Cresol
Copper	Copper	Tin	2,3-dichloroaniline
Hex chromium	Hex chromium	Titanium	
Lead	Lead	Zinc	
Manganese	Manganese	Alpha-terpineol	
Mercury	Mercury	Bis-2-ethylhexyl	
Nickel	Nickel	phthalate	
Selenium	Silver	Carbazole	
Silver	Tin	Fluoranthene	
Tin	Titanium	N-decane	
Titanium	Total cyanide	N-octadecane	
Total cyanide	Vanadium	SGT-HEM ⁸	
Vanadium	Zinc		
Zinc			

⁸EPA has not proposed regulating SGT-HEM. However, EPA has asked for comment on whether SGT-HEM should be used as an indicator parameter for the organic analytes in this subcategory.

WASTEWATER TREATMENT TECHNOLOGIES

This section discusses a number of wastewater treatment technologies considered by EPA for the development of these guidelines and standards for the CWT Industry. Many of these technologies are being used currently at CWT facilities. This section also reviews other technologies with potential application in treating certain CWT pollutants of concern.

Facilities in the CWT industry use a wide variety of technologies for treating wastes received for treatment or recovery operations and wastewater generated on site. The technologies are grouped into the following five categories for this discussion:

- Best Management Practices, section 8.2.1;
- Physical/Chemical/Thermal Treatment, section 8.2.2;
- Biological Treatment, section 8.2.3;
- Sludge Treatment and Disposal, section 8.2.4; and
- Zero Discharge Options, section 8.2.5.

The processes reviewed here include both those that remove pollutant contaminants in wastewater and those that destroy them. Using a wastewater treatment technology that removes, rather than destroys, a pollutant will produce a treatment residual. In many instances, this residual is in the form of a sludge, that, typically, a CWT further treats on site in preparation for disposal. Section 8.2.4 discusses technologies for dewatering sludges to concentrate them prior to disposal. In the case of other types of treatment residuals, such as spent activated carbon and

filter media, CWT facilities generally send those off site to a vendor facility for management.

TECHNOLOGIES CURRENTLY IN USE 8.1

EPA obtained information on the treatment technologies in use in the CWT industry from responses to the Waste Treatment Industry (WTI) Questionnaire, site visits, public comments to the original proposal and the 1996 Notice of Data Availability. As described in Section 4, of the estimated 205 CWT facilities, EPA has obtained detailed facility-specific technology information for 116 of the direct and indirect discharging CWT facilities. Although EPA has facility-specific information for 145 facilities, only 116 of these facilities provided technology information. The detail provided regarding the technology information differs depending on the source. Information for the 65 facilities that completed the WTI Questionnaire was the most explicit because the questionnaire contained a detailed checklist of wastewater treatment technologies, many of which are discussed in this section. Technology information from other sources, however, is much less descriptive.

Table 8-1 presents treatment technology information by subcategory for the 116 indirect and direct discharging CWT facilities for which EPA has facility-specific treatment technology information. The information in Table 8-1 has not been scaled to represent the entire population of CWT facilities. Responses to the WTI Questionnaire provide the primary basis for the technology information for the metals and the organics subcategories. Comments to the 1996 Notice of Data Availability provide the primary

source of the technology information for the oils subcategory. It should be noted that a number of facilities commingle different subcategory wastes for treatment. EPA has attributed these treatment technologies to all appropriate subcategories.

Table 8-1. Percent Treatment In-place by Subcategory and by Method of Wastewater Disposal

Disposal Type	<u>Metals Subcategory</u>		<u>Oils Subcategory</u>		<u>Organics Subcategory</u>	
	Direct	Indirect	Direct	Indirect	Direct	Indirect
Number of Facilities with Treatment Technology Data	9 ¹	41 ¹	3 ^{1,2}	80 ^{1,3}	4 ¹	14 ¹
Equalization ⁴	78	68	100	65	75	71
Neutralization ⁴	89	73	100	61	100	57
Flocculation ⁴	44	51	100	48	75	57
Emulsion Breaking	11	29	33	56	25	50
Gravity-Assisted Separation	89	61	100	85	100	64
Skimming ⁴	22	27	100	58	25	57
Plate/Tube Separation ⁴	0	10	0	19	0	21
Dissolved Air Flotation	22	5	33	23	50	0
Chromium Reduction ⁴	33	76	0	48	0	57
Cyanide Destruction ⁴	33	46	100	23	25	29
Chemical Precipitation	78	88	0	34	25	64
Filtration	44	32	33	19	25	21
Sand Filtration ⁴	11	15	0	16	0	21
Multimedia Filtration ⁴	11	5	0	0	0	7
Ultrafiltration	0	0	0	8	0	0
Reverse Osmosis ⁴	11	0	0	3	0	0
Carbon Adsorption	22	12	67	18	0	21
Ion Exchange ⁴	0	2	0	0	0	0
Air Stripping	0	7	0	11	0	0
Biological Treatment	56	2	100	11	100	7
Activated Sludge	33	0	100	0	100	0
Sequencing Batch Reactors ⁴	0	2	0	0	0	7
Vacuum Filtration ⁴	11	17	100	6	25	7
Pressure Filtration ⁴	67	61	100	39	75	36

¹Sum does not add to 116 facilities. Some facilities treat wastes in multiple subcategories.

²Of the 3 direct discharging oils facilities for which EPA has facility-specific information, only one completed the WTI Questionnaire.

³Of the 80 indirect discharging oils facilities for which EPA has facility-specific information, only 31 completed the WTI Questionnaire.

⁴Information for these technologies for the oils subcategory is based on responses to the WTI Questionnaire only.

TECHNOLOGY DESCRIPTIONS
Best Management Practices**8.2**
8.2.1**Physical/Chemical/
Thermal Treatment**
Equalization**8.2.2**
8.2.2.1

In addition to physical/chemical treatment technologies, CWT facilities employ a number of ancillary means to prevent or reduce the discharge of pollutants. These efforts are termed "best management practices. EPA believes that CWT facilities should design best management practices in the CWT industry with the following objectives in mind:

- Maximize the amount of waste materials and residuals that are recycled rather than disposed as residuals, as wastewater, or as waste material.
- Maximize recycling and reuse of wastewaters generated on site.
- Minimize the introduction of uncontaminated wastewaters into the treatment waste stream.
- Encourage waste generators to minimize the mixing of different wastes.
- Segregate wastes for treatment particularly where waste segregation would improve treatment performance and maximize opportunities for recycling.

Waste segregation is one of the most important tools available for maximizing waste recycling and improving treatment performance. For example, separate treatment of wastes containing different types of metals allows the recovery of the individual metals from the resultant sludges. Similarly, separate treatment collection and treatment of waste oils will allow recycling. Many oils subcategory facilities currently practice waste oil recycling.

GENERAL DESCRIPTION

The wastes received at many facilities in the CWT industry vary considerably in both strength and volume. Waste treatment facilities often need to equalize wastes by holding wastestreams in a tank for a certain period of time prior to treatment in order to obtain a stable waste stream which is easier to treat. CWT facilities frequently use holding tanks to consolidate small waste volumes and to minimize the variability of incoming wastes prior to certain treatment operations. The receiving or initial treatment tanks of a facility often serve as equalization tanks.

The equalization tank serves many functions. Facilities use equalization tanks to consolidate smaller volumes of wastes so that, for batch treatment systems, full batch volumes are available. For continuous treatment systems, facilities equalize the waste volumes so that they may introduce effluent to downstream processes at a uniform rate and strength. This dampens the effect of peak and minimum flows. Introducing a waste stream with a more uniform pollutant profile to the treatment system facilitates control of the operation of downstream treatment units, resulting in more predictable and uniform treatment results. Equalization tanks are usually equipped with agitators or aerators where mixing of the wastewater is desired and to prevent suspended solids from settling to the bottom of the unit. An example of effective equalization is the mixing of acid and alkaline wastes. Figure 8-1 illustrates an equalization system.

EPA does not consider the use of equalization tanks for dilution as a legitimate use. In this context, EPA defines dilution as the mixing of more concentrated wastes with greater volumes of less concentrated wastes in a manner that reduces the concentration of pollutant in the concentrated wastes to a level that enables the facility to avoid treatment of the pollutant.

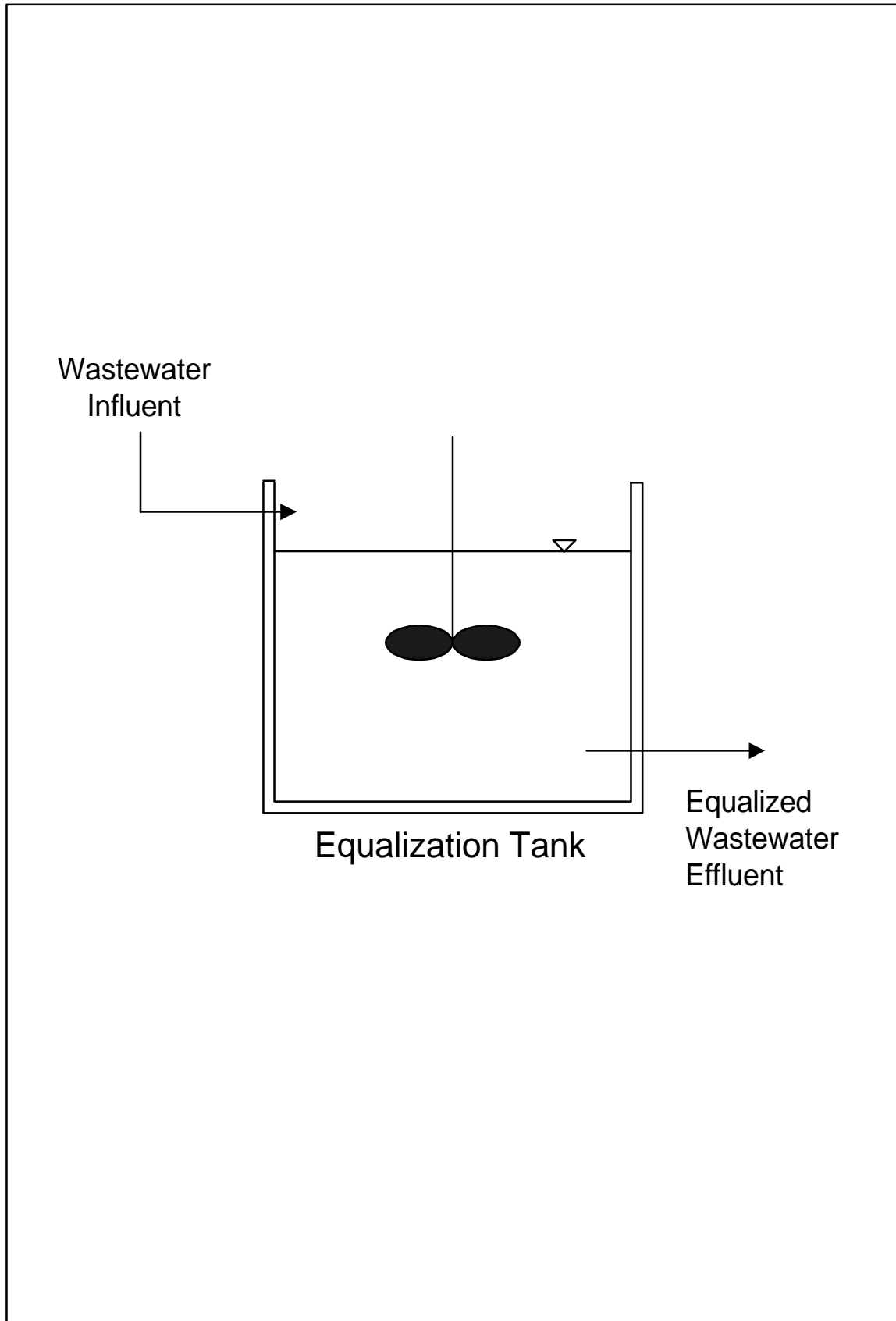


Figure 8-1. Equalization System Diagram

INDUSTRY PRACTICE

EPA found equalization being used at facilities in all of the CWT subcategories. Of the 65 CWT facilities in EPA's WTI Questionnaire data base that provided information concerning the use of equalization, 44 operate equalization systems. Of these, approximately 44 percent employ unstirred tanks and 56 percent use stirred or aerated tanks.

The combining of separate waste receipts in large receiving tanks provides for effective equalization even though it is not necessarily recognized as such. Nearly every facility visited by EPA performed equalization, either in tanks specifically designed for that purpose or in waste receiving tanks. Consequently, EPA has concluded that equalization is underreported in the data base.

Neutralization 8.2.2.2

GENERAL DESCRIPTION

Wastewaters treated at CWT facilities have a wide range of pH values depending on the types of wastes accepted. Untreated wastewater may require neutralization to eliminate either high or low pH values prior to certain treatment systems, such as biological treatment. Facilities often use neutralization systems also in conjunction with certain chemical treatment processes, such as chemical precipitation, to adjust the pH of the wastewater to optimize treatment efficiencies. These facilities may add acids, such as sulfuric acid or hydrochloric acid, to reduce pH, and alkalis, such as sodium hydroxides, to raise pH values. Many metals subcategory facilities use waste acids and waste alkalis for pH adjustment. Neutralization may be performed in a holding tank, rapid mix tank, or an equalization tank. Typically, facilities use neutralization systems at the end of a treatment system to control the pH of the discharge to between 6 and 9 in order to meet NPDES and POTW pretreatment limitations.

Figure 8-2 presents a flow diagram for a typical neutralization system.

INDUSTRY PRACTICE

EPA found neutralization systems in-place at facilities identified in all of the CWT subcategories. Of the 65 CWT facilities in EPA's WTI Questionnaire data base that provided information concerning the use of neutralization, 45 operate neutralization systems.

Flocculation/Coagulation 8.2.2.3

GENERAL DESCRIPTION

Flocculation is the stirring or agitation of chemically-treated water to induce coagulation. The terms coagulation and flocculation are often used interchangeably. More specifically, "coagulation" is the reduction of the net electrical repulsive forces at particle surfaces by addition of coagulating chemicals, whereas "flocculation" is the agglomeration of the destabilized particles by chemical joining and bridging. Flocculation enhances sedimentation or filtration treatment system performance by increasing particle size resulting in increased settling rates and filter capture rates.

Flocculation generally precedes sedimentation and filtration processes and usually consists of a rapid mix tank or in-line mixer, and a flocculation tank. The waste stream is initially mixed while a coagulant and/or a coagulant aid is added. A rapid mix tank is usually designed for a detention time of 15 seconds to several minutes. After mixing, the coagulated wastewater flows to a flocculation basin where slow mixing of the waste occurs. The slow mixing allows the particles to agglomerate into heavier, more settleable/filterable solids. Either mechanical paddle mixers or diffused air provides mixing. Flocculation basins are typically designed for a detention time of 15 to 60 minutes. Figure 8-3 presents a diagram of a clarification system incorporating coagulation and flocculation.

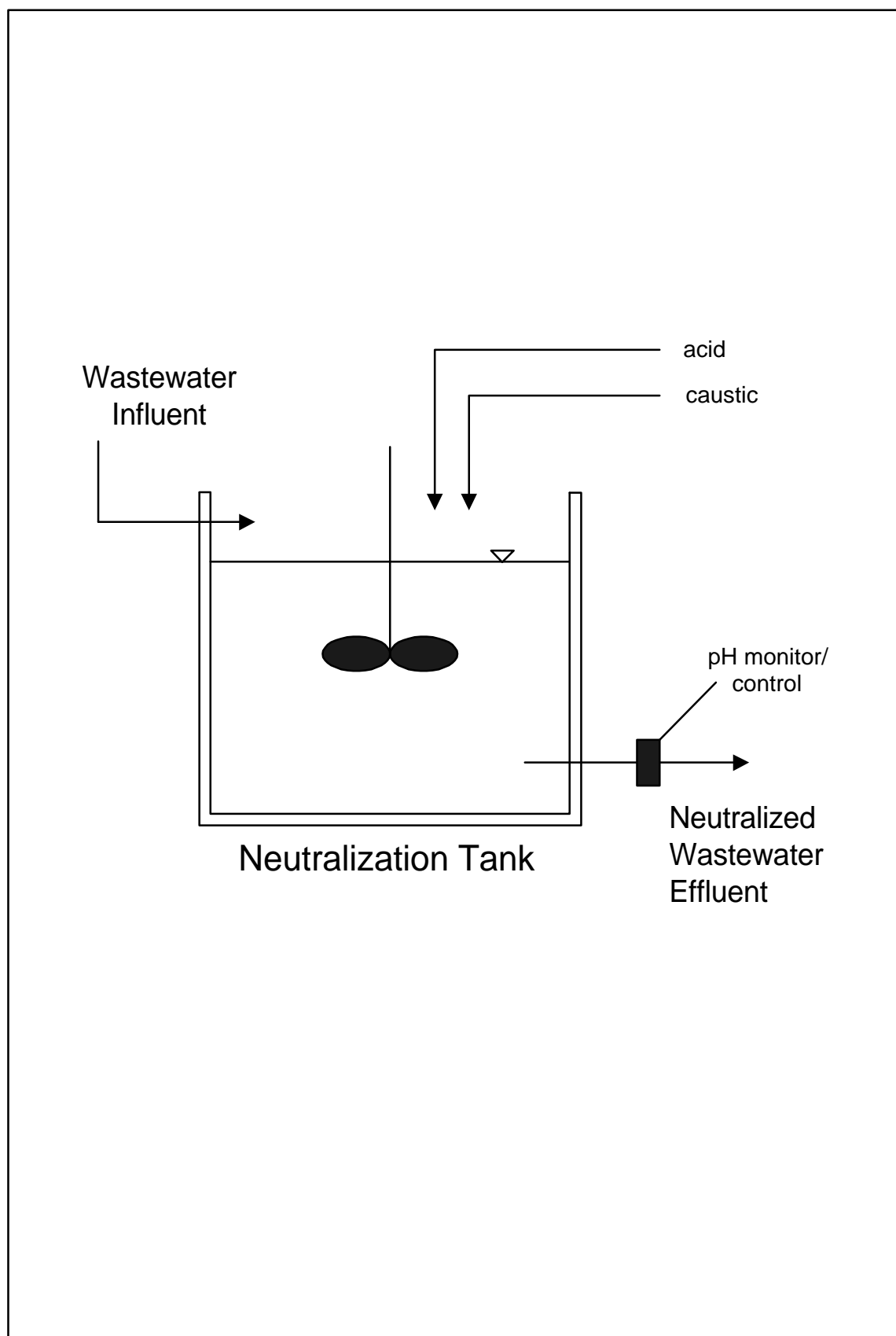


Figure 8-2. Neutralization System Diagram

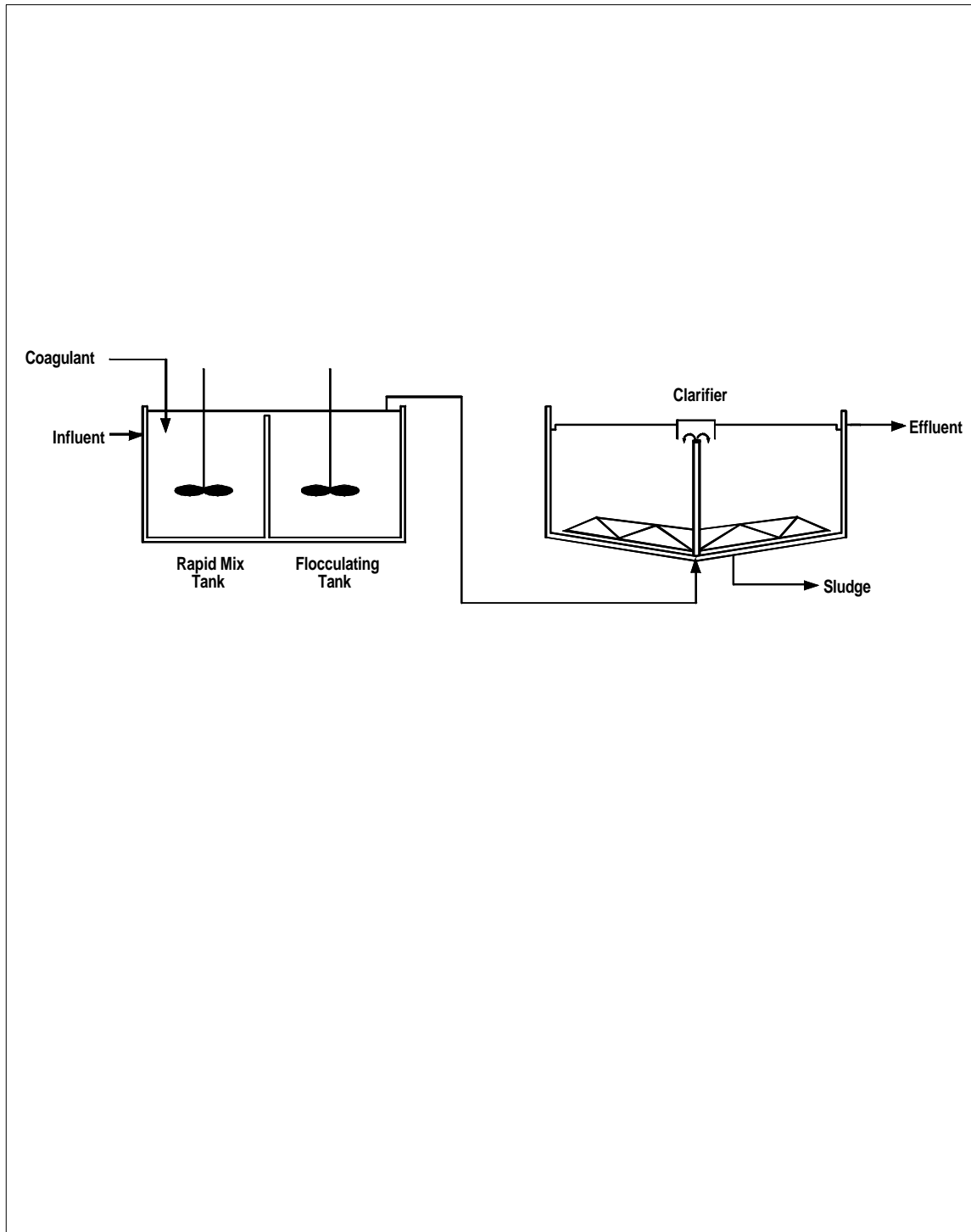


Figure 8-3. Clarification System Incorporating Coagulation and Flocculation

There are three different types of treatment chemicals commonly used in coagulation/flocculation processes: inorganic electrolytes, natural organic polymers, and synthetic polyelectrolytes. The selection of the specific treatment chemical is highly dependent upon the characteristics and chemical properties of the contaminants. Many CWT facilities use bench-scale jar tests to determine the appropriate type and optimal dosage of coagulant/flocculent for a given waste stream.

INDUSTRY PRACTICE

Chemical treatment methods to enhance the separation of pollutants from water as a solid residual may include both chemical precipitation and coagulation/flocculation. Chemical precipitation is the conversion of soluble pollutants such as metals into an insoluble precipitate and is described separately. Flocculation is often an integral step in chemical precipitation, gravity separation, and filtration. Of the 65 CWT facilities in EPA's WTI Questionnaire data base that provided information concerning the use of coagulation/flocculation, 31 operate coagulation/flocculation systems. However, due to the integral nature of flocculation in chemical precipitation and coagulation, and the interchangeable use of the terminology, the use of coagulation/flocculation at CWT facilities may have been underreported.

Emulsion Breaking

8.2.2.4

GENERAL DESCRIPTION

One process used to treat emulsified oil/water mixtures is emulsion breaking. An emulsion, by definition, is either stable or unstable. A stable emulsion is one where small droplets of oil are dispersed within the water and are prevented from coalescing by repulsive electrical surface charges that are often a result of the presence of

emulsifying agents and/or surfactants. In stable emulsions, coalescing and settling of the dispersed oil droplets would occur very slowly or not at all. Stable emulsions are often intentionally formed by chemical addition to stabilize the oil mixture for a specific application. Some examples of stable emulsified oils are metal-working coolants, lubricants, and antioxidants. An unstable emulsion, or dispersion, settles very rapidly and does not require treatment to break the emulsion.

Emulsion breaking is achieved through the addition of chemicals and/or heat to the emulsified oil/water mixture. The most commonly-used method of emulsion breaking is acid-cracking where sulfuric or hydrochloric acid is added to the oil/water mixture until the pH reaches 1 or 2. An alternative to acid-cracking is chemical treatment using emulsion-breaking chemicals such as surfactants and coagulants. After addition of the treatment chemical, the tank contents are mixed. After the emulsion bond is broken, the oil residue is allowed to float to the top of the tank. At this point, heat (100 to 150° F) may be applied to speed the separation process. The oil is then skimmed by mechanical means, or the water is decanted from the bottom of the tank. The oil residue is then further processed or disposed. A diagram of an emulsion breaking system is presented in Figure 8-4.

INDUSTRY PRACTICE

Emulsion breaking is a common process in the CWT industry. Of the 116 CWT facilities in EPA's WTI Questionnaire and NOA comment data base that provided information concerning the use of emulsion breaking, 49 operate emulsion breaking systems. Forty-six of the 83 oils subcategory facilities in EPA's data base use emulsion-breaking. As such, EPA has concluded that emulsion breaking is the baseline, current performance technology for oils subcategory facilities that treat emulsified oily wastes.

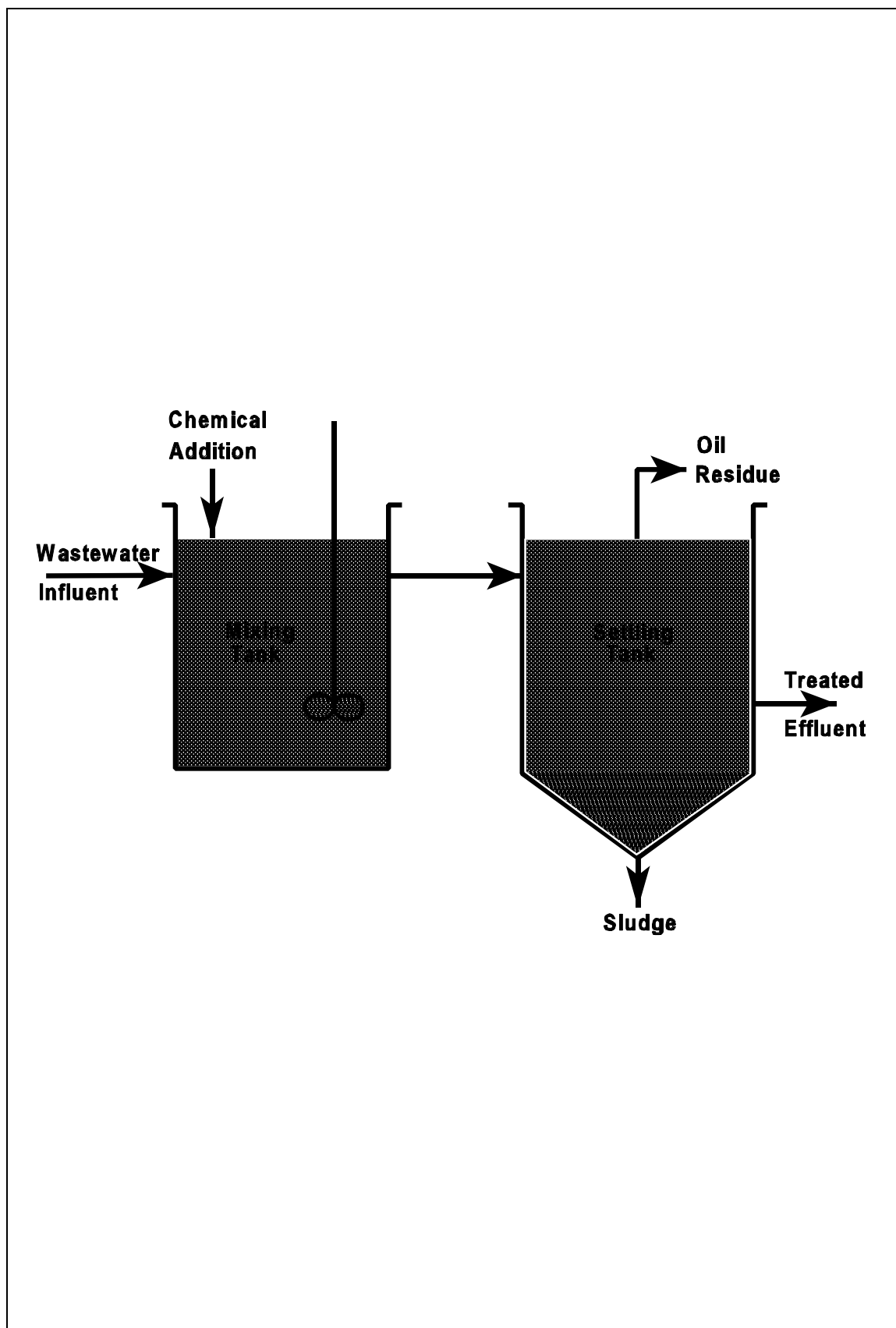


Figure 8-4. Emulsion Breaking System Diagram

Gravity Assisted Separation

8.2.2.5

INDUSTRY PRACTICE

1. *GRAVITY OIL/WATER SEPARATION*

GENERAL DESCRIPTION

Like emulsion breaking, another in-place treatment process primarily used to remove oil and grease and related pollutants from oil/water mixtures, is gravity separation. Unlike emulsion breaking, gravity separation is only effective for the bulk removal of free oil and grease. It is not effective in the removal of emulsified or soluble oils. Gravity separation is often used in conjunction with emulsion breaking at CWT facilities.

Gravity separation may be performed using specially designed tanks or it may occur within storage tanks. During gravity oil/water separation, the wastewater is held under quiescent conditions long enough to allow the oil droplets, which have a lower specific gravity than water, to rise and form a layer on the surface. Large droplets rise more readily than smaller droplets.

Once the oil has risen to the surface of the wastewater, it must be removed. This is done mechanically via skimmers, baffles, plates, slotted pipes, or dip tubes. When treatment or storage tanks serve as gravity separators, the oil may be decanted off the surface or, alternately, the separated water may be drawn off the bottom until the oil layer appears. The resulting oily residue from a gravity separator must then be further processed or disposed.

Because gravity separation is such a widely-used technology, there is an abundance of equipment configurations available. A very common unit is the API (American Petroleum Institute) separator, shown in Figure 8-5. This unit uses an overflow and an underflow baffle to skim the floating oil layer from the surface. Another oil/water gravity separation process utilizes parallel plates which shorten the necessary retention time by shortening the distance the oil droplets must travel before separation occurs.

Of the 116 CWT facilities in EPA's WTI Questionnaire and NOA comment data base that provided information concerning the use of oil/water gravity separation, 16 operate skimming systems, seven operate coalescing plate or tube separation systems, and 42 operate oil/water gravity separation systems. Oil/water separation is such an integral step at oils subcategory facilities that every oils subcategory facility visited by EPA performed gravity oil/water separation, either in tanks specifically designed for that purpose or in waste receiving or storage tanks.

2. *CLARIFICATION*

GENERAL DESCRIPTION

Like oil/water separators, clarification systems utilize gravity to provide continuous, low-cost separation and removal of particulates, flocculated impurities, and precipitates from water. These systems typically follow wastewater treatment processes which generate suspended solids, such as chemical precipitation and biological treatment.

In a clarifier, wastewater is allowed to flow slowly and uniformly, permitting the solids more dense than water to settle to the bottom. The clarified wastewater is discharged by flowing from the top of the clarifier over a weir. Solids accumulate at the bottom of a clarifier and a sludge must be periodically removed, dewatered and disposed. Conventional clarifiers are typically circular or rectangular tanks. Some specialized types of clarifiers additionally incorporate tubes, plates, or lamellar networks to increase the settling area. A circular clarification system is illustrated in Figure 8-6.

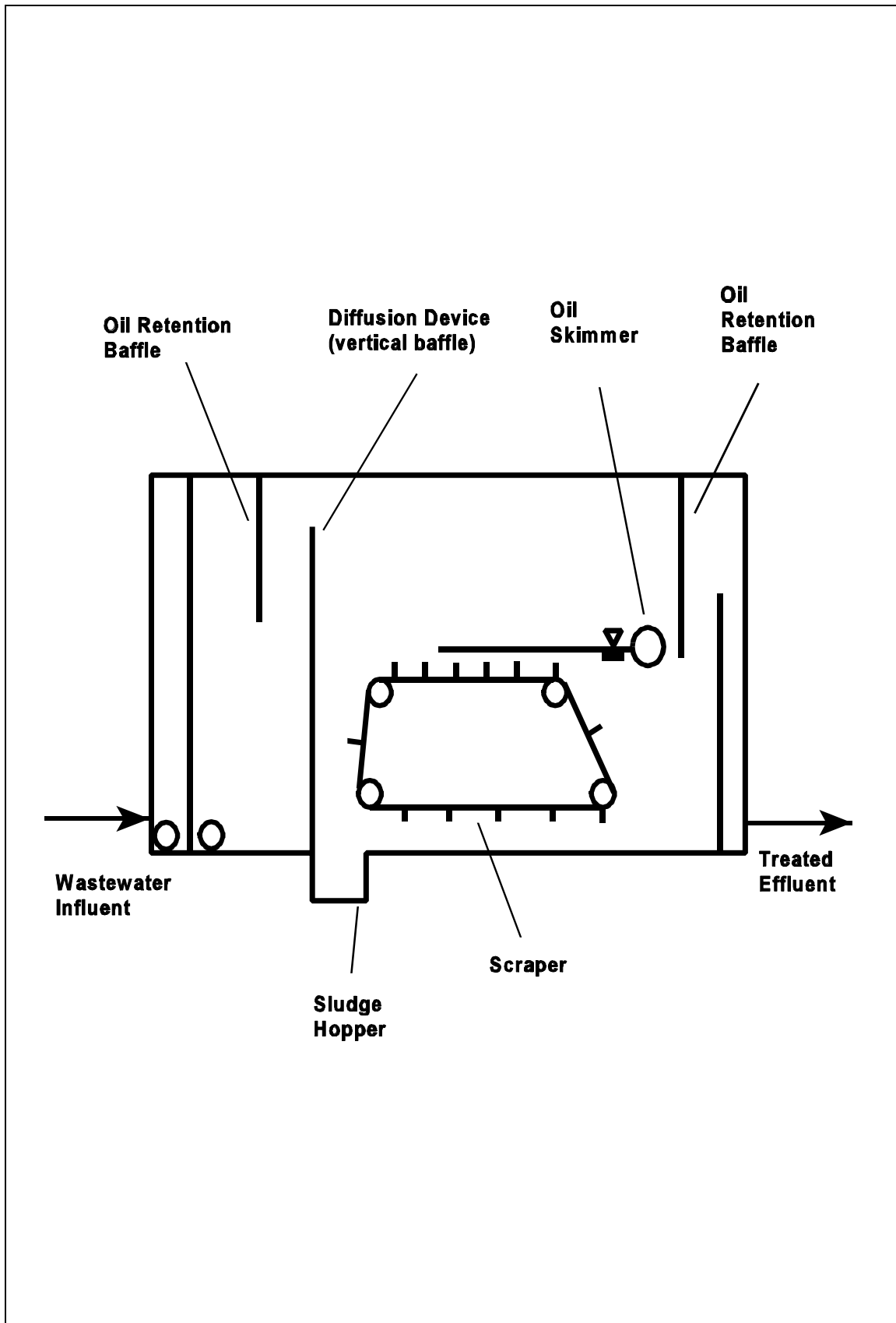


Figure 8-5. Gravity Separation System Diagram

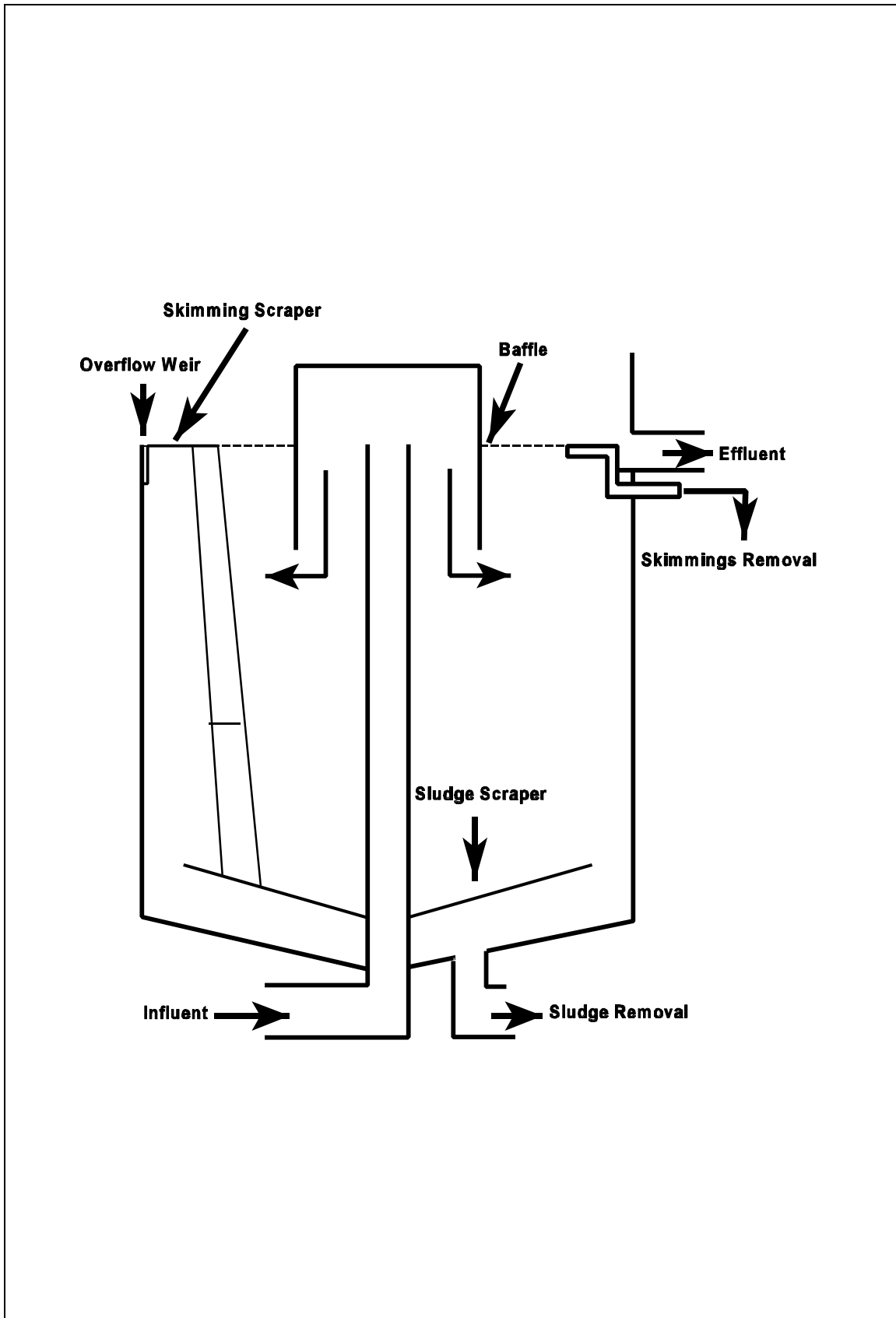


Figure 8-6. Clarification System Diagram

INDUSTRY PRACTICE

Of the 65 CWT facilities in EPA's WTI Questionnaire data base that provided information concerning the use of clarification systems, 39 operate settling systems and seven operate coalescing plate or tube separation systems. EPA did not obtain detailed enough treatment technology information from the Notice of Data Availability comments for the oils subcategory facilities to determine the presence or absence of clarification systems. In general, oils subcategory facilities are more likely to utilize gravity oil/water separation. However, oils facilities that also utilize solids generation processes such as chemical precipitation or biological treatment as part of their waste treatment train will likely utilize clarification systems.

3. *DISSOLVED AIR FLOTATION*

GENERAL DESCRIPTION

Flotation is the process of using fine bubbles to induce suspended particles to rise to the surface of a tank where they can be collected and removed. Gas bubbles are introduced into the wastewater and attach themselves to the particles, thereby reducing their specific gravity and causing them to float. Fine bubbles may be generated by dispersing air mechanically, by drawing them from the water using a vacuum, or by forcing air into solution under elevated pressure followed by pressure release. The latter, called dissolved air flotation (DAF), is the flotation process used most frequently by CWT facilities and is the focus of the remaining discussion.

DAF is commonly used to remove suspended solids and dispersed oil and grease from oily wastewater. It may effectively reduce the sedimentation times of suspended particles that have a specific gravity close to that of water. Such particles may include both solids with specific gravity slightly greater than water and oil/grease particles with specific gravity slightly

less than water. Flotation processes are particularly useful for inducing the removal of oil-wet solids that may exhibit a combined specific gravity nearly the same as water. Oil-wet solids are difficult to remove from wastewater using gravity sedimentation alone, even when extended sedimentation times are utilized. Figure 8-7 is a flow diagram of a DAF system.

The major components of a conventional DAF unit include a centrifugal pump, a retention tank, an air compressor, and a flotation tank. For small volume systems, the entire influent wastewater stream is pressurized and contacted with air in a retention tank for several minutes to allow time for the air to dissolve. The pressurized water that is nearly saturated with air is then passed through a pressure reducing valve and introduced into the flotation tank near the bottom. In larger units, rather than pressurizing the entire wastewater stream, a portion of the flotation cell effluent is recycled through the pressurizing pump and the retention tank. The recycled flow is then mixed with the unpressurized main stream just prior to entering the flotation tank.

As soon as the pressure is released, the supersaturated air begins to come out of solution in the form of fine bubbles. The bubbles attach to suspended particles and become enmeshed in sludge flocs, floating them to the surface. The float is continuously swept from the tank surface and is discharged over the end wall of the tank. Sludge, if generated, may be collected from the bottom of the tank.

The mechanics of the bubble-particle interaction include: (1) attachment of the bubbles on the particle surface, (2) collision between a bubble and a particle, (3) agglomeration of individual particles or a floc structure as the bubbles rise, and (4) absorption of the bubbles into a floc structure as it forms. As such, surface chemistry plays a critical role in the effective performance of air flotation.

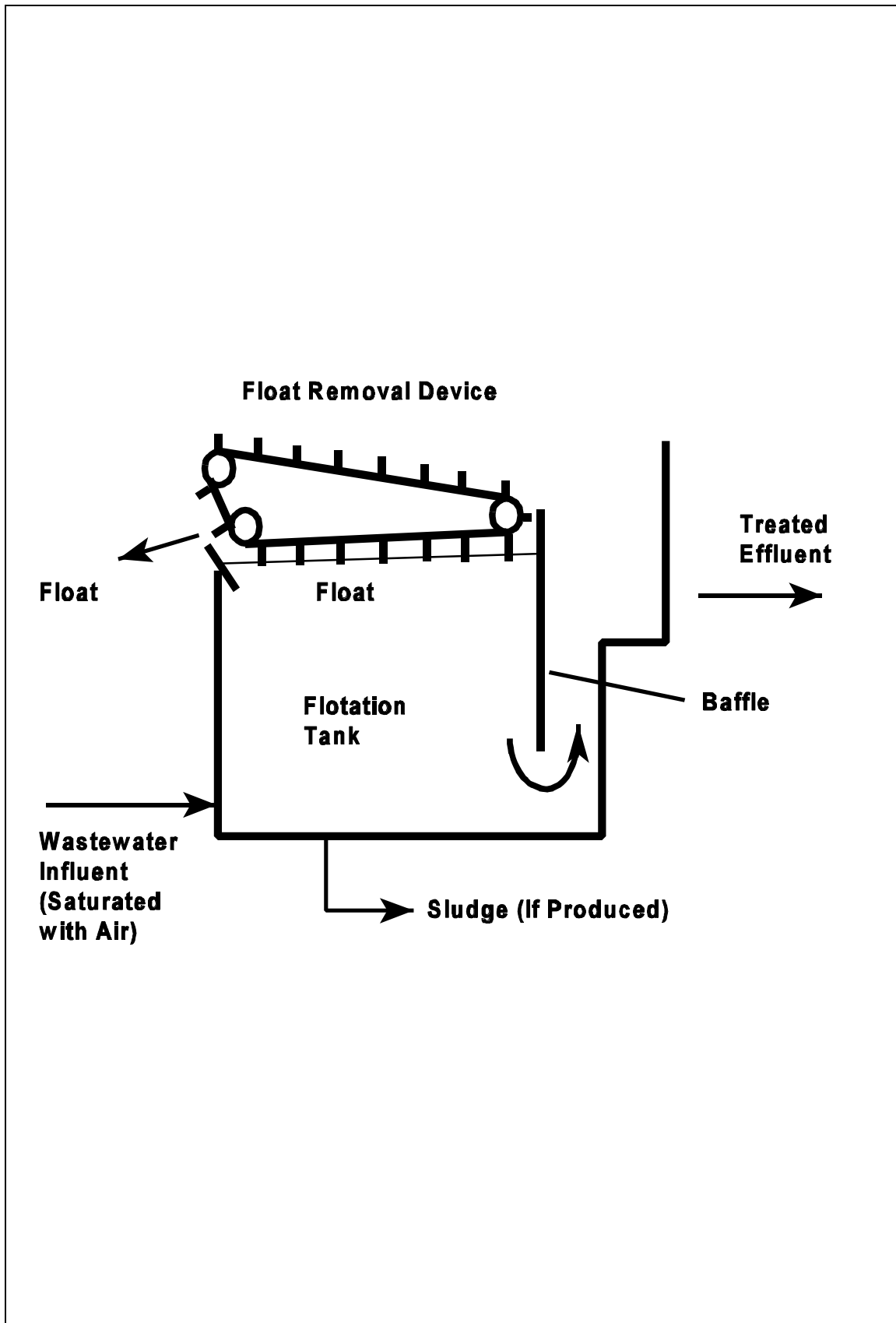


Figure 8-7. Dissolved Air Flotation System Diagram

Other operating variables which affect the performance of DAF include the operating pressure, recycle ratio, detention time, the air/solids ratio, solids and hydraulic loading rates, and the application of chemical aids.

The operating pressure of the retention tank influences the size of the bubbles released. If the bubbles are too large, they do not attach readily to the suspended particles. If the bubbles are too fine, they will disperse and break up fragile floc. Wastewater treatment textbooks generally recommend a bubble size of 100 micrometers. The most practical way to establish the proper rise rate is to conduct experiments at various air pressures.

The air-to-solids ratio in the DAF unit determines the effluent quality and solids concentration in the float. This is because adequate air bubbles are needed to float suspended solids to the surface of the tank. Partial flotation of solids will occur if inadequate or excessive amounts of air bubbles are present.

Researchers have demonstrated that the addition of chemicals to the water stream is an effective means of increasing the efficiencies of DAF treatment systems. The use of coagulants can drastically increase the oil removal efficiency of DAF units. Three types of chemicals are generally utilized to improve the efficiency of air flotation units used for treatment of produced water; these chemicals are surface active agents, coagulating agents, and polyelectrolytes. The use of treatment chemicals may also enhance the removal of metals in air flotation units. EPA's collection of data from the CWT industry has shown that many facilities use DAF systems to remove metals from their waste streams.

INDUSTRY PRACTICE

Of the 116 CWT facilities in EPA's WTI Questionnaire and NOA comment data base that provided information concerning use of DAF, 21 operate DAF systems.

Chromium Reduction

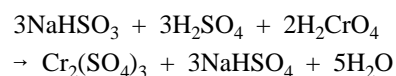
8.2.2.6

GENERAL DESCRIPTION

Reduction is a chemical reaction in which electrons are transferred from one chemical to another. The main reduction application at CWT facilities is the reduction of hexavalent chromium to trivalent chromium, which is subsequently precipitated from the wastewater in conjunction with other metallic salts. A low pH of 2 to 3 will promote chromium reduction reactions. At pH levels above 5, the reduction rate is slow. Oxidizing agents such as dissolved oxygen and ferric iron interfere with the reduction process by consuming the reducing agent.

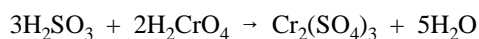
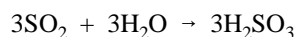
The use of strong reducing agents such as sulfur dioxide, sodium bisulfite, sodium metabisulfite, and ferrous sulfate also promotes hexavalent chromium reduction. The two most commonly used reducing agents in the CWT industry are sodium metabisulfite or sodium bisulfite and gaseous sulfur dioxide. The remaining discussion will focus on chromium reduction using these agents only. Figure 8-8 is a diagram of a chromium reduction system.

Chromium reduction using sodium metabisulfite ($\text{Na}_2\text{S}_2\text{O}_5$) and sodium bisulfite (NaHSO_3) are essentially similar. The mechanism for the reaction using sodium bisulfite as the reducing agent is:



The hexavalent chromium is reduced to trivalent chromium using sodium metabisulfite, with sulfuric acid used to lower the pH of the solution. The amount of sodium metabisulfite needed to reduce the hexavalent chromium is reported as 3 parts of sodium bisulfite per part of chromium, while the amount of sulfuric acid is 1 part per part of chromium. The theoretical retention time is about 30 to 60 minutes.

A second process uses sulfur dioxide (SO_2) as the reducing agent. The reaction mechanism is as follows:



The hexavalent chromium is reduced to trivalent chromium using sulfur dioxide, with sulfuric acid used to lower the pH of the solution. The amount of sulfur dioxide needed to reduce the hexavalent chromium is reported as 1.9 parts of sulfur dioxide per part of chromium, while the amount of sulfuric acid is 1 part per part of chromium. At a pH of 3, the theoretical retention time is approximately 30 to 45 minutes.

INDUSTRY PRACTICE

Of the 65 CWT facilities in EPA's WTI Questionnaire data base that provided information concerning the use of chromium reduction, 35 operate chromium reduction systems. All of the 35 facilities are in the metals subcategory. At these 35 facilities, there are four sulfur dioxide processes, 21 sodium bisulfite processes, and two sodium metabisulfite processes. The remaining systems use various other reducing agents.

Cyanide Destruction

8.2.2.7

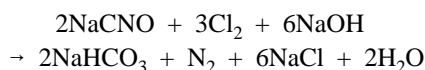
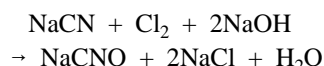
GENERAL DESCRIPTION

Electroplating and metal finishing operations produce the major portion of cyanide-bearing wastes accepted at CWT facilities. EPA observed three separate cyanide destruction techniques during site visits at CWT facilities. The first two methods are alkaline chlorination with gaseous chlorine and alkaline chlorination with sodium hypochlorite. The third method is a cyanide destruction process, details of which the generator has claimed are confidential business information (CBI). The two alkaline chlorination procedures are discussed here.

Alkaline chlorination can destroy free dissolved hydrogen cyanide and can oxidize all simple and some complex inorganic cyanides. It, however, cannot effectively oxidize stable iron, copper, and nickel cyanide complexes. The

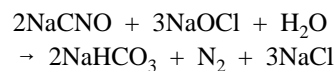
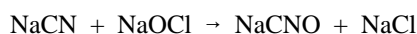
addition of heat to the alkaline chlorination process can facilitate the more complete destruction of total cyanides. The use of an extended retention time can also improve overall cyanide destruction. Figure 8-9 is a diagram of an alkaline chlorination system.

In alkaline chlorination using gaseous chlorine, the oxidation process is accomplished by direct addition of chlorine (Cl_2) as the oxidizer and sodium hydroxide (NaOH) to maintain pH levels. The reaction mechanism is:



The destruction of the cyanide takes place in two stages. The primary reaction is the partial oxidation of the cyanide to cyanate at a pH above 9. In the second stage, the pH is lowered to a range of 8 to 8.5 for the oxidation of the cyanate to nitrogen and carbon dioxide (as sodium bicarbonate). Each part of cyanide requires 2.73 parts of chlorine to convert it to cyanate and an additional 4.1 parts of chlorine to oxidize the cyanate to nitrogen and carbon dioxide. At least 1.125 parts of sodium hydroxide are required to control the pH with each stage.

Alkaline chlorination can also be conducted with sodium hypochlorite (NaOCl) as the oxidizer. The oxidation of cyanide waste using sodium hypochlorite is similar to the gaseous chlorine process. The reaction mechanism is:



In the first step, cyanide is oxidized to cyanate with the pH maintained in the range of 9 to 11. The second step oxidizes cyanate to carbon dioxide (as sodium bicarbonate) and nitrogen at a controlled pH of 8.5. The amount of sodium hypochlorite and sodium hydroxide needed to perform the oxidation is 7.5 parts and 8 parts per part of cyanide, respectively.

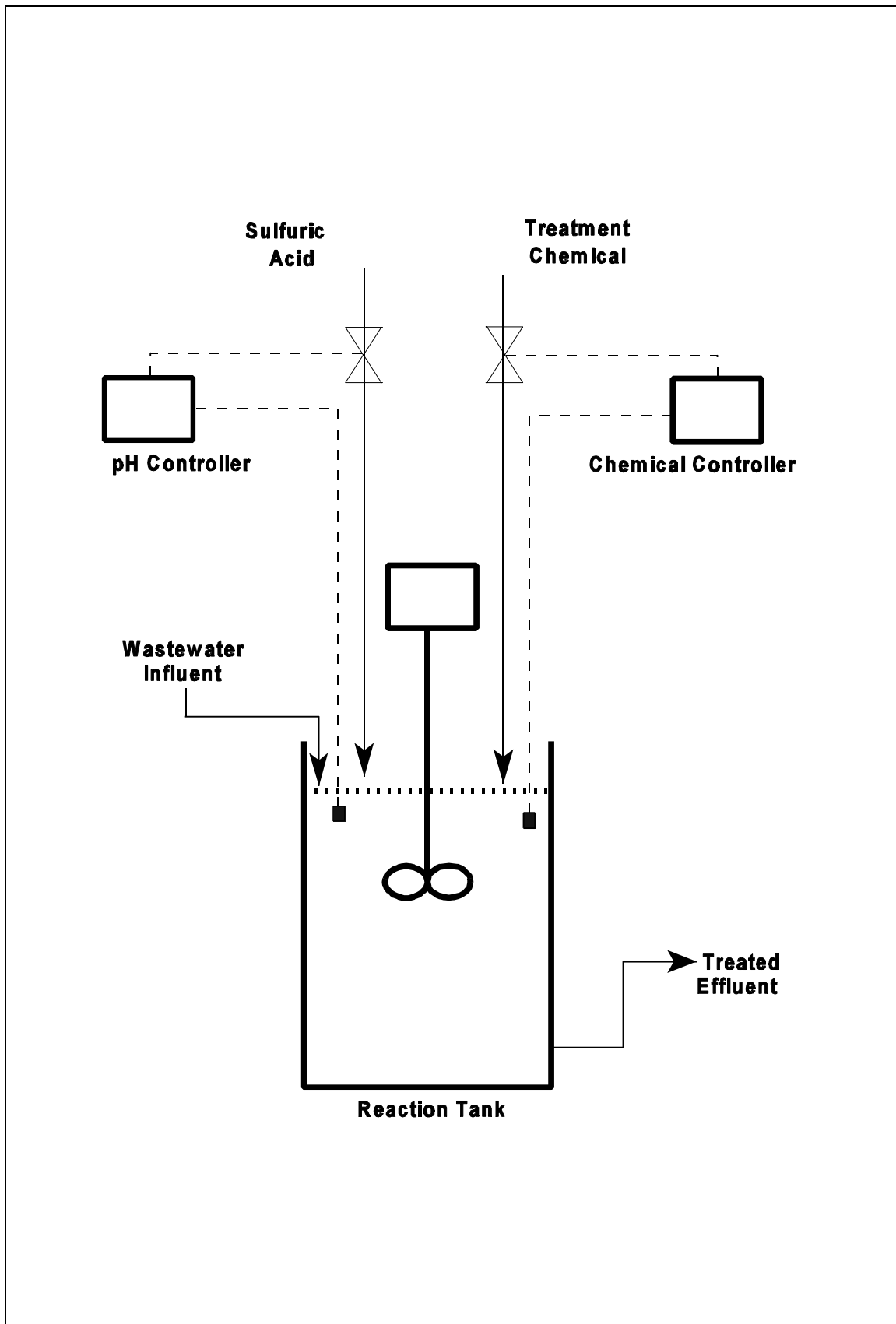


Figure 8-8. Chromium Reduction System Diagram

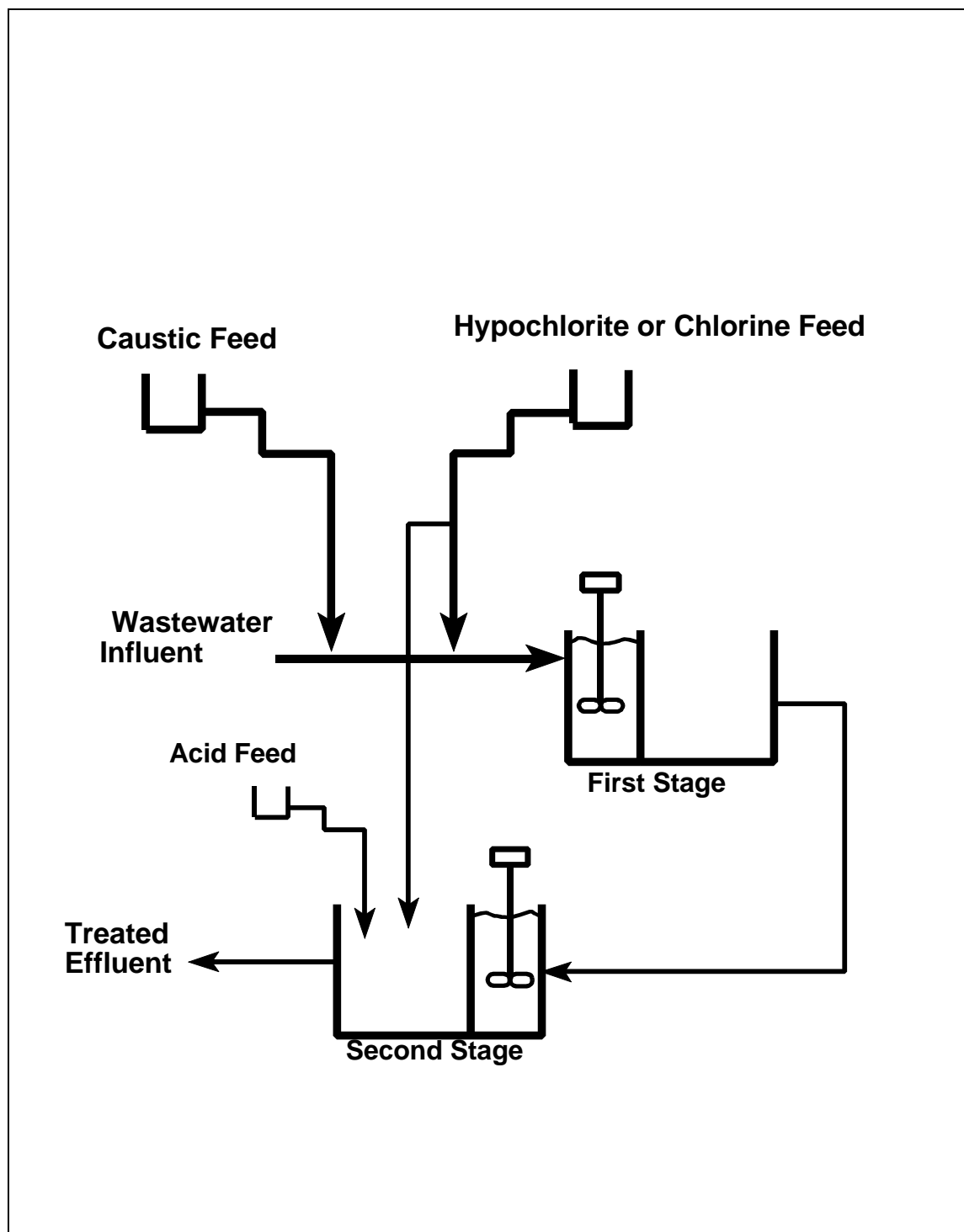


Figure 8.9 Cyanide Destruction by Alkaline Chlorination

INDUSTRY PRACTICE

Of the 65 CWT facilities in EPA's WTI Questionnaire data base that provided information concerning the use of cyanide destruction, 22 operate cyanide destruction systems. All of the 22 facilities are in the metals subcategory. Of these 22 facilities, one is a thermal unit, one is the CBI unit, and the rest are chemical reagent systems.

Chemical Precipitation

8.2.2.8

GENERAL DESCRIPTION

Many CWT facilities use chemical precipitation to remove metal compounds from wastewater. Chemical precipitation converts soluble metallic ions and certain anions to insoluble forms, which precipitate from solution. Chemical precipitation is usually performed in conjunction with coagulation/flocculation processes which facilitate the agglomeration of suspended and colloidal material. Most metals are relatively insoluble as hydroxides, sulfides, or carbonates. Coagulation/flocculation processes are used in conjunction with precipitation to facilitate removal by agglomeration of suspended and colloidal materials. The precipitated metals are subsequently removed from the wastewater stream by liquid filtration or clarification (or some other form of gravity-assisted separation). Other treatment processes such as equalization, or chemical oxidation or reduction (e.g., hexavalent chromium reduction) usually precede the chemical precipitation process. Chemical interactions, temperature, pH, solubility of waste contaminants, and mixing effects all affect the performance of the chemical precipitation process.

Chemical precipitation is a two-step process. At CWT facilities, it is typically performed in batch operations. In the first step, precipitants are mixed with the wastewater, typically by mechanical means, such as mixers, allowing the

formation of the insoluble metal precipitants. The detention time in this step of the process is specific to the wastewater being treated, the treatment chemicals used, and the desired effluent quality. In the second step, the precipitated metals are removed from the wastewater, typically through filtration or clarification. If clarification is used, a flocculent is sometimes added to aid the settling process. The resulting sludge from the clarifier or filter must be further treated, disposed, or recycled. A typical chemical precipitation system is shown in Figure 8-10.

Various chemicals may be used as precipitants. These include lime, sodium hydroxide (caustic), soda ash, sodium sulfide, and ferrous sulfate. Other chemicals used in the precipitation process for pH adjustment and/or coagulation include sulfuric and phosphoric acid, ferric chloride, and polyelectrolytes. Often, facilities use a combination of these chemicals. CWT facilities generally use hydroxide precipitation and/or sulfide precipitation. Hydroxide precipitation is effective in removing metals such as antimony, arsenic, chromium, copper, lead, mercury, nickel, and zinc. Sulfide precipitation is used instead of, or in addition to, hydroxide precipitation to remove specific metal ions including lead, copper, silver, cadmium, zinc, mercury, nickel, thallium, arsenic, antimony, and vanadium. Both hydroxide and sulfide precipitation are discussed in greater detail below.

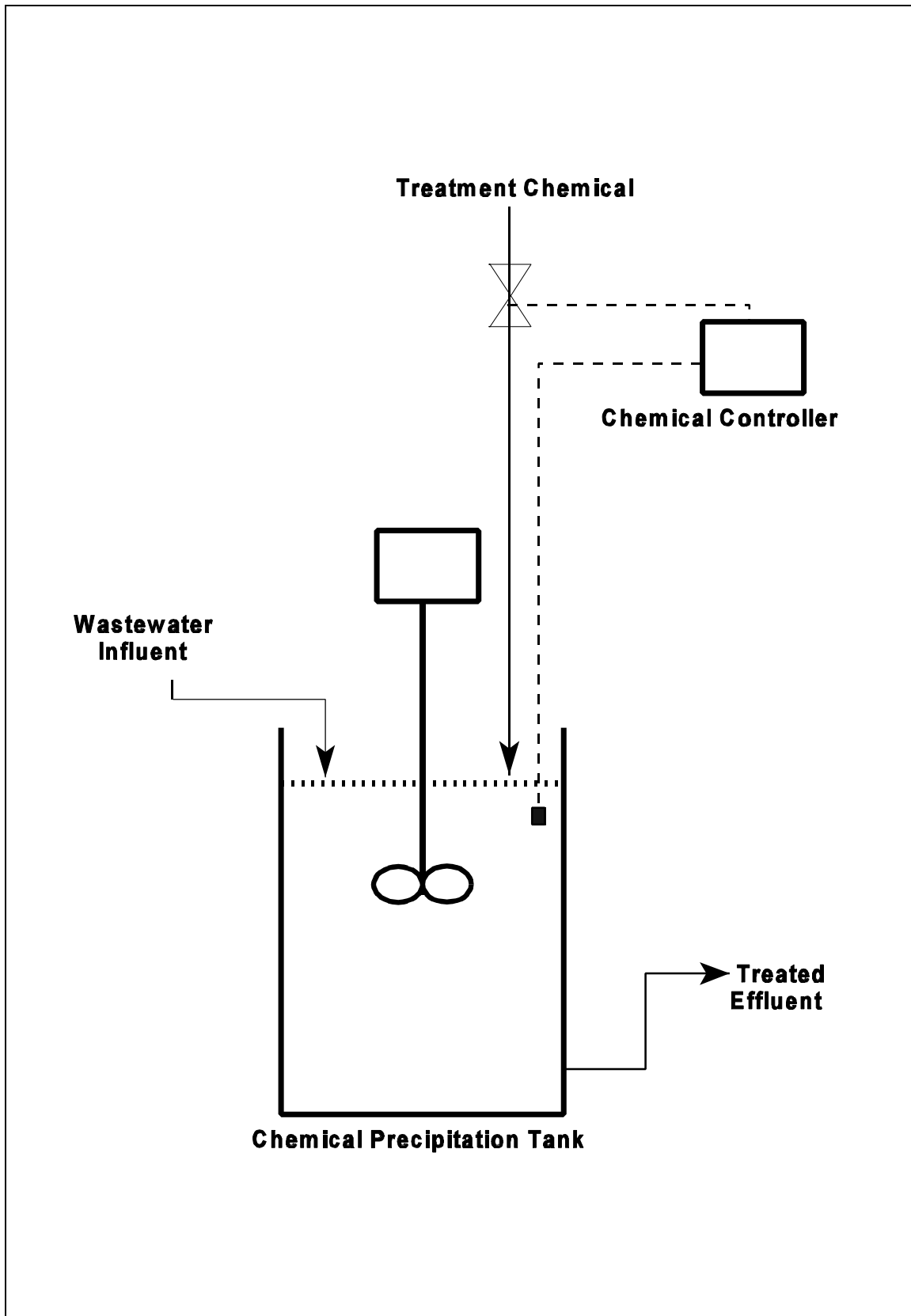
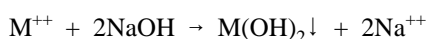
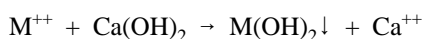


Figure 8-10. Chemical Precipitation System Diagram

Hydroxide precipitation using lime or caustic is the most commonly-used means of chemical precipitation at CWT facilities. Of these, lime is used more often than caustic. The reaction mechanism for each of these is as follows:

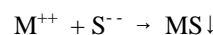


The chief advantage of lime over caustic is its lower cost. However, lime is more difficult to handle and feed, as it must be slaked, slurried, and mixed, and can plug the feed system lines. Lime also produces a larger volume of sludge than caustic, and the sludge is generally not suitable for reclamation due to its homogeneous nature.

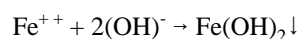
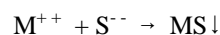
Sulfide precipitation is the next most commonly-used means of chemical precipitation at CWT facilities. It is used to remove lead, copper, silver, cadmium, zinc, mercury, nickel, thallium, arsenic, antimony, and vanadium from wastewaters. An advantage of the sulfide process over the hydroxide process is that it can reduce hexavalent chromium to the trivalent state under the same process conditions required for metals precipitation. The use of sulfides also allows for the precipitation of metals when chelating agents are present. The two most common sulfide precipitation processes are the soluble sulfide process and the insoluble sulfide (Sulfex) process.

In the soluble sulfide process, either sodium sulfide or sodium hydrosulfide, both highly soluble, is added in high concentration either as a liquid reagent or from rapid mix tanks using solid reagents. This high concentration of soluble sulfides results in rapid precipitation of metals which then results in the generation of fine precipitate particles and hydrated colloidal particles. These fine particles do not settle or filter well without the addition of coagulating and

flocculating agents to aid in the formation of larger, fast-settling floc. The high concentration of soluble sulfides may also lead to the generation of highly toxic and odorous hydrogen sulfide gas. To control this problem, the treatment facility must carefully control the dosage and/or the process vessels must be enclosed and vacuum evacuated. The reaction mechanism for soluble sulfide precipitation is:



The basic principle governing the insoluble sulfide process is that ferrous sulfide (FeS) will disassociate into ferrous and sulfide ions, as predicted by its solubility, producing a sulfide concentration of approximately 2 mg/l under normal conditions. In the insoluble sulfide process, a slurry of freshly prepared FeS (prepared by reactive FeSO₄ and NaHS) is added to the wastewater. As the sulfide ions are consumed in precipitating the metal pollutants, additional FeS will disassociate. This will continue as long as other heavy metals with lower equilibrium constants are present in solution. Because most heavy metals have sulfides that are less soluble than ferrous sulfate, they will precipitate as metal sulfides. In addition, if given enough time, any metal hydroxides present will dissolve and precipitate out as sulfides. If the operation is performed under alkaline conditions, the released ferrous ion will precipitate out as a hydroxide. The following reactions occur when FeS is added to a solution that contains dissolved metal and metal hydroxide:



One advantage of the insoluble sulfide

process over the soluble sulfide process is that the insoluble sulfide process generates no detectable H_2S gas odor. This is because the dissolved sulfide concentration is maintained at a relatively low concentration. Disadvantages of the insoluble sulfide process include considerably higher than stoichiometric reagent consumption and significantly higher sludge generation than either the hydroxide or soluble sulfide process.

Wastewater treatment facilities often choose to combine hydroxide precipitation and sulfide precipitation for optimal metals removal. A common configuration is a two-stage process in which hydroxide precipitation is followed by sulfide precipitation with each stage followed by a separate solids removal step. This will produce the high quality effluent of the sulfide precipitation process while significantly reducing the volume of sludge generated and the consumption of sulfide reagent.

In addition to the type of treatment chemical chosen, another important operational variable in chemical precipitation is pH. Metal hydroxides are amphoteric, meaning they can react chemically as acids or bases. As such, their solubilities increase toward both lower and higher pH levels. Therefore, there is an optimum pH for hydroxide precipitation for each metal, which corresponds to its point of minimum solubility. Figure 8-11 presents calculated solubilities of metal hydroxides. For example, as demonstrated in this figure, the optimum pH range where zinc is the least soluble is between 8 and 10. The solubility of metal sulfides is not as sensitive to changes in pH as hydroxides and generally decreases as pH increases. The typical operating pH range for sulfide precipitation is between 7 and 9. Arsenic and antimony are exceptions to this rule and require a pH below 7 for optimum removal. As such, another advantage of sulfide precipitation over hydroxide precipitation is that most metals can be removed to extremely low

concentrations at a single pH.

For wastewater contaminated with a single metal, selecting the optimum treatment chemical and treatment pH for precipitation simply requires the identification of the treatment chemical/pH combination that produces the lowest solubility of that metal. This is typically done using a series of bench-scale treatability tests. However, when wastewater is contaminated with more than one metal, as is often the case for wastewaters at CWT facilities, selecting the optimum treatment chemical and pH for a single-stage precipitation process becomes more difficult and often involves a tradeoff between optimal removal of two or more metals. In general, for wastewater contaminated with multiple metals, EPA has concluded that a single-stage precipitation process does not provide for adequate treatment. In such cases, a series of chemical treatment steps using different pH values and/or different treatment chemicals may be more appropriate. Each of these treatment steps needs to be followed by a solids separation step in order to prevent the resolubilization of metal precipitates during the subsequent treatment step.

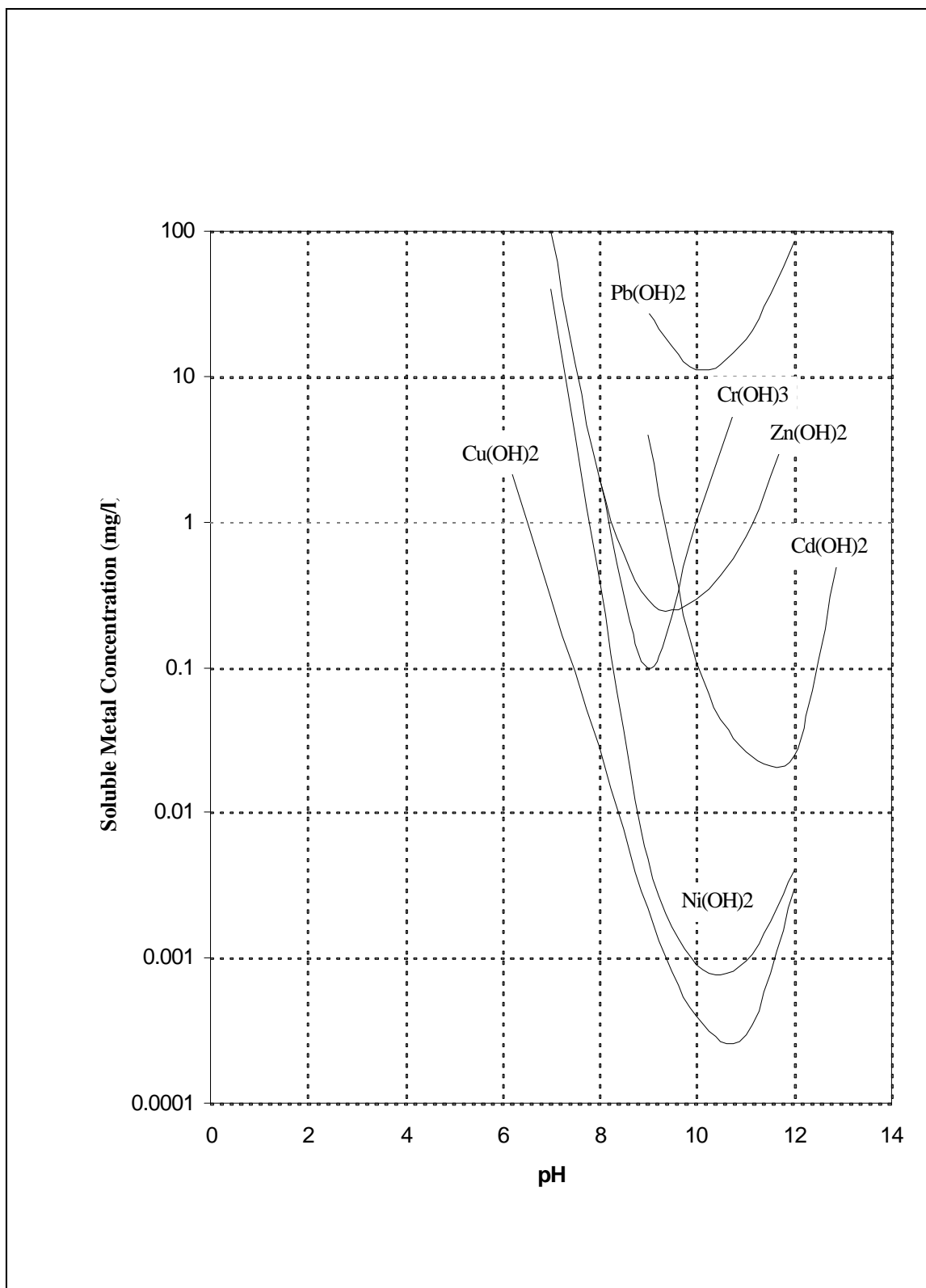


Figure 8-11. Calculated Solubilities of Metal Hydroxides

In order to take advantage of the effects of pH and treatment chemical selection on metals precipitation, a facility may hold its wastes and segregate them by pollutant content for treatment. This type of waste treatment management, called selective metals precipitation, may be adopted in order to optimize the recovery of specific metal pollutants. In instances where the segregated wastes contain several metals, the pH of the precipitation process may be adjusted so that the desired metal for recovery is precipitated in greater proportion than the other metals. Multiple precipitation steps are then performed in series on a single waste stream using different pH values, resulting in different metals being selectively precipitated into separate sludges. The production of specific sludges containing only the target metals makes the sludges more suitable for reclamation. If the sludge is to be sold to a smelter for re-use, then hydroxide precipitation using only caustic should be performed. The calcium compounds from lime would interfere with the smelting process.

Selective precipitation is advantageous because the metals may be reclaimed and re-used rather than disposed as a sludge in a landfill and because it allows for optimal removal of the metals of concern. However, selective metals precipitation does have additional costs such as those associated with the extra tanks and operating personnel required for waste segregation.

INDUSTRY PRACTICE

Of the 116 CWT facilities in EPA's WTI Questionnaire and NOA comment data base that provided information concerning the use of chemical precipitation, 57 operate chemical precipitation systems. Fifty-one of these facilities treat metals subcategory wastewaters. As discussed previously, a single facility may use several chemical precipitation steps, depending

upon the type of waste being treated. Of the 51 chemical precipitation systems at metals subcategory facilities, 13 operate secondary precipitation processes, four operate tertiary precipitation processes, and one employs selective chemical precipitation processes.

Filtration

8.2.2.9

Filtration is a method for separating solid particles from a fluid through the use of a porous medium. The driving force in filtration is a pressure gradient caused by gravity, centrifugal force, pressure, or a vacuum. CWT facilities use filtration treatment processes to remove solids from wastewaters after physical/chemical or biological treatment, or as the primary source of waste treatment. Filtration processes utilized in the CWT industry include a broad range of media and membrane separation technologies.

To aid in removal, the filter medium may be precoated with a filtration aid such as ground cellulose or diatomaceous earth. Polymers are sometimes injected into the filter feed piping downstream of feed pumps to enhance flocculation of smaller flocs to improve solids capture. The following sections discuss the various types of filtration in use at CWT facilities.

1. SAND FILTRATION

GENERAL DESCRIPTION

Sand filtration processes consist of either a fixed or moving bed of media that traps and removes suspended solids from water passing through the media. There are two types of fixed sand bed filters: pressure and gravity. Pressure filters contain media in an enclosed, watertight pressure vessel and require a feed pump to force the water through the media. A gravity filter operates on the basis of differential pressure of a static head of water above the media, which causes flow through the filter. Filter loading rates

for sand filters are typically between 2 to 6 gpm/sq ft .

Fixed media filters have influent and effluent distribution systems consisting of pipes and fittings. A stainless steel screen covered with gravel generally serves as the tank bottom and support for the sand. Dirty water enters the top of the filter and travels downward.

Moving bed filters use an air lift pump and draft tube to recirculate sand from the bottom to the top of the filter vessel, which is usually open at the top. Dirty water entering the filter at the bottom must travel upward, countercurrently, through the downward moving fluidized sand bed. Particles are strained from the rising water and carried downward with the sand. Due to the difference in specific gravity, the lighter particles are removed from the filter when the sand is recycled through a separation box often located at the top of the filter. The heavier sand falls back into the filter, while the lighter particles are washed over a weir to waste.

Both fixed media and moving bed filters build up head loss over time. Head loss is a measure of solids trapped in the filter. As the filter becomes filled with trapped solids, the efficiency of the filtration process falls off, and the filter must be backwashed. Reversing the flow will backwash filters so that the solids in the media are dislodged and may exit the filter. Sometimes air is dispersed into the sand bed to scour the media.

Fixed bed filters may be automatically backwashed when the differential pressure exceeds a preset limit or when a timer starts the backwash cycle. A supply of clean backwash water is required. Backwash water and trapped particles are commonly discharged to an equalization tank upstream of the wastewater treatment system's gravity separation system or screen for removal. Moving bed filters are continuously backwashed and have a constant

rate of effluent flow.

INDUSTRY PRACTICE

Of the 65 CWT facilities in EPA's WTI Questionnaire data base that provided information concerning use of sand filtration, eight operate sand filtration systems.

2. *MULTIMEDIA FILTRATION*

GENERAL DESCRIPTION

CWT facilities may use multimedia, or granular bed, filtration to achieve supplemental removal of residual suspended solids from the effluent of chemical and biological treatment processes. In granular bed filtration, the wastewater stream is sent through a bed containing two or more layers of different granular materials. The solids are retained in the voids between the media particles while the wastewater passes through the bed. Typical media used in granular bed filters include anthracite coal, sand, and garnet.

A multimedia filter is designed so that the finer, denser media is at the bottom and the coarser, less dense media at the top. A common arrangement is garnet at the bottom of the bed, sand in the middle, and anthracite coal at the top. Some mixing of these layers occurs and is anticipated. During filtration, the removal of the suspended solids is accomplished by a complex process involving one or more mechanisms such as straining, sedimentation, interception, impaction, and adsorption. The medium size is the principal characteristic that affects the filtration operation. If the medium is too small, much of the driving force will be wasted in overcoming the frictional resistance of the filter bed. If the medium is too large, small particles will travel through the bed, preventing optimum filtration.

By designing the filter bed so that pore size decreases from the influent to the effluent side of the bed, different size particles are filtered out at

different depths (larger particles first) of the filter bed. This helps prevent the build up of a single layer of solids at the bed surface which can quickly increase the pressure drop over the bed resulting in shorter filter runs and more frequent backwash cycles. Thus, the advantage of multimedia filtration over sand filtration is longer filter runs and less frequent backwash cycles.

The flow pattern of multimedia filters is usually top-to-bottom. Upflow filters, horizontal filters, and biflow filters are also used. Figure 8-12 is a top-to-bottom multimedia filter. The classic multimedia filter operates by gravity. However, pressure filters are occasionally used.

The complete filtration process involves two phases: filtration and backwashing. As the filter becomes filled with trapped solids, the efficiency of the filtration process falls off. Head loss is a measure of solids trapped in the filter. As the head loss across the filter bed increases to a limiting value, the end of the filter run is reached and the filter must be backwashed to remove the suspended solids in the bed. During backwashing, the flow through the filter is reversed so that the solids trapped in the media are dislodged and can exit the filter. The bed may also be agitated with air to aid in solids removal. Backwash water and trapped particles are commonly discharged to an equalization tank upstream of the wastewater treatment system's gravity separation system or screen for removal.

An important feature in filtration and backwashing is the underdrain. The underdrain is the support structure for the filtration bed. The underdrain provides an area for the accumulation of the filtered water without it being clogged from the filtered solids or the media particles. During backwash, the underdrain provides even flow distribution over the bed. This is important because the backwash flowrate is set so that the filter bed expands but the media is not carried out with the backwashed solids. The media with

different densities then settle back down in somewhat discrete layers at the end of the backwash step.

INDUSTRY PRACTICE

Of the 65 CWT facilities in EPA's WTI Questionnaire data base that provided information concerning use of multimedia filtration, four operate multimedia filtration systems.

3. *PLATE AND FRAME PRESSURE FILTRATION* GENERAL DESCRIPTION

Another filtration system for the removal of solids from waste streams is a plate and frame pressure filtration systems. Although plate and frame filter presses are more commonly used for dewatering sludges, they are also used to remove solids directly from wastewater streams. The liquid stream plate and frame pressure filtration system is identical to the system used for the sludge stream (section 8.4.1) with the exception of a lower solids level in the influent stream. The same equipment is used for both applications, with the difference being the sizing of the sludge and liquid units. See section 8.4.1 for a detailed description of plate and frame pressure filtration. No CWT facilities in EPA's database use plate and frame filtration.

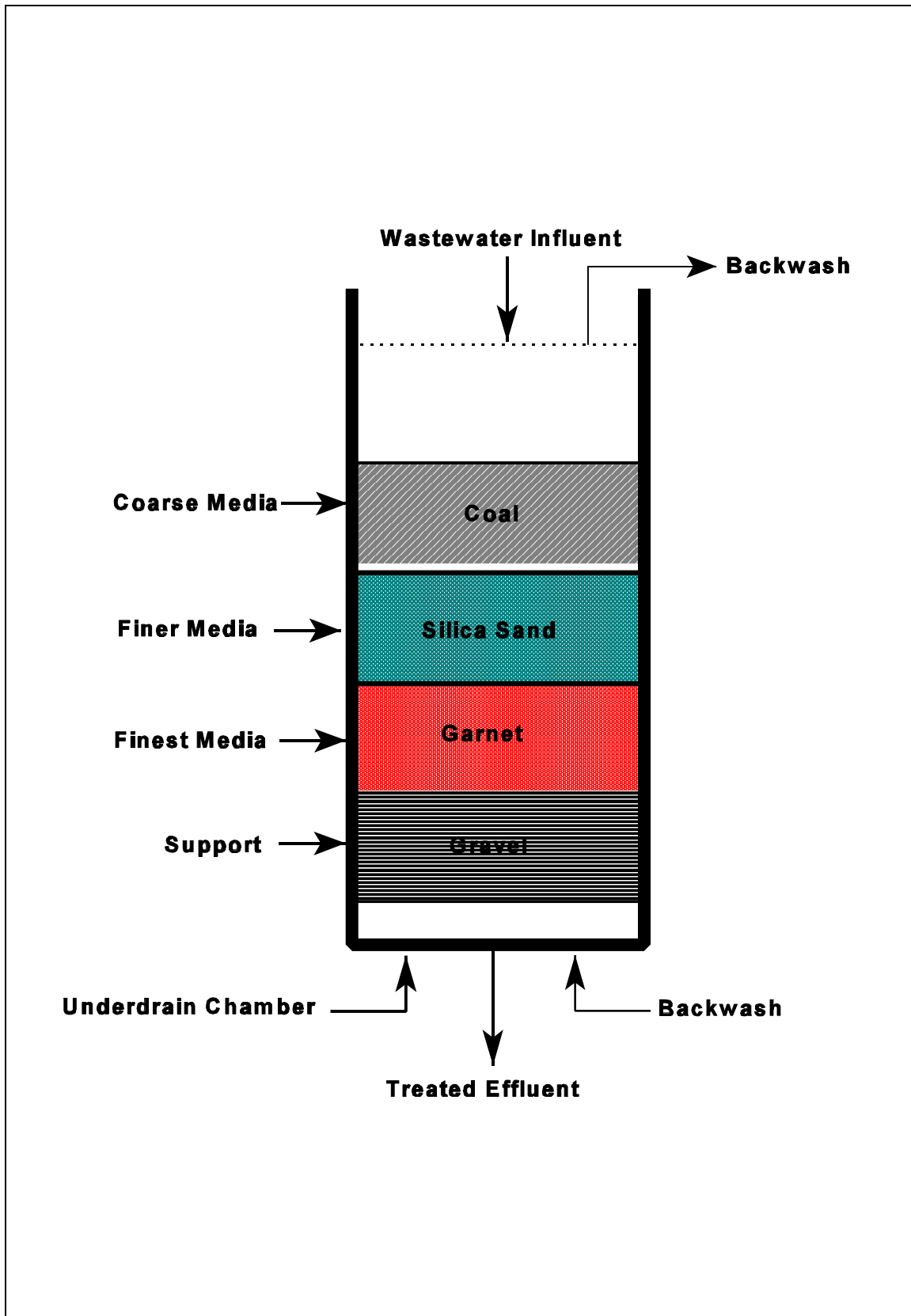


Figure 8-12. Multi-Media Filtration System Diagram

4. MEMBRANE FILTRATION

GENERAL DESCRIPTION

Membrane filtration systems are processes which employ semi-permeable membranes and a pressure differential to remove solids in wastestreams. Reverse osmosis and ultrafiltration are two commonly-used membrane filtration processes.

A. ULTRAFILTRATION

GENERAL DESCRIPTION

CWT facilities commonly use ultrafiltration (UF) for the treatment of metal-finishing wastewater and oily wastes. It can remove substances with molecular weights greater than 500, including suspended solids, oil and grease, large organic molecules, and complexed heavy metals. UF can be used when the solute molecules are greater than ten times the size of the solvent molecules, and are less than one-half micron. In the CWT industry, UF is applied in the treatment of oil/water emulsions. Oil/water emulsions contain both soluble and insoluble oil. Typically the insoluble oil is removed from the emulsion by gravity separation assisted by emulsion breaking. The soluble oil is then removed by UF. Oily wastewater containing 0.1 to 10 percent oil can be effectively treated by UF. Figure 8-13 shows a UF system.

In UF, a semi-permeable microporous membrane performs the separation. Wastewater is sent through membrane modules under pressure. Water and low-molecular-weight solutes (for example, salts and some surfactants) pass through the membrane and are removed as permeate. Emulsified oil and suspended solids are rejected by the membrane and are removed as concentrate. The concentrate is recirculated through the membrane unit until the flow of permeate drops. The permeate may either be discharged or passed along to another treatment unit. The concentrate is contained and held for

further treatment or disposal. An important advantage of UF over reverse osmosis is that the concentrate may be treated to remove the concentrated solids and the separated water may then be retreated through the UF system.

The primary design consideration in UF is the membrane selection. A membrane pore size is chosen based on the size of the contaminant particles targeted for removal. Other design parameters to be considered are the solids concentration, viscosity, and temperature of the feed stream, pressure differential, and the membrane permeability and thickness. The rate at which a membrane fouls is also an important design consideration.

INDUSTRY PRACTICE

Of the 116 CWT facilities in EPA's WTI Questionnaire and NOA comment data base that provided information concerning use of ultrafiltration, six operate ultrafiltration systems.

B. REVERSE OSMOSIS

GENERAL DESCRIPTION

Reverse osmosis (RO) is a process for separating dissolved solids from water. CWT facilities commonly use RO in treating oily or metal-bearing wastewater. RO is applicable when the solute molecules are approximately the same size as the solvent molecules. A semi-permeable, microporous membrane and pressure are used to perform the separation. RO systems are typically used as polishing processes, prior to final discharge of the treated wastewater. Reverse osmosis systems have been demonstrated to be effective in removing dissolved metals.

