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Technical Development Document for the Final Action Regarding Pretreatment Standards for the Industrial Laundries Point Source Category (Revised March 2000)

TECHNICAL DEVELOPMENT DOCUMENT FOR

THE FINAL ACTION REGARDING PRETREATMENT STANDARDS

FOR THE

INDUSTRIAL LAUNDRIES POINT SOURCE CATEGORY

(Revised March 2000)

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FOREWORD

This document includes technical support for the options considered during rulemaking for the Industrial Laundries Point Source Category.

After the Administrator signed the notice of final action, EPA received revised analytical data for some of the samples measured for semivolatile organic compounds, due to errors found in using dilution factors to calculate the sample concentrations. The revised data did not cause major changes, and provided a stronger basis for EPA's decision not to regulate this industry. Based on revised analytical data for semivolatile organic compounds for two sampling episodes conducted in 1996 and 1998, EPA revised this document in March 2000. The following chapters and appendices have been revised:

- Chapter 5
  —Table 5-11;
  —Table 5-12;
  —Table 5-14
  —Table 5-15; and
  —Table 5-16.

- Chapter 7
  —Table 7-1;
  —Table 7-3;
  —Table 7-4;
  —Table 7-5;
  —Table 7-7;
  —Table 7-11; and
  —Tables 7-12 through 7-16.

- Chapter 9
  —Table 9-1;
  —Table 9-4;
  —Tables 9-9 through 9-16.

- Appendix C
  —Table C-3; and
  —Table C-4.

- Appendix D, References D-4 through D-8.

- Appendix E.

Throughout the document, EPA refers to many commonly used titles and phrases by their acronyms to avoid spelling them out each time. As an aid to the reader, EPA has included in Chapter 12 a glossary of commonly used acronyms and definitions of terms used throughout the document.

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CHAPTER 1

SUMMARY

1.1 Introduction

This chapter presents a summary of the U.S. Environmental Protection Agency's (EPA's) decisions regarding effluent limitations guidelines and standards for the Industrial Laundries Point Source Category. Section 1.2 presents the scope and definition of the industry; Section 1.3 presents a brief overview of the industry; and Section 1.4 discusses EPA's final action.

1.2 Scope and Definition of the Industrial Laundries Industry

EPA has developed the following definition of industrial laundries:

> An *industrial laundry* is any facility that launders industrial textile items from off site as a business activity (i.e., launders industrial textile items for other business entities for a fee or through a cooperative arrangement). Either the industrial laundry facility or the off-site customer may own the industrial textile items. This definition includes textile rental companies that perform laundering operations. *Laundering* means washing with water, including water washing following dry cleaning. Laundering exclusively through dry cleaning and oil cleaning of mops in a process that does not use any water are not included in this definition of laundering. *Industrial textile items* include, but are not limited to: industrial shop towels, printer towels/rags, furniture towels, rags, uniforms, mops, mats, rugs, tool covers, fender covers, dust-control items, gloves, buffing pads, absorbents, and filters. If any of these items are used at hotels, hospitals, or restaurants, they are not considered industrial textile items.

A facility that performs any laundering of industrial textile items is classified as an industrial laundry, even if the facility also performs activities that are not defined as industrial laundering. EPA does not include the following activities within the scope of the industrial laundries industry: on-site laundering at industrial facilities (e.g., a chemical manufacturer that washes employee uniforms on site), laundering of industrial textile items originating from the same business entity (e.g., a chain of auto repair shops that operates a central laundry for items from individual shops), and exclusively laundering linen items, denim prewash items, clean room items, new items (i.e., items directly from the textile manufacturer, not yet used for their intended purpose), hotel, hospital, or restaurant items, or any combination of these items. However, EPA does consider hotels, hospitals, and restaurants to be within the scope of the industrial laundries industry if they launder industrial textile items originating from industrial facilities. Linen items include sheets, pillowcases, blankets, bath towels and washcloths, hospital gowns and robes,

tablecloths, napkins, tableskirts, kitchen textile items, continuous roll towels, laboratory coats, household laundry (such as clothes, but not industrial uniforms), executive wear, mattress pads, incontinence pads, and diapers (this list is meant to be all-inclusive).

1.3 Overview of the Industrial Laundries Industry

The industrial laundries industry includes facilities that launder industrial garments and uniforms, shop towels, printer towels/rags, mops, mats, and dust-control items. Either the laundry facilities or their customers own the laundered items. Many industrial laundries also wash other items not classified as industrial laundry items, such as linen garments, linen flatwork, health-care items, and miscellaneous other items.

Industrial laundries are located in all 50 states and all 10 EPA Regions. By state, the largest number of laundries are located in California. By EPA Region, the largest concentration of laundries is in Region V. Most of the laundering facilities are situated in large urban areas. EPA estimates that there are 1,742 industrial laundry facilities nationwide.

Industrial laundries vary in size from one- to two-person shops to large corporations that operate many facilities nationwide. The industry shows a correspondingly wide range of annual laundry production. Facilities laundering more than 15,000,000 pounds per year account for approximately eight percent of the total industry, whereas facilities laundering less than 3,000,000 pounds per year account for approximately 37 percent of the total industry. Approximately 10 percent of the facilities that meet EPA's definition of an industrial laundry launder less than 1,000,000 pounds per year.

Facilities wash most items using a water-washing process. Water washing involves washing items in water with detergents and other chemicals. Some facilities wash items using a dry-cleaning process, which involves washing items in an organic solvent. In some cases, facilities combine the two processes to wash items that have large amounts of both water-soluble and organic solvent-soluble soils. Dry cleaning followed by water washing of industrial textile items is considered an industrial laundry process. When water washing and dry cleaning are performed in series without drying the items between the water and solvent phases, the process is called dual-phase washing. The order in which these processes are performed depends on the solvent used, type of soil, and drying energy requirements. Some mops are laundered through a combination of water washing and oil treatment. The oil is applied to the mop to help collect dust during use. Both dual-phase washing of industrial textile items and water-washing/oil treatment of mops are considered industrial laundry processes.

Nationwide, industrial laundry facilities water-wash nearly 97 percent of their items. Approximately one percent of items are dry-cleaned, including items that are dry-cleaned and then water-washed. Dual-phase washing and mop cleaning with water and oil each accounts for less than one percent of the total production. The remaining laundry items are processed using other cleaning operations (e.g., oil cleaning of mops in a process that does not use any water). Chemicals frequently used in laundering operations include alkaline solutions, detergents, bleach, antichlor, sours, softeners, and starch. Other items that are added to some

wash formulas include enzymes, builders, oil treatment chemicals, water conditioners, dyes, stain treatment chemicals, and bactericides.

Based on data collected by EPA for the 1993 operating year, industrial laundries use over 90 percent of all incoming service water as laundry process water, followed in descending amounts by sanitary water, noncontact cooling water, and boiler water. All of the industrial laundries identified by EPA discharge their process wastewater to publicly owned treatment works (POTWs). The primary pollutants discharged by industrial laundries to POTWs include oil and grease, five-day biochemical oxygen demand (BOD_5), and total suspended solids (TSS), which are conventional pollutants, and a number of priority and nonconventional pollutants, including copper, lead, zinc, ethylbenzene, toluene, and total petroleum hydrocarbons (TPH), measured as silica gel treated-hexane extractable material (SGT-HEM)[1].

1.4 Final Action for the Industrial Laundries Point Source Category

EPA carefully considered all of the information in the Industrial Laundries Administrative Record, and has decided not to promulgate national categorical pretreatment standards for the Industrial Laundries Point Source Category because industrial laundry discharges to POTWs do not present a national problem warranting national regulation. EPA has determined that indirect discharges from industrial laundries do not warrant national regulation because of the small amount of pollutants removed by the pretreatment options determined to be economically achievable and because EPA believes that POTWs are generally not experiencing problems from industrial laundry discharges, and to the extent that isolated problem discharges occur, they will be controlled by the existing pretreatment program. EPA is not issuing effluent limitations guidelines or new source performance standards for direct dischargers because there are no direct discharging facilities in the industry and, therefore, EPA has no means to evaluate performance and develop guidelines.

Although EPA has decided not to promulgate national pretreatment standards, EPA evaluated technology performance data that can be used by control authorities to develop local limits on a best professional judgement (BPJ) basis. These data can be found in Chapter 7 of this document.

[1]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as TPH.

2.0 BACKGROUND

2.1 Introduction

This chapter presents background information supporting the development of effluent limitations guidelines and pretreatment standards for the Industrial Laundries Point Source Category. Section 2.2 presents the legal authority to regulate the industrial laundries industry. Section 2.3 discusses the Clean Water Act, the Pollution Prevention Act, and the Regulatory Flexibility Act as amended by the Small Business Regulatory Enforcement Fairness Act, as well as prior regulation of the industrial laundries industry.

2.2 Legal Authority

This final action for the Industrial Laundries Point Source Category is being performed under authority of sections 301, 304, 306, 307, 308, and 501 of the Clean Water Act (the Federal Water Pollution Control Act Amendments of 1972, 33 U.S.C. 1251 et seq., as amended), also referred to as "the CWA" or "the Act."

2.3 Background

2.3.1 Clean Water Act (CWA)

The Clean Water Act (CWA) established a comprehensive program to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (section 101(a)). To implement the Act, EPA is to issue effluent limitations guidelines, pretreatment standards, and new source performance standards for industrial dischargers.

These guidelines and standards are summarized briefly below:

1. Best Practicable Control Technology Currently Available (BPT) (section 304(b)(1) of the Act).

   BPT effluent limitations guidelines are generally based on the average of the best existing performance by plants of various sizes, ages, and unit processes within the category or subcategory for control of pollutants.

   In establishing BPT effluent limitations guidelines, EPA considers the total cost of achieving effluent reductions in relation to the effluent reduction benefits, the age of equipment and facilities involved, the processes employed, process changes required, engineering aspects of the control technologies, non-water quality environmental impacts (including energy requirements) and other factors as the EPA Administrator deems appropriate (section 304(b)(1)(B) of the Act). The Agency considers the category- or subcategory-wide cost of applying the technology in relation to the effluent reduction benefits. Where existing performance is

uniformly inadequate, BPT may be transferred from a different subcategory or category.

2. Best Available Technology Economically Achievable (BAT) (sections 304(b)(2)(B) and 307(a)(2) of the Act).

   In general, BAT effluent limitations represent the best existing economically achievable performance of plants in the industrial subcategory or category. The Act establishes BAT as the principal national means of controlling the direct discharge of priority pollutants and nonconventional pollutants to navigable waters. The factors considered in assessing BAT include the age of equipment and facilities involved, the process employed, potential process changes, and non-water quality environmental impacts, including energy requirements (section 304(b)(2)(B)). The Agency retains considerable discretion in assigning the weight to be accorded these factors. As with BPT, where existing performance is uniformly inadequate, BAT may be transferred from a different subcategory or category. BAT may include process changes or internal controls, even when these technologies are not common industry practice.

3. Best Conventional Pollutant Control Technology (BCT) (section 301(b)(2)(e) of the Act).

   The 1977 Amendments added section 301(b)(2)(E) to the Act establishing BCT for discharges of conventional pollutants from existing industrial point sources. Section 304(a)(4) designated the following as conventional pollutants: biochemical oxygen demanding pollutants (BOD), 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).

   BCT is not an additional limitation, but replaces BAT for the control of conventional pollutants. In addition to other factors specified in section 304(b)(4)(B), the Act requires that BCT limitations be established in light of a two-part "cost-reasonableness" test. [American Paper Institute v. EPA, 660 F.2d 954 (4th Cir. 1981)]. EPA's current methodology for the general development of BCT limitations was issued in 1986 (51 FR 24974; July 9, 1986).

4. New Source Performance Standards (NSPS) (section 306 of the Act).

   NSPS are based on the best available demonstrated treatment technology. New plants 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 numerical values attainable through the application of the best available demonstrated control technology for all pollutants (i.e., 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.

5. Pretreatment Standards for Existing Sources (PSES) (section 307(b) of the Act).

   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 (POTWs). The Act requires pretreatment standards for pollutants that pass through POTWs or interfere with POTWs' treatment processes or sludge disposal methods. The legislative history of the 1977 Act indicates that pretreatment standards are to be technology-based and analogous to the BAT effluent limitations guidelines for removal of toxic pollutants. For the purpose of determining whether to promulgate national category-wide pretreatment standards, EPA generally determines that there is pass through of a pollutant if the nationwide average percent of a pollutant removed by well-operated POTWs achieving secondary treatment is less than the percent removed by the BAT model treatment system. EPA retains discretion not to issue such standards where the total amount of pollutants passing through is not significant.

   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 does not use the percent removal comparison test described above (52 FR 1586; January 14, 1987).

6. Pretreatment Standards for New Sources (PSNS) (section 307(b) of the Act).

   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, like the new direct 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. EPA retains discretion not to issue such standards where the total amount of pollutants passing through is not significant.

2.3.2 Pollution Prevention Act (PPA)

In the Pollution Prevention Act of 1990 (42 U.S.C. 13101 et seq., Pub.L. 101-508, November 5, 1990), Congress declared pollution prevention to be the national policy of the United States. The Act declares that pollution should be prevented or reduced whenever feasible; where the generation of waste materials cannot be prevented, the waste materials should be recycled or reused in an environmentally safe manner wherever feasible; waste materials that cannot be recycled should be treated; and disposal or release into the environment should be chosen only as a last resort. The PPA directs the Agency to, among other things, "review regulations of the Agency prior and subsequent to their proposal to determine their effect on source reduction" (Sec. 6604; 42 U.S.C. 13103(b)(2)). EPA considered pollution prevention during the development of this final action. Chapter 6 of this document describes the results of this effort.

2.3.3 Regulatory Flexibility Act (RFA) as Amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA)

Under the Regulatory Flexibility Act (RFA), 5 U.S. C. 601 et seq., as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA), EPA generally is required to conduct a regulatory flexibility analysis describing the impact of the regulatory action on small entities as part of rulemaking. EPA conducted an initial regulatory flexibility analysis (IRFA) for the proposal (62 FR 66181; December 17, 1997) for the industrial laundries industry. However, under section 605(b) of the RFA, if EPA certifies that a rule will not have a significant economic impact on a substantial number of small entities, EPA is not required to prepare a regulatory flexibility analysis. Because the Administrator has decided not to promulgate pretreatment standards for this industry, EPA did not prepare a final regulatory flexibility analysis because the requirement in section 604 of the RFA to prepare a regulatory flexibility analysis when an agency promulgates a final rule does not apply to this action.

However, as part of EPA's decision not to promulgate pretreatment standards for this industry, EPA conducted an analysis equivalent to a regulatory flexibility analysis addressing:

- The need for, objectives of, and legal basis for a rule.
- A description of, and where feasible, an estimate of the number of small entities to which a rule would apply.
- The projected reporting, recordkeeping, and other compliance requirements of a rule, including an estimate of the classes of small entities that would be subject to a rule and the types of professional skills necessary for preparation of the report or record.
- An identification, where practicable, of all relevant federal rules which may duplicate, overlap, or conflict with a rule.

- A description of any significant regulatory alternatives to a rule which accomplish the stated objectives of applicable statutes and which minimize any significant economic impact of a rule on small entities. Consistent with the stated objectives of the CWA, the analysis discussed significant alternatives such as:

  – Establishing differing compliance or reporting requirements or timetables that take into account the resources available to small entities.

  – Clarification, consolidation, or simplification of compliance and reporting requirements under the rule for such small entities.

  – The use of performance rather than design standards.

  – An exclusion from coverage of a rule, or any part thereof, for such small entities. Based on the regulatory flexibility analysis and other factors, EPA considered an exclusion to eliminate disproportionate impacts on small businesses which reduced the number of small businesses that would be affected by a rule.

Pursuant to the RFA as amended by SBREFA, EPA convened a Small Business Advocacy Review Panel. The Panel comprised representatives from three federal agencies: EPA, the Small Business Administration, and the Office of Management and Budget. The Panel reviewed materials EPA prepared in connection with the IRFA, and collected the advice and recommendations of small entity representatives. Small entity representatives included owners of small industrial laundries and trade association representatives. The Panel prepared a report (available in the Industrial Laundries Administrative Record) that summarizes their outreach to small entities and the comments submitted by the small entity representatives. The Panel's report also presented their findings on issues related to the elements of the IRFA.

2.3.4 Prior Regulation of the Industrial Laundries Point Source Category

The Federal Water Pollution Control Act Amendments of 1972 established a program to clean up the nation's waters that consisted of, along with other requirements, a program of establishing technology-based effluent limitations guidelines for point source dischargers by industry categories and a timetable for issuing these guidelines. Pursuant to a 1976 settlement agreement and the 1977 Clean Water Act Amendments, EPA was required to develop a program and adhere to a schedule in promulgating effluent limitations guidelines and pretreatment standards for 65 "toxic" pollutants and classes of pollutants, for 21 major industries. Moreover, the Agency is required by section 301 (d) of the Federal Water Pollution Control Act Amendments of 1972 and the Clean Water Act of 1977 to review and revise, if necessary, effluent limitations promulgated pursuant to sections 301, 304, 306, 307, 308, and 501 of the Act.

The Auto and Other Laundries Category, of which industrial laundries was a subcategory, was one of the categories mandated for study and possible effluent limitations guidelines and standards development by the 1976 Settlement Agreement. Several studies were undertaken in 1977 through 1980 to collect more information about the industrial laundries industry, including two surveys (1977 and 1979) and wastewater sampling and analysis programs conducted in 1978. However, in 1981, the Auto and Other Laundries Category, including the industrial laundries subcategory, was excluded from regulation. The industrial laundries subcategory was excluded because, based on assessments made at that time, it was determined that 95 percent of the industry discharged pollutants that could be treated by POTWs and that did not pass through, interfere with, or otherwise prove incompatible with the operation of POTWs.

However, following these assessments, additional data were collected by the Industrial Technology Division (ITD - now Engineering and Analysis Division (EAD)) as part of work efforts in conjunction with EPA's Office of Solid Waste's Resource Conservation and Recovery Act (RCRA) Program in 1985 through 1987. In 1986, EPA published its Domestic Sewage Study (DSS), which identified industrial laundries as potential contributors of large amounts of hazardous pollutants to the POTWs. Based on information gathered to that point, EPA compiled a profile of the industrial laundries industry that was published as a Preliminary Data Summary in 1989.

Section 304(m) of the Clean Water Act (33 U.S.C. 1314(m)), added by the Water Quality Act of 1987, requires EPA to establish schedules for (i) reviewing and revising existing effluent limitations guidelines and standards ("effluent guidelines"), and (ii) promulgating new effluent guidelines. On January 2, 1990, EPA published an Effluent Guidelines Plan (55 FR 80), in which schedules were established for developing new and revised effluent guidelines for several industrial categories. In addition, the plan listed several industrial categories that were to be studied to determine whether rulemakings to develop effluent guidelines and standards should be initiated. One of those categories was the Industrial Laundries Point Source Category, based on the results of the 1985 to 1987 work contained in the DSS.

Natural Resources Defense Council, Inc. (NRDC) and Public Citizen, Inc. challenged the Effluent Guidelines Plan in a suit filed in U.S. District Court for the District of Columbia (NRDC et al. v. Reilly, Civ. No. 89-2980). The plaintiffs charged that EPA's plan did not meet the requirements of section 304(m). A Consent Decree (the "304(m) Decree") in this litigation was entered by the Court on January 31, 1992 (57 FR 19748), which established schedules for, among other things, EPA's proposal and promulgation of effluent guidelines for a number of categories, including the Industrial Laundries Point Source Category. The Effluent Guidelines Plan update published on February 26, 1997 (62 FR 8726) required, among other things, that EPA propose effluent limitations guidelines and pretreatment standards for the Industrial Laundries Point Source Category by September 1997 and take final action by June 1999. Further modification of the Decree in August 1997 set the proposal date no later than November 7, 1997.

On December 17, 1997 (62 FR 66181), EPA published proposed pretreatment standards for the control of wastewater pollutants from the industrial laundries industry. EPA published a notice of data availability (NODA) on December 23, 1998 (63 FR 71054). The

NODA presented a summary of the data gathered or received from commenters since the proposal, an assessment of the usefulness of the data in EPA's analyses, and a discussion of a voluntary industry program submitted by the industry as part of comments on the proposal.

CHAPTER 3

DATA COLLECTION METHODOLOGY AND INFORMATION SOURCES

3.1 Introduction

In 1992, EPA published a notice in the Federal Register (57 FR 19748) indicating its intent to develop effluent limitations guidelines and standards for the Industrial Laundries Point Source Category. EPA collected information necessary for the development of these effluent guidelines and standards from many sources. EPA initially collected data on a broad group of laundry facilities that included industrial laundries as well as linen laundries, denim prewash facilities, and other laundry facilities. These data were necessary to define the scope of the industry. Throughout this chapter, the term "laundry" is used to indicate that information was collected from industrial laundries as well as other laundry facilities, such as facilities that launder only linen items.

On December 17, 1997 (62 FR 66181), EPA published proposed pretreatment standards for the Industrial Laundries Point Source Category, based on EPA's data collection efforts. In response to this proposal, EPA obtained data from industry and publicly owned treatment works (POTWs), which were described in the Notice of Data Availability (NODA) published on December 23, 1998 (63 FR 71054). EPA received additional data from industry and POTWs in comments on the NODA.

This chapter summarizes the information collection activities undertaken and the information sources used to develop the final action for the Industrial Laundries Point Source Category, as presented below:

- Section 3.2 summarizes data collection efforts prior to 1992;
- Section 3.3 discusses the questionnaire activities conducted after 1992;
- Section 3.4 summarizes EPA's site visit program conducted from 1993 through 1998;
- Section 3.5 discusses EPA's sampling program conducted from 1993 through 1998;
- Section 3.6 discusses EPA's Method 1664 Characterization Study;
- Section 3.7 presents other industry-supplied data;
- Section 3.8 discusses data collected from POTWs;
- Section 3.9 summarizes literature searches performed on the industrial laundries industry;

- Section 3.10 summarizes other sources of data on the industrial laundries industry; and

- Section 3.11 presents the references used in this chapter.

3.2 Summary of Data Collection Prior to 1992

Prior to 1992, EPA conducted several studies of the laundries industry. These efforts consisted of the following:

- The 1971 EPA survey of 160 industrial laundries, linen services, and diaper services (Section 3.2.1);

- The 1975 data collection at 73 facilities (Section 3.2.2);

- The 1977 data collection portfolio (DCP) for approximately 70 facilities (Section 3.2.3);

- The 1978 screening and verification analysis of samples from approximately 10 facilities for priority pollutants (Section 3.2.4);

- The 1979 laundries survey (Section 3.2.5); and

- The 1985 through 1987 Industrial Technology Division (ITD)/Resource Conservation and Recovery Act (RCRA) sampling program and development of the Preliminary Data Summary for the Industrial Laundries Industry (1) (Section 3.2.6).

Sections 3.2.1 through 3.2.6 describe each of these data-gathering efforts in more detail.

3.2.1 1971 Survey

EPA's first study of the industrial laundries industry, initiated in 1971, involved sending a survey to 160 facilities. These facilities were all members of the Institute of Industrial Launderers (IIL, now the Uniform and Textile Service Association (UTSA)) or the Linen Supply Association of America (LSAA, now the Textile Rental Services Association of America (TRSA)) and included industrial laundries, linen services, and diaper services. In addition to wastewater analytical data obtained from the survey, EPA analyzed wastewater samples it had collected at a small number of facilities for conventional and nonconventional pollutants and some metals.

3.2.2 1975 Data Collection

In 1975, EPA initiated sampling and analysis of wastewaters generated by the Auto and Other Laundries Point Source Category, of which the industrial laundries industry was

identified as a subcategory. These early programs concentrated primarily on collecting data on conventional and nonconventional pollutants and trace metals. EPA collected samples at 73 laundries for conventional pollutants (pH, biochemical oxygen demand (BOD_5), total suspended solids (TSS), and oil and grease) and nonconventional pollutants (chemical oxygen demand (COD), total organic carbon (TOC), and phosphorus).

3.2.3 1977 Data Collection Portfolio (DCP)

In 1977, EPA sent a data collection portfolio (DCP) to a number of laundry facilities including industrial laundries (SIC Code 7218), power laundries (SIC Code 7211), linen supply laundries (SIC Code 7213), and institutional laundries. Completed DCPs were received from approximately 70 industrial laundries. The survey requested the following types of information:

- Type of laundry;
- Number of hours/day and days/year of operation and number of employees;
- Types of processes;
- Production information;
- Types of customers serviced;
- Laundering chemicals used;
- Water usage;
- Effluent discharge;
- Information on wastewater treatment and in-plant controls;
- Recommendations for design features;
- Space available for treatment;
- Available priority pollutant data; and
- Unique features.

3.2.4 1978 Sampling Program

In 1978, EPA initiated a sampling program to determine the presence and concentrations of 129 priority pollutants, which were identified from the 65 toxic pollutants and classes of pollutants (and subsequently reduced to 126 priority pollutants), as defined by the

1976 Consent Decree (see Section 2.3.4 of this document for discussion of the Consent Decree), in wastewaters from facilities in the Auto and Other Laundries Point Source Category. EPA sampled a total of 40 facilities for toxic and conventional pollutants using automatic time-compositing equipment during operating hours at each facility. In most cases, sampling was for one day only. At facilities where wastewater treatment was in place, EPA collected samples of both treatment system influent and effluent. Over a one-month period, EPA also sampled an industrial laundry that used a dissolved air flotation (DAF) treatment system to obtain data on the variability of treatment efficiency for this type of technology.

3.2.5 1979 Laundries Survey

In 1979, EPA sent a survey to 31 industrial laundries and 14 linen laundries in five major cities to determine the availability of sufficient space for installation of treatment systems. Approximately 50 percent of the survey dealt specifically with available space at facilities without treatment. Other information obtained included:

- Business classification;
- Number of hours/day and days/year of operation and number of employees;
- Processes used;
- Production information;
- Water usage;
- Effluent discharge;
- In-plant controls used; and
- Wastewater treatment practiced.

EPA conducted the Industrial Technology Division (ITD)/Resource Conservation and Recovery Act (RCRA) Sampling Program and the Preliminary Data Study in response to a recommendation made in the Domestic Sewage Study and because of concern for the potential discharge of toxic pollutants. In 1981, EPA decided not to establish effluent limitations guidelines and standards for the Auto and Other Laundries Point Source Category, of which industrial laundries were a subcategory, because EPA determined that 95 percent of the discharged pollutants were amenable to treatment by POTWs and did not pass through, interfere with, or prove otherwise incompatible with the operation of POTWs. Therefore, no further data collection efforts were undertaken until 1985.

3.2.6 Industrial Technology Division (ITD)/Resource Conservation and Recovery Act (RCRA) Sampling Program and Development of the Preliminary Data Summary (1985 through 1987)

EPA conducted a program to obtain wastewater and solid waste samples at five industrial laundries located in different regions of the U.S. EPA used information obtained during previous data-gathering efforts in conjunction with advice and assistance from the UTSA (known as the Institute of Industrial Launderers (IIL) at the time) to select seven laundries for site visits. Four of these facilities were sampled in 1986 and 1987. The fifth facility was sampled in 1985 as part of the Domestic Sewage Study (discussed in Section 3.10.3 of this document).

At the industrial laundry sampled in 1985, EPA collected composite samples of the final effluent from a settling basin over the course of one operating day. EPA collected samples of untreated wastewater streams and final effluent at the four other industrial laundry facilities. EPA sampled these four facilities for two consecutive days and composited the wastewater over the course of each operating day. EPA collected final effluent samples from two DAF systems, one ultrafiltration system, and a settling basin.

EPA analyzed the samples for conventional pollutants, priority and nonconventional organic pollutants, metal pollutants, and other nonconventional pollutants.

Other EPA activities to collect information about the industrial laundries industry investigated during this time period included:

- Telephone interviews with, and visits to, personnel at EPA regional and state offices, industry trade associations, and representative industrial laundries;
- Telephone interviews with POTW representatives; and
- Literature review, including research reports, journals and magazines, computer-based abstract databases, and computer-based censuses.

The information collected during 1985 to 1987 was used to prepare the Preliminary Data Summary for the Industrial Laundries Industry (1) and formed the basis for EPA's decision to initiate work on effluent limitations guidelines and standards for the Industrial Laundries Point Source Category in 1992.

3.3 Summary of Industrial Laundries Questionnaire Activity After 1992

EPA's first step in developing a rule for the industrial laundries industry was to gather current data from the industry, under the authority of section 308 of the Clean Water Act. EPA conducted a screener survey by sending questionnaires to four different segments of the laundry industry between 1993 and 1995. The screener questionnaires requested information to be used in identifying the population of the laundry industry, developing the scope of the

regulation, and determining which facilities should receive a more detailed questionnaire. Based on data collected from the screener survey and a search of the Dun & Bradstreet listing for laundry facilities, EPA identified a representative subset of laundries to receive a detailed questionnaire. Based on the responses to this detailed questionnaire, EPA sent an additional questionnaire to a subset of the facilities that had received the detailed questionnaire to obtain effluent monitoring data. These data-gathering efforts are described in more detail below. Additional details on the data-gathering efforts are also contained in the Statistical Support Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category (2). Copies of completed nonconfidential questionnaire responses are contained in the Industrial Laundries Administrative Record.

3.3.1 Screener Questionnaires

EPA conducted four separate mailings of slightly different screener questionnaires to collect data it could use to define the scope of the industrial laundries industry, identify the population of the industry, and select facilities to receive the more detailed questionnaire. EPA also used the screener questionnaires to characterize the industry and to determine the size of the industrial laundries population. More details on determining the industrial laundries population are provided in the Statistical Support Document (2). Summarized industry characterization data are provided in Chapters 4, 5, and 6 of this document. The four different screener questionnaires and their mailings are discussed in the following sections.

3.3.1.1 The 1993 Industrial Laundries Industry Screener Questionnaire

In 1993, EPA developed and mailed out the two-page 1993 Industrial Laundries Industry Screener Questionnaire to 1,751 industrial laundries to solicit updated information on the industry. The screener questionnaire requested information on the relative amounts and types of items received for laundering, the type of waste treatment operations, the amount of water used, and wastewater disposal practices. A blank copy of the questionnaire, along with copies of the nonconfidential portions of the completed screener questionnaires, are contained in Section 6.2 of the Industrial Laundries Administrative Record.