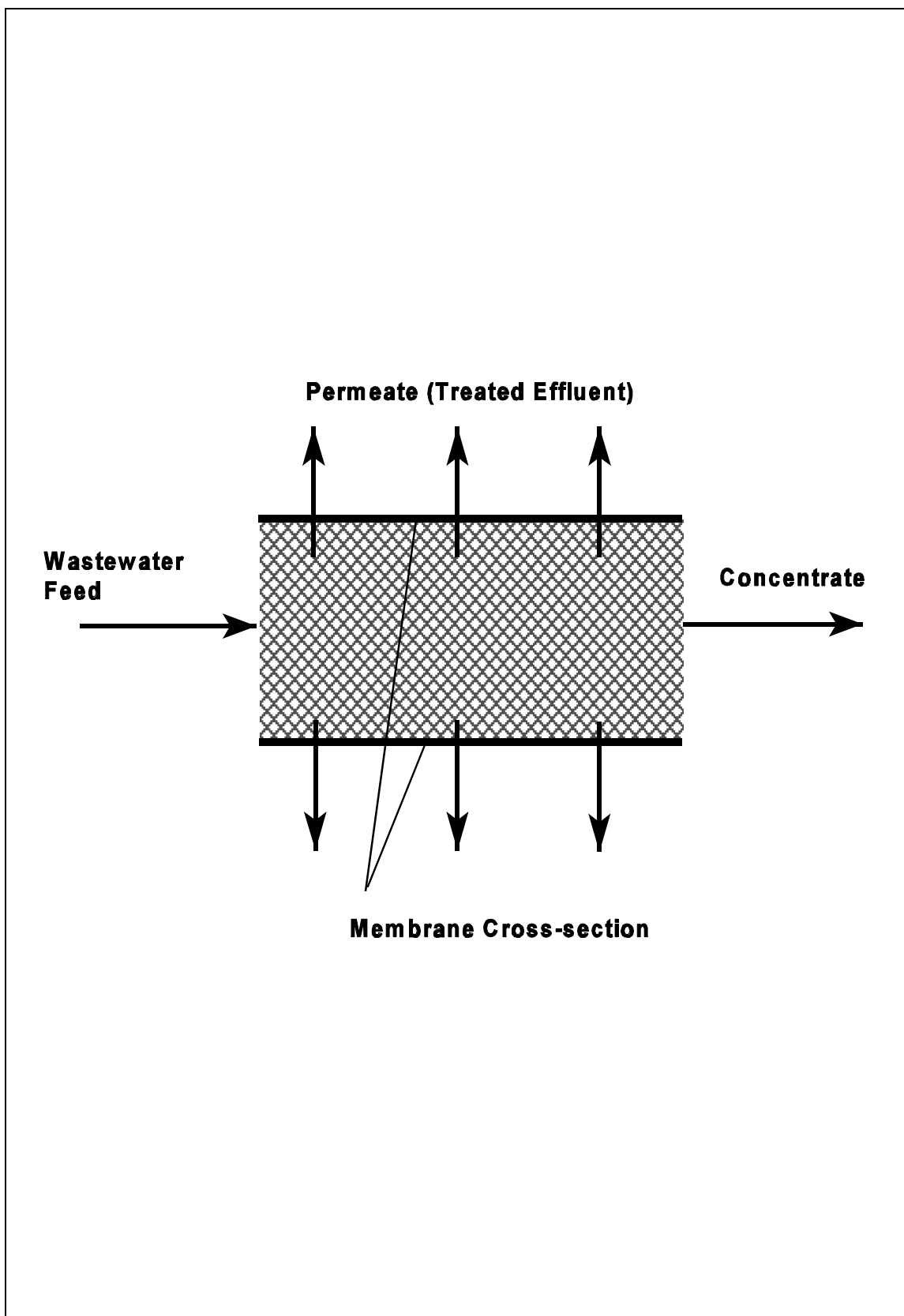


Figure 8-13. Ultrafiltration System Diagram

Osmosis is the diffusion of a solvent (such as water) across a semi-permeable membrane from a less concentrated solution into a more concentrated solution. In the reverse osmosis process, pressure greater than the normal osmotic pressure is applied to the more concentrated solution (the waste stream being treated), forcing the purified water through the membrane and into the less concentrated stream which is called the permeate. The low-molecular-weight solutes (for example, salts and some surfactants) do not pass through the membrane. They are referred to as concentrate. The concentrate is recirculated through the membrane unit until the flow of permeate drops. The permeate can either be discharged or passed along to another treatment unit. The concentrate is contained and held for further treatment or disposal. Figure 8-14 shows an RO system.

The performance of an RO system is dependent upon the dissolved solids concentration and temperature of the feed stream, the applied pressure, and the type of membrane selected. The key RO membrane properties to be considered are: selectivity for water over ions, permeation rate, and durability. RO modules are available in various membrane configurations, such as spiral-wound, tubular, hollow-fiber, and plate and frame. In addition to the membrane modules, other capital items needed for an RO installation include pumps, piping, instrumentation, and storage tanks. The major operating cost is attributed to membrane replacement. A major consideration for RO systems is the disposal of the concentrate due to its elevated concentrations of salts, metals, and other dissolved solids.

INDUSTRY PRACTICE

Of the 65 CWT facilities in EPA's WTI Questionnaire data base that provided information concerning use of reverse osmosis,

two operate reverse osmosis systems.

5. LANCY FILTRATION

GENERAL DESCRIPTION

The Lancy Sorption Filter System is a patented method for the continuous recovery of heavy metals. The Lancy sorption filtration process may reduce metals not removed by conventional waste treatment technologies to low concentrations.

In the first stage of the Lancy filtration process, a soluble sulfide is added to the wastewater in a reaction tank, converting most of the heavy metals to sulfides. From the sulfide reaction tank, the solution is passed through the sorption filter media. Precipitated metal sulfides and other suspended solids are filtered out. Any remaining soluble metals are absorbed by the media. Excess soluble sulfides are also removed from the waste stream.

The Lancy filtration process reportedly reduces zinc, silver, copper, lead, and cadmium to less than 0.05 mg/l and mercury to less than 2 µg/l. In addition to the effective removal of heavy metals, the system has a high solids filtration capacity and a fully automatic, continuous operation. The system continuously recycles and reuses the same filter media thereby saving on operating costs. The system may be installed with a choice of media discharge - slurry or solid cake. Figure 8-15 illustrates the Lancy Sorption Filtration System.

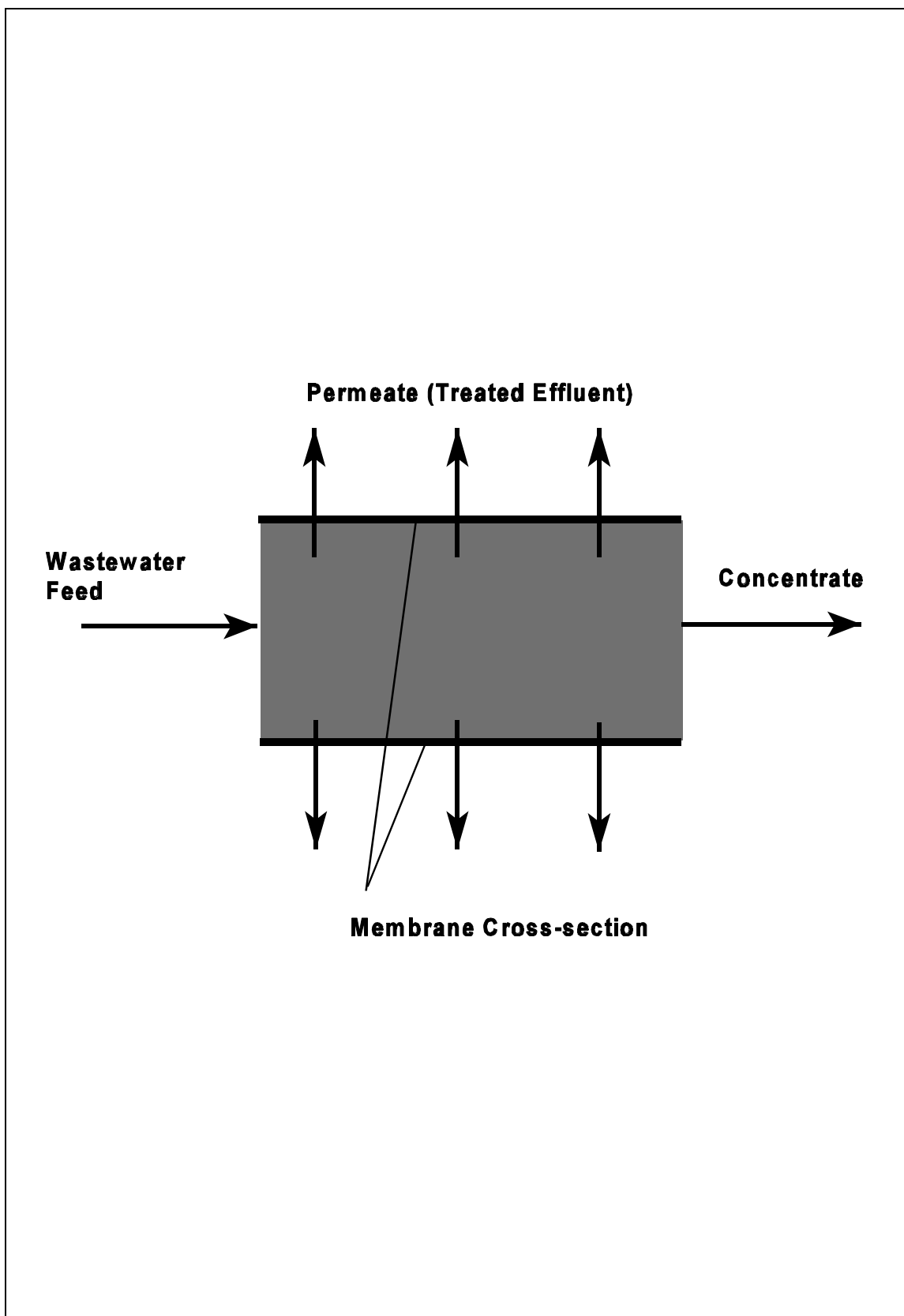


Figure 8-14. Reverse Osmosis System Diagram

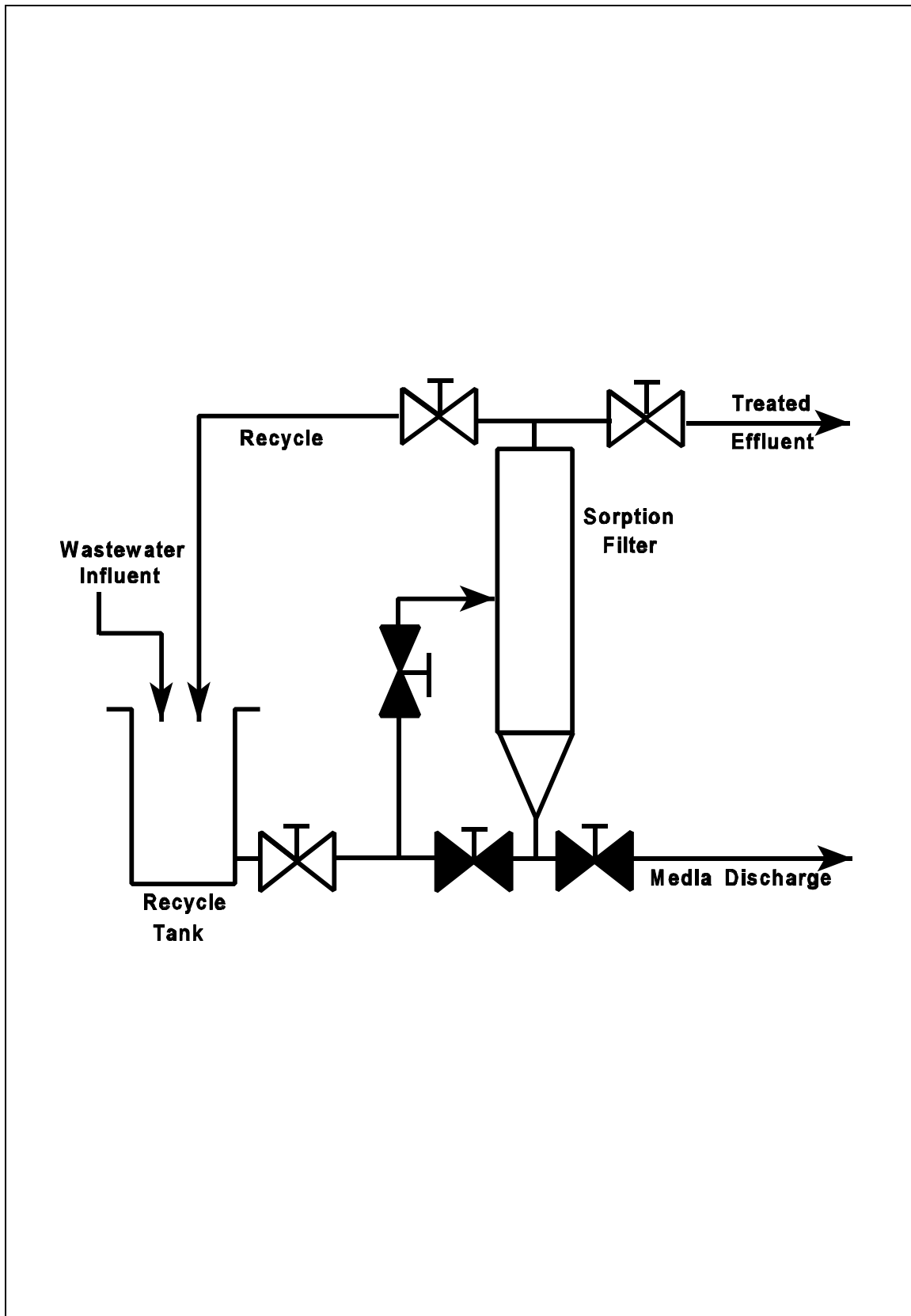


Figure 8-15. Lancy Filtration System Diagram

INDUSTRY PRACTICE

Of the 65 CWT facilities in EPA's WTI Questionnaire data base that provided information concerning use of filtration systems, only one operates the Lancy Sorption Filtration System. This unit is used for polishing effluent from a treatment sequence including chemical precipitation, clarification, and sand filtration. EPA obtained performance data for this system during a sampling episode at one of the metals subcategory facilities. The performance data showed that some metals were reduced to the target levels while the concentration of some pollutants increased. This may not represent optimal performance of the system, however, because the facility reported that they were experiencing operational problems throughout the sampling episode.

Carbon Adsorption

8.2.2.10

GENERAL DESCRIPTION

Activated carbon adsorption is a demonstrated wastewater treatment technology that uses activated carbon to remove dissolved organic pollutants from wastewater. The activated carbon is made from many carbonaceous sources including coal, coke, peat, wood, and coconut shells. The carbon source material is "activated" by treating it with an oxidizing gas to form a highly porous structure with a large internal surface area. CWT facilities generally use granular forms of activated carbon (GAC) in fixed bed columns to treat wastewater. However, some use powdered activated carbon (PAC) alone or in conjunction with biological treatment. Figure 8-16 presents a diagram of a fixed-bed GAC column.

In a fixed bed system, the wastewater enters the top of the unit and is allowed to flow downward through a bed of granular activated carbon. As the wastewater comes into contact

with the activated carbon, the dissolved organic compounds adsorb onto the surface of the activated carbon. In the upper area of the bed, the pollutants are rapidly adsorbed. As more wastewater passes through the bed, this rapid adsorption zone moves downward until it reaches the bottom of the bed. At this point, all of the available adsorption sites are filled and the carbon is said to be exhausted. This condition can be detected by an increase in the effluent pollutant concentration, and is called breakthrough.

GAC systems are usually comprised of several beds operated in series. This design allows the first bed to go to exhaustion, while the other beds still have the capacity to treat to an acceptable effluent quality. The carbon in the first bed is replaced, and the second bed then becomes the lead bed. The GAC system piping is designed to allow switching of bed order.

After the carbon is exhausted, it can be removed and regenerated. Usually heat or steam is used to reverse the adsorption process. The light organic compounds are volatilized and the heavy organic compounds are pyrolyzed. Spent carbon may also be regenerated by contacting it with a solvent which dissolves the adsorbed pollutants. Depending on system size and economics, some facilities may choose to dispose of the spent carbon instead of regenerating it. For very large applications, an on-site regeneration facility is more economical. For smaller applications, such as in the CWT industry, it is generally cost-effective to use a vendor service to deliver regenerated carbon and remove the spent carbon. These vendors transport the spent carbon to their centralized facilities for regeneration.

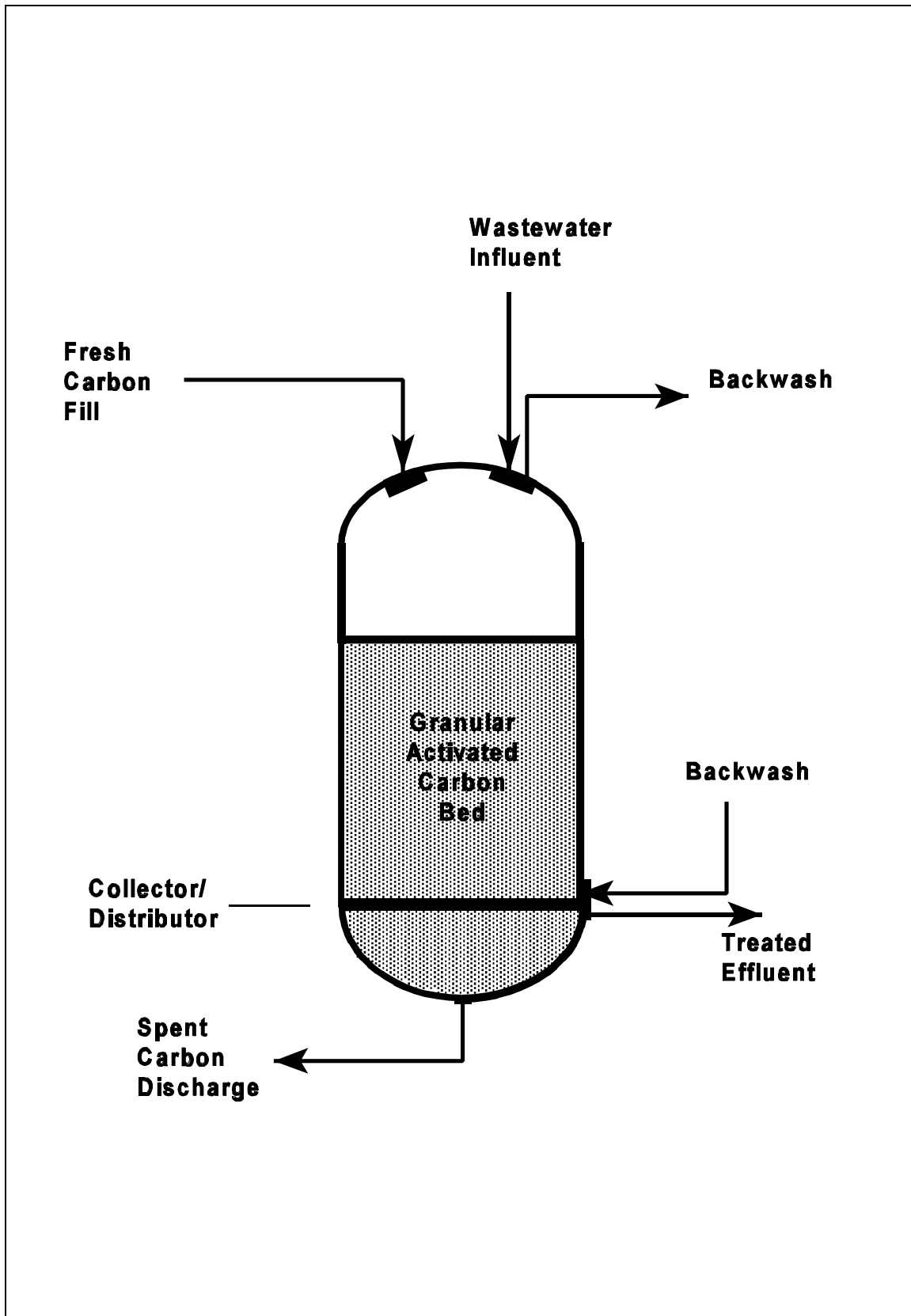


Figure 8-16. Carbon Adsorption System Diagram

The carbon adsorption mechanism is complicated and, although the attraction is primarily physical, is a combination of physical, chemical, and electrostatic interactions between the activated carbon and the organic compound. The key design parameter for activated carbon is the adsorption capacity of the carbon. The adsorption capacity is a measure of the mass of contaminant adsorbed per unit mass of activated carbon and is a function of the compound being adsorbed, the type of carbon used, and the process design and operating conditions. In general, the adsorption capacity is inversely proportional to the adsorbate solubility. Nonpolar, high molecular weight organics with low solubility are readily adsorbed. Polar, low molecular weight organics with high solubilities are more poorly adsorbed.

Competitive adsorption between compounds has an effect on adsorption. The carbon may preferentially adsorb one compound over another. This competition could result in an adsorbed compound being desorbed from the carbon. This is most pronounced when carbon adsorption is used to treat wastewater with highly variable pollutant character and concentration.

INDUSTRY PRACTICE

Of the 116 CWT facilities in EPA's WTI Questionnaire and NOA comment data base that provided information concerning use of carbon adsorption, 17 operate carbon adsorption systems.

Ion Exchange

8.2.2.11

GENERAL DESCRIPTION

A common process employed to remove heavy metals from relatively low-concentration waste streams, such as electroplating wastewater, is ion exchange. A key advantage of the ion exchange process is that the metal contaminants

can be recovered and reused. Another advantage is that ion exchange may be designed to remove certain metals only, providing effective removal of these metals from highly-contaminated wastewater. A disadvantage is that the resins may be fouled by some organic substances.

In an ion exchange system, the wastewater stream is passed through a bed of resin. The resin contains bound groups of ionic charge on its surface, which are exchanged for ions of the same charge in the wastewater. Resins are classified by type, either cationic or anionic. The selection is dependent upon the wastewater contaminant to be removed. A commonly-used resin is polystyrene copolymerized with divinylbenzene.

The ion exchange process involves four steps: treatment, backwash, regeneration, and rinse. During the treatment step, wastewater is passed through the resin bed and ions are exchanged until pollutant breakthrough occurs. The resin is then backwashed to reclassify the bed and to remove suspended solids. During the regeneration step, the resin is contacted with either an acidic or alkaline solution containing high concentrations of the ion originally present in the resin. This "reverses" the ion exchange process and removes the metal ions from the resin. The bed is then rinsed to remove residual regenerating solution. The resulting contaminated regenerating solution must be further processed for reuse or disposal. Depending upon system size and economics, some facilities choose to remove the spent resin and replace it with resin regenerated off-site instead of regenerating the resin in-place.

Ion exchange equipment ranges from simple, inexpensive systems such as domestic water softeners, to large, continuous industrial applications. The most commonly-encountered industrial setup is a fixed-bed resin in a vertical column, where the resin is regenerated in-place. Figure 8-17 is a diagram of this type of system.

These systems may be designed so that the regenerant flow is concurrent or countercurrent to the treatment flow. A countercurrent design, although more complex to operate, provides a higher treatment efficiency. The beds may contain a single type of resin for selective treatment, or the beds may be mixed to provide for more complete deionization of the waste stream. Often, individual beds containing different resins are arranged in series, which makes regeneration easier than in the mixed bed system.

INDUSTRY PRACTICE

EPA is aware of only one CWT facility using ion exchange.

Electrolytic Recovery

8.2.2.12

GENERAL DESCRIPTION

Another process for reclaiming metals from wastewater is electrolytic recovery. It is a common technology in the electroplating, mining, and electronic industries. It is used for the recovery of copper, zinc, silver, cadmium, gold, and other heavy metals. Nickel is poorly recovered due to its low standard potential.

The electrolytic recovery process uses an oxidation and reduction reaction. Conductive electrodes (anodes and cathodes) are immersed in the metal-bearing wastewater, with an electric potential applied to them. At the cathode, a metal ion is reduced to its elemental form (electron-consuming reaction). At the same time, gases such as oxygen, hydrogen, or nitrogen form at the anode (electron-producing reaction). After the metal coating on the cathode reaches a desired thickness, it may be removed and recovered. The metal-stripped cathode can then be used as the anode.

The equipment consists of an electrochemical reactor with electrodes, a gas-venting system,

recirculation pumps, and a power supply. Figure 8-18 is a diagram of an electrolytic recovery system. Electrochemical reactors are typically designed to produce high flow rates to increase the process efficiency.

A conventional electrolytic recovery system is effective for the recovery of metals from relatively high-concentration wastewater. A specialized adaptation of electrolytic recovery, called extended surface electrolysis, or ESE, operates effectively at lower concentration levels. The ESE system uses a spiral cell containing a flow-through cathode which has a very open structure and therefore a lower resistance to fluid flow. This also provides a larger electrode surface. ESE systems are often used for the recovery of copper, lead, mercury, silver, and gold.

INDUSTRY PRACTICE

Of the 65 CWT facilities in EPA's WTI Questionnaire data base that provided information concerning use of electrolytic recovery, three operate electrolytic recovery systems.

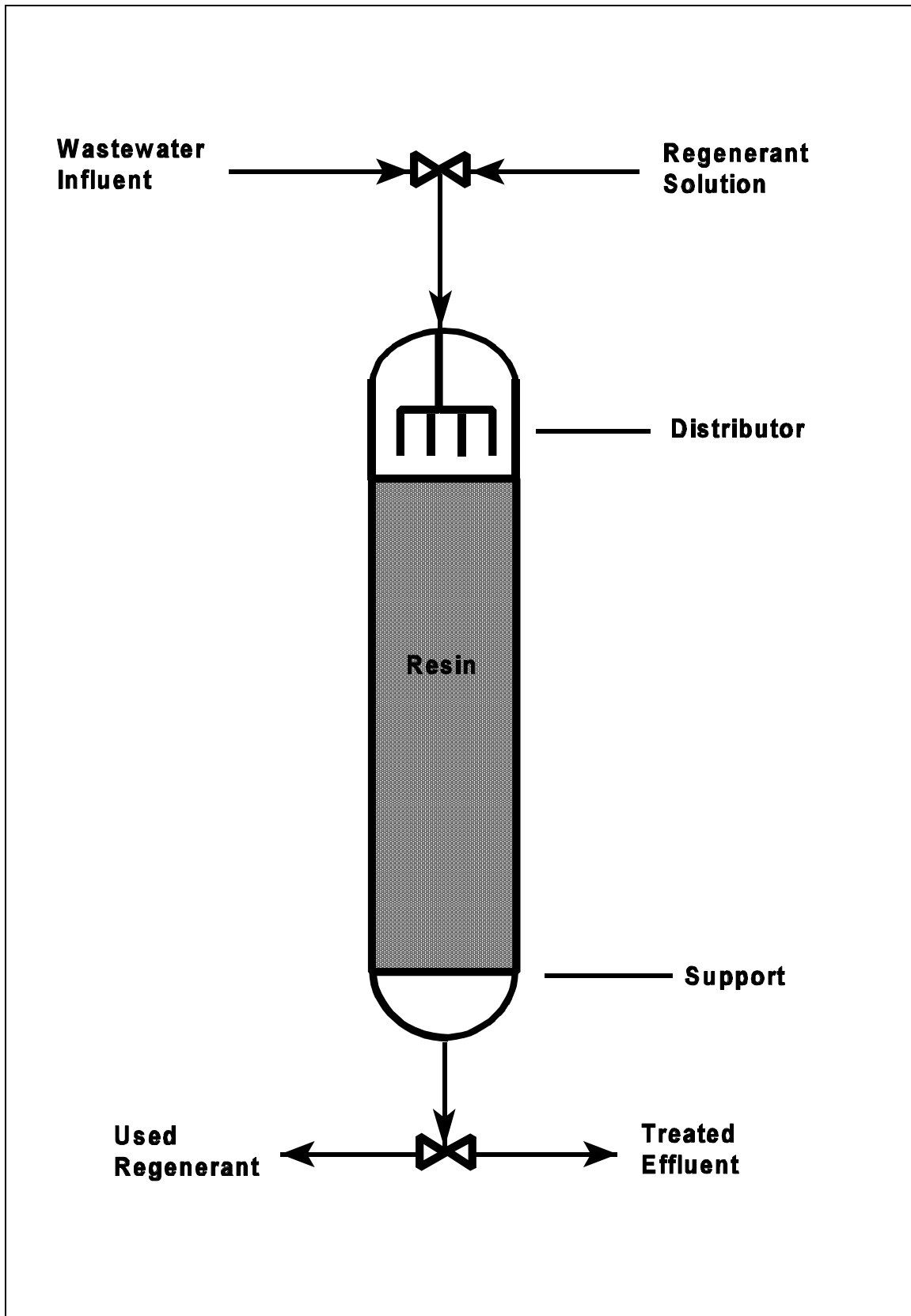


Figure 8-17. Ion Exchange System Diagram

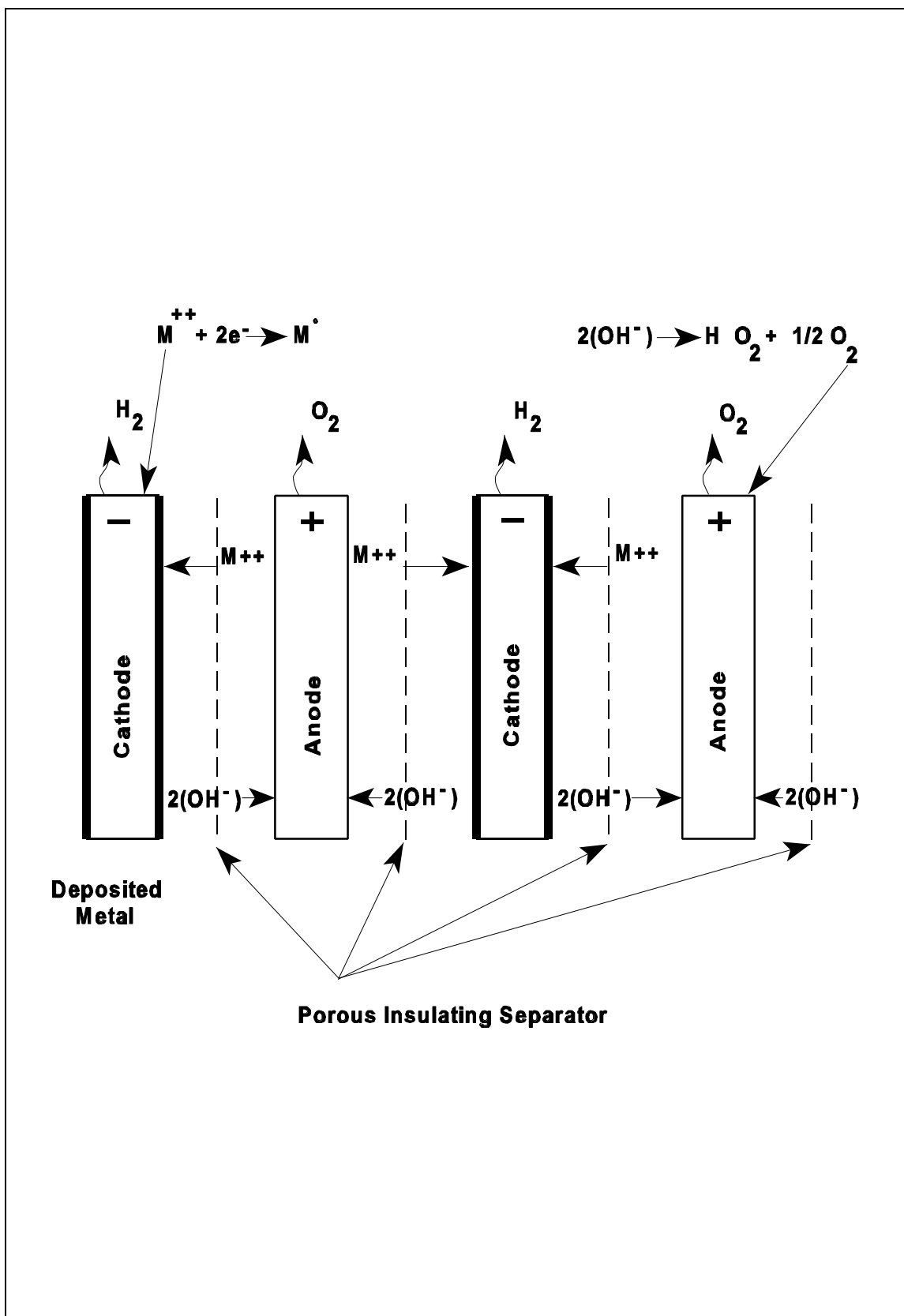


Figure 8-18. Electrolytic Recovery System Diagram

Stripping

8.2.2.13

Stripping is a method for removing dissolved volatile organic compounds from wastewater. The removal is accomplished by passing air or steam through the agitated waste stream. The primary difference between air stripping and steam stripping is that steam stripping is operated at higher temperatures and the resultant off-gas stream is usually condensed and recovered or incinerated. The off-gas from air stripping contains non-condenseable air which must be either passed through an adsorption unit or incinerated in order to prevent transfer of the volatile pollutants to the environment. EPA is not aware of any applications of steam stripping technologies in the CWT industry.

1. AIR STRIPPING

GENERAL DESCRIPTION

Air stripping is effective in removing dissolved volatile organic compounds from wastewater. The removal is accomplished by passing high volumes of air through the agitated wastewater stream. The process results in a contaminated off-gas stream which, depending upon air emissions standards, usually requires air pollution control equipment. Stripping can be performed in tanks or in spray or packed towers. Treatment in packed towers is the most efficient application. The packing typically consists of plastic rings or saddles. The two types of towers that are commonly used, cross-flow and countercurrent, differ in design only in the location of the air inlets. In the cross-flow tower, the air is drawn through the sides for the total height of the packing. The countercurrent tower draws the entire air flow from the bottom. Cross-flow towers have been found to be more susceptible to scaling problems and are less efficient than countercurrent towers. Figure 8-19 is a countercurrent air stripper.

The driving force of the air stripping mass-transfer operation is the difference in concentrations between the air and water streams. Pollutants are transferred from the more concentrated wastewater stream to the less concentrated air stream until equilibrium is reached. This equilibrium relationship is known as Henry's Law. The strippability of a pollutant is expressed as its Henry's Law Constant, which is a function of both its volatility or vapor pressure and solubility.

Air strippers are designed according to the strippability of the pollutants to be removed. For evaluation purposes, organic pollutants can be divided into three general strippability ranges (low, medium, and high) according to their Henry's Law Constants. The low strippability group (Henry's Law Constants of 10^{-4} [mg/m³ air]/[mg/m³ water] and lower) are not effectively removed. Pollutants in the medium (10^{-1} to 10^{-4}) and high (10^{-1} and greater) groups are effectively stripped. Pollutants with lower Henry's law constants require greater column height, more trays or packing material, greater temperature, and more frequent cleaning than pollutants with a higher strippability.

The air stripping process is adversely affected by low temperatures. Air strippers experience lower efficiencies at lower temperatures, with the possibility of freezing within the tower. For this reason, depending on the location of the tower, it may be necessary to preheat the wastewater and the air feed streams. The column and packing materials must be cleaned regularly to ensure that low effluent levels are attained.

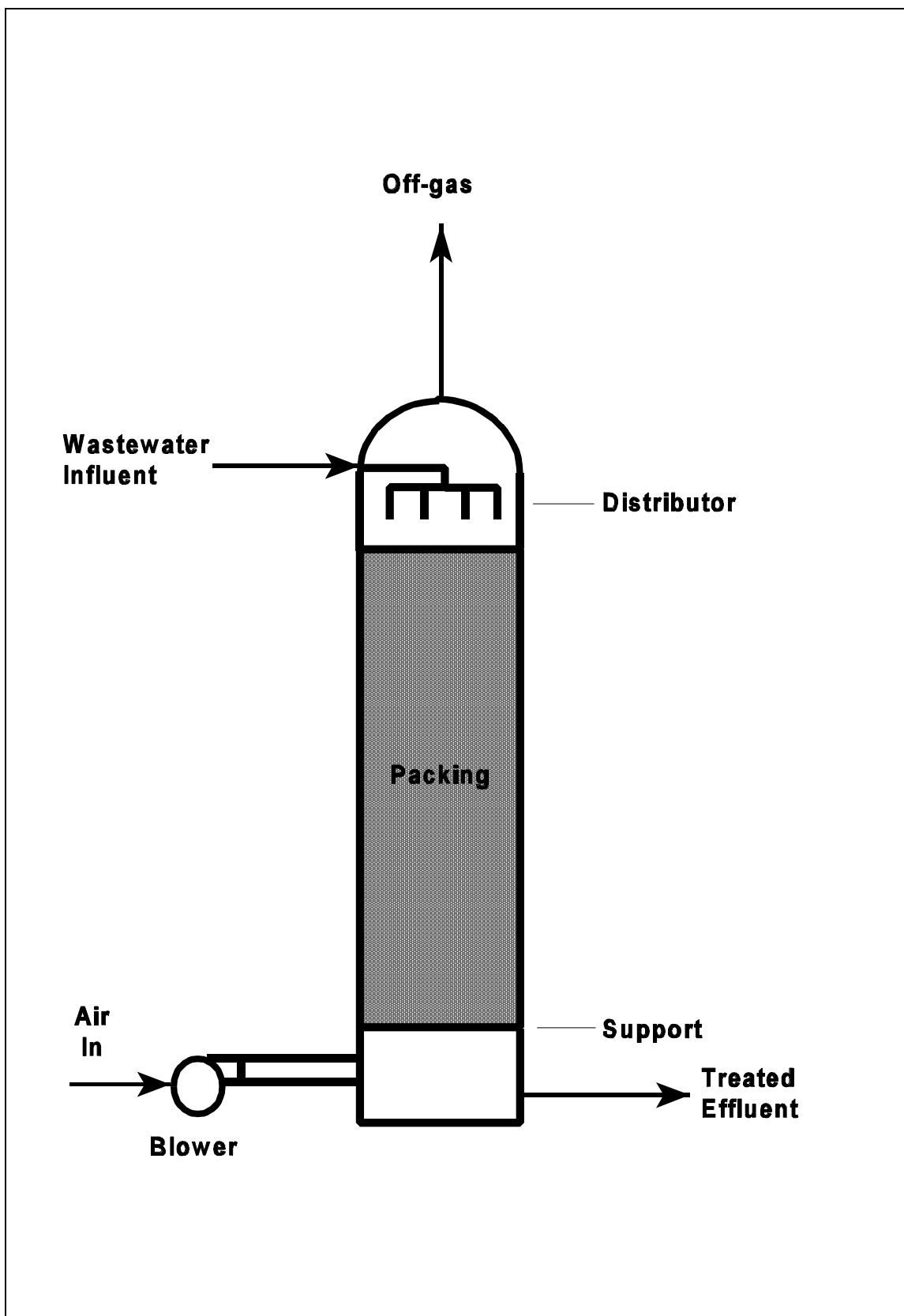


Figure 8-19. Air Stripping System Diagram

Air stripping has proved to be an effective process in the removal of volatile pollutants from wastewater. It is generally limited to influent concentrations of less than 100 mg/l organics. Well-designed and operated systems can achieve over 99 percent removals.

INDUSTRY PRACTICE

Of the 65 CWT facilities in EPA's WTI Questionnaire data base that provided information concerning use of air stripping, 11 operate air stripping systems.

Liquid Carbon Dioxide Extraction 8.2.2.14

GENERAL DESCRIPTION

Liquid carbon dioxide (CO₂) extraction is a process used to extract and recover organic contaminants from aqueous waste streams. A licensed, commercial application of this technology is utilized in the CWT industry under the name "Clean Extraction System" (CES). The process may be effective in the removal of organic substances such as hydrocarbons, aldehydes and ketones, nitriles, halogenated compounds, phenols, esters, and heterocyclics. It is not effective in the removal of some compounds which are very water-soluble, such as ethylene glycol, and low molecular weight alcohols. It may provide an alternative in the treatment of waste streams which historically have been incinerated.

In liquid carbon dioxide extraction, the waste stream is fed into the top of a pressurized extraction tower containing perforated plates, where it is contacted with a countercurrent stream of liquefied CO₂. The organic contaminants in the waste stream are dissolved in the CO₂; this extract is then sent to a separator, where the CO₂ is redistilled. The distilled CO₂ vapor is compressed and reused. The concentrated organics bottoms from the separator can then be disposed or recovered. The treated wastewater

stream which exits the extractor (raffinate) is pressure-reduced and may be further treated for residual organics removal if necessary to meet discharge standards. Figure 8-20 is a diagram of the CES is presented in.

INDUSTRY PRACTICE

EPA is aware of only one facility using this technology in the CWT industry. Pilot-scale information submitted to EPA by the CWT facility showed effective removal for a variety of organic compounds. EPA sampled this commercial CWT CES unit during this rulemaking effort. Performance was not optimal, however, as the facility reported operational problems with the unit throughout the sampling episode.

Biological Treatment 8.2.3

A portion of the CWT industry accepts waste receipts that contain organic pollutants, which are often amenable to biological degradation. This subset of CWT facilities is referred to as the organics subcategory. In addition, a portion of the facilities in the oils subcategory also use biological treatment to treat wastewater separated from oily wastes.

Biological treatment systems use microbes which consume, and thereby destroy, organic compounds as a food source. The microbes use the organic compounds as both a source of carbon and as a source of energy. These microbes may also need supplemental nutrients for growth, such as nitrogen and phosphorus, if the waste stream is deficient in these nutrients. Aerobic microbes require oxygen to grow, whereas anaerobic microbes will grow only in the absence of oxygen. Facultative microbes are an adaptive type of microbe that can grow with or without oxygen.

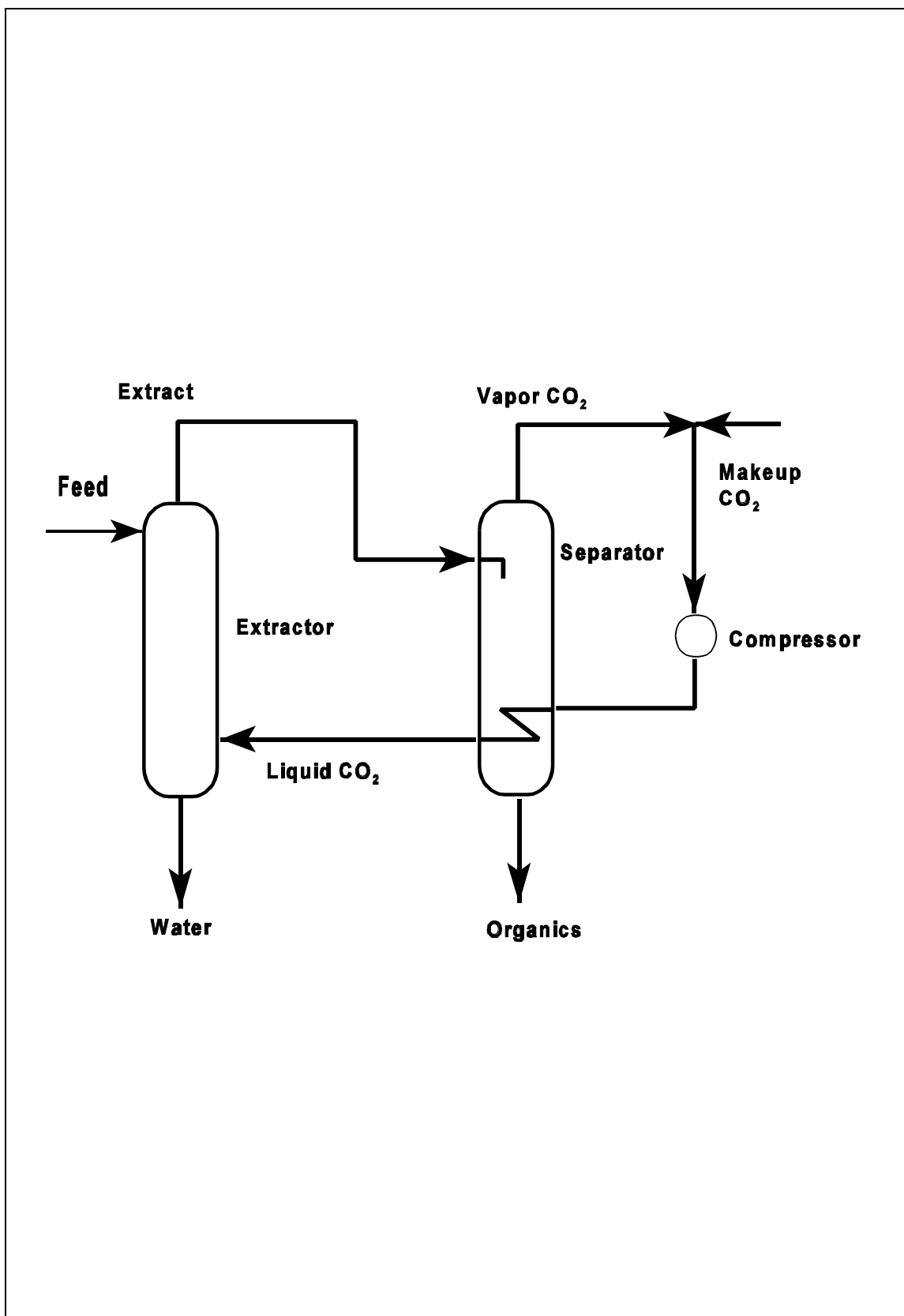


Figure 8-20. Liquid CO₂ Extraction System Diagram

The success of biological treatment is dependent on many factors, such as the pH and temperature of the wastewater, the nature of the pollutants, the nutrient requirements of the microbes, the presence of inhibiting pollutants, and variations in the feed stream loading. Certain compounds, such as heavy metals, may be toxic to the microorganisms and must be removed from the waste stream prior to biological treatment. Load variations are a major concern, especially in the CWT industry, where waste receipts vary over time in both concentration and volume.

There are several adaptations of biological treatment. These adaptations differ in three basic ways. First, a system may be aerobic, anaerobic, or facultative. Second, the microorganisms may either be attached to a surface (as in a trickling filter), or be unattached in a liquid suspension (as in an activated sludge system). Third, the operation may be either batch or continuous.

Of the 116 facilities in the WTI Questionnaire and NOA comment data base that responded to EPA's inquiry concerning the use of biological treatment, 17 operate biological treatment systems. There were no anaerobic systems reported. These systems include sequencing batch reactors, attached growth systems (biotowers and trickling filters) and activated sludge systems. With the exception of trickling filters, EPA sampled at least one application of each of the following biological treatment technologies during the development of these effluent guidelines.

clarifier. An SBR is operated on a batch basis where the wastewater is mixed and aerated with the biological floc for a specific period of time. The contents of the basin are allowed to settle and the supernatant is decanted. The batch operation of an SBR makes it a useful biological treatment option for the CWT industry, where the wastewater volumes and characteristics are often highly variable. Each batch can be treated differently depending on waste characteristics. Figure 8-21 shows an SBR.

The SBR has a four cycle process: fill, react, settle, and decant. The fill cycle has two phases. The first phase, called static fill, introduces the wastewater to the system under static conditions. This is an anaerobic period and may enhance biological phosphorus uptake. During the second phase of the fill cycle wastewater is mechanically mixed to eliminate the scum layer and prepare the microorganisms to receive oxygen. In the second cycle, the react cycle, aeration is performed. The react cycle is a time-dependent process where wastewater is continually mixed and aerated, allowing the biological degradation process to occur. The third cycle, called the settling cycle, provides quiescent conditions throughout the tank and may accommodate low settling rates by increasing the settling time. During the last or decant cycle, the treated wastewater is decanted by subsurface withdrawal from below the scum layer. This treated, clarified effluent may then be further treated or discharged.

Sequencing Batch Reactors

8.2.3.1

GENERAL DESCRIPTION

A sequencing batch reactor (SBR) is a suspended growth system in which wastewater is mixed with existing biological floc in an aeration basin. SBRs are unique in that a single tank acts as an equalization tank, an aeration tank, and a

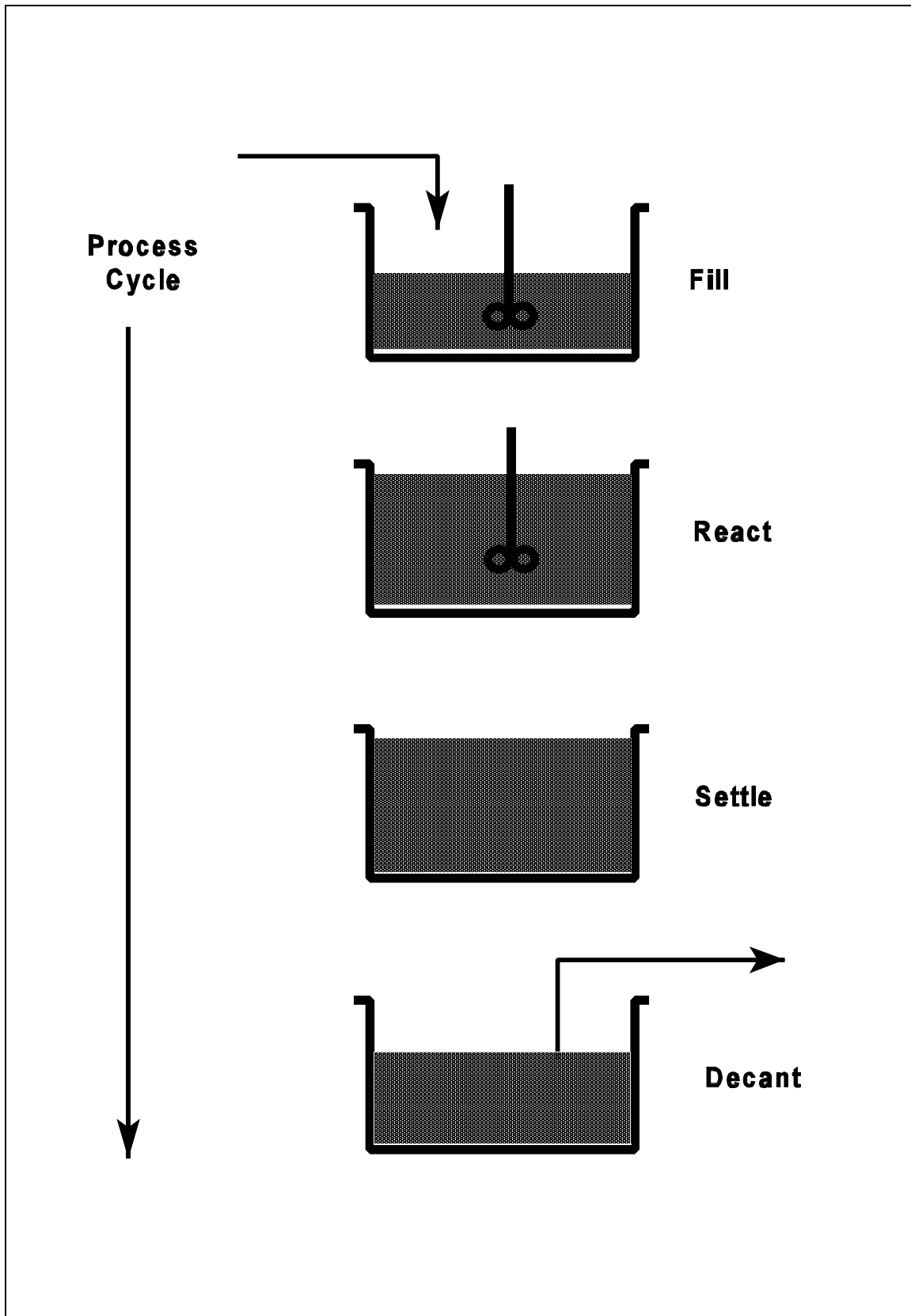


Figure 8-21. Sequencing Batch Reactor System Diagram

When the quantity of biomass in the SBR exceeds that needed for operation, the excess biomass is removed. The sludge that is removed from the SBR may be reduced in volume by thickening and dewatering using any of the sludge treatment processes discussed in section 8.2.4. The dewatered sludge may be disposed in a landfill or used as an agricultural fertilizer.

An SBR carries out all of the functions of a conventional continuous flow activated sludge process, such as equalization, biological treatment, and sedimentation, in a time sequence rather than a space sequence. Detention times and loadings vary with each batch and are highly dependent on the specific raw wastewater loadings. Typically, an SBR operates with a hydraulic detention time of 1 to 10 days and a sludge retention time of 10 to 30 days. The mixed liquor suspended solids (MLSS) concentration is maintained at 3,500 to 10,000 mg/l. The overall control of the system may be accomplished automatically by using level sensors or timing devices. By using a single tank to perform all of the required functions associated with biological treatment, an SBR reduces land requirements. It also provides for greater operation flexibility for treating wastes with viable characteristics by allowing the capability to vary detention time and mode of aeration in each stage. SBRs also may be used to achieve complete nitrification/denitrification and phosphorus removal.

INDUSTRY PRACTICE

EPA is aware of only one CWT facility that uses an SBR. This facility is in the organics subcategory, and its SBR unit was sampled during the development of these effluent guidelines.

Attached Growth Biological Treatment Systems

8.2.3.2

Another system used to biodegrade the organic components of a wastewater is the

attached growth biological treatment system. In these systems, the biomass adheres to the surfaces of rigid supporting media. As wastewater contacts the supporting medium, a thin-film biological slime develops and coats the surfaces. As this film (consisting primarily of bacteria, protozoa, and fungi) grows, the slime periodically breaks off the medium and is replaced by new growth. This phenomenon of losing the slime layer is called sloughing and is primarily a function of organic and hydraulic loadings on the system. The effluent from the system is usually discharged to a clarifier to settle and remove the agglomerated solids.

Attached growth biological systems are appropriate for treating industrial wastewaters amenable to aerobic biological treatment. When used in conjunction with suitable pre- and post-treatment processes, attached growth biological systems remove suspended and colloidal materials effectively. The two major types of attached growth systems used at CWT facilities are trickling filters and biotowers. The following section describes these processes.

1. *TRICKLING FILTERS*

GENERAL DESCRIPTION

Trickling filtration is an aerobic fixed-film biological treatment process that consists of a structure, packed with inert medium such as rock, wood, or plastic. The wastewater is distributed over the upper surface of the medium by either a fixed spray nozzle system or a rotating distribution system. The inert medium develops a biological slime that absorbs and biodegrades organic pollutants. Air flows through the filter by convection, thereby providing the oxygen needed to maintain aerobic conditions. Figure 8-22 is a flow diagram of a trickling filter.

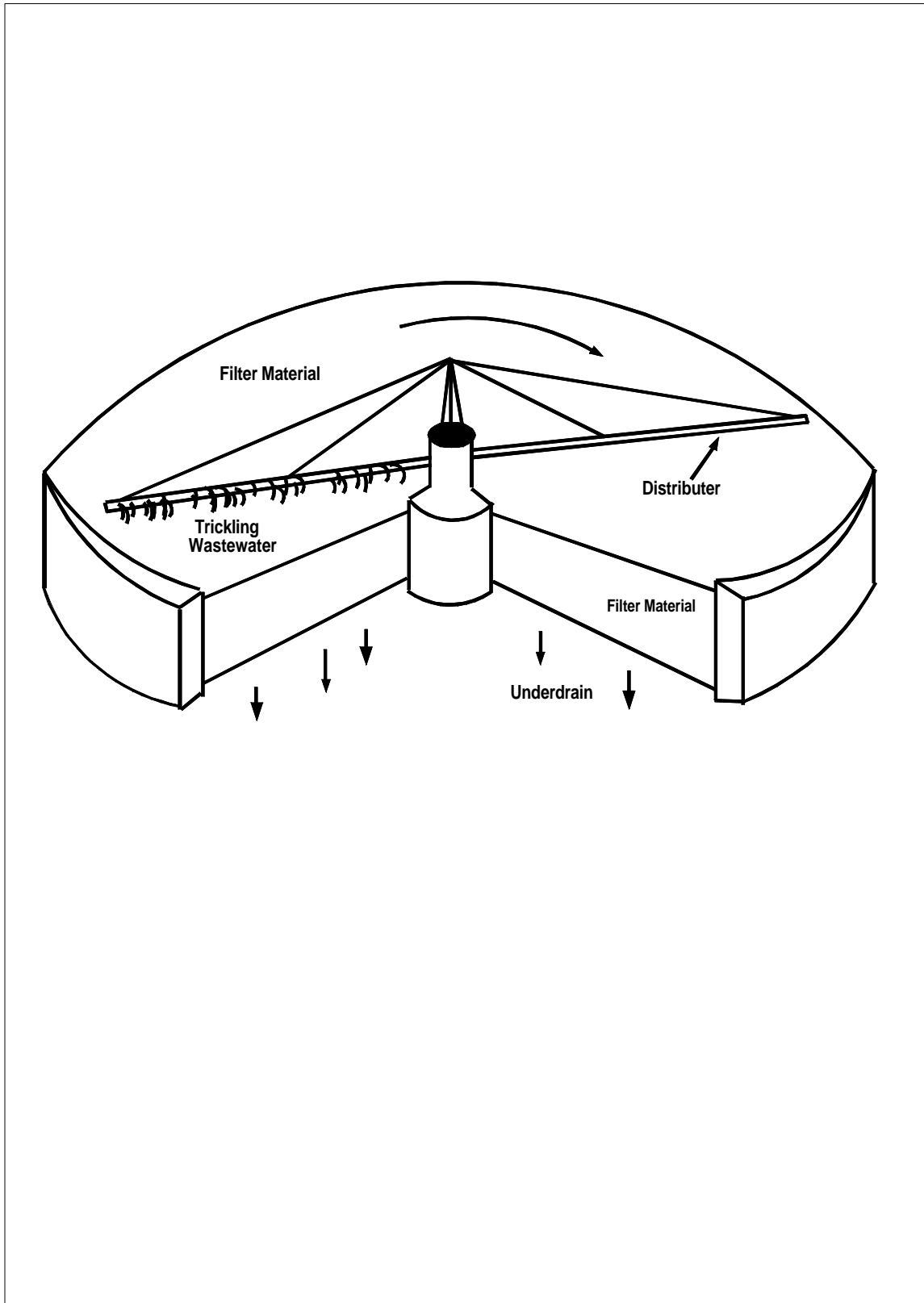


Figure 8-22. Trickling Filter System Diagram

Trickling filters are classified as low-rate or high-rate, depending on the organic loading. Typical design organic loading values range from 5 to 25 pounds and 25 to 45 pounds BOD₅ per 1,000 cubic feet per day for low-rate and high-rate, respectively. A low-rate filter generally has a media bed depth of 1.5 to 3 meters and does not use recirculation. A high-rate filter may have a bed depth from 1 to 9 meters and recirculates a portion of the effluent for further treatment.

INDUSTRY PRACTICE

EPA is aware of only one CWT facility that uses a trickling filter. This facility is in the oils subcategory.

2. BIOTOWERS

GENERAL DESCRIPTION

A variation of a trickling filtration process is the aerobic biotower. Biotowers may be operated in a continuous or semi-continuous manner and may be operated in an upflow or downflow manner. In the downflow mode, influent is pumped to the top of a tower, where it flows by gravity through the tower. The tower is packed with plastic or redwood media containing the attached microbial growth. Biological degradation occurs as the wastewater passes over the media. Treated wastewater collects in the bottom of the tower. If needed, additional oxygen is provided via air blowers countercurrent to the wastewater flow. In the upflow mode, the wastewater stream is fed into the bottom of the biotower and is passed up through the packing along with diffused air supplied by air blowers. The treated effluent exits from the top of the biotower.

Variations of this treatment process involve the inoculation of the raw influent with bacteria and the addition of nutrients. Wastewater collected in the biotowers is delivered to a clarifier to separate the biological solids from the

treated effluent. A diagram of a biotower is presented in Figure 8-23.

INDUSTRY PRACTICE

EPA is aware of two biotowers in operation in the CWT Industry. One system treats a waste stream which is primarily composed of leachate from an on-site landfill operation. The other system treats high-TOC wastewater from a metals recovery operation. EPA conducted sampling at this facility during the development of these effluent guidelines.

Activated Sludge

8.2.3.3

GENERAL DESCRIPTION

The activated sludge process is a continuous-flow, aerobic biological treatment process that employs suspended-growth aerobic microorganisms to biodegrade organic contaminants. In this process, a suspension of aerobic microorganisms is maintained by mechanical mixing or turbulence induced by diffused aerators in an aeration basin. This suspension of microorganisms is called the mixed liquor. Figure 8-24 is a diagram of a conventional activated sludge system.

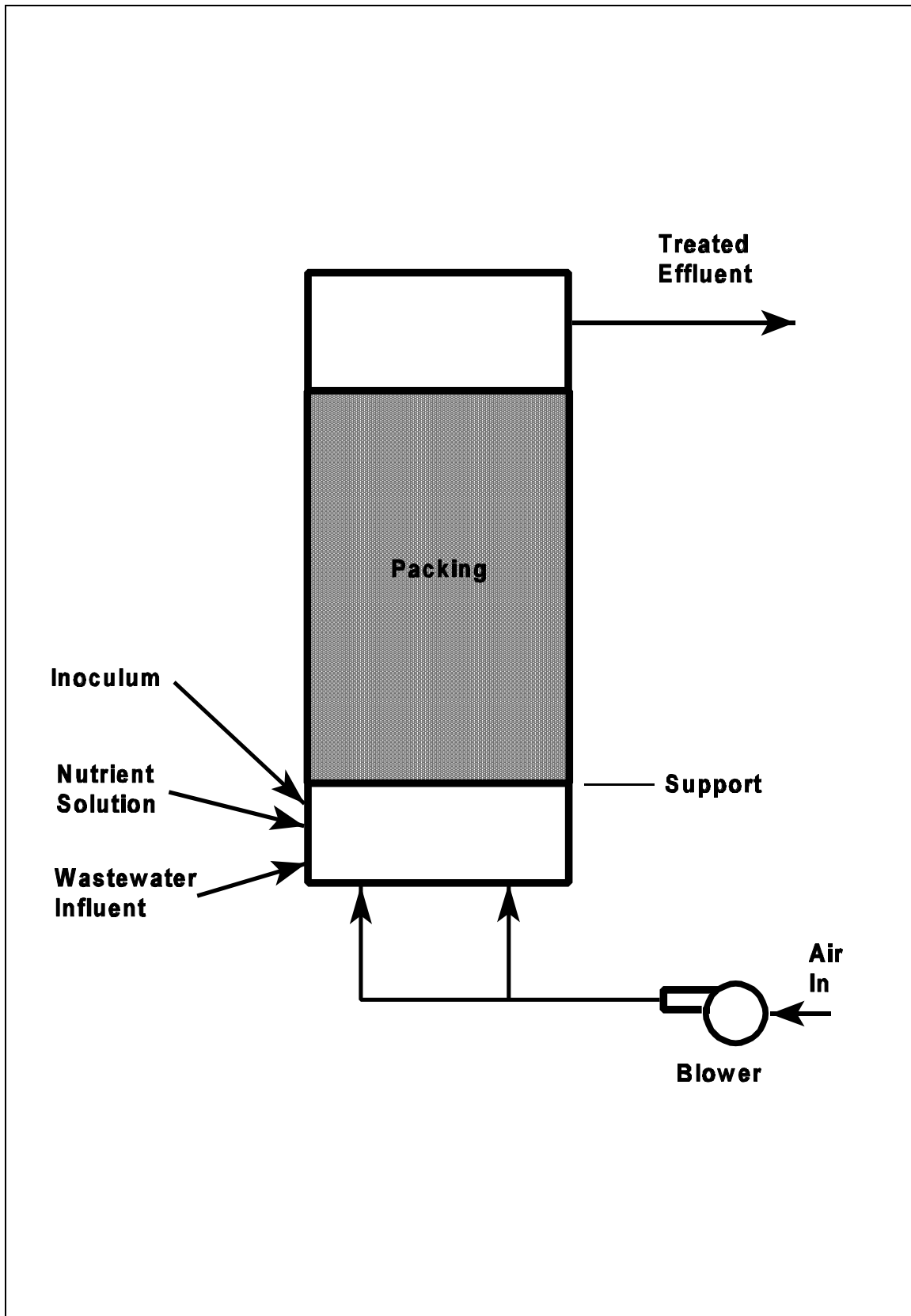


Figure 8-23. Biotower System Diagram

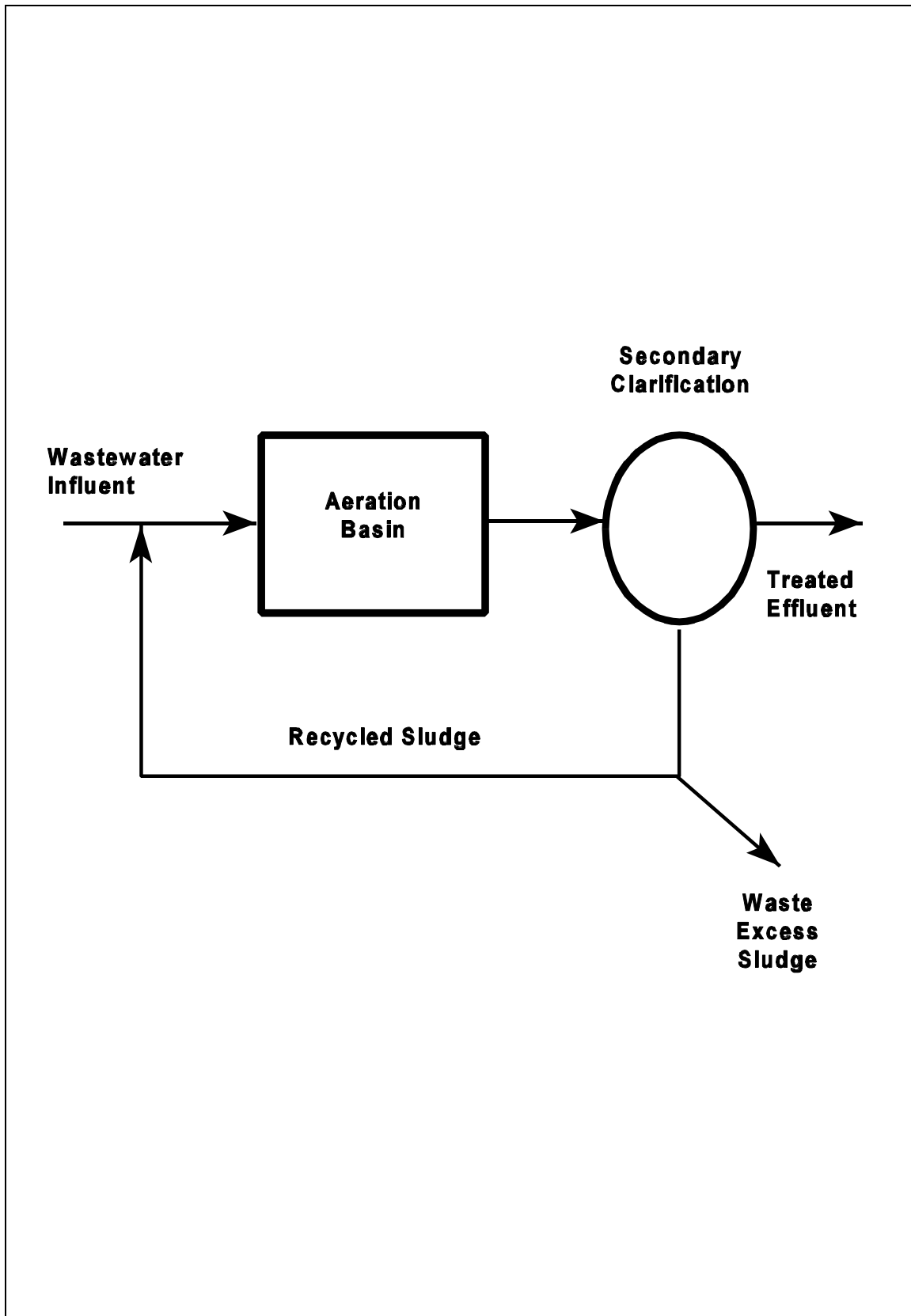


Figure 8-24. Activated Sludge System Diagram

Influent is introduced into the aeration basin and is allowed to mix with the contents. A series of biochemical reactions is performed in the aeration basin, degrading organics and generating new biomass. Microorganisms oxidize the soluble and suspended organic pollutants to carbon dioxide and water using the available supplied oxygen. These organisms also agglomerate colloidal and particulate solids. After a specific contact period in the aeration basin, the mixture is passed to a settling tank, or clarifier, where the microorganisms are separated from the treated water. A major portion of the settled solids in the clarifier is recycled back to the aeration system to maintain the desired concentration of microorganisms in the reactor. The remainder of the settled solids is wasted and sent to sludge handling facilities.

To ensure biological stabilization of organic compounds in activated sludge systems, adequate nutrient levels must be available to the biomass. The primary nutrients are nitrogen and phosphorus. Lack of these nutrients can impair biological activity and result in reduced removal efficiencies. Certain wastes may have low concentrations of nitrogen and phosphorus relative to the oxygen demand. As a result, nutrient supplements (e.g., phosphoric acid addition for additional phosphorus) have been used in activated sludge systems at CWT facilities.

The effectiveness of the activated sludge process is governed by several design and operation variables. The key variables are organic loading, sludge retention time, hydraulic or aeration detention time, and oxygen requirements. The organic loading is described as the food-to-microorganism (F/M) ratio, or kilograms of BOD₅ applied daily to the system per kilogram of mixed liquor suspended solids (MLSS). The MLSS in the aeration tank is determined by the rate and concentration of

activated sludge returned to the tank. The organic loading (F/M ratio) affects the BOD₅ removal, oxygen requirements, biomass production, and the settleability of the biomass. The sludge retention time (SRT) or sludge age is a measure of the average retention time of solids in the activated sludge system. The SRT affects the degree of treatment and production of waste sludge. A high SRT results in a high quantity of solids in the system and therefore a higher degree of treatment while also resulting in the production of less waste sludge. The hydraulic detention time determines the size of the aeration tank and is calculated using the F/M ratio, SRT, and MLSS. Oxygen requirements are based on the amount required for biodegradation of organic matter and the amount required for endogenous respiration of the microorganisms. The design parameters will vary with the type of wastewater to be treated and are usually determined in a treatability study.

Modifications of the activated sludge process are common, as the process is extremely versatile and can be adapted for a wide variety of organically contaminated wastewaters. The typical modification may include a variation of one or more of the key design parameters, including the F/M loading, aeration location and type, sludge return, and contact basin configuration. The modifications in practice have been identified by the major characteristics that distinguish the particular configuration. The characteristic types and modifications are briefly described as follows:

- Conventional. The aeration tanks are long and narrow, with plug flow (i.e., little forward or backwards mixing).
- Complete Mix. The aeration tanks are shorter and wider, and the aerators, diffusers, and entry points of the influent and return

sludge are arranged so that the wastewater mixes completely.

- Tapered Aeration. A modification of the conventional process in which the diffusers are arranged to supply more air to the influent end of the tank, where the oxygen demand is highest.
- Step Aeration. A modification of the conventional process in which the wastewater is introduced to the aeration tank at several points, lowering the peak oxygen demand.
- High Rate Activated Sludge. A modification of conventional or tapered aeration in which the aeration times are shorter, the pollutants loadings are higher per unit mass of microorganisms in the tank. The rate of BOD₅ removal for this process is higher than that of conventional activated sludge processes, but the total removals are lower.
- Pure Oxygen. An activated sludge variation in which pure oxygen instead of air is added to the aeration tanks, the tanks are covered, and the oxygen-containing off-gas is recycled. Compared to normal air aeration, pure oxygen aeration requires a smaller aeration tank volume and treats high-strength wastewaters and widely fluctuating organic loadings more efficiently.
- Extended Aeration. A variation of complete mix in which low organic loadings and long aeration times permit more complete wastewater degradation and partial aerobic digestion of the microorganisms.
- Contact Stabilization. An activated sludge modification using two aeration stages. In the first, wastewater is aerated with the return

sludge in the contact tank for 30 to 90 minutes, allowing finely suspended colloidal and dissolved organics to absorb to the activated sludge. The solids are settled out in a clarifier and then aerated in the sludge aeration (stabilization) tank for 3 to 6 hours before flowing into the first aeration tank.

- Oxidation Ditch Activated Sludge. An extended aeration process in which aeration and mixing are provided by brush rotors placed across a race-track-shaped basin. Waste enters the ditch at one end, is aerated by the rotors, and circulates.

INDUSTRY PRACTICE

Because activated sludge systems are sensitive to the loading and flow variations typically found at CWT facilities, equalization is often required prior to activated sludge treatment. Of the 65 CWT facilities in EPA's WTI Questionnaire data base that provided information concerning use of activated sludge, four operate activated sludge systems.

Sludge Treatment and Disposal **8.2.4**

Several of the waste treatment processes used in the CWT industry generate a sludge. These processes include chemical precipitation of metals, clarification, filtration, and biological treatment. Some oily waste treatment processes, such as dissolved air flotation and centrifugation, also produce sludges. These sludges typically contain between one and five percent solids. They require dewatering to concentrate them and prepare them for transport and/or disposal.

Sludges are dewatered using pressure, gravity, vacuum, or centrifugal force. There are several widely-used, commercially-available methods for sludge dewatering. Plate and frame pressure filtration, belt pressure filtration, and

vacuum filtration are the primary methods used for sludge dewatering at CWT facilities. A plate and frame filter press can produce the driest filter cake of these three systems, followed by the belt press, and lastly, the vacuum filter. Each of these sludge dewatering methods are discussed below.

In some instances, depending upon the nature of the sludge and the dewatering process used, the sludge may first be stabilized, conditioned, and/or thickened prior to dewatering. Certain sludges require stabilization (via chemical addition or biological digestion) because they have an objectionable odor or are a health threat. Sludges produced by the CWT industry usually do not fall into this category. Sludge conditioning is used to improve dewaterability; it can be accomplished via the addition of heat or chemicals. Sludge thickening, or concentration, reduces the volume of sludge to be dewatered and is accomplished by gravity settling, flotation, or centrifugation.

Plate and Frame Pressure Filtration 8.2.4.1

GENERAL DESCRIPTION

Plate and frame pressure filtration systems is a widely used method for the removal of solids from waste streams. In the CWT industry, plate and frame pressure filtration system are used for filtering solids out of treated wastewater streams and sludges. The same equipment is used for both applications, with the difference being the solids level in the influent stream and the sizing of the sludge and liquid units. Figure 8-25 is a plate and frame filter press.

A plate and frame filter press consists of a number of recessed filter plates or trays connected to a frame and pressed together between a fixed end and a moving end. Each plate is constructed with a drainage surface on the depressed portion of the face. Filter cloth is mounted on the face of each plate and then the plates are pressed together. The sludge is

pumped under pressure into the chambers between the plates of the assembly while water passes through the media and drains to the filtrate outlets. The solids are retained in the cavities of the filter press between the cloth surfaces and form a cake that ultimately fills the chamber. At the end of the cycle when the filtrate flow stops, the pressure is released and the plates are separated. The filter cake drops into a hopper below the press. The filter cake may then be disposed in a landfill. The filter cloth is washed before the next cycle begins.

The key advantage of plate and frame pressure filtration is that it can produce a drier filter cake than is possible with the other methods of sludge dewatering. In a typical plate and frame pressure filtration unit, the filter cake may exhibit a dry solids content between 30 and 50 percent. It is well-suited for use in the CWT industry as it is a batch process. However, its batch operation results in greater operating labor requirements.

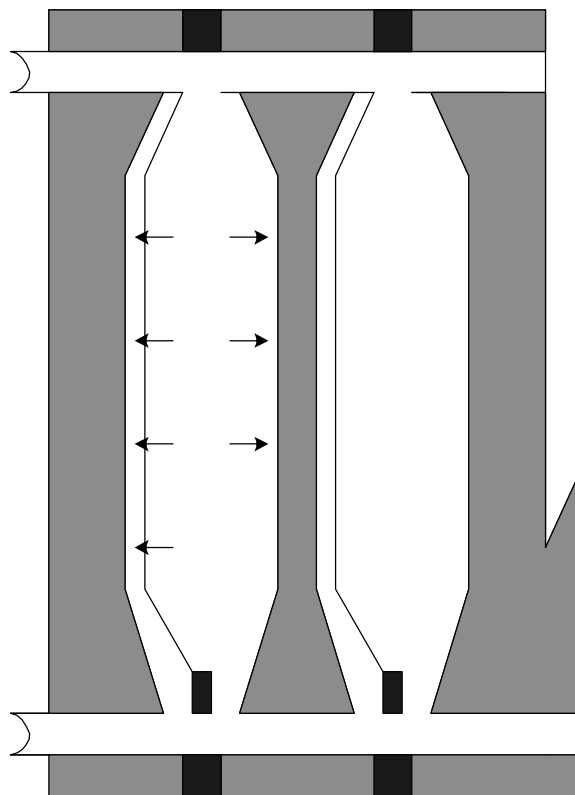


Figure 8-25. Plate and Frame Filter Press System Diagram

INDUSTRY PRACTICE

Of the 65 CWT facilities in EPA's WTI Questionnaire data base that provided information concerning the use of pressure filtration, 34 operate pressure filtration systems. Of these 34 facilities, 25 operate plate and frame pressure filtration systems, three operate belt pressure filtration systems, and six did not specify the type of pressure filtration systems utilized.

Belt Pressure Filtration 8.2.4.2

GENERAL DESCRIPTION

A belt pressure filtration system uses gravity followed by mechanical compression and shear force to produce a sludge filter cake. Belt filter presses are continuous systems which are commonly used to dewater biological treatment sludge. Most belt filter installations are preceded by a flocculation step, where polymer is added to create a sludge which has the strength to withstand being compressed between the belts without being squeezed out. **Figure 8-26** shows a typical belt filter press.

During the press operation, the sludge stream is fed onto the first of two moving cloth filter belts. The sludge is gravity-thickened as the water drains through the belt. As the belt holding the sludge advances, it approaches a second moving belt. As the first and second belts move closer together, the sludge is compressed between them. The pressure is increased as the two belts travel together over and under a series of rollers. The turning of the belts around the rollers shear the cake which furthers the dewatering process. At the end of the roller pass, the belts move apart and the cake drops off. The feed belt is washed before the sludge feed point. The dropped filter cake may then be disposed.

The advantages of a belt filtration system are its lower labor requirements and lower power

consumption. The disadvantages are that the belt filter presses produce a poorer quality filtrate, and require a relatively large volume of belt wash water.

Typical belt filtration applications may dewater an undigested activated sludge to a cake containing 15 to 25 percent solids. Heat-treated, digested sludges may be reduced to a cake of up to 50 percent solids.

INDUSTRY PRACTICE

Of the 65 CWT facilities in EPA's WTI Questionnaire data base that provided information concerning the use of pressure filtration, 36 operate pressure filtration systems. Of these 34 facilities, 25 operate plate and frame pressure filtration systems, three operate belt pressure filtration systems, and six did not specify the type of pressure filtration systems utilized.

Vacuum Filtration 8.2.4.3

GENERAL DESCRIPTION

A commonly-used process for dewatering sludge is rotary vacuum filtration. These filters come in drum, coil, and belt configurations. The filter medium may be made of cloth, coil springs, or wire-mesh fabric. A typical application is a rotary vacuum belt filter; a diagram of this equipment is shown in Figure 8-27.

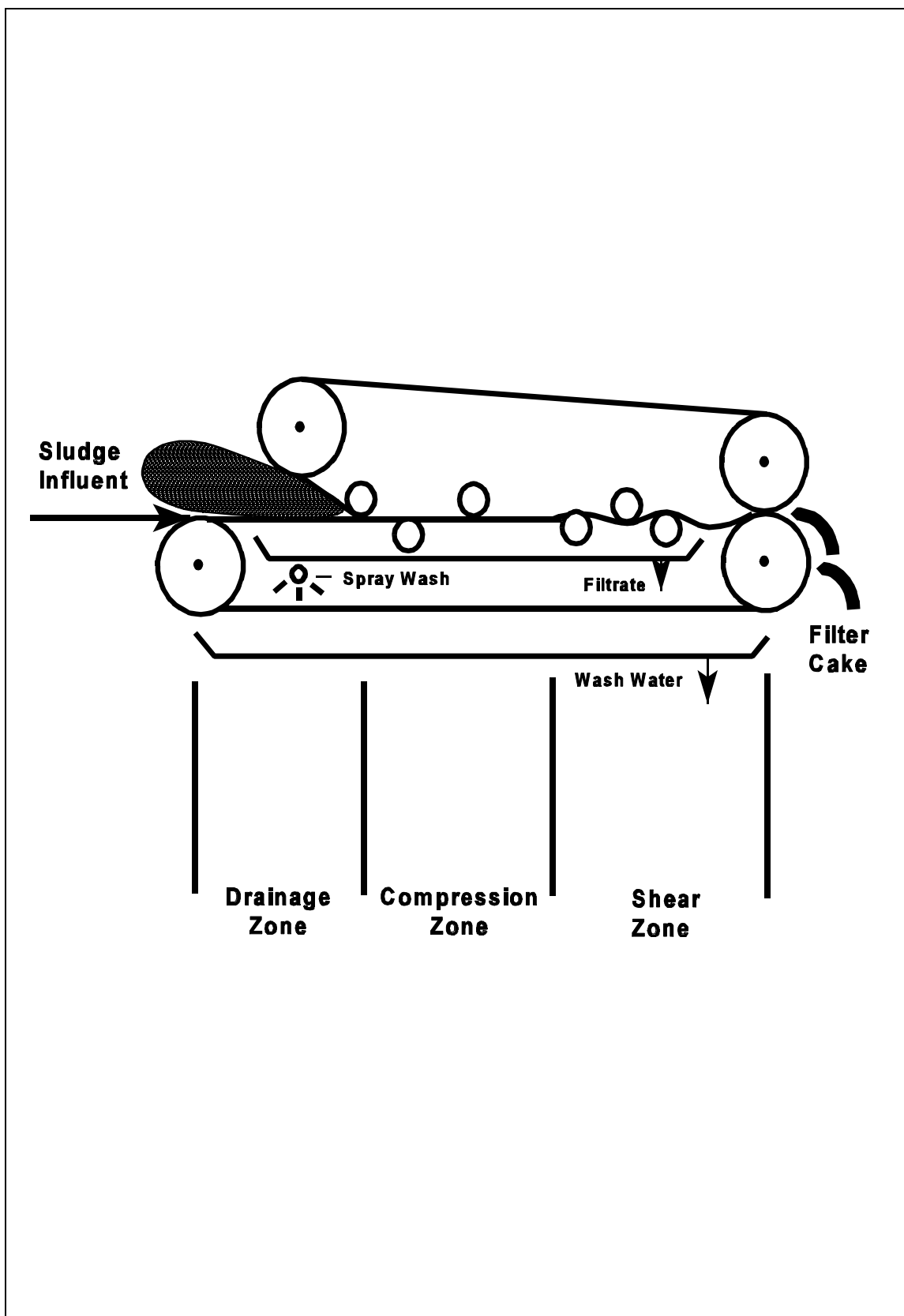


Figure 8-26. Belt Pressure Filtration System Diagram

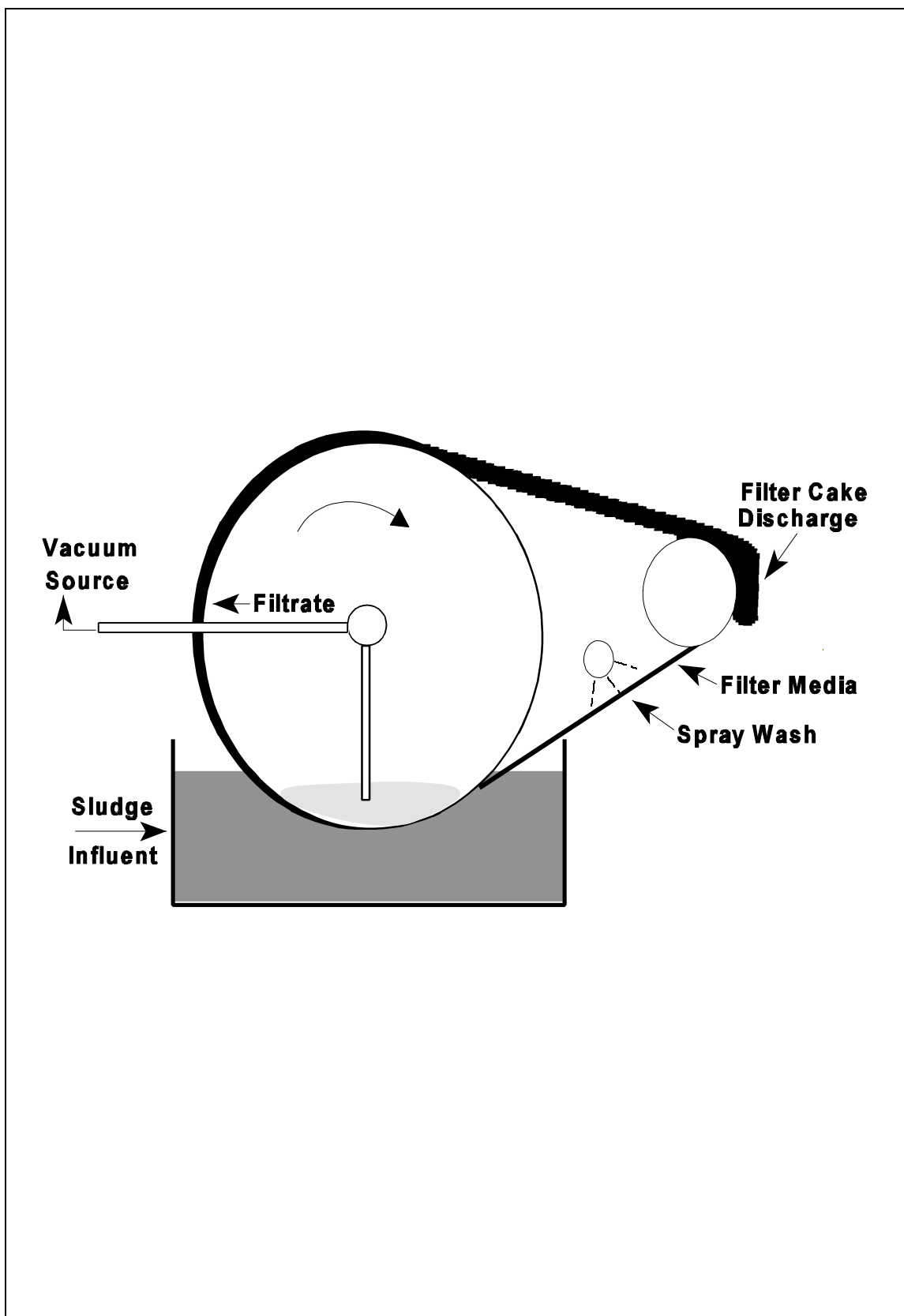


Figure 8-27. Vacuum Filtration System Diagram

In a rotary vacuum belt filter, a continuous belt of filter fabric is wound around a horizontal rotating drum and rollers. The drum is perforated and is connected to a vacuum. The drum is partially immersed in a shallow tank containing the sludge. As the drum rotates, the vacuum which is applied to the inside of the drum draws the sludge onto the filter fabric. The water from the sludge passes through the filter and into the drum, where it exits via a discharge port. As the fabric leaves the drum and passes over the roller, the vacuum is released. The filter cake drops off of the belt as it turns around the roller. The filter cake may then be disposed.

Vacuum filtration may reduce activated sludge to a cake containing 12 to 20 percent solids. Lime sludge may be reduced to a cake of 25 to 40 percent solids.

Because vacuum filtration systems are relatively expensive to operate, they are usually preceded by a thickening step which reduces the volume of sludge to be dewatered. An advantage of vacuum filtration is that it is a continuous process and therefore requires less operator attention.

INDUSTRY PRACTICE

Of the 65 CWT facilities in EPA's WTI Questionnaire data base that provided information concerning the use of vacuum filtration, eight operate vacuum filtration systems.

Filter Cake Disposal 8.2.4.4

After a sludge is dewatered, the resultant filter cake must be disposed. The most common method of filter cake management used in the CWT industry is transport to an off-site landfill for disposal. Other disposal options are incineration or land application. Land application is usually restricted to biological treatment residuals.

Zero or Alternate Discharge Treatment Options

8.2.5

This section discusses zero discharge wastewater treatment and disposal methods. In this context, zero discharge refers to any wastewater disposal method other than indirect discharge to a POTW or direct discharge to a surface water. A common zero discharge method employed by CWT facilities that generate small volumes of wastewater is transportation of the wastewater to an off-site disposal facility such as another CWT facility. Other methods discussed below include deep well disposal, evaporation, and solidification.

Deep well disposal consists of pumping the wastewater into a disposal well, that discharges the liquid into a deep aquifer. Normally, these aquifers are thoroughly characterized to insure that they are not hydrogeologically-connected to a drinking water supply. The characterization requires the confirmation of the existence of impervious layers of rock above and below the aquifer. Pretreatment of the wastewater using filtration is often practiced to prevent the plugging of the face of the receiving aquifer.

Traditionally used as a method of sludge dewatering, evaporation (or solar evaporation) also can involve the discharge and ultimate storage of wastewater into a shallow, lined, on-site basin or ditch. Because the system is open to the atmosphere, the degree of evaporation is greatly dependent upon climatic conditions. This option is generally available only to those facilities located in arid regions.

Solidification is a process in which materials, such as fly ash, cement, and lime, are added to the waste to produce a solid. Depending on both the contaminant and binding material, the solidified waste may be disposed of in a landfill or incinerated.

INDUSTRY PRACTICE

EPA has information for 24 CWT facilities not discharging directly to surface waters or POTWs that employ zero and alternate discharge methods. Of those 24 facilities, seven dispose of wastewater by deep well injection, 13 transport wastewater to an off-site commercial or intra-company wastewater treatment facility, two dispose of wastewater by evaporation, one solidifies wastewater and landfills it on-site, and one discharges wastewater to a privately-owned treatment works.

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REGULATORY OPTIONS CONSIDERED AND SELECTED FOR BASIS OF REGULATION

This section presents the technology options considered by EPA as the basis for the proposed effluent limitations guidelines and standards for the CWT industry. It also describes the methodology for EPA's selection of the proposed technology options. The limitations and standards discussed in this section are Best Practicable Control Technology Currently Available (BPT), Best Conventional Pollutant Control Technology (BCT), Best Available Technology Economically Achievable (BAT), New Source Performance Standards (NSPS), Pretreatment Standards for Existing Sources (PSES), and Pretreatment Standards for New Sources (PSNS).

ESTABLISHMENT OF BPT

9.1

Section 304(b)(1)(A) requires EPA to identify effluent reductions attainable through the application of "best practicable control technology currently available for classes and categories of point sources." EPA determines BPT effluent levels based upon the average of the best existing performance by facilities of various sizes, ages, and unit processes within each industrial category or subcategory. However, in industrial categories where present practices are uniformly inadequate, EPA may determine that BPT requires higher levels of control than any currently in place if the technology to achieve those levels can be practicably applied.

In addition, CWA Section 304(b)(1)(B) requires a cost reasonableness assessment for BPT limitations. In determining the BPT limits, EPA must consider the total cost of treatment

technologies in relation to the effluent reduction benefits achieved.

In balancing costs against the benefits of effluent reduction, EPA considers the volume and nature of expected discharges after application of BPT, the general environmental effects of pollutants, and the cost and economic impacts of the required level of pollution control.

In assessing BPT for this industry, EPA considered age, size, unit processes, other engineering factors, and non-water quality impacts pertinent to the facilities treating waste in each subcategory. For all subcategories, no basis could be found for identifying different BPT limitations based on age, size, process, or other engineering factors for the reasons previously discussed. For a service industry whose service is wastewater treatment, the pertinent factors for establishing the limitations are cost of treatment, the level of effluent reductions obtainable, and non-water quality effects.

EPA determined that, while some CWT facilities are providing adequate treatment of all wastestreams, wastewater treatment at some CWT facilities is poor. EPA has determined that facilities which mix different types of highly concentrated CWT wastes with non-CWT wastestreams or with storm water are not providing BPT treatment. In addition, while some CWT facilities pretreat subcategory wastestreams for optimal removal prior to commingling, some facilities mix wastes from different subcategories without pretreatment. This practice essentially dilutes the waste rather than treats the waste. As such, the mass of

pollutants being discharged at some CWT facilities is higher than that which can be achieved, given the demonstrated removal capacity of treatment systems that the Agency reviewed. Many CWT facilities recognize that commingling often leads only to dilution and have encouraged their customers to segregate wastes as much as possible. Waste minimization techniques at most manufacturing facilities have also led to increased waste stream segregation.

Comparison of EPA sampling data and CWT industry-supplied monitoring information establishes that, in the case of metal-bearing wastestreams, virtually all the facilities are discharging large amounts of heavy metals. As measured by total suspended solids (TSS) levels following treatment, TSS concentrations are substantially higher than levels observed at facilities in other industry categories employing the very same treatment technology.