EPA sent the screener questionnaire to a total of 1,751 facilities. EPA selected 1,745 of these facilities from the UTSA customer and prospective customer lists, the Textile Rental Service Association (TRSA) mailing list, and the Occupational Safety and Health Administration's (OSHA) list of violations for industrial laundries. EPA added six facilities to the list as a result of companies requesting screeners for their facilities that had not received one.

Of the 1,751 screener questionnaires mailed, 1,543 were returned. In addition, three facilities that were not on the mailing list received a copy of the screener from their parent company, and returned the completed copy, bringing the total of completed screener questionnaires returned to 1,546. A summary of the results of the screener questionnaire mailings is shown in the following table.

Status of 1993 Screener Questionnaire	Number of Questionnaires
Returned	1,546[1]
Screener undeliverable or facility known to be out of scope	86
Nonresponsive	122
Duplicate facilities found	46[2]
Total	1,754

[1]Three facilities not on the original mailing list completed and returned the questionnaire at the request of their parent company.
[2]This number is included in the number of screeners returned.

EPA received the screener questionnaire responses, reviewed them for completeness and accuracy, and entered the information into a database. EPA contacted by telephone respondents who provided incomplete or contradictory technical information to obtain correct information.

3.3.1.2 1993 Industrial Laundries Industry Supplemental Screener Questionnaire

The Dun & Bradstreet listing was used to identify industrial laundries not captured by the trade association mailing lists developed for the original screener questionnaire. Facilities listed in Dun & Bradstreet with primary SIC codes of 7218 (industrial laundries) or 7213 (linen supply laundries) and facilities with secondary SIC codes of 7218 were identified and compared to the original screener questionnaire mailing list. EPA selected 200 facilities identified from the Dun & Bradstreet listing to receive the supplemental screener questionnaire to obtain more data representative of the entire industry as follows: 100 facilities with a primary SIC code of 7218; 60 facilities with a primary SIC code of 7213; and 40 facilities with a secondary SIC code of 7218. The table below summarizes the results of the supplemental screener questionnaire mailing.

Status of D&B Screener Questionnaires	Number of Questionnaires
Returned	134
Screener undeliverable	34
Nonresponsive	32
Total	200

EPA received the screener questionnaire responses, reviewed them for completeness and accuracy, and entered the information into a database. EPA contacted by telephone respondents who provided incomplete or contradictory technical information to obtain correct information.

3.3.1.3 Large Industrial Laundry Screener

Abbreviated screener questionnaires were sent to five large industrial laundry companies to identify facilities owned by these five companies that were not identified from the original screener questionnaire or the supplemental screener questionnaire. Abbreviated screener questionnaires were also sent to four additional facilities that were not included on the mailing list for the original screener due to lack of address information. Information from the abbreviated screener, along with information from the other screener questionnaire, was used to determine the industrial laundry industry population.

3.3.1.4 1995 Industrial Laundries Industry Screener (On-Site) Questionnaire

In response to comments from industrial laundry and linen trade associations, EPA mailed 100 modified screener questionnaires in January 1995 to hospitals, hotels, and prisons that potentially operate on-site laundries. These facilities are not traditional industrial laundry facilities, but generate wastewater from laundering. EPA randomly selected 25 facility addresses from each of the following four sources:

- A list provided by the TRSA;
- A list provided by the UTSA;
- Responses to Question 25 (Q25) in Part B of the 1994 Industrial Laundries Industry Questionnaire; and
- National Association of Institutional Linen Management (NAILM) members.

The 1995 screener questionnaire requested the following information: discharge status (i.e., direct, indirect, zero), water use information, amount of laundry accepted from off site, the amount of total laundry processed, number of employees, SIC code, percentage of items laundered (both generated on site and accepted from off site), and type of treatment system. The main goal of this effort was to obtain a snapshot of the activities of on-site laundries to determine if they should be included in the scope of the industrial laundries industry. EPA received 86 responses to the 1995 screener questionnaire.

3.3.2 1994 Industrial Laundries Industry Questionnaire (Detailed Questionnaire)

EPA designed the 1994 Industrial Laundries Industry Questionnaire (detailed questionnaire) to collect detailed technical and economic information from industrial laundry and linen facilities. EPA sent the detailed questionnaire to laundries statistically selected from the 1993 Industrial Laundries Industry Screener Questionnaire database (screener questionnaire database) and from the Dun & Bradstreet database. Additional information concerning the selection of facilities to receive the detailed questionnaire is presented in the Statistical Support Document (2). EPA used the information reported by the respondents in the detailed questionnaire to develop an industry profile, characterize industry production and water use,

develop pollutant loadings and reduction estimates, and develop compliance cost estimates, as discussed throughout this document. A blank copy of the detailed questionnaire and copies of the nonconfidential portions of the completed detailed questionnaires are contained in the Industrial Laundries Administrative Record.

3.3.2.1 Detailed Questionnaire Recipient Selection and Mailing

EPA mailed the detailed questionnaire in June and July of 1994 to 250 selected laundries. EPA selected 24 facilities from the Dun & Bradstreet database and 226 facilities from the industrial laundries industry screener database. After mailing the questionnaires, EPA deactivated the questionnaires for one of the selected Dun & Bradstreet facilities and three of the selected screener questionnaire facilities because they were closed, out of scope, or otherwise unable to respond to the questionnaire. EPA replaced these facilities with other facilities not previously selected. The methods used to select the recipients of the detailed questionnaires are described in the Statistical Support Document (2). A summary of the results of the mailout of the 254 detailed questionnaires is shown in the following table.

Activity	Number of Sites
Mailed detailed questionnaire (four questionnaires were mailed to replace four facilities determined to be inactive within a few days of the initial mail-out)	254[1]
Questionnaires received	231
Questionnaires not received	23
Questionnaires deactivated (deactivated because facility closed, facility was a pretest facility, facility destroyed by fire, facility did not generate laundry wastewater, or otherwise could not provide the necessary information)	16 (Not received-12) (Received-4)
Questionnaires with sufficient technical and economic information to perform the analyses necessary to conduct a final action	208

[1]EPA originally selected 250 recipients of the detailed questionnaire and later selected another four to replace facilities that had been deactivated.

In addition, EPA mailed pretest questionnaires to nine facilities in November 1993. Although not identical, the pretest questionnaire contained questions similar to the questionnaire mailed in June and July of 1994. EPA received eight pretest questionnaire responses.

3.3.2.2 Information Collected by the Detailed Questionnaire

This section describes the information collected in each part of the detailed questionnaire and the reasons this information was collected. The Information Collection Request (ICR) (3) for this project contains further details on the types of information collected and the potential use of the information.

EPA developed the detailed questionnaire in conjunction with the industrial laundries trade associations (TRSA and UTSA), EPA's Office of Pollution Prevention and

Toxics, and EPA's Office of Solid Waste to collect information necessary to develop effluent limitations guidelines and standards for the industrial laundries industry. EPA sent a draft version of the questionnaire to nine pretest facilities, and incorporated comments from these facilities into the final version of the detailed questionnaire.

The detailed questionnaire comprised the following parts:

- Part A: Technical Information
  - -- Section 1: Facility Identification,
  - -- Section 2: Operating Information; and

- Part B: Financial and Economic Information
  - -- Section 1: Facility Financial Information,
  - -- Section 2: Owner Company Financial Information,
  - -- Section 3: Parent Company Financial Information.

Part A, Section 1 requested information necessary to identify the site and to determine wastewater discharge locations (to surface water or POTWs). The information requested in this section included site name, address, parent company name, address, site contact, age of facility, major modifications made to the facility, operating hours and days, permits held by the facility, and wastewater discharge location.

Part A, Section 2 was divided into the following subparts:

- Process Operations and Production Information;
- Water Use and Conservation Practices; and
- Wastewater Treatment Operations.

The section on process operations and production information requested detailed information on laundering processes, types of items laundered, production of laundered items, types of customers, laundering formulas, laundering chemicals, laundering equipment, and pollution reduction activities. EPA used the information collected in this section to determine the types and amounts of each item laundered at a facility, the types of customers a facility has, the amount of laundering chemicals and water used for laundering each item type, and pollution reduction practices at laundry facilities.

The section on water use and conservation practices requested detailed information on water intake amounts for various uses, water conservation practices in place, wastewater generation and discharge locations, and a facility process diagram showing a water balance for the facility and wastewater treatment in place. EPA used this information to evaluate the overall water use and wastewater discharge for the site.

The section on wastewater treatment operations requested detailed information on wastewater treatment operations, costs of wastewater treatment equipment, wastewater sample collection, wastewater treatment residual types and generation amounts, costs of residual

disposal, and space availability at the facility. EPA used this information to evaluate current treatment in place at industrial laundries and the costs of operating this treatment.

Part B requested detailed financial and economic information for each site and the owner companies of each site. Detailed information on this section is presented in the Economic Assessment for the Final Action Regarding Pretreatment Standards for the Industrial Laundries Point Source Category (4).

3.3.2.3 Data Review and Data Entry

EPA completed a detailed engineering review of Part A of the detailed questionnaires to evaluate the accuracy of information provided by the respondents. During engineering review, responses to questions were coded to facilitate data entry into the detailed questionnaire database. The Data Element Dictionary for the Industrial Laundries Industry Questionnaire Part A Database (5) contains the codes used by reviewers. EPA contacted, by telephone, respondents who provided incomplete or contradictory technical information to obtain correct information.

EPA developed a database for the technical information provided by the detailed questionnaire respondents. After engineering review and coding, data from the detailed questionnaires were double-key entered using a data entry and verification system. Reviewers of the questionnaire verified errors in the double-key entry. EPA entered basic information (i.e., name, address, telephone number, etc.) for all 254 facilities into the database. EPA entered other information provided by the 231 facilities responding to Part A. EPA also entered the information for three pretest facilities.

3.3.2.4 Compilation of Respondent Data

EPA compiled information reported in the detailed questionnaire and summaries of this information are located in Chapters 4, 5, and 6 of this document. These chapters include information on facility location, process and production information, water use and discharge practices, and wastewater characteristics and treatment.

3.3.3 Detailed Monitoring Questionnaire

In 1995, EPA mailed a detailed monitoring questionnaire (DMQ) to 37 industrial laundries that had received the detailed questionnaire in 1994. After reviewing responses to the detailed questionnaire, EPA identified facilities with available monitoring data that could be used to identify effluent discharge quality after certain treatment technologies and in conjunction with laundering certain industrial items. EPA selected the industrial laundries that would receive the DMQ based on the following criteria:

- Facilities that EPA had sampled;
- Facilities with paired monitoring data (i.e., facilities that monitor both influent and effluent pollutant concentrations);

- At least one facility with each technology being considered for inclusion in the treatment technology options; and
- Facilities that had no treatment (or that have gravity settling and screens only) to characterize untreated industrial laundry wastewater and current pollutant discharge loadings.

The DMQ requested that facilities submit analytical data they had reported (but not submitted) in their detailed questionnaire responses and any additional data that were available (e.g., raw wastewater data, POTW data, chemical vendor data, wastewater treatment vendor data, disposal company data). The facilities were also asked to include a process diagram for verification of sampling points. All 37 recipients completed and returned their DMQ.

3.3.3.1 Data Review and Data Entry

EPA completed a detailed engineering review of the DMQs to evaluate the accuracy of information provided by the respondents. The engineering review also included coding of responses to questions to facilitate data entry into the DMQ database. The Data Element Dictionary for the DMQ Database (6) contains the codes used by reviewers. EPA contacted, by telephone, respondents who provided incomplete or contradictory technical information to obtain correct information.

EPA developed a database for the technical information provided by the DMQ respondents. After engineering review and coding, data from the DMQ were double-key entered using a data entry and verification system. Reviewers of the questionnaires verified errors in the double-key entry. EPA entered information for all 37 facilities into the DMQ database.

3.3.3.2 Compilation of Respondent Data

EPA compiled information reported in the DMQ responses and summarized it in Chapter 5 of this document, which includes information on wastewater characteristics. DMQ data were also used to develop summaries reflecting wastewater control technology performance for the industrial laundries industry, as presented in Chapter 7 of this document.

3.4 Summary of EPA's Site Visit Program (1993-1998)

EPA conducted 38 site visits to industrial laundries between 1993 and 1998 to collect information about industrial laundry processes, water use practices, pollution reduction practices, wastewater treatment technologies, and waste disposal methods. EPA also visited these sites to evaluate potential sampling locations (as described in Section 3.5 of this document). EPA visited a range of laundry facilities, such as industrial laundries, linen facilities, hospital cooperative laundries, clean room facilities, and denim prewash facilities, to collect data it could use to define the scope of the industry.

3.4.1 Criteria for Site Visit Selection

EPA based site selection on information in responses to the screener and detailed questionnaires and information obtained from the industrial laundries trade associations. In addition to choosing sites of varying sizes, EPA used the following general criteria to select sites that encompassed the range of processes and treatment technologies within the industrial laundries industry:

- The site laundered a broad range of industrial textile items;
- The site performed specific operations, such as denim prewashing or dry cleaning followed by water washing;
- The site had wastewater treatment technologies that were believed to be representative of the "best" within the industry;
- The site split heavy and light wastewater streams; and
- The site practiced water reuse.

3.4.2 Types of Information Collected

EPA documented information for each site visit in a site visit report; these reports are contained in the Industrial Laundries Administrative Record. During the site visits, EPA collected the following information for each facility:

- Types of laundering processes conducted and the types of items laundered, as well as the production volume of each item;
- Types of customers served;
- Types and sizes of laundering equipment used;
- Types, amounts, and disposition of wastewater generated;
- Types of pollution reduction activities performed;
- Types of wastewater treatment technologies operated; and
- Logistical information for sampling.

3.5 Summary of EPA's Sampling Program (1993-1998)

EPA conducted sampling episodes at nine facilities between 1993 and 1998 to obtain data on the characteristics of industrial laundry wastewaters and to assess the following: the amount of pollutants discharged to POTWs from industrial laundries; the effectiveness of

technologies designed to reduce and remove pollutants from industrial laundry wastewater; and the variation of wastewater characteristics across item type.

3.5.1 Criteria for Sampling Site Selection

EPA used information collected during industrial laundry site visits to identify candidate sites for sampling. EPA used the following general criteria to select sites for sampling:

- The site accepted a variety of items for laundering; and
- The site operated in-process source reduction or end-of-pipe treatment technologies that were considered for treatment technology option development.

After selecting a site for sampling, EPA prepared a detailed sampling and analysis plan, based on the information obtained during the site visit and follow-up contact with the site. The sampling and analysis plans were prepared to ensure collection of samples that would be representative of the sampled waste streams, and contained the following types of information: site-specific selection criteria for sampling; information about site operations; sampling point locations and sample collection, preservation, and transportation procedures; site contacts; and sampling schedules.