In the case of oil discharges, many facilities are achieving low removal of oil and grease relative to the performance required for other point source categories. Many collect samples infrequently to analyze for metal and organic constituents in their discharge since these parameters are not included in their discharge permits. Further, facilities treating organic wastes, while successfully removing organic pollutants through biological treatment, fail to remove metals associated with these organic wastes.

The poor pollutant removal performance observed for some direct discharging CWT facilities is not unexpected. As pointed out previously, some of these facilities are treating highly concentrated wastes that, in many cases, are process residuals and sludges from other point source categories. EPA's review of permit limitations for the direct dischargers show that, in most cases, the dischargers are subject to "best professional judgment" limitations which were based primarily on guidelines for facilities treating and discharging much more dilute

wastestreams. EPA has concluded that treatment performance in the industry is often inadequate and that the mass of pollutants being discharged is high, given the demonstrated removal capability of treatment option that the Agency has reviewed.

EPA's options to evaluate treatment systems in place at direct discharging CWTs were extremely limited since most of the facilities in this industry are indirect dischargers. This is particularly true of the metals and oils facilities. Many indirect discharging CWTs are not required to control discharges of conventional pollutants because the receiving POTWs are designed to achieve removal of conventional pollutants and therefore, generally do not monitor or optimize the performance of their treatment systems for control of conventional pollutants. Because BPT applies to direct dischargers, the data used to establish limitations and standards are normally collected from such facilities. For this rule, EPA relied on information and data from widely available treatment technologies in use at CWT facilities discharging indirectly -- so called "technology transfer." EPA concluded that certain technologies in place at indirect discharging CWT facilities are appropriate for use as the basis for regulation of direct dischargers.

Rationale for Metals Subcategory

BPT Limitations

9.1.1

In developing BPT limitations for the metals subcategory, EPA considered three regulatory options (two previously assessed for the 1995 proposal as well as one new treatment option). All rely on chemical precipitation to reduce the discharge of pollutants from CWT facilities. The three currently available treatment systems for which EPA assessed performance for the metals subcategory BPT are discussed below.

METALS SUBCATEGORY OPTION 2¹ - SELECTIVE METALS PRECIPITATION, LIQUID-SOLID SEPARATION, SECONDARY PRECIPITATION, AND LIQUID-SOLID SEPARATION

The first treatment option (Option 2) that EPA evaluated is based on “selective metals precipitation.” “Selective metals precipitation” is a specialized metals removal technology that tailors precipitation conditions to the metal to be removed. The extent to which a metal is precipitated from a solution will vary with a number of factors including pH, temperature, and treatment chemicals. Selective metals precipitation adjusts these conditions sequentially in order to provide maximum precipitation of metals. Selective metals precipitation requires segregation of incoming wastestreams and careful characterization of the metals content of the waste stream. Next, there are multiple precipitations in batches at different pH levels in order to achieve maximum removal of specific metals. Selective metals precipitation results in the formation of a metal-rich filter cake. This treatment option requires numerous treatment tanks and personnel to handle incoming wastestreams, greater quantities of treatment chemicals, and increased monitoring of the batch treatment processes. One of the benefits of this technology, however, is that it results in a metal-rich filter cake that facilities employing this treatment have the option of selling as feed material for metal reclamation. For metal streams which contain concentrated cyanide complexes, achievement of the BPT limitations under this option would require alkaline chlorination at specific operating conditions prior to metals

treatment. These BPT cyanide limitations are discussed in greater detail below.

METALS SUBCATEGORY OPTION 3¹ - SELECTIVE METALS PRECIPITATION, LIQUID-SOLID SEPARATION, SECONDARY PRECIPITATION, LIQUID-SOLID SEPARATION, TERTIARY PRECIPITATION, AND CLARIFICATION

The second treatment option EPA evaluated (Option 3) is the same as Option 2 with an additional third precipitation step added for increased pollutant removals. Again, for metals streams which contain concentrated cyanide complexes, like Option 2, BPT limitations for Option 3 are also based on alkaline chlorination at specific operating conditions prior to metals precipitation.

METALS SUBCATEGORY OPTION 4¹ - BATCH PRECIPITATION, LIQUID-SOLID SEPARATION, SECONDARY PRECIPITATION, AND SAND FILTRATION

The new technology EPA evaluated as the basis of BPT for this regulation (Option 4) is a two stage precipitation process. The first stage of this technology is similar to the Option 1 chemical precipitation technology considered (and rejected) for the earlier proposal and is based on chemical precipitation, followed by some form of solids separation and sludge dewatering. In Option 4, however, a second precipitation step is also performed followed by sand filtration. Since most CWT metal facilities utilize single-stage chemical precipitation only, generally BPT limitations based on Option 4 would require facilities to use increased quantities of treatment chemicals, perform additional monitoring of batch processes, perform an additional precipitation step, and add a sand filtration step. Once again, for metals which contain concentrated cyanide complexes, like Options 2 and 3, alkaline chlorination at specific operating conditions is also part of the Option 4

¹The numbering of options reflects the numbering for the 1995 proposal. Options 2 and 3 were first considered for that proposal. Option 4 is a new technology EPA evaluated for this proposal. EPA is no longer evaluating Option 1 as the treatment basis for the proposed limitations and standards.

treatment process that forms the basis for BPT limitations.

The Agency is proposing to adopt BPT limitations based on Option 4 for the metals subcategory. EPA's decision to base BPT limitations on Option 4 treatment reflects primarily an evaluation of two factors: the degree of effluent reductions attainable through this technology and the total cost of the proposed treatment in relation to the effluent reductions benefits (These are detailed in Chapter 11 and 12). Option 4 technology is readily applicable to all facilities that are treating metal-bearing wastestreams. It is currently used at 25 percent of the facilities in this subcategory. The adoption of this level of control would represent a significant reduction in pollutants discharged into the environment by facilities in this subcategory. Option 4 would remove approximately 13.8 million pounds annually of conventional pollutants now discharged to the Nation's waters. The Agency also assessed the total cost of water pollution controls likely to be incurred for Option 4 in relation to the effluent reduction benefits and determined these costs were economically reasonable, less than \$0.19 per pound.

The Agency has decided not to propose BPT limitations based on Option 3, selective metals precipitation, for a number of reasons. First, while both Option 3 and Option 4 provide significant pollutant removals, are economically achievable, and expected to result in non-water quality benefits through increased recycling of metals, Option 3 is nearly four times as costly as Option 4. Furthermore, there is little, if any, expected increase in total removals associated with the Option 3 technology. (Total removals associated with Option 3 are virtually identical to those achieved by Option 4 -- less than 1.25 percent greater.) Second, EPA has some concern about whether selective metals precipitation could be applied throughout the industry because

currently, only one facility is employing this technology. Moreover, as noted above, the effectiveness of selective metals precipitation depends, in part, on the separation and holding of wastestreams in numerous treatment tanks. EPA is aware that there may be physical constraints on the ability of certain facilities to install the additional, required treatment tanks. These and other factors support EPA's determination not to propose limitations based on the Option 3 technology.

The Agency used chemical precipitation treatment technology performance data from the Metal Finishing regulation (40 CFR Part 433) to establish direct discharge limitations for TSS because the facility from which the Option 4 limitations were derived is an indirect discharger and the treatment system is not designed to optimize removal of conventional parameters. EPA has concluded that the transfer of this data is appropriate given the absence of adequate treatment technology for this pollutant at the only otherwise well-operated BPT CWT facility. Given the treatment of similar wastes with similar TSS concentrations at both metal finishing and centralized waste treatment facilities, use of the data is warranted. Moreover, EPA has every reason to believe that chemical precipitation treatment systems will perform similarly when treating TSS in waste in this subcategory. Because CWT is based on additional chemical precipitation and solid-liquid separation steps, facilities should be able to meet the transferred limit. Finally, since the metal finishing TSS limitation was based on chemical precipitation followed by clarification, EPA has costed all direct discharging CWT facilities for a clarification unit prior to the sand filtration unit.

EPA believes it is important to note that BPT limitations established by Option 4 are based on data from a single, well-operated system. In reviewing technologies currently in use in this subcategory, however, EPA found that facilities generally utilize a single stage chemical

precipitation step -- not a technology calculated to achieve significant metals removals for the wastestreams observed at these operations. EPA did identify a handful of facilities which utilize additional metals wastewater treatment, generally secondary chemical precipitation. Of these facilities, EPA believes that only one accepts a full spectrum of waste, often with extremely high metals concentrations and is, therefore, designed and operated to achieve optimal performance for a wide range of raw waste concentrations. Consequently, EPA is proposing to adopt BPT limitations based on performance data from this one, well-designed and operated facility.

CYANIDE SUBSET

As discussed above, the presence of high cyanide concentrations detrimentally affects the performance of metal precipitation processes due to the formation of metal-cyanide complexes. Effective treatment of such wastes typically involves a cyanide destruction step prior to any metal precipitation steps. Consequently, in the case of metal streams which contain concentrated cyanide complexes, EPA based BPT limitations on an additional treatment step to destroy cyanide prior to metals precipitation. EPA considered the following three regulatory options for the destruction of cyanide.

CYANIDE SUBSET OPTION 1 - ALKALINE CHLORINATION

The Option 1 technology, alkaline chlorination, is widely used for cyanide destruction in this industry as well as in others. For this subset, it represents current performance.

CYANIDE SUBSET OPTION 2 - ALKALINE CHLORINATION AT SPECIFIC OPERATING CONDITIONS

The technology basis for Option 2 BPT limitations is also alkaline chlorination. The differences between the technology basis for Option 1 and Option 2 cyanide destruction

treatment are specific operating conditions which have been claimed confidential.

The oxidation of cyanide waste by alkaline chlorination is a two step process. In the first step, cyanide is oxidized to cyanate in the presence of hypochlorite, and sodium hydroxide is used to maintain a specific pH range. The second step oxidizes cyanate to carbon dioxide and nitrogen at a controlled pH. The application of heat can facilitate the more complete destruction of total cyanide.

CYANIDE SUBSET OPTION 3 - CONFIDENTIAL CYANIDE DESTRUCTION

EPA evaluated a third technology which is extremely effective in reducing cyanide. Application of this technology resulted in cyanide reductions of 99.8 percent for both amenable and total cyanide. The Option 3 technology is also claimed confidential.

For the 1995 proposal, the Agency proposed limitations based on Cyanide Option 2 for the cyanide subset of the metals subcategory. For this proposal, this technology remains the basis for the BPT limitations for metals streams with concentrated cyanide complexes. Although Option 3 provides greater removals than Option 2, the Agency has decided to reject Option 3 as a basis for BPT limitations because the technology is not publicly available. The cyanide destruction system used at the one facility employing Option 3 is a proprietary process that does not employ off-the-shelf technology. There are, in addition, several reasons supporting the selection of limitations based on Option 2. First, the facility achieving Option 2 removals accepts a full spectrum of cyanide waste. Consequently, the treatment used by the Option 2 facility can be readily applied to all facilities in the subset of this subcategory. Second, adoption of this level of control would represent a significant reduction in pollutants discharged into the environment by facilities in this subset. Finally, the Agency

assessed the total cost for Option 2 in relation to the effluent reduction benefits and determined these costs were economically reasonable.

***Rationale for Oils Subcategory
BPT Limitations***

9.1.2

EPA has considered twelve technology options in establishing BPT effluent reduction levels for the oils subcategory during development of this rule. The first four options were evaluated at the time of the 1995 proposal (60 FR 5478); the other eight options following the 1995 proposal. The twelve technology options considered are:

- Option 1: emulsion breaking/gravity separation
- Option 2: emulsion breaking/gravity separation and ultrafiltration
- Option 3: emulsion breaking/gravity separation, ultrafiltration, carbon adsorption, and reverse osmosis
- Option 4: emulsion breaking/gravity separation, ultrafiltration, carbon adsorption, reverse osmosis, and carbon adsorption
- Option 5: emulsion breaking/gravity separation, ultrafiltration, and chemical precipitation
- Option 6: emulsion breaking/gravity separation, dissolved air flotation, and gravity separation
- Option 7: emulsion breaking/gravity separation, secondary gravity separation, dissolved air flotation, and biological treatment
- Option 8: emulsion breaking/gravity separation and dissolved air flotation
- Option 8v: emulsion breaking/gravity separation, air stripping, and dissolved air flotation

Option 9: emulsion breaking/gravity separation, secondary gravity separation, and dissolved air flotation

Option 9v: emulsion breaking/gravity separation, air stripping, secondary gravity separation, and dissolved air flotation

Option 10: emulsion breaking/gravity separation and secondary gravity separation

As detailed in the 1995 proposal, while emulsion breaking/gravity separation (Option 1) is widely used in this subcategory, EPA dropped it from further consideration at the time of the original proposal since emulsion breaking/gravity separation did not adequately control the pollutants of concern and, therefore, did not represent a BPT technology. The Agency also dropped the Option 4 technology (emulsion breaking/gravity separation, ultrafiltration, carbon adsorption, reverse osmosis, and carbon adsorption) from consideration at the time of the original proposal because EPA's analysis showed that some pollutant concentrations actually increased following the additional carbon adsorption.

At the time of the 1995 proposal, the Agency co-proposed BPT limitations based on emulsion breaking/gravity separation and ultrafiltration as well as emulsion breaking/gravity separation and ultrafiltration with added carbon adsorption and reverse osmosis to remove metal compounds found at significant levels in this subcategory. Because the costs associated with the latter option were four times higher than ultrafiltration alone, EPA was concerned about its impacts on facilities in this subcategory. After the 1995 proposal, EPA collected additional information on facilities in the oils subcategory and revisited its conclusion about the size and nature of the oils subcategory. EPA published a Notice of Data Availability in 1996 describing the new

information and EPA's revised assessment of the oils subcategory. Based on analyses presented in the 1996 Notice, EPA determined it should no longer consider emulsion breaking/gravity separation and ultrafiltration with added treatment steps (Option 3) as the basis for BPT limitations because the projected total costs relative to effluent reductions benefit were not economically reasonable.

Based on comments to the 1995 proposal and the 1996 Notice of Data Availability, EPA was strongly encouraged to look at alternate technology options to emulsion breaking/gravity filtration and ultrafiltration. This concern was driven in large measure by the fact that many of the facilities in the oils subcategory are classified as "small businesses" and the economic cost of installing and operating ultrafiltration technology was quite high. Additionally, many commenters stated that ultrafiltration is a sophisticated technology which would be difficult to operate and maintain with the majority of these wastestreams. Commenters also noted that the Agency had failed to consider non-water quality impacts adequately -- particularly those associated with the disposal of the concentrated filtrate from these operations. As a result, based on comments to the original proposal, the 1996 Notice of Data Availability, and additional site visits, EPA identified several other treatment options that were efficient, produced tighter oil and grease limits, and were less expensive. As such, EPA is no longer considering emulsion breaking/gravity separation and ultrafiltration (Option 2) as an appropriate technology for limitations for the oils subcategory.

Following the 1995 proposal and the 1996 Notice of Data Availability, EPA preliminarily considered Options 5 - 9v in establishing BPT effluent reduction levels for this subcategory. However, EPA dropped Options 5, 6, and 7 early in the process. EPA dropped Option 5 since it relied on ultrafiltration which, as described previously, the Agency determined was

inappropriate for this subcategory. The Agency dropped Option 6 since EPA is unaware of any CWT facilities that currently use the Option 6 treatment technologies in the sequence considered. Finally, EPA dropped Option 7 because EPA's sampling data showed little additional pollutant reduction associated with the addition of the biological treatment system.

Following the SBREFA panel, at the request of panel members, EPA also examined another option, Option 10, which is based on emulsion breaking/gravity separation followed by a second gravity separation step. The Agency has now concluded that it should not propose BPT limitations based on this technology.

EPA recognizes that a majority of the industry currently employs primary emulsion breaking/gravity separation (typically as a pretreatment step prior to dissolved air flotation, biological treatment, or chemical precipitation). However, the data EPA has examined supports the Agency's concerns that the performance of emulsion breaking and/or gravity separation unit operations are inadequate because they do not achieve acceptable pollutant removals. For example, one of the facilities in the oils subcategory that EPA sampled discharged a biphasic sample (oil and water) from the emulsion breaking/gravity separation unit during an EPA sampling visit. When EPA analyzed the sample, the biphasic liquid stream had a relatively small organic phase percentage, yet contained extremely high overall concentrations of toxic pollutants, especially priority, semi-volatile organics (such as polynuclear aromatic hydrocarbons, phthalates, aromatic hydrocarbons, n-paraffins, and phenols). Hence, the Agency believes that gravity separation systems without further treatment provide inadequate removals and, thus, do not represent BPT treatment for this subcategory.

Therefore, the four new technology options considered for the oils subcategory BPT limitations are:

- Option 8²: emulsion breaking/gravity separation and dissolved air flotation
- Option 8v²: emulsion breaking/gravity separation, air stripping, and dissolved air flotation
- Option 9²: emulsion breaking/gravity separation, secondary gravity separation, and dissolved air flotation
- Option 9v²: emulsion breaking/gravity separation, air stripping, secondary gravity separation, and dissolved air flotation

Each of these are discussed below.

OILS SUBCATEGORY OPTION 8² - DISSOLVED AIR FLOTATION

The technology basis for Option 8 is dissolved air flotation (DAF). DAF separates solid or liquid particles from a liquid phase by introducing air bubbles into the liquid phase. The bubbles attach to the particles and rise to the top of the mixture. Often chemicals are added to increase the removal of metal constituents. Generally, BPT limitations based on Option 8 would require facilities with currently installed DAF systems to perform better monitoring and operation of their system or to install and operate a DAF system. For oils streams with significant concentrations of metals, Option 8 would also require increased quantities of treatment chemicals to enhance metals removals.

OILS SUBCATEGORY OPTION 8v² - AIR STRIPPING WITH EMISSIONS CONTROL AND DISSOLVED AIR FLOTATION

The technology basis for Option 8v is the same as Option 8 except air stripping with emissions control is added to control the release of volatile pollutants into the air. The wastewater effluent limitations and standards are the same for Options 8 and 8v.

OILS SUBCATEGORY OPTION 9² - SECONDARY GRAVITY SEPARATION AND DISSOLVED AIR FLOTATION

The technology basis for limitations based on Option 9 is secondary gravity separation and DAF. Secondary gravity separation involves using a series of tanks to separate the oil and water and then skimming the oily component off. The resulting water moves to the next step. The gravity separation steps are then followed by DAF. As mentioned previously, EPA believes all oils facilities currently utilize some form of gravity separation, although most perform primary gravity separation only. Generally, BPT limitations based on Option 9 would require facilities to perform additional gravity separation steps, perform better monitoring and operation of their DAF system, or install and operate a DAF system. For oils streams with relatively high concentrations of metals, Option 9 would also require the use of increased quantities of treatment chemicals to enhance the removal of metals.

OILS SUBCATEGORY OPTION 9v² - AIR STRIPPING WITH EMISSIONS CONTROL, SECONDARY GRAVITY SEPARATION, AND DISSOLVED AIR FLOTATION.

The technology basis for Option 9v is the same as for Option 9 with the addition of air stripping with emissions control to control the release of volatile pollutants into the air. The wastewater effluent limitations and guidelines are the same for Options 9 and 9v.

²As noted above, EPA is no longer considering Oils Options 1- 4 proposed in 1995. During development of today's proposal, EPA also preliminarily considered seven other options numbered 5 - 9v. EPA has chosen to focus its attention on Options 8 through 9v.

The Agency is proposing BPT limitations for the oils subcategory based on Option 9 (emulsion breaking/gravity separation, secondary gravity separation, and dissolved air flotation) for two reasons. First, the adoption of this level of control would represent a significant reduction in pollutants discharged into the environment by facilities in this subcategory. Second, the Agency assessed the total costs of water pollution controls likely to be incurred for this option in relation to the effluent reduction benefits and determined these costs were economically reasonable.

EPA proposes to reject emulsion breaking/gravity separation and DAF alone as the basis for BPT limitations because the estimated costs of complying with both options are equivalent and the estimated removals associated with the added gravity separation step are greater. Additionally, BPT pollutant removals based on Option 8, for a number of parameters (particularly oil and grease), are much less stringent than current BPT effluent limitations guidelines promulgated for other industries. EPA believes that the vast majority of DAF systems in use in this subcategory are not performing optimally. As mentioned earlier, all of the DAF systems studied by EPA were used at facilities that discharge to POTWs. As such, optimal control of oil and grease is not required. Many do not even monitor the oil and grease levels in the material entering and, in some cases, leaving the DAF.

EPA has studied the performance of DAF systems in other largely indirect discharging industries and has found the same lack of optimal performance. EPA believes that all facilities, including indirect dischargers, should monitor the levels of oil and grease entering and leaving the DAF system. Even though oil and grease levels are not of great concern for indirect dischargers, removal of many organic compounds is directly related to removal of oil and grease. As such, the overall efficacy of the DAF system in removing the vast majority of specific toxic parameters can

be improved by improving removals of oil and grease.

The facilities that were sampled were not required to optimize their oil and grease removals because they discharge to POTWs that treat these pollutants. Current POTW/local permit limitations for oil and grease in this subcategory range from 100 mg/L to 2,000 mg/L. Many have no oil and grease limits at all. One of the systems sampled was designed to remove oil and grease to concentrations below 100 ug/L. Consequently, EPA based the proposed oil and grease limitation on data from this single facility.

EPA has also reviewed data from the Industrial Laundries and the TECI rulemaking for dissolved air flotation systems. For similar influent oil and grease concentrations, these systems removed oil and grease to levels well below those achieved at the DAF systems sampled for development of this regulation. Table 9-1 shows average influent and effluent concentrations of oil and grease and TPH at sampled industrial laundry facilities with chemical emulsion breaking or dissolved air flotation. Given the similarities in the treated waste, EPA is considering whether use of this data is appropriate in determining CWT limitations.

Table 9-1. Average Influent and Effluent Oil and Grease and Total Petroleum Hydrocarbon (TPH) Concentrations at Sampled Industrial Laundry Facilities

Episode Number	Treatment Technology	5-Day Average Influent and Effluent Concentrations When Sampled (mg/L)			
		Oil and Grease (measured as HEM)		TPH (measured as SGT-HEM)	
		Influent	Effluent	Influent	Effluent
A	Dissolved Air Flotation	777.2	23.8	308.6	10.4
B	Dissolved Air Flotation	1,530	50.7	681	15.7
C	Chemical Emulsion Breaking	1,030	952	159	164
D	Dissolved Air Flotation	1,110*	216*	245*	41.4*

* The pollutant loadings presented for this facility are based on 4-day average concentrations because a process upset made the data for one day unusable

EPA projects additional pollutant removals associated with the technology that is the basis for the proposed limitations, has costed facilities for the additional technology (a series of gravity separation steps) associated with this option, and has determined that it is economically achievable. However, EPA believes that many CWT facilities may be able to achieve these limitations using emulsion breaking/gravity separation and DAF only. As described above, EPA believes that many DAF systems in this industry are not performing optimally. Careful observations of the influent and effluent of these systems would allow facilities to better understand and control the resulting effluent.

The Agency is not proposing BPT limitations based on air stripping with overhead recovery or destruction. While limitations based on air stripping with overhead recovery or destruction would seem to provide some additional protection from volatile and semi-volatile pollutants to all environmental media, no substantial additional removal of volatile and semi-volatile parameters from the water would be achieved through these options. While gravity separation systems and dissolved air flotation systems are often effective in removing volatile

and semi-volatile pollutants from water, a large portion of these volatile and semi-volatile organic pollutants are emitted into the surrounding air. Thus, while removing the pollutants from the wastewater, these systems do not remove these pollutants from the environment, but rather transfer a large portion of them to another environmental medium. The use of air stripping coupled with emissions capture reduces or eliminates the air emissions that otherwise would occur by the air stripping of the volatile organic pollutants in gravity separation and dissolved air flotation systems. However, compliance with any proposed limitation would not require installation of such equipment.

EPA highly recommends that plants incorporate air stripping with overhead recovery or destruction into their wastewater treatment systems for more complete environmental protection. EPA also notes that CWT facilities determined to be major sources of hazardous air pollutants are currently subject to maximum achievable control technology (MACT) as promulgated for off-site waste and recovery operations on July 1, 1996 (61 FR 34140).

Rationale for Organics Subcategory BPT Limitations

9.1.3

In developing BPT limitations for the organics subcategory, EPA re-examined the treatment options considered for the 1995 proposal as well as assessed two new treatment options. As a result of this re-examination, EPA is no longer considering as a basis for BPT limitations the two options considered earlier (60 FR 5479). The first treatment system EPA examined as a basis for BPT limitations included the following treatment steps: equalization, two air strippers in series equipped with a carbon adsorption unit for control of air emissions, biological treatment in the form of a sequential batch reactor, and, finally, a multimedia filtration unit. The second option was the same as the first, but included a final carbon adsorption step.

For the previous proposal, the Agency selected BPT limitations based on the first treatment system, even though, theoretically, the second system under consideration should have provided greater removal of pollutants. EPA selected the first system as the technology basis since EPA's sampling data showed that, following the carbon adsorption treatment step, specific pollutants of concern actually increased. Therefore, for today's proposal, EPA is no longer considering the second system which includes the final carbon adsorption unit as the basis for BPT limitations. Additionally, EPA has concluded that it should no longer consider the first system (equalization, air stripping, biological treatment, and multimedia filtration) as the basis for BPT limitations. The multimedia filtration step is primarily included in the treatment train to protect the carbon adsorption unit installed downstream from high TSS levels. Since EPA rejected the option which includes the carbon adsorption unit, EPA similarly rejects the option which includes the multimedia filtration step.

The two technology options considered for the organics subcategory BPT are:

- Option 3: equalization, air-stripping with emissions control, and biological treatment; and
- Option 4: equalization and biological treatment

Each of these are discussed below.

ORGANICS SUBCATEGORY OPTION 3 - EQUALIZATION, AIR STRIPPING WITH EMISSIONS CONTROL, AND BIOLOGICAL TREATMENT

Option 3 BPT effluent limitations are based on the following treatment system: equalization, two air-strippers in series equipped with a carbon adsorption unit for control of air emissions, and biological treatment in the form of a sequential batch reactor (which is operated on a batch basis).

Waste treatment facilities often need to equalize wastes by holding wastestreams in a tank for a certain period of time prior to treatment in order to obtain a stable waste stream which is easier to treat. CWT facilities frequently use holding tanks to consolidate small waste volumes and to minimize the variability of incoming wastes prior to certain treatment operations. The receiving or initial treatment tanks of a facility often serve as equalization tanks.

Air stripping is effective in removing dissolved volatile organic compounds from wastewater. The removal is accomplished by passing high volumes of air through the agitated wastewater stream. The process results in a contaminated off-gas stream which, depending upon air emissions standards, usually requires air pollution control equipment.

A sequencing batch reactor (SBR) is a suspended growth system in which wastewater is mixed with existing biological floc in an aeration basin. SBRs are unique in that a single tank acts as an equalization tank, an aeration tank, and a clarifier. An SBR is operated on a batch basis where the wastewater is mixed and aerated with the biological floc for a specific period of time.

The contents of the basin are allowed to settle and the supernatant is decanted. The batch operation of an SBR makes it a useful biological treatment option for the CWT industry, where the wastewater volumes and characteristics are often highly variable. Each batch can be treated differently depending on waste characteristics.

An SBR carries out all of the functions of a conventional continuous flow activated sludge process, such as equalization, biological treatment, and sedimentation, in a time sequence rather than a space sequence. Detention times and loadings vary with each batch and are highly dependent on the specific raw wastewater loadings. By using a single tank to perform all of the required functions associated with biological treatment, an SBR reduces land requirements. It also provides for greater operation flexibility for treating wastes with variable characteristics by allowing the capability to vary detention time and mode of aeration in each stage. SBRs also may be used to achieve complete nitrification/denitrification and phosphorus removal.

ORGANICS SUBCATEGORY OPTION 4 - EQUALIZATION AND BIOLOGICAL TREATMENT

Option 4 BPT effluent limitations are based on the same treatment system as Option 3 without the use of air strippers.

The Agency is proposing to adopt BPT effluent limitations for the organics subcategory based on the Option 4 technology. The Agency's decision to select Option 4 is based primarily on the pollutant reductions, the cost and impacts to the industry, and non-water quality impacts. Unlike the other BPT proposed limitations, the adoption of limitations based on Option 4 would not represent a significant reduction in pollutants discharged into the environment by facilities in this subcategory. EPA believes that all direct discharging facilities in this subcategory currently employ equalization and biological treatment systems. EPA has assumed that all facilities

which currently utilize equalization and biological treatment will be able to meet the BPT limitations without additional capital or operating costs. However, many of these facilities are not currently required to monitor for organic parameters or are only required to monitor one or two times a year. The costs associated with complying with BPT limitations for this subcategory are, therefore, associated with additional monitoring only. The Agency believes the additional monitoring is warranted and will promote more effective treatment at these facilities.

The Agency proposes to reject Option 3. BPT effluent limitations based on Option 3 treatment would be essentially the same as those established by Option 4. The main difference between Options 4 and 3 is that Option 3, which includes air stripping with emissions control, would be effective in reducing the levels of volatile and semi-volatile organic pollutants in all environmental media—not just the water. While biological systems are often effective in removing volatile and semi-volatile pollutants from water, a large portion of these volatile and semi-volatile organic pollutants are emitted by biological systems into the surrounding air. Thus, while removing them from the wastewater, the typical biological system does not remove these pollutants from the environment but rather transfers a large portion of them to another environmental medium. The use of air stripping with emissions control reduces or eliminates the air emissions that otherwise would occur by the volatilization of the volatile organic pollutants in the biological system.

While EPA is concerned about volatile pollutants, particularly for this subcategory, it believes that the use of the CAA to address air emissions from CWT wastewater is preferable. EPA also notes that CWT facilities determined to be major sources of hazardous air pollutants are subject to maximum achievable control technology (MACT) as promulgated for off-site

waste and recovery operations on July 1, 1996 (61 FR 34140) as 40 CFR Part 63.

The Agency used biological treatment performance data from the Thermosetting Resin Subcategory of the OCPSF regulation to establish direct discharge limitations for BOD₅ and TSS, because the facility from which Option 4 limitations were derived is an indirect discharger and the treatment system is not operated to optimize removal of conventional pollutants. EPA has concluded that the transfer of these data is appropriate given the absence of adequate treatment technology for these pollutants at the only otherwise well-operated BPT CWT facility. Given the treatment of similar wastes at both OCPSF and CWT facilities, use of the data is warranted. Moreover, EPA has every reason to believe that the same treatment systems will perform similarly when treating the wastes in this subcategory.

Once again, the selected BPT option is based on the performance of a single facility. Many facilities that are treating wastes that will be subject to the organics subcategory effluent limitations also operate other industrial processes that generate much larger amounts of wastewater than the quantity of off-site-generated organic waste receipts. The off-site-generated CWT organic waste receipts are directly mixed with the wastewater from the other industrial processes for treatment. Therefore, identifying facilities to sample for limitations development was difficult because the waste receipts and treatment unit effectiveness could not be properly characterized for off-site-generated waste. The treatment system on which Option 4 is based was one of the few facilities identified which treated organic waste receipts separately from other on-site industrial wastewater.

BEST CONVENTIONAL TECHNOLOGY (BCT)

9.2

EPA is proposing BCT equal to BPT for the conventional pollutants regulated under BPT for all subcategories of the CWT industry. In deciding whether to propose BCT limits, EPA considered whether there are technologies that achieve greater removals of conventional pollutants than proposed for BPT, and whether those technologies are cost-reasonable under the standards established by the CWA. This is called the "BCT Cost Test." For all three subcategories, EPA identified no technologies that can achieve greater removals of conventional pollutants than those that are the basis for BPT that are also cost-reasonable under the BCT Cost Test. Accordingly, EPA is proposing BCT effluent limitations equal to the proposed BPT effluent limitations guidelines and standards.

BEST AVAILABLE TECHNOLOGY (BAT)

9.3

EPA is proposing BAT effluent limitations for all subcategories of the CWT industry based on the same technologies selected as the basis for BPT for each subcategory. Therefore, the proposed BAT limitations are the same as the proposed BPT limitations. The proposed BAT effluent limitations would control identified toxic and non-conventional pollutants discharged from facilities. As described in the BPT discussion, in general, the adoption of this level of control would represent a significant reduction in pollutants discharged into the environment by facilities in this subcategory. Additionally, EPA has evaluated the economic impacts associated with adoption of these limitations and found them to be economically achievable.

With the exception of the metals subcategory, EPA has not identified any more stringent treatment technology option different from those evaluated for BPT that might represent best available technology economically achievable for

this industry. For the metals subcategory, EPA did consider as BAT technology two treatment technologies that it had evaluated for the 1995 proposal, Options 2 and 3, based on the use of selective metals precipitation. However, the costs to the industry for Option 2 and Option 3 are more than four times greater than the cost of the BPT option, Option 4, with no additional toxics removal³. Given the comparable toxic removals, EPA has concluded it should not adopt a more costly option.

For the oils and organics subcategories, EPA has evaluated treatment technologies for BAT limitations which theoretically should provide greater removal of pollutants of concern. For example, EPA identified an add-on treatment technology to technologies considered for BPT—carbon adsorption—that should have further increased removals of pollutants of concern. However, EPA's data show increases rather than decreases in concentrations of specific pollutants of concern. Consequently, EPA is not proposing BAT limitations based on this technology.

NEW SOURCE PERFORMANCE

STANDARDS (NSPS)

9.4

As previously noted, under Section 306 of the Act, new industrial direct dischargers must comply with standards which reflect the greatest degree of effluent reduction achievable through application of the best available demonstrated control technologies. Congress envisioned that new treatment systems could meet tighter controls than existing sources because of the opportunity to incorporate the most efficient processes and treatment systems into plant design. Therefore,

Congress directed EPA to consider the best demonstrated process changes, in-plant controls, operating methods and end-of-pipe treatment technologies that reduce pollution to the maximum extent feasible.

For the oils and the organics subcategories, EPA is proposing NSPS that would control the same conventional toxic and non-conventional pollutants proposed for control by the BPT effluent limitations. The technologies used to control pollutants at existing facilities are fully applicable to new facilities. Furthermore, EPA has not identified any technologies or combinations of technologies that are demonstrated for new sources that are different from those used to establish BPT/BCT/BAT for existing sources. Therefore, EPA is establishing NSPS oils and organic subcategories similar to the oils and organics subcategories for existing facilities and proposing NSPS limitations that are identical to those proposed for BPT/BCT/BAT.

For the metals subcategory, however, EPA is proposing NSPS effluent limitations based on the technology proposed in 1995: selective metals precipitation, liquid-solid separation, secondary precipitation, liquid-solid separation, tertiary precipitation, and clarification. This technology provides the most stringent controls attainable through the application of the best available control technology.

In establishing NSPS, EPA is directed to take into consideration the cost of achieving the effluent reduction and any non-water quality environmental impacts and energy requirements. Option 3 provides the opportunity for the new source to recover selected metals from the wastestreams they accept, whereas Option 4 does not provide this flexibility. (With Option 3, the metals would be recovered and could be re-used, but with Option 4 the metals would be collected as a sludge and deposited in a landfill). EPA believes that this technology is fully applicable to all metal wastestreams in the CWT industry, including those with high concentrations of total

³EPA's data show that Option 4 would remove a greater level of toxic pound-equivalents than Option 3. Whether or not this is related to the small size of EPA's sampling data set, EPA believes either option would achieve comparable pound-equivalent removals.

dissolved solids (TDS). Commenters to the original proposal had questioned whether the level of TDS in wastewater would increase the solubility of the metals and negatively affect the ability of the Option 3 treatment technology to perform optimally. As detailed in Chapter 2, EPA has concluded that the evidence does not support a direct relationship between TDS and the solubility of metals in water. Finally, EPA has concluded that there is no barrier to entry for new sources to install, operate, and maintain treatment systems that will achieve discharge levels associated with these Option 3 technologies.

PRETREATMENT STANDARDS FOR EXISTING SOURCES (PSES)

9.5

Indirect dischargers in the CWT industry, like the direct dischargers, accept wastes for treatment that contain many toxic and non-conventional pollutants. Like direct dischargers, indirect dischargers may be expected to discharge many of these pollutants to POTWs at significant mass and concentration levels. EPA estimates that CWT indirect dischargers annually discharge ≈ 8.5 million pounds of pollutants.

CWA Section 307(b) requires EPA to promulgate pretreatment standards to prevent pass-through of pollutants from POTWs to waters of the United States or to prevent pollutants from interfering with the operation of POTWs. EPA is establishing PSES for this industry to prevent pass-through of the same pollutants controlled by BAT from POTWs to waters of the United States. A detailed description of the pass-through analysis methodology and the results are presented in Chapter 7.

PSES OPTIONS CONSIDERED

For the metals and organics subcategories, the Agency is proposing to establish pretreatment standards for existing sources (PSES) based on

the same technologies as proposed for BPT and BAT. These standards would apply to existing facilities in the metals or organics subcategories of the CWT industry that discharge wastewater to POTWs and would prevent pass-through of pollutants and help control sludge contamination. Based on EPA's pass-through analysis, all of the BAT pollutants controlled by the metals subcategory and half of the BAT pollutants controlled by the organics subcategory would pass-through and are proposed for PSES. As detailed in Chapter 7, the pollutants in the organics subcategory that were determined not to pass-through are: antimony, copper, zinc, acetophenone, pyridine, and 2,4,6-trichlorophenol.

In establishing PSES, the Agency generally sets the technology basis for PSES equivalent to BAT and then conducts a pass-through analysis. However, if the extent of the economic impacts is questionable, the Agency also considers alternative technology options. In developing PSES for the oils subcategory, EPA carefully considered several types of economic impacts: to the CWT oils facilities, to the CWT oils firms, and to specific segments of the CWT industry such as small businesses. Early results from these analyses supported basing PSES on Option 8 rather than Option 9 (the basis for the BAT limitations) since the additional technology associated with Option 9, while removing additional pollutants, was associated with higher costs and greater adverse economic impacts. Therefore, EPA preliminarily concluded that Option 9 was not economically achievable for indirect dischargers.

As explained in Chapter 2, EPA held a number of discussions with the small business community engaged in oils treatment operations. EPA also convened a SBREFA review panel for this proposal. The panel and the small entity representatives provided many pertinent discussions and insights on possible impacts of this regulation to small businesses. Many

commented that even Option 8 was too expensive. However, EPA believes that any waste transferred to a CWT facility should be treated to at least the same or similar level as that required for the same wastes if treated on-site at the manufacturing facility. Therefore, EPA has concluded that Option 8 is economically achievable even with the projected level of impacts.

More recent results of the economic analysis for this proposal (which include final cost estimates, etc.) indicate that projected impacts for Option 9, while greater than Option 8, were not as high as originally projected in EPA's preliminary analyses. However, while EPA estimates that removals for Option 9 for indirect dischargers are approximately one percent higher than removals for Option 8, EPA believes that many facilities could actually achieve the Option 9 limitations with the Option 8 technology alone if designed and operated efficiently.

Still, in estimating the economic impacts associated with Option 9, EPA costed facilities for the additional treatment technology associated with the Option 9 technology basis. As such, EPA estimates additional process closures and impacts to small businesses associated with the Option 9 technology basis.

Therefore, the proposed PSES standards for the oils subcategory are based on the Option 8 technology -- emulsion breaking/gravity separation and DAF. Fifteen of the 20 BAT pollutants controlled by the oils subcategory would pass-through and are proposed for regulation. As detailed in Chapter 7, the five pollutants in the oils subcategory that were determined not to pass-through are: arsenic, cadmium, chromium, lead, and mercury.

PRETREATMENT STANDARDS FOR NEW SOURCES (PSNS)

9.6

Section 307 of the Act requires EPA to promulgate pretreatment standards for new

sources (PSNS) at the same time it promulgates new source performance standards (NSPS). New indirect discharging facilities, like new direct discharging facilities, have the opportunity to incorporate the best available demonstrated technologies, including process changes, in-facility controls, and end-of-pipe treatment technologies.

As discussed in Chapter 7, EPA determined that a broad range of pollutants discharged by CWT industry facilities pass-through POTWs. The same technologies discussed previously for BAT, NSPS, and PSES are available as the basis for PSNS.

EPA is proposing that PSNS be set equal to NSPS for toxic and non-conventional pollutants for all subcategories. Since the pass-through analysis remains unchanged, the Agency is proposing to establish PSNS for the same toxic and non-conventional pollutants as are being proposed for PSES. EPA considered the cost of the proposed PSNS technology for new facilities. EPA concluded that such costs are not so great as to present a barrier to entry, as demonstrated by the fact that currently operating facilities are using these technologies.

LONG-TERM AVERAGES, VARIABILITY FACTORS, AND LIMITATIONS AND STANDARDS

This chapter describes the data selected and statistical methodology used by EPA in calculating the long-term averages, variability factors, and limitations. Effluent limitations and standards¹ for each subcategory are based on long-term average effluent values and variability factors that account for variation in treatment performance within a particular treatment technology over time. This chapter replaces the discussion of how limitations were determined in the 1995 statistical support document.²

FACILITY SELECTION

10.1

In determining the long-term averages and limitations for each pollutant of concern and each subcategory option, EPA first evaluated information about individual facilities and the analytical data from their treatment systems. As a result of this evaluation, EPA selected only those facilities that operated the model technology to achieve adequate pollutant removals for use in calculating subcategory long-term averages and limitations. EPA used data from the appropriate influent and effluent sample points to develop the long-term averages, variability factors, and limitations. Table 10-1 identifies these facilities and sampling points for the proposed options. The EPA sampling episodes are identified with an 'E' preceding the

facility's 4-digit number (for example, E4378). Data supplied by the facilities ("self-monitoring data") are not preceded by any alphabetic character (for example, facility 602). The table includes some options that EPA did not use as the basis for the proposed limitations. These are included because the data are listed in Appendix C and/or in items in the record for the proposed rulemaking.

EPA selected some facilities for more than one subcategory option if the facility treated its wastes using more than one of the model technologies. For example, EPA selected facility 4378 for both options 2 and 3 in the Metals subcategory because the effluent from sample point SP07 represents the option 2 model technology and the effluent from SP09 represents the option 3 model technology. For the Oils subcategory, facilities 4814A, 4814B, and 701 had the model technology for option 8. The model technology for option 9 is a combination of the option 8 model technology and an additional pretreatment step of gravity separation and are based on facilities 4813, 4814A, 4814B, and 701. Even though the technology basis for Option 9 is based on an additional treatment step, EPA included the data from the option 8 facilities to ensure that the limitations were based on facilities which treat the full breadth of pollutants and pollutant concentrations found in oils subcategory wastes. Thus, EPA selected these facilities to characterize both the model technology for options 8 and 9.

If the concentration data from a facility was collected over two or more distinct time periods, EPA analyzed the data from each time period

¹In the remainder of this chapter, references to 'limitations' includes 'standards.'

²*Statistical Support Document For Proposed Effluent Limitations Guidelines And Standards For The Centralized Waste Treatment Industry*, EPA 821-R-95-005, January 1995.

separately. In the documentation, EPA identifies each time period with a distinct “facility” identifier. For example, facilities 4378 and 4803 are actually one facility, but the corresponding data are from two time periods. In effluent guidelines for other industrial categories, EPA has made similar assumptions for such data, because data from different time periods generally characterize different operating conditions due to changes such as management, personnel, and procedures.

Further, if EPA obtained the concentration data from both an EPA sampling episode and self-monitoring data provided by the facility, EPA analyzed the data from each source separately. Again, this is similar to assumptions that EPA has made for effluent guidelines for other industrial categories. The exception to this general rule was for facility 701 in which EPA combined data that EPA and the facility collected during overlapping time periods. The facility provided effluent measurements collected on four consecutive days by the control authority and monthly effluent measurements collected by the facility. EPA, however, only collected influent and effluent measurements on one day. (In Table 10-1, the data from the facility are identified as ‘701.’ The EPA sampling data is identified as ‘E5046.’ In this document, the data from the two sources are collectively identified as ‘facility 701.’) EPA believes that it is inappropriate to include the effluent measurements from E5046 in its calculations because the sample was collected as a grab sample rather than as a composite sample of the continuous flow system at that sample point. However, EPA retained the influent measurements because influent measurements were otherwise unavailable and this information was crucial for determining if the facility accepted wastes containing the pollutants that were measured in the effluent. EPA also used this influent information in evaluating the pollutant removals for facility 701.

Although EPA collected the data for Episode 4814 during the same time period and from the same facility, EPA has determined that data from facility 4814 should be used to characterize two separate facilities. Facility 4814 has two entirely separate treatment trains which EPA sampled separately. Because the systems were operated separately and treated different wastes, EPA has treated the data as if they were collected from two different facilities (EPA has identified the systems as 4814A and 4814B)

SAMPLE POINT SELECTION ***10.2***

Effluent Sample Point ***10.2.1***

For each facility, EPA determined the effluent sample point representing wastewater discharged by the model technology selected as the basis for that subcategory option. For example, the effluent discharged from sample point SP09 at facility 4378 is the effluent resulting from the model technology selected for option 3 of the Metals subcategory.

Influent Sample Point ***10.2.2***

Influent data were available for all EPA sampling episodes. However, relevant influent data were not available for any of the self-monitoring effluent data except for Facility 701 (as explained in section 10.1). As detailed previously in Chapter 12, for the metals and organics subcategories, this influent data represent pollutant concentrations in “raw”, untreated wastes. For the oils subcategory, however, influent data represent pollutant concentrations following emulsion breaking/gravity separation. Therefore, for each facility, EPA determined the relevant influent sample point for the waste entering the model technology selected as the basis for that subcategory option.

In some cases, EPA estimated influent pollutant concentrations by combining pollutant measurements from two or more influent sample

points into a single flow-weighted value. For example, in Option 3 of the metals subcategory, EPA collected influent samples at five points (SP01, SP03, SP05, SP07, and SP10) during the sampling episode at Facility 4803. EPA calculated a single value from these five sampling points representing the influent to the model technology using the methodology described in Section 10.4.3.3.

Special Cases

10.2.3

As detailed previously in Chapter 2, for samples collected during EPA sampling episodes, EPA did not analyze for the full spectrum of pollutants at each sampling point. The specific constituents analyzed at each episode and sampling point varied and depended on the waste type being treated and the treatment technology being evaluated. For example, for the metals subcategory, EPA did not generally analyze for organic pollutants in effluent from chemical precipitation and clarification. Therefore, in some cases, for specific pollutants, EPA selected a different sample point to represent influent to and effluent from the model treatment technology than the sample point selected for all other pollutants. For example, for Episode 4803 in Metals Option 3, EPA selected sample point 15 to represent the effluent from the model technology. Since EPA did not analyze the wastewater collected at sample point 15 for oil and grease, sgt-hem, total cyanide, and organic constituents, for these pollutants only, EPA selected sample point 16 to represent the effluent point for Episode 4803 of Metals Option 3. EPA believes this is appropriate since the treatment step between sample point 15 and sample point 16 should not have affected the levels of these pollutants in the wastewater.

DETERMINATION OF BATCH AND CONTINUOUS FLOW SYSTEMS

10.3

For each influent and effluent sample point of

interest, EPA determined whether wastewater flows were ‘*continuous*’ or ‘*batch*.’ At sample points associated with continuous flow processes, EPA collected composite samples for all analytes except for oil and grease (for which the analytical methods specify grab samples). At sample points associated with batch flow processes, EPA collected grab samples. For self-monitoring data, EPA assumed the wastewater flow to be either continuous or batch based on the type of discharge at the facility (i.e., continuous or batch discharge).

EPA made different assumptions depending on the two types of flow processes. For a sample point associated with a continuous flow process, EPA aggregated all measurements within a day to obtain one value for the day. This daily value was then used in the calculations of long-term averages, variability factors, and limitations. For example, if samples were collected at the sample point on four consecutive days, the long-term average would be the arithmetic average of four daily values. (Sections 10.4.2 and 10.5 discuss data aggregation and calculation of long-term averages, respectively.) In contrast, for a sample point associated with a batch flow process, EPA aggregated all measurements within a batch to obtain one value for the batch process. This batch value was then used as if it were a daily value. For example, if one sample was collected from each of 20 batches treated on four consecutive days (i.e., a total of 20 samples during a four day period), the long-term average would be the arithmetic average of the 20 batch values. For simplicity, the remainder of the chapter refers to both types of aggregated values (i.e., daily and batch values) as ‘daily values.’ In addition, references to ‘sampling day’ or ‘day’ mean either a sampling day at a continuous flow facility or a batch from a batch flow facility. The sample points followed by an asterisk in Table 10-1 are associated with batch flow systems. EPA assumed all other sample points to be associated with continuous flow systems.

Table 10-1 Facilities and Sample Points Used to Develop Long-term Averages and Limitations

Subcategory	Option	Facility	Pollutants	Effluent Sample Point	Influent Sample Point
Metals	1A	E1987	All	SP03	SP01, SP02 <u>day3 flows:</u> SP01=2500gal SP02=1290gal (on other days, samples weren't collected at both sample points.)
		E4382	All	SP12	SP07
		613	analytes that pass tests in E4382	SP16 *	none
		E4798	All	SP03	SP02
	2	E4378	Total cyanide	SP07	SP06
			Organics	SP07	SP08
			All others	SP07	SP01= 5,000 gal * SP03=20,000 gal *
	3	E4378	Total cyanide	SP09	SP06
			Organics	SP09	SP08
			All others	SP09	SP01= 5,000 gal SP03=20,000 gal
		602	Analytes passing the tests in E4378 OR E4803	SP01	none
		E4803	Oil and Grease, SGT-HEM, total cyanide, and organics	SP16	SP12
			All others	SP15	SP01= 3,400 gal * SP03=12,600 gal * SP05=18,000 gal * SP07= 8,000 gal * SP10= 4,355 gal * ‡
	4	E4798	All	SP05	SP02
		700	Analytes passing the tests in E4798	SP01	none
Cyanide Subset of Metals Subcategory	1	E4393	Total cyanide	SP07	SP06
	2	E4055	Total cyanide	SP03 *	SP02 *
Oils	1C	E4381	All	SP01 *	none
		E4382	All	SP11	none
		E4440	All	SP06	none
		E4620	All	SP02	none
		E4813	Total cyanide	SP06	none
			All others	SP05	none
		E4814A	All	SP07	none
		E4814B	All	SP08	none
	8/8v	E4814A	All	SP09	SP07
		E4814B	All	SP10	SP08
		701 and E5046 †	All	SP01 from 701	none from 701 and SP01 from E5046

Table 10-1 Facilities and Sample Points Used to Develop Long-term Averages and Limitations

Subcategory	Option	Facility	Pollutants	Effluent Sample Point	Influent Sample Point
Oils (cont.)	9/9v	E4813	Total cyanide	SP07	SP06
			All others	SP07	SP05
		E4814A	All others	SP09	SP07
		E4814B	All	SP10	SP08
		701 and E5046 †	All	SP01 from 701	none from 701 and SP01 from E5046
Organics	0	E4377	All	SP01	none
		E4472	All	SP01	none
	3/4	E1987	All	SP12	SP07B

* Batch flow systems. All others are continuous flow systems.

‡ EPA collected samples from four separate batches at SP10. The flows associated with the four batches 10A, 10B, 10C, and 10D were 3500 gal, 5130 gal, 3500 gal, and 5130 gal, respectively. EPA used the average flow of 4355 gal in flow-weighting SP10 with the four other sample points SP01, SP03, SP05, and SP07.

† These are identified as facility 701 in other tables in this document and in the record.

When multiple sample points are identified in this table, the data listing and data summaries identify the last sample point. For example, for facility 4803 (metals subcategory, option 3), the influent sample point is identified as 'SP10.'

DATA SELECTION

10.4

EPA performed a detailed review of the analytical data and sampling episode reports. As a result, EPA corrected some errors in the database. EPA also re-evaluated the bases for the data exclusions and assumptions as used in calculating limitations for the 1995 proposal. EPA made some modifications to its approach for this proposal after reviewing the assumptions it used for excluding or modifying certain data. These are discussed in this section. The database was corrected and the corrected version has been placed in the record to this proposed rulemaking.

Data Exclusions and Substitutions 10.4.1

In some cases, EPA did not use all of the data detailed in Table 10-1 to calculate long-term averages, variability factors and limitations. This section details these data exclusions and substitutions Other than the data exclusions and substitutions described in this section and those resulting from the data editing procedures

(described in section 10.4.3), EPA has used all the data from the facilities and sample points presented in Table 10-1.

Operational Difficulties 10.4.1.1

EPA excluded data that were collected while the facility was experiencing operational difficulties. For the data used in calculating long-term averages and limitations, this occurred during sampling at episode 4814 only. During the second day of sampling, 9/17/96, the facility was required to shut-down and re-start the operation of both of their DAF systems due to poor performance and equipment failures. As such, EPA excluded all data collected on 9/17/97 associated with sample point 09 at facility 4814A and sample point 10 at facility 4814B.

Treatment Not Reflective of BPT/BCT/BAT Treatment 10.4.1.2

EPA reviewed the effluent data used to develop the limitations and excluded any facility data set where the long-term average did not reflect the performance expected by

BPT/BCT/BAT treatment. Other than excluding mercury values from facility 602 in option 3 of the metals subcategory, the other excluded facility data sets were for conventional parameters (i.e., oil and grease, BOD₅, and TSS). In all cases, these data sets were collected at facilities that are indirect dischargers and that are not required to optimize performance of their system for removal of these pollutants. In most cases, the conventional pollutants are not limited by the POTW and the facility is not required to monitor for these pollutants. These exclusions were for oil and grease (facilities 4813, 4814A, and 4814B for option 9³ of the oils subcategory), BOD₅ (facility 1987 for option 3/4 of the organics subcategory), TSS (facility 1987 for option 3/4 of the organics subcategory, and facilities 4798 and 700 for option 4 of the metals subcategory).

Similarly, in calculating long-term averages for oils option 9, EPA excluded the TSS data for facilities 4813, 4814A, and 4814B. However, EPA used these data to calculate variability factors for TSS for oils option 9 since EPA believes that the data reflected the overall variability associated with the model technology. (Sections 10.5, 10.6, and 10.7 describe the development of the long-term averages, variability factors, and limitations, respectively.)

*Exclusions to EPA Sampling Data
Based Upon the Availability of the
Influent and Effluent*

10.4.1.3

For the data from the EPA sampling episodes, EPA determined the availability of the influent and effluent data for each sampling day. Both influent and effluent levels are important in evaluating whether the treatment system efficiently removed the pollutants. In addition, the pollutant levels in the influent indicate

whether the pollutants existed at treatable levels. In most cases, influent and effluent data were both available for a given day.

For the cases when effluent data were unavailable for some days, but influent data were available, EPA generally determined that the influent data still provided useful information about the pollutant levels and should be retained. However, for the organic pollutants at facility 4378, the effluent data were only available for one day while the influent data were available for several days. In this case, EPA determined that the influent levels on that single date should be considered and the levels on the other dates excluded.

When the effluent data were available but influent data were unavailable, EPA determined that the effluent data should be excluded from further consideration. Without the influent data, EPA could not evaluate the treatability of the pollutants and the effectiveness of the treatment system.

More Reliable Results Available *10.4.1.4*

In some cases, EPA had analytical data which represent a single facility (and time period) that were analyzed by two different laboratories or using two different analytical methods. For two of these cases, EPA determined that one analytical result was more reliable than the other and excluded the less reliable result. This section describes these cases.

In limited instances, facility 700 provided two analytical results for the same date from different laboratories. For the total cyanide effluent data collected on 11/6/96, the analytical results from the two laboratories differed considerably. The facility representative considered the result generated by the off-site laboratory to be more reliable than the result generated by the facility's on-site laboratory and recommended that EPA use the off-site data only. EPA agrees with this suggestion and has used only the value from the off-site laboratory.

³EPA did not similarly exclude data for facilities 4814A and 4814B from the Option 8 calculations since EPA did not select this option as the basis of the proposed BPT/BCT limitations.

Some chlorinated phenolics in episode 1987 were analyzed by both method 85.01 and method 1625. Thus, for a given sample, there were two results for a specific chlorinated phenolic. Of the pollutants of concern, these compounds were pentachlorophenol, 2,3,4,6-tetrachlorophenol, 2,4,5-trichlorophenol, and 2,4,6-trichlorophenol. Where two results were provided for the same pollutant in a sample, EPA used the analytical result from Method 1625. This decision is based on the knowledge that Method 1625 is an isotope dilution GC/MS procedure, and therefore produces more reliable results than Method 85.01.

*Data from Facilities Which
Accepted Waste from More
than One Subcategory*

10.4.1.5

EPA also excluded data that were collected during time periods when the facility treated wastes from more than one CWT subcategory. For the oil and grease calculations for metals option 4, EPA excluded all oil and grease values greater than 143 mg/L since this was the highest value of oil and grease measured in the *influent* samples collected at any metals subcategory facility. EPA believes that values of oil and grease in the *effluent* above this level indicate that the facility was also treating oils subcategory wastes and has, therefore, excluded this data from its calculations.

*Substitution Using the
Baseline Values*

10.4.1.6

In developing the pollutant long-term averages and limitations, EPA compared each laboratory-reported sample result to a baseline value (defined in Chapter 15). For certain pollutants, EPA substituted a larger value than the measured value or sample-specific detection limit in calculating the long-term averages and limitations. These pollutants were measured by Methods 1624 and 1625 (organic pollutants) and Method 1664 (n-hexane extractable material (HEM) and silica gel treated n-hexane extractable

material (sgt-hem)). For these pollutants, EPA substituted the value of the minimum level (ML) specified in the method and assumed that the measurement was non-detected when a measured value or sample-specific detection limit was reported with a value less than the ML. For example, if the ML was 10 ug/l and the laboratory reported a detected value of 5 ug/l, EPA assumed that the concentration was non-detected with a sample-specific detection limit of 10 ug/l. For all other pollutants, EPA used the reported measured value or sample-specific detection limit.

Data Aggregation

10.4.2

In some cases, EPA determined that two or more samples had to be mathematically aggregated to obtain a single value. In some cases, this meant that field duplicates, grab samples, and/or multiple daily observations were aggregated for a single sample point. In other cases, data from multiple sample points were aggregated to obtain a single value representing the influent to the model technology.

In all aggregation procedures, EPA considered the censoring type associated with the data. EPA considered measured values to be *detected*. In statistical terms, the censoring type for such data was 'non-censored' (NC). Measurements reported as being less than some sample-specific detection limit (e.g., <10 mg/L) are censored and were considered to be *non-detected* (ND). In the tables and data listings in this document and the record for the proposed rulemaking, EPA has used the abbreviations NC and ND to indicate the censoring types.

The distinction between the two censoring types is important because the procedure used to determine the variability factors considers censoring type explicitly. This estimation procedure modeled the facility data sets using the modified delta-lognormal distribution. In this distribution, data are modeled as a mixture of two distributions corresponding to different process

conditions. Because this industry treats different types of waste from day to day, EPA assumed that the process conditions leading to non-detected values are generally different than process conditions leading to the detected values. (For example, a facility may treat wastewater with relatively high levels of organics and low levels of metals and the next day treat wastes that have high metals concentrations and non-detectable levels of organics.) Thus, the distinctions between detected and non-detected measurements were important in estimating the variability factors.

Because each aggregated data value entered into the model as a single value, the censoring type associated with that value was also important. In many cases, a single aggregated value was created from unaggregated data that were all either detected or non-detected. In the remaining cases with a mixture of detected and non-detected unaggregated values, EPA determined that the resulting aggregated value should be considered to be detected because the pollutant was measured at detectable levels.

This section describes each of the different aggregation procedures. They are presented in the order that the aggregation was performed. That is, field duplicates were aggregated first, grab and multiple samples second, and finally multiple streams. For example, if EPA has four pairs of data (i.e., four influent samples and four duplicate influent samples), then EPA aggregated each of the four pairs to obtain four values -- one for each pair of data. These four values were then aggregated to obtain one daily value for the influent stream. As a further example, suppose the same facility had two additional streams entering into the treatment system. Thus, the influent into the treatment system would be characterized by the combination of the pollutant levels of the three streams. To obtain one value to characterize the influent, the pollutant levels in the three streams would be '*flow-weighted*' by the wastewater flow in each stream. The

following three sections specify the procedures used to aggregate field duplicates, grab samples (and daily values), and multiple influent streams, respectively.

Aggregation of Field Duplicates 10.4.2.1

During the EPA sampling episodes, EPA collected a small number of field duplicates. Generally, ten percent of the number of samples collected were duplicated. Field duplicates are two or more samples collected for the same sampling point at approximately the same time, assigned different sample numbers, and flagged as duplicates for a single sample point at a facility. Because the analytical data from each duplicate pair characterize the same conditions at that time at a single sampling point, EPA aggregated the data to obtain one data value for those conditions. The data value associated with those conditions was the arithmetic average of the duplicate pair. In most cases, both duplicates in a pair had the same censoring type. In these cases, the censoring type of the aggregate was the same as the duplicates. In the remaining cases, one duplicate was a non-censored value and the other duplicate was a non-detected value. In these cases, EPA determined that the appropriate censoring type of the aggregate was 'non-censored' because the pollutant had been present in one sample. (Even if the other duplicate had a zero value⁴, the pollutant still would have been present if the samples had been physically combined.) Table 10-2 summarizes the procedure for aggregating the analytical results from the field duplicates. This aggregation step for the duplicate pairs was the first step in the aggregation procedures for both influent and effluent measurements.

⁴This is presented as a 'worst-case' scenario. In practice, the laboratories cannot measure 'zero' values. Rather they report that the value is less than some level (see chapter 15).

Table 10-2. Aggregation of Field Duplicates

If the field duplicates are:	Censoring type of average is:	Value of aggregate is:	Formulas for aggregate value of duplicates:
Both non-censored	NC	arithmetic average of measured values	$(NC_1 + NC_2)/2$
Both non-detected	ND	arithmetic average of sample-specific detection limits	$(DL_1 + DL_2)/2$
One non-censored and one non-detected	NC	arithmetic average of measured value and sample-specific detection limit	$(NC + DL)/2$
NC=non-censored (or detected) ND=non-detected DL=sample-specific detection limit			

Aggregation of Grab Samples and Multiple Daily Values

10.4.2.2

This section describes the aggregation of grab samples and multiple daily values for effluent sample points associated with continuous flow facilities (defined in section 10.3).

During the EPA sampling episodes, EPA collected two types of samples: grab and composite. Typically, for a continuous flow system, EPA collected composite samples; however, for oil and grease, the method specifies that grab samples must be used. For that pollutant, EPA collected four grab samples during a sampling day at a sample point associated with a continuous flow system. To obtain one value characterizing the pollutant levels at the sample point on a single day, EPA mathematically aggregated the measurements from the grab samples.

In the self-monitoring data, facilities occasionally reported more than one value for a single day. If the sample point was associated with a continuous flow system, then EPA mathematically aggregated the results to obtain one daily value.

EPA used the same procedure for grab samples and multiple daily values. The method arithmetically averaged the measurements to obtain a single value for the day. When one or more measurements were non-censored, EPA

determined that the appropriate censoring type of the aggregate was 'non-censored' because the pollutant was present. Table 10-3 summarizes the procedure.

Table 10-3 Aggregation of Grab Samples and Daily Values

If the grab or multiple samples are:	Censoring type of Daily Value is:	Daily value is:	Formulas for Calculating Daily Value:
All non-censored	NC	arithmetic average of measured values	$\frac{\sum_{i=1}^n NC_i}{n}$
All non-detected	ND	arithmetic average of sample-specific detection limits	$\frac{\sum_{i=1}^n DL_i}{n}$
Mixture of non-censored and non-detected values (total number of observations is n=k+m)	NC	arithmetic average of measured values and sample-specific detection limits	$\frac{\sum_{i=1}^k NC_i + \sum_{i=1}^m DL_i}{n}$

NC=non-censored (or detected) ND=non-detected DL=sample-specific detection limit

Aggregation of Data Across Streams (“Flow-Weighting”)

10.4.2.3

After field duplicates and grab samples were aggregated, the data were further aggregated across sample points. This step was necessary when more than one sample point characterized the wastestream of concern. For example, this situation occurred for facility 4803 where five different wastestreams entered into the treatment process. EPA sampled each of these wastestreams individually at sample points SP01,

SP03, SP05, SP07, and SP10. In aggregating values across sample points, if one or more of the values were non-censored, then the aggregated result was non-censored (because the pollutant was present in at least one stream). When all of the values were non-detected, then the aggregated result was considered to be non-detected. The procedure for aggregating data across streams is summarized in Table 10-4. The following example demonstrates the procedure for hypothetical pollutant X at a facility with three streams entering into the treatment system.

Example of calculating an aggregated flow-weighted value:

Sample Point	Flow (gal)	Concentration (ug/L)	Censoring
SP33	10,000	10	ND
SP34	20,000	50	NC
SP35	5,000	100	ND

Calculation to obtain aggregated, flow-weighted value:

$$\frac{(10,000 \text{ gal} * 10 \text{ ug/L}) + (20,000 \text{ gal} * 50 \text{ ug/L}) + (5,000 \text{ gal} * 100 \text{ ug/L})}{10,000 \text{ gal} + 20,000 \text{ gal} + 5,000 \text{ gal}} = 45.7 \text{ ug/L}$$

because one of the three values was non-censored, the aggregated value of 45.7 ug/L is non-censored.

Table 10-4 Aggregation of Data Across Streams

If the n observations are:	Censoring type is:	Formulas for value of aggregate
All non-censored	NC	$\frac{\sum_{i=1}^n NC_i \times flow_i}{\sum_{i=1}^n flow_i}$
All non-detected	ND	$\frac{\sum_{i=1}^n DL_i \times flow_i}{\sum_{i=1}^n flow_i}$
Mixture of k non-censored and m non-detected (total number of observations is n=k+m)	NC	$\frac{\sum_{i=1}^k NC_i \times flow_i + \sum_{j=1}^m DL_j \times flow_j}{\sum_{i=1}^n flow_i}$

NC=non-censored (or detected)

ND=non-detected

DL=sample-specific detection limit

Data Editing Criteria

10.4.3

After excluding some data (as detailed in Section 10.4.1) and aggregating the data, EPA applied data editing criteria to select facility data sets from the EPA sampling episodes to use in calculating the long-term averages and limitations. These criteria were specified by the 'long-term average test' and 'percent removals

test.' In addition, the criteria for the self-monitoring data depended upon the results of the data editing criteria for the data that EPA collected at the facilities. These data editing criteria are described in the following sections. When the influent data at a facility failed the editing criteria, EPA excluded the effluent data for the facility in calculating the long-term averages and limitations for the corresponding

option in the subcategory. For example, at facility 1987, if the arsenic data from influent sample point 07B failed any of the editing criteria, then the effluent data at sample point SP12 were excluded from calculating the long-term averages and limitations for option 4 of the organics subcategory. For each of the proposed options and pollutants of concern evaluated for long-term averages and limitations, Attachment 10-1 indicates whether the data failed the data editing criteria, indicates when no data were available for a pollutant at any of the facilities, or provides the facility-specific long-term average (calculated as described in section 10.5).

Long-Term Average Test 10.4.3.1

EPA established the long-term average test ('LTA test') to ensure that the pollutants were present in the influent at sufficient concentrations to evaluate treatment effectiveness at the facility. After the data aggregation described in section 10.4.2, EPA compared the daily values of the influent and their long-term average to the baseline values described in chapter 15. The influent had to pass one of the following two steps to pass the LTA test:

- Step 1: Fifty percent of the influent measurements had to be detected at concentration levels equal to or greater than ten times the baseline value for the pollutant (these values are listed in Attachment 15-1); or
- Step 2: The influent long-term average had to be equal to or greater than ten times the baseline value and at least 50 percent of the influent measurements had to be detected (at any level). Section 10.5 describes the calculations for long-term averages.

Percent Removal Test 10.4.3.2

If the influent data passed either step in the LTA test, then EPA calculated the facility's influent and effluent averages without all of the data aggregation steps described in section 10.4.2. This is a deviation from the procedure used to calculate the influent averages used in LTA test (in section 10.4.3.1) and the effluent long-term averages used in the limitations (in section 10.7). For the percent removals, EPA used a different aggregation procedure that emphasized the detection of pollutant levels. In this modified aggregation procedure, EPA aggregated field duplicates using the procedure in section 10.4.2.1 and flow weighted wastestreams using the procedure in Section 10.4.2.3. EPA did not aggregate batches, grabs, or multiple daily values (other than duplicates) as an interim step prior to obtaining one overall value for the wastestream. For example, if a facility had five influent measurements of which three were batches from sample point 33 and the remaining two were a duplicate pair at sample point 34, EPA first aggregated the duplicate measurements at sample point 34 to obtain one value for the duplicate pair. EPA then arithmetically averaged the three batches from sample point 33 without considering the flows corresponding to each batch. For the percent removals, the influent average was then the flow-weighted average of two values: one from sample point 33 and one from sample point 34. In contrast, the influent average for the LTA test would have flow-weighted the batches from sample point 33 using the flows for each batch.

The percent removal test compared the influent and effluent averages to determine if the treatment associated with the effluent sample point removed any of the pollutant. If the removals were negative, then EPA excluded the effluent data from developing the long-term averages and limitations.

$$\text{Percent removal} = \frac{\text{Influent average} - \text{Effluent average}}{\text{Influent average}} \times 100$$

Evaluation of Self-Monitoring Data 10.4.3.3

EPA used self-monitoring data for effluent at three facilities in developing the long-term averages and limitations. These facilities were 602, 700, and 701. These facilities provided concentration values for some of the pollutants that EPA considered in developing the long-term averages and limitations. However, the self-monitoring data were for effluent only (i.e., no influent data were provided). In its evaluation of the data, EPA determined that influent data provided critical evidence that the facility treated wastes containing these pollutants. Thus, EPA used influent data from its sampling episodes to determine if the facility accepted wastes containing these pollutants.

For facility 701, EPA collected influent information during the same time period as the effluent data provided by the facility. As described in section 10.1, EPA used this influent information with the facility 701 effluent data.

For the remaining two facilities, 602 and 700, EPA considered the pollutant levels in the influent at the EPA sampling episodes. As explained in section 10.1, different facility numbers may refer to the same facility. For example, for option 3 of the metals subcategory, facilities 602, 4378, and 4803 are the same facility. (Facilities 4378 and 4803 were EPA sampling episodes.) If the influent data at facility 4378 or facility 4803 met the data editing criteria (i.e., LTA test and percent removals test), then EPA used the effluent data from facility 602 in calculating the long-term averages and limitations for the pollutant. If the influent data for the pollutant at facility 4378 and facility 4803 did not meet the criteria, then EPA excluded the data

from facility 602. In a similar manner, facilities 4798 and 700 for option 4 of the metals subcategory were linked. If the influent data for a pollutant at facility 4798 (an EPA sampling episode at the same facility as facility 700) met the data editing criteria, then EPA used the effluent data from facility 700 in calculating the long-term averages and limitations for the pollutant. If the influent data for the pollutant at facility 4798 did not meet the criteria, then EPA excluded the data from facility 700.

DEVELOPMENT OF LONG-TERM AVERAGES

10.5

In order to develop the long-term averages and proposed limitations for the centralized waste treatment industry, it was necessary to estimate long-term averages and variability factors. This section discusses the estimation of long-term averages by facility (“facility-specific”) and by option (“pollutant-specific”). For each pollutant of concern (see Chapter 7), EPA calculated long-term averages for each regulatory option and each subcategory. The long-term average represents the average performance level that a facility with well-designed and operated model technologies is capable of achieving.

EPA calculated the long-term average for each pollutant for each facility by arithmetically averaging the pollutant concentrations. The pollutant long-term average for an option was the median of the long-term averages from selected facilities with the technology basis for the option. The following two subsections describe the estimation of the facility-specific and pollutant-specific long-term averages.

Estimation of Facility-Specific***Long-Term Averages******10.5.1***

The facility-specific long-term average for each pollutant for each facility is the arithmetic average of the daily pollutant concentrations of wastewater from the facility. EPA substituted the sample-specific detection limit for each non-detected measurement.

For example, for facility A, if the concentration values for hypothetical pollutant X are:

10 mg/l,

13 mg/l,

non-detect ("ND") with sample-specific detection

limit = 5 mg/l,

12 mg/l, and

15 mg/l

then the facility-specific long-term average is calculated using the sample-specific detection limit of 5 mg/l for the non-detected measurement. This facility-specific long-term average is equal to the average of the five values:

$(10 + 13 + 5 + 12 + 15)/5 \text{ mg/l} = 11 \text{ mg/l}$.

Estimation of Pollutant-Specific***Long-Term Averages******10.5.2***

The pollutant-specific long-term average was the median of the facility-specific long-term averages from the facilities with the model technologies for the option. The median is the midpoint of the values ordered (i.e., ranked) from smallest to largest. If there is an odd number of values (with n =number of values), then the value of the $(n+1)/2$ ordered observation is the median. If there are an even number of values, then the two values of the $n/2$ and $[(n/2)+1]$ ordered observations are arithmetically averaged to obtain the median value.

For example, for subcategory Y option Z, if the four (i.e., $n=4$) facility-specific long-term averages for pollutant X are:

Facility***Long-term average***

A 20 mg/l

B 9 mg/l

C 16 mg/l

D 10 mg/l

then the ordered values are:

Order Facility Long-term average

1 B 9 mg/l

2 D 10 mg/l

3 C 16 mg/l

4 A 20 mg/l

And the pollutant-specific long-term average for option Z is the median of the ordered values (i.e., the average of the 2nd and 3rd ordered values): $(10+16)/2 \text{ mg/l} = 13 \text{ mg/l}$.

The pollutant-specific long-term averages were used in developing the limitations for each pollutant within each proposed option.

Substitutions for***Long-Term Averages******10.5.3******Baseline Values Substituted******for Long-Term Averages******10.5.3.1***

After calculating the pollutant-specific long-term averages for the proposed options, EPA compared these values to the baseline values provided in chapter 15. EPA performed this comparison in response to comments on the 1995 proposal. These comments stated that it was not possible to measure to the low levels required in that proposal. If the long-term average was less than the baseline value, EPA substituted the baseline value for the pollutant-specific long-term average. Table 10-5 identifies the pollutants for options 3 and 4 in the Metals subcategory where this situation occurs. (This situation did not occur for the other subcategories.)

Table 10-5 Metals Subcategory: Long-Term Averages Replaced by the Baseline Values

Option	Pollutant	CAS number	Baseline Value (mg/L)	Long-Term Average (mg/L)
3	beryllium	7440417	5	1
	manganese	7439965	15	12
	silver	7440224	10	5
	tin	7440315	30	28
	titanium	7440326	5	4
	vanadium	7440622	50	11
4	iridium	7439885	1000	500
	vanadium	7440622	50	12

Arsenic Long-Term Average for Metals Subcategory Option 4 10.5.3.2

In developing the limitations for arsenic for option 4 of the metals subcategory, EPA used the long-term average from option 1A. During the EPA sampling episode, the influent concentrations of arsenic were at levels less than EPA's criteria for treatable levels (see explanation of LTA test in section 10.4.3.1). Thus, the data editing criteria excluded the arsenic data from both facilities 4798 and 700. However, the arsenic concentration at facilities in option 1A were at treatable levels. Because the treatment technology in option 4 should provide better removals than option 1A, EPA expects that facilities utilizing the option 4 technologies can achieve arsenic effluent concentration levels at least as low as the values from facilities using the option 1A technologies. Thus, EPA has transferred the long-term average from option 1A to option 4.⁵

⁵Because the data for option 4 provided group variability factors (see section 10.6.7) for the semi-metals group (which includes arsenic), EPA did not transfer develop variability factors using the data from option 1A. Because each group is composed of pollutants with similar chemical structure, EPA expects the variability of the model technology in option 4 to be consistent for all pollutants in the group and thus used the variability factor from option 4.

DEVELOPMENT OF VARIABILITY FACTORS

10.6

In developing the variability factors that were used in calculating the limitations, EPA first developed facility-specific variability factors using the modified delta-lognormal distribution. Second, EPA used these facility-specific variability factors to develop the group-level variability factors. (Chapter 7 describes the assignment of pollutants to groups. Appendix A provides a list of the groups and the associated pollutants.) Third, EPA used the pollutant-specific variability factors to develop the group-level variability factors. For pollutants assigned to groups, EPA then used the group variability factors in calculating the limitations. For pollutants that were not assigned to groups, EPA used the pollutant-specific variability factor.

The following sections describe the modified delta-lognormal distribution and the estimation of the facility-specific, pollutant-specific, and group-level variability factors.

Basic Overview of the Modified Delta-Lognormal Distribution 10.6.1

EPA selected the modified delta-lognormal distribution to model pollutant effluent concentrations from the centralized waste treatment industry in developing the variability

factors. In this industry, wastewater is generated from treating wastes from different sources and industrial processes. A typical effluent data set from a facility in this industry consists of a mixture of measured (detected) and non-detected values. Within a data set, gaps between the values of detected measurements and the sample-specific detection limits associated with non-detected measurements may indicate that different pollutants were present in the different industrial wastes treated by a facility. Non-detected measurements may indicate that the pollutant is not generated by a particular source or industrial process. The modified delta-lognormal distribution is appropriate for such data sets because it models the data as a mixture of measurements that follow a lognormal distribution and non-detect measurements that occur with a certain probability. The model also allows for the possibility that non-detect measurements occur at multiple sample-specific detection limits. Because the data appeared to fit the modified delta-lognormal model reasonably well, EPA believes that this model is the most appropriate model of those evaluated for the centralized waste treatment data.

The modified delta-lognormal distribution is a modification of the 'delta distribution' originally developed by Aitchison and Brown.⁶ The resulting mixed distributional model, that combines a continuous density portion with a discrete-valued spike at zero, is also known as the delta-lognormal distribution. The delta in the name refers to the proportion of the overall distribution contained in the discrete distributional spike at zero, that is, the proportion of zero amounts. The remaining non-zero, non-censored (NC) amounts are grouped together and fit to a lognormal distribution.

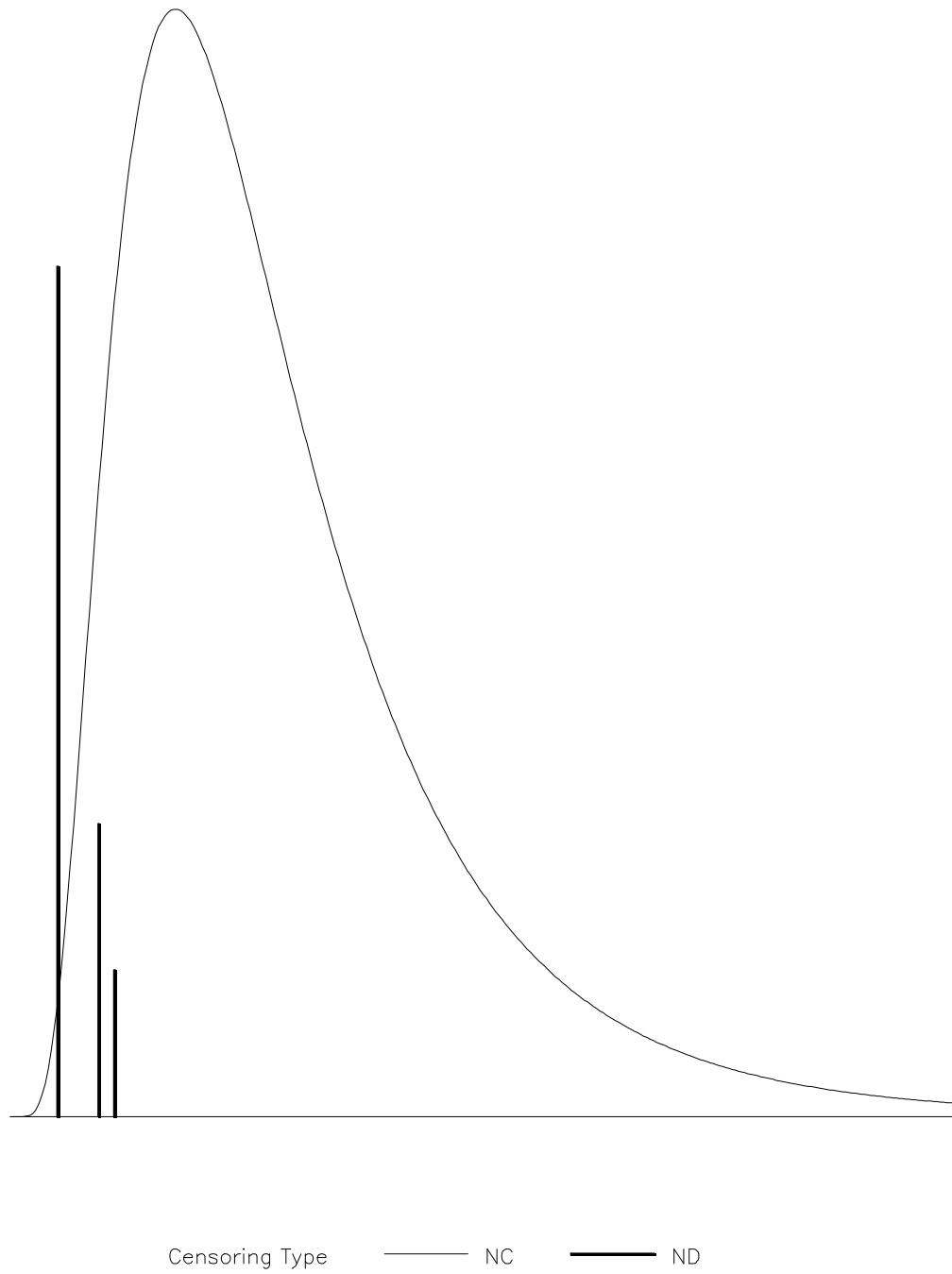
⁶ Aitchison, J. and Brown, J.A.C. (1963) The Lognormal Distribution. Cambridge University Press, pages 87-99.

EPA modified this delta-lognormal distribution to incorporate multiple detection limits. In the modification of the delta portion, the single spike located at zero is replaced by a discrete distribution made up of multiple spikes. Each spike in this modification is associated with a distinct sample-specific detection limit associated with non-detected (ND) measurements in the database.⁷ A lognormal density is used to represent the set of measured values. This modification of the delta-lognormal distribution is shown in Figure 10-1.

The following two subsections describe the delta and lognormal portions of the modified delta-lognormal distribution in further detail.

⁷Previously, EPA had modified the delta-lognormal model to account for non-detected measurements by placing the distributional "spike" at the detection limit (i.e., a single positive value, usually equal to the nominal method detection limit) rather than at zero. For further details, see Kahn and Rubin, 1989. This adaptation was used in developing limitations and standards for the organic chemicals, plastics, and synthetic fibers (OCPSF) and pesticides manufacturing rulemakings. The current modification was used in the pulp and paper and pharmaceutical industry rulemakings.

Figure 10-1
Modified Delta – Lognormal Distribution



Discrete Portion of the Modified Delta-Lognormal Distribution**10.6.2**

In the discrete portion of the modified delta-lognormal distribution, non-detected values were associated with multiple values corresponding to the reported sample-specific detection limits.

Multiple spikes were then constructed and linked to the values of the k distinct sample-specific detection limits observed in the facility data set for the pollutant. In the model, δ represents the proportion of non-detected values and is the sum of smaller fractions, δ_i , each representing the proportion of non-detected values associated with the distinct value of a particular sample-specific detection limit. By letting D_i equal the value of the i^{th} smallest distinct detection limit in the data set and the random variable X_D represent a randomly chosen non-detected measurement, the cumulative distribution function of the discrete portion of the modified delta-lognormal model can be mathematically expressed as:

$$Pr(X_D \leq x) = \sum_{i: D_i \leq x} \delta_i \quad 0 < x \quad (1)$$

$$\hat{E}(X_D) = \frac{1}{\delta} \sum_{i=1}^k \delta_i D_i \quad (2)$$

The mean and variance of this discrete distribution can be calculated using the following formulas:

$$\hat{Var}(X_D) = \frac{1}{\delta^2} \sum_{i=1}^k \sum_{j=i+1}^k \delta_i \delta_j (D_j - D_i)^2 \quad (3)$$

Continuous Portion of the Modified Delta-Lognormal Distribution**10.6.3**

This section describes the lognormal portion of the modified delta-lognormal distribution. The continuous, lognormal portion of the modified delta-lognormal distribution was used to model the detected measurements from the centralized waste treatment industry database.

The cumulative probability distribution of the continuous portion of the modified delta-lognormal distribution can be mathematically expressed as

$$Pr(X_C \leq x) = \Phi [(\log(x) - \mu)/\sigma] \quad (4)$$

where the random variable X_C represents a randomly chosen detected measurement and Φ is the standard normal distribution.

The expected value, $E(X_C)$, and the variance, $Var(X_C)$, of the continuous (lognormal) distribution can be calculated as:

$$E(X_C) = \exp\left(\mu + \frac{\sigma^2}{2}\right) \quad (5)$$

$$\text{Var}(X_C) = \exp(2\mu + \sigma^2) (\exp(\sigma^2) - 1) \quad (6)$$

where

$$\begin{aligned} \mu &= \sum_{i=1}^n \frac{\log(x_i)}{n} \\ \sigma^2 &= \sum_{i=1}^n \frac{[\log(x_i) - \mu]^2}{n-1} \end{aligned} \quad (7)$$

x_i = measured value of the i^{th} detected measurement

n = number of detected values

As shown in the next section, the continuous portion of the modified delta-lognormal distribution combines the discrete and continuous portions to model data sets that contain a mixture of non-detected and detected measurements.

Estimation Under the Modified Delta-Lognormal Distribution

10.6.4

It is possible to fit a wide variety of observed effluent data sets to the modified delta-lognormal distribution. Multiple detection limits for non-detect measurements can be handled, as can measured (“detected”) values. The same basic framework can be used even if there are no non-detected values in the data set. Thus, the modified delta-lognormal distribution offers a large degree of flexibility in modeling effluent data.

The modified delta-lognormal random variable U can be expressed as a combination of three other independent variables, that is,

$$U = I_u X_D + (1 - I_u) X_C \quad (8)$$

where X_D represents a random non-detect from the discrete portion of the distribution, X_C represents a random detected measurement from the continuous lognormal portion, and I_u is an indicator variable signaling whether any particular random measurement is detected or not. Using a weighted sum, the cumulative distribution function from the discrete portion of the distribution (equation 1) can be combined with the function from the continuous portion (equation 4) to obtain the overall cumulative

probability distribution of the modified delta-lognormal distribution as follows,

$$Pr(U \leq u) = \begin{cases} \sum_{i: D_i < u} \delta_i + (1 - \delta) \Phi[(\log(u) - \mu)/\sigma] & \text{if } 0 < u < D_k \\ \delta + (1 - \delta) \Phi[(\log(u) - \mu)/\sigma] & \text{if } u \geq D_k \end{cases} \quad (9)$$

where D_i is the value of the i^{th} sample-specific detection limit with D_k equal to the value of the largest sample-specific detection limit.

The expected value of the random variable U can be derived as a weighted sum of the expected values of the discrete and continuous portions of the distribution (equations 2 and 5, respectively) as follows

$$\hat{E}(U) = \sum_i \delta_i D_i + (1 - \delta) \exp(\hat{\mu} + 0.5 \hat{\sigma}^2) \quad (10)$$

The variance can be obtained by using the following relationship

$$\hat{Var}(U) = \hat{E}(U^2) - [\hat{E}(U)]^2 \quad (11)$$

and using equation 10:

$$\begin{aligned} \hat{Var}(U) = & \frac{1}{\delta^2} \sum_{i=1}^k \sum_{j=i+1}^k \delta_i \delta_j (D_i - D_j)^2 + (1 - \delta) \exp(2\hat{\mu}_{MLE} + \hat{\sigma}^2) (\exp(\hat{\sigma}^2) - 1) \\ & + \delta(1 - \delta) \left[\frac{\sum_{i=1}^k \delta_i D_i}{\delta} - \exp(\hat{\mu} + 0.5 \hat{\sigma}^2) \right]^2 \end{aligned} \quad (12)$$

where D_i equals i^{th} individual sample-specific detection limit for the non-detects, the δ_i are the corresponding proportions of non-detected values associated with D_i , k is the number of unique sample-

specific detection limits, and $\delta = \sum_{i=1}^k \delta_i$.

The next section applies the modified delta-lognormal distribution to the data in estimating facility-specific variability factors for the centralized waste treatment industry. Equations 10 and 12 are particularly important in the estimation of facility-specific variability factors described in the next section.

Estimation of Facility-Specific Variability Factors

10.6.5

This section applies the methodology described in the previous section to the estimation of facility-specific variability factors for each pollutant. EPA estimated the daily variability factors by fitting a modified delta-lognormal distribution to the daily measurements. In contrast, EPA estimated monthly variability factors by fitting a modified delta-lognormal distribution to the monthly averages. These averages were developed using the same number of measurements as the assumed monitoring frequency for the pollutant. EPA is assuming that some pollutants such as organics will be monitored weekly (approximately four times a month) and others will be monitored daily (approximately 20 times a month).⁸ Section 11.5.2 identifies these assumed monitoring frequencies. The following sections describe the facility data set requirements to be used in estimating variability factors, and the estimation of facility-specific daily and monthly variability factors that were used in developing the limitations. These facility-specific variability factors are listed in Attachment 10-3.

Facility Data Set Requirements **10.6.5.1**

Estimates of the necessary parameters for the lognormal portion of the distribution can be calculated with as few as two distinct detected values in a data set (which may also include non-detected measurements). EPA used the facility data set for a pollutant if the data set contained:

- four or more observations with two or more distinct detected concentration values; or

- three detected observations with two or more distinct values.

Further, the each facility data set for a pollutant had to pass the data editing criteria described in section 10.4.3.

In statistical terms, each measurement was assumed to be independently and identically distributed from the other measurements of that pollutant in the facility data set.

Estimation of Facility-Specific

Daily Variability Factors

10.6.5.2

The facility-specific daily variability factor is a function of the expected value, $\hat{E}(U)$, and the 99th percentile of the modified delta-lognormal distribution fit to the daily concentration values of the pollutant in the wastewater from the facility. The expected value, $\hat{E}(U)$, was estimated using equation 10.

The 99th percentile of the modified delta-lognormal distribution fit to each data set was estimated by using an iterative approach. First, $D_0=0$, $\delta_0=0$, and $D_{k+1} = \infty$ were defined as boundary conditions where D_i equaled the i^{th} smallest detection limit and δ_i was the associated proportion of non-detects at the i^{th} detection limit. Next, a cumulative distribution function, p , for each data subset was computed as a step function ranging from 0 to 1. The general form, for a given value c , was:

⁸Compliance with the monthly average limitations will be required in the final rulemaking regardless of the number of samples analyzed and averaged.

$$p = \sum_{i=0}^m \delta_i + (1 - \delta) \Phi \left[\frac{\log(c) - \hat{\mu}}{\hat{\sigma}} \right], \quad D_m \leq c < D_{m+1}, \quad m=0,1,\dots,k. \quad (13)$$

where Φ is the standard normal cumulative distribution function. The following steps were completed to compute the estimated 99th percentile of each data subset:

Step 1 Using equation 13, k values of p at $c=D_m$, $m=1,\dots,k$ were computed and labeled p_m .

Step 2 The smallest value of m ($m=1,\dots,k$), such that $p_m \geq 0.99$, was determined and labeled as p_j . If no such m existed, steps 3 and 4 were skipped and step 5 was computed instead.

Step 3 Computed $p^* = p_j - \delta_j$.

Step 4 If $p^* < 0.99$, then $P99 = D_j$
 else if $p^* \geq 0.99$, then

$$\hat{P}99 = \exp \left[\hat{\mu} + \Phi^{-1} \left[\frac{0.99 - \sum_{i=0}^{j-1} \delta_i}{(1 - \delta)} \right] \hat{\sigma} \right] \quad (14)$$

where Φ^{-1} is the inverse normal distribution function.

Step 5 If no such m exists such that $p_m \geq 0.99$ ($m=1,\dots,k$), then

$$\hat{P}99 = \exp \left[\hat{\mu} + \Phi^{-1} \left[\frac{0.99 - \delta}{(1 - \delta)} \right] \hat{\sigma} \right] \quad (15)$$

The facility-specific daily variability factor, VF1, was then calculated as:

$$VF1 = \frac{\hat{P}99}{\hat{E}(U)} \quad (16)$$

Estimation of Facility-Specific Monthly Variability Factors

10.6.5.3

EPA estimated the monthly variability factors by fitting a modified delta-lognormal distribution to the monthly averages. EPA developed these averages using the same number of measurements as the assumed monitoring frequency for the pollutant. EPA is assuming that some pollutants such as organics will be monitored weekly (approximately four times a month) and others will be monitored daily

(approximately 20 times a month).⁹ Section 11.5.2 identifies these assumed monitoring frequencies.

ESTIMATION OF FACILITY-SPECIFIC 4-DAY VARIABILITY FACTORS

Variability factors based on 4-day monthly averages were estimated for pollutants with the monitoring frequency assumed to be weekly (approximately four times a month). In order to calculate the 4-day variability factors (VF₄), the assumption was made that the approximating distribution of \bar{U}_4 , the sample mean for a random sample of four independent concentrations, was also derived from the modified delta-lognormal distribution.¹⁰ To obtain the expected value of the 4-day averages, equation 10 is modified for the mean of the distribution of 4-day averages in equation 17:

$$\hat{E}(\bar{U}_4) = \delta_4 \hat{E}(\bar{X}_4)_D + (1 - \delta_4) \hat{E}(\bar{X}_4)_C \quad (17)$$

where $(\bar{X}_4)_D$ denotes the mean of the discrete portion of the distribution of the average of four independent concentrations, (i.e., when all observations are non-detected values) and $(\bar{X}_4)_C$ denotes the mean of the continuous lognormal portion (i.e., when all observations are detected).

First, it was assumed that the probability of detection (δ) on each of the four days was independent of the measurements on the other three days. (As explained in section 10.6.5.1, daily measurements were also assumed to be independent.) Thus, $\delta_4 = \delta^4$ and because $\hat{E}(\bar{X}_4)_D = \hat{E}(X_D)$, then equation 17 can be expressed as

$$\hat{E}(\bar{U}_4) = \delta^4 \sum_{i=1}^k \frac{\delta_i D_i}{\delta} + (1 - \delta^4) \exp(\hat{\mu}_4 + 0.5 \hat{\sigma}_4^2) \quad (18)$$

where k is the number of distinct non-detected values. Solving for $\hat{\mu}_4$ using equation 18 and because $\hat{E}(\bar{U}_4) = \hat{E}(U)$:

$$\hat{\mu}_4 = \log \left[\frac{\hat{E}(U) - \delta^3 \sum_{i=1}^k \delta_i D_i}{(1 - \delta^4)} \right] - 0.5 \hat{\sigma}_4^2 \quad (19)$$

The expression for $\hat{\sigma}_4^2$ was derived from the following relationship

⁹The attachments to this chapter (except Attachment 10-5 which provides the proposed limitations) sometimes identify two monthly variability factors and monthly average limitations for a single pollutant in an option. These two sets of variability factors and limitations correspond to monitoring four and twenty times a month. In developing the limitations, EPA considered both monitoring frequencies. However, EPA is proposing only the monitoring frequencies identified in section 11.5.2.

¹⁰This assumption appeared to be reasonable for the pulp and paper industry data that had percentages of non-detected and detected measurements similar to the data sets for the centralized waste treatment industry. This conclusion was based on the results of a simulation of 7,000 4-day averages. A description of this simulation and the results are provided in the record for the proposed rulemaking.

$$\begin{aligned}\hat{Var}(\bar{U}_4) &= \delta_4 \hat{Var}((\bar{X}_4)_D) + (1 - \delta_4) \hat{Var}((\bar{X}_4)_C) \\ &\quad + \delta_4(1 - \delta_4)[\hat{E}(\bar{X}_4)_D - \hat{E}(\bar{X}_4)_C]^2\end{aligned}\quad (20)$$

by substituting the following

$$\hat{Var}((\bar{X}_4)_D) = \frac{\hat{Var}(X_D)}{4}, \quad \hat{E}(\bar{X}_4)_D = \hat{E}(X_D), \quad \text{and} \quad \delta_4 = \delta^4 \quad (21)$$

into equation 20. This substitution provides the following

$$\hat{Var}(\bar{U}_4) = \delta^4 \frac{\hat{Var}(X_D)}{4} + (1 - \delta^4) \hat{Var}((\bar{X}_4)_C) + \delta^4(1 - \delta^4)[\hat{E}(\bar{X}_D) - \hat{E}(\bar{X}_4)_C]^2 \quad (22)$$

which further simplifies to

$$\begin{aligned}\hat{Var}(\bar{U}_4) &= \frac{\delta^4 \sum_{i=1}^k \sum_{j=1}^k \delta_i \delta_j (D_i - D_j)^2}{4\delta^2} + (1 - \delta^4) \exp(2\hat{\mu}_4 + \hat{\sigma}_4^2) [\exp(\hat{\sigma}_4^2) - 1] \\ &\quad + \delta^4(1 - \delta^4) \left[\sum_{i=1}^k \frac{\delta_i D_i}{\delta} - \exp(\hat{\mu}_4 - 0.5\hat{\sigma}_4^2) \right]^2\end{aligned}\quad (23)$$

Next, equation 24 results from solving for $[\exp(\hat{\sigma}_4^2) - 1]$ in equation 23.

$$\exp(\hat{\sigma}_4^2) - 1 =$$

$$\frac{\left[\hat{Var}(\bar{U}_4) - \frac{\delta^2 \sum_{i=1}^k \sum_{j=1}^k \delta_i \delta_j (D_i - D_j)^2}{4} - \delta^2(1 - \delta^4) \left[\sum_{i=1}^k \delta_i D_i - \delta \exp(\hat{\mu}_4 - 0.5\hat{\sigma}_4^2) \right]^2 \right]}{(1 - \delta^4) \exp(2\hat{\mu}_4 + \hat{\sigma}_4^2)} \quad (24)$$

Then solving for $\exp(\hat{\mu}_4 + 0.5\hat{\sigma}_4^2)$ using equation 18 and substituting $\hat{E}(\bar{U}_4) = \hat{E}(U)$ results in

$$\exp(\hat{\mu}_4 + 0.5\hat{\sigma}_4^2) = \frac{[\hat{E}(\bar{U}_4) - \delta^3 \sum_{i=1}^k \delta_i D_i]}{(1 - \delta^4)} = \frac{[\hat{E}(U) - \delta^3 \sum_{i=1}^k \delta_i D_i]}{(1 - \delta^4)} \quad (25)$$

Letting

$$\eta = \hat{E}(U) - \delta^3 \sum_{i=1}^k \delta_i D_i \quad (26)$$

simplifies equation 25 to

$$\exp(\hat{\mu}_4 + 0.5\hat{\sigma}_4^2) = \frac{\eta}{(1 - \delta^4)} \quad (27)$$

Next, solving for $\hat{\sigma}_4^2$ in equation 24 and using the substitution in equation 27 provides

$$\hat{\sigma}_4^2 = \log \left[1 + \frac{\left[\hat{Var}(\bar{U}_4) - \frac{\delta^2 \sum_{i=1}^k \sum_{j=1}^k \delta_i \delta_j (D_i - D_j)^2}{4} - \delta^2 (1 - \delta^4) \left(\sum_{i=1}^k \delta_i D_i - \frac{\delta \eta}{(1 - \delta^4)} \right)^2 \right]}{(1 - \delta^4) \eta^2} \right] \quad (28)$$

Finally, using the relationship $\hat{Var}(\bar{U}_4) = \hat{Var}(U)/4$ and rearranging terms:

$$\hat{\sigma}_4^2 = \log \left[1 + \frac{(1 - \delta^4) \hat{Var}(U)}{4\eta^2} - \frac{(1 - \delta^4) \delta^2 \sum_{i=1}^k \sum_{j=1}^k \delta_i \delta_j (D_i - D_j)^2}{4\eta^2} - \frac{\delta^2 \left[\sum_{i=1}^k \delta_i D_i (1 - \delta^4) - \delta \eta \right]^2}{\eta^2} \right] \quad (29)$$

Thus, estimates of $\hat{\mu}_4$ and $\hat{\sigma}_4^2$ in equations 19 and 29, respectively, were derived by using estimates of $\delta_1, \dots, \delta_k$ (sample proportion of non-detects at observed sample-specific detection limits D_1, \dots, D_k), $\hat{E}(U)$ from equation 10, and $\hat{Var}(U)$ from equation 12.

In finding the estimated 95th percentile of the average of four observations, four non-detects, not all at the same sample-specific detection limit, can generate an average that is not necessarily equal to D_1 , D_2, \dots , or D_k . Consequently, more than k discrete points exist in the distribution of the 4-day averages. For example, the average of four non-detects at $k=2$ detection limits, are at the following discrete points with the associated probabilities:

i	D_i^*	δ_i^*
1	D_1	δ_1^4
2	$(3D_1 + D_2)/4$	$4\delta_1^3\delta_2$
3	$(2D_1 + 2D_2)/4$	$6\delta_1^2\delta_2^2$
4	$(D_1 + 3D_2)/4$	$4\delta_1\delta_2^3$
5	D_2	δ_2^4

When all four observations are non-detected values, and when k distinct non-detected values exist, the multinomial distribution can be used to determine associated probabilities. That is,

$$Pr\left[\bar{U}_4 = \frac{\sum_{i=1}^k u_i D_i}{4}\right] = \frac{4!}{u_1! u_2! \dots u_k!} \prod_{i=1}^k \delta_i^{u_i} \quad (30)$$

where u_i is the number of non-detected measurements in the data set with the D_i detection limit. The number of possible discrete points, k^* , for $k=1,2,3,4$, and 5 are as follows:

k	k^*
1	1
2	5
3	15
4	35
5	70

To find the estimated 95th percentile of the distribution of the average of four observations, the same basic steps (described in section 10.6.5.2) as for the 99th percentile of the distribution of daily observations, were used with the following changes:

- Step 1 Change P_{99} to P_{95} , and 0.99 to 0.95.
- Step 2 Change D_m to D_m^* , the weighted averages of the sample-specific detection limits.
- Step 3 Change δ_i to δ_i^* .
- Step 4 Change k to k^* , the number of possible discrete points based on k detection limits.
- Step 5 Change the estimates of δ , $\hat{\mu}$, and $\hat{\sigma}$ to estimates of δ^4 , $\hat{\mu}_4$, and $\hat{\sigma}_4^2$, respectively.

Then, using $\hat{E}(\bar{U}_4) = \hat{E}(U)$, the estimate of the facility-specific 4-day variability factor, VF4, was calculated as:

$$VF4 = \frac{\hat{P}_{95}}{\hat{E}(U)} \quad (31)$$

AUTOCORRELATION IN THE DAILY MEASUREMENTS

Before estimating the facility-specific 20-day variability factors, EPA considered whether autocorrelation was likely to be present in the effluent data. When data are said to be positively autocorrelated, it means that measurements taken at consecutive time periods are related. For example, positive autocorrelation would be present in the data if the final effluent concentration of oil and grease was relatively high one day and was likely to remain at similar high values the next and possibly succeeding days. Because EPA is assuming that some pollutants (BOD₅, TSS, oil and grease, metals, and total cyanide) will be monitored daily, EPA based the 20-day variability factors on the distribution of the averages of 20 measurements.¹¹ If concentrations measured on consecutive days were positively correlated, then the autocorrelation would have had an effect on the estimate of the variance of the monthly average and thus on the 20-day variability factor. (The estimate of the long-term average and the daily variability factor would not be affected by autocorrelation.)

EPA believes that autocorrelation in any significant amount is unlikely to be present in daily measurements in wastewater from this industry. Thus, EPA has not incorporated autocorrelation into its estimates of the 20-day variability factors. In many industries, measurements in final effluent are likely to be similar from one day to the next because of the consistency from day-to-day in the production processes and in final effluent discharges due to

the hydraulic retention time of wastewater in basins, holding ponds, and other components of wastewater treatment systems. Unlike these other industries, where the industrial processes are expected to produce the same type of wastewater from one day to the next, the wastewater from centralized waste treatment industry is generated by treating wastes from different sources and industrial processes. The wastes treated on a given day will often be different than the waste treated on the following day. Because of this, autocorrelation would be expected to be absent from measurements of wastewater from the centralized waste treatment industry.

EPA believes that a statistical evaluation of appropriate data sets would likely support its assertion that autocorrelation is absent from daily measurements in the centralized waste treatment industry. However, the monitoring data that EPA has received thus far are insufficient for the purpose of evaluating the autocorrelation.¹² To determine autocorrelation in the data, many measurements for each pollutant would be required with values for every single day over an extended period of time. Such data were not available to EPA. In the preamble to the proposal, EPA requests additional data that can be used to evaluate autocorrelation in the data.

¹¹In other rulemakings, EPA has used the averages of 30 measurements when the assumed monitoring frequency was daily measurements throughout the month. However, many centralized waste treatment facilities are closed on weekends. Therefore, EPA assumed that 20 daily measurements rather than 30 would be collected each month.

¹²In the 1995 statistical support document, EPA included a discussion of the autocorrelation in the effluent data from facility 602. The document states that the facility provided 'sufficient amounts of pollutant measurements.' That statement is not correct. To have sufficient amounts of data, the data set would need to include many more measurements for every single day. In addition, in the 1995 document, the conclusions about statistical significance were flawed due to an error in the software.

ESTIMATION OF FACILITY-SPECIFIC 20-DAY VARIABILITY FACTORS

Based upon the discussion on autocorrelation in the previous section, it was assumed that consecutive daily measurements were independent of one another, and therefore

$$\hat{E}(\bar{U}_{20}) = \hat{E}(U) \quad \text{and} \quad \hat{Var}(\bar{U}_{20}) = \frac{\hat{Var}(U)}{20} \quad (32)$$

where $\hat{E}(U)$ and $\hat{Var}(U)$ were calculated as shown in section 10.6.5.3.2 (see equations 10 and 12). Finally, since \bar{U}_{20} is approximately normally distributed by the Central Limit Theorem, the estimate of the 95th percentile of a 20-day mean and the corresponding facility-specific 20-day variability factor (VF20) were approximated by

$$\hat{P}95_{20} = \hat{E}(\bar{U}_{20}) + [\Phi^{-1}(0.95)]\sqrt{\hat{Var}(\bar{U}_{20})} \quad (33)$$

By using the substitutions in equation 32, equation 33 simplified to

$$\hat{P}95_{20} = \hat{E}(U) + [\Phi^{-1}(0.95)]\sqrt{\frac{1}{20}\hat{Var}(U)} \quad (34)$$

Then, the estimate of the facility-specific 20-day variability factor, VF20, was calculated using:

$$VF20 = \frac{\hat{P}95}{\hat{E}(U)} \quad \text{because} \quad \hat{E}(\bar{U}_{20}) = \hat{E}(U) \quad (35)$$

where $\Phi^{-1}(0.95)$ is the 95th percentile of the inverse normal distribution.

Evaluation of Facility-Specific Variability Factors

10.6.5.4

Estimates of the necessary parameters for the lognormal portion of the distribution can be calculated with as few as two distinct measured values in a data set (which may also include non-detected measurements); however, these estimates are likely to be unstable unless a more sizable number of measured values is available. As stated in section 10.6.5.1, EPA used the modified delta-lognormal distribution to develop facility-specific variability factors for data sets that had a four or more observations with two or more distinct measured concentration values or three measured values with two or more distinct values. Some variance estimates produced unexpected results such as a daily variability

factor with a value less than 1.0 which would result in a limitation with a value less than the long-term average. This was an indication that the estimate of $\hat{\sigma}$ (the log standard deviation) was unstable. To identify situations producing unexpected results, EPA carefully reviewed all of the variability factors and compared daily to monthly variability factors. EPA determined that when the facility's daily variability factor was less than 1.0, the daily and monthly variability factors for that pollutant should be excluded from further consideration. Similarly, when the facility's monthly variability factors for a pollutant were greater than the daily variability factor, EPA excluded the daily and monthly variability factors from further consideration. If the daily variability factor was greater than 10.5,

EPA reviewed the data in detail to determine if one or more values were the result of process upsets or data errors.

Estimation of Pollutant-Specific Variability Factors

10.6.6

After the facility-specific variability factors were estimated for a pollutant as described in section 10.6.5, the pollutant-specific variability factor was calculated. The pollutant-specific daily variability factor was the mean of the facility-specific daily variability factors for that pollutant in the subcategory and option. Likewise, the pollutant-specific monthly variability factor was the mean of the facility-specific monthly variability factors for that pollutant in the subcategory and option. For example, for option 4 of the Metals subcategory, the cadmium daily variability factor was the mean of the cadmium daily variability factors from facilities 4798 and facility 700. A more detailed example of estimating pollutant-specific monthly variability factors is provided in section 10.7.2. Attachment 10-2¹³ lists the pollutant-specific variability factors.

Estimation of Group-Level Variability Factors

10.6.7

After the pollutant-specific variability factors were estimated as described in section 10.6.6, the

¹³Attachments 10-2 through 10-7 include some pollutants for which EPA has not proposed limitations. In some cases, the data from these additional pollutants were used to develop the group variability factors (see section 10.6.7). For other pollutants, at some point in developing the proposal, EPA considered proposing limitations; however, EPA later excluded them from the proposed limitations (see chapter 7 for further explanation). These attachments reflect the calculations prior to transfers of limitations as described in section 10.8. In addition, a revision to the TSS limitations for oils subcategory option 9 is not incorporated into these attachments.

group-level variability factors were calculated. Each group contained pollutants that had similar chemical structure (e.g., the metals group consisted of metal pollutants). For some pollutants such as BOD₅, EPA determined that there were no other pollutants that could be considered chemically similar for the purpose of determining variability factors; therefore, these pollutants were not assigned to a group.¹⁴ For the pollutants (such as BOD₅) that were not assigned to a group, the pollutant-specific variability factors were used in developing limitations. However, in most cases, group-level variability factors were used in developing limitations. (The derivation of limitations is described in section 10.7.1.) Appendix A identifies the groups and the pollutants assigned to them.

The group-level daily variability factor was the median of the pollutant-specific daily variability factors for the pollutants within the group. Similarly for the monthly variability factors, the group-level monthly variability factor was the median of the pollutant-specific monthly variability factors for the pollutants within the group. Attachment 10-4 provides the group-level daily and monthly variability factors that could be calculated for the proposed options.

Transfers of Variability Factors

10.6.8

In some cases, EPA transferred variability factors for pollutants when its associated group-level variability factors could not be estimated. In these cases, the facility data sets for that pollutant and the other pollutants in the group were excluded (section 10.4.1), did not meet the data editing criteria (section 10.4.3), did not meet the facility data set requirements (section 10.6.5.1), or the facility-specific variability factors were excluded (section 10.6.5.4).

¹⁴In some data listings, such cases are sometimes identified with a group; however, the group name and the pollutant name are the same.

EPA transferred variability factors for these cases using other group-level variability factors in the option for the subcategory.¹⁵ In developing these transferred variability factors, EPA calculated the transferred variability factors as the median (i.e., mid-point value) of the group-level variability factors from all groups except the metals, semi-metals, and non-metals groups. For example, for hypothetical subcategory X, suppose its option 2 had five groups: TSS, oil and grease, n-paraffins, aromatics, and metals. In addition, suppose that group-level variability factors had been calculated for all groups except n-paraffins, then the transferred daily variability factor for the pollutants in the n-paraffins group would be the median of the group-level daily variability factors from the TSS, oil and grease, and aromatics group. (The daily variability factor from the metals group would be excluded.) The transferred monthly (4-day) variability factor would be the 4-day variability factor from the aromatics group, because 4-day variability factors were not calculated for TSS and oil and grease (because the monitoring frequency was assumed to be 20 times per month.)

¹⁵In the 1995 proposal, EPA proposed using fraction-level variability factors when group-level variability factors were unavailable. EPA has determined that more appropriate transfers are available.

Table 10-6 Cases where Variability Factors were Transferred

Subcategory	Option	Pollutant	Transferred Variability Factors		Monitoring Frequency (days per month)
			Daily	Monthly	
Metals	4	Hexavalent chromium	3.348	1.235	20
Oils	8/8v	alpha-terpineol	2.907	1.467	4
		carbazole			
	9/9v	alpha-terpineol	3.434	1.682	4
		carbazole			
Organics	3/4	acetophenone	4.330	1.992	4
		aniline			
		benzoic acid			
		2,3-dichloroaniline			

LIMITATIONS***10.7***

The proposed limitations and standards are the result of multiplying the long-term averages by the appropriate variability factors. The same basic procedures apply to the calculation of all limitations and standards for this industry, regardless of whether the technology is BPT, BCT, BAT, NSPS, PSES or PSNS.

The proposed limitations for pollutants for each option are provided as ‘daily maximums’ and ‘maximums for monthly averages.’ Definitions provided in 40 CFR 122.2 state that the daily maximum limitation is the “highest allowable ‘daily discharge’” and the maximum for monthly average limitation (also referred to as the “monthly average limitation”) is the “highest allowable average of ‘daily discharges’ over a calendar month, calculated as the sum of all ‘daily discharges’ measured during a calendar month divided by the number of ‘daily discharges’ measured during that month.” Daily discharges are defined to be the “‘discharge of a pollutant’ measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of samplings.”

EPA calculates the limitations based upon percentiles chosen with the intention, on one hand, to be high enough to accommodate reasonably anticipated variability within control of the facility and, on the other hand, to be low

enough to reflect a level of performance consistent with the Clean Water Act requirement that these effluent limitations be based on the “best” technologies. The daily maximum limitation is an estimate of the 99th percentile of the distribution of the daily measurements. The monthly average limitation is an estimate of the 95th percentile of the distribution of the monthly averages of the daily measurements. EPA used the 95th percentile rather than the 99th percentile for monthly average limitations because the variability of monthly averages is less than the variability of individual daily measurements. The percentiles for both types of limitations are estimated using the products of long-term averages and variability factors.

In the first of two steps in estimating both types of limitations, EPA determines an average performance level (the “long-term average” discussed in section 10.7) that a facility with well-designed and operated model technologies (which reflect the appropriate level of control) is capable of achieving. This long-term average is calculated from the data from the facilities using the model technologies for the option. EPA expects that all facilities subject to the limitations will design and operate their treatment systems to achieve the long-term average performance level on a consistent basis because facilities with well-designed and operated model technologies have demonstrated that this can be done.

In the second step of developing a limitation, EPA determines an allowance for the variation in pollutant concentrations when processed through extensive and well designed treatment systems. This allowance for variance incorporates all components of variability including shipping, sampling, storage, and analytical variability. This allowance is incorporated into the limitations through the use of the variability factors (discussed in section 10.6) which are calculated from the data from the facilities using the model technologies. If a facility operates its treatment system to meet the relevant long-term average, EPA expects the facility to be able to meet the limitations. Variability factors assure that normal fluctuations in a facility's treatment are accounted for in the limitations. By accounting for these reasonable excursions above the long-term average, EPA's use of variability factors results in limitations that are generally well above the actual long-term averages.

After completing the data screening tests to select the appropriate data sets, EPA calculated the long-term averages for the limitations. For some pollutants of concern, none of the facility data sets with the technology basis for the option met the data screening criteria; thus, these pollutants of concern are not proposed to be regulated for that option. These pollutants are listed in Chapter 7, Table 7-1. Further, because of these criteria, the options within a subcategory may have slightly different lists of pollutants proposed to be regulated. These data were used to develop long-term averages and variability factors, by pollutant and technology option, for each subcategory. The limitations prior to transfers are listed in Attachment 10-7.

Steps Used to Derive Limitations **10.7.1**

This section summarizes the steps used to derive the limitations. These steps were used separately for the daily maximum limitation and

the monthly average limitation. Depending on the assumed monitoring frequency of the pollutant, either the 4-day variability factor or the 20-day variability factor was used in deriving the monthly average limitation.

Step 1 EPA calculated the facility-specific long-term averages and variability factors for all facilities that had the model technology for the option in the subcategory. EPA calculated variability when the facility had four or more observations with two or more distinct detected values or three detected values with two or distinct values. In addition, the facility data set for the pollutant had to meet the data screening criteria.

Step 2 For each option in the subcategory, EPA calculated the median of the facility-specific long-term averages and the mean of the facility-specific variability factors from the facilities with the model technology to provide the pollutant-specific long-term average and variability factors for each pollutant.

Step 3 EPA calculated the group-level variability factor using the median of the pollutant-specific variability factors for the pollutants within each group.

Step 4 In most cases, EPA calculated the limitation for a pollutant using the product of the pollutant-specific long-term average and the group-level variability factor. If the group-level variability factor could not be estimated (because none of the pollutant-specific variability factors in the group could be estimated), then EPA transferred variability factors (see section 10.6.8)

and the used pollutant-specific long-term average in calculating the limitation. If the pollutant was not assigned to a group, then EPA calculated the limitation using the product of the pollutant-specific long-term average and the pollutant-specific variability factors. (See exceptions to step 4 described in section 10.8.2.)

Example

10.7.2

This example illustrates the derivation of limitations using the steps described above. In this example, four pollutants, A, B, C, and D all belong to hypothetical group X. The facility-specific long-term averages and variability factors for the pollutants are shown in Attachments 10-1 and 10-3, respectively (step 1). Table 10-7 shows the pollutant-specific long-term averages and variability factors calculated as described in step 2. Then, using the procedure in step 3, the group-level variability factor (see attachment 10-4 in Appendix E) is the median of the variability factors for pollutants A, B, and C (D is excluded because facility-specific variability factors could not be calculated for any of the facilities that provided data on pollutant D).

- The group-level daily variability factor for group X is 2.2 which is the median of 2.2 (pollutant A), 2.4 (pollutant B), and 2.1 (pollutant C).
- The group-level 4-day variability factor for group X is 1.4 which is the median of 1.5 (pollutant A), 1.4 (pollutant B), and 1.2 (pollutant C).

In this example, the limitations are calculated using the pollutant-specific long-term averages and the group-level variability factors in the following way:

Daily maximum limitation

= pollutant-specific long-term average
* group-level daily variability factor

For each pollutant, the daily maximum limitation is:

Pollutant A: $15 \text{ mg/l} * 2.2 = 33 \text{ mg/l}$

Pollutant B: $14 \text{ mg/l} * 2.2 = 31 \text{ mg/l}$

Pollutant C: $22 \text{ mg/l} * 2.2 = 48 \text{ mg/l}$

Pollutant D: $20 \text{ mg/l} * 2.2 = 44 \text{ mg/l}$

Monthly average limitation

= pollutant-specific long-term average
* group-level 4-day variability factor

For each pollutant, the monthly average limitation is:

Pollutant A: $15 \text{ mg/l} * 1.4 = 21 \text{ mg/l}$

Pollutant B: $14 \text{ mg/l} * 1.4 = 20 \text{ mg/l}$

Pollutant C: $22 \text{ mg/l} * 1.4 = 31 \text{ mg/l}$

Pollutant D: $20 \text{ mg/l} * 1.4 = 28 \text{ mg/l}$

Table 10-7. Long-Term Averages and Variability Factors Corresponding to Example for Hypothetical Group X

Pollutant	Facility	Long-term Average (mg/l)	Daily Variability Factor	4-day Variability Factor
A	A1	10	2.1	1.4
	A2	12	2.3	1.5
	A3	15	2.0	1.4
	A4	20	1.8	1.3
	A5	26	2.8	1.9
	Pollutant-specific	15 (median)	2.2 (mean)	1.5 (mean)
B	B1	17	2.7	1.7
	B2	16	2.2	1.2
	B3	10	2.3	1.3
	B4	12	*	*
	Pollutant-specific	14 (median)	2.4 (mean)	1.4 (mean)
C	C1	22	1.9	1.1
	C2	24	*	*
	C3	12	2.3	1.3
	Pollutant-specific	22 (median)	2.1 (mean)	1.2 (mean)
D	D1	20	*	*
	D2	22	*	*
	D3	14	*	*
	Pollutant-specific	20 (median)	*	*

* could not be estimated (i.e., the data set did not contain four or more observations with two or more distinct detected values or three detected values with two or more distinct values.)

TRANSFERS OF LIMITATIONS

10.8

limitations were transferred.

In some cases, EPA was either unable to calculate a limitation using the available data for an option or determined that the treatment provided by facilities employing the option did not represent BPT/BCT/BAT treatment. In these cases, EPA transferred limitations from another option or from another industrial category. The following sections describe each case where the

Transfer of Oil and Grease Limitation for Metals Subcategory Option 4 to Option 3

10.8.1

Because of the relatively low levels of oil and grease in the influent of the facilities with the model technology for Metals subcategory option 3, application of the LTA test to the influent data

(described in section 10.4.3.1) resulted in excluding the effluent data. EPA believes that this parameter should be regulated for all options in this subcategory. EPA based the oil and grease limitations upon data from facilities with the option 4 model technology. In effect, EPA has transferred the limitations from option 4 to option 3 for oil and grease. EPA has concluded that transfer of this data is appropriate given that the technology basis for metals option 3 includes additional treatment steps than the technology basis for metals option 4. As such, EPA has every reason to believe that facilities employing the option 3 technology could achieve the limitations based on the option 4 technology.

Transfers of Limitations from Other Rulemakings to CWT Industry 10.8.2

In some cases, the model technology did not optimally remove BOD₅ and TSS for an option in a subcategory. EPA believes this occurred because the limitations are largely based on indirect discharging facilities that are not required to control or optimize their treatment systems for the removal of conventional parameters. Thus, EPA transferred the BPT/BCT limitations (for direct dischargers data) from effluent guidelines from other industries with similar wastewaters and treatment technologies. In one case, EPA proposes the transfer of the BPT/BCT TSS limitations from the Metal Finishing rulemaking to the Metals subcategory BPT/BCT limitations (option 4). In the other case, EPA proposes the transfer of the BPT/BCT BOD₅ and TSS limitations from the Organic Chemical, Plastics, and Synthetic Fibers (OCPSF) rulemaking to the Organics subcategory BPT/BCT limitations (option 3/4). EPA used different procedures from the one discussed in section 10.7.1 to develop the proposed limitations for BOD₅ and TSS for the organics subcategory and TSS for option 4 in the Metals subcategory. The following sections describe these different

procedures.

Transfer of BOD₅ and TSS for the Organics Subcategory 10.8.2.1

EPA based the transferred limitations of BOD₅ and TSS for the organics subcategory on biological treatment performance data used to develop the limitations for the thermosetting resins subcategory in the Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) industry rulemaking. As described in the preamble to the proposed rulemaking, EPA determined that the transfer of the data was warranted because facilities in the organics subcategory treat wastes similar to wastes treated by OCPSF facilities.

For the organics subcategory of the centralized waste treatment industry, the proposed daily maximum limitations for BOD₅ and TSS were transferred directly from the OCPSF rulemaking. No modifications were required before transferring these daily maximum limitations.

Some modifications of the OCPSF monthly average limitations were required before the values could be transferred to the centralized waste treatment industry. The OCPSF limitations for BOD₅ and TSS were based on assumptions of a monitoring frequency of 30 days and the presence of autocorrelation in the measurements. In the proposed rulemaking for the centralized waste treatment industry, the monthly limitations for BOD₅ and TSS were based on an assumed monitoring frequency of 20 days and no autocorrelation (see section 10.6.5.3.2 for a discussion of the absence of autocorrelation in the centralized waste treatment data). Therefore, the following conversion steps were necessary to convert the OCPSF 30-day variability factors to 20-day variability factors.

The following formula was used in the OCPSF rulemaking to calculate the 30-day variability factors. This formula incorporates autocorrelation between measurements on adjacent days (i.e., the lag-1 autocorrelation).

$$VF_{30} = 1 + 1.645 \sqrt{\frac{(e^{\sigma^2} - 1)f_{30}(\rho, \sigma)}{30}} \quad (36)$$

where the function $f_{30}(\rho, \sigma)$ represents the additional variability attributable to autocorrelation, and is given by

$$f_{30}(\rho, \sigma) = 1 + \frac{2}{30(e^{\sigma^2} - 1)} \sum_{k=1}^{29} (30-k)(e^{\rho^k \sigma^2} - 1) \quad (37)$$

The above two formulas can be generalized to estimate n-day variability factors. These formulas are:

$$VF_n = 1 + 1.645 \sqrt{\frac{(e^{\sigma^2} - 1)f_n(\rho, \sigma)}{n}} \quad n \geq 2 \quad (38)$$

where

$$f_n(\rho, \sigma) = 1 + \frac{2}{n(e^{\sigma^2} - 1)} \sum_{k=1}^{n-1} (n-k)(e^{\rho^k \sigma^2} - 1) \quad n \geq 2 \quad (39)$$

For the proposed limitations, the autocorrelation, ρ , has been assumed to be absent; thus, the value of ρ is set equal to zero. Therefore, the value of $f_n(0, \sigma)$ is equal to 1, and equation 38 becomes:

$$VF_n = 1 + 1.645 \sqrt{\frac{(e^{\sigma^2} - 1)}{n}} \quad n \geq 2 \quad (40)$$

Because all of the values were detected (i.e., there were no non-detected measurements) in the OCPSF data base for BOD₅ and TSS, the delta-lognormal distribution of these data is the same as the lognormal distribution (i.e., the delta portion does not apply because it is used to model non-detect measurements). Therefore, an estimate of σ^2 was obtained from the daily variability factor from the lognormal distribution by using the following equation:

$$VF_1 = e^{\sigma \Phi^{-1}(0.99) - \frac{\sigma^2}{2}} \quad (41)$$

where $\Phi^{-1}(0.99)$ is the 99th percentile of the inverse normal distribution. (The value of $\Phi^{-1}(0.99)$ is 2.326.) By solving this equation using maximum likelihood estimation for σ and substituting it into

equation 40, an estimate of VF_n may be obtained. Finally, the n-day limitation is given by:

$$Limit_n = \frac{VF_n}{E(X)} \quad (42)$$

The expected value, $E(X)$ can be estimated by solving for $E(X)$ in the following equation for the daily maximum limitation (which is the same for both the OCPSF, and centralized waste treatment industries):

$$Limit_1 = \frac{VF_1}{E(X)} \quad (43)$$

to obtain

$$E(X) = \frac{VF_1}{Limit_1} \quad (44)$$

Then, equation 40 (using the estimate of σ^2 from equation 41) and equation 44 can be substituted into equation 42 to obtain:

$$Limit_n = \frac{Limit_1}{VF_1} \left(1 + 1.645 \sqrt{\frac{e^{\sigma^2} - 1}{n}} \right) \quad (45)$$

In particular, for the monthly average limitation based on assuming daily monitoring (i.e., approximately 20 times a month), the limitation is

$$Limit_{20} = \frac{Limit_1}{VF_1} \left(1 + 1.645 \sqrt{\frac{e^{\sigma^2} - 1}{20}} \right) \quad (46)$$

Table 10-8 provides the values of the BOD_5 and TSS limitations and other parameters for the thermosetting resins subcategory from the OCPSF industry and the organics subcategory in the centralized waste treatment industry.

Table 10-8 BOD₅ and TSS Parameters for Organics Subcategory

Parameter	OCPSF: Thermosetting Resins Subcategory		Centralized Waste Treatment: Organics Subcategory	
	BOD ₅	TSS	BOD ₅	TSS
σ	0.6971	0.8174	0.6971	0.8174
Long-Term Average (mg/l)	41	45	41	45
VF ₁	3.97	4.79	3.97	4.79
VF ₃₀	1.58	1.45	n/a	n/a
VF ₂₀	n/a	n/a	1.29	1.36
Daily Maximum Limitation (mg/l)	163	216	163	216
Monthly Average Limitation (mg/l)	61	67	53.0	61.3

Transfer of TSS for Option 4 of the Metals Subcategory 10.8.2.2

For TSS for option 4 of the metals subcategory, EPA transferred the proposed limitations directly from the Metal Finishing rulemaking (see Table 10-9). EPA based the Metal Finishing monthly average limitation for TSS upon an assumed monitoring frequency of ten days per month and the absence of autocorrelation in the measurements. EPA has also assumed an absence of autocorrelation in TSS for the centralized waste treatment industry. However, EPA assumed a monitoring frequency of 20 measurements a month for TSS for the centralized waste treatment industry, rather than the ten measurements assumed in the metal finishing rulemaking. EPA will consider whether it should adjust the monthly average limitation from the metal finishing rulemaking for the increase in monitoring frequency. This adjustment would result in a monthly average limitation with a slightly lower value than presented in the proposal. (The monitoring frequency does not effect the value of long-term averages and daily maximum limitations.)

Table 10-9 TSS Parameters for Metal Finishing

Metal Finishing TSS Values	TSS (mg/L)
Long-Term Average (mg/l)	16.8
Daily variability factor	3.59
Monthly Variability Factor	1.85
Assumed monitoring frequency	10/month
Daily Maximum Limitation (mg/l)	60.0
Monthly Average Limitation (mg/l)	31.0

EFFECT OF GROUP AND POLLUTANT VARIABILITY FACTORS ON LIMITATIONS

10.9

In the preamble to the proposed rulemaking, EPA solicited comment on using pollutant (or ‘pollutant-specific’) variability factors rather than group (or ‘group-level’) variability factors in calculating the limitations. For the 1995 proposed limitations and in today’s proposed limitations, EPA generally used the product of the group variability factor and the pollutant long-term average in calculating each pollutant limitation. For today’s re-proposal, EPA alternatively considered using the pollutant variability factor instead of the group variability factor. (Group and pollutant variability factors are listed in Attachment 10-6.) For pollutants where pollutant variability factors could not be

calculated (due to data constraints), EPA would continue to use the group variability factor.

Using the group variability factor eliminates the extremely low and high pollutant variability factors. Thus, limitations for some pollutants would be more stringent and for others less stringent. Attachment 10-7 provides a listing of the limitations calculated using both methods.

EPA believes that the variability of the pollutants with similar chemical structures would behave similarly in treatment systems; thus, EPA believes that using a single group variability factor may be appropriate for those pollutants. In the preamble to the proposed rulemaking, EPA solicited comment on whether the pollutant or group variability factors or some combination should be used in calculating the limitations to accurately reflect the variability of the pollutants discharged by the centralized waste treatment industry.

ATTACHMENTS

10.10

Attachments 10.1 through 10.7 to this chapter are located in Appendix E at the end of the document.

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COST OF TREATMENT TECHNOLOGIES

In this chapter, EPA presents the costs estimated for compliance with the proposed CWT effluent limitations guidelines and standards. Section 11.1 provides a general description of how the individual treatment technology and regulatory option costs were developed. In sections 11.2 through 11.4, EPA describes the development of costs for each of the wastewater and sludge treatment technologies.

In section 11.5, EPA presents additional compliance costs to be incurred by facilities, which are not technology specific. These additional items are retrofit costs, monitoring costs, RCRA permit modification costs, and land costs.

In Section 11.6, EPA presents some examples of capital and O&M cost calculations for CWT facilities using this methodology. Finally, Section 11.7 summarizes, by subcategory, the total capital expenditures and annual O&M costs for implementing the proposed regulation. Appendix D contains, by subcategory, the facility-specific capital, O&M, land, RCRA, and monitoring cost estimates for each facility to comply with the proposed limitations and standards.

COSTS DEVELOPMENT

Technology Costs

11.1

11.1.1

EPA obtained cost information for the technologies selected from the following sources:

- the data base developed from the 1991 Waste Treatment Industry (WTI) Questionnaire responses (This contained some process cost information, and was used wherever possible.),

- technical information developed for EPA rulemaking efforts such as the guidelines and standards for: the Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) category, Metal Products and Machinery (MP&M) category, and Industrial Laundries industries category,
- engineering literature,
- the CWT sampling/model facilities, and
- vendors' quotations (used extensively in estimating the cost of the various technologies).

The total costs developed by EPA include the capital costs of investment, annual O&M costs, land requirement costs, sludge disposal costs, monitoring costs, RCRA permit modification costs, and retrofit costs. Because 1989 is the base year for the WTI Questionnaire, EPA scaled all of the costs either up or down to 1989 dollars using the Engineering News Record (ENR) Construction Cost Index.

EPA based the capital costs for the technologies primarily on vendors' quotations. The standard factors used to estimate the capital costs are listed in Table 11-1. Equipment costs typically include the cost of the treatment unit and some ancillary equipment associated with that technology. Other investment costs in addition to the equipment cost include piping, instrumentation and controls, pumps, installation, engineering, delivery, and contingency.

EPA estimated certain design parameters for costing purposes. One such parameter is the flow rate used to size many of the treatment technologies. EPA used the total daily flow in all cases, unless specifically stated. The total daily flow represents the annual flow divided by 260,

the standard number of operating days for a CWT per year.

EPA derived the annual O&M costs for the various systems from vendors' information or from engineering literature, unless otherwise stated. The annual O&M costs represent the costs of maintenance, taxes and insurance, labor, energy, treatment chemicals (if needed), and residuals management (also if needed). Table 11-2 lists the standard factors EPA used to estimate the O&M costs.

Sections 11.2 through 11.4 present cost equations for capital costs, O&M costs, and land requirements for each technology and option. For

most technologies, EPA also developed capital cost upgrade and O&M cost upgrade equations. EPA used these equations for facilities which already have the treatment technology forming the basis of the option (or some portion of the treatment technology) in place. EPA also presents the flow rate ranges recommended for use in each equation. EPA is confident the equations are representative of costs for such facilities within these ranges. Outside these ranges, the equations become extrapolations. EPA does not believe these equations, however, yield representative results below the recommended low flow rate.

Table 11-1. Standard Capital Cost Algorithm

Factor	Capital Cost
Equipment Cost	Technology-Specific Cost
Installation	25 to 55 percent of Equipment Cost
Piping	31 to 66 percent of Equipment Cost
Instrumentation and Controls	6 to 30 percent of Equipment Cost
<i>Total Construction Cost</i>	Equipment + Installation + Piping + Instrumentation and Controls
Engineering	15 percent of Total Construction Cost
Contingency	15 percent of Total Construction Cost
<i>Total Indirect Cost</i>	Engineering + Contingency
<i>Total Capital Cost</i>	Total Construction Cost + Total Indirect Cost

Option Costs

11.1.2

EPA developed engineering costs for each of the individual treatment technologies which comprise the CWT regulatory options. These technology-specific costs are broken down into capital, O&M, and land components. To estimate the cost of an entire regulatory option, it is necessary to sum the costs of the individual treatment technologies which make up that option. In a few instances, an option consists of only one treatment technology; for those cases, the option cost is obviously equal to the technology cost. The CWT subcategory technology options are shown in Table 11-3. The

treatment technologies included in each option are listed, and the subsections which contain the corresponding cost information are indicated.

EPA generally calculated the capital and O&M costs for each of the individual treatment technologies using a flow rate range of 1 gallon per day to five million gallons per day. However, the flow rate ranges recommended for use in the equations are in a smaller range and are presented for each cost equation in Sections 11.2 to 11.4.

Land Requirements and Costs 11.1.2.1

EPA calculated land requirements for each piece of new equipment based on the equipment dimensions. The land requirements include the

total area needed for the equipment plus peripherals (pumps, controls, access areas, etc.). Additionally, EPA included a 20-foot perimeter around each unit. In the cases where adjacent tanks or pieces of equipment were required, EPA used a 20-foot perimeter for each piece of equipment, and configured the geometry to give the minimum area requirements possible. The land requirement equations for each technology are presented in the tables throughout sections 11.2 to 11.4. EPA then multiplied the land requirements by the corresponding land costs (as detailed in 11.5.4) to obtain facility specific land cost estimates.

Operation and Maintenance Costs 11.1.2.2

EPA based O&M costs on estimated energy usage, maintenance, labor, taxes and insurance, and chemical usage cost. With the principal exception of chemical usage and labor costs, EPA

calculated the O&M costs using a single methodology. This methodology is relatively consistent for each treatment technology, unless specifically noted otherwise.

EPA's energy usage costs include electricity, lighting, and controls. EPA estimated electricity requirements at 0.5 Kwhr per 1,000 gallons of wastewater treated. EPA assumed lighting and controls to cost \$1,000 per year and electricity cost \$0.08 per Kwhr. Manufacturers' recommendations form the basis of these estimates.

EPA based maintenance, taxes, and insurance on a percentage of the total capital cost as detailed in Table 11-2.

Chemical usage and labor requirements are technology specific. These costs are detailed for each specific technology according to the index given in Table 11-3.

Table 11-2. Standard Operation and Maintenance Cost Factor Breakdown

Factor	O&M Cost (1989 \$/year)
Maintenance	4 percent of Total Capital Cost
Taxes and Insurance	2 percent of Total Capital Cost
Labor	\$30,300 to \$31,200 per man-year
Electricity	\$0.08 per kilowatt-hour
Chemicals:	
Lime (Calcium Hydroxide)	\$57 per ton
Polymer	\$3.38 per pound
Sodium Hydroxide (100 percent solution)	\$560 per ton
Sodium Hydroxide (50 percent solution)	\$275 per ton
Sodium Hypochlorite	\$0.64 per pound
Sulfuric Acid	\$80 per ton
Aries Tek Ltd Cationic Polymer	\$1.34 per pound
Ferrous Sulfate	\$0.09 per pound
Hydrated Lime	\$0.04 per pound
Sodium Sulfide	\$0.30 per pound
Residuals Management	Technology-Specific Cost
<i>Total O&M Cost</i>	Maintenance + Taxes and Insurance + Labor + Electricity + Chemicals + Residuals

Table 11-3. CWT Treatment Technology Costing Index -- A Guide to the Costing Methodology Sections

Subcategory/ Option	Treatment Technology	Section
Metals 2	Selective Metals Precipitation	11.2.1.1
	Plate and Frame Liquid Filtration	11.2.2.1
	Secondary Chemical Precipitation	11.2.1.2
	Clarification	11.2.2.2
	Plate and Frame Sludge Filtration	11.4.1
	Filter Cake Disposal	11.4.2
Metals 3	Selective Metals Precipitation	11.2.1.1
	Plate and Frame Liquid Filtration	11.2.2.1
	Secondary Chemical Precipitation	11.2.1.2
	Clarification	11.2.2.2
	Tertiary Chemical Precipitation and pH Adjustment	11.2.1.3
	Clarification	11.2.2.2
	Plate and Frame Sludge Filtration	11.4.1
Metals 4	Filter Cake Disposal	11.4.2
	Primary Chemical Precipitation	11.2.1.4
	Clarification	11.2.2.2
	Secondary (Sulfide) Chemical Precipitation	11.2.1.5
	Secondary Clarification (for Direct Dischargers Only)	11.2.2.2
	Multi-Media Filtration	11.2.5
Metals - Cyanide Waste Pretreatment	Plate and Frame Sludge Filtration ¹	11.4.1
	Cyanide Destruction at Special Operating Conditions	11.2.6
Oils 8	Dissolved Air Flotation	11.2.8
Oils 8v	Dissolved Air Flotation	11.2.8
	Air Stripping	11.2.4
Oils 9	Secondary Gravity Separation	11.2.7
	Dissolved Air Flotation	11.2.8
Oils 9v	Secondary Gravity Separation	11.2.7
	Dissolved Air Flotation	11.2.8
	Air Stripping	11.2.4
Organics 4	Equalization	11.2.3
	Sequencing Batch Reactor	11.3.1
Organics 3	Equalization	11.2.3
	Sequencing Batch Reactor	11.3.1
	Air Stripping	11.2.4

¹Metals Option 4 sludge filtration includes filter cake disposal.

**PHYSICAL/CHEMICAL WASTEWATER
TREATMENT TECHNOLOGY COSTS 11.2
Chemical Precipitation 11.2.1**

Wastewater treatment facilities widely use chemical precipitation systems to remove dissolved metals from wastewater. EPA evaluated systems that utilize sulfide, lime, and caustic as the precipitants because of their common use in CWT chemical precipitation systems and their effectiveness in removing dissolved metals.

*Selective Metals Precipitation--Metals
Option 2 and Metals Option 3 11.2.1.1*

The selective metals precipitation equipment assumed by EPA for costing purposes for Metals Option 2 and Metals Option 3 consists of four mixed reaction tanks, each sized for 25 percent of the total daily flow, with pumps and treatment chemical feed systems. EPA costed for four reaction tanks to allow a facility to segregate its wastes into small batches, thereby facilitating metals recovery and avoiding interference with other incoming waste receipts. EPA assumed that these four tanks would provide adequate surge and equalization capacity for a metals subcategory CWT. EPA based costs on a four batch per day treatment schedule (that is, the sum of four batch volumes equals the facility's daily incoming waste volume).

As shown in Table 11-3, plate and frame liquid filtration follows selective metals precipitation for Metals Options 2 and 3. EPA has not presented the costing discussion for plate and frame liquid filtration in this section (consult section 11.2.3.2). Likewise, EPA has presented the discussion for sludge filtration and filter cake disposal in sections 11.4.1 and 11.4.2, respectively.

CAPITAL COSTS

Because only one facility in the metals subcategory has selective metals precipitation in-

place, EPA included selected metals precipitation capital costs for all facilities (except one) for Metals Options 2 and 3.

EPA obtained the equipment capital cost estimates for the selective metals precipitation systems from vendor quotations. These costs include the cost of the mixed reaction tanks with pumps and treatment chemical feed systems. The total construction cost estimates include installation, piping and instrumentation, and controls. The total capital cost includes engineering and contingency at a percentage of the total construction cost plus the total construction cost (as explained in Table 11-1). The equation for calculating selective metals precipitation capital costs for Metals Option 2 and Option 3 is presented in Table 11-4 at the end of this section.

**CHEMICAL USAGE AND LABOR
REQUIREMENT COSTS**

EPA based the labor requirements for selective metals precipitation on the model facility's operation. EPA estimated the labor cost at eight man-hours per batch (four treatment tanks per batch, two hours per treatment tank per batch).

EPA estimated selective metals precipitation chemical costs based on stoichiometric, pH adjustment, and buffer adjustment requirements. For facilities with no form of chemical precipitation in-place, EPA based the stoichiometric requirements on the amount of chemicals required to precipitate each of the metal and semi-metal pollutants of concern from the metals subcategory average raw influent concentrations to current performance levels (See Chapter 12 for a discussion of raw influent concentrations and current loadings). The chemicals used were caustic at 40 percent of the required removals and lime at 60 percent of the required removals. (Caustic at 40 percent and lime at 60 percent add up to 100 percent of the stoichiometric requirements.) These chemical

dosages reflect the operation of the selective metals precipitation model facility. Selective metals precipitation uses a relatively high percentage of caustic because the sludge resulting from caustic precipitation is amenable to metals recovery. EPA estimated the pH adjustment and buffer adjustment requirements to be 40 percent of the stoichiometric requirement. EPA added an excess of 10 percent to the pH and buffer adjustment requirements, bringing the total to 50 percent. EPA included a 10 percent excess because this is typical of the operation of the CWT facilities visited and sampled by EPA.

EPA estimated selective metals precipitation upgrade costs for facilities that currently utilize some form of chemical precipitation. Based on responses to the Waste Treatment Industry

Questionnaire, EPA assumed that the in-place chemical precipitation systems use a dosage ratio of 25% caustic and 75% lime and achieve a reduction of pollutants from “raw” to “current” levels. The selective metals precipitation upgrade would require a change in the existing dosage mix to 40% caustic and 60 % lime. Therefore, the selective metals precipitation upgrade for facilities with in-place chemical precipitation is the increase in caustic cost (from 25 % to 40%) minus the lime credit (to decrease from 75% to 60%).

The O&M cost equation for selective metals precipitation is presented in Table 11-4 along with the O&M upgrade cost equation for facilities with primary and secondary chemical precipitation in-place.

Table 11-4. Cost Equations for *Selective Metals Precipitation* in Metals Options 2 and 3

Description	Equation	Recommended Flow Rate Range (MGD)
Capital cost	$\ln(Y1) = 14.461 + 0.544\ln(X) + 0.0000047(\ln(X))^2$	1.0 E -6 to 5.0
O&M cost for facilities with no chemical precipitation treatment in-place	$\ln(Y2) = 15.6402 + 1.001\ln(X) + 0.04857(\ln(X))^2$	3.4 E -5 to 5.0
O&M <i>upgrade</i> cost for facilities with precipitation in-place	$\ln(Y2) = 14.2545 + 0.8066\ln(X) + 0.04214(\ln(X))^2$	7.4 E -5 to 5.0
Land requirements	$\ln(Y3) = -0.575 + 0.420\ln(X) + 0.025(\ln(X))^2$	1.6 E -2 to 4.0

Y1 = Capital Costs (1989 \$)

Y2 = Operation and Maintenance Costs (1989 \$ /year)

Y3 = Land Requirement (Acres)

X = Flow Rate (million gallons per day)

Secondary Precipitation -- Metals

Option 2 and Metals Option 3 11.2.1.2

The secondary precipitation system in the model technology for Metals Option 2 and Metals Option 3 follows selective metals precipitation and plate and frame liquid filtration. This secondary chemical precipitation equipment consists of a single mixed reaction tank with pumps and a treatment chemical feed system,

which is sized for the full daily batch volume.

As shown in Table 11-3, clarification follows secondary chemical precipitation for Metals Options 2 and 3. The costing discussion for clarification following secondary precipitation is presented in section 11.2.2.2. The discussions for sludge filtration and the associated filter cake disposal are presented in sections 11.4.1, and 11.4.2, respectively.

Many facilities in the metals subcategory currently have chemical precipitation units in-place. For these facilities, cost upgrades may be appropriate. EPA used the following set of rules to decide whether a facility's costs should be based on a full cost equation or an upgrade equation for the secondary chemical precipitation step of metals Options 2 and 3:

- Facilities with no chemical precipitation in-place should use the full capital and O&M costs.
- Facilities with primary chemical precipitation in-place should assume no capital costs, no land requirements, but an O&M upgrade cost for the primary step.
- Facilities with secondary chemical precipitation currently in-place should assume no capital costs, no land requirements, and no O&M costs for the secondary step.

CAPITAL COSTS

For facilities that have no chemical precipitation in-place, EPA calculated capital cost estimates for the secondary precipitation treatment systems from vendor quotations.

EPA estimated the other components (i.e., piping, instrumentation and controls, etc.) of the total capital cost by applying the same factors and additional costs as detailed for selective metals precipitation (see Section 11.2.1.1 above). The capital cost equation for secondary precipitation in Metals Option 2 and Option 3 is shown in Table 11-5 at the end of this section.

For the facilities that have at least primary chemical precipitation in-place, EPA assumed that the capital cost for the secondary precipitation treatment system would be zero. The in-place primary chemical precipitation systems would serve as secondary precipitation systems after the installation of upstream selective metals precipitation units.

CHEMICAL USAGE AND LABOR REQUIREMENT COSTS

EPA developed O&M cost estimates for the secondary precipitation step of Metals Option 2 and 3 for facilities with and without chemical precipitation currently in-place. For facilities with no chemical precipitation in-place, EPA calculated the amount of lime required to precipitate each of the metals and semi-metals from the metals subcategory current performance concentrations (achieved with the previously explained selective metals precipitation step) to the Metals Option 2 long-term average concentrations. EPA then added a ten percent excess dosage factor and based the chemical addition costs on the required amount of lime only, which is based on the operation of the model facility for this technology. EPA assumed the labor cost to be two hours per batch, based on manufacturers' recommendations.

For facilities with chemical precipitation in-place, EPA calculated an O&M upgrade cost. In calculating the O&M upgrade cost, EPA assumed that there would be no additional costs associated with any of the components of the annual O&M cost, except for increased chemical costs.

Since EPA already applied credit for chemical costs for facilities with primary precipitation in estimating the selective metals precipitation chemical costs, the chemical upgrade costs for facilities with primary precipitation are identical to facilities with no chemical precipitation in-place.

Since EPA assumed that facilities with secondary precipitation would achieve the metals option 2 long term average concentrations with their current system and chemical additions (after installing the selective metals precipitation system), EPA assumed these facilities would not incur any additional chemical costs. In turn, EPA also assumed that facilities with secondary precipitation units in-place would incur no O&M upgrade costs.

Table 11-5. Cost Equations for *Secondary Chemical Precipitation* in Metals Options 2 and 3

Description	Equation	Recommended Flow Rate Range (MGD)
Capital cost	$\ln(Y1) = 13.829 + 0.544\ln(X) + 0.00000496(\ln(X))^2$	1.0 E -6 to 5.0
O&M cost for facilities with no chemical precipitation in-place	$\ln(Y2) = 11.6553 + 0.48348\ln(X) + 0.02485(\ln(X))^2$	6.5 E -5 to 5.0
O&M <i>upgrade</i> cost for facilities with primary precipitation in-place	$\ln(Y2) = 9.97021 + 1.00162\ln(X) + 0.00037(\ln(X))^2$	5.0 E -4 to 5.0
Land requirements	$\ln(Y3) = -1.15 + 0.449\ln(X) + 0.027(\ln(X))^2$	4.0 E -3 to 1.0

Y1 = Capital Costs (1989 \$)

Y2 = Operation and Maintenance Costs (1989 \$ /year)

Y3 = Land Requirement (Acres)

X = Flow Rate (million gallons per day)

*Tertiary Precipitation and pH**Adjustment-- Metals Option 3* 11.2.1.3

The tertiary chemical precipitation step for Metals Option 3 follows the secondary precipitation and clarification steps. This tertiary precipitation system consists of a rapid mix neutralization tank and a pH adjustment tank. In this step, the wastewater is fed to the rapid mix neutralization tank where lime slurry is added to raise the pH to 11.0. Effluent from the neutralization tank then flows to a clarifier for solids removal. The clarifier overflow goes to a pH adjustment tank where sulfuric acid is added to achieve the desired final pH of 9.0. This section explains the development of the cost estimates for the rapid mix neutralization tank and the pH adjustment tank. The discussions for clarification, sludge filtration, and associated filter cake disposal are presented in Sections 11.2.2.2, 11.4.1, and 11.4.2, respectively.

CAPITAL COSTS

EPA developed the capital cost estimates for the rapid mix tank assuming continuous flow and a 15-minute detention time, which is based on the model facility's standard operation. The equipment cost includes one tank, one agitator, and one lime feed system.

EPA developed the capital cost estimates for

the pH adjustment tank assuming continuous flow and a five-minute detention time, also based on the model facility's operation. The equipment cost includes one tank, one agitator, and one sulfuric acid feed system.

EPA estimated the other components (i.e., piping, instrumentation and controls, etc.) of the total capital cost for both the rapid mix and pH adjustment tank by applying the same factors and additional costs as detailed for selective metals precipitation (see Section 11.2.1.1 above). The capital cost equations for the rapid mix and pH adjustment tanks are presented in Table 11-6 at the end of this section.

CHEMICAL USAGE AND LABOR
REQUIREMENT COSTS

EPA did not assign O&M costs, and in turn, chemical usage and labor requirement costs for tertiary precipitation and pH adjustment to the few facilities which have tertiary precipitation (and pH adjustment) systems in-place. For those facilities without tertiary precipitation (and pH adjustment) in-place, EPA estimated the labor requirements at one man-hour per day for the rapid mix and pH adjustment tanks. EPA based this estimate on the model facility's typical operation.

EPA estimated chemical costs for the rapid

mix tank based on lime addition to achieve the stoichiometric requirements of reducing the metals in the wastewater from the Metals Option 2 long-term averages to the Metals Option 3 long-term averages, with a 10 percent excess. EPA estimated the chemical requirements for the

pH adjustment tank based on the addition of sulfuric acid to lower the pH from 11.0 to 9.0, based on the model facility's operation. The O&M cost equations for the rapid mix tank and pH adjustment tank are presented in Table 11-6.

Table 11-6. Cost Equations for *Tertiary Chemical Precipitation* in Metals Option 3

Description	Equation	Recommended Flow Rate Range (MGD)
Capital cost for rapid mix tank	$\ln(Y1) = 12.318 + 0.543\ln(X) - 0.000179(\ln(X))^2$	1.0 E -5 to 5.0
Capital cost for pH adjustment tank	$\ln(Y1) = 11.721 + 0.543\ln(X) + 0.000139(\ln(X))^2$	1.0 E -5 to 5.0
O&M cost for rapid mix tank	$\ln(Y2) = 9.98761 + 0.37514\ln(X) + 0.02124(\ln(X))^2$	1.6 E -4 to 5.0
O&M cost for pH adjustment tank	$\ln(Y2) = 9.71626 + 0.33275\ln(X) + 0.0196(\ln(X))^2$	2.5 E -4 to 5.0
Land requirements for rapid mix tank	$\ln(Y3) = -2.330 + 0.352\ln(X) + 0.019(\ln(X))^2$	1.0 E -2 to 5.0
Land requirements for pH adjustment tank	$\ln(Y3) = -2.67 + 0.30\ln(X) + 0.033(\ln(X))^2$	1.0 E -2 to 5.0

Y1 = Capital Costs (1989 \$)

Y2 = Operation and Maintenance Costs (1989 \$ /year)

Y3 = Land Requirement (Acres)

X = Flow Rate (million gallons per day)

Primary Chemical Precipitation -- Metals Option 4

11.2.1.4

The primary chemical precipitation system equipment for the model technology for Metals Option 4 consists of a mixed reaction tank with pumps, a treatment chemical feed system, and an unmixed wastewater holding tank. EPA designed the system to operate on a batch basis, treating one batch per day, five days per week. The average chemical precipitation batch duration reported by respondents to the WTI Questionnaire was four hours. Therefore, a one batch per day treatment schedule should provide sufficient time for the average facility to pump, treat, and test its waste. EPA also included a holding tank, equal to the daily waste volume, up to a maximum size of 5,000 gallons (equivalent to the average tank truck receipt volume throughout the industry), to allow facilities

flexibility in managing waste receipts. (The Metals Option 4 model facility utilizes a holding tank.)

As shown in Table 11-3, clarification follows primary chemical precipitation for metals Option 4. The costing discussion for clarification following primary precipitation in Metals Option 4 is presented in section 11.2.2.2. The discussions for sludge filtration and the associated filter cake disposal are presented in sections 11.4.1, and 11.4.2, respectively.

CAPITAL COSTS

EPA developed total capital cost estimates for the Metals Option 4 primary chemical precipitation systems. For facilities with no chemical precipitation units in-place, the components of the chemical precipitation system included a precipitation tank with a mixer,

pumps, and a feed system. In addition, EPA included a holding tank equal to the size of the precipitation tank, up to 5,000 gallons. EPA obtained these cost estimates from manufacturer's recommendations.

EPA estimated the other components (i.e., piping, instrumentation and controls, etc.) of the total capital cost for both the rapid mix and pH adjustment tank by applying the same factors and additional costs as detailed for selective metals precipitation (see Section 11.2.1.1 above).

For facilities that already have any chemical precipitation (treatment in-place), EPA included as capital expense only the cost of a holding tank. The capital cost equations for primary chemical precipitation and the holding tank only for Metals Option 4 are presented in Table 11-7.

LABOR AND CHEMICAL COSTS

EPA approximated the labor cost for primary chemical precipitation in Metals Option 4 at two hours per batch, one batch per day. EPA based this approach on the model facility's operation.

EPA estimated chemical costs based on stoichiometric, pH adjustment, and buffer adjustment requirements. For facilities with no chemical precipitation in-place, EPA based the stoichiometric requirements on the amount of chemicals required to precipitate each of the metal pollutants of concern from the metals subcategory average raw influent concentrations to Metals Option 4 (Sample Point-03) concentrations. Metals Option 4, Sample Point-03 concentrations represent the sampled effluent from primary chemical precipitation at the model facility. The chemicals used were lime at 75 percent of the required removals and caustic at 25 percent of the required removals, which are based on the option facility's operation. EPA estimated the pH adjustment and buffer adjustment requirements to be 50 percent of the stoichiometric requirement, which includes a 10 percent excess of chemical dosage. The O&M

cost equation for primary chemical precipitation in Metals Option 4 for facilities with no treatment in-place is presented in Table 11-7.

For facilities which already have chemical precipitation treatment in-place, EPA estimated an O&M upgrade cost. EPA assumed that facilities with primary chemical precipitation in-place have effluent concentrations exiting the primary precipitation/solid-liquids separation system equal to the metals subcategory primary precipitation current loadings. Similarly, EPA assumed that facilities with secondary chemical precipitation in place have effluent concentrations exiting the secondary precipitation/solid-liquids separation system equal to metals subcategory secondary precipitation current loadings (see chapter 12 for a detailed discussion of metals subcategory primary and secondary chemical precipitation current loadings).

For the portion of the O&M upgrade equation associated with energy, maintenance, and labor, EPA calculated the percentage difference between the primary precipitation current loadings and Metals Option 4 (Sample Point-03) concentrations. For facilities which currently have primary precipitation systems this difference is an increase of approximately two percent. Therefore, EPA calculated the energy, maintenance, and labor components of the O&M upgrade cost for facilities with primary chemical precipitation in-place at two percent of the O&M cost for facilities with no chemical precipitation in-place.

For the portion of the O&M upgrade equation associated with energy, maintenance, and labor, EPA calculated the percentage difference between secondary precipitation current loadings and Metals Option 4 (Sample Point-03) concentrations. For secondary precipitation systems, this difference is also an

increase of approximately two percent¹. Therefore, EPA calculated the energy, maintenance, and labor components of the O&M upgrade cost for facilities with secondary chemical precipitation in-place at two percent of the O&M cost for facilities with no chemical precipitation in-place.

For the chemical cost portion of the O&M upgrade, EPA also calculated upgrade costs depending on whether the facility had primary precipitation or secondary precipitation currently in-place. For facilities with primary precipitation, EPA calculated chemical upgrade costs based on current-to-Metals Option 4 (Sample Point-03) removals. Similarly for facilities with secondary precipitation, EPA calculated chemical upgrade costs based on secondary precipitation removals to Metals Option 4 (Sample Point -03) removals. In both cases, EPA did not include costs for pH adjustment or buffering chemicals since these chemicals should already be used in the in-place treatment system. Finally, EPA included a 10 percent excess of chemical dosage to the stoichiometric requirements of the precipitation chemicals.

EPA then combined the energy, maintenance and labor components of the O&M upgrade with the chemical portion of the O&M upgrade to develop two sets of O&M upgrade equations for the primary chemical precipitation portion of Metals Option 4. These cost equations for Metals Option 4 (primary chemical precipitation O&M upgrade costs) for facilities with primary and secondary treatment in place are presented Table 11-7.

¹While pollutant concentrations resulting from secondary chemical precipitation are generally lower than those resulting from primary chemical precipitation, the percentage increase (when rounded) for primary and secondary precipitation are the same.

Table 11-7. Cost Equations for *Primary Chemical Precipitation* in Metals Option 4

Description	Equation	Recommended Flow Rate Range (MGD)
Capital cost for primary precipitation and no treatment in-place	$\ln(Y1) = 14.019 + 0.481\ln(X) - 0.00307(\ln(X))^2$	1.0 E -6 to 5.0
Capital cost for holding tank only - used for facilities with chemical precipitation currently in-place.	$\ln(Y1) = 10.671 - 0.083\ln(X) - 0.032(\ln(X))^2$	1.0 E -6 to 0.005
O&M cost for primary precipitation and no treatment in-place	$\ln(Y2) = 15.3086 + 1.08349\ln(X) + 0.04891(\ln(X))^2$	1.7 E -5 to 5.0
O&M <i>upgrade</i> for facilities with primary precipitation in-place	$\ln(Y2) = 11.4547 + 1.04337\ln(X) + 0.04575(\ln(X))^2$	2.0 E -5 to 5.0
O&M <i>upgrade</i> for facilities with secondary precipitation in-place	$\ln(Y3) = 10.9647 + 0.98525\ln(X) + 0.04426(\ln(X))^2$	1.7 E -5 to 5.0
Land requirements	$\ln(Y3) = -1.019 + 0.299\ln(X) + 0.015(\ln(X))^2$	6.7 E -5 to 1.0
Land requirements (associated with holding tank only)	$\ln(Y3) = -2.866 - 0.023\ln(X) - 0.006(\ln(X))^2$	1.0 E -5 to 0.5

Y1 = Capital Costs (1989 \$)

Y2 = Operation and Maintenance Costs (1989 \$ /year)

Y3 = Land Requirement (Acres)

X = Flow Rate (million gallons per day)

Secondary (Sulfide) Precipitation for Metals Option 4

11.2.1.5

The Metals Option 4 secondary sulfide precipitation system follows the primary metals precipitation/clarification step. This equipment consists of a mixed reaction tank with pumps and a treatment chemical feed system, sized for the full daily batch volume. For direct dischargers, the overflow from secondary sulfide precipitation would carry on to a clarifier and then multi-media filtration. For indirect discharges, the overflow would go immediately to the filtration unit, without clarification. Cost estimates for the clarifier are discussed in section 11.2.2.2 of this document. Cost estimates for multi-media filtration are presented in section 11.2.5.

For costing purposes, EPA assumed that facilities either have secondary precipitation currently in-place and attributes no additional capital and O&M costs to these facilities, or EPA assumes that facilities do not have secondary

sulfide precipitation in-place and, consequently, EPA developed costs for full O&M and capital costs. Therefore, EPA has not developed upgrade costs associated with secondary precipitation in Metals Option 4.

CAPITAL COSTS

EPA developed capital cost estimates for the secondary sulfide precipitation systems in Metals Option 4 from vendor's quotes. EPA estimated the other components (i.e., piping, instrumentation, and controls, etc.) of the sulfide precipitation system by applying the same methodology, factors and additional costs as outlined for the primary chemical precipitation system for Metals Option 4 (see Section 11.2.1.4 above). The capital cost equation for Metals Option 4 secondary sulfide precipitation is presented in Table 11-8 at the end of this section.

LABOR AND CHEMICAL COSTS

For facilities with no secondary precipitation systems in-place, EPA estimated the labor requirements at two hours per batch, one batch per day. EPA based this estimate on standard operation at the Metals Option 4 model facility.

For secondary sulfide precipitation in Metals Option 4, EPA did not base the chemical cost

estimates on stoichiometric requirements. Instead, EPA estimated the chemical costs based on dosage rates for the addition of polymer and ferrous sulfide obtained during the sampling of the Metals Option 4 model plant with BAT performance. The O&M cost equation for the Metals Option 4, secondary sulfide precipitation is presented in Table 11-8.

Table 11-8. Cost Equations for *Secondary (Sulfide) Precipitation* for Metals Option 4

Description	Equation	Recommended Flow Rate Range (MGD)
Capital cost for secondary precipitation and no treatment in-place	$\ln(Y1) = 13.829 + 0.544\ln(X) + 0.00000496(\ln(X))^2$	1.0 E -6 to 5.0
O&M cost for secondary precipitation and no treatment in-place	$\ln(Y2) = 12.076 + 0.63456\ln(X) + 0.03678(\ln(X))^2$	1.8 E -4 to 5.0
Land requirements	$\ln(Y3) = -1.15 + 0.449\ln(X) + 0.027(\ln(X))^2$	2.5 E -4 to 1.0

Y1 = Capital Costs (1989 \$)

Y2 = Operation and Maintenance Costs (1989 \$ /year)

Y3 = Land Requirement (Acres)

X = Flow Rate (million gallons per day)

Plate and Frame Liquid Filtration and Clarification

11.2.2

Clarification systems provide continuous, low-cost separation and removal of suspended solids from water. Waste treatment facilities use clarification to remove particulates, flocculated impurities, and precipitants, often following chemical precipitation. Similarly, waste treatment facilities also use plate and frame pressure systems to remove solids from waste streams. As described in this section, these plate and frame filtration systems serve the same function as clarification and are used to remove solids following chemical precipitation from *liquid* wastestreams. The major difference between clarification systems and plate and frame liquid filtration systems is that the sludge generated by clarification generally needs to be

processed further prior to landfilling, whereas, the sludge generated by plate and frame liquid filtration does not.

EPA costed facilities to include a plate and frame liquid filtration system following selective metals precipitation in Metals Options 2 and 3. The components of the plate and frame liquid filtration system include: filter plates, filter cloth, hydraulic pumps, control panel, connector pipes, and a support platform. Since EPA costed all metals facilities for selective metals precipitation systems for metals Options 2 and 3 (except the one facility which already utilizes this technology), EPA also costed all metals facilities for plate and frame liquid filtration systems. Consequently, EPA did not develop any upgrade costs associated with the use of plate and frame liquid filtration.

EPA also costed facilities to include a

clarifier following secondary precipitation for Metals Option 2 and following both secondary and tertiary precipitation for Metals Option 3. For Metals Option 4, EPA costed facilities to include a clarifier following primary chemical precipitation and following secondary precipitation (for direct dischargers only). EPA designed and costed a single clarification system for all options and locations in the treatment train. The components of this clarification system include a clarification unit, flocculation unit, pumps, motor, foundation, and accessories.

*Plate and Frame Liquid
Filtration Following Selective
Metals Precipitation*

11.2.2.1

CAPITAL COSTS

The plate and frame liquid filtration equipment following the selective metals precipitation step for the model technology in Metals Option 2 and 3 consists of two plate and frame liquid filtration systems. EPA assumed that each system would be used to process two batches per day for a total of four batches. EPA costed the plate and frame liquid filtration systems in this manner to allow facilities to segregate their wastes into smaller batches, thereby facilitating selective metals recovery. EPA sized each of the units to process a batch consisting of 25 percent of the daily flow and assumed that the influent to the plate and frame filtration units would consist of 96 percent liquid and four percent (40,000 mg/l) solids (based on the model facility). EPA based the capital cost equation for plate and frame liquid filtration for Metals Options 2 and 3 on information provided by vendors. This capital cost equation is listed in Table 11-9.

CHEMICAL USAGE AND LABOR REQUIREMENTS

EPA estimated that labor requirements for plate and frame liquid filtration for Metals Options 2 and 3 would be 30 minutes per batch per filter press (based on the metals Options 2

and 3 model facility). There are no chemicals associated with the operation of the plate and frame filtration systems. EPA estimated the remaining components of O&M using the factors listed in Table 11-2. The O&M equation for plate and frame liquid filtration is listed in Table 11-9.

Even though the metal-rich sludge generated from selective metals precipitation and plate and frame liquid filtration may be recycled and re-used, EPA additionally included costs associated with disposal of these sludges in a landfill. The discussion for filter cake disposal is presented separately in Section 11.4.2. These disposal costs are additional O&M costs which must be added to the O&M costs calculated above to obtain the total O&M costs associated with plate and frame liquid filtration for Metals Options 2 and 3.

*Clarification for Metals
Options 2,3, and 4*

11.2.2.2

CAPITAL COSTS

EPA obtained the capital cost estimate for clarification systems from vendors. EPA designed the clarification system assuming an influent total suspended solids (TSS) concentration of 40,000 mg/L (four percent solids) and an effluent TSS concentration of 200,000 mg/L (20 percent solids). In addition, EPA assumed a design overflow rate of 600 gpd/ft². EPA estimated the influent and effluent TSS concentrations and overflow rate based on the WTI Questionnaire response for Questionnaire ID 105. The capital cost equation for clarification is presented in Table 11-9 at the end of this section. As detailed earlier, the same capital cost equation is used for all of the clarification systems for all of the metals options regardless of its location in the treatment train. EPA did not develop capital cost upgrades for facilities which already have clarification systems in-place. Therefore, facilities which currently have clarifiers have no land or capital costs.

CHEMICAL USAGE AND LABOR REQUIREMENTS

EPA estimated the labor requirements for the clarification systems for Metals Options 2 and 3 following secondary precipitation and Metals Option 4 following primary and secondary (for direct dischargers only) precipitation at three hours per day for low-flow clarifiers and four to six hours per day for high-flow clarifiers. Based on manufacturers recommendations, EPA selected the flow cut-off between high-flow and low-flow systems to be 1000 gallons per day. For the clarifier following tertiary precipitation in Metals Option 3 only, EPA estimated the labor requirement at one hour per day (based on the operation of the Metals Option 3 model facility). For all clarifiers for all metals options and treatment train locations, EPA estimated a polymer dosage rate of 2.0 mg per liter of wastewater (for the flocculation step) based on the MP&M industry cost model. EPA estimated the remaining components of O&M using the factors listed in Table 11-2. The two cost equations developed for clarification are listed in Table 11-9. One equation is used for the clarifier following the tertiary precipitation step of Metals Option 3 and the other equation is used for all other Metals options and locations in the treatment train.

As shown in Table 11-3, sludge filtration follows clarification for the secondary precipitation step of Metals Options 2 and 3 and the primary and secondary (direct dischargers only) of Metals Option 4. The costing discussion and equations for sludge filtration and the associated filter cake disposal are presented in Section 11.4.1 and 11.4.2, respectively.

For facilities which already have clarification systems or plate and frame liquid filtration systems in-place for each option and location in the treatment train, EPA estimated clarification upgrade costs. EPA assumed that in-place clarification systems and in-place plate and frame liquid filtration systems are equivalent. Therefore, if a facility has an in-place liquid filtration system which can serve the same

purpose as a clarifier, EPA costed this facility for an up-grade only and not a new clarification system.

For the clarification step following secondary precipitation in Metals Options 2 and 3, in order to quantify the O&M increase necessary for the O&M upgrade, EPA compared the difference between secondary precipitation current performance concentrations and the Metals Option 2 long-term averages. EPA determined facilities would need to increase their current removals by 3 percent. Therefore, for in-place clarification systems (or plate and frame liquid filtration systems) which could serve as the clarifier following secondary chemical precipitation for Metals Option 2 and 3, EPA included an O&M cost upgrade of three percent of the O&M costs for a brand new system (except for taxes, insurance, and maintenance which are a function of the capital cost). The O&M upgrade equations for clarification following secondary chemical precipitation for Metals Option 2 and 3 (one for facilities which currently have a clarifier and one for facilities which currently have a plate and frame liquid filtration system) are listed in Table 11-9.

For facilities which already have clarifiers or plate and frame liquid filtration systems in-place which could serve as the clarifier following the tertiary chemical precipitation of Metals Option 3, EPA did not estimate any O&M upgrade costs. EPA assumed the in-place technologies could perform as well as (or better) than the technology costed by EPA.

For facilities which already have clarifiers or plate and frame liquid filtration systems in-place which could serve as the clarifier following the primary chemical precipitation of Metals Option 4, EPA compared the difference between primary precipitation current loadings and the long-term averages for Metals Option 4, Sample Point 03 (Sample Point 03 follows primary precipitation and clarification at the Metals Option 4 model facility). EPA determined that facilities would need to increase their removals by 2%.

Therefore, for in-place clarification systems (or plate and frame liquid filtration systems) which could serve as the clarifier following primary chemical precipitation for Metals Option 4, EPA included an O&M cost upgrade of two percent of the O&M costs for a brand new system (except for taxes, insurance, and maintenance which are a function of the capital cost). The O&M upgrade equations for clarification following primary chemical precipitation for Metals Option 4 (one for facilities which currently have a

clarifier and one for facilities which currently have a plate and frame liquid filtration system) are listed in Table 11-9.

EPA did not calculate an O&M upgrade equation for the clarification step following secondary chemical precipitation (direct dischargers only) of Metals Option 4. EPA costed all direct discharging facilities for a new clarification system following secondary chemical precipitation for Metals Option 4 since none of the direct discharging metals facilities had treatment in-place for this step.

Table 11-9. Cost Equations for *Clarification and Plate and Frame Liquid Filtration* in Metals Option 2,3,4

Description	Equation	Recommended Flow Rate Range (MGD)
Capital cost for plate and frame liquid filtration for Metals Options 2 and 3 ¹	$\ln(Y1) = 14.024 + 0.859\ln(X) + 0.040(\ln(X))^2$	1.0 E -6 to 1.0
Capital Cost for Clarification for Metals Options 2,3, and 4	$\ln(Y1) = 11.552 + 0.409\ln(X) + 0.020(\ln(X))^2$	4.0 E -5 to 1.0
O&M cost for plate and frame liquid filtration for Metals Options 2 and 3 ¹	$\ln(Y2) = 13.056 + 0.193\ln(X) + 0.00343(\ln(X))^2$	1.0 E -6 to 1.0
O&M cost for Clarification for Metals Options 2,3 ³ , and 4	$\ln(Y2) = 10.673 + 0.238\ln(X) + 0.013(\ln(X))^2$	1.2 E -4 to 1.0
O&M cost for clarification for Metals Option 3 ⁴	$\ln(Y2) = 10.294 + 0.362\ln(X) + 0.019(\ln(X))^2$	8.0 E -5 to 1.0
O&M <i>upgrade</i> for Clarification for Metals Options 2 and 3 -- facilities which currently have clarification in-place ⁵	$\ln(Y2) = 7.166 + 0.238\ln(X) + 0.013(\ln(X))^2$	7.0 E -5 to 1.0
O&M <i>upgrade</i> for Clarification for Metals Options 2 and 3 -- facilities which currently have plate and frame liquid filtration in-place	$\ln(Y2) = 8.707 + 0.333\ln(X) + 0.012(\ln(X))^2$	1.0 E -6 to 1.0
O&M <i>upgrade</i> for Clarification for Metals Option 4 ⁶	$\ln(Y2) = 6.8135 + 0.3315\ln(X) + 0.0242(\ln(X))^2$	1.2 E -3 to 1.0
Land requirements for plate and frame liquid filtration for Metals Options 2 and 3	$\ln(Y3) = -1.658 + 0.185\ln(X) + 0.009(\ln(X))^2$	1.0 E -6 to 1.0
Land requirements for clarification	$\ln(Y3) = -1.773 + 0.513\ln(X) + 0.046(\ln(X))^2$	1.0 E -2 to 1.0

Y1 = Capital Costs (1989 \$)

Y2 = Operation and Maintenance Costs (1989 \$ /year)

Y3 = Land Requirement (Acres)

X = Flow Rate (million gallons per day)

¹Follows selective metals precipitation

³For metals option 3, this equation is used for clarification following secondary chemical precipitation only

⁴This equation is used for clarification following tertiary precipitation only.

⁵For Metals Option 3, this equation is used for clarification following secondary precipitation only. No O&M upgrade costs included for tertiary precipitation.

⁶This equation is used for clarification following primary precipitation only. No facilities require O&M upgrades for clarification following secondary chemical precipitation.

Equalization**11.2.3**

To improve treatment, facilities often need to equalize wastes by holding them in a tank. The CWT industry frequently uses equalization to minimize the variability of incoming wastes effectively.

EPA costed an equalization system which consists of a mechanical aeration basin based on responses to the WTI Questionnaire. EPA obtained the equalization cost estimates from the 1983 U.S. Army Corps of Engineers' Computer Assisted Procedure for Design and Evaluation of Wastewater Treatment Systems (CAPDET). EPA originally used this program to estimate equalization costs for the OCPSF Industry. Table 11-10 lists the default design parameters that EPA used in the CAPDET program. These default design parameters are reasonable for the CWT industry since they reflect values seen in the CWT industry. For example, the default detention time (24 hours) is appropriate since this was the median equalization detention time reported by respondents to the WTI Questionnaire.

Table 11-10. Design Parameters Used for Equalization in CAPDET Program

Aerator mixing requirements = 0.03 HP per 1,000 gallons;
Oxygen requirements = 15.0 mg/l per hour;
Dissolved oxygen in basin = 2.0 mg/l;
Depth of basin = 6.0 feet; and
Detention time = 24 hours.

EPA did not calculate capital or O&M upgrade equations for equalization. If a CWT facility currently has an equalization tank in-place, the facility received no costs associated with equalization. EPA assumed that the equalization tanks currently in-place at CWT

facilities would perform as well as (or better than) the system costed by EPA.

CAPITAL COSTS

The CAPDET program calculates capital costs which are "total project costs." These "total project costs" include all of the items previously listed in Table 11-1 as well as miscellaneous nonconstruction costs, 201 planning costs, technical costs, land costs, interest during construction, and laboratory costs. Therefore, to obtain capital costs for the equalization systems for this industry, EPA calculated capital costs based on total project costs minus: miscellaneous nonconstruction costs, 201 planning costs, technical costs, land costs, interest during construction, and laboratory costs. The resulting capital cost equation for equalization is presented in Table 11-11 at the end of this section.

OPERATION AND MAINTENANCE COSTS

EPA obtained O&M costs directly from the initial year O&M costs produced by the CAPDET program. The O&M cost equation for equalization systems is presented in Table 11-11.

LAND REQUIREMENTS

EPA used the CAPDET program to develop land requirements for the equalization systems. EPA scaled up the requirements to represent the total land required for the system plus peripherals (pumps, controls, access areas, etc.). The land requirement equation for equalization systems is also presented in Table 11-11.

Table 11-11. Summary of Cost Equations for *Equalization*

Description	Equation	Recommended Flow Rate Range (MGD)
Capital cost for equalization	$\ln(Y1) = 12.057 + 0.433\ln(X) + 0.043(\ln(X))^2$	6.6 E -3 to 5.0
O&M cost for equalization	$\ln(Y2) = 11.723 + 0.311\ln(X) + 0.019(\ln(X))^2$	3.0 E -4 to 5.0
Land requirements	$\ln(Y3) = -0.912 + 1.120\ln(X) + 0.011(\ln(X))^2$	1.4 E -2 to 5.0

Y1 = Capital Costs (1989 \$)

Y2 = Operation and Maintenance Costs (1989 \$ /year)

Y3 = Land Requirement (Acres)

X = Flow Rate (million gallons per day)

Air Stripping

11.2.4

Air stripping is an effective wastewater treatment method for removing dissolved gases and volatile compounds from wastewater streams. The technology passes high volumes of air through an agitated gas-water mixture. This promotes volatilization of compounds, and, preferably capture in air pollution control systems.

The air stripping system costed by EPA includes transfer pumps, control panels, blowers, and ancillary equipment. EPA also included catalytic oxidizers as part of the system for air pollution control purposes.

If a CWT facility currently has an air stripping system in-place, EPA did not assign the facility any costs associated with air stripping. EPA assumed that the air stripping systems currently in-place at CWT facilities would perform as well as (or better than) the system costed by EPA.

CAPITAL COSTS

EPA's air stripping system is designed to remove pollutants with medium to high volatilities. EPA used the pollutant 1,2-dichloroethane, which has a Henry's Law Constant of $9.14 \text{ E } -4 \text{ atm} \cdot \text{L/mol}$, as the design basis with an influent concentration of $4,000 \text{ } \mu\text{g/L}$ and an effluent concentration of $68 \text{ } \mu\text{g/L}$.

EPA based these concentration on information collected on the model facility's operation. EPA used the same design basis for the air stripping systems costed for the option 8v and 9v in the oils subcategory.

EPA obtained the equipment costs from vendor quotations. The capital cost equation for air stripping systems is presented in Table 11-13 at the end of this section.

OPERATION AND MAINTENANCE COSTS

For air stripping, O&M costs include electricity, maintenance, labor, catalyst replacement, and taxes and insurance. EPA obtained the O&M costs from the same vendor which provided the capital cost estimates.

EPA based the electricity usage for the air strippers on the amount of horsepower needed to operate the system and approximated the electricity usage for the catalytic oxidizers at 50 percent of the electricity used for the air strippers. EPA based both the horsepower requirements and the electricity requirements for the catalytic oxidizer on vendor's recommendations. EPA estimated the labor requirement for the air stripping system at three hours per day, which is based on the model facility's operation. EPA assumed that the catalyst beds in the catalytic oxidizer would require replacement every four years based on the rule of thumb (provided by the vendor) that precious metal catalysts have a

lifetime of approximately four years. EPA divided the costs for replacing the spent catalysts by four to convert them to annual costs. As is the standard used by EPA for this industry, taxes and

insurance were estimated at 2 percent of the total capital cost. The resulting O&M cost equation for air stripping systems is presented in Table 11-12.

Table 11-12. Cost Equations for *Air Stripping*

Description	Equation	Recommended Flow Rate Range(MGD)
Capital cost for air stripping	$\ln(Y1) = 12.899 + 0.486\ln(X) + 0.031(\ln(X))^2$	4.0 E -4 to 1.0
O&M cost for air stripping	$\ln(Y2) = 10.865 + 0.298\ln(X) + 0.021(\ln(X))^2$	8.5 E -4 to 1.0
Land requirements	$\ln(Y3) = -2.207 + 0.536\ln(X) + 0.042(\ln(X))^2$	0.1 to 1.0

Y1 = Capital Costs (1989 \$)

Y2 = Operation and Maintenance Costs (1989 \$ /year)

Y3 = Land Requirement (Acres)

X = Flow Rate (million gallons per day)

Multi-Media Filtration

11.2.5

Filtration is a proven technology for the removal of residual suspended solids from wastewater. The multimedia filtration system costed by EPA for this industry is a system which contains sand and anthracite coal, supported by gravel.

EPA based the design for the model multimedia filtration system on the TSS effluent long- term average concentration for Metals Option 4 -- 15 mg/L. EPA assumed that the average influent TSS concentration to the multimedia filtration system would range from 75 to 100 mg/L. EPA based the influent concentration range on vendor's recommendations on realistic TSS concentrations resulting from wastewater treatment following chemical precipitation and clarification.

EPA did not calculate capital or O&M upgrade equations for multi-media filtration. If a CWT facility currently has a multimedia filter in-place, EPA assigned the facility no costs associated with multi-media filtration. EPA assumed that the multi-media filter currently in-

place at CWT facilities would perform as well as (or better than) the system costed by EPA.

CAPITAL COSTS

EPA based the capital costs of multi-media filters on vendor's recommendations. The resulting capital cost equation for multi-media filtration systems is presented in Table 11-13.

CHEMICAL USAGE AND LABOR REQUIREMENT COSTS

EPA estimated the labor requirement for the multi-media filtration system at four hours per day, which is based on manufacturer's recommendations. There are no chemicals associated with the operation of a multimedia filter. The O&M cost equation for the multi-media filtration system is presented in Table 11-13.

Table 11-13. Cost Equations for *Multi-Media Filtration*

Description	Equation	Flow Rate Range (MGD)
Capital cost for multi-media filtration	$\ln(Y1) = 12.0126 + 0.48025\ln(X) + 0.04623(\ln(X))^2$	5.7 E -3 to 1.0
O&M cost for multi-media filtration	$\ln(Y2) = 11.5039 + 0.72458\ln(X) + 0.09535(\ln(X))^2$	2.3 E -2 to 1.0
Land requirements	$\ln(Y3) = -2.6569 + 0.19371\ln(X) + 0.02496(\ln(X))^2$	2.4 E -2 to 1.0

Y1 = Capital Costs (1989 \$)

Y2 = Operation and Maintenance Costs (1989 \$ /year)

Y3 = Land Requirement (Acres)

X = Flow Rate (million gallons per day)

Cyanide Destruction

11.2.6

Many CWTs achieved required cyanide destruction by oxidation. These facilities primarily use chlorine (in either the elemental or hypochlorite form) as the oxidizing agent in this process. Oxidation of cyanide with chlorine is called alkaline chlorination.