3.5.2 Information Collected

In addition to wastewater samples, EPA collected the following types of information during each sampling episode:

- Dates and times of sample collection;
- Flow data corresponding to each sample;
- Production data corresponding to each wastewater sample;
- Design and operating parameters for source reduction and treatment technologies characterized during sampling;
- Information about site operations that had changed since the site visit or that was not included in the site visit report; and
- Temperature and pH of the sampled wastewater streams.

EPA documented all data collected during sampling episodes in the Sampling Episode Report (SER) for each sampled site; these reports are contained in the Industrial Laundries Administrative Record. The sampling episode reports also contain preliminary technical analyses of treatment system performance.

3.5.3 Sample Collection and Analysis

All samples were collected, preserved, and transported according to EPA protocols as specified in EPA's Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants (7). This document is contained in the Industrial Laundries Administrative Record.

In general, EPA collected composite samples from the wastewater streams from laundering operations over the course of the operating day. Most facilities were sampled for a consecutive five-day period. For item-specific sampling, EPA collected wastewater samples from individual laundered loads during each discharge from the washer and composited the samples. EPA collected the required types of quality control samples as described in the Industrial Laundries Quality Assurance Project Plan (QAPP), such as blanks and duplicate samples, to verify the precision and accuracy of sample analyses.

EPA had samples shipped via overnight air transportation to EPA-approved laboratories, which analyzed the samples for metal and organic pollutants and additional parameters (including several water quality parameters). The laboratories analyzed metal pollutants using EPA Method 1620 (8), volatile organic pollutants using EPA Method 1624 (9), and semivolatile organic pollutants using EPA Method 1625 (10). Tables A-1 and A-2 in Appendix A of this document list the metal and organic pollutants, respectively, analyzed using these methods. The laboratories analyzed oil and grease and total petroleum hydrocarbon (TPH) using EPA Method 1664 (11), which is now promulgated at 40 CFR, Part 136. Method 1664 measures oil and grease as n-hexane extractable material (HEM) and measures TPH as silica gel treated-hexane extractable material (SGT-HEM[1]). Method 1664 may extract a different fraction of oil and grease and TPH than is extracted by the freon methods. The amount extracted by n-hexane and freon is dependent upon the composition of oils and grease in the samples. Sludge samples were analyzed using both the regular wastewater methods and the Toxicity Characteristic Leaching Procedure (TCLP), using SW-846, Method 1311 (12). Table A-3 in Appendix A of this document lists other parameters analyzed during the sampling program and the methods by which they were analyzed (13, 14).

Quality control (QC) measures used in performing all analyses complied with the guidelines specified in the analytical methods and in the QAPP. EPA reviewed all analytical data to ensure that these measures were followed and that the resulting data were within the QAPP-specified acceptance criteria for accuracy and precision.

As discussed previously, upon receipt and review of the analytical data for each site, EPA wrote a sampling episode report (SER) to document the sampling episode, the data collected during sampling, the analytical results, and the technical analyses of the results. The SERs include sampling and analysis plans and correspondence with site personnel as appendices.

[1]In Method 1664 (promulgated at 64 FR 26315; May 14, 1999), EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as TPH.

3.6 Summary of EPA's Method 1664 Characterization Study

In response to comments on the proposed rule, EPA conducted a characterization study of wastewater generated at industrial laundries to determine the specific constituents of oil and grease and TPH, measured using EPA Method 1664. EPA collected influent and effluent samples from six facilities that operate DAF or chemical precipitation, and were previously sampled by EPA.

Samples from the facilities were analyzed for volatile organics by Method 1624, semivolatile organics by Method 1625, and oil and grease and TPH by Method 1664. Two additional oil and grease/TPH aliquots were collected for the Method 1664 characterization study analysis. These aliquots were subjected to the Method 1664 oil and grease and TPH analytical protocols, and the oil and grease and TPH residues were subsequently dissolved in an appropriate solvent and analyzed for volatile organics by modified Method 1624 and semivolatile organics by modified Method 1625. These analyses allow for comparison between the organic constituents measured in the wastewater and the organic constituents of the fractions measured as oil and grease and TPH. The analytical protocols prepared by EPA's Sample Control Center (SCC) used in this characterization study are presented in The Study Plan for Determination of the Components of n-Hexane Extractable Material (HEM) and Silica Gel Treated n-Hexane Extractable Material (SGT-HEM; Non-polar Material) in Discharges from Selected Industrial Laundry Facilities (15).

All samples were collected, preserved, and transported according to EPA protocols as specified in EPA's Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants (7) and the Industrial Laundries QAPP. All samples were preserved on site and shipped via overnight air transportation to the EPA-approved laboratories.

Quality control (QC) measures used in performing all analyses complied with the guidelines specified in the analytical methods and in the QAPP. EPA reviewed all analytical data to ensure that these measures were followed and that the resulting data were within the QAPP-specified acceptance criteria for accuracy and precision.

The results and data collected during this study are presented in Chapter 5 of this document and Section 16.2 of the Industrial Laundries Administrative Record.

3.7 Other Industry-Supplied Data

The industrial laundry trade associations, the Uniform and Textile Service Association (UTSA), and the Textile Rental Services Association (TRSA), as well as individual laundries and other interested parties, submitted data to be used in the development of the proposed rule and in the final action.\

3.7.1 Data Submitted Prior to 1992

In 1977, TRSA sponsored a wastewater study of linen and industrial laundries. In addition to pH, this study analyzed wastewater for the following 10 pollutants: BOD_5, TSS, oil

and grease, lead, mercury, nickel, cadmium, zinc, total chromium, and TOC. The two-part study first analyzed untreated wastewater from 20 laundries and then analyzed untreated and treated wastewater from five laundries.

The first part of the study presented sampling and analytical data from 20 linen and industrial laundries. Samples were collected for untreated wastewater at 15-minute intervals during an 8- to 10-hour period and composited based on the flow rate at the time of sampling. The wastewater flow was calculated from process water meter readings and flow readings in the wastewater treatment system. The process water flows were used to calculate maximum pollutant loadings. These are maximum loadings because all of the water metered into the facility is not discharged as wastewater. The production-normalized pollutant loading level was based on the maximum pollutant loading level and the actual poundage of laundry produced on the sampling days. The types of items laundered on the sampling days were not reported; soil classification provided information on the soil loading only. Also, from the sampling point location information, it was difficult to determine the exact location of the sampling point and the source of wastewater sampled. In some cases, the untreated wastewater sampled may have passed through settling pits or screens before sampling.

The second part of the TRSA study presented data from five linen and industrial laundries. All of these laundries had treatment systems in place. Four facilities had DAF systems and one facility had a proprietary filter system. Sampling was conducted as described for the first part of the study, except that both untreated and treated wastewater samples were collected. Process water flows were used to calculate maximum pollutant loadings, and wastewater flows in the treatment system were used to calculate actual pollutant loadings. The production-normalized pollutant loading level was based on the maximum pollutant loading level and the average poundage of clean, dry laundry produced per week at the facility.

This study included information on the percentages of different types of items laundered at sampled laundries, although no information was provided on the types of articles laundered during the sampling days. Also, the descriptions of the sampling point locations were more extensive than those presented in the first part of the study. Diagrams of the wastewater treatment systems were provided and the operations of the treatment systems were discussed briefly. Several of the facilities sampled experienced difficulties with their treatment system during the sampling days. Also, unlike in the first part of the study, the production-normalized pollutant loading levels were based on average production levels instead of actual production levels.

3.7.2 Trade Associations Solicitation of Data

After the publication of the proposed rule, the industrial laundries trade associations, UTSA and the TRSA, solicited data from all of the facilities that were sent a detailed questionnaire. The purpose of the solicitation, as stated by UTSA and TRSA, was to provide EPA with updated data to calculate new baseline information on the industry, because the EPA questionnaire data are for the 1993 operating year.

The trade associations' solicitation requested the following information: the year the data were supplied, the average flow rate of wastewater, modifications to treatment system since 1993, the year modifications to treatment system occurred, a description of the current wastewater treatment system, the portion of the wastewater treated, the facility's discharge permit limits and the facility's average discharge concentration for 13 parameters, the weekly production of the facility, the average percentage of total pounds per item laundered, whether a subcontractor is used to process towels, the amount of towels subcontracted out for processing, whether the subcontractor water-washes or dry-cleans the towels, and whether the subcontractor's wash water from the laundering of the towels is treated.

Of the 193 facilities that EPA used to model compliance costs and pollutant loading reductions for the proposed rule, 165 responded to the UTSA/TRSA survey. EPA reviewed the data from the survey and compared, for each facility, the treatment system description contained in the UTSA/TRSA solicitation to the treatment system components reported in the detailed questionnaire.

3.7.3 Data Included with Comments on the Proposed Rulemaking and Notice of Data Availability

In response to the proposal published on December 17, 1997 and the NODA published on December 23, 1998, EPA received additional data from the industrial laundries in individual comment submittals. The data received included: industrial laundry effluent loadings, treatment technology costs, the constituents of TPH, data on the analytical variability of bis(2-ethylhexyl) phthalate, local limits for specific laundries, and POTW treatability of specific pollutants. Costs submitted by commenters included: general annual and capital costs for both chemical precipitation and DAF, the annual costs associated with treating 1,000 gallons of wastewater with DAF, analytical costs, the costs associated with the construction of a new building for an industrial laundry, and facility-specific cost information.

The industrial laundries industry and its trade associations also submitted reports and case studies. Reports and studies submitted by commenters ranged in content from data pertaining to the calculation of the toxic weighting factor for TPH to general economic and industry profiles for the industrial laundries industry.

These data are contained in Section 14 of the Industrial Laundries Administrative Record. Data submitted with comments and used by EPA as part of specific analyses are described in more detail in other sections of this document.

3.7.4 Request for Substantiation of Claims Made in Comments

Many of the commenters on the proposed rule stated that EPA underestimated compliance costs and that EPA overestimated the treatment performance of chemical precipitation and DAF. However, many commenters did not present data to substantiate these claims. Without additional data to support these claims, EPA would have to rely on data obtained prior to proposal (vendor quotes, previously submitted cost data and comment

submittals, and sampling data) and data acquired since proposal through EPA's data collection activities.

To obtain data to support unsubstantiated comments made on the proposed rule, EPA contacted some commenters directly to request additional information. EPA developed a set of four questions that requested specific information that would enable EPA to consider the commenter's information in development of the final action.

EPA requested the following information: a diagram presenting the facility's wastewater treatment system, including all treatment units, average and residual flows, chemical addition locations; a description of the facility's operations including total production and item-specific production, average operation days and hours per year; and specific wastewater treatment system capital and annual costs.

To comply with the Paperwork Reduction Act, EPA sent letters to nine of the commenters that submitted unsubstantiated comments. EPA selected commenters to receive letters based on the content of their comments, the number of comments submitted, whether or not the comment was a standard letter prepared by the trade associations, and the size of the firm. The methodology used to select these nine letter recipients and copies of the letters sent to each of them are presented in Section 14.6.1 of the Industrial Laundries Administrative Record. EPA also solicited comments from the public on these issues in the NODA.

3.7.5 The Trade Associations Split-Sampling Efforts

The industrial laundries trade associations split samples with EPA during one of the nine facility sampling episodes (Episode 4900) and several of the Method 1664 Characterization Study sampling episodes. The data collected by the industry during Episode 4900 were supplied to EPA in a comment submittal; these data are located in Section 14 of the Industrial Laundries Administrative Record. The industry did not supply EPA with the split sample data collected during the Method 1664 Characterization Study.

3.8 POTW Data

Several POTWs submitted data and comments that were used for the final action, and are discussed below.

3.8.1 AMSA Questionnaire

The Association of Metropolitan Sewerage Agencies (AMSA), in an effort to assist EPA in collecting data for the development of effluent limitations guidelines and standards for the industrial laundries industry, developed and distributed a questionnaire to its member POTWs in 1993. The questionnaire asked the POTWs to provide already collected data on industrial laundries, which were defined as facilities with the SIC code of 7218 (facilities that supply laundered and dry-cleaned work uniforms, wiping towels, safety equipment (such as gloves, flame-resistant clothing), dust covers and cloths, and other items to commercial and

industrial facilities). The questionnaire asked the POTWs for the following information about the industrial launderers that discharge to their facilities:

- Identify facilities that discharge to the POTW that do industrial laundering on a contract basis (outside of their normal business classification) that are not classified as an industrial laundry (i.e., hotels, hospitals, prisons, etc.);
- Identify whether facilities discharge directly or indirectly to the POTW;
- Specify what numerical discharge standards the POTW applies to industrial laundries (i.e., local limits, category-specific local limits, other limits); and
- Provide the following specific information for each industrial laundry that discharges to the POTW:
  - Industrial user information (facility location information, average daily wastewater discharge in gallons per day, and permit information);
  - Industrial discharge sampling information, including the following: whether the sample point contained only industrial laundry wastewater, and, if not, what other types of waste streams; whether the wastewater was treated prior to the sampling point; types of treatment used; and the types of pollution prevention techniques used at the facility; and
  - Sampling data for each sampling point (either POTW or Industrial User (IU) self-monitoring data) for calendar year 1992 (including parameter, measurement, type of sample, whether an EPA-approved method was used to analyze the sample, and, if not, what type of method was used).

Approximately 280 POTWs returned completed questionnaires. EPA analyzed the data included in the responses to the questionnaires and used the data to evaluate current local limits imposed on industrial laundries. The completed questionnaires are located in Section 6.6 of the Industrial Laundries Administrative Record.

3.8.2 Data Submittals Related to POTWs with Comments on the Proposed Rulemaking and Notice of Data Availability

EPA received comment submittals from numerous commenters pertaining to POTW data related to the pass-through analysis. These commenters included: individual POTWs, local control authorities, and AMSA, along with the industry's trade associations. Individual POTWs primarily provided data related to the following subjects: the method used to measure TPH, estimated POTW pollutant removal efficiencies, influent and effluent

concentration values to be used in the calculation of POTW pollutant removal efficiencies for the pass-through analysis, industrial laundry facility monitoring data, and local limits covering industrial laundries. These data and results of any evaluations of these data are contained in Sections 14 and 17 of the Industrial Laundries Administrative Record, respectively.

3.9 Summary of Literature Searches

EPA conducted several searches of the open literature throughout the development of the rule to provide information on the industrial laundries industry. The sources searched included the following:

- Journal articles and technology brochures (early 1970 through 1986);
- Census of Service Industries, Department of Commerce (1982);
- Computerized databases containing information on treatment technologies for industrial laundries (1986);
- Lists of industrial laundries from various on-line searching methods (1986); and
- POTW and State Water Quality Agency lists (1986).

EPA conducted additional literature searches in 1993 to gather publicly available information on the industrial laundries industry. EPA conducted one literature search to obtain information about industrial laundry wastewater, wastewater treatment technologies, operations, and costs of operations, and also a search to obtain information about printer towels/rags, wipers, and shop towels.

The literature searches focused on the following topics: waste streams, waste treatment technologies, operations, and costs of operation. The following databases were searched:

Database	Description
Water Resources Abstracts	Water resources topics
Waternet	Index of the American Water Works Association Publications
NTIS	Government-sponsored research, development, and engineering reports and analysis
COMPENDEX	Engineering and technology applications
ENVIRONLINE	Environmental Sciences

Database	Description
Pollution Abstracts	Pollution control and research
Books in Print	Books in print, forthcoming books, and books going out of print in the U.S.
LC Mark	Library of Congress catalogued publications
Textile Technology Digest	Worldwide coverage of textiles and related subjects
World Textiles	Textiles in areas of technology and management

As part of the literature search, EPA identified three trade journals important in the industrial laundries industry: Textile Rental, Industrial Launderer, and Laundry News. These journals provide up-to-date information on the industrial laundries industry. EPA conducted regular reviews of these journals during the development of this final action.

EPA conducted a separate literature search for data on pollution prevention in the industrial laundries industry by examining various on-line databases, including EPA's Pollution Prevention Information Exchange System (PIES).

3.10 Summary of Other Data Sources

In developing the industrial laundries effluent guidelines, EPA also evaluated the following existing data sources:

- The Office of Research and Development (ORD) Risk Reduction Engineering Laboratory (RREL) treatability database;
- The Fate of Priority Pollutants in Publicly Owned Treatment Works (50 POTW Study) database;
- The Domestic Sewage Study (DSS);
- Canadian studies; and
- Industrial Pollution Prevention Project.

These data sources and their uses in the development of the final action are discussed below.

3.10.1 Risk Reduction Engineering Laboratory Treatability Database

EPA's ORD developed the RREL treatability database to provide data on the removal and destruction of chemicals in various types of media, including water, soil, debris,

sludge, and sediment. This database contains treatability data from POTWs for various pollutants. This database includes physical and chemical data for each pollutant, the types of treatment used to treat the specific pollutants, the type of wastewater treated, the size of the POTW, and the treatment concentrations achieved. EPA used this database to assess POTW removal efficiencies of various pollutants.

3.10.2 Fate of Priority Pollutants in Publicly Owned Treatment Works Database

In September 1982, EPA published the Fate of Priority Pollutants in Publicly Owned Treatment Works (16), referred to as the 50 POTW Study. The purpose of this study was to generate, compile, and report data on the occurrence and fate of the 129 priority pollutants in 50 POTWs. The report presents all of the data collected, the results of preliminary evaluations of these data, and the results of calculations to determine the following:

- The quantity of priority pollutants in the influent to POTWs;
- The quantity of priority pollutants discharged from the POTWs;
- The quantity of priority pollutants in the effluent from intermediate process streams; and
- The quantity of priority pollutants in the POTW sludge streams.

EPA used the data from this study to assess POTW removal efficiencies of various pollutants.

3.10.3 The Domestic Sewage Study

In February 1986, EPA issued the Report to Congress on the Discharge of Hazardous Wastes to Publicly Owned Treatment Works (17), referred to as the Domestic Sewage Study (DSS). This report, which was based in part on the 50 POTW Study, demonstrated that a significant number of sites discharging pollutants to POTWs were a threat to the treatment capability of these POTWs and were not regulated by national categorical pretreatment standards. Among the unregulated sources were industrial laundries, which at the time were estimated to discharge significant quantities of toxic and hazardous pollutants on a facility-specific basis. During the course of the DSS, EPA contacted a number of state and local agencies to obtain toxic pollutant data and other relevant data. EPA used the information in the DSS in developing the Preliminary Data Summary for the Industrial Laundries Industry (1).

3.10.4 Canadian Studies

EPA studied other sources of data, as described below, to obtain as comprehensive a picture of the industrial laundries industry as possible. One of these sources was the Ministry of the Environment and Energy (MOEE) of Canada. As in the U.S., industrial laundries in Canada have been found to be a source of oil and grease in sewer systems. The MOEE's Municipal/Industrial Strategy for Abatement (MISA) section and the Ontario, Canada industrial laundry associations conducted a survey of Canadian industrial laundries to assess the

amount of oil and grease and other pollutants discharged into sewer systems. The survey was conducted to obtain an overview of the industrial laundries industry, sources of contamination, and treatment used to reduce the pollutant loads to sewers.

The laundries surveyed in this report included industrial laundries, linen establishments, and commercial launderers and excluded retail-only, coin-operated, dry cleaning, and health-care facilities. The industrial laundries processed industrial garments and wiper towels, which, according to this survey, were considered major sources of oil and grease. The survey showed that many industrial laundries in this study used some wastewater pretreatment; however, only four facilities used advanced pretreatment techniques, and several facilities did not pretreat their wastewater.

In addition, the Ontario Laundry Industry Pollution Prevention Task Force has been meeting regularly to discuss pollution prevention measures in the laundries industry and how to promote those practices. The Task Force consists of the following entities: the Ontario Ministry of Environment and Energy, the Metropolitan Area of Toronto, the City of Brantford, and several Canadian laundries, some of which represent the laundry associations Dry Cleaners and Launderers Institute (DCLI) and Textile Rental Institute of Canada (TRIO). In 1994, the Task Force held a workshop on pollution prevention in the laundries industry, which discussed pollution prevention in general, how using pollution prevention practices benefits industrial laundries, and approaches to and techniques for reducing waste in the industry.

3.10.5 Industrial Pollution Prevention Project

EPA has undertaken several pollution prevention-related activities involving the industrial laundries industry. Some of the efforts were Agency-wide, including ORD and EPA's Region IX, while other efforts were part of the engineering studies in the development of the proposed rule.

The Agency-wide efforts, called the Industrial Pollution Prevention Project (IP3), were multimedia and examined how industrial pollution prevention can be incorporated into EPA's regulatory framework and how the pollution prevention ethic can be promoted throughout industry, the public, and government. A report summarizing the results of these efforts, entitled Industrial Pollution Prevention Project (IP3) - Summary Report (18), included the results of two case studies involving industrial laundries. More detailed discussions of the two studies are contained in the individual reports, Pollution Prevention at Industrial Laundries: Assessment Observations and Waste Reduction Options (19), and Pollution Prevention at Industrial Laundries: A Collaborative Approach in Southern California (20). These studies identified a number of "best management practices" (BMPs) and water and energy savings technologies as potential pollution prevention at industrial laundries.

Similarly, during the engineering study phase of the development of a final action, EPA identified a number of potential pollution prevention practices and technology applications. Section VI of the preamble to the proposed rule and Chapters 6 and 8 of this document discuss the pollution prevention technologies and practices and their uses with respect to the final action.

3.11 References

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15. DynCorp Environmental. The Study Plan for Determination of the Components of n-Hexane Extractable Material (HEM) and Silica Gel Treated n-Hexane Extractable Materials (SGT-HEM: Non-polar Material) in Discharges from Selected Industrial Laundry Facilities. Prepared for the U.S. Environmental Protection Agency, Office of Water, Washington, D.C., July 1998.

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18. U.S. Environmental Protection Agency. Industrial Pollution Prevention Project (IP3)-Summary Report. EPA-820-R-95-007, July 1995.

19. U.S. Environmental Protection Agency. Pollution Prevention at Industrial Laundries: Assessment Observations and Waste Reduction Options. EPA-820-R-95-010, July 1995.

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CHAPTER 4

INDUSTRY PROFILE

4.1 Introduction

Chapter 4 discusses the processes, items, customers, chemicals, facilities and equipment, and pollution reduction activities found in the industrial laundries industry. This chapter also provides a definition of the industrial laundries industry. Most of the data presented in this chapter are from facility responses to the 1994 Industrial Laundries Industry Questionnaire (detailed questionnaire), additional data are from the 1993 Industrial Laundries Screener Questionnaire. EPA sent the detailed questionnaires to 250 facilities, and 231 facilities returned the questionnaire, as described in Section 3.3.2 of this document. Two hundred eight (208) facilities that responded to the detailed questionnaire provided sufficient data to perform complete technical and economic analyses. The percentages and number of facilities performing various processes discussed in this section were estimated based on the responses from all facilities determined to be industrial laundries. The data for these facilities were then extrapolated to represent the industry population of 1,747 facilities, using appropriate survey weights. The survey weights calculated for each of the facilities can be found in the Statistical Support Document for the proposed rule (1). Three facilities of the 193 identified industrial laundries were later determined to be out-of-scope because they process only clean room items (see Section 4.8). The following topics are discussed in this section:

- Section 4.2 discusses the geographic location, relative size, types of items laundered, customers, and Standard Industrial Classification (SIC) code distribution of facilities in the industrial laundries industry;
- Section 4.3 discusses general information on industrial laundering processes and chemicals used in the laundering processes;
- Section 4.4 discusses facilities and equipment used at industrial laundries;
- Section 4.5 presents pollution reduction activities;
- Section 4.6 discusses trends within the industry;
- Section 4.7 lists treatment technologies in use;
- Section 4.8 provides EPA's definition of the industry; and
- Section 4.9 presents the references used in this section.

4.2 Overview of the Industry

This section provides an overview of the industrial laundries industry. This overview includes general information pertaining to the industry, including geographic location, SIC codes, facility size, types of items laundered, and customers.

4.2.1 Geographic Distribution of Facilities

Information on geographic distribution was based on the 1993 Industrial Laundries Screener Questionnaire. This questionnaire was completed by 1,500 industrial laundries that EPA identified using trade association mailing lists. Since there were no direct discharging industrial laundries identified by the questionnaire responses, only industrial laundries that reported generating laundry process wastewater and discharging a wastewater to a publicly owned treatment works (POTW) were used to determine the geographic distribution of facilities. These facilities are located in all 50 states and in all 10 EPA Regions, as well as several U.S. territories. Figure 4-1 and Table 4-1 present the geographic distribution of these facilities. By state, the greatest number of in-scope laundries (102 facilities) are in California. By EPA region, the greatest number of in-scope laundries (203 facilities) are in Region V, followed by Region IV, which has 181 facilities. Most of the laundries are located in large urban areas.

4.2.2 SIC Codes Reported

The facilities responding to the detailed questionnaire reported 7218 (Industrial Laundries) and 7213 (Linen Supply Laundries) as their primary SIC codes. Other secondary and tertiary SIC codes reported were 7211 (Power Laundries, Family and Commercial), 7216 (Dry-cleaning Plants, except rug cleaning), and 7219 (Laundry and Garment Services, not elsewhere classified).

4.2.3 Facility Size

Industrial laundries vary in size from one- to two-person shops to large corporations that operate many facilities nationwide. For the purpose of this section, EPA based the relative size of each facility on the pounds of dirty (as-received) laundry washed per year.

Table 4-2 presents the national estimates of the number of industrial laundries by production category. Annual laundry production per facility ranges from 44,100 to 32,600,000 pounds and the total annual industry production is 9,360,000,000 pounds. Although there are a fewer percentage of large facilities exist (more than 15 million pounds/year (lbs/yr) production) than small facilities (less than 1 million lbs/yr production), the larger facilities represent a significant percentage of the total industry production. One hundred thirty-eight (138) facilities launder more than 15 million lbs/yr each. These facilities represent 8 percent of the facilities in the industry, but their combined production (2,660,000,000 lbs/yr) accounts for 28 percent of the total industry production. Facilities laundering less than 1 million lbs/yr represent 10 percent of the facilities in the industry and account for less than 1 percent of the total industry production.

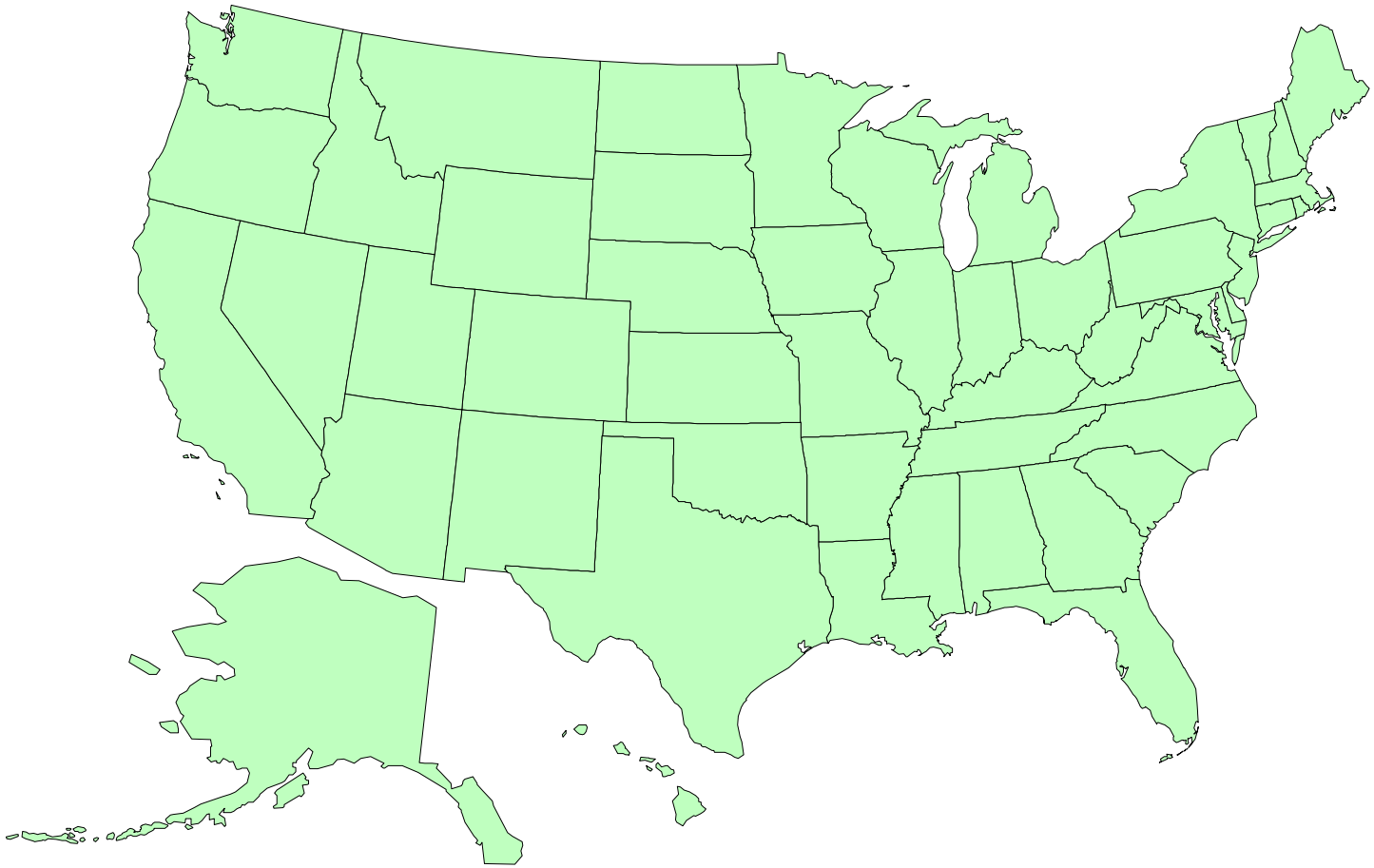

Figure 4-1. Geographic Distribution of Industrial Laundries

Table 4-1

Geographic Distribution of Industrial Laundries by EPA Region and State

Region/State	Number of Facilities in Region/State[1]
Region I	**55**
Connecticut	11
Maine	4
Massachusetts	29
New Hampshire	6
Rhode Island	4
Vermont	1
Region II	**72**
New Jersey	19
New York	51
Puerto Rico	2
Region III	**101**
Delaware	4
District of Columbia	3
Maryland	17
Pennsylvania	49
Virginia	21
West Virginia	7
Region IV	**181**
Alabama	14
Florida	42
Georgia	28
Kentucky	27
Mississippi	6
North Carolina	35
South Carolina	13
Tennessee	16
Region V	**203**
Illinois	42
Indiana	33
Michigan	36

Table 4-1 (Continued)

Region/State	Number of Facilities in Region/State[1]
Minnesota	17
Ohio	56
Wisconsin	19
Region VI	**131**
Arkansas	18
Louisiana	16
New Mexico	10
Oklahoma	15
Texas	72
Region VII	**57**
Iowa	14
Kansas	8
Missouri	24
Nebraska	11
Region VIII	**36**
Colorado	16
Montana	3
North Dakota	1
South Dakota	4
Utah	6
Wyoming	6
Region IX	**136**
Arizona	14
California	102
Guam	3
Hawaii	8
Nevada	9
Region X	**39**
Alaska	4
Idaho	8
Oregon	14
Washington	13

[1]Number of facilities is based on number of facilities identified by the 1993 Industrial Laundries Screener Questionnaire that reported generating laundry process wastewater and discharging that wastewater to a POTW.