The oxidation of cyanide waste using sodium hypochlorite is a two step process. In the first step, cyanide is oxidized to cyanate in the presence of hypochlorite, and sodium hydroxide is used to maintain a pH range of 9 to 11. The second step oxidizes cyanate to carbon dioxide and nitrogen at a controlled pH of 8.5. The amounts of sodium hypochlorite and sodium hydroxide needed to perform the oxidation are 8.5 parts and 8.0 parts per part of cyanide, respectively. At these levels, the total reduction occurs at a retention time of 16 to 20 hours. The application of heat can facilitate the more complete destruction of total cyanide.

The cyanide destruction system costed by EPA includes a two-stage reactor with a retention time of 16 hours, feed system and controls, pumps, piping, and foundation. The two-stage reactor includes a covered tank, mixer, and containment tank. EPA designed the system based on a total cyanide influent concentration of 4,633,710 µg/L and an effluent concentration of total cyanide of 135,661 µg/L. EPA based these influent and effluent concentrations on data

collected during EPA's sampling of cyanide destruction systems.

Because the system used by the facility which forms the basis of the proposed cyanide limitation and standards uses special operation conditions, EPA assigned full capital and O&M costs to all facilities which perform cyanide destruction.

CAPITAL COSTS

EPA obtained the capital costs curves for cyanide destruction systems with special operating conditions from vendor services. The capital cost equation is presented in Table 11-14.

CHEMICAL USAGE AND LABOR REQUIREMENT COSTS

In estimating chemical usage and labor requirements, EPA assumed the systems would treat one batch per day. EPA based this assumption on responses to the WTI Questionnaire. Based on vendor's recommendations, EPA estimated the labor requirement for the cyanide destruction to be three hours per day. EPA determined the amount of sodium hypochlorite and sodium hydroxide required based on the stoichiometric amounts to maintain the proper pH and chlorine concentrations to facilitate the cyanide destruction as described earlier. The O&M cost equation for cyanide destruction is presented in Table 11-14.

Table 11-14. Cost Equations for *Cyanide Destruction*

Description	Equation	Recommended Flow Rate Range (MGD)
Capital cost for cyanide destruction	$\ln(Y1) = 13.977 + 0.546\ln(X) + 0.0033(\ln(X))^2$	1.0 E -6 to 1.0
O&M cost for cyanide destruction	$\ln(Y2) = 18.237 + 1.318\ln(X) + 0.04993(\ln(X))^2$	1.0 E -5 to 1.0
Land requirements	$\ln(Y3) = -1.168 + 0.419\ln(X) + 0.021(\ln(X))^2$	1.0 E -4 to 1.0

Y1 = Capital Costs (1989 \$)

Y2 = Operation and Maintenance Costs (1989 \$ /year)

Y3 = Land Requirement (Acres)

X = Flow Rate (million gallons per day)

Secondary Gravity Separation **11.2.7**

Primary gravity separation provides oil and grease removal from oily wastewater. During gravity separation, the wastewater is held in tanks under quiescent conditions long enough to allow the oil droplets to rise and form a layer on the surface, where it is skimmed.

Secondary gravity separation systems provide additional oil and grease removal for oily wastewater. Oily wastewater, after primary gravity separation/emulsion breaking, is pumped into a series of skimming tanks where additional oil and grease removal is obtained before the wastewater enters the dissolved air flotation unit. The secondary gravity separation equipment discussed here consists of a series of three skimming tanks in series. The ancillary equipment for each tank consists of a mix tank with pumps and skimming equipment.

In estimating capital and O&M cost associated with secondary gravity separation, EPA assumed that facilities either currently have

or do not have secondary gravity separation. Therefore, EPA did not develop any secondary gravity separation upgrade costs.

CAPITAL COSTS

EPA obtained the capital cost estimates for the secondary gravity separation system from vendor quotes. The capital cost equation for secondary gravity separation is presented in Table 11-15 at the end of this section.

**CHEMICAL USAGE AND LABOR
REQUIREMENT COSTS**

EPA estimated the labor requirement to operate secondary gravity separation to be 3 to 9 hours per day depending on the size of the system. EPA obtained this estimate from one of the model facilities for Oils Option 9. There are no chemicals associated with the operation of the secondary gravity separation system. The O&M Cost equation for the secondary gravity separation system is presented in Table 11-15.

Table 11-15. Cost Equations for *Secondary Gravity Separation*

Description	Equation	Recommended Flow Rate Range (MGD)
Capital cost for secondary gravity separation	$\ln(Y1) = 14.3209 + 0.38774\ln(X) - 0.01793(\ln(X))^2$	5.0 E -4 to 5.0
O&M cost for secondary gravity separation	$\ln(Y2) = 12.0759 + 0.4401\ln(X) + 0.01544(\ln(X))^2$	5.0 E -4 to 5.0
Land requirements	$\ln(Y3) = -0.2869 + 0.31387\ln(X) + 0.01191(\ln(X))^2$	1.0 E -6 to 1.0

Y1 = Capital Costs (1989 \$)

Y2 = Operation and Maintenance Costs (1989 \$ /year)

Y3 = Land Requirement (Acres)

X = Flow Rate (million gallons per day)

Dissolved Air Flotation***11.2.8***

Flotation is the process of inducing suspended particles to rise to the surface of a tank where they can be collected and removed. Dissolved Air Flotation (DAF) is one of several flotation techniques employed in the treatment of oily wastewater. DAF is commonly used to extract free and dispersed oil and grease from oily wastewater.

CAPITAL COSTS

EPA developed capital cost estimates for dissolved air flotation systems for the oils subcategory Options 8 and 9. EPA based the capital cost estimates for the DAF units on vendor's quotations. EPA assigned facilities with DAF units currently in-place no capital costs. For facilities with no DAF treatment in-place, the DAF system consists of a feed unit, a chemical addition mix tank, and a flotation tank. EPA also included a sludge filtration/dewatering unit. EPA developed capital cost estimates for a series of flow rates ranging from 25 gpm (0.036 MGD) to 1000 gpm (1.44 MGD). EPA was unable to obtain costs estimates for units with flows below 25 gallons per minute since manufacturers do not sell systems smaller than those designed for flows below 25 gallons per minute.

The current DAF system capital cost estimates include a sludge filtration/dewatering unit. For facilities which do not have a DAF unit in-place, but have other treatment systems that produce sludge (i.e. chemical precipitation and/or biological treatment), EPA assumed that the existing sludge filtration unit could accommodate the additional sludge produced by the DAF unit. For these facilities, EPA did not include sludge filtration/dewatering costs in the capital cost estimates. EPA refers to the capital cost equation for these facilities as "modified" DAF costs. The resulting total capital cost equations for the DAF and modified DAF treatment systems are

presented in Table 11-17 at the end of this section.

Because the smallest design capacity for DAF systems that EPA could obtain from vendors is 25 gpm and since more than 75 percent of the oils subcategory facilities have flow rates lower than 25 gpm, EPA assumed that only facilities with flow rates above 20 gpm would operate their DAF systems everyday (i.e. five days per week). EPA assumed that the rest of the facilities could hold their wastewater and run their DAF systems from one to four days per week depending on their flowrate. Facilities that are not operating their DAF treatment systems everyday would need to install a holding tank to hold their wastewater until treatment. Therefore, for facilities which do not currently have DAF treatment in place and which have flow rates less than 20 gallons per minute, EPA additionally included costs for a holding tank. For these facilities, EPA based capital costs on a combination of DAF costs (or modified DAF costs) and holding tank costs. Table 11-16A lists the capacity of the holding tank costed for various flowrates.

Table 11-16A. Estimate Holding Tank Capacities for DAF Systems

Flowrate (GPM)	Holding Tank Capacity (gallons)
<5	7,200
5-10	14,400
10-15	21,600
15-20	28,800
>20	none

The resulting capital cost equation for the holding tank associated with the DAF and modified DAF systems is presented in Table 11-17 at the end of this section.

CHEMICAL USAGE AND LABOR REQUIREMENT COSTS

EPA estimated the labor requirements associated with the model technology at four hours per day for the small systems to eight hours per day for the large systems, which is based on the average of the Oils Options 8 and 9 model facilities. EPA used the same labor estimate for DAF and “modified” DAF systems.

As discussed in the capital cost section, EPA has assumed that facilities with flow rates below 20 gpm will not operate the DAF daily. Therefore, for these lower flow rate facilities, EPA only included labor to operate the DAF (or “modified” DAF) systems for the days the system will be operational. Table 11-16B lists the number of days per week EPA assumed these lower flow facilities would operate their DAF systems.

Table 11-16B. Estimate Labor Requirements for DAF Systems

Flowrate (GPM)	Labor Requirements (days/week)
<5	1
5-10	2
10-15	3
15-20	4
>20	5

As detailed earlier, however, EPA also assumed that facilities with flow rates below 20 gpm, would also operate a holding tank. Therefore, for facilities with flow rates below 20 gallons per minute, EPA included additional labor to operate the holding tank.

EPA calculated chemical cost estimates for DAF and “modified” DAF systems based on additions of aluminum sulfate, caustic soda, and polymer. EPA costed for facilities to add 550 mg/L alum, 335 mg/L polymer and 1680 mg/L of

NaOH. EPA also included costs for perlite addition at 0.25 lbs per lb of dry solids for sludge conditioning and sludge dewatering operations (for DAF, not “modified” DAF systems). EPA based the chemical additions on information gathered from literature, the database for the proposed Industrial Laundries Industry guidelines and standards, and sampled facilities.

For a special set of facilities--referred to as “group 5 facilities” in the oils subcategory current performance modeling estimates -- EPA estimated the chemical additions at 760 mg/L alum, 460 mg/L polymer, and 2300 mg/L NaOH. EPA costed these facilities for additional chemicals because the concentration of metal analytes assigned to the group 5 facilities was significantly higher than the metal concentrations assigned to the facilities in the other modeling groups (See Chapter 12). Hence, it would be necessary to use larger dosages of flocculent chemicals to remove the higher metals concentrations associated with these group 5 facilities. Therefore, in addition to the four O&M equations developed for DAF and modified DAF systems with flowrates above and below 20 gpm, EPA additionally developed four O&M equations for these group 5 facilities

Finally, similar to the labor requirements shown in table 11-16B, EPA based chemical usage cost estimates for the DAF and modified DAF systems assuming five days per week operation for facilities with flowrates greater than 20 gpm and from one to four days per week for facilities with flowrates of 5 to 20 gpm.

The eight equations relating the various types of O&M costs developed for DAF treatment for facilities with no DAF treatment in-place are presented in Table 11-17 at the end of this section.

For facilities with DAF treatment in-place, EPA estimated O&M upgrade costs. These facilities would need to improve pollutant removals from their current DAF current

performance concentrations to the Oils Option 8 and Option 9 long-term averages. As detailed in Chapter 12, EPA does not have current performance concentration data for the majority of the oils facilities with DAF treatment in-place. EPA does, however, have seven data sets which represent effluent concentrations from emulsion breaking/gravity separation. While the pollutant concentrations in wastewater exiting emulsion breaking/gravity separation treatment are higher (in some cases, considerably higher) than the pollutant concentrations in wastewater exiting DAF treatment, EPA has, nevertheless, used the emulsion breaking/gravity separation data sets to estimate DAF upgrade costs. For each of the seven emulsion breaking/gravity separation data sets, EPA calculated the percent difference between these concentrations and the Option 8 and Option 9 long-term averages. The median of these seven calculated percentages is 25 percent.

Therefore, EPA estimated the energy, labor, and chemical cost components of the O&M upgrade cost as 25 percent of the full O&M cost of a new system. EPA assumed that maintenance, and taxes and insurance would be zero since they are functions of the capital cost (that is, there is no capital cost for the upgrade). EPA developed two separate O&M upgrade cost equations for facilities which currently have DAF treatment in place -- one for facilities with flowrates up to 20 gpm and one for facilities with flow rates greater than 20 gpm. Similarly, EPA developed two separate O&M upgrade equations -- one for facilities which currently have DAF treatment in-place and were assigned Group 5 concentrations in the first step of EPA's current performance modeling procedure and one for facilities which currently have DAF treatment in-place and were assigned concentrations from one of the other six groups in the first step of EPA's current performance modeling procedure. The four equations representing O&M upgrade costs for facilities with DAF treatment in-place are

presented in Table 11-17.

Table 11-17. Cost Equations for *Dissolved Air Flotation (DAF)* in Oils Options 8 and 9

Description	Equation	Recommended Flow Rate Range (MGD)
Total capital cost for DAF	$\ln(Y1) = 13.9518 + 0.29445\ln(X) - 0.12049(\ln(X))^2$	0.036 to 1.44
Total capital cost for modified DAF	$\ln(Y1) = 13.509 + 0.29445\ln(X) - 0.12049(\ln(X))^2$	0.036 to 1.44
Holding tank capital cost for DAF and modified DAF ¹	$\ln(Y1) = 13.4616 + 0.54421\ln(X) + 0.00003(\ln(X))^2$	5.0 E -4 to 0.05
O&M cost for DAF with flowrate above 20 gpm	$\ln(Y2) = 14.5532 + 0.96495\ln(X) + 0.01219(\ln(X))^2$	0.036 to 1.44
O&M cost for modified DAF with flowrate above 20 gpm	$\ln(Y2) = 14.5396 + 0.97629\ln(X) + 0.01451(\ln(X))^2$	0.036 to 1.44
O&M cost for DAF with flowrate below 20 gpm	$\ln(Y2) = 21.2446 + 4.14823\ln(X) + 0.36585(\ln(X))^2$	7.2 E -3 to 0.029
O&M cost for modified DAF with flowrate below 20 gpm	$\ln(Y2) = 21.2005 + 4.07449\ln(X) + 0.34557(\ln(X))^2$	7.2 E -3 to 0.029
O&M cost for group 5, DAF with flowrate above 20 gpm	$\ln(Y2) = 14.8255 + 0.9741\ln(X) + 0.01005(\ln(X))^2$	0.036 to 1.44
O&M cost for group 5, modified DAF with flowrate above 20 gpm	$\ln(Y2) = 14.8151 + 0.98286\ln(X) + 0.01176(\ln(X))^2$	0.036 to 1.44
O&M cost for group 5, DAF with flowrate below 20 gpm	$\ln(Y2) = 21.8136 + 4.25239\ln(X) + 0.36592(\ln(X))^2$	7.2 E -3 to 0.029
O&M cost for group 5, modified DAF with flowrate below 20 gpm	$\ln(Y2) = 21.6503 + 4.11939\ln(X) + 0.33896(\ln(X))^2$	7.2 E -3 to 0.029
O&M <i>upgrade</i> for DAF with flowrate below 20 gpm	$\ln(Y2) = 19.0459 + 3.5588\ln(X) + 0.25553(\ln(X))^2$	7.2 E -3 to 0.029
O&M <i>upgrade</i> for DAF with flowrate above 20 gpm	$\ln(Y2) = 13.1281 + 0.99778\ln(X) + 0.01892(\ln(X))^2$	0.036 to 1.44
O&M <i>upgrade</i> for group 5, DAF with flowrate below 20 gpm	$\ln(Y2) = 19.2932 + 3.50923\ln(X) + 0.23946(\ln(X))^2$	7.2 E -3 to 0.029
O&M <i>upgrade</i> for group 5, DAF with flowrate above 20 gpm	$\ln(Y2) = 13.4098 + 0.99925\ln(X) + 0.01496(\ln(X))^2$	0.036 to 1.44
Land required for holding tank ¹	$\ln(Y3) = -1.5772 + 0.35955\ln(X) + 0.02013(\ln(X))^2$	5.0 E -4 to 0.05
Land required for DAF and modified DAF	$\ln(Y3) = -0.5107 + 0.51217\ln(X) - 0.01892(\ln(X))^2$	0.036 to 1.44

Y1 = Capital Costs (1989 \$)

Y2 = Operation and Maintenance Costs (1989 \$ /year)

Y3 = Land Requirement (Acres)

X = Flow Rate (million gallons per day)

¹Only facilities with flow rates below 20 gpm receive holding tank costs.**BIOLOGICAL WASTEWATER****TREATMENT TECHNOLOGY COSTS****11.3****Sequencing Batch Reactors****11.3.1**

A sequencing batch reactor (SBR) is a suspended growth system in which wastewater is mixed with retained biological floc in an aeration basin. SBR's are unique in that a single tank acts as an equalization tank, an aeration tank, and a clarifier.

The SBR system costed by EPA for the

model technology consists of a SBR tank, sludge handling equipment, feed system and controls, pumps, piping, blowers, and valves. The design parameters that EPA used for the SBR system were the average influent and effluent BOD₅, ammonia, and nitrate-nitrite concentrations. The average influent concentrations were 4800 mg/L, 995 mg/L, and 46 mg/L for BOD₅, ammonia, and nitrate-nitrite, respectively. The average effluent BOD₅, ammonia, and nitrate-nitrite

concentrations used were 1,600 mg/l, 615 mg/l, and 1.0 mg/l, respectively. EPA obtained these concentrations from the sampling data at the SBR model facility. EPA assumed that all existing biological treatment systems in-place at organics subcategory facilities can meet the limitations of this proposal without incurring cost. This includes facilities which utilize any form of biological treatment -- not just SBRs. Therefore, the costs presented here only apply to facilities without biological treatment in-place. EPA did not develop SBR upgrade costs for either capital or O&M.

CAPITAL COSTS

EPA estimated the capital costs for the SBR systems using vendor quotes which include installation costs. The SBR capital cost equation is presented in Table 11-18 at the end of this section.

OPERATION AND MAINTENANCE COSTS

The O&M costs for the SBR system include electricity, maintenance, labor, and taxes and insurance. No chemicals are utilized in the SBR system. EPA assumed the labor requirements for the SBR system to be four hours per day and based electricity costs on horsepower requirements. EPA obtained the labor and horsepower requirements from vendors. EPA estimated maintenance, taxes, and insurance using the factors detailed in Table 11-2. The SBR O&M cost equation is presented in Table 11-18.

Table 11-18. Cost Equations for *Sequencing Batch Reactors*

Description	Equation	Recommended Flow Rate Range(MGD)
Capital cost for sequencing batch reactors	$\ln(Y1) = 15.707 + 0.512\ln(X) + 0.0022(\ln(X))^2$	1.0 E -7 to 1.0
O&M cost for sequencing batch reactors	$\ln(Y2) = 13.139 + 0.562\ln(X) + 0.020(\ln(X))^2$	3.4 E -7 to 1.0
Land requirements	$\ln(Y3) = -0.531 + 0.906\ln(X) + 0.072(\ln(X))^2$	1.9 E -3 to 1.0

Y1 = Capital Costs (1989 \$)

Y2 = Operation and Maintenance Costs (1989 \$ /year)

Y3 = Land Requirement (Acres)

X = Flow Rate (million gallons per day)

SLUDGE TREATMENT AND

DISPOSAL COSTS

11.4

Plate and Frame Pressure

Filtration -- Sludge Stream

11.4.1

Pressure filtration systems are used for the removal of solids from waste streams. This section details *sludge stream* filtration which is used to treat the solids removed by the clarifiers

in the metals options.

The pressure filtration system costed by EPA for sludge stream filtration consists of a plate and frame filtration system. The components of the plate and frame filtration system include: filter plates, filter cloth, hydraulic pumps, pneumatic booster pumps, control panel, connector pipes, and a support platform. For design purposes,

EPA assumed the sludge stream to consist of 80 percent liquid and 20 percent (200,000 mg/l) solids. EPA additionally assumed the sludge stream to be 20 percent of the total volume of wastewater treated. EPA based these design parameters on CWT Questionnaire 105.

In costing for sludge stream treatment, if a facility does not have sludge filtration systems in-place, EPA estimated capital costs to add a plate and frame pressure filtration system to their on-site treatment train². If a facility's treatment train includes more than one clarification step in its treatment train (such as for Metals Option 3), EPA only costed the facility for a single plate and frame filtration system. EPA assumed one plate and frame filtration system could be used to process the sludge from multiple clarifiers. Likewise, if a facility already had a sludge filtration system in-place, EPA assumed that the in-place system would be sufficient and did not estimate any sludge filtration capital costs for these facilities.

CAPITAL COSTS

EPA developed the capital cost equation for plate and frame sludge filtration by adding installation, engineering, and contingency costs to vendors' equipment cost estimates. EPA used the same capital cost equation for the plate and frame sludge filtration system for all of the metals options. The plate and frame sludge filtration system capital cost equation is presented in Table 11-19.

²If a facility only had to be costed for a plate and frame pressure filtration system to process the sludge produced during the tertiary chemical precipitation and clarifications steps of metals Option 3, EPA did not cost the facility for a plate and frame pressure filtration system. Likewise, EPA assumed no O&M costs associated with the treatment of sludge from the tertiary chemical precipitation and clarification steps in Metals Option 3. EPA assumed that the total suspended solids concentration at this point is so low that sludge stream filtration is unnecessary.

OPERATION AND MAINTENANCE COSTS

METALS OPTION 2 AND 3

The operation and maintenance costs for metals option 2 and 3 plate and frame sludge filtration consist of labor, electricity, maintenance, and taxes and insurance. EPA approximated the labor requirements for the plate and frame sludge filtration system to be thirty minutes per batch based on the Metals Option 2 and 3 model facility. Because no chemicals are used with the plate and frame sludge filtration units, EPA did not include costs for chemicals. EPA estimated electricity, maintenance, and taxes and insurance using the factors listed in Table 11-2. The resulting plate and frame sludge filtration O&M cost equation is listed in Table 11-19.

For facilities which already have a sludge filtration system in-place, EPA included plate and frame filtration O&M upgrade costs. Since the sludge generated from the secondary precipitation and clarification steps in metals option 2 and 3 is the sludge which requires treatment for these options, these facilities would be required to improve pollutant removals from their secondary precipitation current performance concentrations to the long term averages for Metals Options 2. Therefore, EPA calculated the percent difference between secondary precipitation current performance and the Metals Option 2 long-term averages. EPA determined this percentage to be an increase of three percent.

As such, for facilities which currently have sludge filtration systems in place, for metals option 2 and 3, EPA included an O&M upgrade cost which is three percent of the O&M costs of a new system (except for taxes and insurance, which are a function of the capital cost). The O&M upgrade cost equation for sludge filtration in Metals Option 2 and Option 3 is presented in Table 11.19.

OPERATION AND MAINTENANCE COSTS

METALS OPTION 4

The operation and maintenance costs for

metals option 4 consists of labor, chemical usage, electricity, maintenance, taxes, and insurance, and filter cake disposal. The O&M plate and frame sludge filtration costing methodology For Metals Option 4 is very similar to the one discussed previously for Metals Option 2 and 3. The primary differences in the methodologies are the estimation of labor, the inclusion of filter cake disposal, and the O&M upgrade methodology.

EPA approximated the labor requirement for Metals Option 4 plate and frame sludge filtration systems at 2 to 8 hours per day depending on the

size of the system. As was the case for metals option 2 and 3, no chemicals are used in the plate and frame sludge filtration units for metals Option 4, and EPA estimated electricity, maintenance and taxes and insurance using the factors listed in Table 11-2. EPA also included filter cake disposal costs at \$0.74 per gallon of filter cake. A detailed discussion of the basis for the filter cake disposal costs is presented in Section 11.4.2. The O&M cost equation for sludge filtration for Metals Option 4 is presented in Table 11-19.

Table 11-19. Cost Equations for *Plate and Frame Sludge Filtration* in Metals Option 2, 3 and 4

Description	Equation	Recommended Flow Rate Range (MGD)
Capital costs for plate and frame sludge filtration	$\ln(Y1) = 14.827 + 1.087\ln(X) + 0.0050(\ln(X))^2$	2.0 E -5 to 1.0
O&M costs for sludge filtration for Metals Option 2 and 3 ^{1,3}	$\ln(Y2) = 12.239 + 0.388\ln(X) + 0.016(\ln(X))^2$	2.0 E -5 to 1.0
O&M costs for sludge filtration for Metals Option 4 ⁴	$\ln(Y2) = 15.9321 + 1.177\ln(X) + 0.04697(\ln(X))^2$	1.0 E -5 to 1.0
O&M <i>upgrade</i> costs for sludge filtration for Metals Option 2,3 ^{1,3}	$\ln(Y2) = 8.499 + 0.331\ln(X) + 0.013(\ln(X))^2$	2.0 E -5 to 1.0
O&M <i>upgrade</i> cost for sludge filtration for Metals Option 4 ⁴	$\ln(Y2) = 12.014 + 1.17846\ln(X) + 0.050(\ln(X))^2$	1.0 E -5 to 1.0
Land requirements for sludge filtration	$\ln(Y3) = -1.971 + 0.281\ln(X) + 0.018(\ln(X))^2$	1.8 E -3 to 1.0

Y1 = Capital Costs (1989 \$)

Y2 = Operation and Maintenance Costs (1989 \$ /year)

Y3 = Land Requirement (Acres)

X = Flow Rate (million gallons per day)

¹Following secondary chemical precipitation/clarification only. EPA assumed the sludge generated from tertiary precipitation/clarification would not produce a significant quantity of sludge.

³This equation does not include filter cake disposal costs.

⁴This equation includes filter cake disposal costs.

For facilities which already have a sludge filtration system in-place, EPA included sludge stream filtration O&M upgrade costs. For Metals Option 4, EPA included these O&M upgrade costs for processing the sludge generated from the primary precipitation and clarification steps³. These facilities would need to improve pollutant removals from their primary precipitation current performance concentrations to Metals Option 4 (Sample Point-03) concentrations. This sample point represents the effluent from the liquid-solids separation unit following primary chemical precipitation at the Metals Option 4 model facility. Therefore, EPA calculated the percent difference between primary precipitation current performance concentrations and Metals Option 4 (Sample Point 03) concentrations. EPA determined that there was an increase of two percent.

As such, for facilities which currently have sludge filtration systems in place, for metals option 4, EPA included an O&M cost upgrade of two percent of the total O&M costs (except for taxes and insurance, which are a function of the capital cost). The O&M upgrade cost equation for sludge filtration for Metals Option is presented in Table 11-19.

Filter Cake Disposal

11.4.2

The liquid stream and sludge stream pressure filtration systems presented in Sections 11.2.3 and 11.4.1, respectively, generate a filter cake residual. There is an annual O&M cost that is associated with the disposal of this residual. This cost must be added to the pressure filtration equipment O&M costs to arrive at the total O&M

costs for pressure filtration operation⁴.

To determine the cost of transporting and disposing filter cake to an off-site facility, EPA performed an analysis on a subset of questionnaire respondents in the WTI Questionnaire response database. This subset consists of metals subcategory facilities that are direct and/or indirect dischargers and that provided information on contract haul and disposal cost to hazardous (Subtitle C) and non-hazardous (Subtitle D) landfills. From this set of responses, EPA tabulated two sets of costs -- those reported for Subtitle C contract haul and disposal and those reported for Subtitle D contract haul and disposal. the reported costs for both the Subtitle C and Subtitle D contract haul/disposal. EPA then edited this information by excluding data that was incomplete or that was not separated by RCRA classification.

EPA used the reported costs information in this data set to determine the median cost for both the Subtitle C and Subtitle D disposal options, and then calculated the weighted average of these median costs. The average was weighted to reflect the ratio of hazardous (67 percent) to nonhazardous (33 percent) waste receipts at these Metals Subcategory facilities. The final disposal cost is \$0.74 per gallon of filter cake.

EPA calculated a single disposal cost for filter cake using both hazardous and non-hazardous landfilling costs. Certain facilities will incur costs, however, that, in reality, are higher and others will incur costs that, in reality, are lower. Thus, some low revenue metals subcategory facilities that generate non-hazardous sludge may show a higher economic burden than is representative. On the other hand, some low revenue metals subcategory facilities that generate hazardous sludge may show a lower

³ EPA did not include O&M upgrade costs for the sludge generated from the secondary precipitation and clarification step (direct dischargers only).

⁴Note that these costs have already been included in the O&M equation for plate and frame sludge filtration for Metals Option 4.

economic burden than is representative. EPA has concluded that in the end, these over- and under estimates will balance out to provide a representative cost across the industry.

The O&M cost equation for filter cake disposal for Metals Option 2 and Option 3 is presented in Table 11-20. Table 11-20 additionally presents an O&M upgrade for filter cake disposal resulting from Metals Option 2 and

Option 3 for facilities that already generate filter cake as part of their operation.

This upgrade is 3 percent of the cost of the O&M upgrade for facilities that do not already generate filter cake as a part of their operation. EPA used 3 percent because this was the same percentage calculated for plate and frame sludge filtration for these same options.

Table 11-20. Cost Equations for *Filter Cake Disposal* for Metals Options 2 and 3¹

Description	Equation	Recommended Flow Rate Range (GPM)
O & M cost for filter cake disposal	$Z = 0.109169 + 7,695,499.8(X)$	1.0 E -6 to 1.0
O & M <i>upgrade</i> for filter cake disposal	$Z = 0.101186 + 230,879.8(X)$	1.0 E -6 to 1.0

Z = Filter Cake Disposal Cost (1989 \$ / year)

X = Flow Rate (million gallons per day)

¹Filter cake disposal costs for Metals Option 4 are included in the sludge filtration equations.

ADDITIONAL COSTS

Retrofit Costs

11.5

11.5.1

EPA assigned costs to the CWT Industry on both an option- and facility-specific basis. The option-specific approach estimated compliance cost for a sequence of individual treatment technologies, corresponding to a particular regulatory option, for a subset of facilities defined as belonging to that regulatory subcategory. Within the costing of a specific regulatory option, EPA assigned treatment technology costs on a facility-specific basis depending upon the technologies determined to be currently in-place at the facility.

Once EPA determined that a treatment technology cost should be assigned to a particular facility, EPA considered two scenarios. The first was the installation of a new individual treatment technology as a part of a new treatment train. The full capital costs presented in Subsections 11.2 through 11.4 of this document apply to this

scenario. The second scenario was the installation of a new individual treatment technology which would have to be integrated into an existing in-place treatment train. For these facilities, EPA applied retrofit costs. These retrofit costs cover such items as piping and structural modifications which would be required in an existing piece of equipment to accommodate the installation of a new piece of equipment prior to or within an existing treatment train.

For all facilities which received retrofit costs, EPA added a retrofit factor of 20 percent of the total capital cost of the newly-installed or upgraded treatment technology unit that would need to be integrated into an existing treatment train. These costs are in addition to the specific treatment technology capital costs calculated with the technology specific equations described in earlier sections.

Monitoring Costs**11.5.2**

CWT facilities that discharge process wastewater directly to a receiving stream or indirectly to a POTW will have monitoring costs. EPA regulations require both direct discharge with NPDES permits and indirect dischargers subject to categorical pretreatment standards to monitor their effluent.

EPA used the following generalizations to estimate the CWT monitoring costs:

1. EPA included analytical cost for parameters at each subcategory as follows:

- TSS, O&G, Cr+6, total CN, and full metals analyses for the metals subcategory direct dischargers, and Cr+6, total CN, and full metals analyses for the metals subcategory indirect dischargers;
- TSS, O&G, and full metals and semi-volatiles analyses for the oils subcategory option 8 and 9 direct dischargers, and full metals, and semi-volatiles for oils subcategory options 8 and 9 indirect dischargers;

- TSS, O&G, and full metals, volatiles and semi-volatiles analyses for the oils subcategory direct dischargers, and full metals, volatiles, and semi-volatiles for oils subcategory option 8V and 9V indirect dischargers;
- TSS, BOD₅, O&G, 6 individual metals, volatiles, and semi-volatiles analyses for the organics subcategory option 3 direct dischargers, and 6 individual metals, volatiles, and semi-volatiles analyses for the organics subcategory option 3 indirect dischargers; and
- TSS, BOD₅, O&G, 6 individual metals, and semi-volatiles analyses for the organics subcategory option 4 direct dischargers, and 6 individual metals and semi-volatiles analyses for the organics subcategory option 4 indirect dischargers.

EPA notes that these analytical costs may be overstated for the oils and the organics subcategories because EPA's final list of pollutants proposed for regulation for these subcategories do not include all of the parameters included above.

2. The monitoring frequencies are listed in Table 11-21 and are as follows:

Table 11-21. Monitoring Frequency Requirements

Parameter	Monitoring Frequency (samples/month)		
	Metals Subcategory	Oils Subcategory	Organics Subcategory
Conventionals*	20	20	20
Total Cyanide and Cr+6	20	-	-
Metals	20	4	4
Semi-Volatile Organics	-	4	4
Volatile Organics	-	4**	4**

*Conventional monitoring for direct dischargers only.

**Volatile organics monitoring for oils option 8V and 9V and organics option 3 only.

3. For facilities in multiple subcategories, EPA applied full multiple, subcategory-specific monitoring costs.
4. EPA based the monitoring costs on the number of outfalls through which process wastewater is discharged. EPA multiplied the cost for a single outfall by the number of outfalls to arrive at the total costs for a facility. For facilities for which this information is not available, EPA assumed a single outfall per facility.
5. EPA did not base monitoring costs on flow rate.
6. EPA did not include sample collection costs (labor and equipment) and sample shipping costs, and
7. The monitoring cost (based on frequency and analytical methods) are incremental to the monitoring currently being incurred by the CWT Industry. EPA applied credit to facilities for current monitoring-in-place (MIP). For facilities where actual monitoring frequencies are unknown, EPA estimated monitoring frequencies based on other subcategory facilities with known monitoring frequencies.

The cost of the analyses needed to determine compliance for the CWT pollutants are shown below in Table 11-22. EPA obtained these costs from actual quotes given by vendors and converted to 1989 dollars using the ENR's Construction Cost Index.

Table 11-22. Analytical Cost Estimates

Analyses	Cost (\$1989)
BOD ₅	\$20
TSS	\$10
O&G	\$32
Cr+6	\$20
Total CN	\$30
Metals:	\$335
Total (27 Metals)	\$335
Per Metal ¹	\$35
Volatile Organics (method 1624) ²	\$285
Semi-volatile Organics (method 1625) ²	\$615

¹For 10 or more metals, use the full metals analysis cost of \$335.

²There is no incremental cost per compound for methods 1624 and 1625 (although there may be a slight savings if the entire scan does not have to be reported). Use the full method cost, regardless of the actual number of constituent parameters required.

RCRA Permit Modification Costs 11.5.3

Respondents to the WTI Questionnaire who indicated that their RCRA Part B permits were modified were asked to report the following information pertaining to the cost of obtaining the modification:

- Legal fees;
- Administrative costs;
- Public relations costs;
- Other costs; and
- Total costs.

EPA also requested the reason for the permit modification. Table 11-23 lists the RCRA permit modification costs reported for installation of new units, installation of new technology, and modifications to existing equipment. As shown, the average cost for these permit modifications is \$31,400. EPA anticipates that many CWT facilities with RCRA Part B permits will be

required to modify their permits to include the upgrade of existing equipment and/or the installation of new treatment technologies to

achieve the proposed CWT effluent limitations and standards. Therefore, for all RCRA B facilities, EPA additionally included a one-time cost of \$31,400 to modify their permit.

Table 11-23. RCRA Permit Modification Costs Reported in WTI Questionnaire

Modification	QID	Year	Total Cost (reported \$)	Total Cost (1989 \$)
New Units	081	1990	26,000	25,357
	255	1990	7,000	6,827
New Technology	081	1990	82,000	79,793
	090	1990	6,300,000*	6,144,231*
Modify Existing Equipment	402	1991	14,080	13,440
Average	-	-	-	31,400

* This cost includes equipment and installation costs; no cost breakdown is given. Therefore, this data was not used in calculating the average cost.

Land Costs

11.5.4

An important factor in the calculation of treatment technology costs is the value of the land needed for the installation of the technology. To determine the amount of land required for costing purposes, EPA calculated the land requirements for each treatment technology for the range of system sizes. EPA fit these land requirements to a curve and calculated land requirements, in acres, for every treatment system costed. EPA then multiplied the individual land requirements by the corresponding state land cost estimates to obtain facility-specific cost estimates.

EPA used different land cost estimates for each state rather than a single nationwide average since land costs may vary widely across the country. To estimate land costs for each state, EPA obtained average land costs for suburban sites for each state from the 1990 Guide to Industrial and Real Estate Office Markets survey.

EPA based these land costs on “unimproved sites” since, according to the survey, they are the most desirable.

The survey additionally provides land costs broken down by size ranges. These are zero to 10 acres, 10 to 100 acres, and greater than 100 acres. Since CWT facilities fall into all three size ranges (based on responses to the WTI Questionnaire), EPA averaged the three size-specific land costs for each state to arrive at the final land costs for each state.

The survey did not provide land cost estimates for Alaska, Idaho, Montana, North Dakota, Rhode Island, South Dakota, Utah, Vermont or West Virginia. For these states, EPA used regional averages of land costs. EPA determined the states comprising each region also based on the aforementioned survey since the survey categorizes the states by geographical region (northeast, north central, south, and west). In estimating the regional average costs for the

western region, EPA did not include Hawaii since Hawaii's land cost is high and would have skewed the regional average.

Table 11-24 lists the land cost per acre for each state. As Table 11-24 indicates, the least expensive state is Kansas with a land cost of \$7,042 per acre and the most expensive state is Hawaii with a land cost of \$1,089,000 per acre.

Table 11-24. State Land Costs for the CWT Industry Cost Exercise

State	Land Cost per Acre (1989 \$)	State	Land Cost per Acre (1989 \$)
Alabama	22,773	Nebraska	24,684
Alaska*	81,105	Nevada	36,300
Arizona	46,101	New Hampshire	52,998
Arkansas	15,899	New Jersey	89,443
California	300,927	New Mexico	26,929
Colorado	43,560	New York	110,013
Connecticut	54,232	North Carolina	33,880
Delaware	54,450	North Dakota*	20,488
Florida	63,273	Ohio	14,578
Georgia	72,600	Oklahoma	24,321
Hawaii	1,089,000	Oregon	50,820
Idaho*	81,105	Pennsylvania	32,307
Illinois	36,300	Rhode Island*	59,822
Indiana	21,078	South Carolina	21,296
Iowa	8,954	South Dakota*	20,488
Kansas	7,042	Tennessee	20,873
Kentucky	29,040	Texas	47,674
Louisiana	56,628	Utah*	81,105
Maine	19,602	Vermont*	59,822
Maryland	112,530	Virginia	39,930
Massachusetts	59,895	Washington	63,670
Michigan	13,649	West Virginia*	47,345
Minnesota	21,054	Wisconsin	17,424
Mississippi	13,068	Wyoming*	81,105
Missouri	39,930	Washington DC	174,240
Montana*	81,105		

* No data available for state, used regional average.

EXAMPLE 11-1:

Costing exercise for direct discharging metals subcategory facility with treatment in-place.

Example Facility Information:

Current Treatment In-Place:

Primary Chemical Precipitation + Clarification + Plate and Frame Sludge Filtration

Daily Flow = 0.12196 MGD (Million Gallons/Day)

[NOTE: Daily Flow = X in costing equations]

Treatment Upgrades To Be Costed:

Primary Chemical Precipitation Upgrade + Clarifier Upgrade + Sludge Filtration Upgrade

Full Treatment Technologies To Be Costed:

Secondary Chemical Precipitation + Secondary Clarification + Multimedia Filtration

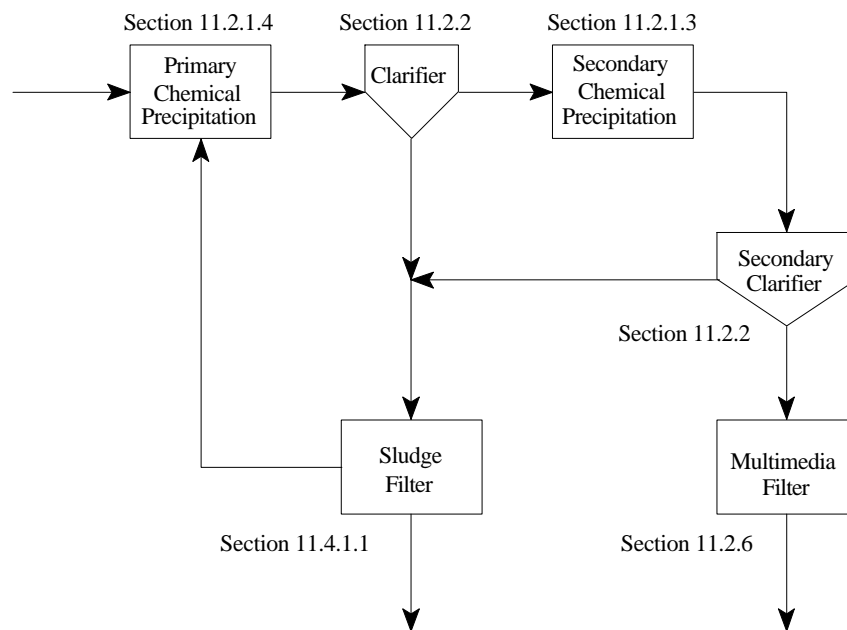


Figure 11-1. Metals Option 4 Model Facility Diagram

EXAMPLE 11-1, CONTINUED:**Capital Costs:**

- Primary chemical precipitation *upgrade*, from Table 11-7, Section 11.2.1.4.
The maximum size holding tank to be costed for a primary chemical precip. *upgrade* is 0.005 MGD. In addition, there is a 20% retrofit cost for the *upgrade*.

$$\begin{aligned}\ln(Y1) &= 10.671 - 0.083*\ln(X) - 0.032*(\ln(X))^2 \\ &= 10.671 - 0.083*\ln(0.005) - 0.032*(\ln(0.005))^2 \\ &= 10.212\end{aligned}$$

$$\therefore Y1 = \$27,240.25 * 1.2 = \$32,688.30 \blacklozenge$$

- Clarification capital cost *upgrade*, following primary precipitation = \$0.00 \blacklozenge
- Sludge filtration capital cost *upgrade* = \$0.00 \blacklozenge
- Secondary chemical precipitation, full capital costs, from Table 11-8, Section 11.2.1.5

$$\begin{aligned}\ln(Y1) &= 13.829 + 0.544*\ln(X) + 4.96E-6*(\ln(X))^2 \\ &= 12.68441\end{aligned}$$

$$\therefore Y1 = \$322,678.63 \blacklozenge$$

- Clarification, following secondary chemical precipitation, from Table 11-9, Section 11.2.2.2

$$\begin{aligned}\ln(Y1) &= 11.552 + 0.409*\ln(X) + 0.020*(\ln(X))^2 \\ &= 10.77998\end{aligned}$$

$$\therefore Y1 = \$48,049.17 \blacklozenge$$

- Multi-media filtration capital costs, from Table 11-13, Section 11.2.5

$$\begin{aligned}\ln(Y1) &= 12.0126 + 0.48025*\ln(X) + 0.04623*(\ln(X))^2 \\ &= 11.20679\end{aligned}$$

$$\therefore Y1 = \$73,628.54 \blacklozenge$$

- Total capital cost (TCC)

$$TCC = \sum (\text{Individual Capital Costs})$$

$$\therefore TCC = \$477,045 \blacksquare$$

EXAMPLE 11-1, CONTINUED:**Operation and Maintenance Costs:**

- Primary chemical precip. O&M *upgrade*, from Table 11-7, Section 11.2.1.4

$$\begin{aligned}\ln(Y2) &= 11.4547 + 1.04337 \cdot \ln(X) + 0.04575 \cdot (\ln(X))^2 \\ &= 11.4547 + 1.04337 \cdot \ln(0.12196) + 0.04575 \cdot (\ln(0.12196))^2 \\ &= 9.46192\end{aligned}$$

$$\therefore Y2 = \$12,860.60 \blacklozenge$$

- Clarification O&M *upgrade*, following primary chemical precipitation, from Table 11-9, Section 11.2.2

$$\begin{aligned}\ln(Y2) &= 6.81347 + 0.33149 \cdot \ln(X) + 0.0242 \cdot (\ln(X))^2 \\ &= 6.22313\end{aligned}$$

$$\therefore Y2 = \$504.28 \blacklozenge$$

- Sludge filtration O&M *upgrade*, from Table 11-19, Section 11.4.1

$$\begin{aligned}\ln(Y2) &= 12.014 + 1.17846 \cdot \ln(X) + 0.05026 \cdot (\ln(X))^2 \\ &= 9.75695\end{aligned}$$

$$\therefore Y2 = \$17,273.90 \blacklozenge \text{ (which includes filter cake disposal costs)}$$

- Secondary chemical precip. O&M costs, from Table 11-8, Section 11.2.1.5

$$\begin{aligned}\ln(Y2) &= 12.076 + 0.63456 \cdot \ln(X) + 0.03678 \cdot (\ln(X))^2 \\ &= 10.9037\end{aligned}$$

$$\therefore Y2 = \$54,375.79 \blacklozenge$$

- Clarification O&M costs, following secondary chemical precipitation, from Table 11-9, Section 11.2.2.2

$$\begin{aligned}\ln(Y2) &= 10.673 + 0.238 \cdot \ln(X) + 0.013 \cdot (\ln(X))^2 \\ &= 10.22979\end{aligned}$$

$$\therefore Y2 = \$27,716.56 \blacklozenge$$

- Multimedia Filtration O&M Costs, from Table 11-13, Section 11.2.5

$$\begin{aligned}\ln(Y2) &= 11.5039 + 0.72458 \cdot \ln(X) + 0.09535 \cdot (\ln(X))^2 \\ &= 10.40146\end{aligned}$$

$$\therefore Y2 = \$32,907.65 \blacklozenge$$

- Total Operation and Maintenance Cost ($O\&M_{Tot}$)

$$O\&M_{Tot} = \sum (\text{Individual O\&M Costs})$$

$$\therefore O\&M_{Tot} = \$145,640 \blacksquare$$

EXAMPLE 11-1, CONTINUED:**Land Requirements:**

- Primary chemical precipitation *upgrade* land requirement associated with capital cost upgrade (Table 11-7, section 11.2.1.4). The maximum size holding tank to be costed for a primary chemical precipitation *upgrade* is 0.005 MGD.

$$\begin{aligned}\ln(Y3) &= -2.866 - 0.023\ln(X) - 0.006(\ln(X))^2 \\ &= -2.866 - 0.023\ln(0.005) - 0.006(\ln(0.005))^2 \\ &= -2.913\end{aligned}$$

$$\therefore Y3 = 0.054 \text{ acre } \blacklozenge$$

- Clarifier, following primary chemical precip., land requirement = 0.0 acre \blacklozenge
- Sludge filtration unit land requirement = 0.0 acre \blacklozenge
- Secondary chemical precipitation land requirement, from Table 11-8, Section 11.2.1.5

$$\begin{aligned}\ln(Y3) &= -1.15 + 0.449\ln(X) + 0.027(\ln(X))^2 \\ &= -1.975\end{aligned}$$

$$\therefore Y3 = 0.139 \text{ acre } \blacklozenge$$

- Clarification, following secondary chemical precipitation, land requirement, from Table 11-9, Section 11.2.2.2

$$\begin{aligned}\ln(Y3) &= -1.773 + 0.513\ln(X) + 0.046(\ln(X))^2 \\ &= -2.6487\end{aligned}$$

$$\therefore Y3 = 0.071 \text{ acre } \blacklozenge$$

- Multimedia filtration land requirement, from Table 11-13, Section 11.2.5

$$\begin{aligned}\ln(Y3) &= -2.6569 + 0.1937\ln(X) + 0.02496(\ln(X))^2 \\ &= -2.95396\end{aligned}$$

$$\therefore Y3 = 0.0521 \text{ acre } \blacklozenge$$

- Total land requirement (TLR)

$$\text{TLR} = \sum (\text{Individual Land Requirement})$$

$$\therefore \text{TLR} = \mathbf{0.316 \text{ acre } \blacksquare}$$

EXAMPLE 11-2:

Costing exercise for a direct discharging oils subcategory facility with only emulsion breaking/gravity separation in-place.

Example Facility Information:

Current Treatment In-Place:

Primary Emulsion Breaking/Gravity Separation

Daily Flow = 0.0081 MGD (Million Gallons/Day) [= 5.63 gpm]

[NOTE: Daily Flow = X in costing equations]

Treatment Upgrades To Be Costed:

None

Full Treatment Technologies To Be Costed:

Secondary Gravity Separation + Dissolved Air Flotation (DAF)

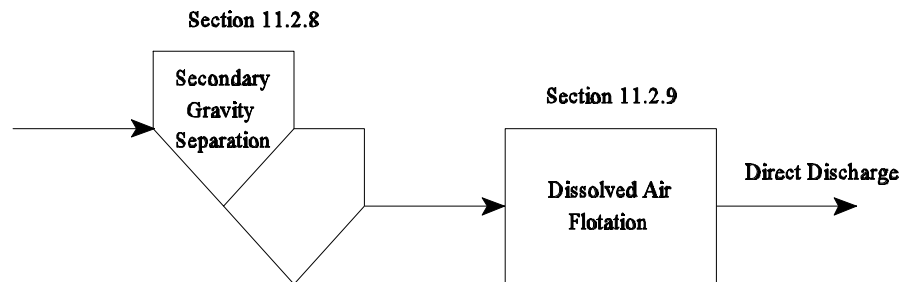


Figure 11-2. Treatment Diagram For Oils Option 9 Facility Improvements

EXAMPLE 11-2, CONTINUED:**Capital Costs:**

- Secondary gravity separation, from Table 11-15, Section 11.2.7

$$\begin{aligned}\ln(Y1) &= 14.3209 + 0.38774*\ln(X) - 0.01793*(\ln(X))^2 \\ &= 14.3209 - 0.38774*\ln(0.0081) - 0.01793*(\ln(0.0081))^2 \\ &= 12.0377\end{aligned}$$

$$\therefore Y1 = \$169,014.42 \blacklozenge$$

- Dissolved air flotation costs, from Table 11-17, Section 11.2.8

$$\begin{aligned}\ln(Y1) &= 13.9518 + 0.29445*\ln(X) - 0.12049*(\ln(X))^2 \\ &= 11.6415\end{aligned}$$

$$\therefore Y1 = \$113,720.41 \blacklozenge$$

- Holding tank for dissolved air flotation (flow < 20 gpm, hence holding tank is sized), from Table 11-17, Section 11.2.8

$$\begin{aligned}\ln(Y1) &= 13.4616 + 0.54421*\ln(X) + 0.00003*(\ln(X))^2 \\ &= 10.8414\end{aligned}$$

$$\therefore Y1 = \$51,094.88 \blacklozenge$$

- Total capital cost (TCC)

$$TCC = \sum (\text{Individual Capital Costs})$$

$$\therefore TCC = \$333,830 \blacksquare$$

EXAMPLE 11-2, CONTINUED:**Operation and Maintenance Costs:**

- Secondary gravity separation, from Table 11-15, Section 11.2.7

$$\begin{aligned}\ln(Y_2) &= 12.0759 + 0.4401 \cdot \ln(X) + 0.01594 \cdot (\ln(X))^2 \\ &= 12.0759 + 0.4401 \cdot \ln(0.0081) + 0.01594 \cdot (\ln(0.0081))^2 \\ &= 10.3261\end{aligned}$$

$$\therefore Y_2 = \$30,519.46 \blacklozenge$$

- Dissolved air flotation (flow < 20 gpm), from Table 11-17, Section 11.2.8

$$\begin{aligned}\ln(Y_2) &= 21.2446 + 4.14823 \cdot \ln(X) + 0.36585 \cdot (\ln(X))^2 \\ &= 9.7523\end{aligned}$$

$$\therefore Y_2 = \$17,193.12 \blacklozenge$$

- Total Operation and Maintenance Cost ($O\&M_{Tot}$)

$$O\&M_{Tot} = \sum (\text{Individual O\& M Costs})$$

$$\therefore O\&M_{Tot} = \mathbf{\$47,713 \blacksquare}$$

EXAMPLE 11-2, CONTINUED:**Land Requirements:**

- Secondary gravity separation, Table 11-15, Section 11.2.7

$$\begin{aligned}\ln(Y3) &= -0.2869 + 0.31387*\ln(X) + 0.01191*(\ln(X))^2 \\ &= -0.2869 + 0.31387*\ln(0.0081) + 0.01191*(\ln(0.0081))^2 \\ &= -1.5222\end{aligned}$$

$$\therefore Y3 = 0.218 \text{ acre } \blacklozenge$$

- Dissolved air flotation (sized at 25 gpm, the minimum available), from Table 11-17, Section 11.2.8

$$\begin{aligned}\ln(Y3) &= -0.5107 + 0.51217*\ln(X) - 0.01892*(\ln(X))^2 \\ &= -2.4224\end{aligned}$$

$$\therefore Y3 = 0.089 \text{ acre } \blacklozenge$$

- Holding tank, from Table 11-17, Section 11.2.8

$$\begin{aligned}\ln(Y3) &= -1.5772 + 0.35955*\ln(X) + 0.02013*(\ln(X))^2 \\ &= -2.8419\end{aligned}$$

$$\therefore Y3 = 0.058 \text{ acre } \blacklozenge$$

- Total land requirement (TLR)

$$TLR = \sum (\text{Individual Land Requirement})$$

$$\therefore TLR = \mathbf{0.365 \text{ acre } \blacksquare}$$

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11.6

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**SUMMARY OF COST OF
TECHNOLOGY OPTIONS****11.7**

This section summarizes the estimated capital and annual O&M expenditures for CWT facilities to achieve each of the proposed effluent limitations and standards. All cost estimates in this section are expressed in terms of 1997 dollars.

BPT Costs**11.7.1**

BPT costs apply to all CWT facilities that discharge wastewater to surface waters (direct dischargers). Table 11-25 summarizes, by subcategory, the total capital expenditures and annual O&M costs for implementing BPT.

Table 11-25. Cost of Implementing BPT Regulations [in 1997 dollars]

Subcategory	Number of Facilities ¹	Total Capital Costs	Annual O&M Costs
Metals Treatment and Recovery	9	3,069,500	1,532,100
Oils Treatment and Recovery	5	931,600	176,700
Organics Treatment	4	75,600	59,600
Combined Regulatory Option	14	4,076,700	1,768,500

¹There are 14 direct dischargers. Because some direct dischargers include operations in more than one subcategory, the sum of the facilities with operations in any one subcategory exceeds the total number of facilities.

EPA notes that this BPT cost summary does not include the additional capital costs of the second clarifier that may be associated with the transferred TSS limitations for the metals subcategory. EPA will re-visit its BPT costs estimates for this subcategory prior to promulgation.

BCT/BAT Costs**11.7.2**

The Agency estimated that there would be no incremental cost of compliance for implementing BCT/BAT, because the technology used to develop

BCT/BAT limitations is identical to BPT and the costs are included with BPT.

PSES Costs**11.7.3**

The Agency estimated the cost for implementing PSES applying the same assumptions and methodology used to estimate cost of implementing BPT. The major difference is that the PSES costs are applied to all CWT facilities that discharge wastewater to a POTW (indirect dischargers). Table 11-26 summarizes, by subcategory, the capital expenditures and annual O&M costs for implementing PSES.

Table 11-26. Cost of Implementing PSES Regulations [in of 1997 dollars]

Subcategory	Number of Facilities ¹	Total Capital Costs	Annual O&M Costs
Metals Treatment and Recovery	41	7,209,100	2,822,500
Oils Treatment and Recovery -	123	17,778,400	6,531,900
Organics Treatment	14	11,084,600	1,149,900
Combined Regulatory Option	147	36,072,000	10,505,400

¹There are 147 indirect dischargers. Because some indirect dischargers include operations in more than one subcategory, the sum of the facilities with operations in any one subcategory exceeds the total number of facilities.

POLLUTANT LOADING AND REMOVAL ESTIMATES

INTRODUCTION

12.1

This chapter presents annual pollutant loading and removal estimates for the CWT industry associated with each of the subcategories and regulatory options considered by EPA in developing the proposed effluent limitations and pretreatment standards. EPA estimated the pollutant loadings and removals from CWT facilities to evaluate the effectiveness of different treatment technologies and to evaluate how costly these regulatory options were in terms of pollutant removals. EPA also used this information in analyzing potential benefits from the removal of pollutants discharged to surface waters directly or indirectly through publicly owned treatment works (POTWs). EPA estimated raw, current, and post-compliance pollutant loadings and pollutant removals for the industry using data collected from the industry throughout development of the proposed rule. This assessment uses the following definitions for raw, current, and post-compliance pollutant loadings:

- Raw loadings -- For the metals and organics subcategory, raw loadings represent CWT waste receipts, that is, typically untreated wastewater as received from customers. For the oils subcategory, raw loadings represent the effluent from the initial processing of oil bearing, CWT waste receipts, that is, effluent from emulsion breaking and/or gravity separation.
- Current loadings -- These are the pollutant loadings in CWT wastewater that are currently being discharged to POTWs and surface waters. These loadings account for

wastewater treatment currently in place at CWTs.

- Post-compliance loadings -- These are the pollutant loadings in CWT wastewater that would be discharged to POTWs and surface waters if the proposed rule is promulgated. EPA calculated these loadings assuming that all CWTs would achieve treatment at least equivalent to that which may be achieved by employing the technology option selected as the basis of the limitations or standards.

The following information is presented in this chapter:

- Section 12.2 summarizes the data sources used to estimate pollutant loadings and removals;
- Section 12.3 discusses the methodology used to estimate current loadings;
- Section 12.4 discusses the methodology used to estimate post-compliance pollutant loadings;
- Section 12.5 discusses the methodology used to estimate pollutant removals;
- Section 12.6 presents the pollutant loadings and removals for each regulatory option, including current and post-compliance pollutant loadings.

DATA SOURCES

12.2

As previously explained in Chapter 2, EPA primarily relied on three data sources to estimate pollutant loadings and removals: industry responses to the 1991 Waste Treatment Industry Questionnaire, industry responses to the Detailed Monitoring Questionnaire, and wastewater sampling data collected by EPA.

Chapter 2 of this document discusses each of these data sources in detail.

METHODOLOGY USED TO DEVELOP CURRENT LOADINGS ESTIMATES **12.3**

EPA calculates current loadings for a specific facility from the effluent flow rate of the facility and the concentration of pollutants in its effluent obtained from effluent monitoring data. EPA does not have data for every facility in the database to calculate current loadings. For some, EPA has no effluent monitoring data, while for others, EPA may have only limited monitoring data for a few parameters. In many cases, EPA has effluent monitoring data, but the data do not represent CWT wastewaters only. As discussed previously, most CWT facilities commingle CWT wastewaters with non-CWT wastewaters such as industrial wastestreams or stormwater prior to monitoring for compliance. Most CWT facilities with waste receipts in more than one subcategory commingle CWT wastestreams prior to monitoring for performance. Some facility supplied data, therefore, is insufficient for estimating current loadings.

When possible, EPA determined current loadings for an individual facility based on information reported by that facility. For most CWT facilities, however, EPA had to develop estimated current loadings. EPA's methodology differs depending on the subcategory of CWT facilities and individual facility characteristics. Factors that EPA took into account in estimating current loadings include: 1) the analytical data available for the subcategory; 2) the characteristics of the facilities in the subcategory; and 3) the facility's treatment train. For facilities in multiple subcategories, EPA estimated loadings for that portion of the wastestream in each subcategory and subsequently added them together. The sections that follow discuss the current loadings methodologies for each subcategory.

Current Loadings Estimates for the Metals Subcategory **12.3.1**

EPA calculated current loadings for the metals subcategory facilities by assigning pollutant concentrations based on the type of treatment currently in-place at each facility. EPA placed in-place treatment for this subcategory in one of five classes:

- 1) raw, or no metals treatment;
- 2) primary precipitation with solids-liquid separation;
- 3) primary precipitation with solids-liquid separation plus secondary precipitation with solids-liquid separation;
- 4) primary precipitation with solids-liquid separation plus secondary precipitation with solids-liquid separation followed by multimedia filtration (EPA based the BAT/BPT/PSES proposed limitations and standards for this subcategory on this technology); and
- 5) selective metals precipitation with solids-liquid separation plus secondary precipitation with solids-liquid separation plus tertiary precipitation with solids-liquid separation (EPA based the NSPS/PSNS proposed limitations and standards on this technology).

Table 12.1 shows the current loadings estimates for each classification and the following five sections (12.3.1.1 through 12.3.1.5) detail the estimation procedure for each classification.

Table 12.1. Metals Subcategory Pollutant Concentration Profiles for Current Loadings

Pollutant of Concern	Raw Treatment (ug/L)	Primary Precipitation (ug/L)	Secondary Precipitation (ug/L)	BAT Option Technology (ug/L)	Selective Metals Precipitation (ug/L)
CONVENTIONALS					
Oil and Grease ²	685,300	143,160	93,348	56,279	< 5,000
Total Suspended Solids (TSS)	27,957,052	840,000	833,266	113,197	9,250
PRIORITY METALS					
Antimony	116,714	7,998	768	170	21
Arsenic	1,790	84	280	143	11
Cadmium	44,629	21	63	45	82
Chromium	1,186,645	387	671	1,177	40
Copper	1,736,413	448	800	581	169
Lead	211,044	393	356	117	55
Mercury	300	50	6	1	0
Nickel	374,739	2,787	1,968	1,070	270
Selenium	328	514	433	347	210
Silver	1,105	91	70	23	5
Thallium	461	26	240	N/A ¹	21
Zinc	978,167	3,900	3,550	422	206
NON-CONVENTIONAL METALS					
Aluminum	378,955	5,580	27,422	856	73
Barium	941	N/A ¹	221	N/A ¹	N/A ¹
Boron	153,726	31,730	32,131	8,403	66,951
Cobalt	25,809	254	200	115	57
Iridium	51,231	3,283	3,500	500	N/A ¹
Iron	588,910	15,476	8,018	6,803	387
Lithium	114,438	53,135	976	1,927	N/A ¹
Manganese	26,157	245	2,195	49	12
Molybdenum	48,403	3,403	2,690	1,747	528
Silicon	284,693	2,590	1,238	1,447	356
Strontium	7,605	3,561	1,223	100	N/A ¹
Tin	1,337,924	1,026	552	90	28
Titanium	795,623	239	45	57	4
Vanadium	38,570	37	85	12	11
Yttrium	96	26	48	5	5
Zirconium	1,477	N/A ¹	762	1,287	N/A ¹
CLASSICAL PARAMETERS					
Chemical Oxygen Demand (COD)	13,963,394	10,628,000	4,537,778	1,333,333	108,802
Hexavalent Chromium	1,923,560	4,114	361	800	43
Ammonia as N	216,097	120,790	89,997	15,630	9,123
Cyanide	12,285	763	1,910	82	N/A ¹

¹Concentration values for certain pollutants were not available for some classifications.

²EPA determined that the oil and grease concentration listed for raw loadings includes data from a facility (4382) which commingles oils subcategory waste receipts with metals subcategory receipts. The recalculated raw loadings oil and grease concentration is 27,589 ug/L, after excluding the data from the facility 4382. EPA will incorporate this change into the overall loadings and removals calculations between proposal and promulgation.

Raw Loadings for the Metals Subcategory

12.3.1.1

EPA classified metals subcategory facilities with no chemical precipitation in the “raw” class (even if they had other treatment in place, such as activated carbon). EPA assigned the “raw” current loadings estimates to three facilities in the metals subcategory. EPA based its estimates for raw wastewaters on data from eight sample points at five sampling episodes (refer to Table 12-2 for sample episode and sample point identifiers). The data from these episodes include composite samples from continuous systems and grab samples from batch systems. In order to compare and use continuous and batch system data interchangeably, EPA calculated a daily average value for the batch systems by averaging sample measurements from all batches for a single day. Therefore, if the facility treated nine batches during a four day

sampling episode, EPA calculated four daily averages for the episode. EPA incorporated non-detect measurements at the sample-specific detection levels. The Agency averaged duplicate batch samples together first, and then included the averaged value in the daily average calculation.

Once EPA calculated daily averages for the batch systems, EPA then averaged the batch daily averages with the daily composite values to obtain raw pollutant concentrations. As an illustrative example, Table 12-2 shows the data used to obtain the raw wastewater estimation for aluminum: 378,955 ug/L. Table 12-2 shows that this estimation comes from twenty-nine daily averages (some from continuous systems and some from batch systems) from fifty-nine analyses. Raw wastewater estimations for other pollutants were calculated in a similar manner.

Table 12-2. Example of Metals Subcategory Influent Pollutant Concentration Calculations¹

Sample Point	Raw Aluminum Daily Averages (ug/L)					# of measurements
Episode 4378-01	389,338	189,223	3,128	8,376		23 (2 duplicate values)
Episode 4378-03	2,080,000	2,090,000	745,000	91,700	130,000	11 (2 duplicate values)
Episode 4055-01	31,800	838,275	260,000			5
Episode 1987-01	839,000	792,000	859,000			3
Episode 1987-02	577,500	53,400				3 (1 duplicate value)
Episode 4393-01	3,730	29,400				2 (1 non-detect value)
Episode 4382-07	84,400	139,000	171,000	145,000	330,000	6 (1 duplicate value)
Episode 4393-05	72,400	3,765	6,150	15,900	11,200	6 (1 duplicate and 1 non-detect value)

¹The Raw Aluminum Concentration is 378,955 ug/L -- the average of sample values in the table.

Primary Precipitation with Solids-Liquid Separation Loadings

12.3.1.2

EPA estimated pollutant concentrations resulting from primary precipitation and solids-liquid separation using data from EPA sampling episodes and industry supplied effluent monitoring data. EPA used data from three sampling episodes and one facility’s effluent monitoring data submissions to represent the

current loadings for 32 of the metals subcategory facilities. The episodes used are detailed monitoring questionnaire 613 (industry supplied effluent monitoring data), sample point 16; episode 4382, sample point 12; episode 1987, sample point 3; and episode 4798, sample point 3. The facility supplied effluent monitoring data was collected as grab samples from batch systems. For each day, EPA averaged the batch

samples together to obtain a daily average. Conversely, the EPA sampling episode data came from continuous systems. Regardless of the sample type, the analysis averaged the daily average values from a facility together to give a facility average, then combined the four facility averages to give a pollutant concentration average. Table 12.1 shows the concentrations representing primary precipitation for the relevant pollutants of concern.

Secondary Precipitation with Solids-Liquid Separation Loadings 12.3.1.3

EPA estimated current loadings for facilities with secondary chemical precipitation using data from three sampling points at three separate episodes. These are episode 4393, sample point 13; episode 4382, sample point 12; and episode 4798, sample point 05 (which represents the technology basis for the proposed metals subcategory BPT/BAT/PSES option). EPA then averaged the facility average effluent values from liquid-solids separation following secondary chemical precipitation to give concentrations for the relevant pollutants of concern. Table 12-1 summarizes these average values.

Technology Basis for the Proposed BPT/BAT/PSES Option 4 Loadings 12.3.1.4

EPA used the long-term averages from Metals Option 4 -- batch primary precipitation with solids-liquid separation plus secondary precipitation with solids-liquid separation followed by multi-media filtration -- to represent current loadings at three facilities in the metals subcategory. The facility sampled by EPA that employs the technology basis for the BPT/BAT/PSES Option, obviously, is assigned its current loadings. EPA modeled the loadings for two facilities that utilize tertiary precipitation with the BPT/BAT/PSES option current loadings. EPA believes that facilities utilizing tertiary precipitation will not need to alter their system to meet the proposed pretreatment standards and

limitations. By assigning current loadings estimates based on the Option 4 technology basis to the tertiary systems, EPA may have overestimated current loadings at these two facilities. However, EPA does not estimate any post-compliance pollutant reductions at these facilities.

Selective Metals Precipitation (NSPS/PSNS Proposed Option 3) Loadings 12.3.1.5

Only one facility in the metals subcategory utilizes selective metals precipitation. EPA sampled this facility during development of this rule. Therefore, the current loadings pollutant concentrations for this facility are not estimates, but measured data. Table 12.1 summarizes these pollutant concentrations.

Current Loadings Estimates for the Oils Subcategory 12.3.2

Based on questionnaire responses and site visits, EPA found that all facilities which treat oily wastewaters, for which EPA has data, currently employ emulsion breaking and/or gravity separation. If emulsions are present in the incoming waste receipts, the facility first makes use of emulsion breaking. If not, the waste receipts generally bypass emulsion breaking and the facility processes the waste through a gravity separation step for gross separation of the water and the oil phase. A facility may often follow up these pretreatment steps by other wastewater treatment technologies. Therefore, EPA believes that, at a minimum, it may characterize current loadings for oils subcategory discharges by analyzing samples obtained from the effluent of emulsion breaking/gravity separation.

EPA has seven data sets which represent effluent from emulsion breaking/gravity separation systems. EPA collected these seven data sets during EPA sampling episodes at various types of oily waste facilities. Six of these seven data sets represent facilities that treat oily

wastewater and recover/process used oil. One facility, which primarily accepts bilge water, performs oily wastewater treatment only. The annual volume of treated oily wastewater discharged at these facilities ranges from 174,000 gallons/year to 35 million gallons/year. Two of the data sets represent facilities that only accept non-hazardous wastes, while the other five data sets represent facilities which are permitted by RCRA to additionally accept hazardous wastes.

For each pollutant of concern, each of the seven emulsion breaking/gravity separation data sets contains the mean concentration of the data collected over the sampling episode (usually a duration of five days). This mean includes measured (detected) and non-detected values. The value substituted for each non-detected measurement was either 1) the sample-specific detection limit or 2) the average of the measured (detected) values across all seven data sets. Section 12.3.2.1 discusses EPA's representation of non-detect values for this analysis. Section 12.3.2.1 further discusses EPA's representation of the one biphasic sample. Table 12-7 presents a compiled summary of these seven data sets. For each episode and each pollutant, the table presents the mean concentration of the data collected over the sampling episode. Figure 12-1 shows the procedure EPA used to estimate the mean concentration data over the seven sampling episodes.

EPA has facility-specific information in its database for 84 oils subcategory facilities. Of these 84 facilities, EPA has sampling data for seven. For the remainder of the facilities, EPA does not have current loadings data. EPA does, however, have facility-specific information on the volume of wastewater being discharged and the treatment train currently in use. EPA evaluated several ways to associate one of the seven emulsion breaking/gravity separation data sets to each of the facilities for which EPA needed to estimate current performance. EPA, therefore,

reviewed the seven emulsion breaking/gravity separation data sets to determine if there was a relationship between the concentration of pollutants, and facility flow, but found no evidence of relationship.

Consequently, EPA randomly assigned one of the seven data sets to each of the facilities that required current loadings estimates. For facilities which only employ emulsion breaking/gravity separation, EPA estimated current loadings for each pollutant using values in the randomly assigned data set. For facilities which use additional treatment after that step, EPA further reduced the pollutant loadings for certain pollutants (or all pollutants depending on the technology) in the randomly assigned data set to account for the additional treatment-in-place at the facility.

TREATMENT-IN-PLACE

As mentioned previously, there are many configurations of treatment trains in this subcategory. While EPA does not have sampling data representing each of these treatment configurations, EPA does have sampling data representing each of the individual treatment technologies currently in place at oily waste facilities. While EPA collected all of the data at CWT facilities, EPA collected some of the data it used to develop treatment-in-place credits at facilities in other CWT subcategories. For some technologies, EPA has sampling data from a single facility, while for others, EPA has sampling data from multiple CWT facilities.

In order to estimate the current pollutant reductions due to additional treatment-in-place at oils facilities, for each technology, EPA compiled and reviewed all CWT sampling data for which EPA collected influent and effluent data. EPA subjected the influent data to a similar screening process as the one used in determining long-term averages. For each episode, EPA retained influent and effluent data for a specific pollutant

only if the pollutant was detected in the influent at treatable levels (10 times the baseline value¹) at least 50 percent of the time. For each facility, EPA then calculated an “average” percent removal for metals (averaging the percent removal for each metal), an “average” percent removal for organics, and an “average” percent removal for BOD₅, TSS, and oil and grease. EPA rounded the averages to the nearest 5 percent. When the “average” percent removal for more than one third of the pollutants in a compound class (i.e., metals, organics, BOD₅, TSS, and oil and grease) was zero or less, EPA set the “average” percent removal for the class of compounds equal to zero. EPA recognizes that treatment technologies are not equally effective in reducing all metals and/or all organics from wastewater, but believes this provides a reasonable estimate. The result is that, for some pollutants, EPA believes it may have underestimated the removals associated with the additional treatment-in-place, while for other pollutants, EPA may have overestimated the removals.

Table 12-3 shows the percent removal credited to each technology. For technologies that EPA evaluated at more than one CWT facility, the value for each class of compounds represents the lowest value at the facilities. For example, EPA sampled at two facilities that use multimedia filtration. The average percent removal of metal pollutants at facility 1 and facility 2 is 60 percent and 30 percent, respectively. Table 12-3 shows that EPA used 30 percent to estimate metals removal in multimedia filtration systems. EPA believes that using the lower percent removal of the “best” performers provides a reasonable estimate of the percent removals of these technologies for the rest of the industry and may even overstate the percent

removals for some facilities that may not be operating the treatment technologies efficiently.

For some classes of compounds and some technologies, EPA does not have empirical data from the CWT industry to estimate percent removals. For these cases, EPA assumed percent removals based on engineering judgement. EPA assumed that air stripping is only effective for the removal of volatile and semi-volatile organic pollutants. EPA also assumed that chemical precipitation is ineffective for the treatment of organic pollutants. Finally, EPA assumed a 50 percent reduction in organic CWT pollutants through carbon adsorption treatment. EPA recognizes that carbon adsorption, given the correct design and operating conditions can achieve much higher pollutant removals. However, for this industry, EPA believes that the complex matrices, variability in waste receipts, and high loadings would compromise carbon adsorption performance.

¹Defined in chapter 15.

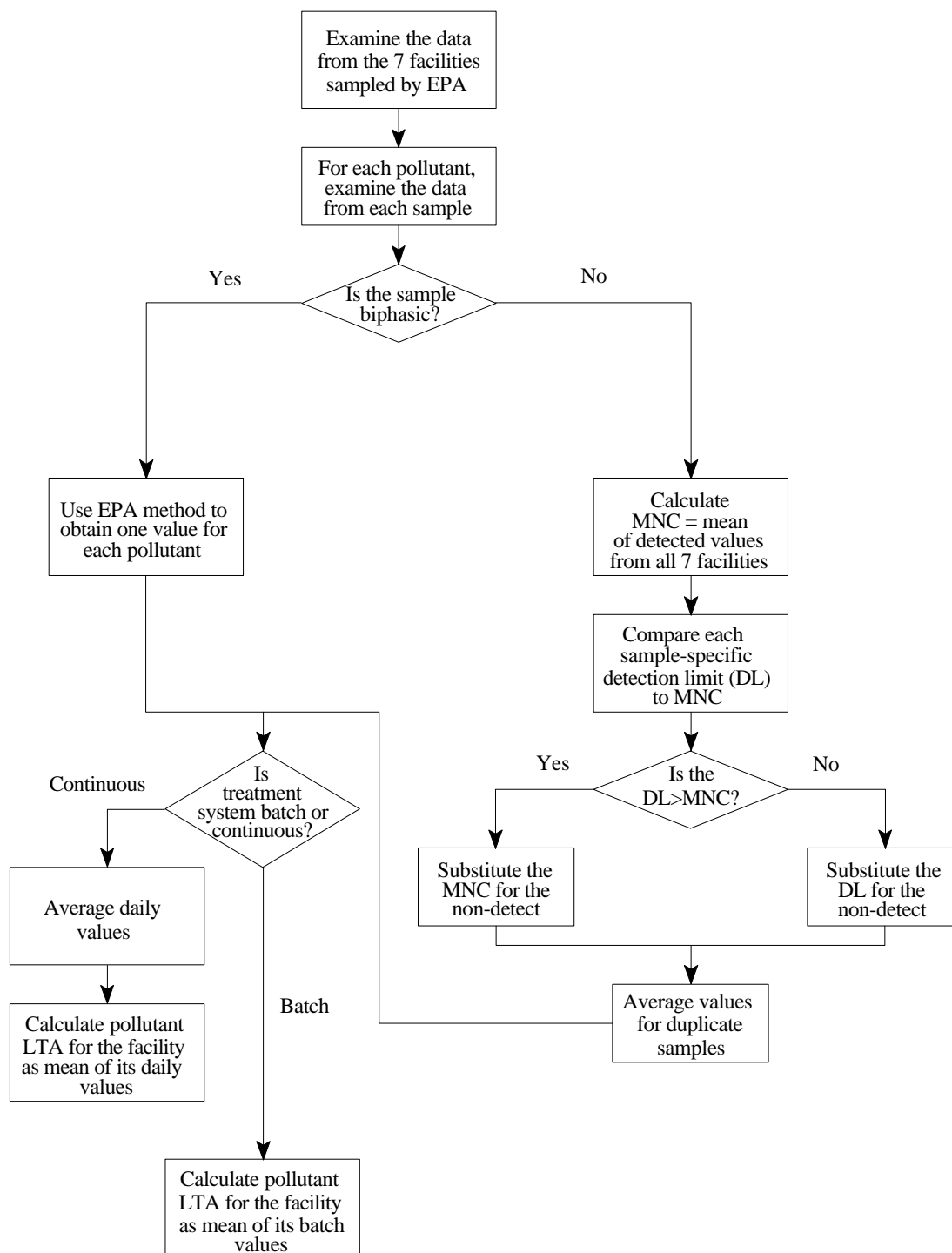


Figure 12-1 Calculation of Current Loadings for Oils Subcategory

Table 12-3. Treatment-in-Place Credit Applied to Oils Facilities

Pollutant Group	Treatment Technology							
	Chemical Precipitation	Carbon Adsorption	Air Stripping	Ultra filtration	Biological	Multi-media/Sand Filtration	DAF	Secondary Separation
BOD ₅	0	0	0*	55	50	10	10	5
Oil and Grease	45	45	0*	85	65	0	60	30
TSS	85	0	0*	100	50	55	80	0
Metals	75	0	0*	75	15	30	50	0
Organics	0*	50*	70	85	75	0	40	50

*Value is based on engineering judgement.

In determining current loadings for facilities with additional treatment-in-place, EPA then reduced the current loadings concentrations established for the facility with gravity separation/emulsion breaking alone by the appropriate percent removal as defined above. For facilities with multiple treatment technologies in their treatment train, EPA credited each of the treatment technologies in the order that the process occurs in their treatment train.

Issues Associated with Oils

Current Performance Analyses 12.3.2.1

This section describes four issues associated with estimating the current performance of the oils subcategory. The first issue is the dilution required in analyses of some highly concentrated samples representing the baseline technology (emulsion breaking/gravity separation). The second issue is the appropriate procedure for incorporating the concentrations of a biphasic sample into the estimates of current performance. The third issue is the appropriateness of various substitution methods for the non-detected measurements, especially of diluted samples. The fourth issue discussed is EPA's approach to assigning the seven emulsion breaking/gravity separation data sets randomly to oils facilities.

DILUTION OF SAMPLES DURING LABORATORY ANALYSIS

Effluent from emulsion breaking/gravity separation operations may be highly concentrated, which may present difficulties in analyzing such effluent. Consequently, in its analysis of some samples, EPA needed to dilute the samples in order to reduce matrix difficulties (such as interference) to facilitate the detection or quantitation of certain target compounds. For some organic compounds, moreover, EPA also had to dilute samples where a highly concentrated sample could not be concentrated to the method-specified final volume.

If EPA diluted a sample for analytical purposes, EPA adjusted the particular pollutant measurement to correct for the dilution. For example, if a sample was diluted by 100 and the measurement was 7.9 ug/L, the reported value was adjusted to 790 ug/L (i.e., 7.9 ug/L * 100). In general, the sample-specific detection limits (DLs) for a pollutant were equal to or greater than the nominal quantitation limit described in Chapter 15. Dilution generated sample-specific DLs greater than the nominal quantitation limit.

Because wastes generated using the proposed technologies will be less concentrated than emulsion breaking/gravity separation operations, EPA does not believe effluent samples collected

to demonstrate compliance with the proposed limitations and standards will necessitate dilution and therefore result in effluent values with large sample-specific DLs. Further, a laboratory can overcome potential analytical interferences using procedures such as those suggested in *Guidance on the Evaluation, Resolution, and Documentation of Analytical Problems Associated with Compliance Monitoring* (EPA 821-B-93-001). Thus, in demonstrating compliance, EPA would not allow dilution of a sample to a sample-specific DL greater than the limitation or standard.

BIPHASIC SAMPLES

EPA used a number of different analytical methods to determine the pollutant levels in the effluent samples from facilities that employ chemical emulsion breaking/gravity separation for treating oily wastewater. Each method is specific to a particular analyte or to structurally similar chemical compounds such as volatile organics (analyzed by Method 1624) and semivolatile organics (analyzed by Method 1625). In developing the laboratory procedures described in Method 1625, EPA included a procedure for analyzing aqueous samples and another procedure for analyzing biphasic samples. Some effluent samples from emulsion breaking/gravity separation were biphasic. That is, each sample separated into two distinct layers, an aqueous layer and an organic one. In these instances, if the phases could not be mixed, EPA analyzed each phase (or layer) separately. Thus, each pollutant in a sample analyzed by Method 1625 had two analytical results, one for the organic phase and the other for the aqueous phase. There were three such samples in the oils subcategory. Only sample number 32823 (episode 4814B), however, represents oily wastes following emulsion breaking/gravity separation. This sample is part of one of the seven data sets representing emulsion breaking/gravity

separation randomly assigned to facilities without concentration data. For this sample, EPA combined the two concentration values into a single value for each pollutant analyzed using Method 1625. The discussion below describes the procedures for combining the two concentration values and Table 12-4 summarizes these procedures. Table 12-5 provides examples of these procedures. DCN² 23.13

If the pollutant was detected in the organic phase, EPA adjusted the analytical results to account for the percent of the sample in each phase. For sample 32823, 96 percent of the sample volume was aqueous and the remaining 4 percent was organic. Thus, EPA multiplied the aqueous value (detected value or sample-specific DL) by 0.96 and the organic value by 0.04. EPA then summed the two adjusted values to obtain the total concentration value for the pollutant in the sample.

If the pollutant was not detected in the organic phase, EPA used several different procedures depending on the pollutant and its concentration in the aqueous phase. A factor which complicated EPA's analysis was that sample-specific DLs for pollutants in the organic phase were 1000³ times greater than the minimum levels for Method 1625. When a measurement result indicates that a pollutant is not detected, then the reported sample-specific DL is an upper bound for the actual concentration of the pollutant in the sample. When some sample-specific DLs for the organic phase (which were 1000 times the minimum level) were

² Items identified with document control numbers (DCN) are located in the record to the proposed rulemaking.

³ Because the volume of the organic phase was small, the organic phase sample required dilution (by 1000) for analysis. In contrast, the aqueous phase had sufficient amount so that it was not diluted.

multiplied by 0.04, the adjusted non-detected values were greater than the measured amount in the aqueous phase. EPA concluded that substituting the sample-specific DL for the non-detected results in the organic phase in these circumstances might over-estimate the amount of pollutant in the sample. Thus, EPA applied one of the two alternative substitution procedures described below for the sample-specific DLs resulting from the organic phase.

First, if EPA did not detect the pollutant in either phase, EPA considered the sample to be non-detect at the sample-specific DL of the aqueous phase. This value for the aqueous phase was equal to the minimum level specified in Method 1625.

Second, if the pollutant was detected in the aqueous phase (and non-detected in the organic phase), EPA used a procedure that compared the non-detected organic values to the detected aqueous value adjusted by a partition ratio (550). EPA determined this partition ratio using the average of the ratios of the detected organic phase concentrations to the detected aqueous phase

concentrations for the pollutants that had detected values in both phases. There were twenty-two pollutants that were used to calculate this value of 550. These pollutants are in four structural groupings of organic pollutants: chlorobenzenes, phenols, aromatic ethers, and polynuclear aromatic hydrocarbons. The ratios were similar in each of the structural groupings; consequently, EPA determined that a single value for the partition ratio was appropriate. EPA then multiplied the aqueous phase concentration value by this partition ratio of 550. If this value was less than the sample-specific DL of the pollutant in the organic phase, EPA substituted this value for the organic phase sample-specific DL. Otherwise, EPA used the organic phase sample-specific DL. EPA then multiplied the values for the aqueous and organic phases by the relative volume amounts (0.96 and 0.04, respectively) and summed them to obtain one value for the sample.

Table 12-4. Biphasic Sample Calculations (Summary of rules for combining aqueous/organic phase concs.)

Censoring types (i.e., detected or non-detected)			Method for obtaining combined value
Aqueous phase	Organic phase	Combined result (same as aqueous)	
NC	NC	NC	$0.96 \cdot \text{AQ} + 0.04 \cdot \text{ORG}$
ND	NC	ND	$0.96 \cdot \text{AQ (use DL)} + 0.04 \cdot \text{ORG}$
ND	ND	ND	AQ (use DL)
NC	ND ($\text{DL} > 550 \cdot \text{AQ}$)	NC	$0.96 \cdot \text{AQ} + 0.04 \cdot (550 \cdot \text{AQ})$
	ND ($\text{DL} \leq 550 \cdot \text{AQ}$)		$0.96 \cdot \text{AQ} + 0.04 \cdot \text{ORG (use DL)}$

AQ = value for aqueous phase
ORG = value for organic phase

NC = non-censored (detected)
ND = non-detected

DL = sample-specific detection limit

Table 12-5. Examples of Combining Aqueous and Organic Phases for Sample 32823

Pollutant	Reported Concs. (ug/L)		Concentration for Sample (ug/L)	Calculation for Sample	Comment
	Aqueous Phase	Organic Phase			
Acenaphthene	668.6	319,400	13,418	$(0.96 \times 668.6 \text{ ug/L}) + (0.04 \times 319,400 \text{ ug/L})$	Concentrations are weighted by relative amounts of the sample volume in each phase: 96% aqueous and 4% organic
Benzo(a)pyrene	158.4	162,950	6,670	$(0.96 \times 158.4 \text{ ug/L}) + (0.04 \times 162,950 \text{ ug/L})$	
4,5-Methylene Phenanthrene †	ND (10)	118,330	ND (4,743)	$(0.96 \times 10 \text{ ug/L}) + (0.04 \times 118,330 \text{ ug/L})$	
Aniline	ND (10)*	ND (10,000)	ND (10)		no calculation necessary
1-phenyl-naphthalene ‡	10.49	ND (10,000)	240.9	$(0.96 \times 10.49 \text{ ug/L}) + (0.04 \times 550 \times 10.49 \text{ ug/L})$	The sample-specific DL of 10,000 ug/L for the organic phase is greater than 5570 ug/L (i.e., 550 times 10.49 ug/L)
Alpha-Terpeneol	1,885.8	ND (10,000)	2,210	$(1,885.8 \text{ ug/L} \times 0.96) + (10,000 \text{ ug/L} \times 0.04)$	The sample-specific DL of 10,000 ug/L for the organic phase is less than 1,037,190 (i.e., 550 times 1885.8 ug/L)

* ND=non-detected measurement. The sample-specific DL is provided in the parentheses.

† None of measurements of the pollutants of concern from this sample resulted in a non-detected measurement for the aqueous phase with a detected measurement for the organic phase. This analyte is shown for demonstration purposes.

‡ None of measurements of the pollutants of concern from this sample resulted in a detected measurement for the aqueous phase with a sample-specific DL for the organic phase that was greater than 550 times the measurement from the aqueous phase. This analyte is shown for demonstration purposes.

NON-DETECT DATA IN COMPLEX SAMPLES

EPA included values for measurements reported as "non-detected" when it calculated the mean for each pollutant of concern in the seven emulsion breaking/gravity separation data sets. In some instances, the measurements reported as non-detected had sample-specific detection limits that were well in excess of the minimum analytical detection limits. The high sample-specific detection limits occurred because the samples contained many pollutants which interfered with the analytical techniques. EPA considered several approaches for handling these sample-specific non-detected measurements because, by definition, if a pollutant is 'not

detected', then the pollutant is either not present at all (that is, the concentration is equal to zero) or has a concentration value somewhere between zero and the sample-specific detection limit (DL).

EPA considered the following five approaches to selecting a value to substitute for non-detected measurements:

1. Assume that the pollutant is not present in the sample and substitute zero for the non-detected measurement (that is, ND=0).
2. Assume that the pollutant is present in the sample at a concentration equal to the minimum analytical level (that is,

ND=minimum analytical detection limit (MADL)).

3. Assume that the pollutant is present at a concentration equal to half the sample-specific DL (that is, $ND=DL/2$). (In general, the values of the sample-specific DLs are equal to or greater than the values of the minimum analytical detection limits used in the second approach.)
4. Assume that the pollutant is present at a concentration equal to the sample-specific DL (that is, $ND=DL$). This is the substitution approach that was used in the 1995 proposal, for the influent pollutant loadings for the other two subcategories, and for the proposed limitations and standards for all three subcategories.
5. Assume that the pollutant is present at a concentration equal to either the sample-specific DL or the mean of the detected (or non-censored) values (MNC) of the pollutant.⁴ EPA used the lower of the two values (that is, $ND=\text{minimum of } DL \text{ or } MNC$).

EPA ultimately selected the approach described in 5. because Agency concluded that it provided the most realistic estimate of current performance in these data sets.

Table 12-6A shows how EPA applied the five substitution approaches to data for hypothetical pollutant X for seven facilities. The example shows the types of calculations EPA performed in comparing the five approaches. The example includes facilities that treat wastes on a batch and continuous basis. It also includes a mixture of detected and non-detected measurements as well as duplicate samples. For each facility, the table lists the analytical results reported by the laboratory for pollutant X. If the reported value is non-detected, then this analytical result is identified in the table as “ND” with the reported sample-specific DL in the parenthesis. If the value is detected, the analytical (measured) result is shown in the table and is identical in all five approaches because the substitutions apply only to non-detected values. Finally, for each of the seven facilities, the table shows five long-term averages for pollutant X--one for each of the five substitution approaches.

⁴For each pollutant, EPA calculated the mean (or average) of the detected (or non-censored) values (MNC) using all detected values in the seven data sets except for the biphasic sample. The substitutions were only applied to non-detected measurements observed in aqueous samples because the non-detected measurements in the biphasic sample were evaluated separately as described in the previous section. While EPA believes that biphasic samples can result from some wastes in this subcategory after processing through emulsion breaking/gravity separation, EPA believes that it is appropriate to use only detected measurements from aqueous samples in calculating the mean that will be compared to each sample-specific DL in aqueous samples.

Table 12-6A. Example of Five Substitution Methods for Non-Detected Measurements of Hypothetical Pollutant X

Facility	Sampling Day or Batch Number	Reported Values (ug/L)	Approach 1 ND=0	Approach 2 ND=MADL † (MADL=10 ug/L)	Approach 3 ND=DL/2	Approach 4 ND=DL	Approach 5 ND= min(DL,MNC)
A	Batch 1	99	99	99	99	99	99
	Batch 1	95	95	95	95	95	95
	Batch 2	ND (300)*	0	10	150	300	300
	Batch 3	84	84	84	84	84	84
	Batch 4	258	258	258	258	258	258
		A: LTA	122	125	160	197	197
B	Day 1	ND (100)	0	10	50	100	100
	Day 2	ND (1000)	0	10	500	1000	315
		B: LTA	0	10	275	550	208
C	Day 1	57	57	57	57	57	57
	Day 2	84	84	84	84	84	84
	Day 3	26	26	26	26	26	26
		C: LTA	56	56	56	56	56
D	Day 1	73	73	73	73	73	73
	Day 2 (duplicate)	ND (100)	0	10	50	100	100
	Day 2 (duplicate)	ND (10)	0	10	5	10	10
	Day 3	62	62	62	62	62	62
		D: LTA	45	48	54	63	63
E	Day 1	411	411	411	411	411	411
	Day 2	257	257	257	257	257	257
	Day 3	79	79	79	79	79	79
	Day 4	ND (1000)	0	10	500	1000	315
	Day 5	ND (220)	0	10	110	220	220
		E: LTA	149	153	271	393	256
F	Day 1	ND (300)	0	10	150	300	300
	Day 2	320	320	320	320	320	320
	Day 3	44	44	44	44	44	44
	Day 4	47	47	47	47	47	47
	Day 5	180	180	180	180	180	180
		F: LTA	118	120	148	178	178
G	Day 1	1234	1234	1234	1234	1234	1234
	Day 2	855	855	855	855	855	855
	Day 3	661	661	661	661	661	661
	Day 4	1377	1377	1377	1377	1377	1377
		G: LTA	1032	1032	1032	1032	1032
		MNC = 315 (MNC = mean of detected values from all seven facilities)					

* ND=non-detected measurement. The sample-specific detection limit is provided in the parentheses.