Table 4-2

Industrial Laundry
Size Distribution

Production Category (lbs/yr)	Estimated Number of Facilities[1]	Estimated Percentage of Total Number of Facilities Reporting Production Data	Total Estimated Production for this Category (lbs/yr)	Estimated Percentage of Total Production
< 1,000,000	167	10	76,600,000	<1
1,000,000 to < 3,000,000	475	27	886,000,000	10
3,000,000 to < 6,000,000	629	36	2,740,000,000	29
6,000,000 to <9,000,000	199	11	1,390,000,000	15
9,000,000 to < 15,000,000	139	8	1,600,000,000	17
> 15,000,000	138	8	2,660,000,000	28
Total	1,747	100	9,360,000,000	100

[1]Number of facilities is estimated using the detailed questionnaire, based on 193 in-scope facilities extrapolated to represent the entire industry (including three facilities that were later determined to be out-of-scope because they process only clean room items).
Source: 1994 Industrial Laundries Industry Questionnaire.

4.2.4 Items Laundered

As reported by the 193 facilities, industrial laundries wash a variety of items. The three main types of items reported in the detailed questionnaire responses were industrial laundry items, linen laundry items, and other items. Typically, industrial laundry items include industrial garments, shop towels, printer towels, floor mats, and fender covers. Linen items typically include linen garments, flatwork/full dry linen, and health-care items. Other items are specialty items or items that are not generally considered to be either industrial laundry items or linen items. Brief descriptions of industrial laundry, linen items, and other items are provided in Chapter 5 of this document.

Table 4-3 presents the number of facilities that launder each item and the percentage of total production by item. Many facilities reported laundering several items. The total extrapolated item-specific production reported in the detailed questionnaire is 9,360,000,000 lbs/yr (calculated by summing the item-specific subtotals reported in the detailed questionnaire and extrapolating the data to represent the entire industry).

The detailed questionnaire requested production data for twelve specific items (questionnaire category codes B01 through B12), as listed on Table 4-3. EPA requested facilities to report any items laundered that did not fall in the B01 through B12 categories and place them in category B13 (Other Items). Based on item types and descriptions provided by the facilities, EPA created supplemental categories B14 through B24 for these "other" B13 items. Items that could not be classified in categories B14 through B24 remained in the B13 "other" category. Because the data for category codes B13 through B24 were collected through "write-in" responses rather than through pre-printed selections, EPA believes that the data for category codes B13 through B24 may not represent total industry production for the items identified in these categories.

4.2.5 Customers

Industrial laundries wash items for many different types of customers, ranging from gasoline stations to restaurants. The pollutants present on an item laundered depend primarily on the customer who used the item and the specific use of the item. For instance, a shop towel from a gasoline station is more likely to have a high concentration of oil and grease or total petroleum hydrocarbon than a napkin from a restaurant. Table 4-4 lists the laundered items reported in the detailed questionnaire responses, the typical customers using these items, and the percentage of the total industry production of each item laundered from each customer. For example, automobile repair, services, dealers, and gas stations represent 31.1 percent of the customers who use industrial garments.

Table 4-3

Types of Items Laundered

Item Type[1]	Estimated Number of Facilities Laundering Item	Estimated Percentage of Total Facilities	Estimated Percentage of Total Production[2]
Industrial Garments (B01)	1,441	82.5	24.4
Shop Towels, Industrial Wipers, etc. (B02)	1,332	76.2	3.7
Printer Towels (B03)	480	27.5	1.4
Floor Mats (B04)	1,644	94.1	19.3
Mops, Dust Cloths, Tool Covers, etc. (B05)[3]	1,400	80.1	1.3
Linen Garments (B06)	942	53.9	2.9
Linen Flatwork/Full Dry Linen (B07)	1,364	78.1	35.2
Health-Care Items (B08)	648	37.1	7.9
Fender Covers (B09)	687	39.3	<1
Continuous Roll Towels (B10)[3]	927	53.1	1.2
Clean Room Garments (B11)	28	1.6	<1
Clean Wipes (B12)	-	-	-
Other Items (B13)[4]	31	1.8	<1
Laundry Bags (B14)	28	1.6	<1
Family Laundry (B15)	84	4.8	<1
Absorbents (B16)	-	-	-
New Items (B17)	74	4.2	1.6
Executive Wear (B18)	43	2.5	<1
Miscellaneous Not Our Goods (NOG) (B19)	14	< 1	<1
Rewash Items (B20)	38	2.2	<1
Airline Carpet and Seat Covers (B22)	-	-	-
Filters (B23)	7	< 1	<1
Buffing Pads (B24)	6	<1	<1
Total	**-**	**-**	**100**

[1]The codes in parentheses are from the detailed questionnaire and were used in the questionnaire database.
[2]Total industry production is estimated based on data from the detailed questionnaire from the 193 in-scope facilities, extrapolated using appropriate survey weights to represent the entire industry (including three facilities that were later determined to be out-of-scope because they process only clean room items).
[3]One facility (with a survey weight of 1.3333) did not report production for this item; therefore, the estimated percentage of total production may be less than the actual amount processed.
[4]Includes items not specified in detailed questionnaire responses.
Source: 1994 Industrial Laundries Industry Questionnaire.

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Table 4-4

Typical Customers for Each Type of Item Laundered

Item Type[1]	Customers[1]	Percentage of Total Production of Item from Customer[2]
Industrial Garments (B01)	- Automobile Repair, Services, Dealers, Gasoline Stations (C01) - Special Trade Contractors for Building Construction (C02) - Dwellings and Other Building Services (C03) - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Chemicals and Allied Products Manufacturing (C05) - Transportation, Communication, Utility, and Sanitary Services (C07) - Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08)	31.1 10.2 5.49 17.2 9.65 10.5 11.1
Shop Towels, Industrial Wipers, etc. (B02)	- Automobile Repair, Services, Dealers, Gasoline Stations (C01) - Special Trade Contractors for Building Construction (C02) - Dwellings and Other Building Services (C03) - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Chemicals and Allied Products Manufacturing (C05) - Transportation, Communication, Utility, and Sanitary Services (C07)	48.1 6.74 5.14 19.6 7.52 6.12
Printer Towels (B03)	- Publishing and Printing Industries (C06) - Other Laundries (C20)	86.1 13.4
Floor Mats (B04)	- Automobile Repair, Services, Dealers, Gasoline Stations (C01) - Dwellings and Other Building Services (C03) - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Chemicals and Allied Products Manufacturing (C05) - Transportation, Communication, Utility, and Sanitary Services (C07) - Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08)	26.8 11.0 11.4 5.92 6.63 24.7
Mops, Dust Cloths, Tool Covers, etc. (B05)	- Automobile Repair, Services, Dealers, Gasoline Stations (C01) - Dwellings and Other Building Services (C03) - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Transportation, Communication, Utility, and Sanitary Services (C07) - Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08) - Health Services (C10)	15.4 23.1 8.17 7.37 20.2 7.46

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Table 4-4 (Continued)

Item Type[1]	Customers[1]	Percentage of Total Production of Item from Customer[2]
Linen Garments (B06)	- Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08)	91.1
Linen Flatwork/Full Dry (B07)	- Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08) - Hotel and Lodging Establishments (C09)	85.2 14.1
Health-Care Items (B08)	- Health Services (C10) - Customer Not Reported (C11)[3]	90.8 8.65
Fender Covers (B09)	- Automobile Repair, Services, Dealers, Gasoline Stations (C01) - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Transportation, Communication, Utility, and Sanitary Services (C07)	77.1 11.6 8.24
Continuous Roll Towels (B10)	- Automobile Repair, Services, Dealers, Gasoline Stations (C01) - Special Trade Contractors for Building Construction (C02) - Dwellings and Other Building Services (C03) - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Transportation, Communication, Utility, and Sanitary Services (C07) - Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08)	21.1 7.31 8.33 9.51 9.23 29.2
Clean Room Garments (B11)	- Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Chemicals and Allied Products Manufacturing (C05) - Customer Not Reported (C11)[3] - Electronics Industry (C18)	17.2 21.2 28.2 30.3
Laundry Bags (B14)	- Automobile Repair, Services, Dealers, Gasoline Stations (C01) - Special Trade Contractors for Building Construction (C02) - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Publishing and Printing Industries (C06) - Transportation, Communication, Utility, and Sanitary Services (C07) - Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08)	23.7 9.34 5.82 7.52 39.2 9.25
Family Laundry (B15)	- Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08) - Families (C23)	8.92 8.33 69.8

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Table 4-4 (Continued)

Item Type[1]	Customers[1]	Percentage of Total Production of Item from Customer[2]
Absorbents (B16)	- Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Publishing and Printing Industries (C06) - Retail/Wholesale Stores (C12) - Miscellaneous Service Industries (C15) - Agricultural Industry (C16) - Miscellaneous Manufacturing (C19)	13.2 6.79 19.3 19.9 5.61 16.8
New Items (B17)	- Retail/Wholesale Stores (C12) - Miscellaneous Manufacturing (C19) - Textile Manufacturing (C24)	31.8 27.2 41.0
Executive Wear (B18)	- Other Laundries (C20) - General Offices (C21) - Families (C23)	56.3 36.2 5.47
Miscellaneous Not Our Goods (NOG) (B19)	- Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08)	96.0
Rewash Items (B20)	- Transportation, Communication, Utility, and Sanitary Services (C07)	94.0
Filters (B23)	- Chemicals and Allied Products Manufacturing (C05) - Wood Product/Furniture Manufacturing (C14)	17.3 82.7
Buffing Pads (B24)	- Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08)	100

[1]The codes in parentheses are from the detailed questionnaire and were used in the questionnaire database.
[2]Customers representing less than 5 percent of the total production for an item are not shown in the table; therefore, the percentages may not add up to 100 percent for each item.
[3] Production data were provided for these items; however, the percentage of customers not reported by the facilities was greater than 5 percent.
Source: 1994 Industrial Laundries Industry Questionnaire.

4.3 Laundering Processes

For all laundering processes, the methods by which the items are received, sorted, and transported to the washing area are similar. Industrial laundries receive soiled items in trucks and weigh the items before washing. These items are typically sorted based on item type, fabric type, color, degree and/or type of soil, and ownership. Sorted items are then placed in slings or carts, which are either automatically or manually moved to the washing area. The items are then cleaned using the appropriate process.

Table 4-5 presents laundering processes reported by the facilities responding to the detailed questionnaire, as well as the percentage of total production laundered by each process and the number of facilities performing each process. Many facilities reported conducting more than one of the listed processes. One process included in Table 4-5, dyeing of new fabrics is not considered a laundering process by EPA. EPA reviewed laundry processes and associated water use and wastewater discharge practices to determine if facilities that used and/or discharged little or no water could be eliminated from the scope of the rule. Only water-washing laundering processes are included in the scope of the rule. EPA does not consider dyeing of new items to be a laundering process; therefore, it is also excluded from the scope of the proposed rule. Dyeing of used textile items such as shop and printer towels/rags, which is often performed as part of the washing process, is included in the scope of the rule. The remaining processes listed in Table 4-5 can be divided into two basic categories: processes that generate wastewater and processes that generate little or no wastewater. The individual processes within these categories are described in more detail below.

4.3.1 Water-Using/Wastewater-Generating Processes

Laundering processes that use significant amounts of water and generate wastewater include water-washing processes and dual-phase washing. Almost all (97 percent) of the industry's production involves water-washing processes. Of the 1,747 in-scope facilities (including three facilities that were later determined to be out-of-scope because they process only clean room items), EPA estimates that 1,443 perform water washing on 100 percent of their production. Water washing is performed on almost all items. Brief descriptions of the different water-using processes are provided below.

4.3.1.1 Water Washing

Water washing involves the washing of soiled items in a water/chemical solution. The concentration, type, and amount of chemicals added during the water-washing process depend on the item type and the degree to which items are soiled. Wash formulas are used to determine the different washing cycles used in water washing, including the chemicals added. Wash formulas are also used to set the order, number, and duration of each wash cycle that is performed during the water-washing process. The typical order of these cycles and brief descriptions of the processing operations that occur in each cycle are described below.

Table 4-5

Laundering Processes Reported in the Detailed Questionnaire

Process[1]	Estimated Number of Facilities Performing the Process	Estimated Percentage of Facilities Performing the Process	Estimated Percentage of Total Production[2]
Water Washing (A01)	1,725	99	97
Dual-Phase Washing - Petroleum solvent wash followed by water washing (A02)	18	1	<1
Dual-Phase Washing - Water wash followed by perchloroethylene solvent wash (A03)	0	0	0
Dry Cleaning - Charged system (A04)	125	7	<1
Dry Cleaning - Fresh soap added to each load (A05)	80	5	<1
Dry Cleaning - No soap added (A06)	80	5	<1
Dry Cleaning Followed by Water Washing (drying between steps) (A12)	29	2	<1
Dust Control Mop Treatment - Water wash followed by oil treatment applied outside wash wheel (A10)	692	40	1
Dust Control Mop Treatment - Water wash followed by oil treatment applied inside wash wheel (A11)	67	4	<1
Dust Control Mop Treatment- Water wash followed by unspecified oil treatment (A07)	22	1	<1
Dust Control Mop Treatment - Oil only (A08)	57	3	<1
Stone/Acid Washing of Denim (A13)	11	1	1
Dyeing (A14)[3]	1	<1	<1
Total	-	-	100

[1]The codes in parentheses are from the detailed questionnaire and were used in the questionnaire database.
[2]Percentages reported are estimated based on the 193 in-scope facilities (including three facilities that were later determined to be out-of-scope because they process only clean room items), extrapolated using appropriate survey weights to represent the entire industry.
[3]This process is not considered a laundering process by EPA.
Source: 1994 Industrial Laundries Industry Questionnaire.