† MADL=minimum analytical detection level

While Table 12-6A provides an example using the five approaches, DCN 23.8 shows the results of the substitution values under the first four approaches to the actual seven concentration data sets from the seven facilities with emulsion breaking/gravity separation. DCN 23.21 shows the results of using the fifth approach. After evaluating the five approaches, EPA prefers Approach 5 because it tends to minimize the effect of large detection levels on the long-term averages while providing reasonable estimates of the actual concentrations. Furthermore, EPA feels that Approach 5 is superior to the other four approaches. In particular, the first and second approaches (substitutions of zero or the MADL, respectively, for non-detects) are poor choices because they are likely to provide unrealistically low estimates of the analyte concentrations in samples with high sample-specific detection limits, especially when all detected values are substantially greater than zero and the MADL. In addition, the third and fourth approaches (substitution of the sample-specific DL or DL/2, respectively) are poor choices because the substitutions could exceed the detected values in some cases, and thus, possibly could over estimate the concentrations in non-detected measurements. EPA's analyses also show that there is little or no difference in the averages between using the sample-specific DL or half the sample-specific DL for many of the facility/analyte data sets. Thus, EPA has followed the approach outlined in 5 above because it concluded that this approach provides reasonable estimates of the actual concentrations because the substituted values are neither unrealistically low nor exceed the greatest detected value.

Table 12-7 shows the pollutant concentration data sets for the seven facilities (identified as A, B, etc.) using the "Original" approach (that is, Approach 1: sample-specific DL substituted for non-detected measurements) and the 'Replaced' approach (that is, Approach 5). Each set provides the overall mean (i.e., the average of all values -- detected and non-detected), the mean of the detected values, and the mean of the NDs (i.e., the mean of the substituted values). Both provide the same detected mean value because, unlike the non-detected measurements, no substitutions were made for detected measurements. In contrast, the overall mean and the mean of the NDs vary when one or more values in a facility data set exceed the mean detected value for the pollutant.

Table 12-6B shows the relative effects of EPA's preferred approach in comparison to Approach 1 on the estimates of priority, conventional, and non-priority pollutant concentrations for baseline loadings and the total removals changes for toxic weighted pollutants. In comparison to Approach 1 (EPA's original method), EPA's preferred (or 'replaced') approach (that is, Approach 5) had little noticeable effect on the baseline loadings for the oils subcategory. In other words, the current loadings are approximately the same using either approach. There is, however, a significant decrease in toxic pound-equivalent removals with EPA's preferred approach. Hence, overall toxic pound-equivalent removal estimates using EPA's preferred approach decreased by approximately 34% from those calculated using its original approach (that is, substituting the sample-specific detection limit for all non-detected measurements). The cost effectiveness document provides more information on toxic pound-equivalent removals.

Table 12-6B. Difference in Oils Subcategory Loadings After Non-Detect Replacement Using EPA Approach

Priority Metals & Organics Current Loading (percent change)	Non-Priority Metals & Organics Current Loading (percent change)	Conventional Pollutant Current Loading (percent change)	Pound-Equivalent Net Removals (percent change)
- 5	+ 1	0	- 34

Table 12-7. Oils Subcategory Emulsion Breaking/Gravity Separation Data Sets Before and After Sample-Specific Non-Detect Replacement¹

Analyte	Facility	# Obs	# NDS	# Analytical	Minimum DL	Units	Original Overall Mean	Original Mean of Detects	Original Mean of NDS	Replaced Overall Mean	Replaced Mean of Detects	Replaced Mean of NDS
Ammonia, as N	A	20	0	0	0.01	mg/L	75.10	75.10	.	75.10	75.10	.
Ammonia, as N	B	2	0	0	0.01	mg/L	122.50	122.50	.	122.50	122.50	.
Ammonia, as N	C	3	0	0	0.01	mg/L	64.00	64.00	.	64.00	64.00	.
Ammonia, as N	E	5	0	0	0.01	mg/L	103.76	103.76	.	103.76	103.76	.
Ammonia, as N	F	5	0	0	0.01	mg/L	98.60	98.60	.	98.60	98.60	.
Ammonia, as N	G	4	0	0	0.01	mg/L	382.13	382.13	.	382.13	382.13	.
Biochemical Oxygen Demand	A	20	0	2	2.00	mg/L	8188.00	8188.00	.	8188.00	8188.00	.
Biochemical Oxygen Demand	B	2	0	2	2.00	mg/L	4670.00	4670.00	.	4670.00	4670.00	.
Biochemical Oxygen Demand	C	3	0	2	2.00	mg/L	7133.33	7133.33	.	7133.33	7133.33	.
Biochemical Oxygen Demand	D	4	0	2	2.00	mg/L	919.75	919.75	.	919.75	919.75	.
Biochemical Oxygen Demand	E	5	0	2	2.00	mg/L	17966.00	17966.00	.	17966.00	17966.00	.
Biochemical Oxygen Demand	F	5	0	2	2.00	mg/L	6940.00	6940.00	.	6940.00	6940.00	.
Biochemical Oxygen Demand	G	4	0	2	2.00	mg/L	10842.50	10842.50	.	10842.50	10842.50	.
Chemical Oxygen Demand (COD)	A	20	0	5	5.00	mg/L	55075.00	55075.00	.	55075.00	55075.00	.
Chemical Oxygen Demand (COD)	B	2	0	5	5.00	mg/L	26900.00	26900.00	.	26900.00	26900.00	.
Chemical Oxygen Demand (COD)	C	3	0	5	5.00	mg/L	49000.00	49000.00	.	49000.00	49000.00	.
Chemical Oxygen Demand (COD)	D	4	0	5	5.00	mg/L	2125.00	2125.00	.	2125.00	2125.00	.
Chemical Oxygen Demand (COD)	E	5	0	5	5.00	mg/L	27730.00	27730.00	.	27730.00	27730.00	.
Chemical Oxygen Demand (COD)	F	5	0	5	5.00	mg/L	32750.00	32750.00	.	32750.00	32750.00	.
Chemical Oxygen Demand (COD)	G	4	0	5	5.00	mg/L	43625.00	43625.00	.	43625.00	43625.00	.
Hexavalent Chromium	A	20	18	10	10.00	ug/L	546.25	2827.50	292.78	546.25	2827.50	292.78
Hexavalent Chromium	E	5	5	10	10.00	ug/L	10.00	.	10.00	.	10.00	10.00
Hexavalent Chromium	F	5	1	10	10.00	ug/L	33.40	39.25	10.00	33.40	39.25	10.00
Hexavalent Chromium	G	4	0	10	10.00	ug/L	48.88	48.88	.	48.88	48.88	.
Nitrate/nitrite	A	20	1	50	50.00	ug/L	5146.00	5416.32	10.00	5146.00	5416.32	10.00
Nitrate/nitrite	B	2	1	50	50.00	ug/L	15155.00	30300.00	10.00	15155.00	30300.00	10.00
Nitrate/nitrite	C	3	0	50	50.00	ug/L	12200.00	12200.00	.	12200.00	12200.00	.
Nitrate/nitrite	E	5	0	50	50.00	ug/L	1682.00	1682.00	.	1682.00	1682.00	.
Nitrate/nitrite	F	5	0	50	50.00	ug/L	36300.00	36300.00	.	36300.00	36300.00	.
Nitrate/nitrite	G	4	0	50	50.00	ug/L	78875.00	78875.00	.	78875.00	78875.00	.
Total Recoverable Oil and Grease	A	20	0	5	5.00	mg/L	19633.00	19633.00	.	19633.00	19633.00	.
Total Recoverable Oil and Grease	B	2	0	5	5.00	mg/L	5960.00	5960.00	.	5960.00	5960.00	.
Total Recoverable Oil and Grease	C	3	0	5	5.00	mg/L	61297.33	61297.33	.	61297.33	61297.33	.
Total Recoverable Oil and Grease	D	4	0	5	5.00	mg/L	81.19	81.19	.	81.19	81.19	.
Oil and Grease	E	5	0	5	5.00	mg/L	1745.88	1745.88	.	1745.88	1745.88	.
Oil and Grease	F	5	0	5	5.00	mg/L	5928.25	5928.25	.	5928.25	5928.25	.
Oil and Grease	G	4	0	5	5.00	mg/L	2954.38	2954.38	.	2954.38	2954.38	.
SGT-HEM	E	5	0	5	5.00	mg/L	849.04	849.04	.	849.04	849.04	.
SGT-HEM	F	5	0	5	5.00	mg/L	1630.99	1630.99	.	1630.99	1630.99	.
SGT-HEM	G	4	0	5	5.00	mg/L	1232.19	1232.19	.	1232.19	1232.19	.
Total Cyanide	A	5	0	0	0.02	mg/L	0.06	0.06	.	0.06	0.06	.
Total Cyanide	E	5	5	0	0.02	mg/L	0.02	.	0.02	0.02	0.02	0.02
Total Cyanide	F	4	0	0	0.02	mg/L	0.29	0.29	.	0.29	0.29	.
Total Cyanide	G	4	1	0	0.02	mg/L	0.38	0.50	0.01	0.38	0.50	0.01
Total Dissolved Solids	D	4	0	10	10.00	mg/L	16000.00	16000.00	.	16000.00	16000.00	.
Total Dissolved Solids	E	5	0	10	10.00	mg/L	1777.00	1777.00	.	1777.00	1777.00	.
Total Dissolved Solids	F	5	0	10	10.00	mg/L	13190.00	13190.00	.	13190.00	13190.00	.
Total Dissolved Solids	G	4	0	10	10.00	mg/L	19912.50	19912.50	.	19912.50	19912.50	.
Total Organic Carbon (TOC)	A	20	0	1	1.00	mg/L	3771.50	3771.50	.	3771.50	3771.50	.
Total Organic Carbon (TOC)	B	2	0	1	1.00	mg/L	22085.00	22085.00	.	22085.00	22085.00	.
Total Organic Carbon (TOC)	C	3	0	1	1.00	mg/L	4700.00	4700.00	.	4700.00	4700.00	.
Total Organic Carbon (TOC)	D	4	0	1	1.00	mg/L	542.00	542.00	.	542.00	542.00	.
Total Organic Carbon (TOC)	E	5	0	1	1.00	mg/L	38055.00	38055.00	.	38055.00	38055.00	.
Total Organic Carbon (TOC)	F	5	0	1	1.00	mg/L	4218.00	4218.00	.	4218.00	4218.00	.
Total Organic Carbon (TOC)	G	4	0	1	1.00	mg/L	4171.25	4171.25	.	4171.25	4171.25	.

¹ #Obs = Total Number of Samples; #NDS = Number of Samples with Non-Detect Values; Replaced = After Replacement of Sample-Specific NDS

Table 12-7. Oils Subcategory Emulsion Breaking/Gravity Separation Data Sets Before and After Sample-Specific Non-Detect Replacement¹

Analyte	Facility	# Obs	# NDs	Minimum	Units	Original	Original	Original	Replaced	Replaced	Replaced
				# Analytical		Overall	Mean of	Mean of	Mean of	Mean of	
				DL		Mean	Detects	NDs	Overall	Detects	NDs
Total Phenols	A	20	0	0.05	mg/L	3.91	3.91	.	3.91	3.91	.
Total Phenols	B	2	0	0.05	mg/L	12.39	12.39	.	12.39	12.39	.
Total Phenols	C	3	0	0.05	mg/L	4.97	4.97	.	4.97	4.97	.
Total Phenols	E	5	0	0.05	mg/L	58.86	58.86	.	58.86	58.86	.
Total Phenols	F	5	0	0.05	mg/L	28.68	28.68	.	28.68	28.68	.
Total Phenols	G	4	0	0.05	mg/L	32.86	32.86	.	32.86	32.86	.
Total Phosphorus	A	20	0	10.00	ug/L	215690.00	215690.00	.	215690.00	215690.00	.
Total Phosphorus	B	2	0	10.00	ug/L	9596000.00	9596000.00	.	9596000.00	9596000.00	.
Total Phosphorus	C	3	0	10.00	ug/L	88000.00	88000.00	.	88000.00	88000.00	.
Total Phosphorus	E	5	0	10.00	ug/L	11255.00	11255.00	.	11255.00	11255.00	.
Total Phosphorus	F	5	0	10.00	ug/L	75670.00	75670.00	.	75670.00	75670.00	.
Total Phosphorus	G	4	0	10.00	ug/L	68650.00	68650.00	.	68650.00	68650.00	.
Total Suspended Solids	A	20	0	4.00	mg/L	6394.90	6394.90	.	6394.90	6394.90	.
Total Suspended Solids	B	2	0	4.00	mg/L	11386.50	11386.50	.	11386.50	11386.50	.
Total Suspended Solids	C	3	0	4.00	mg/L	5806.67	5806.67	.	5806.67	5806.67	.
Total Suspended Solids	D	4	0	4.00	mg/L	40.00	40.00	.	40.00	40.00	.
Total Suspended Solids	E	5	0	4.00	mg/L	896.20	896.20	.	896.20	896.20	.
Total Suspended Solids	F	5	0	4.00	mg/L	6104.00	6104.00	.	6104.00	6104.00	.
Total Suspended Solids	G	4	0	4.00	mg/L	4510.00	4510.00	.	4510.00	4510.00	.
Sulfide, Total (Iodometric)	A	20	5	1000.00	ug/L	865.00	1150.00	10.00	865.00	1150.00	10.00
Sulfide, Total (Iodometric)	B	2	0	1000.00	ug/L	6260.00	6260.00	.	6260.00	6260.00	.
Sulfide, Total (Iodometric)	E	5	0	1000.00	ug/L	829.00	829.00	.	829.00	829.00	.
Sulfide, Total (Iodometric)	F	5	5	1000.00	ug/L	1000.00	.	1000.00	1000.00	.	1000.00
Sulfide, Total (Iodometric)	G	4	4	1000.00	ug/L	1000.00	.	1000.00	1000.00	.	1000.00
Acenaphthene	A	5	5	10.00	ug/L	1720.00	.	1720.00	990.44	.	990.44
Acenaphthene	B	2	2	10.00	ug/L	550.00	.	550.00	550.00	.	550.00
Acenaphthene	C	3	3	10.00	ug/L	3400.00	.	3400.00	968.15	.	968.15
Acenaphthene	D	4	4	10.00	ug/L	10.00	.	10.00	10.00	.	10.00
Acenaphthene	E	5	5	10.00	ug/L	26.00	.	26.00	26.00	.	26.00
Acenaphthene	F	5	3	10.00	ug/L	593.01	872.52	406.67	593.01	872.52	406.67
Acenaphthene	G	4	0	10.00	ug/L	4225.42	4225.42	.	4225.42	4225.42	.
Alpha-terpineol	A	5	5	10.00	ug/L	1720.00	.	1720.00	820.40	.	820.40
Alpha-terpineol	B	2	1	10.00	ug/L	1343.37	1686.74	1000.00	1343.37	1686.74	1000.00
Alpha-terpineol	C	3	1	10.00	ug/L	4660.90	1991.35	10000.00	1662.24	1991.35	1004.03
Alpha-terpineol	D	4	0	10.00	ug/L	128.91	128.91	.	128.91	128.91	.
Alpha-terpineol	E	5	5	10.00	ug/L	26.00	.	26.00	26.00	.	26.00
Alpha-terpineol	F	5	4	10.00	ug/L	472.59	842.95	380.00	472.59	842.95	380.00
Alpha-terpineol	G	4	2	10.00	ug/L	923.47	1596.93	250.00	923.47	1596.93	250.00
Aluminum	A	20	0	200.00	ug/L	15760.00	15760.00	.	15760.00	15760.00	.
Aluminum	B	2	1	200.00	ug/L	8050.00	1200.00	14900.00	8050.00	1200.00	14900.00
Aluminum	C	3	0	200.00	ug/L	131476.67	131476.67	.	131476.67	131476.67	.
Aluminum	D	4	1	200.00	ug/L	191.75	246.33	28.00	191.75	246.33	28.00
Aluminum	E	5	0	200.00	ug/L	14130.00	14130.00	.	14130.00	14130.00	.
Aluminum	F	5	0	200.00	ug/L	41110.00	41110.00	.	41110.00	41110.00	.
Aluminum	G	4	0	200.00	ug/L	18200.00	18200.00	.	18200.00	18200.00	.
Aniline	A	5	5	10.00	ug/L	1720.00	.	1720.00	255.63	.	255.63
Aniline	B	2	2	10.00	ug/L	550.00	.	550.00	197.27	.	197.27
Aniline	C	3	3	10.00	ug/L	3400.00	.	3400.00	164.85	.	164.85
Aniline	D	4	0	10.00	ug/L	220.02	220.02	.	220.02	220.02	.
Aniline	E	5	5	10.00	ug/L	26.00	.	26.00	26.00	.	26.00
Aniline	F	5	5	10.00	ug/L	318.00	.	318.00	175.81	.	175.81
Aniline	G	4	5	10.00	ug/L	204.08	306.30	170.00	177.71	306.30	134.85
Anthracene	A	5	5	10.00	ug/L	1720.00	.	1720.00	944.44	.	944.44
Anthracene	B	2	2	10.00	ug/L	550.00	.	550.00	550.00	.	550.00
Anthracene	C	3	3	10.00	ug/L	3400.00	.	3400.00	814.80	.	814.80
Anthracene	D	4	4	10.00	ug/L	10.00	.	10.00	10.00	.	10.00
Anthracene	E	5	1	10.00	ug/L	459.47	564.33	40.00	459.47	564.33	40.00
Anthracene	F	5	3	10.00	ug/L	398.16	735.39	173.33	398.16	735.39	173.33
Anthracene	G	4	0	10.00	ug/L	5613.63	5613.63	.	5613.63	5613.63	.

¹ #Obs = Total Number of Samples; #NDs = Number of Samples with Non-Detect Values; Replaced = After Replacement of Sample-Specific NDs

Table 12-7. Oils Subcategory Emulsion Breaking/Gravity Separation Data Sets Before and After Sample-Specific Non-Detect Replacement¹

Analyte	Facility	# Obs	# NDS	Minimum Analytical DL	Units	Original Overall Mean	Original Mean of Detects	Original Mean of NDS	Replaced Overall Mean	Replaced Mean of Detects	Replaced Mean of NDS
Antimony	A	20	1	20.00	ug/L	62.38	61.66	76.00	62.38	61.66	76.00
Antimony	B	2	2	20.00	ug/L	6375.00	.	6375.00	210.09	.	210.09
Antimony	C	2	0	20.00	ug/L	101.67	101.67	.	101.67	101.67	.
Antimony	D	4	4	20.00	ug/L	18.00	.	18.00	18.00	.	18.00
Antimony	E	5	0	20.00	ug/L	115.68	115.68	.	115.68	115.68	.
Antimony	F	5	1	20.00	ug/L	858.40	1068.00	20.00	858.40	1068.00	20.00
Antimony	G	4	1	20.00	ug/L	102.94	130.58	20.00	102.94	130.58	20.00
Arsenic	A	20	0	10.00	ug/L	162.18	162.18	.	162.18	162.18	.
Arsenic	B	2	1	10.00	ug/L	543.50	487.00	600.00	543.50	487.00	600.00
Arsenic	C	3	0	10.00	ug/L	117.00	117.00	.	117.00	117.00	.
Arsenic	D	4	0	10.00	ug/L	97.80	97.80	.	97.80	97.80	.
Arsenic	E	5	1	10.00	ug/L	45.16	55.95	2.00	45.16	55.95	2.00
Arsenic	F	5	0	10.00	ug/L	5942.00	5942.00	.	5942.00	5942.00	.
Arsenic	G	4	0	10.00	ug/L	382.38	382.38	.	382.38	382.38	.
Barium	A	20	0	200.00	ug/L	2801.40	2801.40	.	2801.40	2801.40	.
Barium	B	2	0	200.00	ug/L	1619.00	1619.00	.	1619.00	1619.00	.
Barium	C	3	0	200.00	ug/L	2693.00	2693.00	.	2693.00	2693.00	.
Barium	D	4	0	200.00	ug/L	100.38	100.38	.	100.38	100.38	.
Barium	E	5	0	200.00	ug/L	115.42	115.42	.	115.42	115.42	.
Barium	F	5	0	200.00	ug/L	2726.00	2726.00	.	2726.00	2726.00	.
Barium	G	4	0	200.00	ug/L	1978.50	1978.50	.	1978.50	1978.50	.
Benzene	A	5	0	10.00	ug/L	16400.80	16400.80	.	16400.80	16400.80	.
Benzene	B	2	0	10.00	ug/L	71.86	71.86	.	71.86	71.86	.
Benzene	C	3	0	10.00	ug/L	127.76	127.76	.	127.76	127.76	.
Benzene	D	4	0	10.00	ug/L	431.81	431.81	.	431.81	431.81	.
Benzene	E	5	0	10.00	ug/L	881.28	881.28	.	881.28	881.28	.
Benzene	F	5	0	10.00	ug/L	1053.17	1053.17	.	1053.17	1053.17	.
Benzene	G	4	0	10.00	ug/L	2312.16	2312.16	.	2312.16	2312.16	.
Benzo(a)anthracene	A	5	5	10.00	ug/L	1720.00	.	1720.00	662.98	.	662.98
Benzo(a)anthracene	B	2	2	10.00	ug/L	550.00	.	550.00	451.86	.	451.86
Benzo(a)anthracene	C	3	3	10.00	ug/L	3400.00	.	3400.00	334.57	.	334.57
Benzo(a)anthracene	D	4	4	10.00	ug/L	10.00	.	10.00	10.00	.	10.00
Benzo(a)anthracene	E	5	0	10.00	ug/L	423.19	423.19	.	423.19	423.19	.
Benzo(a)anthracene	F	5	3	10.00	ug/L	315.08	135.84	500.00	315.08	135.84	434.57
Benzo(a)anthracene	G	4	0	10.00	ug/L	1899.63	1899.63	.	1899.63	1899.63	.
Benzo(a)pyrene	A	5	5	10.00	ug/L	1720.00	.	1720.00	870.97	.	870.97
Benzo(a)pyrene	B	2	2	10.00	ug/L	550.00	.	550.00	550.00	.	550.00
Benzo(a)pyrene	C	3	3	10.00	ug/L	3400.00	.	3400.00	569.89	.	569.90
Benzo(a)pyrene	D	4	4	10.00	ug/L	10.00	.	10.00	10.00	.	10.00
Benzo(a)pyrene	E	5	5	10.00	ug/L	26.00	.	26.00	26.00	.	26.00
Benzo(a)pyrene	F	5	4	10.00	ug/L	327.02	65.12	392.50	327.02	65.12	392.50
Benzo(a)pyrene	G	4	1	10.00	ug/L	1891.79	2389.05	400.00	1891.79	2389.05	400.00
Benzo(b)fluoranthene	A	5	5	10.00	ug/L	1720.00	.	1720.00	783.82	.	783.82
Benzo(b)fluoranthene	B	2	2	10.00	ug/L	550.00	.	550.00	527.38	.	527.39
Benzo(b)fluoranthene	C	3	3	10.00	ug/L	3400.00	.	3400.00	384.92	.	384.92
Benzo(b)fluoranthene	D	4	4	10.00	ug/L	10.00	.	10.00	10.00	.	10.00
Benzo(b)fluoranthene	E	5	3	10.00	ug/L	59.32	113.31	23.33	59.32	113.31	23.33
Benzo(b)fluoranthene	F	5	4	10.00	ug/L	321.52	37.60	392.50	312.47	37.60	381.19
Benzo(b)fluoranthene	G	4	1	10.00	ug/L	1643.54	2058.05	400.00	1643.54	2058.05	400.00
Benzo(k)fluoranthene	A	5	5	10.00	ug/L	1720.00	.	1720.00	848.16	.	848.16
Benzo(k)fluoranthene	B	2	2	10.00	ug/L	550.00	.	550.00	550.00	.	550.00
Benzo(k)fluoranthene	C	3	3	10.00	ug/L	3400.00	.	3400.00	493.88	.	493.88
Benzo(k)fluoranthene	D	4	4	10.00	ug/L	10.00	.	10.00	10.00	.	10.00
Benzo(k)fluoranthene	E	5	5	10.00	ug/L	26.00	.	26.00	26.00	.	26.00
Benzo(k)fluoranthene	F	5	4	10.00	ug/L	321.52	37.60	392.50	321.52	37.60	392.50
Benzo(k)fluoranthene	G	4	1	10.00	ug/L	1631.40	2041.86	400.00	1631.40	2041.86	400.00

¹ #Obs = Total Number of Samples; #NDS = Number of Samples with Non-Detect Values; Replaced = After Replacement of Sample-Specific NDS

Table 12-7. Oils Subcategory Emulsion Breaking/Gravity Separation Data Sets Before and After Sample-Specific Non-Detect Replacement¹

Analyte	Facility	# Obs	# NDS	Minimum Analytical DL	Units	Original Overall Mean	Original Mean of Detects	Original Mean of NDS	Replaced Overall Mean	Replaced Mean of Detects	Replaced Mean of NDS
Benzoic Acid	A	5	2	50.00	ug/L	16199.82	16166.37	16250.00	13710.07	16166.37	10025.62
Benzoic Acid	B	2	2	50.00	ug/L	2750.00	.	2750.00	2750.00	.	2750.00
Benzoic Acid	C	4	0	50.00	ug/L	19716.67	19716.67	.	19716.67	19716.67	.
Benzoic Acid	D	4	0	50.00	ug/L	5860.72	5860.72	.	5860.72	5860.72	.
Benzoic Acid	E	5	0	50.00	ug/L	72327.80	72327.80	.	72327.80	72327.80	.
Benzoic Acid	F	5	0	50.00	ug/L	27372.75	27372.75	.	27372.75	27372.75	.
Benzoic Acid	G	4	0	50.00	ug/L	6419.25	6419.25	.	6419.25	6419.25	.
Benzyl Alcohol	A	5	5	10.00	ug/L	1720.00	.	1720.00	452.83	.	452.83
Benzyl Alcohol	B	2	2	10.00	ug/L	550.00	.	550.00	320.52	.	320.52
Benzyl Alcohol	C	3	2	10.00	ug/L	3515.87	447.60	5050.00	362.88	447.60	320.52
Benzyl Alcohol	D	4	3	10.00	ug/L	17.41	39.65	10.00	17.41	39.65	10.00
Benzyl Alcohol	E	5	2	10.00	ug/L	341.20	542.00	40.00	341.20	542.00	40.00
Benzyl Alcohol	F	5	4	10.00	ug/L	404.44	502.20	380.00	312.65	502.20	265.26
Benzyl Alcohol	G	4	3	10.00	ug/L	325.66	782.66	173.33	325.66	782.66	173.33
Beryllium	A	20	5	5.00	ug/L	35.28	46.90	0.42	35.28	46.90	0.42
Beryllium	B	2	2	5.00	ug/L	63.75	.	63.75	23.19	.	23.19
Beryllium	C	3	1	5.00	ug/L	46.33	54.50	30.00	46.33	54.50	30.00
Beryllium	D	4	4	5.00	ug/L	1.00	.	1.00	1.00	.	1.00
Beryllium	E	5	5	5.00	ug/L	1.00	.	1.00	1.00	.	1.00
Beryllium	F	5	4	5.00	ug/L	1.01	1.04	1.00	1.01	1.04	1.00
Beryllium	G	4	4	5.00	ug/L	1.00	.	1.00	1.00	.	1.00
Biphenyl	A	5	5	10.00	ug/L	1720.00	.	1720.00	905.30	.	905.30
Biphenyl	B	2	2	10.00	ug/L	550.00	.	550.00	550.00	.	550.00
Biphenyl	C	3	3	10.00	ug/L	3400.00	.	3400.00	684.33	.	684.33
Biphenyl	D	4	0	10.00	ug/L	40.05	40.05	.	40.05	40.05	.
Biphenyl	E	5	0	10.00	ug/L	2821.92	2821.92	.	2821.92	2821.92	.
Biphenyl	F	5	1	10.00	ug/L	523.49	579.37	300.00	523.49	579.37	300.00
Biphenyl	G	4	2	10.00	ug/L	2755.09	5260.19	250.00	2755.09	5260.19	250.00
Bis(2-ethylhexyl) Phthalate	A	5	4	10.00	ug/L	2308.33	8441.65	775.00	2308.33	8441.65	775.00
Bis(2-ethylhexyl) Phthalate	B	2	2	10.00	ug/L	550.00	.	550.00	550.00	.	550.00
Bis(2-ethylhexyl) Phthalate	C	3	0	10.00	ug/L	279928.66	279928.66	.	279928.66	279928.66	.
Bis(2-ethylhexyl) Phthalate	D	4	4	10.00	ug/L	10.00	.	10.00	10.00	.	10.00
Bis(2-ethylhexyl) Phthalate	E	5	0	10.00	ug/L	198.21	198.21	.	198.21	198.21	.
Bis(2-ethylhexyl) Phthalate	F	5	3	10.00	ug/L	490.02	475.05	500.00	490.02	475.05	500.00
Bis(2-ethylhexyl) Phthalate	G	4	2	10.00	ug/L	1707.40	3164.80	250.00	1707.40	3164.80	250.00
Boron	A	20	0	100.00	ug/L	45570.00	45570.00	.	45570.00	45570.00	.
Boron	B	2	0	100.00	ug/L	974000.00	974000.00	.	974000.00	974000.00	.
Boron	C	3	0	100.00	ug/L	72585.00	72585.00	.	72585.00	72585.00	.
Boron	D	4	0	100.00	ug/L	2247.50	2247.50	.	2247.50	2247.50	.
Boron	E	5	0	100.00	ug/L	8868.00	8868.00	.	8868.00	8868.00	.
Boron	F	5	0	100.00	ug/L	33530.00	33530.00	.	33530.00	33530.00	.
Boron	G	4	0	100.00	ug/L	38717.50	38717.50	.	38717.50	38717.50	.
Butanone	A	5	2	50.00	ug/L	39276.18	62126.96	5000.0	39276.18	62126.96	5000.00
Butanone	B	2	0	50.00	ug/L	506.40	506.40	.	506.40	506.40	.
Butanone	C	3	0	50.00	ug/L	1193.77	1193.77	.	1193.77	1193.77	.
Butanone	D	4	0	50.00	ug/L	1129.62	1129.62	.	1129.62	1129.62	.
Butanone	E	5	0	50.00	ug/L	1400.40	1400.40	.	1400.40	1400.40	.
Butanone	F	5	0	50.00	ug/L	13465.65	13465.65	.	13465.65	13465.65	.
Butanone	G	4	0	50.00	ug/L	24277.21	24277.21	.	24277.21	24277.21	.
Butyl Benzyl Phthalate	A	5	5	10.00	ug/L	1720.00	.	1720.0	1380.84	.	1380.84
Butyl Benzyl Phthalate	B	2	0	10.00	ug/L	24781.83	24781.83	.	24781.83	24781.83	.
Butyl Benzyl Phthalate	C	3	3	10.00	ug/L	3400.00	.	3400.0	2269.48	.	2269.48
Butyl Benzyl Phthalate	D	4	4	10.00	ug/L	10.00	.	10.0	10.00	.	10.00
Butyl Benzyl Phthalate	E	5	5	10.00	ug/L	26.00	.	26.0	26.00	.	26.00
Butyl Benzyl Phthalate	F	5	3	10.00	ug/L	360.15	150.38	500.0	360.15	150.38	500.00
Butyl Benzyl Phthalate	G	4	2	10.00	ug/L	742.95	1235.91	250.0	742.95	1235.91	250.00

¹ #Obs = Total Number of Samples; #NDS = Number of Samples with Non-Detect Values; Replaced = After Replacement of Sample-Specific NDS

Table 12-7. Oils Subcategory Emulsion Breaking/Gravity Separation Data Sets Before and After Sample-Specific Non-Detect Replacement¹

Analyte	Facility	# Obs	# NDS	Minimum Analytical DL	Units	Original Overall Mean	Original Mean of Detects	Original Mean of NDs	Replaced Overall Mean	Replaced Mean of Detects	Replaced Mean of NDs
Cadmium	A	20	3	5.00	ug/L	218.82	257.13	1.7	218.82	257.13	1.70
Cadmium	B	20	1	5.00	ug/L	228.75	37.50	420.0	106.35	37.50	175.20
Cadmium	C	44	0	5.00	ug/L	281.67	367.50	110.0	281.67	367.50	110.00
Cadmium	D	44	0	5.00	ug/L	81.63	81.63	.	81.63	81.63	.
Cadmium	E	55	4	5.00	ug/L	5.72	8.60	5.0	5.72	8.60	5.00
Cadmium	F	55	0	5.00	ug/L	79.29	79.29	.	79.29	79.29	.
Cadmium	G	44	0	5.00	ug/L	51.94	51.94	.	51.94	51.94	.
Carbazole	A	55	5	20.00	ug/L	3440.00	.	3440.0	409.74	.	409.74
Carbazole	B	20	2	20.00	ug/L	1100.00	.	1100.0	331.09	.	331.09
Carbazole	C	33	3	20.00	ug/L	6800.00	.	6800.0	287.39	.	287.39
Carbazole	D	44	4	20.00	ug/L	20.00	.	20.0	20.00	.	20.00
Carbazole	E	55	2	20.00	ug/L	133.54	169.23	80.0	133.54	169.23	80.00
Carbazole	F	44	1	20.00	ug/L	642.14	105.36	1000.0	307.01	105.36	441.45
Carbazole	G	55	1	20.00	ug/L	800.69	1000.93	200.0	800.69	1000.93	200.00
Carbon Disulfide	A	55	5	10.00	ug/L	820.00	.	820.0	307.00	.	307.00
Carbon Disulfide	B	20	1	10.00	ug/L	218.98	427.96	10.0	218.98	427.96	10.00
Carbon Disulfide	C	33	0	10.00	ug/L	112.97	112.97	.	112.97	112.97	.
Carbon Disulfide	D	44	3	10.00	ug/L	504.86	1989.44	10.0	504.86	1989.44	10.00
Carbon Disulfide	E	55	1	10.00	ug/L	15.47	16.84	10.0	15.47	16.84	10.00
Carbon Disulfide	F	55	2	10.00	ug/L	527.27	872.12	10.0	527.27	872.12	10.00
Carbon Disulfide	G	44	2	10.00	ug/L	27.24	44.47	10.0	27.24	44.47	10.00
Chlorobenzene	A	55	5	10.00	ug/L	820.00	.	820.0	159.15	.	159.15
Chlorobenzene	B	20	2	10.00	ug/L	10.00	.	10.0	10.00	.	10.00
Chlorobenzene	C	33	1	10.00	ug/L	77.39	66.09	100.0	77.39	66.09	100.00
Chlorobenzene	D	44	4	10.00	ug/L	10.00	.	10.0	10.00	.	10.00
Chlorobenzene	E	55	5	10.00	ug/L	10.00	.	10.0	10.00	.	10.00
Chlorobenzene	F	44	0	10.00	ug/L	154.11	154.11	.	154.11	154.11	.
Chlorobenzene	G	55	0	10.00	ug/L	198.58	198.58	.	198.58	198.58	.
Chloroform	A	55	5	10.00	ug/L	820.00	.	820.0	524.39	.	524.39
Chloroform	B	20	2	10.00	ug/L	10.00	.	10.0	10.00	.	10.00
Chloroform	C	33	0	10.00	ug/L	322.51	322.51	.	322.51	322.51	.
Chloroform	D	44	4	10.00	ug/L	10.00	.	10.0	10.00	.	10.00
Chloroform	E	55	5	10.00	ug/L	10.00	.	10.0	10.00	.	10.00
Chloroform	F	44	0	10.00	ug/L	421.68	421.68	.	421.68	421.68	.
Chloroform	G	55	0	10.00	ug/L	1007.76	1007.76	.	1007.76	1007.76	.
Chromium	A	20	0	10.00	ug/L	1618.98	1618.98	.	1618.98	1618.98	.
Chromium	B	20	0	10.00	ug/L	781.50	781.50	.	781.50	781.50	.
Chromium	C	44	0	10.00	ug/L	4100.33	4100.33	.	4100.33	4100.33	.
Chromium	D	44	0	10.00	ug/L	30.40	30.40	.	30.40	30.40	.
Chromium	E	55	0	10.00	ug/L	44.84	44.84	.	44.84	44.84	.
Chromium	F	55	0	10.00	ug/L	2507.00	2507.00	.	2507.00	2507.00	.
Chromium	G	44	0	10.00	ug/L	1467.00	1467.00	.	1467.00	1467.00	.
Chrysene	A	55	5	10.00	ug/L	1720.00	.	1720.0	835.03	.	835.03
Chrysene	B	20	2	10.00	ug/L	550.00	.	550.0	550.00	.	550.00
Chrysene	C	33	3	10.00	ug/L	3400.00	.	3400.0	450.10	.	450.10
Chrysene	D	44	4	10.00	ug/L	10.00	.	10.0	10.00	.	10.00
Chrysene	E	55	0	10.00	ug/L	701.19	701.19	.	701.19	701.19	.
Chrysene	F	44	3	10.00	ug/L	373.55	183.88	500.0	373.55	183.88	500.00
Chrysene	G	55	0	10.00	ug/L	2586.09	2586.09	.	2586.09	2586.09	.
Cobalt	A	20	0	50.00	ug/L	648.93	648.93	.	648.93	648.93	.
Cobalt	B	20	2	50.00	ug/L	999.00	.	999.0	999.00	.	999.00
Cobalt	C	33	2	50.00	ug/L	642.67	868.00	530.0	642.67	868.00	530.00
Cobalt	D	44	2	50.00	ug/L	7.33	8.65	6.0	7.33	8.65	6.00
Cobalt	E	55	4	50.00	ug/L	18.76	53.80	10.0	18.76	53.80	10.00
Cobalt	F	55	0	50.00	ug/L	2133.00	2133.00	.	2133.00	2133.00	.
Cobalt	G	44	0	50.00	ug/L	30903.75	30903.75	.	30903.75	30903.75	.

¹ #Obs = Total Number of Samples; #NDS = Number of Samples with Non-Detect Values; Replaced = After Replacement of Sample-Specific NDs

Table 12-7. Oils Subcategory Emulsion Breaking/Gravity Separation Data Sets Before and After Sample-Specific Non-Detect Replacement¹

Analyte	Facility	# Obs	# NDs	Minimum Analytical DL	Units	Original Overall Mean	Original Mean of Detects	Original Mean of NDs	Replaced Overall Mean	Replaced Mean of Detects	Replaced Mean of NDs
Copper	A	20	0	25.00	ug/L	14135.50	14135.50	.	14135.50	14135.50	.
Copper	B	2	0	25.00	ug/L	1900.00	1900.00	.	1900.00	1900.00	.
Copper	C	3	0	25.00	ug/L	27795.33	27795.33	.	27795.33	27795.33	.
Copper	D	4	1	25.00	ug/L	31.40	26.50	46.1	31.40	26.50	46.10
Copper	E	5	0	25.00	ug/L	956.04	956.04	.	956.04	956.04	.
Copper	F	5	0	25.00	ug/L	3168.00	3168.00	.	3168.00	3168.00	.
Copper	G	4	0	25.00	ug/L	2841.25	2841.25	.	2841.25	2841.25	.
Di-n-butyl Phthalate	A	5	5	10.00	ug/L	1720.00	.	1720.0	293.44	.	293.44
Di-n-butyl Phthalate	B	2	2	10.00	ug/L	550.00	.	550.0	220.90	.	220.90
Di-n-butyl Phthalate	C	3	3	10.00	ug/L	3400.00	.	3400.0	180.60	.	180.60
Di-n-butyl Phthalate	D	4	4	10.00	ug/L	10.00	.	10.0	10.00	.	10.00
Di-n-butyl Phthalate	E	5	4	10.00	ug/L	42.34	121.68	22.5	42.34	121.68	22.50
Di-n-butyl Phthalate	F	5	4	10.00	ug/L	337.39	116.94	392.5	205.75	116.94	227.95
Di-n-butyl Phthalate	G	4	2	10.00	ug/L	466.54	683.08	250.0	451.99	683.08	220.90
Dibenzofuran	A	5	5	10.00	ug/L	1720.00	.	1720.0	1012.76	.	1012.76
Dibenzofuran	B	2	2	10.00	ug/L	550.00	.	550.0	550.00	.	550.00
Dibenzofuran	C	3	3	10.00	ug/L	3400.00	.	3400.0	1042.52	.	1042.52
Dibenzofuran	D	4	4	10.00	ug/L	10.00	.	10.0	10.00	.	10.00
Dibenzofuran	E	5	5	10.00	ug/L	26.00	.	26.0	26.00	.	26.00
Dibenzofuran	F	5	4	10.00	ug/L	327.46	117.30	380.0	327.46	117.30	380.00
Dibenzofuran	G	4	0	10.00	ug/L	4286.00	4286.00	.	4286.00	4286.00	.
Dibenzothiophene	A	5	5	10.00	ug/L	1720.00	.	1720	824.48	.	824.48
Dibenzothiophene	B	2	2	10.00	ug/L	550.00	.	550	550.00	.	550.00
Dibenzothiophene	C	3	3	10.00	ug/L	3400.00	.	3400	414.94	.	414.94
Dibenzothiophene	D	4	4	10.00	ug/L	10.00	.	10	10.00	.	10.00
Dibenzothiophene	E	5	0	10.00	ug/L	815.35	815.35	.	815.35	815.35	.
Dibenzothiophene	F	5	5	10.00	ug/L	318.00	.	318	318.00	.	318.00
Dibenzothiophene	G	4	0	10.00	ug/L	1662.37	1662.37	.	1662.37	1662.37	.
Diethyl Phthalate	A	5	5	10.00	ug/L	1720.00	.	1720	939.50	.	939.50
Diethyl Phthalate	B	2	2	10.00	ug/L	550.00	.	550	550.00	.	550.00
Diethyl Phthalate	C	3	3	10.00	ug/L	3400.00	.	3400	798.33	.	798.33
Diethyl Phthalate	D	4	4	10.00	ug/L	10.00	.	10	10.00	.	10.00
Diethyl Phthalate	E	5	2	10.00	ug/L	366.27	593.78	25	366.27	593.78	25.00
Diethyl Phthalate	F	5	1	10.00	ug/L	3916.63	4645.78	1000	3916.63	4645.78	1000.00
Diethyl Phthalate	G	4	5	10.00	ug/L	1078.81	1305.08	400	1078.81	1305.08	400.00
Diphenyl Ether	A	5	5	10.00	ug/L	1720.00	.	1720	1328.05	.	1328.05
Diphenyl Ether	B	2	2	10.00	ug/L	550.00	.	550	550.00	.	550.00
Diphenyl Ether	C	3	3	10.00	ug/L	3400.00	.	3400	2093.49	.	2093.49
Diphenyl Ether	D	4	4	10.00	ug/L	10.00	.	10	10.00	.	10.00
Diphenyl Ether	E	5	5	10.00	ug/L	9229.70	9229.70	.	9229.70	9229.70	.
Diphenyl Ether	F	5	4	10.00	ug/L	333.86	149.30	380	333.86	149.30	380.00
Diphenyl Ether	G	4	3	10.00	ug/L	203.40	303.59	170	203.40	303.59	170.00
Ethylbenzene	A	5	0	10.00	ug/L	12647.80	12647.80	.	12647.80	12647.80	.
Ethylbenzene	B	2	0	10.00	ug/L	215.90	215.90	.	215.90	215.90	.
Ethylbenzene	C	3	0	10.00	ug/L	820.00	820.00	.	820.00	820.00	.
Ethylbenzene	D	4	0	10.00	ug/L	97.18	97.18	.	97.18	97.18	.
Ethylbenzene	E	5	0	10.00	ug/L	794.14	794.14	.	794.14	794.14	.
Ethylbenzene	F	5	0	10.00	ug/L	1585.12	1585.12	.	1585.12	1585.12	.
Ethylbenzene	G	4	0	10.00	ug/L	7096.11	7096.11	.	7096.11	7096.11	.
Fluoranthene	A	5	5	10.00	ug/L	1720.00	.	1720	999.94	.	999.94
Fluoranthene	B	2	2	10.00	ug/L	550.00	.	550	550.00	.	550.00
Fluoranthene	C	3	3	10.00	ug/L	3400.00	.	3400	999.81	.	999.81
Fluoranthene	D	4	4	10.00	ug/L	10.00	.	10	10.00	.	10.00
Fluoranthene	E	5	0	10.00	ug/L	279.73	279.73	.	279.73	279.73	.
Fluoranthene	F	5	1	10.00	ug/L	892.90	1066.13	200	892.90	1066.13	200.00
Fluoranthene	G	4	0	10.00	ug/L	8867.33	8867.33	.	8867.33	8867.33	.

¹ #Obs = Total Number of Samples; #NDs = Number of Samples with Non-Detect Values; Replaced = After Replacement of Sample-Specific NDs

Table 12-7. Oils Subcategory Emulsion Breaking/Gravity Separation Data Sets Before and After Sample-Specific Non-Detect Replacement¹

Analyte	Facility	# Obs	# NDS	Minimum Analytical DL	Units	Original Overall Mean	Original Mean of Detects	Original Mean of NDS	Replaced Overall Mean	Replaced Mean of Detects	Replaced Mean of NDS
Fluorene	A	5	5	10.00	ug/L	1720.00	.	1720	909.39	.	909.39
Fluorene	B	3	3	10.00	ug/L	550.00	.	550	550.00	.	550.00
Fluorene	C	3	3	10.00	ug/L	3400.00	.	3400	697.96	.	697.96
Fluorene	D	4	4	10.00	ug/L	10.00	.	10	10.00	.	10.00
Fluorene	E	5	2	10.00	ug/L	167.68	252.79	40	167.68	252.79	40.00
Fluorene	F	5	3	10.00	ug/L	356.67	141.68	500	356.67	141.68	500.00
Fluorene	G	4	0	10.00	ug/L	5199.70	5199.70	.	5199.70	5199.70	.
Germanium	B	2	2	500.00	ug/L	53125.00	.	53125	8777.50	.	8777.50
Germanium	C	3	1	500.00	ug/L	10146.67	11305.00	7830	10146.67	11305.00	7830.00
Germanium	E	5	5	500.00	ug/L	500.00	.	500	500.00	.	500.00
Germanium	F	5	5	500.00	ug/L	500.00	.	500	500.00	.	500.00
Germanium	G	4	4	500.00	ug/L	500.00	.	500	500.00	.	500.00
Hexanoic Acid	A	5	1	10.00	ug/L	6698.58	8348.22	100	6698.58	8348.22	100.00
Hexanoic Acid	B	2	2	10.00	ug/L	550.00	.	550	550.00	.	550.00
Hexanoic Acid	C	3	0	10.00	ug/L	5613.10	5613.10	.	5613.10	5613.10	.
Hexanoic Acid	D	4	0	10.00	ug/L	2104.34	2104.34	.	2104.34	2104.34	.
Hexanoic Acid	E	5	0	10.00	ug/L	41560.56	41560.56	.	41560.56	41560.56	.
Hexanoic Acid	F	5	0	10.00	ug/L	10988.88	10988.88	.	10988.88	10988.88	.
Hexanoic Acid	G	4	3	10.00	ug/L	440.09	1640.37	40	440.09	1640.37	40.00
Iron	A	20	0	100.00	ug/L	190030.00	190030.00	.	190030.00	190030.00	.
Iron	B	2	0	100.00	ug/L	83300.00	83300.00	.	83300.00	83300.00	.
Iron	C	3	0	100.00	ug/L	401870.00	401870.00	.	401870.00	401870.00	.
Iron	D	4	0	100.00	ug/L	2631.00	2631.00	.	2631.00	2631.00	.
Iron	E	5	0	100.00	ug/L	8575.00	8575.00	.	8575.00	8575.00	.
Iron	F	5	0	100.00	ug/L	350580.00	350580.00	.	350580.00	350580.00	.
Iron	G	4	0	100.00	ug/L	77200.00	77200.00	.	77200.00	77200.00	.
Lead	A	20	0	50.00	ug/L	9939.25	9939.25	.	9939.25	9939.25	.
Lead	B	2	0	50.00	ug/L	1468.50	1468.50	.	1468.50	1468.50	.
Lead	C	3	1	50.00	ug/L	9623.00	13464.50	1940	9623.00	13464.50	1940.00
Lead	D	4	0	50.00	ug/L	45.68	45.68	.	45.68	45.68	.
Lead	E	5	0	50.00	ug/L	177.60	177.60	.	177.60	177.60	.
Lead	F	5	0	50.00	ug/L	2234.00	2234.00	.	2234.00	2234.00	.
Lead	G	4	0	50.00	ug/L	1974.25	1974.25	.	1974.25	1974.25	.
Lithium	B	2	2	100.00	ug/L	10625.00	.	10625	1286.05	.	1286.05
Lithium	C	3	3	100.00	ug/L	2910.00	.	2910	1322.09	.	1322.09
Lithium	E	5	5	100.00	ug/L	100.00	.	100	100.00	.	100.00
Lithium	F	5	0	100.00	ug/L	761.00	761.00	.	761.00	761.00	.
Lithium	G	4	0	100.00	ug/L	2458.00	2458.00	.	2458.00	2458.00	.
Lutetium	B	2	0	100.00	ug/L	10625.00	10625	1247.00	1247.00	.	1247.00
Lutetium	C	3	2	100.00	ug/L	1247.00	1247.00	.	1247.00	1247.00	.
Lutetium	E	5	5	100.00	ug/L	100.00	.	100	100.00	.	100.00
Lutetium	F	5	5	100.00	ug/L	100.00	.	100	100.00	.	100.00
Lutetium	G	4	4	100.00	ug/L	100.00	.	100	100.00	.	100.00
M-xylene	A	5	0	10.00	ug/L	20696.72	20696.72	.	20696.72	20696.72	.
M-xylene	B	2	0	10.00	ug/L	207.79	207.79	.	207.79	207.79	.
M-xylene	C	3	0	10.00	ug/L	3250.70	3250.70	.	3250.70	3250.70	.
M-xylene	D	4	0	10.00	ug/L	189.85	189.85	.	189.85	189.85	.
M-xylene	E	5	0	10.00	ug/L	791.01	791.01	.	791.01	791.01	.
M-xylene	F	5	3	10.00	ug/L	1971.00	4912.50	10	1971.00	4912.50	10.00
M-xylene	G	4	2	10.00	ug/L	5395.13	10780.25	10	5395.13	10780.25	10.00
Magnesium	A	20	0	5000.00	ug/L	43422.50	43422.50	.	43422.50	43422.50	.
Magnesium	B	2	0	5000.00	ug/L	24000.00	24000.00	.	24000.00	24000.00	.
Magnesium	C	3	0	5000.00	ug/L	180886.67	180886.67	.	180886.67	180886.67	.
Magnesium	D	4	0	5000.00	ug/L	578500.00	578500.00	.	578500.00	578500.00	.
Magnesium	E	5	0	5000.00	ug/L	6329.00	6329.00	.	6329.00	6329.00	.
Magnesium	F	5	0	5000.00	ug/L	102480.00	102480.00	.	102480.00	102480.00	.
Magnesium	G	4	0	5000.00	ug/L	59637.50	59637.50	.	59637.50	59637.50	.

¹ #Obs = Total Number of Samples; #NDS = Number of Samples with Non-Detect Values; Replaced = After Replacement of Sample-Specific NDS

Table 12-7. Oils Subcategory Emulsion Breaking/Gravity Separation Data Sets Before and After Sample-Specific Non-Detect Replacement¹

Analyte	Facility	# Obs	# NDS	Minimum Analytical DL	Units	Original Overall Mean	Original Mean of Detects	Original Mean of NDS	Replaced Overall Mean	Replaced Mean of Detects	Replaced Mean of NDS
Manganese	A	20	0	15.00	ug/L	4789.75	4789.75	.	4789.75	4789.75	.
Manganese	B	2	0	15.00	ug/L	2200.00	2200.00	.	2200.00	2200.00	.
Manganese	C	3	0	15.00	ug/L	15175.33	15175.33	.	15175.33	15175.33	.
Manganese	D	4	0	15.00	ug/L	5930.00	5930.00	.	5930.00	5930.00	.
Manganese	E	5	0	15.00	ug/L	749.40	749.40	.	749.40	749.40	.
Manganese	F	5	0	15.00	ug/L	9340.00	9340.00	.	9340.00	9340.00	.
Manganese	G	4	0	15.00	ug/L	12972.50	12972.50	.	12972.50	12972.50	.
Mercury	A	20	0	0.20	ug/L	2.37	2.37	.	2.37	2.37	.
Mercury	B	2	1	0.20	ug/L	1.19	0.38	2.0	1.19	0.38	2.00
Mercury	C	3	1	0.20	ug/L	3.96	4.94	2.0	3.96	4.94	2.00
Mercury	D	4	3	0.20	ug/L	0.68	2.10	0.2	0.68	2.10	0.20
Mercury	E	5	3	0.20	ug/L	0.25	0.34	0.2	0.25	0.34	0.20
Mercury	F	5	0	0.20	ug/L	10.38	10.38	.	10.38	10.38	.
Mercury	G	4	0	0.20	ug/L	19.81	19.81	.	19.81	19.81	.
Methylene Chloride	A	5	2	10.00	ug/L	2653.78	3756.30	1000.0	2653.78	3756.30	1000.00
Methylene Chloride	B	2	0	10.00	ug/L	382.91	382.91	.	382.91	382.91	.
Methylene Chloride	C	3	0	10.00	ug/L	234.99	234.99	.	234.99	234.99	.
Methylene Chloride	D	4	0	10.00	ug/L	40.27	40.27	.	40.27	40.27	.
Methylene Chloride	E	5	0	10.00	ug/L	57.08	57.08	.	57.08	57.08	.
Methylene Chloride	F	5	1	10.00	ug/L	4500.62	5623.27	10.0	4500.62	5623.27	10.00
Methylene Chloride	G	4	0	10.00	ug/L	5788.27	5788.27	.	5788.27	5788.27	.
Molybdenum	A	20	0	10.00	ug/L	1575.70	1575.70	.	1575.70	1575.70	.
Molybdenum	B	2	0	10.00	ug/L	7515.00	7515.00	.	7515.00	7515.00	.
Molybdenum	C	3	1	10.00	ug/L	2518.67	3503.00	550.0	2518.67	3503.00	550.00
Molybdenum	D	4	3	10.00	ug/L	8.30	15.20	6.0	8.30	15.20	6.00
Molybdenum	E	5	0	10.00	ug/L	627.40	627.40	.	627.40	627.40	.
Molybdenum	F	5	0	10.00	ug/L	3334.00	3334.00	.	3334.00	3334.00	.
Molybdenum	G	4	0	10.00	ug/L	1405.88	1405.88	.	1405.88	1405.88	.
N-decane	A	5	0	10.00	ug/L	67283.40	67283.40	.	67283.40	67283.40	.
N-decane	B	2	2	10.00	ug/L	550.00	550.00	550.0	550.00	550.00	550.00
N-decane	C	3	0	10.00	ug/L	193443.61	193443.61	.	193443.61	193443.61	.
N-decane	D	4	0	10.00	ug/L	88.82	88.82	.	88.82	88.82	.
N-decane	E	5	1	10.00	ug/L	3351.70	4187.13	10.0	3351.70	4187.13	10.00
N-decane	F	5	1	10.00	ug/L	6157.36	7621.70	300.0	6157.36	7621.70	300.00
N-decane	G	4	0	10.00	ug/L	94097.42	94097.42	.	94097.42	94097.42	.
N-docosane	A	5	2	10.00	ug/L	2866.38	2610.63	3250.0	2015.04	2610.63	1121.65
N-docosane	B	2	2	10.00	ug/L	550.00	550.00	550.0	550.00	550.00	550.00
N-docosane	C	3	1	10.00	ug/L	3443.68	165.52	10000.0	605.89	165.52	1486.62
N-docosane	D	4	0	10.00	ug/L	25.78	25.78	.	25.78	25.78	.
N-docosane	E	5	1	10.00	ug/L	478.49	593.11	20.0	478.49	593.11	20.00
N-docosane	F	5	2	10.00	ug/L	872.67	1021.12	650.0	872.67	1021.12	650.00
N-docosane	G	4	2	10.00	ug/L	4153.82	8057.65	250.0	4153.82	8057.65	250.00
N-dodecane	A	5	0	10.00	ug/L	43124.00	43124.00	.	43124.00	43124.00	.
N-dodecane	B	2	1	10.00	ug/L	7362.65	13725.30	1000.0	7362.65	13725.30	1000.00
N-dodecane	C	3	1	10.00	ug/L	157856.91	236735.36	100.0	157856.91	236735.36	100.00
N-dodecane	D	4	0	10.00	ug/L	163.87	163.87	.	163.87	163.87	.
N-dodecane	E	5	1	10.00	ug/L	6676.20	8335.25	40.0	6676.20	8335.25	40.00
N-dodecane	F	5	0	10.00	ug/L	23565.56	23565.56	.	23565.56	23565.56	.
N-dodecane	G	4	1	10.00	ug/L	65739.50	87619.34	100.0	65739.50	87619.34	100.00

¹ #Obs = Total Number of Samples; #NDS = Number of Samples with Non-Detect Values; Replaced = After Replacement of Sample-Specific NDS

Table 12-7. Oils Subcategory Emulsion Breaking/Gravity Separation Data Sets Before and After Sample-Specific Non-Detect Replacement¹

Analyte	Facility	# Obs	# NDS	Minimum Analytical DL	Units	Original Overall Mean	Original Mean of Detects	Original Mean of NDS	Replaced Overall Mean	Replaced Mean of Detects	Replaced Mean of NDS
N-eicosane	A	5	0	10.00	ug/L	20641.71	20641.71	.	20641.71	20641.71	.
N-eicosane	B	2	0	10.00	ug/L	1755.73	1755.73	.	1755.73	1755.73	.
N-eicosane	C	3	0	10.00	ug/L	106713.64	106713.64	.	106713.64	106713.64	.
N-eicosane	D	4	0	10.00	ug/L	80.44	80.44	.	80.44	80.44	.
N-eicosane	E	5	1	10.00	ug/L	1013.91	1257.39	40.00	1013.91	1257.39	40.00
N-eicosane	F	5	1	10.00	ug/L	4734.04	5842.55	300.00	4734.04	5842.55	300.00
N-eicosane	G	4	0	10.00	ug/L	16508.48	16508.48	.	16508.48	16508.48	.
N-hexacosane	A	5	1	10.00	ug/L	2925.34	2281.67	5500.00	2139.49	2281.67	1570.73
N-hexacosane	B	2	2	10.00	ug/L	550.00	.	550.00	550.00	.	550.00
N-hexacosane	C	3	1	10.00	ug/L	3509.20	263.80	10000.00	889.69	263.80	2141.45
N-hexacosane	D	4	3	10.00	ug/L	11.48	15.92	10.00	11.48	15.92	10.00
N-hexacosane	E	5	4	10.00	ug/L	28.18	30.92	27.50	28.18	30.92	27.50
N-hexacosane	F	5	4	10.00	ug/L	2030.20	9561.00	147.50	2030.20	9561.00	147.50
N-hexacosane	G	4	4	10.00	ug/L	132.50	.	132.50	132.50	.	132.50
N-hexadecane	A	5	1	10.00	ug/L	26302.30	32852.87	100.00	26302.30	32852.87	100.00
N-hexadecane	B	2	0	10.00	ug/L	14877.80	14877.80	.	14877.80	14877.80	.
N-hexadecane	C	3	0	10.00	ug/L	456985.75	456985.75	.	456985.75	456985.75	.
N-hexadecane	D	4	0	10.00	ug/L	429.93	429.93	.	429.93	429.93	.
N-hexadecane	E	5	1	10.00	ug/L	73600.00	91990.00	40.00	73600.00	91990.00	40.00
N-hexadecane	F	5	0	10.00	ug/L	11036.54	11036.54	.	11036.54	11036.54	.
N-hexadecane	G	4	0	10.00	ug/L	65676.48	65676.48	.	65676.48	65676.48	.
N-octadecane	A	5	2	10.00	ug/L	7391.46	11652.43	1000.00	7391.46	11652.43	1000.00
N-octadecane	B	2	1	10.00	ug/L	6907.55	13715.10	100.00	6907.55	13715.10	100.00
N-octadecane	C	3	0	10.00	ug/L	300956.57	300956.57	.	300956.57	300956.57	.
N-octadecane	D	4	0	10.00	ug/L	69.51	69.51	.	69.51	69.51	.
N-octadecane	E	5	0	10.00	ug/L	7235.35	7235.35	.	7235.35	7235.35	.
N-octadecane	F	5	0	10.00	ug/L	6906.68	6906.68	.	6906.68	6906.68	.
N-octadecane	G	4	0	10.00	ug/L	39607.26	39607.26	.	39607.26	39607.26	.
N-tetracosane	A	5	2	10.00	ug/L	4483.55	6805.92	1000.00	3754.71	5591.18	1000.00
N-tetracosane	B	2	2	10.00	ug/L	550.00	.	550.00	550.00	.	550.00
N-tetracosane	C	3	2	10.00	ug/L	3437.53	212.59	5050.00	1008.05	212.59	1405.78
N-tetracosane	D	4	0	10.00	ug/L	26.84	26.84	.	26.84	26.84	.
N-tetracosane	E	5	4	10.00	ug/L	83.94	309.69	27.50	83.94	309.69	27.50
N-tetracosane	F	5	5	10.00	ug/L	318.00	.	318.00	318.00	.	318.00
N-tetracosane	G	4	3	10.00	ug/L	1719.78	6359.14	173.33	1719.78	6359.14	173.33
N-tetradecane	A	5	2	10.00	ug/L	10106.30	16177.17	1000.00	10106.30	16177.17	1000.00
N-tetradecane	B	2	0	10.00	ug/L	107047.15	107047.15	.	107047.15	107047.15	.
N-tetradecane	C	3	0	10.00	ug/L	854184.38	854184.38	.	854184.38	854184.38	.
N-tetradecane	D	4	0	10.00	ug/L	106.15	106.15	.	106.15	106.15	.
N-tetradecane	E	5	0	10.00	ug/L	120070.00	120070.00	.	120070.00	120070.00	.
N-tetradecane	F	5	0	10.00	ug/L	20623.52	20623.52	.	20623.52	20623.52	.
N-tetradecane	G	4	0	10.00	ug/L	85899.52	85899.52	.	85899.52	85899.52	.
N,N-dimethylformamide	A	5	5	10.00	ug/L	1720.00	.	1720.00	306.27	.	306.27
N,N-dimethylformamide	B	2	2	10.00	ug/L	550.00	.	550.00	228.92	.	228.92
N,N-dimethylformamide	C	3	3	10.00	ug/L	3400.00	.	3400.00	185.95	.	185.95
N,N-dimethylformamide	D	4	0	10.00	ug/L	135.38	135.38	.	135.38	135.38	.
N,N-dimethylformamide	E	5	5	10.00	ug/L	26.00	.	26.00	26.00	.	26.00
N,N-dimethylformamide	F	5	4	10.00	ug/L	464.55	802.75	380.00	336.12	802.75	219.46
N,N-dimethylformamide	G	4	4	10.00	ug/L	132.50	.	132.50	121.96	.	121.96

¹ #Obs = Total Number of Samples; #NDS = Number of Samples with Non-Detect Values; Replaced = After Replacement of Sample-Specific NDS

Table 12-7. Oils Subcategory Emulsion Breaking/Gravity Separation Data Sets Before and After Sample-Specific Non-Detect Replacement¹

Analyte	Facility	# Obs	# NDs	Minimum Analytical DL	Units	Original Overall Mean	Original Mean of Detects	Original Mean of NDs	Replaced Overall Mean	Replaced Mean of Detects	Replaced Mean of NDs
Naphthalene	A	5	3	10.00	ug/L	3645.41	8063.52	700.00	3457.54	7593.86	700.00
Naphthalene	B	2	0	10.00	ug/L	4168.47	4168.47	.	4168.47	4168.47	.
Naphthalene	C	2	0	10.00	ug/L	18127.58	18127.58	.	18127.58	18127.58	.
Naphthalene	D	4	0	10.00	ug/L	242.44	242.44	.	242.44	242.44	.
Naphthalene	E	5	0	10.00	ug/L	1851.62	1851.62	.	1851.62	1851.62	.
Naphthalene	F	5	0	10.00	ug/L	6612.13	6612.13	.	6612.13	6612.13	.
Naphthalene	G	4	0	10.00	ug/L	25478.36	25478.36	.	25478.36	25478.36	.
Nickel	A	20	0	40.00	ug/L	50213.50	50213.50	.	50213.50	50213.50	.
Nickel	B	2	1	40.00	ug/L	1216.50	313.00	2120.00	1216.50	313.00	2120.00
Nickel	C	3	0	40.00	ug/L	3642.00	3642.00	.	3642.00	3642.00	.
Nickel	D	4	0	40.00	ug/L	203.50	203.50	.	203.50	203.50	.
Nickel	E	5	0	40.00	ug/L	198.22	198.22	.	198.22	198.22	.
Nickel	F	5	0	40.00	ug/L	2055.00	2055.00	.	2055.00	2055.00	.
Nickel	G	4	0	40.00	ug/L	2987.75	2987.75	.	2987.75	2987.75	.
o+p Xylene	A	5	0	10.00	ug/L	9328.55	9328.55	.	9328.55	9328.55	.
o+p Xylene	B	2	0	10.00	ug/L	95.65	95.65	.	95.65	95.65	.
o+p Xylene	C	3	0	10.00	ug/L	1687.32	1687.32	.	1687.32	1687.32	.
o+p Xylene	D	4	0	10.00	ug/L	110.44	110.44	.	110.44	110.44	.
o+p Xylene	E	5	0	10.00	ug/L	1087.85	1087.85	.	1087.85	1087.85	.
o+p Xylene	F	5	3	10.00	ug/L	3253.70	8119.25	10.00	3253.70	8119.25	10.00
o+p Xylene	G	4	2	10.00	ug/L	6816.50	13623.00	10.00	6816.50	13623.00	10.00
o-cresol	A	5	5	10.00	ug/L	1720.00	.	1720.00	893.95	.	893.95
o-cresol	B	2	1	10.00	ug/L	3604.55	7109.10	100.00	3604.55	7109.10	100.00
o-cresol	C	3	3	10.00	ug/L	3400.00	.	3400.00	646.52	.	646.52
o-cresol	D	4	0	10.00	ug/L	190.25	190.25	.	190.25	190.25	.
o-cresol	E	5	1	10.00	ug/L	2242.57	2793.21	40.00	2242.57	2793.21	40.00
o-cresol	F	5	4	10.00	ug/L	370.24	281.22	392.50	370.24	281.22	392.50
o-cresol	G	4	3	10.00	ug/L	321.10	854.41	143.33	321.10	854.41	143.33
p-cresol	A	5	5	10.00	ug/L	1720.00	.	1720.00	851.97	.	851.97
p-cresol	B	2	2	10.00	ug/L	550.00	.	550.00	550.00	.	550.00
p-cresol	C	3	0	10.00	ug/L	1101.24	1101.24	.	1101.24	1101.24	.
p-cresol	D	4	0	10.00	ug/L	1365.47	1365.47	.	1365.47	1365.47	.
p-cresol	E	5	0	10.00	ug/L	1529.10	1529.10	.	1529.10	1529.10	.
p-cresol	F	5	2	10.00	ug/L	784.83	941.38	550.00	784.83	941.38	550.00
p-cresol	G	4	1	10.00	ug/L	1361.08	1781.43	100.00	1361.08	1781.43	100.00
p-cymene	A	5	5	10.00	ug/L	1720.00	.	1720.00	831.41	.	831.41
p-cymene	B	2	2	10.00	ug/L	550.00	.	550.00	550.00	.	550.00
p-cymene	C	3	3	10.00	ug/L	3400.00	.	3400.00	438.03	.	438.03
p-cymene	D	4	4	10.00	ug/L	10.00	.	10.00	10.00	.	10.00
p-cymene	E	5	5	10.00	ug/L	26.00	.	26.00	26.00	.	26.00
p-cymene	F	5	2	10.00	ug/L	580.24	800.40	250.00	580.24	800.40	250.00
p-cymene	G	4	1	10.00	ug/L	1479.65	1939.53	100.00	1479.65	1939.53	100.00
Pentamethylbenzene	A	5	4	10.00	ug/L	3757.20	11186.00	1900.00	3028.51	11186.00	989.14
Pentamethylbenzene	B	2	2	10.00	ug/L	550.00	.	550.00	550.00	.	550.00
Pentamethylbenzene	C	3	3	10.00	ug/L	3400.00	.	3400.00	971.05	.	971.05
Pentamethylbenzene	D	4	4	10.00	ug/L	10.00	.	10.00	10.00	.	10.00
Pentamethylbenzene	E	5	5	10.00	ug/L	26.00	.	26.00	26.00	.	26.00
Pentamethylbenzene	F	5	3	10.00	ug/L	350.47	126.18	500.00	350.47	126.18	500.00
Pentamethylbenzene	G	4	0	10.00	ug/L	3151.33	3151.33	.	3151.33	3151.33	.

¹ #Obs = Total Number of Samples; #NDs = Number of Samples with Non-Detect Values; Replaced = After Replacement of Sample-Specific NDs

Table 12-7. Oils Subcategory Emulsion Breaking/Gravity Separation Data Sets Before and After Sample-Specific Non-Detect Replacement¹

Analyte	Facility	# Obs	# NDS	Minimum Analytical DL	Units	Original Overall Mean	Original Mean of Detects	Original Mean of NDS	Replaced Overall Mean	Replaced Mean of Detects	Replaced Mean of NDS
Phenanthrene	A	5	5	10.00	ug/L	1720.00	.	1720.00	1257.35	.	1257.35
Phenanthrene	B	2	2	10.00	ug/L	550.00	.	550.00	550.00	.	550.00
Phenanthrene	C	3	3	10.00	ug/L	3400.00	.	3400.00	1857.82	.	1857.82
Phenanthrene	D	4	0	10.00	ug/L	19.55	19.55	.	19.55	19.55	.
Phenanthrene	E	5	0	10.00	ug/L	3755.32	3755.32	.	3755.32	3755.32	.
Phenanthrene	F	5	0	10.00	ug/L	3099.13	3099.13	.	3099.13	3099.13	.
Phenanthrene	G	4	0	10.00	ug/L	18468.31	18468.31	.	18468.31	18468.31	.
Phenol	A	5	3	10.00	ug/L	2302.56	2006.39	2500.00	2302.56	2006.39	2500.00
Phenol	B	2	0	10.00	ug/L	7547.35	7547.35	.	7547.35	7547.35	.
Phenol	C	3	0	10.00	ug/L	4914.50	4914.50	.	4914.50	4914.50	.
Phenol	D	4	0	10.00	ug/L	3026.83	3026.83	.	3026.83	3026.83	.
Phenol	E	5	0	10.00	ug/L	36046.00	36046.00	.	36046.00	36046.00	.
Phenol	F	5	0	10.00	ug/L	10575.38	10575.38	.	10575.38	10575.38	.
Phenol	G	4	0	10.00	ug/L	6817.00	6817.00	.	6817.00	6817.00	.
Phosphorus	C	3	0	1000.00	ug/L	91583.33	91583.33	.	91583.33	91583.33	.
Phosphorus	E	5	0	1000.00	ug/L	22986.60	22986.60	.	22986.60	22986.60	.
Phosphorus	F	5	0	1000.00	ug/L	83770.00	83770.00	.	83770.00	83770.00	.
Phosphorus	G	4	0	1000.00	ug/L	69025.00	69025.00	.	69025.00	69025.00	.
Pyrene	A	5	5	10.00	ug/L	1720.00	.	1720.00	1039.02	.	1039.02
Pyrene	B	2	2	10.00	ug/L	550.00	.	550.00	550.00	.	550.00
Pyrene	C	3	3	10.00	ug/L	3400.00	.	3400.00	1130.08	.	1130.08
Pyrene	D	4	4	10.00	ug/L	10.00	.	10.00	10.00	.	10.00
Pyrene	E	5	0	10.00	ug/L	2448.05	2448.05	.	2448.05	2448.05	.
Pyrene	F	5	2	10.00	ug/L	830.67	984.45	600.00	830.67	984.45	600.00
Pyrene	G	4	0	10.00	ug/L	6926.59	6926.59	.	6926.59	6926.59	.
Pyridine	A	5	5	10.00	ug/L	1720.00	.	1720.00	386.23	.	386.23
Pyridine	B	2	2	10.00	ug/L	550.00	.	550.00	278.90	.	278.90
Pyridine	C	3	2	10.00	ug/L	3426.92	180.77	5050.00	246.19	180.77	278.90
Pyridine	D	4	3	10.00	ug/L	12.48	19.91	10.00	12.48	19.91	10.00
Pyridine	E	5	3	10.00	ug/L	38.21	45.52	33.33	38.21	45.52	33.33
Pyridine	F	5	2	10.00	ug/L	795.36	892.27	650.00	686.92	892.27	378.90
Pyridine	G	4	2	10.00	ug/L	425.64	601.29	250.00	425.64	601.29	250.00
Selenium	A	20	7	5.00	ug/L	19.93	29.00	3.09	19.93	29.00	3.09
Selenium	B	2	2	5.00	ug/L	180.00	.	180.00	84.95	.	84.95
Selenium	C	3	3	5.00	ug/L	25.00	.	25.00	25.00	.	25.00
Selenium	D	4	3	5.00	ug/L	37.45	80.80	23.00	37.45	80.80	23.00
Selenium	E	5	5	5.00	ug/L	20.00	.	20.00	20.00	.	20.00
Selenium	F	5	0	5.00	ug/L	170.46	170.46	.	170.46	170.46	.
Selenium	G	4	0	5.00	ug/L	346.28	346.28	.	346.28	346.28	.
Silicon	B	2	0	100.00	ug/L	31350.00	31350.00	.	31350.00	31350.00	.
Silicon	C	3	0	100.00	ug/L	38660.67	38660.67	.	38660.67	38660.67	.
Silicon	E	5	0	100.00	ug/L	6065.00	6065.00	.	6065.00	6065.00	.
Silicon	F	5	0	100.00	ug/L	62670.00	62670.00	.	62670.00	62670.00	.
Silicon	G	4	0	100.00	ug/L	29087.50	29087.50	.	29087.50	29087.50	.

¹ #Obs = Total Number of Samples; #NDS = Number of Samples with Non-Detect Values; Replaced = After Replacement of Sample-Specific NDS

Table 12-7. Oils Subcategory Emulsion Breaking/Gravity Separation Data Sets Before and After Sample-Specific Non-Detect Replacement¹

Analyte	Facility	# Obs	# NDs	Minimum Analytical DL	Units	Original Overall Mean	Original Mean of Detects	Original Mean of NDs	Replaced Overall Mean	Replaced Mean of Detects	Replaced Mean of NDs
Silver	A	20	0	10.00	ug/L	156.44	156.44	.	156.44	156.44	.
Silver	B	2	2	10.00	ug/L	531.25	.	531.25	188.47	.	188.47
Silver	C	2	2	10.00	ug/L	2973.33	7740.00	590.00	2789.62	7740.00	314.43
Silver	D	4	4	10.00	ug/L	3.00	.	3.00	3.00	.	3.00
Silver	E	5	5	10.00	ug/L	5.00	.	5.00	5.00	.	5.00
Silver	F	5	0	10.00	ug/L	19.34	19.34	.	19.34	19.34	.
Silver	G	4	0	10.00	ug/L	13.08	13.08	.	13.08	13.08	.
Strontium	B	2	2	100.00	ug/L	10625.00	.	10625.00	1376.17	.	1376.17
Strontium	C	3	0	100.00	ug/L	1978.00	1978.00	.	1978.00	1978.00	.
Strontium	E	5	4	100.00	ug/L	105.60	128.00	100.00	105.60	128.00	100.00
Strontium	F	5	0	100.00	ug/L	1709.00	1709.00	.	1709.00	1709.00	.
Strontium	G	4	0	100.00	ug/L	1441.88	1441.88	.	1441.88	1441.88	.
Styrene	A	5	5	10.00	ug/L	1720.00	.	1720.00	410.22	.	410.22
Styrene	B	2	2	10.00	ug/L	550.00	.	550.00	293.89	.	293.89
Styrene	C	3	3	10.00	ug/L	3400.00	.	3400.00	229.26	.	229.26
Styrene	D	4	4	10.00	ug/L	10.00	.	10.00	10.00	.	10.00
Styrene	E	5	5	10.00	ug/L	26.00	.	26.00	26.00	.	26.00
Styrene	F	5	2	10.00	ug/L	491.05	385.08	650.00	388.60	385.08	393.89
Styrene	G	4	2	10.00	ug/L	443.69	637.38	250.00	443.69	637.38	250.00
Sulfur	C	3	0	1000.00	ug/L	1952700.00	1952700.00	.	1952700.00	1952700.00	.
Sulfur	E	5	0	1000.00	ug/L	151420.00	151420.00	.	151420.00	151420.00	.
Sulfur	F	5	0	1000.00	ug/L	1802000.00	1802000.00	.	1802000.00	1802000.00	.
Sulfur	G	4	0	1000.00	ug/L	2406250.00	2406250.00	.	2406250.00	2406250.00	.
Tetrachloroethene	A	5	2	10.00	ug/L	1148.47	1247.45	1000.00	1148.47	1247.45	1000.00
Tetrachloroethene	B	2	0	10.00	ug/L	7038.50	7038.50	.	7038.50	7038.50	.
Tetrachloroethene	C	3	0	10.00	ug/L	597.95	597.95	.	597.95	597.95	.
Tetrachloroethene	D	4	4	10.00	ug/L	10.00	.	10.00	10.00	.	10.00
Tetrachloroethene	E	5	3	10.00	ug/L	34.25	70.62	10.00	34.25	70.62	10.00
Tetrachloroethene	F	5	0	10.00	ug/L	1223.02	1223.02	.	1223.02	1223.02	.
Tetrachloroethene	G	4	0	10.00	ug/L	2615.46	2615.46	.	2615.46	2615.46	.
Tin	A	20	0	30.00	ug/L	817.75	817.75	.	817.75	817.75	.
Tin	B	2	2	30.00	ug/L	4250.00	.	4250.00	767.26	.	767.26
Tin	C	2	2	30.00	ug/L	2812.00	6216.00	1110.00	2761.68	6216.00	1034.51
Tin	D	4	4	30.00	ug/L	118.50	152.00	85.00	118.50	152.00	85.00
Tin	E	5	5	30.00	ug/L	28.00	.	28.00	28.00	.	28.00
Tin	F	5	0	30.00	ug/L	1348.90	1348.90	.	1348.90	1348.90	.
Tin	G	4	1	30.00	ug/L	1132.75	1500.67	29.00	1132.75	1500.67	29.00
Titanium	A	20	0	5.00	ug/L	383.24	383.24	.	383.24	383.24	.
Titanium	B	2	2	5.00	ug/L	210.00	.	210.00	189.40	.	189.40
Titanium	C	3	2	5.00	ug/L	502.33	1407.00	50.00	502.33	1407.00	50.00
Titanium	D	4	4	5.00	ug/L	10.00	.	10.00	10.00	.	10.00
Titanium	E	5	4	5.00	ug/L	8.96	28.80	4.00	8.96	28.80	4.00
Titanium	F	5	0	5.00	ug/L	427.00	427.00	.	427.00	427.00	.
Titanium	G	4	0	5.00	ug/L	177.13	177.13	.	177.13	177.13	.
Toluene	A	5	0	10.00	ug/L	66687.90	66687.90	.	66687.90	66687.90	.
Toluene	B	2	0	10.00	ug/L	860.29	860.29	.	860.29	860.29	.
Toluene	C	3	0	10.00	ug/L	1458.72	1458.72	.	1458.72	1458.72	.
Toluene	D	4	0	10.00	ug/L	400.14	400.14	.	400.14	400.14	.
Toluene	E	5	0	10.00	ug/L	4030.87	4030.87	.	4030.87	4030.87	.
Toluene	F	5	0	10.00	ug/L	9407.42	9407.42	.	9407.42	9407.42	.
Toluene	G	4	0	10.00	ug/L	22499.40	22499.40	.	22499.40	22499.40	.

¹ #Obs = Total Number of Samples; #NDs = Number of Samples with Non-Detect Values; Replaced = After Replacement of Sample-Specific NDs

Table 12-7. Oils Subcategory Emulsion Breaking/Gravity Separation Data Sets Before and After Sample-Specific Non-Detect Replacement¹

Analyte	Facility	# Obs	# NDs	Minimum Analytical DL	Units	Original Overall Mean	Original Mean of Detects	Original Mean of NDs	Replaced Overall Mean	Replaced Mean of Detects	Replaced Mean of NDs
Trichloroethene	A	5	4	10.00	ug/L	837.09	185.47	1000.00	737.28	185.47	875.24
Trichloroethene	B	2	1	10.00	ug/L	15.52	21.04	10.00	15.52	21.04	10.00
Trichloroethene	C	2	3	10.00	ug/L	40.00	.	40.00	40.00	.	40.00
Trichloroethene	D	4	0	10.00	ug/L	38.73	38.73	.	38.73	38.73	.
Trichloroethene	E	5	5	10.00	ug/L	10.00	.	10.00	10.00	.	10.00
Trichloroethene	F	5	0	10.00	ug/L	559.08	559.08	.	559.08	559.08	.
Trichloroethene	G	4	0	10.00	ug/L	2606.47	2606.47	.	2606.47	2606.47	.
Tripropyleneglycol Methyl Ether	A	4	1	99.00	ug/L	135980.76	167500.95	9900.00	133494.12	164392.65	9900.00
Tripropyleneglycol Methyl Ether	B	2	2	99.00	ug/L	5445.00	5445.00	5445.00	5445.00	5445.00	5445.00
Tripropyleneglycol Methyl Ether	C	3	1	99.00	ug/L	57977.97	37466.95	99000.00	49689.17	37466.95	74133.60
Tripropyleneglycol Methyl Ether	D	4	4	99.00	ug/L	99.00	.	99.00	99.00	.	99.00
Tripropyleneglycol Methyl Ether	E	5	4	99.00	ug/L	9685.20	47535.00	222.75	9685.20	47535.00	222.75
Tripropyleneglycol Methyl Ether	F	5	3	99.00	ug/L	4706.72	4341.80	4950.00	4706.72	4341.80	4950.00
Tripropyleneglycol Methyl Ether	G	4	2	99.00	ug/L	2908.13	3341.26	2475.00	2908.13	3341.26	2475.00
Vanadium	A	20	0	50.00	ug/L	227.69	227.69	.	227.69	227.69	.
Vanadium	B	2	1	50.00	ug/L	1031.00	2000.00	62.00	1031.00	2000.00	62.00
Vanadium	C	3	2	50.00	ug/L	674.00	1062.00	480.00	533.47	1062.00	269.21
Vanadium	D	4	0	50.00	ug/L	27.05	27.05	.	27.05	27.05	.
Vanadium	E	5	5	50.00	ug/L	10.00	.	10.00	10.00	.	10.00
Vanadium	F	5	0	50.00	ug/L	161.11	161.11	.	161.11	161.11	.
Vanadium	G	4	3	50.00	ug/L	50.50	166.00	12.00	50.50	166.00	12.00
Zinc	A	20	0	20.00	ug/L	13468.00	13468.00	.	13468.00	13468.00	.
Zinc	B	2	0	20.00	ug/L	68000.00	68000.00	.	68000.00	68000.00	.
Zinc	C	3	0	20.00	ug/L	72201.33	72201.33	.	72201.33	72201.33	.
Zinc	D	4	0	20.00	ug/L	197.95	197.95	.	197.95	197.95	.
Zinc	E	5	0	20.00	ug/L	936.80	936.80	.	936.80	936.80	.
Zinc	F	5	0	20.00	ug/L	25424.00	25424.00	.	25424.00	25424.00	.
Zinc	G	4	0	20.00	ug/L	13925.00	13925.00	.	13925.00	13925.00	.
1-methylfluorene	A	5	5	10.00	ug/L	1720.00	.	1720.00	787.35	.	787.35
1-methylfluorene	B	2	2	10.00	ug/L	550.00	529.59	.	529.59	.	529.59
1-methylfluorene	C	3	3	10.00	ug/L	3400.00	.	3400.00	386.39	.	386.39
1-methylfluorene	D	4	4	10.00	ug/L	10.00	10.00	.	10.00	10.00	.
1-methylfluorene	E	5	1	10.00	ug/L	477.49	586.87	40.00	477.49	586.87	40.00
1-methylfluorene	F	5	4	10.00	ug/L	326.27	111.35	380.00	313.11	111.35	369.80
1-methylfluorene	G	4	1	10.00	ug/L	1733.22	2277.63	100.00	1733.22	2277.63	100.00
1-methylphenanthrene	A	5	5	10.00	ug/L	1720.00	.	1720.00	873.15	.	873.15
1-methylphenanthrene	B	2	2	10.00	ug/L	550.00	.	550.00	550.00	.	550.00
1-methylphenanthrene	C	3	3	10.00	ug/L	3400.00	.	3400.00	577.17	.	577.17
1-methylphenanthrene	D	4	4	10.00	ug/L	10.00	10.00	.	10.00	10.00	.
1-methylphenanthrene	E	5	0	10.00	ug/L	2098.00	2098.00	.	2098.00	2098.00	.
1-methylphenanthrene	F	5	4	10.00	ug/L	332.34	91.72	392.50	332.34	91.72	392.50
1-methylphenanthrene	G	4	0	10.00	ug/L	1858.23	1858.23	.	1858.23	1858.23	.
1,1-dichloroethene	A	5	5	10.00	ug/L	820.00	.	820.00	409.46	.	409.46
1,1-dichloroethene	B	2	2	10.00	ug/L	10.00	10.00	.	10.00	10.00	.
1,1-dichloroethene	C	3	2	10.00	ug/L	51.41	134.24	10.00	51.41	134.24	10.00
1,1-dichloroethene	D	4	4	10.00	ug/L	10.00	.	10.00	10.00	.	10.00
1,1-dichloroethene	E	5	5	10.00	ug/L	10.00	.	10.00	10.00	.	10.00
1,1-dichloroethene	F	5	2	10.00	ug/L	112.01	180.01	10.00	112.01	180.01	10.00
1,1-dichloroethene	G	4	1	10.00	ug/L	685.73	910.97	10.00	685.73	910.97	10.00

¹ #Obs = Total Number of Samples; #NDs = Number of Samples with Non-Detect Values; Replaced = After Replacement of Sample-Specific NDs

Table 12-7. Oils Subcategory Emulsion Breaking/Gravity Separation Data Sets Before and After Sample-Specific Non-Detect Replacement¹

Analyte	Facility	# Obs	# NDS	Minimum Analytical DL	Units	Original Overall Mean	Original Mean of Detects	Original Mean of NDS	Replaced Overall Mean	Replaced Mean of Detects	Replaced Mean of NDS
1,1,1-trichloroethane	A	5	0	10.00	ug/L	3921.14	3921.14	.	3921.14	3921.14	.
1,1,1-trichloroethane	B	2	0	10.00	ug/L	175.61	175.61	.	175.61	175.61	.
1,1,1-trichloroethane	C	3	0	10.00	ug/L	5482.97	5482.97	.	5482.97	5482.97	.
1,1,1-trichloroethane	D	4	2	10.00	ug/L	16.99	23.98	10.	16.99	23.98	10.00
1,1,1-trichloroethane	E	5	3	10.00	ug/L	10.13	10.32	10.	10.13	10.32	10.00
1,1,1-trichloroethane	F	5	0	10.00	ug/L	330.98	330.98	.	330.98	330.98	.
1,1,1-trichloroethane	G	4	0	10.00	ug/L	367.36	367.36	.	367.36	367.36	.
1,2-dichloroethane	A	5	4	10.00	ug/L	835.00	174.99	1000.	272.10	174.99	296.38
1,2-dichloroethane	B	2	2	10.00	ug/L	10.00	.	10.	10.00	.	10.00
1,2-dichloroethane	C	3	1	10.00	ug/L	43.97	15.95	100.	43.97	15.95	100.00
1,2-dichloroethane	D	4	4	10.00	ug/L	10.00	.	10.	10.00	.	10.00
1,2-dichloroethane	E	5	5	10.00	ug/L	10.00	.	10.	10.00	.	10.00
1,2-dichloroethane	F	5	0	10.00	ug/L	275.31	275.31	.	275.31	275.31	.
1,2-dichloroethane	G	4	0	10.00	ug/L	404.95	404.95	.	404.95	404.95	.
1,2,4-trichlorobenzene	A	5	5	10.00	ug/L	1720.00	.	1720.	1230.10	.	1230.10
1,2,4-trichlorobenzene	B	2	2	10.00	ug/L	550.00	.	550.	550.00	.	550.00
1,2,4-trichlorobenzene	C	3	3	10.00	ug/L	3400.00	.	3400.	1767.01	.	1767.01
1,2,4-trichlorobenzene	D	4	4	10.00	ug/L	10.00	.	10.	10.00	.	10.00
1,2,4-trichlorobenzene	E	5	5	10.00	ug/L	26.00	.	26.	26.00	.	26.00
1,2,4-trichlorobenzene	F	5	0	10.00	ug/L	7748.96	7748.96	.	7748.96	7748.96	.
1,2,4-trichlorobenzene	G	4	1	10.00	ug/L	1867.93	2357.24	400.	1867.93	2357.24	400.00
1,4-dichlorobenzene	A	5	5	10.00	ug/L	1720.00	.	1720.	823.18	.	823.18
1,4-dichlorobenzene	B	2	2	10.00	ug/L	550.00	.	550.	550.00	.	550.00
1,4-dichlorobenzene	C	3	3	10.00	ug/L	3400.00	.	3400.	410.59	.	410.59
1,4-dichlorobenzene	D	4	4	10.00	ug/L	10.00	.	10.	10.00	.	10.00
1,4-dichlorobenzene	E	5	5	10.00	ug/L	26.00	.	26.	26.00	.	26.00
1,4-dichlorobenzene	F	5	1	10.00	ug/L	1115.80	1344.76	200.	1115.80	1344.76	200.00
1,4-dichlorobenzene	G	4	1	10.00	ug/L	725.68	834.24	400.	725.68	834.24	400.00
1,4-dioxane	A	5	5	10.00	ug/L	820.00	.	820.	661.62	.	661.62
1,4-dioxane	B	2	1	10.00	ug/L	99.73	189.47	10.	99.73	189.47	10.00
1,4-dioxane	C	3	1	10.00	ug/L	772.20	1108.30	100.	772.20	1108.30	100.00
1,4-dioxane	D	4	4	10.00	ug/L	10.00	.	10.	10.00	.	10.00
1,4-dioxane	E	5	5	10.00	ug/L	10.00	.	10.	10.00	.	10.00
1,4-dioxane	F	5	5	10.00	ug/L	10.00	.	10.	10.00	.	10.00
1,4-dioxane	G	4	4	10.00	ug/L	10.00	.	10.	10.00	.	10.00
2-methylnaphthalene	A	5	3	10.00	ug/L	3521.52	5053.80	2500.	3034.04	5053.80	1687.54
2-methylnaphthalene	B	2	1	10.00	ug/L	4323.95	8547.90	100.	4323.95	8547.90	100.00
2-methylnaphthalene	C	3	2	10.00	ug/L	3415.61	146.83	5050.	1790.68	146.83	2612.61
2-methylnaphthalene	D	4	0	10.00	ug/L	93.59	93.59	.	93.59	93.59	.
2-methylnaphthalene	E	5	0	10.00	ug/L	1570.80	1570.80	.	1570.80	1570.80	.
2-methylnaphthalene	F	5	0	10.00	ug/L	5450.47	5450.47	.	5450.47	5450.47	.
2-methylnaphthalene	G	4	0	10.00	ug/L	17401.62	17401.62	.	17401.62	17401.62	.
2-phenylnaphthalene	A	5	5	10.00	ug/L	1720.00	.	1720.00	206.17	.	206.17
2-phenylnaphthalene	B	2	2	10.00	ug/L	550.00	.	550.00	166.35	.	166.35
2-phenylnaphthalene	C	3	3	10.00	ug/L	3400.00	.	3400.00	144.24	.	144.24
2-phenylnaphthalene	D	4	4	10.00	ug/L	10.00	.	10.00	10.00	.	10.00
2-phenylnaphthalene	E	5	1	10.00	ug/L	213.21	256.51	40.00	213.21	256.51	40.00
2-phenylnaphthalene	F	5	5	10.00	ug/L	318.00	.	318.00	151.08	.	151.08
2-phenylnaphthalene	G	4	4	10.00	ug/L	132.50	.	132.50	90.68	.	90.68

¹ #Obs = Total Number of Samples; #NDS = Number of Samples with Non-Detect Values; Replaced = After Replacement of Sample-Specific NDS

Table 12-7. Oils Subcategory Emulsion Breaking/Gravity Separation Data Sets Before and After Sample-Specific Non-Detect Replacement¹

Analyte	Facility	# Obs	# NDS	Minimum Analytical DL	Units	Original Overall Mean	Original Mean of Detects	Original Mean of NDS	Replaced Overall Mean	Replaced Mean of Detects	Replaced Mean of NDS
2-propanone	A	5	0	50.00	ug/L	434901.13	434901.13	.	434901.13	434901.13	.
2-propanone	B	2	0	50.00	ug/L	3756.99	3756.99	.	3756.99	3756.99	.
2-propanone	C	3	0	50.00	ug/L	9566.12	9566.12	.	9566.12	9566.12	.
2-propanone	D	4	0	50.00	ug/L	3688.19	3688.19	.	3688.19	3688.19	.
2-propanone	E	5	0	50.00	ug/L	15685.72	15685.72	.	15685.72	15685.72	.
2-propanone	F	5	1	50.00	ug/L	76457.88	95559.85	50.00	76457.88	95559.85	50.00
2-propanone	G	4	0	50.00	ug/L	179763.00	179763.00	.	179763.00	179763.00	.
2,3-benzofluorene	A	5	5	10.00	ug/L	1720.00	.	1720.00	578.19	.	578.19
2,3-benzofluorene	B	2	2	10.00	ug/L	550.00	.	550.00	398.87	.	398.87
2,3-benzofluorene	C	3	3	10.00	ug/L	3400.00	.	3400.00	299.25	.	299.25
2,3-benzofluorene	D	4	4	10.00	ug/L	10.00	.	10.00	10.00	.	10.00
2,3-benzofluorene	E	5	0	10.00	ug/L	811.19	811.19	.	811.19	811.19	.
2,3-benzofluorene	F	5	5	10.00	ug/L	318.00	.	318.00	257.55	.	257.55
2,3-benzofluorene	G	4	3	10.00	ug/L	245.30	461.22	173.33	245.30	461.22	173.33
2,4-dimethylphenol	A	5	5	10.00	ug/L	1720.00	.	1720.00	693.96	.	693.96
2,4-dimethylphenol	B	2	2	10.00	ug/L	550.00	.	550.00	471.22	.	471.22
2,4-dimethylphenol	C	3	2	10.00	ug/L	3637.61	812.82	5050.00	585.09	812.82	471.22
2,4-dimethylphenol	D	4	1	10.00	ug/L	192.70	253.60	10.00	192.70	253.60	10.00
2,4-dimethylphenol	E	5	1	10.00	ug/L	1148.89	1426.11	40.00	1148.89	1426.11	40.00
2,4-dimethylphenol	F	5	4	10.00	ug/L	319.23	76.15	380.00	287.72	76.15	340.61
2,4-dimethylphenol	G	4	3	10.00	ug/L	271.41	565.63	173.33	271.41	565.63	173.33
3,6-dimethylphenanthrene	A	5	5	10.00	ug/L	1720.00	.	1720.00	628.23	.	628.23
3,6-dimethylphenanthrene	B	2	2	10.00	ug/L	550.00	.	550.00	430.15	.	430.15
3,6-dimethylphenanthrene	C	3	3	10.00	ug/L	3400.00	.	3400.00	320.10	.	320.10
3,6-dimethylphenanthrene	D	4	4	10.00	ug/L	10.00	.	10.00	10.00	.	10.00
3,6-dimethylphenanthrene	E	5	0	10.00	ug/L	837.21	837.21	.	837.21	837.21	.
3,6-dimethylphenanthrene	F	5	5	10.00	ug/L	318.00	.	318.00	270.06	.	270.06
3,6-dimethylphenanthrene	G	4	4	10.00	ug/L	132.50	.	132.50	132.50	.	132.50
4-chloro-3-methylphenol	A	5	0	10.00	ug/L	20756.41	20756.41	.	20756.41	20756.41	.
4-chloro-3-methylphenol	B	2	0	10.00	ug/L	10132.50	10132.50	.	10132.50	10132.50	.
4-chloro-3-methylphenol	C	3	0	10.00	ug/L	32690.67	32690.67	.	32690.67	32690.67	.
4-chloro-3-methylphenol	D	4	4	10.00	ug/L	10.00	.	10.00	10.00	.	10.00
4-chloro-3-methylphenol	E	5	1	10.00	ug/L	903.79	1127.24	10.00	903.79	1127.24	10.00
4-chloro-3-methylphenol	F	5	2	10.00	ug/L	851.79	1079.48	700.00	851.79	1079.48	700.00
4-chloro-3-methylphenol	G	4	4	10.00	ug/L	32.50	.	32.50	32.50	.	32.50
4-methyl-2-pentanone	A	5	4	50.00	ug/L	4162.84	814.20	5000.00	4162.84	814.20	5000.00
4-methyl-2-pentanone	B	2	0	50.00	ug/L	478.91	478.91	.	478.91	478.91	.
4-methyl-2-pentanone	C	3	2	50.00	ug/L	249.65	198.96	275.00	249.65	198.96	275.00
4-methyl-2-pentanone	D	4	0	50.00	ug/L	313.74	313.74	.	313.74	313.74	.
4-methyl-2-pentanone	E	5	0	50.00	ug/L	1037.94	1037.94	.	1037.94	1037.94	.
4-methyl-2-pentanone	F	5	0	50.00	ug/L	15457.91	15457.91	.	15457.91	15457.91	.
4-methyl-2-pentanone	G	4	0	50.00	ug/L	8749.82	8749.82	.	8749.82	8749.82	.