In typical water-washing processes, the first cycle is the flush, which is defined as any rinsing operation prior to bleaching. This cycle removes loosely attached solids and a portion of the water-soluble soils. The next cycle is the break, during which items are treated with an alkali solution that swells the cellulosic fibers, allowing the soil to be more readily removed. Detergents may also be added during the break cycle. Sudsing occurs after the break cycle and is the cycle in which the actual washing of the items occurs. During sudsing, detergent is added in varying concentrations and the items are agitated until they are clean. After sudsing, a bleaching cycle may be performed, during which the detergent is replaced with a bleach solution and agitation continues. Following the sudsing and bleaching cycles, a rinsing cycle is typically performed, which removes the excess alkali and soap from the items. Additional chemicals are added in the blueing/brightening cycle to whiten/brighten the items. The final operation in water washing is the finish, which involves souring or acidifying the final bath water to a pH of 5, which prevents the yellowing of fabrics by sodium bicarbonate during pressing.

4.3.1.2 Dual-Phase Processing

Some facilities combine the water-washing and dry-cleaning processes to wash items that have large amounts of both organic-solvent-soluble and water-soluble soils. When these processes are performed in series, without drying the item between the solvent and water phases, the process is called dual-phase processing. The order in which these processes are carried out is determined by the solvent used, type of soil, and drying energy requirements. Dual-phase processing involving a petroleum solvent wash followed by water washing is used by only one percent of the industry. None of the facilities responding to the detailed questionnaire reported performing dual-phase processing involving water washing followed by solvent wash.

4.3.1.3 Water-Washing of Mops

This process entails first water washing mops and then applying oil to the mops by a sprayer either outside or inside the washer. This method of washing mops generates wastewater.

4.3.2 Processes with Minimal Wastewater Discharge

There are several laundering processes that generate minimal to no wastewater. Dry cleaning is a processes that generates minimal amounts of wastewater. Data from the detailed questionnaire indicate water use associated with dry cleaning typically ranges from zero gallons of process water per pound of laundry processed to 0.25 gallons of process water per pound of laundry processed. (Water use associated with water washing ranges between 1.5 and 3.6 gallons of process water per pound of laundry, for over 60 percent of the industry.) Dust control mop treatment using only oil is the only industrial laundry process that generates no wastewater. Each of the processes represents less than one percent of the total industry production and is described in more detail below.

4.3.2.1 Dry Cleaning

Dry cleaning involves the use of an organic solvent instead of an aqueous detergent solution to clean laundry items. Water washing of certain items causes hydrophilic fibers to swell and undergo dimensional changes, causing wrinkles and shrinkage that can be avoided by the use of dry-cleaning solvents. These solvents dissolve soils at low temperatures and under relatively mild conditions, unlike water washing, which usually involves high temperatures and the use of harsh chemicals, such as alkalis and bleaches. The primary solvents used by industrial laundries are perchloroethylene ("perc") and petroleum-based solvent. Because these solvents are typically expensive and are considered hazardous wastes, they are commonly recycled and reused in subsequent dry-cleaning loads. During dry cleaning, the solvent becomes contaminated with dirt, oil, and grease removed from the items processed. To minimize the solvent contamination, industrial laundries use multiple solvent rinses to process items. As with water washing, the first few rinses typically contain the most pollutants, and subsequent rinses become less contaminated.

The general process steps for dry cleaning are similar to those for water washing. The items may be washed and dried in the same unit or washed in one unit and manually transferred to a dryer. In the drying step, steam is injected into the unit to volatilize the solvent. The steam and solvent are captured in a condenser. The water/solvent mixture is transferred to a phase separator where the solvent and water are separated. The solvent is either reused or contract hauled off-site for disposal. The water is discharged to a POTW either with or without pretreatment. The three major methods of dry cleaning items at industrial laundries are listed below.

1) Charged system: A small percentage of water and detergent (between 0.5 percent and 4 percent) is added to the dry-cleaning solvent. The water and detergent concentration in the solvent is maintained throughout the washing processes by using conductivity meters to control the addition of water and detergent automatically.

2) Fresh soap added to each load: A given amount of soap or detergent is added at the beginning of each load; no additional detergent is added during the cleaning cycle. Because the process is not monitored as closely as the charged system, excess water, soap, and energy may be expended with this system.

3) No soap added: This method uses only a dry-cleaning solvent.

4.3.2.2 Oil Treatment of Dust Mops

At some facilities, dust mops are not water-washed but are cleaned and treated with heated oil instead of water. After cleaning, the oil is extracted from the mops, leaving them coated with the desired quantity of treatment oil. The dirty oil is then purified by filtration and is reused. This is a closed-loop processing system that uses no process water.

4.3.3 Chemicals Used in Industrial Laundries

Industrial laundries use a variety of chemicals in their laundering processes. Chemicals that are frequently added to wash formulas include:

- Alkaline solution - to swell the fibers in the items;
- Detergent - to remove soil from the items (including sodium hypochlorite and hydrogen peroxide);
- Bleach - to brighten the items (including sodium sulfites);
- Antichlor - to remove excess bleach from the items;
- Sour - to reduce the pH of the water to prevent yellowing of the items (including acetic acid and sodium silica fluorides);
- Softener - to soften the items; and
- Starch - to finish the items.

A variety of other chemicals are added to some wash formulas, including enzymes, builders, oil treatment chemicals, water conditioners, dyes, stain treatment chemicals, and bactericides.

Table 4-6 lists, based on the detailed questionnaire, the types of chemicals that are added during laundering operations, the number of facilities that add each chemical, the amount of each chemical added per year and the number of facilities that reported using the chemical but did not report the amount of the chemical used. Facilities that did not report chemical amounts were included in the number of facilities that added the chemicals, but they were not reflected in the amounts of chemicals added per year. As shown in Table 4-6, the two chemicals added most frequently to industrial laundering processes (besides detergent) are bleach and sour. The majority of the facilities (89 percent) use bleach as part of their laundering process. Eighty-one percent of the facilities use sour to prevent the yellowing of laundered items.

Some facilities reported using a chemical for more than one purpose. For these facilities, Table 4-6 includes only the primary purpose of the chemical. The amounts of mop oil treatment and dry cleaning solvents listed in Table 4-6 are lower than actual use because many respondents who reported conducting mop oil treatment or dry cleaning processes did not report the amounts of chemicals used in these processes.

Table 4-7 presents the average amount of detergent added per 1,000 pounds of laundry for the items laundered in the greatest amounts. Buffing pads, filters, shop towels, and printer towels require on average the highest amounts of detergent per pound of laundry, whereas health-care items and floor mats require significantly less detergent per pound of laundry.

4.4 Facilities and Equipment

Table 4-8 presents the history of industrial laundries construction and startup from before 1940 to 1995. Facility construction refers to the year the building that the facility operates in was built. Facility startup refers to the year that actual industrial laundry processing began. As shown in the table, construction of laundries has fluctuated to some degree over the years. In the 1940s, construction of facilities dipped, then rose in the 1960s, and has declined somewhat into

Table 4-6

Industrial Laundering Wash Formula Chemicals Reported in the Detailed Questionnaire

Type of Chemical	Estimated Number of Facilities Adding Chemical	Total Estimated Amount Added (gal/yr)[1]	Total Estimated Amount Added (lb/yr)[1]
Detergent	1,742	3,923,590	105,087,072
Bleach	1,562	5,603,861	3,768,844
Sour	1,419	639,586	4,942,014
Antichlor	1,059	200,546	2,144,738
Softener/Antistatic	990	329,038	1,074,365
Starch	972	198,754	8,741,770
Alkaline Solution	547	2,018,373	7,256,211
Mildewcide/Bactericide	533	81,304	955,824
Solvent-Based Detergent	470	530,513	0
Dye Products	436	46,127	456,012
Builder	275	851,861	1,962,176
Oil Treatment Chemical	258	1,552,455	33,314
Stain Treatment Chemical	157	3,879	124,059
Water Conditioner	141	53,920	1,467,531
Miscellaneous Others[2]	105	239,056	32,140
Solvent (Dry Cleaning)	116	244,278	0
Enzymes	55	861	42,160
Denim Treatment	9	23,018	12,874

[1]Some facilities reported using a specific type of chemical but did not provide the amount added per year. Therefore, the total amounts added per year do not necessarily represent the total industry chemical use. In the detailed questionnaire, facilities were given the choice of reporting the amount of a chemical in either pounds per year or gallons per year.
[2]This category includes chemicals such as pH adjustors, lubricants, fabric coatings, emulsifiers, dispersants, and desizers.
Source: 1994 Industrial Laundries Industry Questionnaire.

Table 4-7

Amounts of Detergent Added Per 1,000 Pounds of Laundry for Items Most Often Laundered

Item[1]	Average Gallons of Detergent Added per 1,000 Pounds of Laundry[2]	Average Pounds of Detergent Added per 1,000 Pounds of Laundry[2]
Industrial Garments (B01)	1.66	23.5
Shop Towels, Industrial Wipers, etc. (B02)	11.2	32.2
Printer Towels (B03)	23.7	35.5
Floor Mats (B04)	0.393	5.37
Mops, Dust Cloths, Tool Covers, etc. (B05)	2.59	21.3
Linen Garments (B06)	2.23	21.2
Linen Flatwork/Full Dry (B07)	1.77	22.8
Health-Care Items (B08)	0.575	8.98
Fender Covers (B09)	1.89	23.0
Continuous Roll Towels (B10)	1.23	14.2
Clean Room Garments (B11)	2.99	12.3
Other (B13)	0.500	---
Laundry Bags (B14)	---	20.2
Family Laundry (B15)	0.667	12.4
New Items (B17)	0.696	6.05
Executive Wear (B18)	1.36	8.65
Miscellaneous NOG (not our goods) (B19)	7.71	---
Rewash Items (B20)	---	31.4
Filters (B23)	---	48.6
Buffing Pads (B24)	48.9	---

[1]The codes in parentheses are from the detailed questionnaire and were used in the questionnaire database.
[2]Facilities were given the choice of reporting the amount of detergent in either pounds per year or gallons per year. These averages reflect the average amount of detergent added, for facilities/formulas that add either liquid detergent or powdered detergent, not a combination of the two.
Source: 1994 Industrial Laundries Industry Questionnaire.

Table 4-8

Age of Facilities and Startup of Laundry/Dry-Cleaning Operations (Estimated Percentage of Total Facilities in Each Time Period)

Time Period	Estimated Number of Facilities Constructed[1]	Estimated Number of Facilities Starting Laundry or Dry-Cleaning Operations
Before 1940	478 (27%)	385 (22%)
1940-1949	108 (6%)	107 (6%)
1950-1959	199 (11%)	192 (11%)
1960-1969	318 (18%)	365 (21%)
1970-1979	207 (12%)	247 (14%)
1980-1989	178 (10%)	274 (16%)
1990-1995	113 (6%)	164 (9%)
Not Specified	147 (8%)	14 (<1%)
Total[2]	1,747 (100%)	1,747 (100%)

[1]Percentages reported are estimated based on the 193 in-scope facilities, extrapolated using appropriate survey weights to represent the entire industry (including three facilities that were later determined to be out-of-scope because they process only clean room items).
[2]Totals may not equal 100% due to rounding.
Source: 1994 Industrial Laundries Industry Questionnaire.

the 1990s. The time periods for the start of laundering operations generally parallel the facility construction time periods.

Industrial laundries typically operate five days per week with one or two shifts per day. Based on information provided in responses to the detailed questionnaire, the average number of operating hours per day is 11 (the range is 5 to 24 hours) and the average number of operating days per year is 261 (the range is 203 to 365 days).

The types of laundering equipment used at these facilities include washing equipment, drying equipment, and finishing equipment. In addition, some facilities have machines specially designed to launder specific items, such as continuous roll towels, mats and rugs, and mops. The most common types of washing equipment used in the industry are washers, extractors, washer-extractors, tunnel washers, and dry-cleaning units; descriptions of these five equipment types are provided below.

4.4.1 Washers, Extractors, and Washer-Extractors

Washers in industrial laundries wash and rinse items without removing excess water. Extractors remove excess rinse water from items after laundering or, in some cases, remove excess liquids from dirty items. Some washers automatically deposit the wash load into adjacent extractors, but others must be emptied manually at the completion of the washing cycle and the laundry transferred into an extractor. Washer-extractors come equipped with an internal extractor where both the washing and extraction of excess liquids occurs in one machine.

Conventional washers used in industrial laundries can handle loads of 15 to 1,200 pounds, as reported by facilities responding to the detailed questionnaire. The average capacity reported by facilities in the detailed questionnaire is 421 pounds per load. A conventional washer consists of a perforated horizontal cylinder rotating in a shell. The cylinder is equipped with ribs that lift the items as the cylinder rotates and drops them back into the washing solution. Conventional washers are traditionally equipped with thermometers for temperature control, gauges for control of water levels, timers, and devices to reverse the direction of rotation every four or five revolutions.

4.4.2 Tunnel Washers

Tunnel washers are washers that operate in a continuous mode. In a tunnel washer, the items move forward through the washer by an “Archimedes screw” arrangement. Rinse water at the discharge end of the washer is recycled back to the first section of the washer. Water, steam, and laundry chemicals are mechanically injected into the washer, and, following washing, the load is moved by conveyer to extractors and dryers.

4.4.3 Dry-Cleaning Units

Dry-cleaning units are similar to those used in water washing, except that the fabrics are cleaned in an organic solvent instead of a detergent solution. Standard dry-cleaning equipment consists of a rotating cylinder in a stationary shell and one or more solvent storage

tanks, a filter system for cleaning the solvent as it is used, a solvent/water separator, distillation equipment for solvent purification, and often a device for recovering solvent vapors (a condenser or an activated carbon filter). The water separated from the solvent is discharged with other process wastewater.

4.4.4 Equipment Use and Age

Tables 4-9 and 4-10 present information on the types of laundry process equipment reported by industrial laundries and the age of this equipment, respectively. As shown in Table 4-9, 95 percent of the facilities have washer-extractors and 42 percent of the facilities own separate washers and extractors. Overall, separate washers and extractors are slightly older than washer-extractors. Facilities reported few tunnel washers and, of those reported, most were purchased in the 1980s or 1990s. Most of the dry-cleaning units reported were also purchased in the 1980s and 1990s. Table 4-10 indicates that, in 1993, 68 percent of all laundry equipment was reported to be 15 years old or less, even though only 16 percent of the facilities were built in the past 15 years and only 25 percent of the facilities started laundering operations in the past 15 years.

4.5 Pollution Reduction Activities

Based on the detailed questionnaire responses, extrapolated to represent the entire industry, 503 facilities have a written pollution reduction policy. Seven hundred forty (740) facilities of the 1,747 extrapolated facilities conduct pollution prevention activities prior to the laundering process (preprocess activities) and 473 of these facilities conduct pollution prevention activities during the laundering process (in-process activities).

Tables 4-11 and 4-12 list the types of preprocess and in-process pollution prevention activities, respectively, reported in responses to the detailed questionnaire. Chapter 6 of this document discusses these activities in greater detail. Although the detailed questionnaire specifically requested that wastewater treatment and water reuse/reduction information not be reported in response to these particular questions, several facilities provided this information. (Water reuse/reduction information was specifically requested by the detailed questionnaire in a different section and is discussed in greater detail in Chapter 5 of this document).

Table 4-11 shows that the preprocess pollution reduction activity that was performed by most facilities was the refusal of items with free liquids. These items are commonly shop towels and printer towels.