¹ #Obs = Total Number of Samples; #NDS = Number of Samples with Non-Detect Values; Replaced = After Replacement of Sample-Specific Nds

*Random Assignment of Seven
Emulsion Breaking/Gravity
Separation Data Sets*

12.3.2.2

While EPA's assignment of one of the seven emulsion breaking/gravity separation data sets to each oils facility for which EPA needed to estimate current performance was random, the SBREFA Panel raised the concern that this approach may not have resulted in a representative assignment of loadings.

The following explains EPA's procedure. To obtain estimates of current pollutant loadings associated with emulsion breaking/gravity separation, EPA developed estimates of the pollutant loadings at each of the 84 facilities identified as having wastestreams in the oils subcategory. To obtain estimates of pollutant loadings, EPA needed concentration and flow information for each facility. EPA had flow information from all facilities, but had data on pollutant concentrations from only seven facilities where EPA had sampled the emulsion breaking/gravity separation operations. Section 12.3.2.1 describes these seven concentration data sets. To obtain concentration estimates for the remaining facilities in the oils subcategory, EPA assigned one of the seven available concentration data sets to each of those 77 facilities without pollutant concentration data at random. EPA assigned each set to no more than 11 facilities. Then, EPA estimated each facility's pollutant loadings as the product of the total oils wastewater flow at the facility and the pollutant concentrations in its assigned data set. Figure 12-2 shows this procedure.

EPA assigned the seven data sets to each of the 77 oil subcategory facilities for which there was no actual concentration data. EPA assigned the data sets randomly. Thus, EPA did not weight some data sets more heavily than others. After this assignment of the data sets, however, EPA determined that there was one additional facility that would fall within the scope of the proposed oils subcategory, and one facility that

was no longer in-scope. EPA removed from the data base the one facility and selected actual concentration data for the newly included facility randomly. The result of this procedure is that each of the seven data sets represented data for 11, 12, or 13 facilities. EPA then calculated pollutant loadings for the total of 84 facilities.

While EPA had randomly assigned the concentration data, EPA reexamined its procedure to assure itself that the results were, in fact, statistically random and concluded they were (see DCNs 23.5, 23.6, and 23.31). Further review of the data established that two of the facilities sampled by EPA had large wastewater flows as compared to all CWT oils subcategory facilities. Of the 84 oils subcategory facilities, flows for these two facilities represented the sixth and second highest wastewater flows. Total flows and total loadings for any groups of facilities that included these facilities would exert influence regardless of the random assignment of the concentration data for facilities for which none was available. In addition, the sampled facility with the highest toxic loadings was assigned to the group with only a total of 11 facilities (the smallest number of facilities in any group).

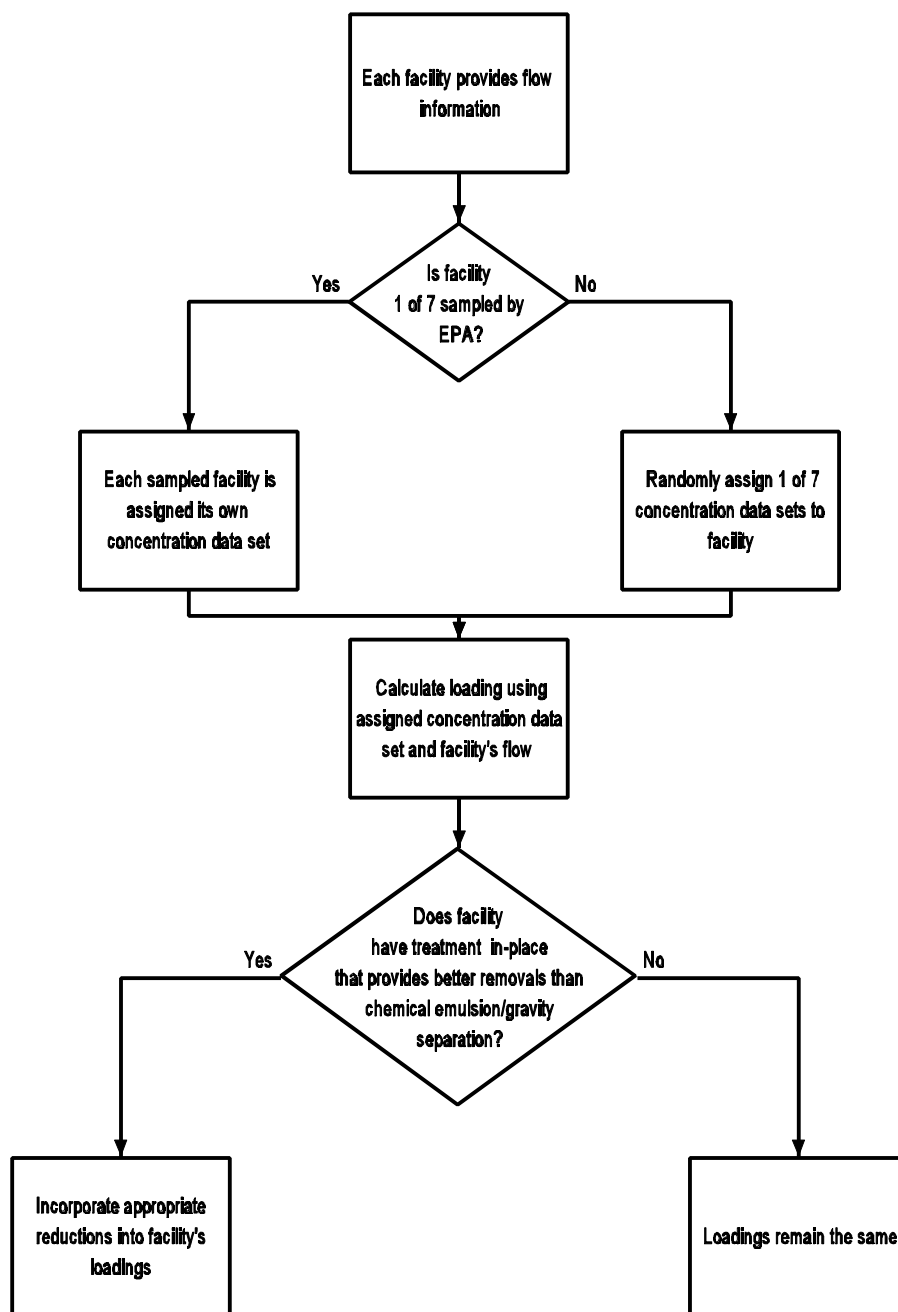


Figure 12-2. Methodology for Current Loadings Estimates in Oils Subcategory

Organics Subcategory**Current Loadings****12.3.3**

EPA had limited available data from the organics subcategory and very little data which represent organic subcategory CWT wastewater only. The vast majority of organic facilities commingle large quantities of non-CWT wastewater prior to the point of discharge. Therefore, EPA estimated current loadings based on the treatment technologies in place except for the two facilities for which EPA has analytical data representing organic subcategory wastewater only.

Based on a review of technologies currently used at organic subcategory facilities, EPA placed in-place treatment for this subcategory in one of five classes:

- 1) raw;
- 2) filtration only;
- 3) carbon adsorption;
- 4) biological treatment; and
- 5) biological treatment and multimedia filtration.

The discussion below describes the methodology EPA used to estimate current loadings for each classification. Table 12-8 lists the current performance estimates for each classification. This table does not include current loadings estimates for all pollutants of concern in the organics subcategory. EPA excluded the non-conventional bulk parameters, such as chemical oxygen demand, many pollutants which serve as treatment chemicals, and all pollutants not detected at treatable levels in the wastewater influent to the treatment system selected as the basis for effluent limitations.

EPA used the first classification (“raw”) for seven organic subcategory facilities with no reported treatment in place for the reduction of organic constituents. EPA based its current loadings estimate for “raw wastewater” on EPA sampling data at two organic facilities. These were Episode 1987, sample points 07A and 07B

and Episode 4472⁵, sample point 01. For each pollutant of concern and each facility, EPA calculated a long-term average or mean. This mean includes measured (detected) and non-detected values. For non-detected values, EPA used the sample-specific detection limit. Once EPA had calculated the long-term average or mean for each facility and each pollutant of concern, EPA then calculated the mean of the long-term averages from the two facilities for each pollutant of concern to estimate the “raw” current loadings concentrations reported in Table 12-8.

EPA classified in the second category (“filtration only”) three organic subcategory facilities which only had multi-media or sand filtration as the on-site treatment technology for the organic waste stream. For these facilities, EPA adjusted the “raw wastewater” concentrations to account for 55 percent removal of TSS, 30 percent removal of metal parameters, 10 percent removal of BOD₅, and no removal of other classical or organic pollutants. EPA estimated the percent reductions for facilities in this group using the procedure previously described in Section 12.3.2.

EPA placed in the third category two organic subcategory facilities with carbon adsorption (usually preceded by sand or multi-media filtration). EPA adjusted the “raw wastewater” concentrations to account for 50 percent removal of organic pollutants, 45 percent removal of oil and grease, and no removal of all other pollutants. Again, EPA also estimated the percent removals

²After further review, EPA determined that data from one episode (4472) represented a combination of organics and oils subcategory wastewater. EPA will re-visit its current loadings estimates classifications prior to promulgation and incorporate the following changes to the oil and grease loadings concentrations: 29,875 ug/L for raw treatment, 29,875 ug/L for filtration only; 19,419 ug/L for carbon adsorption, 5,440 ug/L for biological treatment, and 5,290 ug/L for biological treatment plus multimedia filtration.

for facilities in this category using the procedure previously described in Section 12.3.2.

EPA based the current loadings concentrations for the fourth and fifth classification on EPA sampling data collected at Episode 1987. EPA calculated the current loadings estimates for each pollutant of concern using a similar procedure to that described above

for the “raw” organics subcategory current performance. EPA based the percent removals for five organic subcategory facilities in the fourth classification (biological treatment) on analytical data collected at sample point 12. For the two organic subcategory facilities in the fifth classification (biological treatment and multimedia filtration) EPA based removals on analytical data collected at sample point 14.

Table 12-8. Current Loadings Estimates for the Organics Subcategory (units = ug/L)

Pollutant	Raw ¹	Filtration Only	Carbon Adsorption	Biological Treatment*	Biological Treatment and Multimedia Filtration
CONVENTIONAL POLLUTANTS					
BOD5	22,027,643	19,824,879	22,027,643	2,440,000	1,564,000
Total Cyanide	3,270	3,270	3,270	2,176	2,120
Oil and Grease	176,649	176,649	97,157	176,649	3,900
TSS	1,454,857	654,686	1,454,857	480,000	399,000
METAL POLLUTANTS					
Aluminum	56,363	39,454	56,363	2,474	2,474
Antimony	456	319	456	569	569
Boron	48,098	33,668	48,098	48,098	48,098
Chromium	553	387	553	553	553
Cobalt	277	194	277	437	437
Iron	32,175	22,522	32,175	3,948	3,948
Lithium	11,888	8,321	11,888	11,888	11,888
Manganese	710	497	710	227	227
Molybdenum	1,337	936	1,337	943	943
Nickel	1,426	998	1,426	1,426	1,426
Phosphorus	6,925	4,848	6,925	6,925	6,925
Silicon	2,813	1,969	2,813	2,680	2,680
Strontium	5,088	3,561	5,088	2,060	2,060
Sulfur	1,601,750	1,121,225	1,601,750	1,370,000	1,370,000
Tin	984	689	984	984	984
Zinc	1,402	981	1,402	382	382
ORGANIC POLLUTANTS					
Acetophenone	1,528	1,528	764	36	36
Aniline	1,367	1,367	684	10	10
Benzene	2,776	2,776	1,388	10	10
Benzoic Acid	10,469	10,469	5,234	320	320
Chloroform	4,449	4,449	2,224	73	73
Dimethyl Sulfone	1,449	1,449	724	158	158
Ethylene-thiourea	5,150	5,150	2,575	4,400	4,400
Hexanoic Acid	2,240	2,240	1,120	64	64
M-xylene	1,206	1,206	603	10	10
Methylene Chloride	1,962,725	1,982,725	981,362	204	204
N,N-dimethylformamide	32,846	32,846	16,423	11	11
O-cresol	7,339	7,339	3,699	185	185

Table 12-8. Current Loadings Estimates for the Organics Subcategory (units = ug/L)

Pollutant	Raw ¹	Filtration Only	Carbon Adsorption	Biological Treatment*	Biological Treatment and Multimedia Filtration
P-cresol	3,367	3,367	1,683	66	66
Pentachlorophenol	6,968	6,968	3,484	791	791
Phenol	6,848	6,848	3,424	362	362
Pyridine	3,881	3,881	1,940	116	116
Tetrachloroethene	2,382	2,382	1,191	112	112
Tetrachloromethane	1,706	1,706	853	14	14
Toluene	746,124	746,124	373,062	10	10
Trans-1,2-dichloroethene	1,228	1,228	614	22	22
Trichloroethene	4,645	4,645	2,323	69	69
Vinyl chloride	691	691	345	10	10
1,1-dichloroethane	544	544	272	10	10
1,1-dichloroethene	579	579	290	10	10
1,1,1-trichloroethane	1,444	1,444	722	10	10
1,1,1,2-tetrachloroethane	727	727	364	10	10
1,1,2-trichloroethane	1,191	1,191	595	13	13
1,2-dibromoethane	2,845	2,845	1,422	10	10
1,2-dichloroethane	4,713	4,713	2,357	10	10
1,2,3-trichloropropane	575	575	288	10	10
2-butanone	59,991	59,991	29,996	878	878
2-propanone	6,849,320	6,849,320	3,424,660	2,061	2,061
2,3-dichloroaniline	1,349	1,349	675	23	23
2,3,4,6-tetrachlorophenol	3,340	3,340	1,670	629	629
2,4,5-trichlorophenol	1,365	1,365	683	97	97
2,4,6-trichlorophenol	1369	1369	684	86	86
4-methyl-2-pentanone	3479	3479	1739	146	146

* Current performance estimates for biological treatment and biological treatment with multimedia filtration are equal for metal and organic constituents because EPA only analyzed for conventional parameters at Episode 1987, sample point 14.

¹ EPA used sampling data from Episodes 1987 and 4472 to estimate these “raw” concentrations. After reviewing the data further, EPA determined that data collected at Episode 4472 did not represent “raw” organic subcategory wastewater only and will re-visit between proposal and promulgation.

METHODOLOGY USED TO ESTIMATE

POST-COMPLIANCE LOADINGS

12.4

Post-compliance pollutant loadings for each regulatory option represent the total industry wastewater pollutant loadings after implementation of the proposed rule. For each proposed option, EPA determined an average performance level (the “long-term average”) that a facility with well designed and operated model technologies (which reflect the appropriate level of control) is capable of achieving. In most cases, EPA calculated these long-term averages using

data from CWT facilities operating model technologies. For a few parameters, EPA determined that CWT performance was uniformly inadequate and transferred effluent long-term averages from other sources.

To estimate post-compliance pollutant loadings for each facility for a particular option, EPA used the long-term average concentrations, the facility’s annual wastewater discharge flow, and a conversion factor in the following equation:

Postcompliance long-term average concentration \times
(mg/L)

Facility annual discharge flow $\times \frac{1 \text{ lb}}{453,600 \text{ mg}}$
(L/yr)

= Facility postcompliance annual loading
(lbs/yr)

EPA expects that all facilities subject to the effluent limitations and standards will design and operate their treatment systems to achieve the long-term average performance level on a consistent basis because facilities with well-designed and operated model technologies have demonstrated that this can be done. Further, EPA has accounted for potential treatment system variability in pollutant removal through the use of variability factors. The variability factors used to calculate the proposed limitations and standards were determined from data for the same facilities employing the treatment technology forming the basis for the proposal. Consequently, EPA has concluded that the standards and limitations take into account the level of treatment variation well within the capability of an individual CWT to control. If a facility is designed and operated to achieve the long-term average on a consistent basis, and if the facility maintains adequate control of treatment variation, the allowance for variability provided in the limitations is sufficient.

Table 12-9 presents the long-term averages for the selected option for each subcategory. The pollutants for which data is presented in Table 12-9 represent the pollutants of concern at treatable levels at the facilities which form the basis of the options. The pollutants selected for regulation are a much smaller subset.

Table 12-9. Long Term Average Concentrations(ug/L) for All Pollutants of Concern

Pollutant of Concern	Cas Number	Metals Option 3 NSPS/PSNS	Metals Option 4 BPT/BAT/PSES	Oils Option 8 PSES	Oils Option 9 BPT/BAT/NSPS/PSNS	Organics Option 4 ALL
Ammonia-nitrogen	7664417	9,122	15,630	184,375	97,222	1,060,000
Biochemical Oxygen Demand	C-003	28,330	158,000	5,947,500	5,947,500	2,440,000
COD	C-004	108,801	1,333,333	17,745,833	17,745,833	3,560,000
Hexavalent Chromium	18540299	43	800	Failed Test	Failed Test	
Nitrate/nitrite	C-005	12,611	531,666	46,208	20,750	2,280
Oil & Grease	C-007	21,281	21,281	226,829	28,325	Failed Test
SGT-HEM	C-037	Failed Test	Failed Test	142,804	42,528	
Sulfide, Total (Iodometric)	18496258	24,952	Failed Test	Failed Test	Failed Test	2,800
TOC	C-012	19,641	236,333	3,433,750	5,578,875	1,006,000
Total Cyanide	57125	Failed Test	87	96	96	2,176
Total Dissolved Solids	C-010	18,112,500	42,566,666	Failed Test	Failed Test	
Total Phenol	C-020			15,522	17,841	No Data
Total Phosphorus	14265442	29,315	28,051	37,027	31,356	No Data
Total Solids	C-008			No Data	No Data	
TSS	C-009	9,250	16,800	549,375	25,500	480,000
Acenaphthene	83329			137	137	
Acetophenone	98862					35
Alpha-terpineol	98555			48	48	
Aluminum	7429905	72	856	14,072	14,072	2,474
Aniline	62533			Failed Test	Failed Test	10
Anthracene	120127			164	90	
Antimony	7440360	21	170	103	103	569
Arsenic	7440382	11	Failed Test	789	789	Failed Test
Barium	7440393	Failed Test	Failed Test	220	220	Failed Test
Benzene	71432			511	511	10
Benzo(a)anthracene	56553			106	59	
Benzo(a)pyrene	50328			70	70	
Benzo(b)fluoranthene	205992			67	67	
Benzo(k)fluoranthene	207089			67	67	
Benzoic Acid	65850	212	3,521	25,581	37,349	320
Benzyl Alcohol	100516	26	Failed Test	Failed Test	80	
Beryllium	7440417	1	Failed Test	Failed Test	Failed Test	
Biphenyl	92524			76	135	
Bis(2-ethylhexyl) Phthalate	117817	10	Failed Test	115	62	
Boron	7440428	7,290	8,403	22,462	22,462	Failed Test
Bromodichloromethane	75274	10	63			Failed Test
Butanone	78933	50	1,272	11,390	11,390	878
Butyl Benzyl Phthalate	85687			54	54	
Cadmium	7440439	81	44	7	7	Failed Test
Carbazole	86748			151	151	
Carbon Disulfide	75150	10	Failed Test	28	28	Failed Test
Chlorobenzene	108907			87	87	Failed Test
Chloroform	67663	10	167	379	379	72
Chromium	7440473	39	1,177	183	183	Failed Test
Chrysene	218019			79	48	
Cobalt	7440484	57	114	7,417	7,417	437
Copper	7440508	169	581	156	112	703
Di-n-butyl Phthalate	84742			55	55	
Dibenzofuran	132649			135	135	

A blank entry indicates the analyte is not pollutant of concern for subcategory
Zero indicates a value less than 1.0

Table 12-9. Long Term Average Concentrations(ug/L) for All Pollutants of Concern

Pollutant of Concern	Cas Number	Metals Option 3 NSPS/PSNS	Metals Option 4 BPT/BAT/PSES	Oils Option 8 PSES	Oils Option 9 BPT/BAT/NSPS/PSNS	Organics Option 4 ALL
Dibenzothiophene	132650			95	59	
Dibromochloromethane	124481	10	56			
Diethyl Ether	60297					Failed Test
Diethyl Phthalate	84662			759	365	
Dimethyl Sulfone	67710					157
Diphenyl Ether	101848		Failed Test		981	
Endosulfan Sulfate	1031078					0
Ethane, Pentachloro-	76017					Failed Test
Ethylbenzene	100414			273	348	
Ethylenethiourea	96457					4,400
Fluoranthene	206440			253	17	
Fluorene	86737			243	129	
Gallium	7440553	Failed Test	Failed Test			
Germanium	7440564			Failed Test	Failed Test	
Hexachloroethane	67721					Failed Test
Hexanoic Acid	142621	10	Failed Test	9,253	9,253	64
Indium	7440746	Failed Test	Failed Test			
Iodine	7553562	Failed Test	Failed Test			Failed Test
Iridium	7439885	Failed Test	500			No Data
Iron	7439896	387	6,802	53,366	23,283	3,948
Isophorone	78591					Failed Test
Lead	7439921	55	116	98	98	Failed Test
Lithium	7439932	Failed Test	1,926	1,579	1,579	Failed Test
Lutetium	7439943			Failed Test	Failed Test	
M-xylene	108383			1,520	940	10
Magnesium	7439954	752	Failed Test	62,900	62,900	
Manganese	7439965	11	48	5,406	3,811	227
Mercury	7439976	0	1	3	3	
Methylene Chloride	75092	10	Failed Test	4,242	4,242	204
Molybdenum	7439987	555	1,746	1,542	1,542	942
N-decane	124185			2,369	238	
N-docosane	629970			75	20	
N-dodecane	112403			3,834	233	
N-eicosane	112958			615	51	
N-hexacosane	630013			Failed Test	Failed Test	
N-hexadecane	544763			1,386	2,551	
N-nitrosomorpholine	59892	10	45			
N-octadecane	593453			792	202	
N-tetracosane	646311			Failed Test	Failed Test	
N-tetradecane	629594			1,820	3,303	
N,N-dimethylformamide	68122	10	68	Failed Test	Failed Test	10
Naphthalene	91203			1,014	248	
Neodymium	7440008	Failed Test	Failed Test			
Nickel	7440020	270	1,070	1,473	1,473	Failed Test
Niobium	7440031	Failed Test	Failed Test			
o+p Xylene	136777612			1,873	1,218	Failed Test
o-cresol	95487			Failed Test	1,769	184
OCDF	39001020					Failed test

A blank entry indicates the analyte is not pollutant of concern for subcategory
Zero indicates a value less than 1.0

Table 12-9. Long Term Average Concentrations(ug/L) for All Pollutants of Concern

Pollutant of Concern	Cas Number	Metals Option 3 NSPS/PSNS	Metals Option 4 BPT/BAT/PSES	Oils Option 8 PSES	Oils Option 9 BPT/BAT/NSPS/PSNS	Organics Option 4 ALL
Osmium	7440042	Failed Test	Failed Test			
p-cresol	106445			630	956	66
p-cymene	99876			55	55	
Pentachlorophenol	87865					791
Pentamethylbenzene	700129			48	48	
Phenanthrene	85018			649	81	
Phenol	108952			Failed Test	30,681	362
Phosphorus	7723140	544	24,751	44,962	30,657	Failed Test
Pyrene	129000			131	58	
Pyridine	110861	10	86	624	624	116
Selenium	7782492	Failed Test	347	107	107	
Silicon	7440213	355	1,446	19,000	16,850	2,680
Silver	7440224	10	22	Failed Test	Failed Test	
Strontium	7440246	Failed Test	100	774	774	2,060
Styrene	100425			56	56	
Sulfur	7704349	2,820,000	1,214,000	Failed Test	Failed Test	1,370,000
Tantalum	7440257	Failed Test	Failed Test			
Tellurium	13494809	Failed Test	Failed Test			
Tetrachloroethene	127184			475	475	112
Tetrachloromethane	56235					14
Thallium	7440280	20	Failed Test			
Tin	7440315	30	89	106	106	Failed Test
Titanium	7440326	5	56	21	21	Failed Test
Toluene	108883			3,613	3,426	10
Trans-1,2-dichloroethene	156605					21
Tribromomethane	75252	10	32			
Trichloroethene	79016	10	344	669	669	69
Tripropyleneglycol Methyl Ether	20324338	99	917	478	478	
Vanadium	7440622	50	50	Failed Test	Failed Test	
Vinyl Chloride	75014					10
Yttrium	7440655	5	5			
Zinc	7440666	206	421	3,138	2,029	381
Zirconium	7440677	Failed Test	1,286			
1-methylfluorene	1730376			48	33	
1-methylphenanthrene	832699			76	54	
1,1-dichloroethane	75343					10
1,1-dichloroethene	75354					10
1,1,1-trichloroethane	71556			219	219	10
1,1,1,2-tetrachloroethane	630206			162	162	10
1,1,2-trichloroethane	79005					13
1,1,2,2-tetrachloroethane	79345					Failed Test
1,2-dibromoethane	106934					10
1,2-dichlorobenzene	95501					Failed Test
1,2-dichloroethane	107062			272	272	10
1,2,3-trichloropropane	96184					10
1,2,4-trichlorobenzene	120821			117	117	
1,3-dichloropropane	142289					Failed Test

A blank entry indicates the analyte is not pollutant of concern for subcategory
Zero indicates a value less than 1.0

Table 12-9. Long Term Average Concentrations(ug/L) for All Pollutants of Concern

Pollutant of Concern	Cas Number	Metals Option 3 NSPS/PSNS	Metals Option 4 BPT/BAT/PSES	Oils Option 8 PSES	Oils Option 9 BPT/BAT/NSPS/PSNS	Organics Option 4 ALL
1,4-dichlorobenzene	106467			87	87	
1,4-dioxane	123911			Failed Test	Failed Test	
1234678-HPCDF	67562394					Failed Test
2-methylnaphthalene	91576			1,540	160	
2-phenylnaphthalene	612942			Failed Test	15	
2-picoline	109068					Failed Test
2-propanone	67641	140	13,081	Failed Test	Failed Test	2,061
2,3-benzofluorene	243174			Failed Test	54	
2,3-dichloroaniline	608275					23
2,3,4,6-tetrachlorophenol	58902					628
2,4-dimethylphenol	105679			Failed Test	Failed Test	Failed Test
2,4,5-TP	93721					8
2,4,5-trichlorophenol	95954					96
2,4,6-trichlorophenol	88062					85
2378-TCDF	51207319					Failed Test
3,4-dichlorophenol	95772					30
3,4,5-trichlorocatechol	56961207					0
3,4,6-trichloroguaiacol	60712449					Failed Test
3,5-dichlorophenol	591355					0
3,6-dichlorocatechol	3938167					Failed Test
3,6-dimethylphenanthrene	1576676			Failed Test	52	
4-chloro-3-methylphenol	59507			Failed Test	655	
4-chlorophenol	106489					Failed Test
4-methyl-2-pentanone	108101			7,848	6,624	146
4,5-dichloroguaiacol	2460493					Failed Test
4,5,6-trichloroguaiacol	2668248					Failed Test
5-chloroguaiacol	3743235					Failed Test
6-chlorovanillin	18268763					Failed Test

A blank entry indicates the analyte is not pollutant of concern for subcategory
Zero indicates a value less than 1.0

**METHODOLOGY USED TO ESTIMATE
POLLUTANT REMOVALS**

12.5

For each regulatory option, the difference between baseline loadings and post-compliance loadings represent the pollutant removals. For direct discharging CWT facilities, this represents removals of pollutants being discharged to surface waters. For indirect dischargers, this represents removals of pollutants being discharged to POTWs less the removals achieved by POTWs. EPA calculated the pollutant removals for each facility using the following equation:

$$\begin{aligned} \text{Baseline Loadings} - \text{Postcompliance Loadings} \\ = \text{Pollutant Removals} \end{aligned}$$

EPA used the following methodology to estimate pollutant removals:

- 1) If the post-compliance loading of a pollutant was higher than the baseline loading, EPA set the removal to zero;
- 2) If EPA did not identify a particular pollutant in the wastewater of a facility at baseline and that pollutant was present at baseline in the wastewater of a facility used as the basis for determining limitations and standards associated with one of the regulatory options, EPA set the removal to zero.);
- 3) If EPA did not calculate a long-term average for a pollutant for a technology option (i.e., the post-compliance loading for the pollutant could not be calculated), EPA set the removal to zero; and
- 4) For indirect dischargers, EPA additionally reduced the pollutant removal estimate by the POTW removal percentage. Therefore, the pollutant removal estimates for indirect dischargers only account for pollutant removals over and above the POTW removals.

**POLLUTANT LOADINGS
AND REMOVALS**

12.6

EPA estimated annual baseline and post-compliance loadings for each of the subcategories and the respective regulatory options using the methodology described in Sections 12.3 through 12.5 of this document. For the oils subcategory, EPA extrapolated the facility-specific loadings and removals from the 84 in-scope discharging facilities to provide estimates of an estimated total population of 141 discharging oils facilities. Facilities with no wastewater discharge (“zero dischargers”) have no pollutant loadings or removals.

Tables 12-10 through 12-13 present the total baseline and post-compliance loadings and the pollutant removals for the facilities in each subcategory.

Table 12-10. Summary of Pollutant Loadings and Removals for the CWT Metals Subcategory¹

Pollutant of Concern	Current Wastewater Pollutant Loading (lbs/vr)		Post-Compliance Wastewater Pollutant Loading (lbs/vr)		Post-Compliance Pollutant Reductions (lbs/vr)	
	Direct Discharges	Indirect Discharges	Direct Discharges	Indirect Discharges	Direct Discharges	Indirect Discharges
CONVENTIONALS						
Biochemical Oxygen Demand 5-Day (BOD ₅)	8,366,557	N/A	570,816	N/A	7,795,741	N/A
Oil and Grease (measured as HEM)	519,480	N/A	74,445	N/A	445,035	N/A
Total Suspended Solids (TSS)	6,109,653	N/A	64,680	N/A	6,044,973	N/A
PRIORITY METALS						
Antimony	34,215	7,504	608	184	33,607	7,320
Arsenic	676	37	301	29	375	8
Cadmium	5,380	16	125	9	5,255	7
Chromium	140,366	289	1,727	147	138,639	142
Copper	205,011	669	1,811	278	203,200	391
Lead	26,012	139	441	36	25,571	103
Mercury	164	16	4	1	160	15
Nickel	52,686	5,024	3,917	1,945	48,769	3,079
Selenium	1,838	1,226	1,346	854	492	372
Silver	421	24	80	6	341	18
Thallium	347	82	347	82	0	0
Zinc	127,400	3,359	1,605	347	125,795	3,012
TOTAL PRIORITY METALS	594,516	18,385	12,312	3,918	582,204	14,467
NON-CONVENTIONAL METALS						
Aluminum	82,842	3,455	3,042	377	79,800	3,078
Barium	308	64	308	64	0	0
Boron	168,406	92,315	34,766	25,153	133,640	67,162
Cobalt	3,865	885	435	401	3,430	484
Iridium	17,288	3,122	3,499	953	13,789	2,169
Iron	114,752	9,248	24,042	4,329	90,710	4,919
Lithium	146,215	125,992	5,884	5,056	140,331	120,936
Manganese	5,645	1,007	175	107	5,470	900
Molybdenum	16,864	5,863	6,445	3,126	10,419	2,737
Silicon	41,066	6,810	5,100	3,876	35,966	2,934
Strontium	10,831	10,106	350	319	10,481	9,787
Tin	159,531	1,856	330	116	159,201	1,740
Titanium	93,683	586	188	64	93,495	522
Vanadium	4,686	119	150	81	4,536	38
Yttrium	122	43	21	8	101	35
Zirconium	857	223	835	223	22	0
TOTAL NON-CONVENTIONAL METALS	866,961	261,694	85,570	44,253	781,391	217,441
CLASSICAL PARAMETERS						
Chemical Oxygen Demand (COD)	32,170,276	N/A	4,733,770	N/A	27,436,506	N/A
Hexavalent Chromium	235,527	15,106	2,431	2,660	233,096	12,446
Ammonia as N	411,874	N/A	60,506	N/A	351,368	N/A
Cyanide	5,295	1,046	304	96	4,991	950

¹All loadings and reductions take into account the removals by POTWs for indirect discharges.

HEM - Hexane extractable material

Table 12-11. Summary of Pollutant Loadings and Removals for the CWT Oils Subcategory¹

Pollutant of Concern	Current Wastewater Pollutant Loading (lbs/yr)		Post-Compliance Wastewater Pollutant Loading (lbs/yr)		Post-Compliance Pollutant Reductions (lbs/yr)	
	Direct Discharges	Indirect Discharges	Direct Discharges	Indirect Discharges	Direct Discharges	Indirect Discharges
CONVENTIONALS						
Biochemical Oxygen Demand 5-Day (BOD ₅)	1,099,760	N/A	845,531	N/A	254,229	N/A
Oil and Grease (measured as HEM)	324,206	N/A	4,840	N/A	319,366	N/A
Total Suspended Solids (TSS)	291,300	N/A	4,214	N/A	287,086	N/A
PRIORITY ORGANICS						
1,1,1-Trichloroethane	38	808	13	71	25	737
1,2,4-Trichlorobenzene	12	723	10	56	2	667
1,4-Dichlorobenzene	8	1,012	7	230	1	782
1,1-Dichloroethene	4	185	4	112	0	73
1,2-Dichloroethane	3	66	3	61	0	5
2,4-Dimethylphenol	19	1,088	19	1,088	0	0
Acenaphthene	10	80	10	13	0	67
Anthracene	14	242	12	42	2	200
Benzene	166	562	84	117	82	445
Benzo(a)anthracene	11	60	9	15	2	45
Benzo(a)pyrene	9	123	6	19	3	104
Benzo(b)fluoranthene	8	100	6	18	2	82
Benzo(k)fluoranthene	8	122	5	20	3	102
Bis(2-ethylhexyl) Phthalate	24	126,764	7	287	17	126,477
Butyl Benzyl Phthalate	13	576	4	18	9	558
Chlorobenzene	2	14	2	11	0	3
Chloroform	5	396	5	303	0	93
Chrysene	15	102	8	16	7	86
Diethyl Phthalate	13	1,902	13	1,304	0	598
Di-n-butyl Phthalate	3	171	3	62	0	109
Ethylbenzene	129	794	36	107	93	687
Fluoranthene	12	4,514	2	812	10	3,702
Fluorene	10	1,459	10	348	0	1,111
Methylene Chloride	26	3,616	26	3,353	0	263
Naphthalene	52	2,319	39	328	13	1,991
Phenanthrene	50	933	13	196	37	737
Phenol	393	2,020	393	1,598	0	422
Pyrene	35	1,309	10	135	25	1,174
Tetrachloroethene	11	823	11	303	0	520
Toluene	677	2,122	314	574	363	1,548
Trichloroethene	7	308	7	179	0	129
TOTAL PRIORITY ORGANICS	1,787	155,313	1,091	11,796	696	143,517
NON-CONVENTIONAL ORGANICS						
1-Methylfluorene	12	384	5	48	7	336
1-Methylphenanthrene	29	592	8	76	21	516
2,3-Benzofluorene	14	236	9	236	5	0
2-Butanone	392	1,508	392	1,144	0	364
2-Methylnaphthalene	45	13,986	26	5,581	19	8,405
2-Phenylnaphthalene	4	90	2	90	2	0
2-Propanone	4,313	62,551	4,313	62,551	0	0
3,6-Dimethylphenanthrene	14	236	8	236	6	0
4-Chloro-3-methylphenol	207	18,504	61	18,504	146	0
4-Methyl-2-pentanone	51	2,158	51	1,894	0	264
α-Terpineol	8	196	4	17	4	179
Benzoic Acid	875	18,858	875	13,631	0	5,227
Benzyl Alcohol	8	287	8	287	0	0
Biphenyl	37	189	20	19	17	170
Carbazole	5	209	5	109	0	100
Carbon Disulfide	5	141	4	26	1	115
Dibenzofuran	10	101	10	14	0	87
Dibenzothiopene	16	414	10	90	6	324
Diphenyl Ether	105	201	94	201	11	0

Table 12-11. Summary of Pollutant Loadings and Removals for the CWT Oils Subcategory¹

Pollutant of Concern	Current Wastewater Pollutant Loading (lbs/yr)		Post-Compliance Wastewater Pollutant Loading (lbs/yr)		Post-Compliance Pollutant Reductions (lbs/yr)	
	Direct Discharges	Indirect Discharges	Direct Discharges	Indirect Discharges	Direct Discharges	Indirect Discharges
Hexanoic Acid	488	6,880	488	4,271	0	2,609
<i>m</i> -Xylene	206	332	83	116	123	216
<i>n</i> -Decane	675	283,150	39	11,910	636	271,240
<i>n</i> -Docosane	24	616	3	60	21	556
<i>n</i> -Dodecane	479	12,720	39	1,173	440	11,547
<i>n</i> -Eicosane	207	10,863	8	295	199	10,568
<i>n</i> -Hexadecane	992	178,720	418	2,645	574	176,075
<i>n</i> -Octadecane	143	108,045	33	1,478	110	106,567
<i>n</i> -Tetradecane	1,303	324,806	373	3,374	930	321,432
<i>o</i> -Cresol	32	1,872	32	1,872	0	0
<i>o</i> -& <i>p</i> -Xylene	100	649	100	359	0	290
<i>p</i> -Cresol	28	1,301	28	1,046	0	255
<i>p</i> -Cymene	8	5	4	1	4	4
Pentamethylbenzene	29	422	4	24	25	398
Pyridine	4	57	4	57	0	0
Styrene	4	67	4	20	0	47
Tripropyleneglycol Methyl Ether	1,370	62,292	79	1,484	1,291	60,808
TOTAL NON-CONVENTIONAL ORGANICS	12,242	1,113,638	7,644	134,939	4,598	978,699
PRIORITY METALS						
Antimony	13	203	13	128	0	75
Arsenic	15	299	15	155	0	144
Cadmium	16	52	1	4	15	48
Chromium	113	633	18	86	95	547
Copper	1,022	6,240	18	161	1,004	6,079
Lead	684	1,420	16	52	668	1,368
Mercury	0	2	0	1	0	1
Nickel	3,405	15,625	133	2,927	3,272	12,698
Selenium	3	259	3	231	0	28
Zinc	977	24,957	229	3,626	748	21,331
TOTAL PRIORITY METALS	6,248	49,690	446	7,371	5,802	42,319
NON-CONVENTIONAL METALS						
Aluminum	2,071	21,296	2,071	9,185	0	12,111
Barium	198	5,132	26	905	172	4,227
Boron	3,726	258,434	3,074	207,342	652	51,092
Cobalt	45	21,953	45	8,563	0	13,390
Iron	13,460	124,007	2,482	43,448	10,978	80,559
Manganese	427	20,365	406	13,275	21	7,090
Molybdenum	151	3,606	151	2,780	0	826
Silicon	2,811	91,782	2,033	66,395	778	25,387
Strontium	117	4,631	81	3,067	36	1,564
Tin	58	1,661	11	214	47	1,447
Titanium	27	329	3	38	24	291
TOTAL NON-CONVENTIONAL METALS	23,091	553,196	10,383	355,212	12,708	197,984
CLASSICAL PARAMETERS						
Chemical Oxygen Demand (COD)	3,389,871	N/A	2,613,803	N/A	776,068	N/A
Ammonia as N	24,847	N/A	14,843	N/A	10,004	N/A
Total Dissolved Solids	1,046,736	N/A	1,046,736	N/A	0	N/A
Total Organic Carbon (TOC)	1,756,618	N/A	666,656	N/A	1,089,962	N/A
Total Cyanide	7	330	6	181	1	149

¹All loadings and reductions take into account the removals by POTWs for indirect discharges.

HEM - Hexane extractable material

Table 12-12. Summary of Pollutant Loadings and Removals for the CWT **Organics Subcategory**¹

Pollutant of Concern	Current Wastewater Pollutant Loading (lbs/yr)		Post-Compliance Wastewater Pollutant Loading (lbs/yr)		Post-Compliance Pollutant Reductions (lbs/yr)	
	Direct Discharges	Indirect Discharges	Direct Discharges	Indirect Discharges	Direct Discharges	Indirect Discharges
CONVENTIONALS						
Biochemical Oxygen Demand 5-Day (BOD ₅)	5,366	N/A	5,366	N/A	0	N/A
Oil and Grease (measured as HEM)	23,062	N/A	23,062	N/A	0	N/A
Total Suspended Solids (TSS)	5,888	N/A	5,888	N/A	0	N/A
PRIORITY ORGANICS						
1,1,1-Trichloroethane	1	154	1	0	0	154
1,1,2-Trichloroethane	2	463	2	1	0	462
1,1-Dichloroethane	1	48	1	1	0	47
1,1-Dichloroethene	1	183	1	1	0	182
1,2-Dichloroethane	1	314	1	0	0	314
Benzene	1	109	1	1	0	108
Chloroform	9	631	9	6	0	625
Methylene Chloride	27	258,747	27	40	0	258,707
Pentachlorophenol	103	1,779	103	243	0	1,536
Phenol	47	54	47	3	0	51
Tetrachloroethene	15	368	15	7	0	361
Toluene	1	7,722	1	0	0	7,722
Trichloroethene	9	211	9	2	0	209
Vinyl Chloride	1	110	1	0	0	110
TOTAL PRIORITY ORGANICS	219	270,893	219	305	0	270,588
NON-CONVENTIONAL ORGANICS						
1,1,1,2-Tetrachloroethane	1	1,312	1	4	0	1,308
1,2,3-Trichloropropane	1	1,576	1	4	0	1,572
1,2-Dibromoethane	1	1,926	1	5	0	1,921
2,3,4,6-Tetrachlorophenol	82	661	82	140	0	521
2,3-Dichloroaniline	3	243	3	7	0	236
2,4,5-Trichlorophenol	13	292	13	26	0	266
2,4,6-Trichlorophenol	11	140	11	10	0	130
2-Butanone	115	2,432	115	26	0	2,406
2-Propanone	269	361,967	269	146	0	361,821
4-Methyl-2-pentanone	19	1,028	19	8	0	1,020
Acetophenone	5	21	5	1	0	20
Aniline	1	151	1	1	0	150
Benzoic Acid	42	594	42	19	0	575
Diethyl Ether	0	7,640	0	24	0	7,616
Dimethyl Sulfoxide	21	22	21	2	0	20
Ethylenethiourea	574	750	574	648	0	102
Hexanoic Acid	8	108	8	5	0	103
m-Xylene	1	638	1	2	0	636
N,N-Dimethylformamide	1	4,957	1	2	0	4,955
o-Cresol	24	1,019	24	31	0	988
Pyridine	15	53	15	2	0	51
p-Cresol	9	280	9	7	0	273
Tetrachloromethane	2	165	2	1	0	164
Trans-1,2-Dichloroethene	3	400	3	2	0	398
TOTAL NON-CONVENTIONAL ORGANICS	1,221	388,375	1,221	1,094	0	387,252
PRIORITY METALS						
Antimony	74	40	74	40	0	0
Chromium	72	13	72	5	0	8
Copper	92	29	92	29	0	0
Nickel	186	351	186	351	0	0
Zinc	50	96	50	34	0	62

Table 12-12. Summary of Pollutant Loadings and Removals for the CWT **Organics Subcategory**¹

Pollutant of Concern	Current Wastewater Pollutant Loading (lbs/yr)		Post-Compliance Wastewater Pollutant Loading (lbs/yr)		Post-Compliance Pollutant Reductions (lbs/yr)	
	Direct Discharges	Indirect Discharges	Direct Discharges	Indirect Discharges	Direct Discharges	Indirect Discharges
TOTAL PRIORITY METALS	474	529	474	459	0	70
NON-CONVENTIONAL METALS						
Aluminum	323	15,395	323	854	0	14,541
Boron	6,279	5,535	6,279	545	0	4,990
Calcium	0	0	0	0	0	0
Iodine	0	1,982	0	0	0	1,982
Iron	515	1,847	515	292	0	1,555
Lithium	1,552	3,911	1,552	3,911	0	0
Magnesium	0	0	0	0	0	0
Manganese	30	219	30	68	0	151
Molybdenum	123	204	123	161	0	43
Phosphorus	904	751	904	0	0	751
Potassium	0	0	0	0	0	0
Silicon	350	893	350	858	0	35
Sodium	0	0	0	0	0	0
Strontium	269	1,723	269	803	0	920
Sulfur	178,861	496,299	178,861	0	0	496,299
Tin	128	147	128	147	0	0
TOTAL NON-CONVENTIONAL METALS	189,334	528,906	189,334	7,639	0	521,267
CLASSICAL PARAMETERS						
Total Cyanide	285	352	285	260	0	92

¹All loadings and reductions take into account the removals by POTWs for indirect discharges.

HEM - Hexane extractable material

Table 12-13. Summary of Pollutant Loadings and Removals for the **Entire CWT Industry**¹

Pollutant of Concern	Current Wastewater Pollutant Loading (lbs/yr)		Post-Compliance Wastewater Pollutant Loading (lbs/yr)		Post-Compliance Pollutant Reductions (lbs/yr)	
	Direct Discharges	Indirect Discharges	Direct Discharges	Indirect Discharges	Direct Discharges	Indirect Discharges
CONVENTIONALS ²	16,225,792	N/A	1,524,397	N/A	14,701,395	N/A
TOTAL PRIORITY ORGANICS	2,006	426,206	1,310	12,101	696	414,105
TOTAL NON-CONVENTIONAL ORGANICS	13,463	1,502,013	8,865	136,032	4,598	1,365,951
TOTAL PRIORITY METALS	601,238	68,604	13,232	11,748	588,006	56,856
TOTAL NON-CONVENTIONAL METALS	1,079,386	1,343,796	285,287	407,104	794,099	936,692

¹All loadings and reductions take into account the removals by POTWs for indirect discharges.

HEM - Hexane extractable material

²Oil and grease loadings and removals for the metals subcategory are not included in this table.

NON-WATER QUALITY IMPACTS

Sections 304(b) and 306 of the Clean Water Act provide that non-water quality environmental impacts are among the factors EPA must consider in establishing effluent limitations guidelines and standards. These impacts are the environmental consequences not directly associated with wastewater that may be associated with the regulatory options considered. For this rule, EPA evaluated the potential effect of the proposed options on air emissions, solid waste generation, and energy consumption.

This section quantifies the non-water quality impacts associated with the options evaluated for this proposal. Cost estimates for the impacts, and the methods used to estimate these costs are discussed in Chapter 11 of this document. In all cases, the costs associated with non-water quality impacts were included in EPA's cost estimates used in the economic evaluation of the proposed limitations and standards.

AIR POLLUTION

13.1

CWT facilities receive and produce wastewaters that contain significant concentrations of organic compounds, some of which are listed in Title 3 of the Clean Air Act Amendments (CAAA) of 1990. These wastewaters often pass through a series of collection and treatment units. These units are open to the atmosphere and allow wastewater containing organic compounds to contact ambient air. Atmospheric exposure of the organic-containing wastewater may result in significant water-to-air transfers of volatile organic compounds (VOCs).

The primary sources of VOCs in the CWT industry are the wastes treated in the oils and the organics subcategory. In general, CWT facilities have not installed air or wastewater treatment technologies designed to control the release of VOCs to the atmosphere. Additionally, most CWT facilities do not employ best management practices designed to control VOC emissions (such as covering their treatment tanks). Therefore, as soon as these VOC-containing oil and organic subcategory wastewaters contact ambient air, volatilization will begin to occur.

Thus, volatilization of VOCs and HAPs from wastewater may begin immediately on receipt, as the wastewater enters the CWT facility, or as the wastewater is discharged from the process unit. Emissions can also occur from wastewater collection units such as process drains, manholes, trenches, sumps, junction boxes, and from wastewater treatment units such as screens, settling basins, equalization basins, biological aeration basins, dissolved air flotation systems, chemical precipitation systems, air or steam strippers lacking air emission control devices, and any other units where the wastewater is in contact with the air. In some cases, volatilization will begin at the facility and continue as the wastewaters are discharged to the local river or POTW.

EPA believes air emissions from existing CWT facilities would be similar before or after implementation of any of the proposed options. This is due primarily to the nature of VOCs, the failure of CWT facilities to equip their wastewater treatment systems with emissions

controls, and the lack of best management practices designed to control the emissions of volatile pollutants. While EPA does not project any net increase in air emissions as a result of the implementation of the proposed effluent guidelines and standards, EPA does project a shift in the location of the VOC emissions.

Table 13-1 provides information on incremental VOC emissions resulting from implementation of the proposed rule at CWT oils and organics facilities. EPA has not provided information for the metals subcategory, but believes these emissions would be negligible. For this analysis, EPA defined a volatile pollutant as described in Chapter 7 and calculated volatile pollutant baseline and post-compliance loadings and reductions as described in Chapter 12. EPA additionally assumed that 80% of the volatile pollutant reduction would be due to volatilization. EPA selected 80% based on an assessment of information developed during the development of OCPSF guidelines (see pages 275-285 of the October 1987 "Development Document for Effluent Limitations Guidelines and Standards for the OCPSF Point Source Category (EPA 440/1-87/009)). EPA believes the information presented in Table 13-1 represents a "worst-case" scenario in terms of incremental volatile air emissions, since the analysis assumes no volatilization of pollutants at baseline. As explained earlier, EPA believes that the majority of these pollutants are already being volatilized in the absence of additional treatment technologies.

Table 13-1 also shows that, for this worst-case scenario, the sum of the annual VOC air emissions at CWT facilities would not exceed 400 tons of HAPs. Under the Clean Air Act, major sources of pollution by HAPs are defined as having either: (1) a total emission of 25 tons/year or higher for the total HAPs from all emission points at a facility; or (2) an emission of 10 tons/year or higher from all emission points at a facility. Based on these criteria, incremental air

emissions from this worst-case scenario analysis of the proposed BPT/BAT/PSES organics subcategory options would cause three facilities to be classified as major sources. For the oils and metals subcategories, EPA does not project any major sources due to incremental removals. Since EPA believes that the three organics subcategory CWT facilities classified as major sources would be classified as such in the absence of the implementation of the proposed options, EPA has determined that air emission impacts from the proposed options are acceptable.

Finally, while this proposal is not based on technology that uses air stripping with emissions control to abate the release of volatile pollutants, EPA encourages all facilities which accept waste containing volatile pollutants to incorporate air stripping with overhead recovery or destruction into their wastewater treatment systems. Additionally, EPA also notes that CWT sources of hazardous air pollutants are subject to maximum achievable control technology (MACT) as promulgated for off-site waste and recovery operations on July 1, 1996 (61 FR 34140) as 40 CFR Part 63.

Table 13-1. Projected Air Emissions at CWT Facilities

Subcategory	VOCs Emitted (tons/yr)	Priority VOCs Emitted (tons/yr)	Number of Projected MACT* Facilities	Major Constituents
Oils	69	32	0	Toluene
Organics	329	323	3	Methylene Chloride and Toluene

* MACT requires 25 tons of volatile emissions for a facility to be a major source or 10 tons of a single pollutant at a single facility.

SOLID WASTE

13.2

Solid waste will be generated by several of the proposed treatment technologies EPA evaluated. These wastes include sludges from biological treatment, chemical precipitation and clarification, gravity separation, and dissolved air flotation systems.

To estimate the incremental sludge generated from the proposed options, EPA subtracted the volume of sludge currently being generated by the CWTs from the estimated volume of sludge that would be generated after implementation of the options. EPA calculated the volume of sludge currently being generated by CWT facilities for all sludge-generating technologies currently being operated at CWT facilities. EPA then calculated the volume of sludge that would be generated by CWT facilities after implementation of the proposed options. Table 13-2 presents the estimated increase in volumes of filter cake generated by CWT facilities that would result from implementation of the proposed limitations and standards.

The precipitation and subsequent separation processes proposed as the technology basis for the metals subcategory will produce a metal-rich filter cake. In most instances, the resulting filter cake will require disposal in Subtitle C and D landfills. EPA estimates that the annual increase in filter cake generated by the metals subcategory facilities will be 3.71 million gallons. In

evaluating the economic impact of sludge disposal, EPA assumed that all of the sludge generated would be disposed in a landfill. This assumption does not take into consideration the fact that an undetermined portion of the generated filter cake may be recovered in secondary metals manufacturing processes rather than being disposed in a landfill.

The dissolved air flotation system and additional gravity separation step proposed as the technology basis for the oils subcategory will produce a filter cake with varying solids and oil content. This filter cake may be either disposed in Subtitle C and D landfills or in some cases through incineration. EPA estimates that the annual increase in filter cake generated by the oils subcategory facilities will be 22.68 million gallons. These estimates are based on implementation of option 8 technology for indirect dischargers (PSES) and option 9 for direct dischargers (BPT/BAT). EPA applied a scale-up factor to include the estimated volume of filter cake generated by the NOA non-respondents. In evaluating the economic impact of sludge disposal, EPA assumed that all of the sludge generated would be disposed in a landfill.

Biological treatment proposed as the technology basis for the organics subcategory will produce a filter cake that consists primarily of biosolids. This filter cake can be disposed by a variety of means including disposal at Subtitle C and Subtitle D landfills, incineration, composting,

and land application. However, contaminants contained in the sludges may limit the use of composting and land application. EPA estimates that the annual increase in filter cake generated by the organics subcategory facilities will be 4.31 million gallons. In evaluating the economic impact of sludge disposal, EPA assumed that all of the sludge generated would be disposed in a landfill.

Table 13-3 presents the percentage of the national volume of hazardous and non-hazardous waste sent to landfills represented by the increase

for each regulatory option. The information presented in this table represents the tonnage of waste accepted by landfills in 1992 and was based on information collected during the development of the proposed Landfills Point Source Category (see pages 3-32 of the January 1998 "Development Document for Proposed Effluent Limitations Guidelines and Standards for the Landfills Point Source Category" (EPA-821-R-97-022)). Based on this analysis, EPA has determined that the solid waste impacts of the proposed regulatory options are acceptable.

Table 13-2. Projected Incremental Filter Cake Generation at CWT Facilities

CWT Subcategory	Option	Filter Cake Generated (million gal/yr)					
		<u>Hazardous</u>			<u>Non-Hazardous</u>		
		Indirect	Direct	Total	Indirect	Direct	Total
Metals	4	0.80	1.68	2.48	0.40	0.83	1.23
Oils	8	10.04	-	10.04	12.28	-	12.28
	9	-	0	0	-	0.36	0.36
Organics	4	2.89	0	2.89	1.42	0	1.42
Total	-	13.73	1.68	15.41	14.1	1.19	15.29

Table 13-3. National Volume of Hazardous and Non-hazardous Waste Sent to Landfills

CWT Subcategory	Option	Percentage of Annual Tonnage of Waste Disposed in National Landfills	
		Hazardous	Non-hazardous
Metals	4	0.032	0.004
Oils	8	0.093	0.028
	9	0	0.001
Organics	4	0.024	0.003
Total		0.149	0.036

ENERGY REQUIREMENTS**13.3**

EPA estimates that the attainment of the proposed options will increase energy consumption by a small increment over present industry use. The projected increase in energy consumption is primarily due to the incorporation of components such as pumps, mixers, blowers, lighting, and controls. Table 13-4 presents the estimated increase in energy requirements that would result from the implementation of the proposed limitations and standards. The estimated total increase in energy consumption of 7.51 million kilowatt hours per year that would result from compliance with the proposed regulation equates to 4,209 barrels of oil per day. According to the United States Department of Energy-Energy Information Administration

website (<http://www.eia.doe.gov/pub/energy/overview/aer>), the United States currently consumes 18.3 million barrels of oil per day. Therefore, EPA has determined that energy impacts from the proposed rule would be acceptable.

LABOR REQUIREMENTS**13.4**

The installation of new wastewater treatment equipment along with improvements in the operation of existing equipment for compliance with the proposed limitations and standards would result in increased operating labor requirements for CWT facilities. It is estimated that compliance with the CWT regulations would result in industry-wide employment gains. Table 13-5 presents the estimated increase in labor requirements for the CWT industry.

Table 13-4. Projected Energy Requirements for CWT Facilities

CWT Subcategory	Option	Energy Usage (kwh/yr)		
		Indirect Dischargers	Direct Dischargers	Total
Metals	4	1,805,369	1,551,195	3,356,564
Cyanide Waste Pretreatment	2	129,000	18,046	147,046
Oils	8	3,336,584	-	3,336,584
	9	-	137,061	137,061
Organics	4	505,175	24,069	529,244
Total	-	5,776,128	1,730,371	7,506,499

Table 13-5. Projected Labor Requirements for CWT Facilities

CWT Subcategory	Option	Operating Labor Requirements					
		Indirect Dischargers		Direct Dischargers		Total	
		(Hours/yr)	(Men/yr)	(Hours/yr)	(Men/yr)	(Hours/yr)	(Men/yr)
Metals	4	85,448	42.7	27,105	13.6	112,553	56.3
Cyanide Waste Pretreatment	2	16,425	8.2	2,190	1.1	18,615	9.3
Oils	8	57,825	25.9	-	-	57,825	25.9
	9	-	-	2,496	1.2	2,496	1.2
Organics	4	29,042	14.5	936	0.5	29,978	15
Total	-	188,740	91.3	32,727	16.4	221,467	107.7

IMPLEMENTATION

Implementation of a regulation is a critical step in the regulatory process. If a regulation is not effectively implemented, the removals and environmental benefits estimated for the regulation may not be achieved. Likewise, ineffective implementation could hinder the facility's operations without achieving the estimated environmental benefits. In discussions with permit writers and pretreatment authorities, many stated that close communication with CWT facilities is important for effective implementation of discharge permits. Control authorities need to have a thorough understanding of a CWT's operations to effectively implement this rule. Likewise, CWT facilities must maintain close communication with the waste generators in order to accurately characterize and treat the incoming waste streams.

APPLICABLE WASTE STREAMS 14.1

Chapter 5 describes the sources of wastewater for the CWT industry, which include the following:

Off-site-generated wastewater:

- Waste receipts via tanker truck, trailer/roll-off bins, and drums.

On-site-generated wastewater:

- Equipment/area washdown
- Water separated from recovered/recycled materials
- Contact/wash water from recovery and treatment operations
- Transport container washdown
- Solubilization water
- Laboratory-derived wastewater
- Air pollution control wastewater

- Incinerator wastewater from on-site incinerators
- Landfill wastewater from on-site landfills
- Contaminated stormwater.

All of these waste streams should be classified as process wastewater and are thus subject to the appropriate subcategory discharge standards. EPA believes that uncontaminated stormwater should not be mixed with waste receipts prior to complete treatment of the waste receipts since this arrangement may allow discharge standards to be met by dilution rather than proper treatment. However, EPA is concerned that only contaminated stormwater (i.e. stormwater which comes in contact with waste receipts and waste handling and treatment areas) be classified as a process wastewater. During site visits at CWT facilities, EPA observed many circumstances in which uncontaminated stormwater was commingled with the CWT wastewaters prior to treatment or was added after treatment prior to effluent discharge monitoring. EPA believes that permit writers and pretreatment authorities should be responsible for determining which stormwater sources warrant designation as process wastewater. Additionally, control authorities should require facilities to monitor and meet their CWT discharge requirements following wastewater treatment and prior to combining these treated CWT wastewaters with non-process wastewaters. If a control authority allows a facility to combine treated CWT wastewaters with non-process wastewaters prior to compliance monitoring, the control authority should ensure that the non-contaminated stormwater dilution flow is factored into the facility's permit limitations.

EPA has also observed situations where stormwater, contaminated and uncontaminated, was recycled as process water (e.g., as solubilization water for wastes in the solid phase to render the wastes treatable). In these instances, dilution is not the major source of pollutant reductions (treatment). Rather, this leads to reduced wastewater discharges. Permit writers and pretreatment authorities should investigate opportunities for use of such alternatives and encourage such practices wherever feasible.

DESCRIPTION OF SUBCATEGORY 14.2

One of the most important aspects of implementation is the determination of which subcategory's limitations are applicable to a facility's operation(s). As detailed in Chapter 5, EPA established a subcategorization scheme based on the character of the wastes being treated and the treatment technologies utilized. The subcategories are as follows:

Subcategory A: Metals Subcategory:

Facilities which treat, recover, or treat and recover metal, from metal-bearing waste, wastewater, or used material received from offsite;

Subcategory B: Oils Subcategory:

Facilities which treat, recover, or treat and recover oil, from oily waste, wastewater, or used material received from offsite; and

Subcategory C: Organics Subcategory:

Facilities which treat, recover, or treat and recover organics, from other organic waste, wastewater, or used material received from offsite;

The determination of a subcategory is primarily based on the type of process generating

the waste, the characteristics of the waste, and the type of treatment technologies which would be effective in treating the wastes. It is important to note that various pollutants were detected in all three subcategories. That is, organic constituents were detected in metal subcategory wastewater and vice versa. The following sections provide a summary description of the wastes in each of the three subcategories; a more detailed presentation is in Chapter 5.

Metals Subcategory Description 14.2.1

Waste receipts classified in the metals subcategory include, but are not limited to: spent electroplating baths and sludges, spent anodizing solutions, air pollution control water and sludges, incineration wastewaters, waste liquid mercury, metal finishing rinse water and sludges, chromate wastes, cyanide-containing wastes, and waste acids and bases. The primary concern with metals subcategory waste streams is the concentration of metal constituents, and some form of chemical precipitation with solid-liquid separation is essential. These raw waste streams generally contain few organic constituents and have low oil and grease levels. The range of oil and grease levels in metal subcategory wastestreams sampled by EPA was 5 mg/L (the minimum analytical detection limit) to 143 mg/L. The average oil and grease level measured at metals facilities by EPA was 39 mg/L. As expected, metal concentrations in wastes from this subcategory were generally high in comparison to other subcategories. In general, wastes that contain significant quantities of inorganics and/or metals should be classified in the metals subcategory.

Oil Subcategory Description 14.2.2

Waste receipts classified in the oils subcategory include, but are not limited to:

lubricants, used petroleum products, used oils, oil spill clean-up, interceptor wastes, bilge water, tank cleanout, off-specification fuels, and underground storage tank remediation waste. Based on EPA's sampling data, oil and grease concentrations in these streams following emulsion breaking and/or gravity separation range from 23 mg/L to 180,000 mg/L. The facility average value is 5,976 mg/L. Based on information provided by industry, oil and grease content in these waste receipts prior to emulsion breaking and/or gravity separation varies between 0.1% and 99.6% (1,000 mg/L to 996,000 mg/L).

Additionally, as measured after emulsion breaking and/or gravity separation, these oily wastewaters generally contain a broad range of organic and metal constituents. Therefore, while the primary concern is often a reduction in oil and grease levels, oils subcategory wastewaters require treatment for metal constituents and organic constituents also. In general, wastes that do not contain a recoverable quantity of oil should not be classified as being in the oils subcategory. The only exception to that would be wastes contaminated with gasoline or other hydrocarbon fuels.

Organics Subcategory Description 14.2.3

Waste receipts classified in the organics subcategory include, but are not limited to: landfill leachate, contaminated groundwater clean-up, solvent-bearing waste, off-specification organic product, still bottoms, used glycols, wastewater from adhesives and epoxies, and wastewater from chemical product operations and paint washes. These wastes generally contain a wide variety and concentration of organic compounds, low concentrations of metal compounds (as compared to waste receipts in the metals subcategory), and low concentrations of oil and grease. The concentration of oil and grease in organic subcategory samples measured

by EPA ranged from 2mg/L to 42 mg/L with an average value of 22 mg/L. The primary concern for organic wastestreams is the reduction in organic constituents which generally requires some form of biological treatment. In general, wastes that do not contain significant quantities of inorganics, metals, or recoverable quantities of oil or fuel should be classified as belonging to the organics subcategory.

FACILITY SUBCATEGORIZATION

IDENTIFICATION

14.3

EPA believes that the paperwork and analyses currently performed at CWT facilities as part of their waste acceptance procedures (as outlined in Chapter 4) are generally sufficient for making a subcategory determination. EPA has strived to base its recommended subcategorization determination procedure on information generally obtained during these waste acceptance and confirmation procedures. EPA discourages permit writers and pretreatment authorities from requiring additional monitoring or paperwork solely for the purpose of subcategory determinations. In most cases, as detailed below, EPA believes the subcategory determination can be made on the type of waste receipt, e.g., metal-bearing sludge, waste oil, landfill leachate. EPA believes that all CWT facilities should, at a minimum, collect information from the generator on the type of waste receipt since this is the minimum information required by CWT facilities to effectively treat off-site wastes.

To determine an existing facility's subcategory classification(s), the facility should review its incoming waste receipt data for a period of one year. The facility should first use Table 14-1 below to classify each of its waste receipts for that one year period into a subcategory. Finally, the facility should determine the relative percent of off-site wastes accepted in each subcategory (by volume).

Table 14-1 Waste Receipt Classification

Metals Subcategory	spent electroplating baths and/or sludges; metal finishing rinse water and sludges; chromate wastes; air pollution control water and sludges; incineration wastewaters; spent anodizing solutions; waste liquid mercury; cyanide-containing wastes (>136 mg/L); and waste acids and bases with or without metals.
Oils Subcategory	used oils; oil-water emulsions or mixtures; lubricants; coolants; contaminated groundwater clean-up from petroleum sources; used petroleum products; oil spill clean-up; bilge water; rinse/wash waters from petroleum or oily sources; interceptor wastes; off-specification fuels; underground storage remediation waste; and tank clean-out from petroleum or oily sources
Organics Subcategory	landfill leachate; contaminated groundwater clean-up from non-petroleum sources; solvent-bearing wastes; off-specification organic product; still bottoms; used glycols; wastewater from paint washes; wastewater from adhesives and/or epoxies; wastewater from chemical product operations; and tank clean-out from organic, non-petroleum sources

If the waste receipt is listed above, the subcategory determination is made solely from the information provided in Table 14-1. If, however, the waste receipt is unknown or not listed above, the facility should use the following hierarchy to determine the appropriate subcategory:

- 1). If the waste receipt contains oil and grease at or in excess of 100 mg/L, the waste receipt should be classified in the oils subcategory;
- 2). If the waste receipt contains oil and grease <100 mg/L, and has either cadmium, chromium, copper, or nickel concentrations in excess of the values listed below, the waste receipt should be classified in the metals subcategory.

cadmium	0.2 mg/L
chromium	8.9 mg/L
copper	4.9 mg/L
nickel	37.5 mg/L
- 3). If the waste receipt contains oil and grease < 100 mg/L, and does not have concentrations of cadmium, chromium,

copper, or nickel above any of the values listed above, the waste receipt should be classified in the organics subcategory.

This process is also illustrated in Figure 14-1.

Members of the CWT industry have expressed concern that wastes may be received from the generator as a “mixed waste”, i.e., the waste may be classified in more than one subcategory. Based on the information collected during the development of this rule, using the subcategorization procedure recommended in this section, EPA is able to classify each waste receipt identified by the industry into the appropriate subcategory. Therefore, EPA believes that these “mixed waste receipt” concerns have been addressed in the current subcategorization procedure.

Once the facility’s subcategory determination has been made, the facility should not be required to make an annual determination. However, if a single subcategory facility alters their operation to accept wastes from another subcategory or if a mixed waste facility alters its annual operations to change the relative percentage of waste receipts in one subcategory by more than 20 percent, the facility should notify the appropriate permit writer or pretreatment authority and the subcategory determination should be re-visited. EPA also recommends that the subcategory determination be re-evaluated whenever the permit is re-issued.

For new CWT facilities, the facility should estimate the percentage of waste receipts expected in each subcategory. Alternatively, the facility could compare the treatment technologies being installed to the selected treatment technologies for each subcategory. After the initial year of operation, the permit writer or pretreatment authority should re-visit the CWT’s subcategory determination and follow the procedure outlined for existing facilities.

Some facilities, such as those located near

auto manufacturers, claim that their waste streams vary significantly for very limited time spans each year, and that they would be unable to meet limitations based on their annual waste receipts during these time periods. In these cases, one set of limits or standards may not be appropriate for the permit’s entire period. EPA recommends that a tiering approach be used in such situations. In tiered permits, the control authority issues one permit for “standard” conditions and another set which take effect when there is a significant change in the waste receipts accepted. EPA’s Industrial User Permitting Guidance Manual (September 1989) recommends that tiered permits should be considered when production rate varies by 20 percent or greater. Since this rule is not production based, EPA recommends that for the CWT industry, tiered permits should be considered when the subcategory determination varies for selected time periods by more than 20 percent. An example when a tiered approach may be appropriate in the CWT industry would be if a CWT facility’s major customer (in terms of flow) does not operate for a two week period in December. The CWT facility would not be receiving waste receipts from the generating facility during their two week closure which could greatly alter the relative percent of waste accepted by the CWT facility for the two week period only.

As explained previously, many facilities have waste streams that vary on a daily basis. EPA cautions that the tiering approach should only be used for facilities which have limited, well-defined, “non-standard” time periods. A tiered permit should only be considered when the control authority thoroughly understands the CWT’s operations and when a substantial change in the relative percentages of waste in each subcategory would effect permit conditions. Additionally, a tiered permit is never required if compliance is measured on a subcategory basis after each treatment system.

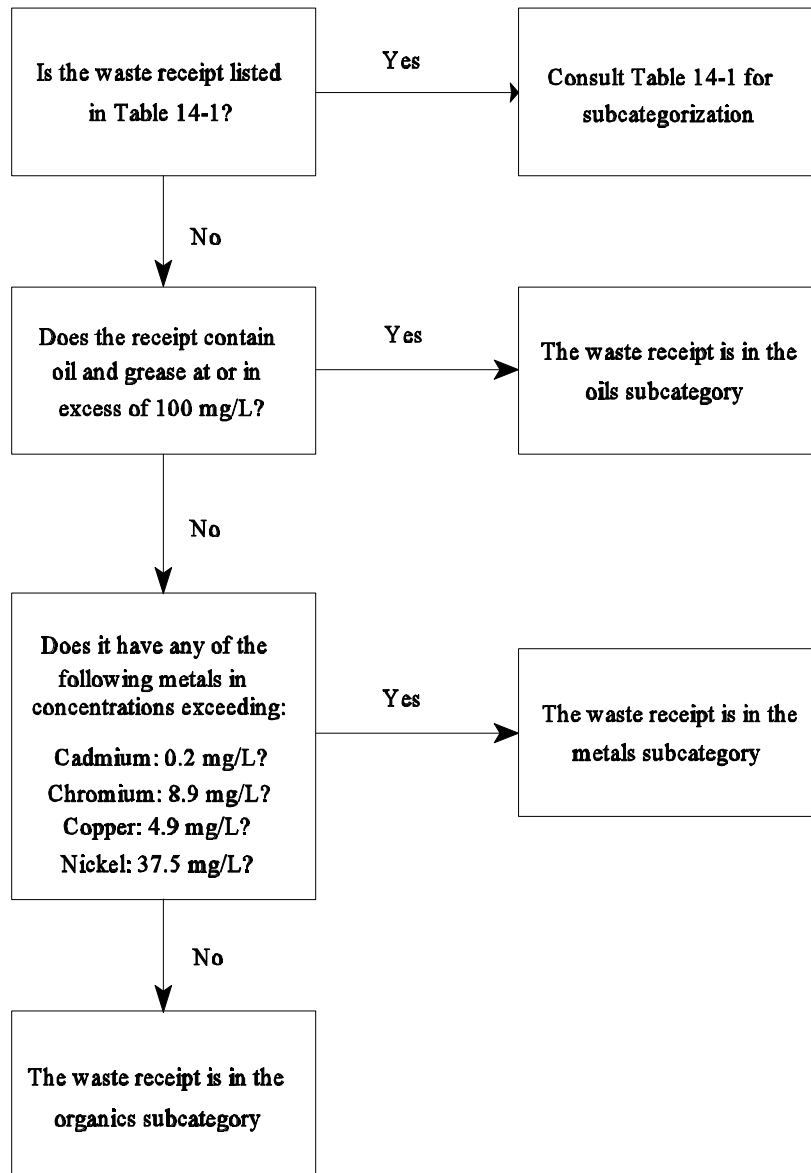


Figure 14-1. Waste Receipt Subcategory Classification Diagram

**ON-SITE GENERATED WASTEWATER
SUBCATEGORY DETERMINATION 14.4**

Section 14.3 details the subcategory determination for off-site waste receipts. For other on-site generated wastewater sources such as those described in Section 14.1, wastewater generated in support of, or as the result of, activities associated with each subcategory should be classified in that subcategory. For facilities that are classified in a single subcategory, the facility should generally classify on-site wastewater in that subcategory. For facilities that are classified in more than one subcategory, however, the facility should apportion the on-site generated wastewater to the appropriate subcategory. Certain waste streams may be associated with more than one subcategory such as stormwater, equipment/area washdown, air pollution control wastewater, etc. For these wastewater sources, the volume generated should be apportioned to each associated subcategory. For example, for contaminated stormwater, the volume can be apportioned based on the proportion of the surface area associated with operations in each subcategory. Equipment/area washdown may be assigned to a subcategory based on the volume of waste treated in each subcategory. Alternatively, control authorities may assign the on-site wastestreams to a subcategory based on the appropriateness of the selected subcategory treatment technologies.

**On-site Industrial Waste Combustors,
Landfills, and Transportation
Equipment Cleaning Operations 14.4.1**

As noted previously, wastewater from on-site industrial waste combustors, landfills, and transportation equipment and cleaning operations that is commingled with CWT wastewater for treatment shall be classified as CWT process wastewater. Like the off-site waste receipts, the subcategory determination of these wastewaters

should be based on the characteristics of the wastewater and the appropriateness of the application of treatment technologies associated with each subcategory.

For wastewater associated with industrial waste combustors, the wastewater should be classified as a metals subcategory wastestream. This reflects the treatment technology selected in the recently proposed rule for Industrial Waste Combustors (63 FR 6392-6423). For landfill wastewater, the wastewater should be classified as an organics subcategory wastestream. This also reflects the treatment technology selected in the recently proposed rule for Landfills (63 FR 6426-6463)¹. For wastewaters associated with transportation equipment cleaning, these wastestreams should be classified in a manner similar to that used for off-site waste receipts.

**SUBCATEGORY DETERMINATION IN EPA
QUESTIONNAIRE DATA BASE 14.5**

In order to estimate the quantities of wastewater being discharged, current pollutant loads, pollutant reductions, post compliance costs, and environmental benefits for each subcategory, EPA developed a methodology to classify waste streams for CWT facilities in the EPA Waste Treatment Industry Questionnaire database into each of the proposed subcategories. The following is a list of the rules used by EPA in the subcategory determination of the wastes reported in 308 Questionnaires. The rules rely primarily on Waste Form Codes (where available) plus RCRA wastes codes. Table 14-2 lists the waste form codes utilized in this classification.

¹For leachate generated at Subtitle C landfills (hazardous), the selected technology basis is chemical precipitation and biological treatment.

Table 14-2. RCRA and Waste Form Codes Reported by Facilities in 1989

<u>RCRA CODES</u>	
D001	Ignitable Waste
D002	Corrosive Waste
D003	Reactive Waste
D004	Arsenic
D005	Barium
D006	Cadmium
D007	Chromium
D008	Lead
D009	Mercury
D010	Selenium
D011	Silver
D012	Endrin(1,2,3,4,10,10-hexachloro-1,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo-5,8-dimeth-ano-naphthalene)
D017	2,4,5-TP Silvex (2,4,5-trichlorophenylpropionic acid)
D035	Methyl ethyl ketone
F001	The following spent halogenated solvents used in degreasing: tetrachloroethylene; trichloroethane; carbon tetrachloride and chlorinated fluorocarbons and all spent solvent mixtures/blends used in degreasing containing, before use, a total of 10 percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures
F002	The following spent halogenated solvents: tetrachloroethylene; 1,1,1-trichloroethane; chlorobenzene; 1,1,2-trichloro-1,2,2-trifluoroethane; ortho-dichlorobenzene; trichloroethane; all spent solvent mixtures/blends containing, before use, a total of 10 percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F001, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures
F003	The following spent nonhalogenated solvents: xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, one or more of the above nonhalogenated solvents, and a total of 10 percent or more (by volume) of one or more of those solvents listed in F001, F002, F004, and F005-1 and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F004	The following spent nonhalogenated solvents: cresols, cresylic acid, and nitrobenzene; and the still bottoms from the recovery of these solvents; all spent solvent mixtures/blends containing before use a total of 10 percent or more (by volume) of one or more of the above nonhalogenated solvents or those solvents listed in F001, F002, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures
F005	The following spent nonhalogenated solvents: toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of 10 percent or more (by volume) of one or more of the above nonhalogenated solvents or those solvents listed in F001, F002, or F004; and still bottoms from the recovery of these spent solvents and spent solvents mixtures
F006	Wastewater treatment sludges from electroplating operations except from the following processes: (1) sulfuric acid anodizing of aluminum; (2) tin plating on carbon steel; (3) zinc plating (segregated basis) on carbon steel; (4) aluminum or zinc-aluminum plating on carbon steel; (5) cleaning/stripping associated with tin, zinc, and aluminum plating on carbon steel; and (6) chemical etching and milling of aluminum
F007	Spent cyanide plating bath solutions from electroplating operations
F008	Plating bath residues from the bottom of plating baths from electroplating operations in which cyanides are used in the process

Table 14-2. RCRA and Waste Form Codes Reported by Facilities in 1989

F009	Spent stripping and cleaning bath solutions from electroplating operations in which cyanides are used in the process
F010	Quenching bath residues from oil baths from metal heat treating operations in which cyanides are used in the process
F011	Spent cyanide solutions from slat bath pot cleaning from metal heat treating operations
F012	Quenching waste water treatment sludges from metal heat treating operations in which cyanides are used in the process
F019	Wastewater treatment sludges from the chemical conversion coating of aluminum
F039	Multi-source leachate
K001	Bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and/or pentachlorophenol
K011	Bottom stream from the wastewater stripper in the production of acrylonitrile
K013	Bottom stream from the acetonitrile column in the production of acrylonitrile
K014	Bottoms from the acetonitrile purification column in the production of acrylonitrile
K015	Still bottoms from the distillation of benzyl chloride
K016	Heavy ends or distillation residues from the production of carbon tetrachloride
K031	By-product salts generated in the production of MSMA and cacodylic acid
K035	Wastewater treatment sludges generated in the production of creosote
K044	Wastewater treatment sludges from the manufacturing and processing of explosives
K045	Spent carbon from the treatment of wastewater containing explosives K048 air flotation (DAF) float from the petroleum refining industry K049 Slop oil emulsion solids from the petroleum refining industry
K050	Heat exchanger bundle cleaning sludge from the petroleum refining industry
K051	API separator sludge from the petroleum refining industry
K052	Tank bottoms (leaded) from the petroleum refining industry
K061	Emission control dust/sludge from the primary production of steel in electric furnaces
K064	Acid plant blowdown slurry/sludge resulting from the thickening of blowdown slurry from primary copper production
K086	Solvent washes and sludges, caustic washes and sludges, or water washes and sludges from cleaning tubs and equipment used in the formulation of ink from pigments, driers, soaps, and stabilizers containing chromium and lead
K093	Distillation light ends from the production of phthalic anhydride from ortho-xylene
K094	Distillation bottoms from the production of phthalic anhydride from ortho-xylene
K098	Untreated process wastewater from the production of toxaphene
K103	Process residues from aniline extraction from the production of aniline K104 Combined wastewater streams generated from nitrobenzene/aniline production
P011	Arsenic pentoxide (t)
P012	Arsenic (III) oxide (t) Arsenic trioxide (t)
P013	Barium cyanide
P020	Dinoseb, Phenol,2,4-dinitro-6-(1-methylpropyl)-
P022	Carbon bisulfide (t) Carbon disulfide (t)
P028	Benzene, (chloromethyl) -Benzyl chloride
P029	Copper cyanides
P030	Cyanides (soluble cyanide salts), not elsewhere specified (t)

Table 14-2. RCRA and Waste Form Codes Reported by Facilities in 1989

P040	0,0-diethyl 0-pyrazinyl phosphorothioate Phosphorothioic acid, 0,0-diethyl 0-pyrazinyl ester
P044	Dimethoate (t) Phosphorodithioic acid, 0,0-dimethyl S-[2-(methylamino)-2-oxoethyl]ester (t)
P048	2,4-dinitrophenol Phenol,2,4-dinitro-
P050	Endosulfan 5-norbornene-2,3-dimethanol, 1,4,5,6,7,7-hexachloro,cyclic sulfite
P063	Hydrocyanic acid Hydrogen cyanide
P064	Methyl isocyanate Isocyanic acid, methyl ester
P069	2-methylactonitrile Propanenitrile,2-hydroxy-2-methyl-
P071	0,0-dimethyl 0-p-nitrophenyl phosphorothioate Methyl parathion
P074	Nickel (II) cyanide Nickel cyanide
P078	Nitrogen (IV) oxide Nitrogen dioxide
P087	Osmium tetroxide Osmium oxide
P089	Parathion (t) Phosphorothiotic acid,0,0-diethyl 0-(p-nitrophenyl) ester (t)
P098	Potassium cyanide
P104	Silver cyanide
P106	Sodium cyanide
P121	Zinc cyanide
P123	Toxaphene Camphene,octachloro-
U002	2-propanone (i) Acetone (i)
U003	Ethanenitrile (i,t) Acetonitrile (i,t)
U008	2-propenoic acid (i) Acrylic acid (i)
U009	2-propenenitrile Acrylonitrile
U012	Benzenamine (i,t) Aniline (i,t)
U019	Benzene (i,t)

Table 14-2. RCRA and Waste Form Codes Reported by Facilities in 1989

U020	Benzenesulfonyl chloride (c,r) Benzenesulfonic acid chloride (c,r)
U031	1-butanol (i) N-butyl alcohol (i)
U044	Methane, trichloro- Chloroform
U045	Methane, chloro-(i,t) Methyl chloride (i,t)
U052	Cresylic acid Cresols
U057	Cyclohexanone (i)
U069	Dibutyl phthalate 1,2-benzenedicarboxylic acid, dibutyl ester
U080	Methane, dichloro- Methylene chloride
U092	Methanamine, N-methyl-(i) Dimethylamine (i)
U098	Hydrazine, 1,1-dimethyl- 1,1-dimethylhydrazine
U105	2,4-dinitrotoluene Benzene, 1-methyl-2,4-dinitro-
U106	2,6-dinitrotoluene Benzene, 1-methyl-2,6-dinitro
U107	Di-n-octyl phthalate 1-2-benzenedicarboxylic acid, di-n-octyl ester
U113	2-propenoic acid, ethyl ester (i) Ethyl acrylate (i)
U118	2-propenoic acid, 2-methyl-, ethyl ester Ethyl methacrylate
U122	Formaldehyde Methylene oxide
U125	Furfural (i) 2-furancarboxaldehyde (i)
U134	Hydrogen fluoride (c,t) Hydrofluoric acid (c,t)
U135	Sulfur hydride Hydrogen sulfide
U139	Ferric dextran Iron dextran
U140	1-propanol, 2-methyl- (i,t) Isobutyl alcohol (i,t)
U150	Melphalan Alanine, 3-[p-bis(2-chloroethyl)amino] phenyl-, L-

Table 14-2. RCRA and Waste Form Codes Reported by Facilities in 1989

U151	Mercury
U154	Methanol (i) Methyl alcohol (i)
U159	Methyl ethyl ketone (i,t) 2-butanone (i,t)
U161	4-methyl-2-pentanone (i) Methyl isobutyl ketone (i)
U162	2-propenoic acid,2-methyl-,methyl ester (i,t) Methyl methacrylate (i,t)
U188	Phenol Benzene, hydroxy-
U190	Phthalic anhydride 1,2-benzenedicarboxylic acid anhydride
U205	Selenium disulfide (r,t) Sulfur selenide (r,t)
U210	Tetrachloroethylene Ethene, 1,1,2,2-tetrachloro
U213	Tetrahydrofuran (i) Furan, tetrahydro- (i)
U220	Toluene Benzene, methyl-
U226	1,1,1-trichloroethane Methylchloroform
U228	Trichloroethylene Trichloroethene
U239	Xylene (i) Benzene, dimethyl- (i,t)
<u>WASTE FORM CODES</u>	
B001	Lab packs of old chemicals only
B101	Aqueous waste with low solvent
B102	Aqueous waste with low other toxic organics
B103	Spent acid with metals
B104	Spent acid without metals
B105	Acidic aqueous waste
B106	Caustic solution with metals but no cyanides
B107	Caustic solution with metals and cyanides
B108	Caustic solution with cyanides but no metals
B109	Spent caustic
B110	Caustic aqueous waste
B111	Aqueous waste with reactive sulfides
B112	Aqueous waste with other reactives (e.g., explosives)
B113	Other aqueous waste with high dissolved solids
B114	Other aqueous waste with low dissolved solids
B115	Scrubber water

Table 14-2. RCRA and Waste Form Codes Reported by Facilities in 1989

B116	Leachate
B117	Waste liquid mercury
B119	Other inorganic liquids
B201	Concentrated solvent-water solution
B202	Halogenated (e.g., chlorinated) solvent
B203	Nonhalogenated solvent
B204	Halogenated/Nonhalogenated solvent mixture
B205	Oil-water emulsion or mixture
B206	Waste oil
B207	Concentrated aqueous solution of other organics
B208	Concentrated phenolics
B209	Organic paint, ink, lacquer, or varnish
B210	Adhesive or epoxies
B211	Paint thinner or petroleum distillates
B219	Other organic liquids
B305	"Dry" lime or metal hydroxide solids chemically "fixed"
B306	"Dry" lime or metal hydroxide solids not "fixed"
B307	Metal scale, filings, or scrap
B308	Empty or crushed metal drums or containers
B309	Batteries or Battery parts, casings, cores
B310	Spent solid filters or adsorbents
B312	Metal-cyanides salts/chemicals
B313	Reactive cyanides salts/chemicals
B315	Other reactive salts/chemicals
B316	Other metal salts/chemicals
B319	Other waste inorganic solids
B501	Lime sludge without metals
B502	Lime sludge with metals/metal hydroxide sludge
B504	Other wastewater treatment sludge
B505	Untreated plating sludge without cyanides
B506	Untreated plating sludge with cyanides
B507	Other sludges with cyanides
B508	Sludge with reactive sulfides
B510	Degreasing sludge with metal scale or filings
B511	Air pollution control device sludge (e.g., fly ash, wet scrubber sludge)
B513	Sediment or lagoon dragout contaminated with inorganics only
B515	Asbestos slurry or sludge
B519	Other inorganic sludges
B601	Still bottoms of halogenated (e.g., chlorinated) solvents or other organic liquids
B603	Oily sludge
B604	Organic paint or ink sludge
B605	Reactive or polymerized organics
B607	Biological treatment sludge
B608	Sewage or other untreated biological sludge
B609	Other organic sludges

Wastes Classified in the Metals Subcategory - Questionnaire Responses**14.5.1**

The wastes that EPA classified in the metals subcategory include the following:

- All wastes reported in Section G, Metals Recovery, of the 308 Questionnaire; and
- All wastes with Waste Form Codes and RCRA codes meeting the criteria specified in Table 14-3

Table 14-3. Waste Form Codes in the Metals Subcategory

All Inorganic Liquids	Waste Form Codes B101-B119	Exceptions: [*] Waste Form Codes B116, and B101, B102, B119 when combined with RCRA Codes: F001-F005 and other organic F, K, P, and U Codes
All Inorganic Solids	Waste Form Codes B301-B319	Exceptions: [*] Waste Form Code B301 when combined with RCRA Codes: F001-F005 and other organic F, K, P, and U Codes
All Inorganic Sludges	Waste Form Codes B501-B519	Exceptions: [*] Waste Form Code B512 when combined with RCRA Codes: F001-F005 and other organic F, K, P, and U Codes

^{*} These exceptions were classified as belonging in the organics subcategory

Wastes Classified in The Oils Subcategory - Questionnaire Responses**14.5.2**

The wastes EPA classified in the oils subcategory include the following:

- All wastes reported in Section E, Waste Oil Recovery, of the 308 Questionnaire;
- All wastes reported in Section H, Fuel Blending Operations, of the 308 Questionnaire that generate a wastewater as a result of the fuel blending operations; and
- All wastes with Waste Form Codes and RCRA codes meeting the criteria in Table 14-4.

Table 14-4. Waste Form Codes in the Oils Subcategory

Organic Liquids	Waste Form Codes B205, B206	Exceptions: None
Organic Sludge	Waste Form Code B603	Exceptions: None

Wastes Classified in the Organics Subcategory - Questionnaire Responses**14.5.3**

The wastes EPA classified in the organics subcategory include the following:

- All wastes with Waste Form Codes and RCRA codes meeting the criteria specified in Table 14-5

Table 14-5. Waste Form Codes in the Organics Subcategory

Organic Liquids	Waste Form Codes B201-B204, B207-B219	Exceptions: None
Organic Solids	Waste Form Codes B401-B409	Exceptions: None
Organic Sludges	Waste Form Codes B601, B602, B604-B609	Exceptions: None
Inorganic Liquids	Waste Form Codes B101, B102, B116, B119	when combined with RCRA Codes: F001-F005 and other organic F, K, P, and U Codes
Inorganic Solids	Waste Form Code B301	when combined with RCRA Codes: F001-F005 and other organic F, K, P, and U Codes
Inorganic Sludges	Waste Form Code B512	when combined with RCRA Codes: F001-F005 and other organic F, K, P, and U Codes

For wastes that can not be easily classified into a subcategory such as lab-packs, the subcategory determination was based on other information provided such as RCRA codes and descriptive comments. Therefore, some judgement was required in assigning some waste receipts to a subcategory.

ESTABLISHING LIMITATIONS AND STANDARDS FOR FACILITY DISCHARGES 14.6

In establishing limitations and standards for CWT facilities, it is important for the permit writer or pretreatment authority to ensure that the CWT facility has an optimal waste management program. First, the control authority should verify that the CWT facility is identifying and segregating waste streams to the extent possible since segregation of similar waste streams is the first step in obtaining optimal mass removals of pollutants from industrial wastes. Next, the control authority should verify that the CWT facility is employing treatment technologies designed and operated to optimally treat all off-site waste receipts. For example, biological treatment is inefficient for treating concentrated metals waste streams like those found in the

metals subcategory or wastestreams with oil and grease compositions and concentrations like those found in the oils subcategory. In fact, concentrated metals streams and high levels of oil and grease compromise the ability of biological treatment systems to function. Likewise, emulsion breaking/gravity separation, and/or dissolved air flotation is typically insufficient for treating concentrated metals wastewaters or wastewaters containing organic pollutants which solubilize readily in water. Finally, chemical precipitation is insufficient for treating organic wastes and waste streams with high oil and grease concentrations.

Once the control authority has established that the CWT facility is segregating its waste receipts and has appropriate treatment technologies for all off-site waste receipts, the permit writer or pretreatment authority can then establish limitations or standards which ensure that the CWT facility is operating its treatment technologies optimally. Available guidance in calculating NPDES categorical limitations for direct discharge facilities can be found in the U.S. EPA NPDES Permit Writers' Manual (December 1996, EPA-833-B-96-003). Sources of

information used for calculating Federal pretreatment standards for indirect discharge facilities include 40 CFR Part 403.6, the Guidance Manual for the Use of Production-Based Pretreatment Standards and the Combined Waste Stream Formula (September 1985), and EPA's Industrial User Permitting Guidance Manual (September 1989). However, as illustrated in the next section, for the CWT point source category, only 40 CFR Part 403.6 and EPA's Industrial User Permitting Guidance Manual should be used as a source of information for calculating Federal CWT pretreatment standards for indirect dischargers.

Existing Guidance for Multiple

Subcategory Facilities

14.6.1

Direct Discharge Guidance

14.6.1.1

For instances where a direct discharge facility's operations are covered by multiple subcategories, the NPDES permit writer must apply the limits from each subcategory in deriving the technology-based effluent limits for the facility. If all wastewaters regulated by the effluent guidelines are combined prior to treatment or discharge to navigable waters, then the permit writer would simply combine the allowable pollutant loadings for each subcategory to arrive at a single, combined set of technology-based effluent limits for the facility -- the "building block" approach (pages 60 & 61, U.S. EPA NPDES Permit Writers' Manual, December 1996). In those circumstances when the limits for one subcategory regulate a different set of pollutants than the limits applicable to another subcategory, the permit writer must ensure proper application of the guidelines. If one subcategory wastestream that does not limit a particular pollutant is combined with another wastestream that limits the pollutant, then the permit writer must ensure that the non-regulated pollutant stream does not dilute the regulated pollutant stream to the point where the pollutant is not analytically detectable. If this circumstance

occurs, then the permit writer is authorized to establish internal monitoring points, as allowed under 40 CFR § 122.45(h).

The methodology for developing "building block" daily maximum limits for selected pollutants for a hypothetical CWT facility is illustrated in Example 14-1.

Example 14-1

Facility A accepts wastes in all three CWT subcategories with separate subcategory treatment systems and a combined end-of-pipe outfall. This facility treats 20,000 l/day of metal-bearing wastes, 10,000 l/day of oily wastes, and 45,000 l/day of organic wastes.

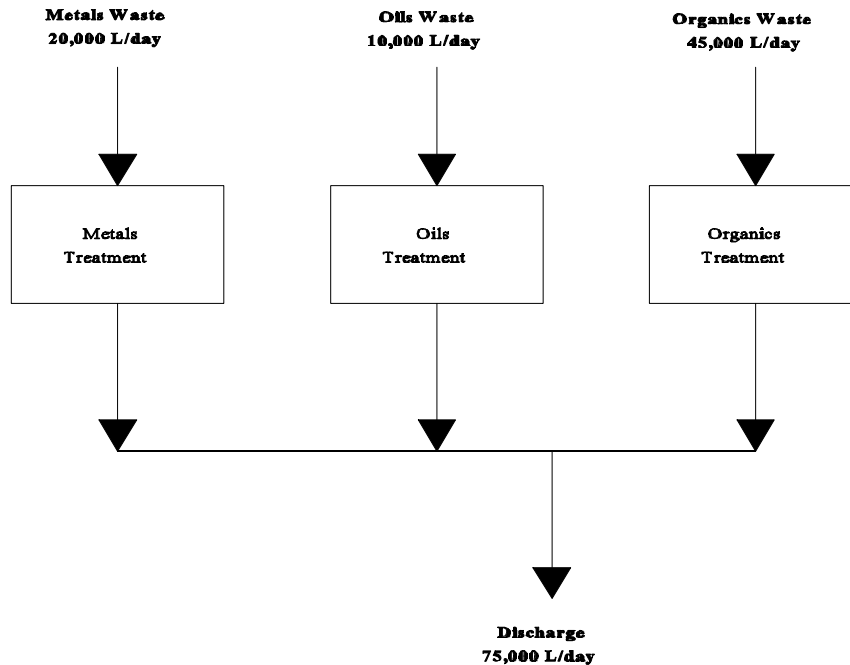


Figure 14-2. Facility Accepting Waste in All Three Subcategories With Treatment in Each.

For this example, EPA has proposed chromium and lead BAT limits for the metals and oils subcategories; fluoranthene limits for only the oils subcategory; and 2,4,6-trichlorophenol limits for only the organics subcategory. Table 14-6 shows the proposed daily maximum limits for these pollutants.

Table 14-6. Proposed BAT Daily Maximum Limits for Selected Parameters

Pollutant	Subcategory		
	Metals Daily Maximum Limit, mg/l	Oils Daily Maximum Limit, mg/l	Organics Daily Maximum Limit, mg/l
Chromium	2.9	0.65	none
Lead	0.29	0.35	none
Flouranthene	none	.045	none
2,4,6-trichlorophenol	none	none	0.16

The flow-weighted building block daily maximum limits for the combined outfall for chromium are calculated using equation 14-1:

$$Cr \text{ Limit} = \sum_{L=A}^C \frac{\text{Flow of subcategory } L}{\text{Total flow}} \times Cr \text{ limit of subcategory } L \quad (14-1)$$

$$\begin{aligned} Cr \text{ limit} &= \frac{20,000 \frac{L}{day}}{20,000 \frac{L}{day} + 10,000 \frac{L}{day} + 45,000 \frac{L}{day}} \times 2.9 \frac{mg}{L} \\ &+ \frac{10,000 \frac{L}{day}}{20,000 \frac{L}{day} + 10,000 \frac{L}{day} + 45,000 \frac{L}{day}} \times 0.65 \frac{mg}{L} \\ &+ \frac{45,000 \frac{L}{day}}{20,000 \frac{L}{day} + 10,000 \frac{L}{day} + 45,000 \frac{L}{day}} \times 0.0 \frac{mg}{L} \\ Cr \text{ limit} &= 0.77 \frac{mg}{L} + 0.09 \frac{mg}{L} + 0 \frac{mg}{L} = 0.86 \frac{mg}{L} \end{aligned}$$

Table 14-7 additionally shows the calculations and calculated limits for lead, fluoranthene, and 2,4,6-trichlorophenol.

Table 14-7. “Building Block Approach” Calculations for Selected Parameters for Example 14-1

Pollutant	Equation	Combined Daily Maximum Limit
Lead	$[(20,000 \text{ L/day})/(75,000 \text{ L/day}) \times 0.29 \text{ mg/L}] + [(10,000 \text{ L/day})/(75,000 \text{ L/day}) \times 0.35 \text{ mg/L}] + [(45,000 \text{ L/day})/(75,000 \text{ L/day}) \times 0 \text{ mg/L}] =$	0.12 mg/L
Fluoranthene	$[(20,000 \text{ L/day})/(75,000 \text{ L/day}) \times 0 \text{ mg/L}] + [(10,000 \text{ L/day})/(75,000 \text{ L/day}) \times 0.045 \text{ mg/L}] + [(45,000 \text{ L/day})/(75,000 \text{ L/day}) \times 0] =$	0.006 mg/L
2,4,6-trichlorophenol	$[(20,000 \text{ L/day})/(75,000 \text{ L/day}) \times 0 \text{ mg/L}] + [(10,000 \text{ L/day})/(75,000 \text{ L/day}) \times 0 \text{ mg/L}] + [(45,000 \text{ L/day})/(75,000 \text{ L/day}) \times 0.16 \text{ mg/L}] =$	0.096 mg/L

EPA notes that in this example, the calculated daily maximum limit for fluoranthene for the combined outfall, 0.006 mg/L, is below the minimum analytical detection level (0.01mg/L). Therefore, this facility would be required to demonstrate compliance with the fluoranthene limit for the oils subcategory prior to commingling at the outfall.

Indirect Discharge Guidance 14.6.1.2

If Facility A in Example 14-1 discharged to a POTW, the control authority would apply the combined wastestream formula (40 CFR § 403.6(e)). The combined wastestream formula (CWF) is based on three types of wastestreams that can exist at an industrial facility: regulated, unregulated, and dilute. As defined (40 CFR 403), a regulated wastestream is a wastestream from an industrial process that is regulated by a categorical standard for pollutant x. An unregulated wastestream is a wastestream that is not covered by categorical pretreatment standards and not classified as dilute, or one that is not regulated for the pollutant in question although it is regulated for others. A dilute wastestream is defined to include sanitary wastewater, noncontact cooling water and boiler blowdown, and wastestreams listed in Appendix D to 40 CFR 403. Since the CWT industry accepts a wide variety of wastestreams, for this point source category, Appendix D does not apply and the only dilute wastestreams are those specifically defined in 40 CFR 403.

Therefore, as described in 40 CFR 403, the combined waste stream formula is

$$C_T = \frac{\sum_{i=1}^N C_i F_i}{\sum_{i=1}^N F_i} \times \frac{F_T - F_D}{F_T}, \quad (14-2)$$

where C_T = the alternate concentration limit for the combined wastestream;

C_i = the categorical pretreatment standard concentration limit for a pollutant in the regulated stream i;

F_i = the average daily flow of stream i;

F_d = the average daily flow from dilute wastestreams as

defined in 40 CFR 403; and
 F_T = the total daily average flow.

For the example 14-1 facility, there are no dilution flows. Therefore, the CWF equation reduces in the following manner:

$$C_T = \frac{\sum_{i=1}^N C_i F_i}{\sum_{i=1}^N F_i} \times \frac{F_T - 0}{F_T}, \quad (14-3)$$

$$C_T = \frac{\sum_{i=1}^N C_i F_i}{\sum_{i=1}^N F_i},$$

$$\sum_{i=1}^N F_i = F_T,$$

$$C_T = \sum_{i=a}^C \frac{F_i}{F_T} \times C_i,$$

which is equivalent to the “building block” equation (equation 14-1).

Therefore, as described in 40 CFR Part 403 and in EPA’s Industrial User Permitting Guidance Manual, the methodology for developing combined wastestream formula daily maximum limits would be essentially the same as the methodology for the “building block” approach used for direct dischargers. For instances where an indirect discharge facility’s operations are covered by multiple subcategories, the control authority must apply the pretreatment standards from each subcategory in deriving the technology-based pretreatment standards for the facility. If all wastewaters regulated by the pretreatment standards are combined prior to treatment or discharge to the POTW, then the control authority would simply combine the allowable pollutant loadings for each subcategory

to arrive at a single, combined set of technology-based pretreatment standards for the facility. In those circumstances when the standards for one subcategory regulate a different set of pollutants than the standards applicable to another subcategory, the control authority must ensure proper application of the pretreatment standards. If one subcategory wastestream that does not limit a particular pollutant is combined with another wastestream that limits the pollutant, then the control authority must ensure that the non-regulated pollutant stream does not dilute the regulated pollutant stream to the point where the pollutant is not analytically detectable. If this occurs, then the control authority will most likely need to establish internal monitoring points, as allowed under 40 CFR § 403.6(e)(2) and (4).

However, as detailed in the Guidance Manual for the Use of Production-Based Pretreatment Standards and the Combined Waste Stream Formula, the CWF approach is applied differently. Unregulated wastestreams are presumed, for purposes of using the CWF, to contain pollutants of concern at a significant level. In effect, the CWF “gives credit” for pollutants which might be present in the unregulated wastestream. Rather than treating the unregulated flow as dilution, which would result in lowering the allowable concentration of a pollutant, the guidance allows the pollutant to be discharged in the unregulated wastestream at the same concentration as the standard for the regulated wastestream that is being discharged. This is based on the assumption that if pollutants are present in the unregulated wastestream, they will be treated to the same level as in the regulated wastestream. In many cases, however, unregulated wastestreams may not actually contain pollutants of concern at a significant level. Regardless of whether the pollutants are present in significant levels or not, they are still considered unregulated when applying the formula (Pages 3-3 to 3-7, Guidance Manual for

the Use of Production-Based Pretreatment Standards and the Combined Waste Stream Formula (September 1985)).

Table 14-8 shows the proposed daily maximum pretreatment standards for Facility A in Example 14-1 for chromium, lead, fluoranthene, and 2,4,6-trichlorophenol. Table 14-9 shows the combined outflow calculations using the CWF as described in EPA’s Industrial User Permitting Guidance Manual (and in 40 CFR 403) and Table 14-10 shows the calculations using the CWF as described in Guidance Manual for the Use of Production-Based Pretreatment Standards and the Combined Waste Stream Formula. Note that, in this example, since there are no proposed daily maximum pretreatment standards for 2,4,6-trichlorophenol in any subcategory, there are no pretreatment standards for this pollutant for the combined outfall.

Table 14-8. Proposed Daily Maximum Pretreatment Standards for Selected Parameters

Pollutant	Subcategory		
	Metals Daily Maximum Pretreatment Standard, mg/l	Oils Daily Maximum Pretreatment Standard, mg/l	Organics Daily Maximum Pretreatment Standard, mg/l
Chromium	2.9	none	none
Lead	0.29	none	none
Flouranthene	none	0.611	none
2,4,6-trichlorophenol	none	none	none

Using the first CWF approach (Table 14-9), EPA is proposing standards for chromium and lead in the metals subcategory, standards for fluoranthene in the oils subcategory, and no standards in any subcategory for 2,4,6-trichlorophenol. After

applying equation 14-3, the CWF daily maximum standards for the combined outfall are shown to be 0.77, 0.08, and 0.08, for chromium, lead, and fluoranthene, respectively.

Table 14-9. CWF Calculations for Selected Parameters for Example 14-1 Using 40 CFR 403 and Guidance in EPA's Industrial User Permitting Guidance Manual

Pollutant	Equation	Combined Daily Maximum Limit, mg/l
Chromium	$[(20,000 \text{ l/day}) / (75,000 \text{ l/day}) \times 2.9 \text{ mg/l}] + [(10,000 \text{ l/day}) / (75,000 \text{ l/day}) \times 0 \text{ mg/l}] + [(45,000 \text{ l/day}) / (75,000 \text{ l/day}) \times 0 \text{ mg/l}] =$	0.77
Lead	$[(20,000 \text{ l/day}) / (75,000 \text{ l/day}) \times 0.29 \text{ mg/l}] + [(10,000 \text{ l/day}) / (75,000 \text{ l/day}) \times 0 \text{ mg/l}] + [(45,000 \text{ l/day}) / (75,000 \text{ l/day}) \times 0 \text{ mg/l}] =$	0.08
Fluoranthene	$[(20,000 \text{ l/day}) / (75,000 \text{ l/day}) \times 0 \text{ mg/l}] + [(10,000 \text{ l/day}) / (75,000 \text{ l/day}) \times 0.611 \text{ mg/l}] + [(45,000 \text{ l/day}) / (75,000 \text{ l/day}) \times 0 \text{ mg/l}] =$	0.08

However, under the second CWF approach (Table 14-10), the metals subcategory chromium and lead standards extend to the oils and organics subcategories, the anthracene standard for the oils subcategory extend to the metals and organics subcategories, and 2,4,6-

trichlorophenol is not limited for any subcategory. The CWF daily maximum standards for the combined outfall are 2.9, 0.290, and 0.611 mg/l for chromium, lead, and anthracene, respectively.

Table 14-10. CWF Calculations for Selected Parameters in Example 14-1 Using the Guidance Manual for Use of Production-Based Pretreatment Standards and Combined Waste Stream Formula

Pollutant	Equation	Combined Daily Maximum Limit, mg/l
Chromium	$[(20,000\text{ l/day})/(75,000\text{ l/day}) \times 2.9\text{ mg/l}] + [(10,000\text{ l/day})/(75,000\text{ l/day}) \times 2.9\text{ mg/l}] + [(45,000\text{ l/day})/(75,000\text{ l/day}) \times 2.9\text{ mg/l}] =$	2.9
Lead	$[(20,000\text{ l/day})/(75,000\text{ l/day}) \times 0.29\text{ mg/l}] + [(10,000\text{ l/day})/(75,000\text{ l/day}) \times 0.29\text{ mg/l}] + [(45,000\text{ l/day})/(75,000\text{ l/day}) \times 0.29\text{ mg/l}] =$	0.29
Fluoranthene	$[(20,000\text{ l/day})/(75,000\text{ l/day}) \times 0.611\text{ mg/l}] + [(10,000\text{ l/day})/(75,000\text{ l/day}) \times 0.611\text{ mg/l}] + [(45,000\text{ l/day})/(75,000\text{ l/day}) \times 0.611\text{ mg/l}] =$	0.611

Table 14-11 lists the daily maximum pretreatment standards for the selected parameters calculated using the two different approaches. For comparison purposes, the table also lists the “building block approach” BAT daily maximum limitations.

Table 14-11: Daily Maximum Limits and Standards for Example 14-1

Pollutant	Direct Dischargers “Building Block”	Indirect Dischargers CWF - 1 ¹	Indirect Dischargers ² CWF - 2 ²
Chromium	0.86 mg/l	0.77 mg/l	2.9 mg/l
Lead	0.12 mg/l	0.08 mg/l	0.29 mg/l
Fluoranthene	0.006 mg/l	0.08 mg/l	0.611 mg/l
2,4,6-trichlorophenol	0.096 mg/l	no standard	no standard

¹ Using 40 CFR Part 403 and EPA’s Industrial User Permitting Guidance Manual

² Using the Guidance Manual for the Use of Production-Based Pretreatment Standards and the Combined Waste Stream Formula

The table shows that if the example facility were to discharge indirectly using the CWF approach detailed in the Guidance Manual for the Use of Production-Based Pretreatment Standards and the Combined Waste Stream Formula (CWF-2), its pretreatment standards would be 337, 242, and over 10,000 percent higher than its direct discharge BAT limitations, for chromium, lead, and fluoranthene, respectively. As such, for the CWT Point Source Category, control authorities should not apply the CWF as described in the Guidance Manual for the Use of Production-

Based Pretreatment Standards and the Combined Waste Stream Formula.

The example 14-1 calculation using the CWF as described in EPA’s Industrial User Permitting Guidance Manual (CWF-1) also illustrates a problem with this approach. Since there are no proposed pretreatment standards for chromium and lead, the daily maximum standards under this CWF approach for chromium and lead would be lower than the direct discharge BAT limitations. In order to alleviate this problem, for the CWT point source category, EPA would

define an individual parameter as having a “regulated flow” if the pollutant is limited through BAT. Therefore, the flow for a pollutant with no established BAT limit would be included as a dilution flow and the flow for a pollutant with an established BAT limit would be included as an allowance.

For the metals and organics subcategories, since the proposed limits and standards are based on identical technologies, the CWF allowance would be determined based on

the BAT limit. For the oils subcategory, however, since the proposed limitations and standards are based on different technologies, the CWF allowance would be determined based on the PSES limit if one had been proposed. For the metals subcategory, all proposed BAT pollutants pass through and were, therefore, proposed for PSES. Tables 14-12 and 14-13 list the CWF allowances for the oils and organics subcategories, respectively.

Table 14-12. Allowances for Use in Applying the Combined Waste Stream Formula for CWT Oils Subcategory Flows (PSES or PSNS)

Pollutant	Daily Maximum Allowance, mg/l	Monthly Average Allowances, mg/l
Arsenic	1.81	1.08
Cadmium	0.024	0.012
Chromium	0.584	0.283
Lead	0.314	0.152
Mercury	0.010	0.005
butyl benzyl phthalate	0.127	0.075

Table 14-13. Allowances for Use in Applying the Combined Waste Stream Formula for CWT Organics Subcategory Flows

Pollutant	Daily Maximum Allowance, mg/l	Monthly Average Allowances, mg/l
Antimony	0.97	0.691
Copper	0.85	0.752
Zinc	0.46	0.408
2-butanone	8.83	2.62
2-propanone	20.7	6.15
2,4,6-trichlorophenol	0.155	0.106
acetophenone	0.155	0.072
phenol	3.70	1.09
pyridine	0.370	0.182

For example 14-1, using the proposed CWF approach with allowances, the combined end-of-pipe standards for chromium, lead, and fluoranthene would be 0.85 mg/l, 0.12 mg/l, and 0.08 mg/l, respectively. Table 14-14 shows the calculations.

Table 14-14 CWF Calculations for Example 14-1 Including Allowances

Pollutant	Equation	Combined Daily Maximum Limit, mg/l
Chromium	$[(20,000 \text{ l/day}) / (75,000 \text{ l/day}) \times 2.9 \text{ mg/l}] +$ $[(10,000 \text{ l/day}) / (75,000 \text{ l/day}) \times 0.58 \text{ mg/l}] +$ $[(45,000 \text{ l/day}) / (75,000 \text{ l/day}) \times 0 \text{ mg/l}] =$	0.85
Lead	$[(20,000 \text{ l/day}) / (75,000 \text{ l/day}) \times 0.29 \text{ mg/l}] +$ $[(10,000 \text{ l/day}) / (75,000 \text{ l/day}) \times 0.31 \text{ mg/l}] +$ $[(45,000 \text{ l/day}) / (75,000 \text{ l/day}) \times 0 \text{ mg/l}] =$	0.12
Fluoranthene	$[(20,000 \text{ l/day}) / (75,000 \text{ l/day}) \times 0 \text{ mg/l}] +$ $[(10,000 \text{ l/day}) / (75,000 \text{ l/day}) \times 0.611 \text{ mg/l}] +$ $[(45,000 \text{ l/day}) / (75,000 \text{ l/day}) \times 0 \text{ mg/l}] =$	0.08

EPA has taken this approach, even for indirect dischargers, since a pollutant may pass the pass-through test and not be regulated at PSES, but still provide a significant contribution of that pollutant in the combined wastestream as in the case of chromium and lead in the example. By adopting this approach for the CWT point source category, EPA can ensure that standards for indirect dischargers are equivalent to limitations for direct dischargers, but still allow for any contribution by these pollutants to the combined wastestream.

Example 14-2 further illustrates the use of the CWF, as proposed, for the CWT point source category.

Example 14-2: Facility Which Accepts Wastes in Multiple Subcategories and Treats the Wastewater Sequentially

Facility B accepts waste in the oils and metals subcategory. The total volume of wastewater discharged to the local POTW is 100,000 liters per day and the relative percentage of oils and metal subcategory flows are 30% and 70% respectively. The facility segregates oils and metals waste receipts and first treats the oils waste receipts using emulsion breaking/gravity separation and dissolved air flotation. (See Figure 14-3) The facility then commingles this wastewater with metal subcategory waste receipts and treats the combined wastestreams using primary and secondary chemical precipitation and solid/liquid separation followed by multimedia filtration.

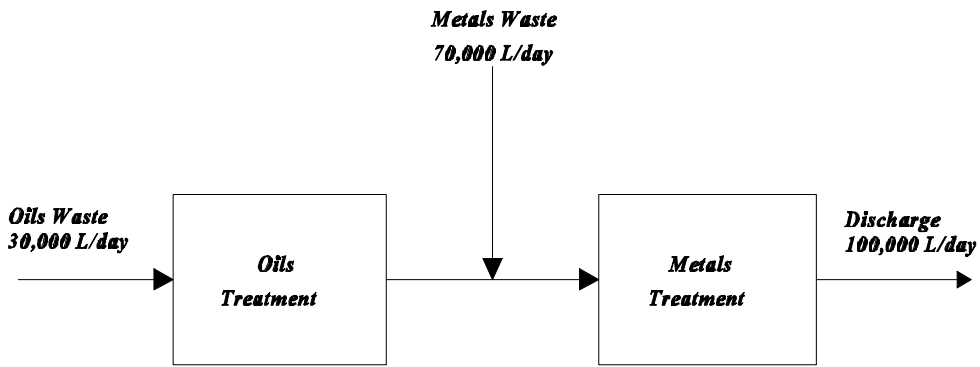


Figure 14-3. Facility Which Accepts Wastes in Multiple Subcategories and Treats Separately

For this example, both the oils and metals subcategory wastewaters are regulated process flows. Looking only at chromium, lead, fluoranthene, and 2,4,6-trichlorophenol again, EPA has proposed chromium (2.9 mg/l) and lead (0.29 mg/l) PSES daily maximum standards for the metals subcategory only; and fluoranthene (0.611 mg/l) daily maximum standards for only the oils subcategory. EPA has also provided an allowance for chromium (0.58 mg/l) and lead (0.31 mg/l) in the oils subcategory. EPA has not proposed daily maximum standards or daily maximum BAT limits for 2,4,6-trichlorophenol in either subcategory.

Even though EPA has not proposed daily maximum standards for chromium and lead in the oils subcategory, their contribution would not be set to zero. In applying the CWF, the control authority would determine the contribution for chromium and lead in the oils subcategory based on Table 14-2. Therefore, the chromium daily maximum standard would be $(0.7 \times 2.9) + (0.3 \times 0.58) = 2.2$ mg/l; and the lead daily maximum standard would be $(0.7 \times 0.29) + (0.3 \times 0.31) = 0.29$ mg/l. The fluoranthene calculation, however, illustrates the case where a pollutant's contribution in a regulated wastestream would be zero. Since EPA has not proposed BAT daily maximum limits for fluoranthene in the metals subcategory, the contribution for fluoranthene in the metals subcategory would be considered a dilution flow and set to zero. Therefore, the fluoranthene daily maximum standard would be $(0.7 \times 0) + (0.3 \times 0.611) = 0.18$ mg/l. The control authority would not establish a daily maximum limitation for 2,4,6-trichlorophenol since EPA has not proposed regulating it for either subcategory.

***CWT Facilities Also Covered
By Another Point Source Category 14.6.2***

As detailed in Chapter 3, some manufacturing facilities, which are subject to existing effluent guidelines and standards, may also be subject to provisions of this rule. In all cases, these manufacturing facilities accept waste from off-site for treatment and/or recovery which

are generated from a different categorical process as the on-site generated wastes. EPA is particularly concerned that these facilities demonstrate compliance with all applicable effluent guidelines and pretreatment standards -- including this rule. Example 14-3 illustrates the daily maximum limitations calculations for a CWT facility which is also subject to another effluent guideline.

Example 14-3 Categorical Manufacturing Facility Which Also Operates as a CWT Facility

Facility C is a manufacturing facility currently discharging wastewater to the local river under the OCPSF point source category. Facility C also performs CWT operations and accepts off-site metal-bearing wastes for treatment. Facility C commingles the on-site wastewater and the off-site wastewater together for treatment in an activated sludge system. The total volume of wastewater discharged at Facility C is 100,000 liters per day. The total volume of wastewater contributed by the off-site wastewater is 10,000 liters per day.

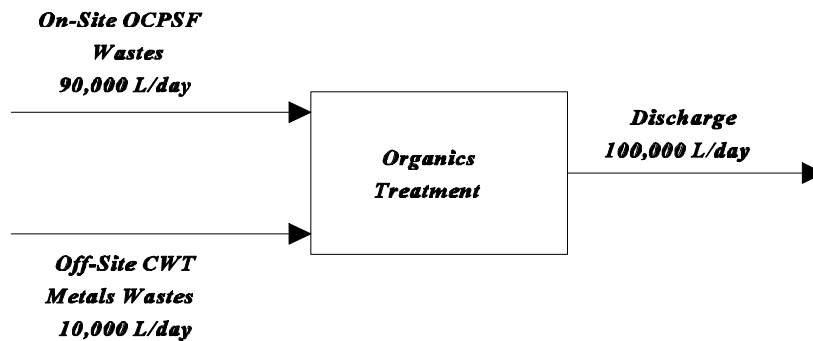


Figure 14-4. Categorical Manufacturing Facility Which Also Operates as a CWT

Facility C would be required to monitor and demonstrate that it has complied with the CWT metals BAT limitations. Since Facility C commingles the wastestreams and has no treatment in place for the metals wastestreams, Facility C would be unable to demonstrate compliance with the BAT limits through treatment rather than dilution. Therefore, Facility C would not be able to commingle the CWT metals wastestreams and on-site OCPSF wastestreams for treatment.

If Facility C chose to install metals treatment for the off-site wastewater and wanted to commingle the effluent from the metals treatment and the biological treatment at a single

discharge point (See Figure 14-5), the permit writer would use the building block approach to determine the limitations. Using lead and chromium, for the metals subcategory, EPA has proposed BAT limits of 2.9 mg/L for chromium and 0.29 mg/L for lead. Since the OCPSF facility has no limits for chromium and lead, the contribution for the OCPSF wastewaters would be zero. Therefore, the chromium daily maximum limit would be $(0.1 \times 2.9) + (0.9 \times 0) = 0.29$ mg/l and the lead daily maximum limit would be $(0.1 \times 0.29) + (0.9 \times 0) = 0.029$ mg/l. Since the daily maximum limit for lead is below the minimum analytical detection level (.050 mg/l), the facility would be required to demonstrate compliance with the lead limit for the CWT metals subcategory prior to commingling at the outfall. The daily maximum limitations for other pollutants would be calculated in a similar manner. Since EPA has not proposed any BAT limits for organic pollutants under the metals subcategory of the CWT point source category, the contribution for these pollutants would be zero.

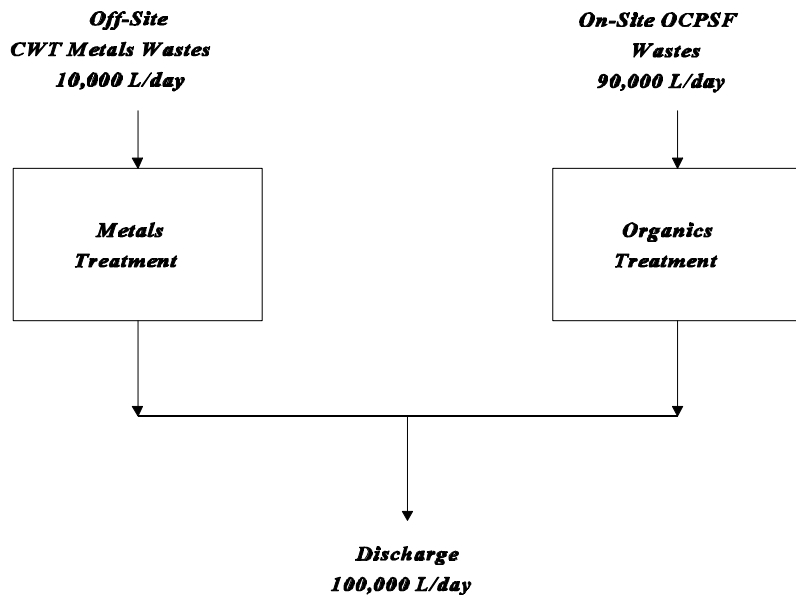


Figure 14-5. Facility that Commingles Wastestreams after Treatment.

ANALYTICAL METHODS AND BASELINE VALUES

INTRODUCTION

This chapter describes the analytical methods that EPA used to analyze the samples collected during EPA's data gathering efforts at a number of facilities. (These sampling efforts are described in section 2). It also discusses how EPA treated the results of its sample analysis for purpose of determining the loadings and proposed limitations and standards.

EPA compared each laboratory-reported analytical result for each pollutant to a baseline value in order to determine whether to use the value as reported in determining the loadings and proposed limitations and standards. In most cases, the baseline value was the "nominal quantitation limit"¹ stipulated for the specific method used to measure a particular pollutant. In general, the term "nominal quantitation limit" is used here to describe the smallest quantity of an analyte that can be measured reliably. In some cases, however, EPA used a value lower than the nominal quantitation limit as the baseline value because data demonstrated that reliable measurements could be obtained for at a lower level. In a few instances, EPA has concluded that the nominal quantitation limit for a specified method was less than that level that laboratories could reliably achieve. For those pollutants, EPA modified the nominal quantitation limit upward and used a higher value as the baseline value. Sections 15.3 and 15.4 provide further

¹In other chapters in this document and in the preamble to the proposed rulemaking, EPA uses the term "minimum analytical detection limit" when it refers to nominal quantitation limit or the baseline value.

15.1

explanation of nominal quantitation limits and baseline values. Table 15-1 sets forth the analytical methods and baseline values used for each pollutant in developing the loadings and proposed limitations and standards.

ANALYTICAL RESULTS

15.2

The laboratories expressed the result of the analysis either numerically or as "not quantitated"² for a pollutant in a sample. When the result is expressed numerically, then the pollutant was quantitated³ in the sample. For example, for a hypothetical pollutant X, the result would be reported as "15 ug/L" when the laboratory quantitated the amount of pollutant X in the sample as being 15 ug/L. For the non-quantitated results, for each sample, the laboratories reported a "sample-specific quantitation limit." For example, for the hypothetical pollutant X, the result would be reported as "<10 ug/L" when the laboratory could not quantitate the amount of pollutant X in the sample. That is, the analytical result indicated a value less than the sample-specific quantitation limit of 10 ug/L. The actual amount of pollutant X in that sample is between zero (i.e., the pollutant is not present) and 10 ug/L. The

²Elsewhere in this document and in the preamble to the proposed rulemaking, EPA refers to pollutants as "not detected" or "non-detected." This chapter uses the term "not quantitated" or "non-quantitated" rather than non-detected.

³Elsewhere in this document and in the preamble to the proposed rulemaking, EPA refers to pollutants as "detected." This chapter uses the term "quantitated" rather than detected.

sample-specific quantitation limit for a particular pollutant is generally the smallest quantity in the calibration range that may be measured reliably in any given sample. If a pollutant is reported as not quantitated in a particular wastewater sample, this does not mean that the pollutant is not present in the wastewater, merely that analytical techniques (whether because of instrument limitations, pollutant interactions or other reasons) do not permit its measurement at levels below the sample specific quantitation limit. In a few instances, some of the laboratories reported numerical results for specific pollutants detected in the samples as “right-censored.” Right-censored measurements are those that were reported as being greater than the largest calibration value of the analysis (e.g., >1000 ug/L).

In calculating pollutant loadings, long-term averages and limitations, EPA generally substituted the value of the reported sample-specific quantitation limit for each non-quantitated result. In a few cases when the sample-specific quantitation limit was less than the baseline value, EPA substituted the baseline value for the non-quantitated result. In a few instances when the quantitated value was below the baseline value, EPA substituted the baseline value for the measured value. EPA further determined that these values should be considered non-quantitated in the statistical analyses. For the rare instances when the laboratory reported a measurement as right-censored, EPA used the largest calibration value in its calculations.

NOMINAL QUANTITATION LIMITS **15.3**

Protocols used for determination of nominal quantitation limits in a particular method depend on the definitions and conventions that EPA used at the time the method was developed. The nominal quantitation limits associated with the methods addressed in the following sections fall

into three general categories. The first category includes Methods 1613, 1624, 1625, and 1664, which used the minimum level (ML) definition as the lowest level at which the entire analytical system must give a recognizable signal and an acceptable calibration point for the analyte. The second category pertains specifically to Method 1620, and is explained in detail in section 15.5.3. The third category pertains to the remainder of the methods (i.e., Method 85.01 and the classical wet chemistry methods), in which a variety of terms are used to describe the lowest level at which measurement results are quantitated. In some cases (especially with the classical wet chemistry analytes) the methods are older (1970s and 1980s) and different concepts of quantitation apply. These methods typically list a measurement range or lower limit of measurement. The terms differ by method and, as discussed in subsequent sections, the levels presented are not always representative of the lowest levels laboratories can achieve currently. For those methods associated with a calibration procedure, the laboratories demonstrated through a low point calibration standard that they were capable of reliable quantitation at method-specified (or lower) levels. In such cases these nominal quantitation limits are operationally equivalent to the ML (though not specifically identified as such in the methods). In the case of titrimetric or gravimetric methods, the laboratory adhered to the established lower limit of the measurement range published in the methods. Details of the specific methods are presented in the following sections.

BASILINE VALUES **15.4**

In developing the pollutant loadings and limitations, EPA compared each analytical result (i.e., quantitated value or sample-specific quantitation limit for a non-quantitated value) to a baseline value for the pollutant. (Section 10.4

describes this comparison.) For example, if a facility data set had five values for oil and grease of which two were non-quantitated with sample-specific quantitation limits of 10 mg/L and the remaining three values were quantitated with measurements of 20 mg/L, 25 mg/L, and 50 mg/L, then all five values (10 mg/L, 10 mg/L, 20 mg/L, 25 mg/L, and 50 mg/L) were compared to the baseline value of 5 mg/L for oil and grease. In most cases, the detected values and sample-specific quantitation limits were equal to or greater than the baseline values.

In general, the baseline value was equal to the nominal quantitation limit identified for the method. For example, for total cyanide, the baseline value was 0.02 mg/L which is the same as the nominal quantitation limit of 0.02 mg/L for total cyanide in method 335.2.

EPA made several exceptions to this general rule when EPA determined that the baseline value should differ from the nominal quantitation limit as specified in the method for a pollutant. For example, EPA determined that the baseline value for COD by method 410.1 should be 5 mg/L rather than the nominal quantitation limit of 50 mg/L. (Section 15.5.7 explains this decision.) EPA made exceptions to the general rule based upon EPA's knowledge about the methods, experiences with laboratories using those methods, and the need for a single baseline value for each pollutant. For example, EPA selected a baseline value to be less than a nominal quantitation limit when the laboratories demonstrated through calibration or other quality control (QC) data that reliable measurements of the pollutant could be made at a lower level. For these pollutants, the nominal quantitation limits reported in the methods are underestimates of what laboratories can reliably achieve and, the baseline values were adjusted downwards. Another example is when EPA selected baseline values greater than the nominal quantitation limits because the nominal quantitation limits

could not be reliably achieved. A third example is when EPA selected a single baseline value when the pollutant was measured by two or more methods, each with a different nominal quantitation limit.

The following section provides a brief description of the analytical methods and explains any differences between the nominal quantitation limits and the baseline values.

Table 15-1 Analytical Methods and Baseline Values

Method	Analyte	CAS Number	Nominal Quantitation Value	Baseline Value	Unit	Assumption for Reported Values < Baseline Value
D4658	Total Sulfide	18496258	0.04	1.0	MG/L	used reported value
160.1	Total Dissolved Solids	C010	10.0	10.0	MG/L	n/a
160.2	Total Suspended Solids	C009	4.0	4.0	MG/L	n/a
1613	Dioxins	*				n/a
1620	Metals Compounds	*				used reported value
1624	Organic Compounds	*				modified
1625	Organic Compounds	*				modified
1664	HEM	C036	5.0	5.0	MG/L	modified
1664	SGT-HEM	C037	5.0	5.0	MG/L	modified
209F	Total Solids	C008	10.0	10.0	MG/L	n/a
218.4	Hexavalent Chromium	18540299	0.01	0.01	MG/L	n/a
335.2	Total Cyanide	57125	0.02	0.02	MG/L	used reported value
350.1	Ammonia as Nitrogen	7664417	0.01	0.01	MG/L	n/a
3500D	Hexavalent Chromium	18540299	0.1	0.1	MG/L	n/a
353.2	Nitrate/Nitrite	C005	0.05	0.05	MG/L	used reported value
365.2	Total Phosphorus	14265442	0.01	0.01	MG/L	n/a
376.1	Total Sulfide	18496258	1.0	1.0	MG/L	used reported value
405.1	BOD5	C003	2.0	2.0	MG/L	n/a
410.1	COD	C004	50.0	5.0**	MG/L	n/a
410.1	D-COD	C004D	50.0	5.0**	MG/L	n/a
410.2	COD	C004	5.0	5.0	MG/L	n/a
410.4	COD	C004	3.20	5.0	MG/L	n/a
413.1	Oil and Grease	C007	5.0	5.0	MG/L	n/a
415.1	Total Organic Carbon	C012	1.0	1.0	MG/L	n/a
420.2	Total Phenols	C020	0.01	0.05	MG/L	used reported value
85.01	Chlorinated Phenolics	*				n/a

* The method analyzed a number of pollutants. Attachment 15-1 identifies the all pollutants of concern and their baseline values. In general, the baseline values are equal to the nominal quantitation limits.

**The baseline value was adjusted to reflect the lowest nominal quantitation limit of the titrimetric procedures (i.e., 410.1 and 410.2). See Section 15.5.7 for a detailed explanation.

n/a: none of the data used for the pollutant loadings and limitations were reported below the baseline value.

ANALYTICAL METHODS**15.5**

Table 15-1 provides a summary of the analytical methods, the associated pollutants measured by the method, the nominal quantitation levels, the baseline levels, and the assumptions for values reported below the baseline levels. Attachment 15-1 to this chapter provides a more complete list of the pollutants and their baseline values. The following subsections provide additional information supporting the summary in Table 15-1.

**Methods 1613, 1624, 1625, 1664
(Dioxins, Organics, HEM)****15.5.1**

As stated earlier, Method 1613 for dioxins, Methods 1624 and 1625 for organic compounds, and Method 1664⁴ for *n*-hexane extractable material (HEM) and silica gel treated *n*-hexane extractable material (SGT-HEM)⁵ use the minimum level concept for quantitation of the pollutants measured by the methods. The ML is defined as the lowest level at which the entire analytical system must give a recognizable signal and an acceptable calibration point for the analyte. When an ML is published in a method, the Agency has demonstrated that the ML can be achieved in at least one well-operated laboratory, and when that laboratory or another laboratory uses that method, the laboratory is required to demonstrate, through calibration of the instrument or analytical system, that it can make measurements at the ML. For these methods, EPA used the minimum levels as the baseline values.

⁴See proposal at 61 *Federal Register* 1730, January 23, 1996.

⁵SGT-HEM measures non-polar material (i.e., *n*-hexane extractable material that is not absorbed by silica gel). Method 1664 measures both oil and grease and non-polar material.

If a measured value or sample-specific quantitation limit was reported with a value less than the ML specified in a method, EPA substituted the value of the ML and assumed that the measurement was non-quantitated. For example, if the ML was 10 ug/L and the laboratory reported a quantitated value of 5 ug/L, EPA assumed that the concentration was non-quantitated with a sample-specific quantitation limit of 10 ug/L.

Method 413.1 (Oil and Grease)**15.5.2**

Method 413.1 was used in early sampling episodes to measure pollutant concentrations of oil and grease. Because this method requires freon, an ozone depleting solvent, to perform the analysis, EPA developed and recently promulgated Method 1664 to replace the procedures currently approved at 40 CFR 136. The same nominal quantitation limit applies to both methods for measuring oil and grease and HEM. In calculating the pollutant loadings and limitations, the data used from this method were all greater than the nominal quantitation limit of 5 mg/L.

Method 1620**15.5.3**

Method 1620, which measures the amounts of specific metals in samples, uses the concept of an instrument detection limit (IDL) which is defined as “the smallest signal above background noise that an instrument can detect reliably.”⁶ IDLs are determined on a quarterly basis by each analytical laboratory participating in the data gathering efforts by EPA’s Engineering and Analysis Division (EAD) and are, therefore, laboratory-specific and time-specific. Data

⁶Keith, L.H., W. Crummett, J. Deegan, R.A. Libby, J.K. Taylor, G. Wentler (1983). “Principles of Environmental Analysis,” *Analytical Chemistry*, Volume 55, Page 2217.

reporting practices for Method 1620 analysis follow conventional metals reporting practices used in other EPA programs, in which values are reported at or above the IDL. Though Method 1620 does contain minimum levels (MLs), these MLs pre-date EPA's recent refinement of the minimum level concept. The ML values associated with Method 1620 are based on a consensus opinion reached between EPA and laboratories during the 1980s regarding levels that could be considered reliable quantitation limits when using Method 1620. These limits do not reflect advances in technology and instrumentation since the 1980s. Consequently, the IDLs were used as the baseline for reporting purposes, with the general understanding that reliable results can be produced at or above the IDL.

The Method 1620 ML values were used as the baseline values in the data screening, with the exception of two analytes: boron and lead. Based on laboratory feedback years ago, it was determined that the boron ML of 10 ug/L specified in Table 9 of Method 1620 could not be reliably achieved. Consequently, for the purposes of EAD's data gathering under the metals contracts, the ML for boron was adjusted to 100 ug/L. In the case of lead, which has an ML of 5 ug/L associated with graphite furnace atomic absorption (GFAA) spectroscopy analysis, EAD determined that it was not necessary to measure down to such low levels, and that lead could be analyzed by inductively coupled plasma atomic emission (ICP) spectroscopy instead. Consequently, the ML requirement was adjusted to 50 ug/L.

Though the baseline values were derived from the MLs (or adjusted MLs) in Method 1620, EPA used the laboratory reported values, which captured concentrations down to the IDLs, in calculating the pollutant loadings and limitations. If the long-term average for a pollutant was less than the baseline value, however, EPA substituted

the ML for the long-term average and recalculated the limitation using this revised long-term average and the group variability factor.

Method 85.01

15.5.4

NCASI Method 85.01 was used to analyze some samples associated with the organics subcategory for chlorinated phenolics. This gas chromatography/electron capture detector (GC/ECD) method predates EPA Method 1653 for chlorinated phenolics determination, and was only used for analysis of samples under one CWT sampling episode (Episode 1987, collected in 1990). Method 1653 is an isotope dilution gas chromatography/mass spectrometry (GC/MS) method. EPA intends to use this method, rather than Method 85.01, for any subsequent data gathering for analyses of chlorinated phenolics not included in semivolatiles organics Method 1625.

Some chlorinated phenolics in Episode 1987 were analyzed by both Method 85.01 and Method 1625. Thus, for a given sample, there were two results for a specific chlorinated phenolic compound. Of the pollutants of concern, these compounds were pentachlorophenol, 2,3,4,6-tetrachlorophenol, 2,4,5-trichlorophenol, and 2,4,6-trichlorophenol. Where two results were provided for the same pollutant in a sample, EPA used the analytical result from Method 1625. This decision is based on the knowledge that Method 1625 is an isotope dilution GC/MS procedure, and therefore produces more reliable results than Method 85.01.

For the remaining chlorinated phenolics analytes that were determined by Method 85.01, EPA used the laboratory-specific quantitation limits as the baseline values (see Table 15-2 below). In all cases, the data used to calculate the pollutant loadings were greater than or equal to the baseline value associated with the pollutant.

Table 15-2 Baseline values for Method 85.01

Analyte	CAS Number	Minimum Level (mg/L)
3,4-dichlorophenol	95772	0.0008
3,4,5-trichlorocatechol	56961207	0.0008
3,4,6-trichloroguaiacol	60712449	0.0008
3,5-dichlorophenol	591355	0.0008
3,6-dichlorocatechol	3938167	0.0008
4-chlorophenol	106489	0.24
4,5-dichloroguaiacol	2460493	0.0008
4,5,6-trichloroguaiacol	2668248	0.0008
5-chloroguaiacol	3743235	0.16
6-chlorovanillin	18268763	0.0008

Methods D4658 and 376.1***(Total Sulfide)******15.5.5***

Total sulfide was analyzed by Methods 376.1 and D4658, each of which have different nominal quantitation limits. Method 376.1 has a nominal quantitation limit of 1 mg/L, while Method D4658 has a nominal quantitation limit of 0.04 mg/L. Rather than use two different baseline values for the same pollutant, EPA used the maximum of the two values (i.e., 1 mg/L) as the baseline value.

In some cases, the reported value was lower than the nominal quantitation limits identified in the method. EPA used these values as reported in calculating the pollutant loadings. (EPA has not proposed limitations for total sulfide.)

Methods 410.1, 410.2, and 410.4***(COD and D-COD)******15.5.6***

Methods 410.1, 410.2, and 410.4 were used to measure COD concentrations. In addition, Method 410.1 was used to measure the D-COD concentrations in Episode 1987.

Methods 410.1 and 410.2 are titrimetric procedures that follow identical analytical

protocols, with the exception of the concentration level of the reagents used for the titration. Method 410.1 is designed to measure “mid-level” concentrations greater than 50 mg/L for chemical oxygen demand (COD) and D-chemical oxygen demand (D-COD). Method 410.2 is designed to measure “low-level” concentrations of those parameters in the range of 5-50 mg/L. When one of the participating laboratories analyzes a sample, they are required to measure down to the lowest quantitation limit possible.

Consequently, if the laboratory analyzes a sample using Method 410.1 and obtains a non-quantitated result, it must reanalyze the sample using Method 410.2. Therefore, the quantitation limit reported for non-quantitations will be equal to 5 mg/L, unless sample dilutions were required because of matrix complexities.

Method 410.4 is a colorimetric procedure with a measurement range of 3-900 mg/L for automated procedures and measurement range of 20-900 mg/L for manual procedures.

For all COD data, EPA used the baseline value of 5 mg/L that is associated with the lower quantitation limit for the titrimetric procedures because most of the data had been obtained by the titrimetric procedures (i.e., Methods 410.1 or 410.2). Regardless of the method used to analyze COD and D-COD, all values used to calculate the pollutant loadings were greater than the nominal quantitation limit of 5 mg/L. (EPA is not proposing limitations for COD.)

Method 420.2 (Total Phenols)***15.5.7***

Method 420.2 was used to analyze for total phenols. The method reports two “working ranges”; one with a lower range limit of 0.002 mg/L and the other with a lower range limit of 0.01 mg/L. In this case, EPA’s experience with the laboratories has indicated that some can meet the lower limits of the method-specified range and others cannot. Consequently, EPA

determined that the baseline value should be 0.05 mg/L, which reflects that quantitation limit that all participating laboratories were capable of achieving.

In some cases, the reported value was lower than the baseline value of 0.05 mg/L. Because some laboratories have demonstrated that they can quantitate to lower levels, EPA used these values as reported in calculating the pollutant loadings. (EPA has not proposed limitations for total phenols.)

***Method 218.4 and 3500D
(Hexavalent Chromium)*** **15.5.8**

Hexavalent chromium was determined by Methods 218.4 and 3500D. Because most of the samples were analyzed using Method 218.4, its baseline value of 0.01 mg/L was used for all hexavalent chromium results. None of the quantitated values and sample-specific quantitation limits were reported with values less than this baseline value.

***Methods 335.2 and 353.2
(Total Cyanide and Nitrate/Nitrate)*** **15.5.9**

Samples were analyzed for total cyanide and nitrate/nitrate using Methods 335.2 and 353.2, respectively. Within each method, the nominal quantitation limit and the baseline value were the same.

In some cases, the reported value was lower than the baseline value for the pollutant. Because some laboratories have demonstrated that they can quantitate to lower levels, EPA used these values as reported in calculating the pollutant loadings and limitations.

Remaining Methods **15.5.10**

The previous subsections in section 15.5 identify many of the methods used to analyze the wastewater samples. The remaining methods

were: 160.1 (total dissolved solids), 160.2 (total suspended solids), 209F (total solids), 350.1 (ammonia as nitrogen), 365.2 (total phosphorus), 405.1 (5-day biochemical oxygen demand), and 415.1 (total organic carbon). For these methods, the nominal quantitation limits and the baseline values were equal. In addition, none of the values were reported below the nominal quantitation limits.

Of the pollutants measured by these methods, EPA proposed limitations for total suspended solids (TSS) and 5-day biochemical oxygen demand (BOD₅).

***ANALYTICAL METHOD
DEVELOPMENT EFFORTS*** **15.6**

Section 304(h) of the Clean Water Act directs EPA to promulgate guidelines establishing test procedures for the analysis of pollutants. These methods allow the analyst to determine the presence and concentration of pollutants in wastewater, and are used for compliance monitoring and for filing applications for the NPDES program under 40 CFR 122.21, 122.41, 122.44 and 123.25, and for the implementation of the pretreatment standards under 40 CFR 403.10 and 403.12. To date, EPA has promulgated methods for all conventional and toxic pollutants, and for some nonconventional pollutants. EPA has identified five pollutants pursuant to section 304(a)(4) of the CWA defined as “conventional pollutants” (See 40 CFR 401.16). Table I-B at 40 CFR 136 lists the analytical methods approved for these pollutants. EPA has listed pursuant to section 307(a) of the Act, 65 metals and organic pollutants and classes of pollutants as “toxic pollutants” at 40 CFR 401.15. From the list of 65 classes of toxic pollutants, EPA identified a list of 126 “Priority Pollutants.” This list of Priority Pollutants is shown, for example, at 40 CFR Part 423, Appendix A. The list includes non-pesticide organic pollutants, metal pollutants, cyanide, asbestos, and pesticide

pollutants.

Currently approved methods for metals and cyanide are included in the table of approved inorganic test procedures at 40 CFR 136.3, Table I-B. Table I-C at 40 CFR 136.3 lists approved methods for measurement of non-pesticide organic pollutants, and Table I-D lists approved methods for the toxic pesticide pollutants and for other pesticide pollutants. Dischargers must use the test methods promulgated at 40 CFR Part 136.3 or incorporated by reference in the tables, when available, to monitor pollutant discharges from the centralized waste treatment (CWT) industry, unless specified otherwise in Part 437 or by the permitting authority.

Table I-C does not list 11 CWT semivolatile organic pollutants and two CWT volatile organic pollutants (2-butanone and 2-propanone). However, the analyte list for EPA Method 1624 contains both volatile organic pollutants and the analyte list for EPA Method 1625 contains four of the semivolatile organic pollutants. EPA promulgated both of these methods for use in Clean Water Act measurement programs at 40 CFR 136, Appendix A. As a part of this rulemaking, EPA is proposing to allow the use of EPA Method 1624 for the determination of the CWT volatile organic pollutants and modified versions of EPA Methods 625 and 1625 for the determination of all CWT semivolatile organic pollutants. The proposed modifications to EPA Methods 625 and 1625 have been included in the Docket for this rulemaking. The modified versions of Methods 625 and 1625 will allow the analysis of all CWT semivolatile organic pollutants by each method. If EPA adopts these proposed modifications, the following pollutants will be added to their respective analyte lists:

Additions to EPA Method 1625 and Method 625

<u>Pollutant</u>	<u>CASRN</u>
acetophenone	98-86-2
aniline	62-53-3
benzoic acid	65-85-0
2,3-dichloroaniline	608-27-5
o-cresol	95-48-7
p-cresol	160-44-5
pyridine	110-86-1

Additions to EPA Method 625

<u>Pollutant</u>	<u>CASRN</u>
alpha-terpineol	98-55-5
carbazole	86-74-8
n-decane	124-18-5
n-octadecane	593-45-3

These pollutants were found in CWT industry wastewaters in EPA's data gathering. The modifications to Methods 625 and 1625 consist of text, performance data, and preliminary quality control (QC) acceptance criteria for the additional analytes, if available. This information will allow a laboratory to practice the methods with the additional analytes as an integral part. The QC acceptance criteria for the additional analytes to be added to Method 1625 have been validated in single-laboratory studies. EPA plans further validation of these method modifications by use in subsequent data gathering for the final rule and plans to promulgate these method modifications for monitoring at 40 CFR part 437 (see 40 CFR 401.13) or at 40 CFR part 136 in the final rule for this rulemaking.

On March 28, 1997, EPA proposed a means to streamline the method development and approval process (62 FR 14975) and on October 6, 1997, EPA published a notice of intent to implement a performance-based measurement system (PBMS) in all of its programs to the extent feasible (62 FR 52098). The Agency is

currently determining the specific steps necessary to implement PBMS in all of its regulatory programs and has approved a plan for implementation of PBMS in the water programs. Under PBMS, regulated entities will be able to modify methods without prior approval and will be able to use new methods without prior EPA approval provided they notify the regulatory authority to which the data will be reported. EPA expects a final rule implementing PBMS in the water programs by the end of calendar year 1998. When the final rule takes effect, regulated entities in the CWT industry will be able to select methods for monitoring other than those approved at 40 CFR parts 136 and 437 provided that certain validation requirements are met. Many of the details were provided at proposal (62 FR 14975) and will be finalized in the final PBMS rule.

ATTACHMENT 15-1: Pollutants of Concern and their Baseline Values

Analyte Name	CAS Number	Method	Baseline Value	Unit
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ACENAPHTHENE	83329	1625	10.0000	UG/L
ACETOPHENONE	98862	1625	10.0000	UG/L
ALPHA-TERPINEOL	98555	1625	10.0000	UG/L
ALUMINUM	7429905	1620	200.0000	UG/L
AMMONIA AS NITROGEN	7664417	350.1	10.0000	UG/L
ANILINE	62533	1625	10.0000	UG/L
ANTHRACENE	120127	1625	10.0000	UG/L
ANTIMONY	7440360	1620	20.0000	UG/L
ARSENIC	7440382	1620	10.0000	UG/L
BARIUM	7440393	1620	200.0000	UG/L
BENZENE	71432	1624	10.0000	UG/L
BENZO(A)ANTHRACENE	56553	1625	10.0000	UG/L
BENZO(A)PYRENE	50328	1625	10.0000	UG/L
BENZO(B)FLUORANTHENE	205992	1625	10.0000	UG/L
BENZO(K)FLUORANTHENE	207089	1625	10.0000	UG/L
BENZOIC ACID	65850	1625	50.0000	UG/L
BENZYL ALCOHOL	100516	1625	10.0000	UG/L
BERYLLIUM	7440417	1620	5.0000	UG/L
BIOCHEMICAL OXYGEN DEMAND	C-003	405.1	2000.0000	UG/L
BIPHENYL	92524	1625	10.0000	UG/L
BIS(2-ETHYLHEXYL) PHTHALATE	117817	1625	10.0000	UG/L
BOD 5-DAY	C-003	405.1	2000.0000	UG/L
BORON	7440428	1620	100.0000	UG/L
BROMODICHLOROMETHANE	75274	1624	10.0000	UG/L
BUTYL BENZYL PHTHALATE	85687	1625	10.0000	UG/L
CADMIUM	7440439	1620	5.0000	UG/L
CARBAZOLE	86748	1625	20.0000	UG/L

ATTACHMENT 15-1: Pollutants of Concern and their Baseline Values

Analyte Name -----	CAS Number -----	Method -----	Baseline Value -----	Unit ----
CARBON DISULFIDE	75150	1624	10.0000	UG/L
CHEMICAL OXYGEN DEMAND (COD)	C-004	410.1	5000.0000	UG/L
		410.2	5000.0000	UG/L
		410.4	5000.0000	UG/L
			5000.0000	UG/L
CHLOROBENZENE	108907	1624	10.0000	UG/L
CHLOROFORM	67663	1624	10.0000	UG/L
CHROMIUM	7440473	1620	10.0000	UG/L
CHRYSENE	218019	1625	10.0000	UG/L
COBALT	7440484	1620	50.0000	UG/L
COPPER	7440508	1620	25.0000	UG/L
D-CHEMICAL OXYGEN DEMAND (COD)	C-004D	410.1	5000.0000	UG/L
DI-N-BUTYL PHTHALATE	84742	1625	10.0000	UG/L
DIBENZOFURAN	132649	1625	10.0000	UG/L
DIBENZOTHIOPHENE	132650	1625	10.0000	UG/L
DIBROMOCHLOROMETHANE	124481	1624	10.0000	UG/L
DIETHYL ETHER	60297	1624	50.0000	UG/L
DIETHYL PHTHALATE	84662	1625	10.0000	UG/L
DIMETHYL SULFONE	67710	1625	10.0000	UG/L
DIPHENYL ETHER	101848	1625	10.0000	UG/L
ENDOSULFAN SULFATE	1031078	1618	0.0200	UG/L
		1656	0.0200	UG/L
ETHANE, PENTACHLORO-	76017	1625	20.0000	UG/L
ETHYLBENZENE	100414	1624	10.0000	UG/L
ETHYLENETHIOUREA	96457	1625	20.0000	UG/L
FLUORANTHENE	206440	1625	10.0000	UG/L
FLUORENE	86737	1625	10.0000	UG/L
GALLIUM	7440553	1620	500.0000	UG/L
GERMANIUM	7440564	1620	500.0000	UG/L
HEXACHLOROETHANE	67721	1625	10.0000	UG/L
HEXANE EXTRACTABLE MATERIAL	C-036	1664	5000.0000	UG/L

ATTACHMENT 15-1: Pollutants of Concern and their Baseline Values

Analyte Name	CAS Number	Method	Baseline Value	Unit
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HEXANOIC ACID	142621	1625	10.0000	UG/L
HEXAVALENT CHROMIUM	18540299	218.4	10.0000	UG/L
		3500D	10.0000	UG/L
INDIUM	7440746	1620	1000.0000	UG/L
IODINE	7553562	1620	1000.0000	UG/L
IRIDIUM	7439885	1620	1000.0000	UG/L
IRON	7439896	1620	100.0000	UG/L
ISOPHORONE	78591	1625	10.0000	UG/L
LEAD	7439921	1620	50.0000	UG/L
LITHIUM	7439932	1620	100.0000	UG/L
LUTETIUM	7439943	1620	100.0000	UG/L
M-XYLENE	108383	1624	10.0000	UG/L
MAGNESIUM	7439954	1620	5000.0000	UG/L
MANGANESE	7439965	1620	15.0000	UG/L
MERCURY	7439976	1620	0.2000	UG/L
METHYLENE CHLORIDE	75092	1624	10.0000	UG/L
MOLYBDENUM	7439987	1620	10.0000	UG/L
N-DECANE	124185	1625	10.0000	UG/L
N-DOCOSANE	629970	1625	10.0000	UG/L
N-DODECANE	112403	1625	10.0000	UG/L
N-EICOSANE	112958	1625	10.0000	UG/L
N-HEXACOSANE	630013	1625	10.0000	UG/L
N-HEXADECANE	544763	1625	10.0000	UG/L
N-NITROSOMORPHOLINE	59892	1625	10.0000	UG/L
N-OCTADECANE	593453	1625	10.0000	UG/L
N-TETRACOSANE	646311	1625	10.0000	UG/L
N-TETRADECANE	629594	1625	10.0000	UG/L
N,N-DIMETHYLFORMAMIDE	68122	1625	10.0000	UG/L

ATTACHMENT 15-1: Pollutants of Concern and their Baseline Values

Analyte Name	CAS Number	Method	Baseline Value	Unit
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NAPHTHALENE	91203	1625	10.0000	UG/L
NEODYMIUM	7440008	1620	500.0000	UG/L
NICKEL	7440020	1620	40.0000	UG/L
NIOBIUM	7440031	1620	1000.0000	UG/L
NITRATE/NITRITE	C-005	353.2	50.0000	UG/L
O+P XYLENE	136777612	1624	10.0000	UG/L
O-CRESOL	95487	1625	10.0000	UG/L
OCDF	39001020	1613	0.0001	UG/L
OSMIUM	7440042	1620	100.0000	UG/L
P-CRESOL	106445	1625	10.0000	UG/L
P-CYMENE	99876	1625	10.0000	UG/L
PENTACHLOROPHENOL	87865	1625 85.01	50.0000 .	UG/L
PENTAMETHYLBENZENE	700129	1625	10.0000	UG/L
PHENANTHRENE	85018	1625	10.0000	UG/L
PHENOL	108952	1625	10.0000	UG/L
PHOSPHORUS	7723140	1620	1000.0000	UG/L
PYRENE	129000	1625	10.0000	UG/L
PYRIDINE	110861	1625	10.0000	UG/L
SELENIUM	7782492	1620	5.0000	UG/L
SGT-HEM	C-037	1664	5000.0000	UG/L
SILICON	7440213	1620	100.0000	UG/L
SILVER	7440224	1620	10.0000	UG/L
STRONTIUM	7440246	1620	100.0000	UG/L
STYRENE	100425	1625	10.0000	UG/L
SULFUR	7704349	1620	1000.0000	UG/L
TANTALUM	7440257	1620	500.0000	UG/L
TELLURIUM	13494809	1620	1000.0000	UG/L

ATTACHMENT 15-1: Pollutants of Concern and their Baseline Values

Analyte Name -----	CAS Number -----	Method -----	Baseline Value -----	Unit ----
TETRACHLOROETHENE	127184	1624	10.0000	UG/L
TETRACHLOROMETHANE	56235	1624	10.0000	UG/L
THALLIUM	7440280	1620	10.0000	UG/L
TIN	7440315	1620	30.0000	UG/L
TITANIUM	7440326	1620	5.0000	UG/L
TOLUENE	108883	1624	10.0000	UG/L
TOTAL CYANIDE	57125	335.2	20.0000	UG/L
TOTAL DISSOLVED SOLIDS	C-010	160.1	10000.0000	UG/L
TOTAL ORGANIC CARBON (TOC)	C-012	415.1	1000.0000	UG/L
TOTAL PHENOLS	C-020	420.2	50.0000	UG/L
TOTAL PHOSPHORUS	14265442	365.2	10.0000	UG/L
TOTAL RECOVERABLE OIL AND GREASE	C-007	413.1	5000.0000	UG/L
TOTAL SOLIDS	C-008	209F	10000.0000	UG/L
TOTAL SULFIDE	18496258	D4658	1000.0000	UG/L
		376.1	1000.0000	UG/L
TOTAL SUSPENDED SOLIDS	C-009	160.2	4000.0000	UG/L
TRANS-1,2-DICHLOROETHENE	156605	1624	10.0000	UG/L
TRIBROMOMETHANE	75252	1624	10.0000	UG/L
TRICHLOROETHENE	79016	1624	10.0000	UG/L
TRIPROPYLENEGLYCOL METHYL ETHER	20324338	1625	99.0000	UG/L
VANADIUM	7440622	1620	50.0000	UG/L
VINYL CHLORIDE	75014	1624	10.0000	UG/L
YTTRIUM	7440655	1620	5.0000	UG/L
ZINC	7440666	1620	20.0000	UG/L
ZIRCONIUM	7440677	1620	100.0000	UG/L
1-METHYLFLUORENE	1730376	1625	10.0000	UG/L
1-METHYLPHENANTHRENE	832699	1625	10.0000	UG/L

ATTACHMENT 15-1: Pollutants of Concern and their Baseline Values

Analyte Name	CAS Number	Method	Baseline Value	Unit
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1,1-DICHLOROETHANE	75343	1624	10.0000	UG/L
1,1-DICHLOROETHENE	75354	1624	10.0000	UG/L
1,1,1-TRICHLOROETHANE	71556	1624	10.0000	UG/L
1,1,1,2-TETRACHLOROETHANE	630206	1624	10.0000	UG/L
1,1,2-TRICHLOROETHANE	79005	1624	10.0000	UG/L
1,1,2,2-TETRACHLOROETHANE	79345	1624	10.0000	UG/L
1,2-DIBROMOETHANE	106934	1624	10.0000	UG/L
1,2-DICHLOROBENZENE	95501	1625	10.0000	UG/L
1,2-DICHLOROETHANE	107062	1624	10.0000	UG/L
1,2,3-TRICHLOROPROPANE	96184	1624	10.0000	UG/L
1,2,4-TRICHLOROBENZENE	120821	1625	10.0000	UG/L
1,3-DICHLOROPROPANE	142289	1624	10.0000	UG/L
1,4-DICHLOROBENZENE	106467	1625	10.0000	UG/L
1,4-DIOXANE	123911	1624	10.0000	UG/L
1234678-HPCDF	67562394	1613	0.0001	UG/L
2-BUTANONE	78933	1624	50.0000	UG/L
2-METHYLNAPHTHALENE	91576	1625	10.0000	UG/L
2-PHENYLNAPHTHALENE	612942	1625	10.0000	UG/L
2-PICOLINE	109068	1625	50.0000	UG/L
2-PROPANONE	67641	1624	50.0000	UG/L
2,3-BENZOFUORENE	243174	1625	10.0000	UG/L
2,3-DICHLOROANILINE	608275	1625	10.0000	UG/L
2,3,4,6-TETRACHLOROPHENOL	58902	1625	20.0000	UG/L
		85.01	.	
2,4-DIMETHYLPHENOL	105679	1625	10.0000	UG/L
2,4,5-TP	93721	1618	0.0400	UG/L
2,4,5-TRICHLOROPHENOL	95954	1625	10.0000	UG/L
		85.01	.	

ATTACHMENT 15-1: Pollutants of Concern and their Baseline Values

Analyte Name	CAS Number	Method	Baseline Value	Unit
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2,4,6-TRICHLOROPHENOL	88062	1625	10.0000	UG/L
		85.01	.	
2378-TCDF	51207319	1613	0.0000	UG/L
3,4-DICHLOROPHENOL	95772	85.01	0.8000	UG/L
3,4,5-TRICHLOROCATECHOL	56961207	85.01	0.8000	UG/L
3,4,6-TRICHLOROGUAIACOL	60712449	85.01	0.8000	UG/L
3,5-DICHLOROPHENOL	591355	85.01	0.8000	UG/L
3,6-DICHLOROCATECHOL	3938167	85.01	0.8000	UG/L
3,6-DIMETHYLPHENANTHRENE	1576676	1625	10.0000	UG/L
4-CHLORO-3-METHYLPHENOL	59507	1625	10.0000	UG/L
4-CHLOROPHENOL	106489	85.01	240.0000	UG/L
4-METHYL-2-PENTANONE	108101	1624	50.0000	UG/L
4,5-DICHLOROGUAIACOL	2460493	85.01	0.8000	UG/L
4,5,6-TRICHLOROGUAIACOL	2668248	85.01	0.8000	UG/L
5-CHLOROGUAIACOL	3743235	85.01	160.0000	UG/L
6-CHLOROVANILLIN	18268763	85.01	0.8000	UG/L

LIST OF DEFINITIONS

A

Administrator - The Administrator of the U.S. Environmental Protection Agency.

Agency - The U.S. Environmental Protection Agency.

Average Monthly Discharge Limitation - The highest allowable average of "daily discharges" over a calendar month, calculated as the sum of all "daily discharges" measured during the calendar month divided by the number of "daily discharges" measured during the month.

B

BAT - The best available technology economically achievable, applicable to effluent limitations to be achieved by July 1, 1984, for industrial discharges to surface waters, as defined by Sec. 304(b)(2)(B) of the CWA.

BCT - The best conventional pollutant control technology, applicable to discharges of conventional pollutants from existing industrial point sources, as defined by Sec. 304(b)(4) of the CWA.

BPT - The best practicable control technology currently available, applicable to effluent limitations to be achieved by July 1, 1977, for industrial discharges to surface waters, as defined by Sec. 304(b)(1) of the CWA.

C

Centralized Waste Treatment Facility - Any facility that treats and/or recovers or recycles any hazardous or non-hazardous industrial waste, hazardous or non-hazardous industrial wastewater, and/or used material from off-site.

Centralized Waste Treatment Wastewater - Wastewater generated as a result of CWT activities. CWT wastewater sources may include, but are not limited to: liquid waste receipts, solubilization water, used oil emulsion-breaking wastewater, tanker truck/drum/roll-off box washes, equipment washes, air pollution control scrubber blow-down, laboratory-derived wastewater, on-site industrial waste combustor wastewaters, on-site landfill wastewaters, and contaminated stormwater.

Clean Water Act (CWA) - The Federal Water Pollution Control Act Amendments of 1972 (33 U.S.C. Section 1251 et seq.), as amended by the Clean Water Act of 1977 (Pub. L. 95-217), and the Water

Quality Act of 1987 (Pub. L. 100-4).

Clean Water Act (CWA) Section 308 Questionnaire - A questionnaire sent to facilities under the authority of Section 308 of the CWA, which requests information to be used in the development of national effluent guidelines and standards.

Commercial Facility - A CWT facility that accepts off-site generated wastes, wastewaters or used material from other facilities not under the same ownership as this facility. Commercial operations are usually made available for a fee or other remuneration.

Contaminated Storm Water - Storm water which comes in direct contact with the waste or waste handling and treatment areas.

Conventional Pollutants - Constituents of wastewater as determined by Sec. 304(a)(4) of the CWA, including, but not limited to, pollutants classified as biochemical oxygen demand, total suspended solids, oil and grease, fecal coliform, and pH.

CWT - Centralized Waste Treatment.

D

Daily Discharge - The discharge of a pollutant measured during any calendar day or any 24-hour period that reasonably represents a calendar day.

Detailed Monitoring Questionnaire (DMQ) - Questionnaires sent to collect monitoring data from 20 selected CWT facilities based on responses to the Section 308 Questionnaire.

Direct Discharger - A facility that discharges or may discharge treated or untreated wastewaters into waters of the United States.

E

Effluent Limitation - Any restriction, including schedules of compliance, established by a State or the Administrator on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged from point sources into navigable waters, the waters of the contiguous zone, or the ocean. (CWA Sections 301(b) and 304(b).)

Existing Source - Any facility from which there is or may be a discharge of pollutants, the construction of which is commenced before the publication of the proposed regulations prescribing a standard of performance under Sec. 306 of the CWA.

F

Facility - All contiguous property owned, operated, leased or under the control of the same person or entity

Fuel Blending - The process of mixing waste, wastewater, or used material for the purpose of regenerating a fuel for re-use.

H

Hazardous Waste - Any waste, including wastewater, defined as hazardous under RCRA, TSCA, or any state law.

High Temperature Metals Recovery (HTMR) - A metals recovery process in which solid forms of metal containing materials are processed with a heat-based pyrometallurgical technology to produce a remelt alloy which can then be sold as feed material in the production of metals.

I

In-scope - Facilities and/or wastewaters that EPA proposes to be subject to this guideline.

Indirect Discharger - A facility that discharges or may discharge wastewaters into a publicly-owned treatment works.

Intercompany - Facilities that treat and/or recycle/recover waste, wastewater, and/or used material generated by off-site facilities *not* under the same corporate ownership. These facilities are also referred to as “commercial” CWTs.

Intracompany Transfer - Facilities that treat and/or recycle/recover waste, wastewater, and/or used material generated by off-site facilities under the same corporate ownership. These facilities are also referred to as “non-commercial” CWTs.

L

LTA - Long-Term Average. For purposes of the effluent guidelines, average pollutant levels achieved over a period of time by a facility, subcategory, or technology option. LTAs were used in developing the limitations and standards in today's proposed regulation.

M

Marine-generated Waste - Waste, wastewater, and/or used material generated as part of the normal maintenance and operation of a ship, boat, or barge operating on inland, coastal, or open waters.

Metal-bearing Wastes - Wastes and/or used materials that contain metal pollutants from manufacturing or processing facilities or other commercial operations. These wastes may include, but are not limited to, the following: process wastewater, process residuals such as tank bottoms or stills, and process wastewater treatment residuals such as treatment sludges.

Minimum Level - the lowest level at which the entire analytical system must give a recognizable signals and an acceptable calibration point for the analyte.

Mixed Commercial/Non-commercial Facility - Facilities that treat and/or recycle/recover waste, wastewater, and/or used material generated by off-site facilities both under the same corporate ownership and different corporate ownership.

N

National Pollutant Discharge Elimination System (NPDES) Permit - A permit to discharge wastewater into waters of the United States issued under the National Pollutant Discharge Elimination system, authorized by Section 402 of the CWA.

New Source - Any facility from which there is or may be a discharge of pollutants, the construction of which is commenced after the proposal of regulations prescribing a standard of performance under section 306 of the Act and 403.3(k).

Non-commercial Facility - Facilities that accept waste from off-site for treatment and/or recovery from generating facilities under the same corporate ownership as the CWT facility.

Non-contaminated Stormwater - Storm water which does not come into direct contact with the waste or waste handling and treatment areas.

Non-conventional Pollutants - Pollutants that are neither conventional pollutants nor priority pollutants listed at 40 CFR Section 401.

Non-detect Value - the analyte is below the level of detection that can be reliably measured by the analytical method. This is also known, in statistical terms, as left-censoring.

Non-water Quality Environmental Impact - Deleterious aspects of control and treatment technologies applicable to point source category wastes, including, but not limited to air pollution, noise, radiation, sludge and solid waste generation, and energy used.

NSPS - New Sources Performance Standards, applicable to industrial facilities whose construction is begun after the publication of the proposed regulations, as defined by Sec. 306 of the CWA.

Q

OCPSF - Organic chemicals, plastics, and synthetic fibers manufacturing point source category. (40 CFR Part 414).

Off Site - Outside the boundaries of a facility.

Oily Wastes - Wastes and/or used materials that contain oil and grease from manufacturing or processing facilities or other commercial operations. These wastes may include, but are not limited to, the following: spent lubricants, cleaning fluids, process wastewater, process residuals such as tank bottoms or stills and process wastewater treatment residuals, such as treatment sludges.

Oligopoly - A market structure with few competitors, in which each producer is aware of his competitors' actions and has a significant influence on market price and quantity.

On Site - The same or geographically contiguous property, which may be divided by a public or private right-of-way, provided the entrance and exit between the properties is at a crossroads intersection, and access is by crossing as opposed to going along the right-of-way. Non-contiguous properties owned by the same company or locality but connected by a right-of-way, which it controls, and to which the public does not have access, is also considered on-site property.

Organic-bearing Wastes - Wastes and/or used materials that contain organic pollutants from manufacturing or processing facilities or other commercial operations. These wastes may include, but are not limited to, process wastewater, process residuals such as tank bottoms or stills and process wastewater treatment residuals, such as treatment sludges.

Outfall - The mouth of conduit drains and other conduits from which a facility effluent discharges into receiving waters.

Out-of-scope - Out-of-scope facilities are facilities which only perform centralized waste treatment activities which EPA has not proposed to be subject to provisions of this guideline. Out-of-scope operations are centralized waste treatment operations which EPA has not proposed to be subject to provisions of this guideline.

P

Pipeline - "Pipeline" means an open or closed conduit used for the conveyance of material. A pipeline includes a channel, pipe, tube, trench, ditch or fixed delivery system.

Pass Through - A pollutant is determined to "pass through" a POTW when the average percentage removed by an efficiently operated POTW is less than the average percentage removed by the industry's direct dischargers that are using well-defined, well-operated BAT technology.

Point Source - Any discernable, confined, and discrete conveyance from which pollutants are or may be discharged.

Pollutants of Concern (POCs) - Pollutants commonly found in centralized waste treatment wastewaters. For the purposes of this guideline, a POC is a pollutant that is detected three or more times above a treatable level in influent wastewater samples from centralized waste treatment facilities. Additionally, a CWT POC must be present in at least ten percent of the influent wastewater samples.

Priority Pollutant - One hundred twenty-six compounds that are a subset of the 65 toxic pollutants and classes of pollutants outlined in Section 307 of the CWA. The priority pollutants are specified in the NRDC settlement agreement (Natural Resources Defense Council et al v. Train, 8 E.R.C. 2120 [D.D.C. 1976], modified 12 E.R.C. 1833 [D.D.C. 1979]).

Product Stewardship - A program practiced by many manufacturing facilities which involves taking back spent, used, or unused products, shipping and storage containers with product residues, off-specification products and waste materials from use of products.

PSES - Pretreatment standards for existing sources of indirect discharges, under Sec. 307(b) of the CWA.

PSNS - Pretreatment standards for new sources of indirect discharges, under Sec. 307(b) of the CWA.

Publicly Owned Treatment Works (POTW) - Any device or system, owned by a state or municipality, used in the treatment (including recycling and reclamation) of municipal sewage or industrial wastes of a liquid nature that is owned by a state or municipality. This includes sewers, pipes, or other conveyances only if they convey wastewater to a POTW providing treatment (40 CFR 122.2).

R

RCRA - The Resource Conservation and Recovery Act of 1976 (RCRA) (42 U.S.C. Section 6901 et seq.), which regulates the generation, treatment, storage, disposal, or recycling of solid and hazardous wastes.

Re-refining - Distillation, hydrotreating, and/or other treatment employing acid, caustic, solvent, clay and/or chemicals of used oil in order to produce high quality base stock for lubricants or other petroleum products.

S

SIC - Standard Industrial Classification (SIC). A numerical categorization system used by the U.S. Department of Commerce to catalogue economic activity. SIC codes refer to the products, or group of products, produced or distributed, or to services rendered by an operating establishment. SIC codes are used to group establishments by the economic activities in which they are engaged. SIC codes often denote a facility's primary, secondary, tertiary, etc. economic activities.

Small-business - Businesses with annual sales revenues less than \$6 million. This is the Small Business Administration definition of small business for SIC code 4953, Refuse Systems (13 CFR Ch.1, § 121.601) which is being used to characterize the CWT industry.

Solidification - The addition of sorbents to convert liquid or semi-liquid waste to a solid by means of adsorption, absorption or both. The process is usually accompanied by stabilization.

Stabilization - A waste process that decreases the mobility of waste constituents by means of a chemical reaction. For the purpose of this rule, chemical precipitation is not a technique for stabilization.

V

Variability Factor - used in calculating a limitation (or standard) to allow for reasonable variation in pollutant concentrations when processed through extensive and well designed treatment systems. Variability factors assure that normal fluctuations in a facility's treatment are accounted for in the limitations. By accounting for these reasonable excursions above the long-term average, EPA's use of variability factors results in limitations that are generally well above the actual long-term averages.

W

Waste Receipt - Wastes, wastewater or used material received for treatment and/or recovery. Waste receipts can be liquids or solids.

Z

Zero or Alternative Discharge - No discharge of pollutants to waters of the United States or to a POTW. Also included in this definition are disposal of pollutants by way of evaporation, deep-well injection, off-site transfer, and land application.

LIST OF ACRONYMS

A

AMSA: Association of Municipal Sewage Authorities

API: American Petroleum Institute

B

BAT: Best Available Technology (Economically Achievable)

BCT: Best Conventional (Pollutant Control) Technology

BDAT: Best Demonstrated Available (Treatment) Technology

BOD: Biological Oxygen Demand

BPJ: Best Professional Judgement

BPT: Best Practicable (Control) Technology (Currently Available)

C

CBI: Confidential Business Information

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act

CMA: Chemical Manufacturers Association

COD: Chemical Oxygen Demand

CWA: Clean Water Act

CWT: Centralized Waste Treatment

D

DAF: Dissolved Air Flotation

DL: Detection Limit

DMQ: Detailed Monitoring Questionnaire

E

EAD: Engineering and Analysis Division

ELG: Effluent Limitations Guidelines

ENR: Engineering News Record

EPA: Environmental Protection Agency

F

F/M: Food-to-microorganism (ratio)

G

GAC: Granular Activated Carbon

GC/ECD: Gas Chromatography/Electron Capture Detector

GFAA: Graphite Furnace Atomic Absorption

H

HAP: Hazardous Air Pollutant

HEM: Hexane-Extractable Material

HSWA: Hazardous and Solid Waste Amendments

HTMR: High Temperature Metals Recovery

I

ICP: Inductively Coupled Plasma (Atomic Emission Spectroscopy)

IDL: Instrument Detection Limit

L

LDR: Land Disposal Restriction

LTA: Long-term Average

M

MACT: Maximum Achievable Control Technology

MADL: Minimum Analytical Detection Limit

MGD: Million Gallons per Day

MIP: Monitoring-in-place

ML: Minimum Level

MLSS: Mixed Liquor Suspended Solids

MNC: Mean Non-censored (Value)

N

ND: Non-detected

NOA: Notice of (Data) Availability

NORA: National Oil Recyclers Association

NPDES: National Pollutant Discharge Elimination System

NRDC: Natural Resources Defense Council

NRMRL: National Risk Management Research Laboratory; formerly **RREL**

NSPS: New Source Performance Standards

NSWMA: National Solid Waste Management Association

O

O&M: Operation and Maintenance

OCPSE: Organic Chemicals, Plastics, and Synthetic Fibers

OMB: Office of Management and Budget

P

PAC: Powdered Activated Carbon

POC: Pollutant of Concern

POTW: Publicly Owned Treatment Works

PSES: Pretreatment Standards for Existing Sources

PSNS: Pretreatment Standards for New Sources

Q

QC: Quality Control

R

RCRA: Resource Conservation and Recovery Act

RO: Reverse Osmosis

RREL: Risk Reduction Engineering Laboratory; now known as **NRMRL**

S

SBA: Small Business Administration

SBR: Sequencing Batch Reactor

SBREFA: Small Business Regulatory Flexibility Act

SGT-HEM: Silica Gel-Treated Hexane-
Extractable Material

SIC: Standard Industrial Code

SRT: Sludge Retention Time

T

TDS: Total Dissolved Solids

TEC: Transportation Equipment Cleaning

TOC: Total Organic Carbon

TSDF: Treatment, Storage, and Disposal
Facility

TSS: Total Suspended Solids

TWF: Toxic Weighting Factor

U

UF: Ultrafiltration

UIC: Underground Injection Control

UTS: Universal Treatment Standards

V

VOC: Volatile Organic Compound

W

WTI: Waste Treatment Industry

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Scope: see **Applicability**

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Total Dissolved Solids: 2-10, 2-13, 7-1, 12-16, 12-37, 12-44, 15-4, 15-8, 15-15

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Total Suspended Solids (*as "TSS"*): 1-1, 1-2, 2-7, 6-4, 6-6, 6-9, 6-24, 6-25, 7-15, 7-33, 9-2, 9-4, 9-11, 9-13, 10-6, 10-27, 10-29, 10-30, 10-35, 10-36, 10-37, 10-38, 11-14, 11-19, 11-31, 11-32, 11-44, 12-3, 12-7, 12-9, 12-33, 12-34, 12-37, 12-42, 12-43, 12-45, 15-8

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