This industry has a potential to incorporate preprocess and in-process reduction practices such as the activities presented in Tables 4-11 and 4-12. In addition, industrial laundries have an opportunity to recycle/reuse water and conserve energy, helping to conserve natural resources and reduce the need for end-of-pipe treatment or disposal. However, the pollution reduction activities are so varied that identifying one set of BMPs to apply to all facilities is not practical.

Table 4-9

Types of Laundry Processing Equipment Reported in the Detailed Questionnaire

Type of Equipment[1]	Estimated Number of Facilities Reporting Equipment[2]	Estimated Percentage of Total Facilities Reporting Equipment
Washer-Extractors (D02)	1,668	95.5
Separate Washers (D01)	737	42.2
Separate Extractors (D03)	740	42.4
Dry-Cleaning Units (D04)	252	14.4
Tunnel Washers (D05)	39	2.23
Continuous Roll Towel (CRT) Washers (D07)	35	2.00
Closed-Loop Oil Washers (D08)	34	1.95
Other (Unspecified) (D06)	8	<1
Dip Tanks (D10)	6	<1
Mat/Rug Washers (D09)	0	0

[1]The codes in parentheses are from the detailed questionnaire and were used in the questionnaire database.
[2]Percentages and number of facilities reported are estimated based on the 193 in-scope facilities, extrapolated using appropriate survey weights to represent 1,747 facilities.
Source: 1994 Industrial Laundries Industry Questionnaire.

Table 4-10

Age of Laundry Processing Equipment Reported in the Detailed Questionnaire (Percentage of Equipment Type Installed in Each Time Period)

Time Period	Estimated Number of Units Installed										
	Washers	Washer-Extractors	Extractors	Dry-Cleaning Units	Tunnel Washers	CRT Washers	Closed-Loop Oil Washers	Mat/Rug Washers	Dip Tanks	Other (Unspecified)	Total
Before 1960	43 (1.3%)	0	22 (1.2%)	0	0	0	0	0	0	0	65 (<1%)
1960-1969	529 (15.4%)	114 (1.3%)	193 (10.7%)	18 (3.2%)	0	4 (10.8%)	11 (32.4%)	0	0	0	869 (6.0%)
1970-1979	1,323 (38.6%)	1,452 (16.9%)	341 (18.9%)	63 (11.3%)	0	14 (37.8%)	1 (2.9%)	0	0	8 (100%)	3,202 (22%)
1980-1989	924 (26.9%)	3,763 (43.7%)	857 (47.6%)	253 (45.4%)	28 (45.2%)	17 (45.9%)	22 (64.7%)	0	0	0	5,864 (40.3%)
1990-1995	524 (15.3%)	2,930 (34%)	347 (19.3%)	219 (39.3%)	34 (54.8%)	2 (5.4%)	0	0	0	0	4,056 (27.9%)
Not Specified	86 (2.5%)	357 (4.1%)	42 (2.3%)	4 (<1%)	0	0	0	0	6 (100%)	0	495 (3.4%)
Total[1]	3,429	8,616	1,802	557	62	37	34	0	6	8	14,551

[1]Totals may not equal 100 percent due to rounding.
Source: 1994 Industrial Laundries Industry Questionnaire.

Table 4-11

Preprocess Pollution Reduction Activities

Activity	Estimated Number of Facilities Performing Activity	Estimated Percentage of Total Number of Facilities Reporting Pre-Laundering Activities[1]
Items with Free Liquids Refused	447	26
Certain Items Refused	273	16
Miscellaneous Activities[2]	26	1
Items Centrifuged to Remove Liquids	6	<1
Items Sent to Another Site with Wastewater Treatment	67	4
Steam/Air Stripping of Volatile Organics from Items	2	<1
Items Dry-Cleaned Before Water Washing	24	1
Items Presorted to Remove Objects	32	2

[1]Percentages are estimated based on the 193 in-scope facilities extrapolated using appropriate survey weights to represent the entire industry.
[2]Miscellaneous activities include a combination of the specific activities listed in the table.
Source: 1994 Industrial Laundries Industry Questionnaire.

Table 4-12

In-Process Pollution Reduction Activities

Activity	Estimated Number of Facilities Performing Activity	Estimated Percentage of Total Number of Facilities Reporting In-Process Activities[1]
Change in Laundering/Dry-Cleaning Chemicals Used[2]	132	8
Liquid Injection System for Wash Chemical Addition[2]	109	6
Wastewater Treatment	79	4
Improved Housekeeping[2]	49	3
Improved Training of Employees[2]	149	8
Water Softening[2]	46	3
Equipment Modifications/Installations	43	2
Removal of Lint Before Air Venting to Atmosphere	26	1
Miscellaneous Activities[3]	25	1
Reduced Fuel Consumption	6	<1
Recycling of Laundry Materials	3	<1

[1]Percentages are estimated based on the 193 in-scope facilities extrapolated using appropriate survey weights to represent the entire industry.
[2]Data for these specific in-process pollution reduction activities were specifically requested in the detailed questionnaire.
[3]Miscellaneous activities include a combination of the specific activities listed in this table.

Source: 1994 Industrial Laundries Industry Questionnaire.

The detailed questionnaire requested data for five specific in-process pollution reduction activities. Facilities were requested to report any additional in-process pollution reduction activities; these activities were labeled as "other." Based on descriptions provided by the facilities, supplemental pollution prevention categories were then created for these "other" activities. Table 4-12 presents data for the five activities specified in the questionnaire, as well as for the remaining seven activities. According to responses to the detailed questionnaire, the facilities reporting pollution prevention activities are equally distributed through all production category sizes.

4.6 Trends in the Industry

Several business and operating trends are emerging in the industrial laundries industry, including changes in industrial laundry processes, facility size, and pollution reduction technologies. These trends are discussed in greater detail below.

4.6.1 Trend Away from Dry Cleaning

Based on information supplied by the industry and gathered by EPA on site visits, EPA has determined that many facilities are moving away from dry-cleaning because of the hazardous nature of the dry cleaning solvents and the expense of their disposal. Nineteen percent of the facilities responding to the detailed questionnaire reported owning dry-cleaning units. In addition, the largest percentage (45 percent) of dry-cleaning units was purchased in the 1980s; only 39 percent of all dry-cleaning units in operation today were purchased between 1990 and 1995, as shown in Table 4-10. The facilities that do operate dry cleaning units have moved away from perchlorethylene as a solvent and are now using petroleum-based solvents.

4.6.2 Trend of Small Facilities being Purchased by Larger Firms

In the past several years, there has been a trend toward large firms purchasing smaller firms. Larger firms realize an economy of scale in their operations and can often offer lower prices than smaller companies. Many smaller single-owner companies are finding it difficult to compete with the larger multi-facility firms due to the rising costs of both washroom and treatment equipment, the difficulty in raising capital, the utilization of new technologies, and the requirement of more professional management (2). Because of this increased difficulty to compete, these smaller facilities are being purchased by the larger firms.

There are many reasons that the larger firms are purchasing smaller facilities. One of the benefits of a large firm is that they have the capability to offer many specialized laundering services, (e.g., laundering of clean room items). In essence, the larger firms are more diversified and thus have the capability to process laundry and treat the wastewater generated from a variety of customers. A 1997 analysis showed that the largest five firms controlled about 55 percent of the market (2).

4.6.3 Trends in Equipment and Technologies

The industry as a whole is moving towards automation in the washing, drying, folding, and packaging of items laundered. This includes practices ranging from installing automatic detergent dispensers in the washers to purchasing washer-extractors instead of separate washers and extractors. Another trend is the installation of tunnel washers; these washers have a built-in "reuse cycle" where the final rinse water is automatically cycled back to the first rinse. The use of these washers lowers the average water used per pound of item laundered and thus saves the facilities money.

The preprocess pollution prevention activities reported by facilities responding to the detailed questionnaire were initiated primarily in the late 1980s to 1994. The trend within the industry appears to be to continue and increase pollution prevention activities. Some of these pollution prevention activities include the installation of more efficient washers and extractors, detergents that allow for lower wash temperatures and a lower pH for the removal of oils and grease from the items which may result in lower residual solids volume and less energy use. Chapter 6 of this document discusses pollution prevention practices in more detail.

4.7 Treatment Technologies in Use

The principal types of wastewater treatment reported by industrial laundries in the detailed questionnaire include gravity settling, screens, equalization/neutralization, air flotation, clarification, and oil/water separation. Chapter 6 of this document discusses wastewater treatment technologies used by the industry in greater detail.

4.8 Industry Definition

One of the steps in developing the proposed pretreatment standards and the final action for the industrial laundries industry was to define the scope of the industry. EPA reviewed data collected from responses to the detailed questionnaires, during site and sampling visits to industrial laundries, and in previous Agency efforts to regulate this industry to define the scope of the industry.

Initially, EPA reviewed laundry processes and associated water use and wastewater discharge practices to determine if facilities that used and/or discharged little or no water could be eliminated from the scope of the industry. Processes generating minimal or no wastewater would have little to no pollutants being discharged into the wastewater stream requiring control. Based on the data collected by EPA, 97 percent of all laundering performed by industrial laundries is water washing. As discussed in this Chapter and Chapter 5, industrial laundry treated by oil-only dust control mop treatment generates no wastewater. Therefore, EPA excluded oil-only dust control mop treatment from the scope of the industry. Industrial laundry treated by dry cleaning generates little wastewater (ranging from zero gallons per pound of laundry processed to 0.25 gallons per pound of laundry processed). Because this process generates an insignificant amount of wastewater, EPA excluded it from the scope of the industry. Only water-washing laundering processes are included in the scope of the industry. In addition, one facility reported dyeing of new items. EPA does not consider dyeing of new items to be a

laundering process; therefore, it is also excluded from the scope of the industry. Dyeing of used textile items such as shop and printer towels/rags, which is often performed as part of the washing process, is included in the scope of the industry.

EPA looked at the types of items that were water-washed to determine if any specific items should be excluded from the scope. EPA performed a statistical comparison of raw wastewater from facilities laundering primarily linen items and raw wastewater from facilities laundering primarily industrial laundry items. EPA also performed a statistical comparison of raw wastewater from facilities laundering primarily linen items and raw wastewater from facilities performing denim prewashing. A summary of the statistical comparison is presented below and a detailed discussion is presented in the Statistical Support Document (1).

Data from EPA's sampling program and the detailed monitoring questionnaire (DMQ) were used in comparing raw linen wastewater to raw industrial laundry wastewater. EPA used data from facilities processing between 60 and 99 percent linen items to represent raw linen wastewater; EPA did not have data available for facilities processing 100 percent linen items. EPA first performed a statistical analysis of the linen wastewater data and a statistical analysis of the industrial laundry wastewater data to determine whether the data were statistically different. If data for a pollutant were determined to be significantly different among the linen wastewater data or among the industrial laundry wastewater data, that pollutant was not included in the comparison. Based on this analysis, a comparison of linen wastewater data and industrial laundry wastewater data could be performed for eight pollutants. These pollutants and the results of the comparison are shown in Table 4-13. Table 4-13 shows that industrial laundry raw wastewater concentrations are significantly different from linen raw wastewater concentrations for all eight pollutants. Also, the industrial laundry wastewater mean concentration is consistently at a significantly higher value than the linen wastewater mean concentration for all eight pollutants. Although the linen facilities were processing less than 100 percent linen, EPA assumes that the results of the statistical comparison would be valid if these facilities were processing 100 percent linen items.

Data from EPA's sampling program, the DMQ, and data obtained from a site visit were used in comparing raw linen wastewater to raw denim prewash wastewater. Raw denim prewash wastewater data were available for only one facility. EPA performed a statistical analysis of the linen wastewater data to determine whether the data were statistically different. Based on this analysis, a comparison of linen wastewater data and denim prewash wastewater data could be performed for seven pollutants. These pollutants and the results of the comparison are shown on Table 4-14. Table 4-14 shows that raw linen wastewater concentrations are significantly higher than raw denim prewash wastewater concentrations for cadmium, chromium, and copper, but the concentrations are similar for the other five pollutants.

Based on the results of the statistical analyses and the relatively low pollutant concentrations found in linen and denim prewash wastewater, EPA decided to exclude linen and denim prewash items from the scope of the industrial laundries industry.

Table 4-13

Comparison of Linen Facility and Industrial Laundry Facility Mean Pollutant Log Concentrations

Analyte	Type of Facility	Sample Size	Mean log Concentration	Mean Concentration (mg/L)	P-value	Significant at a=0.01?
TPH (as SGT-HEM)	Industrial Laundry	30	6.05	425	0.0001	Yes
	Linen	5	2.64	14		
Oil and Grease (as HEM)	Industrial Laundry	8	7.18	1310	0.0012	Yes
	Linen	8	4.56	96		
Total Suspended Solids	Industrial Laundry	34	7.10	1206	<0.0001	Yes
	Linen	9	5.08	161		
Cadmium	Industrial Laundry	34	-2.66	.070	0.0001	Yes
	Linen	15	-4.33	.013		
Chromium	Industrial Laundry	34	-1.47	.230	<0.0001	Yes
	Linen	15	-3.19	.041		
Copper	Industrial Laundry	34	0.85	2.32	<0.0001	Yes
	Linen	15	-1.54	.21		
Iron	Industrial Laundry	34	3.23	25.2	<0.0001	Yes
	Linen	5	1.00	2.71		
Zinc	Industrial Laundry	34	1.47	4.16	<0.0001	Yes
	Linen	17	1.15	0.32		

Source: U.S. Environmental Protection Agency, Statistical Support Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category, EPA 821-R-97-006, Washington, DC, November 1997.

Table 4-14

Comparison of Linen Facility and Denim Prewash Facility Mean Pollutant Log Concentrations

Analyte	Type of Facility	Sample Size	Mean log (Conc)	Mean Concentration (mg/L)	p-value	Significant at a=0.01?
Oil and Grease (as HEM)	Linen	8	4.56	95	0.018	No
	Denim Prewash	7	2.96	19		
Total Suspended Solids	Linen	9	5.08	161	0.021	No
	Denim Prewash	15	6.15	470		
Cadmium	Linen	15	-4.33	0.013	0.0001	Yes
	Denim Prewash	13	-5.68	0.003		
Chromium	Linen	15	-3.19	0.04	0.0014	Yes
	Denim Prewash	13	-4.47	0.01		
Copper	Linen	15	-1.54	0.21	0.001	Yes
	Denim Prewash	13	-2.85	0.06		
Iron	Linen	5	1.00	2.71	0.027	No
	Denim Prewash	12	-0.69	0.50		
Zinc	Linen	17	-1.15	0.32	0.114	No
	Denim Prewash	8	-2.87	0.06		

Source: U.S. Environmental Protection Agency, Statistical Support Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category, EPA 821-R-97-006, Washington, DC, November 1997.

As part of comments on the proposed rule, EPA received data including wastewater monitoring data on clean room items. The term "clean room items" refers to specialty items used in particle- and static-free environments by computer manufacturing, pharmaceutical, biotechnology, aerospace, and other industrial customers. EPA evaluated the data and determined that the concentrations of pollutants found in clean room item wastewater were lower than the concentrations found in wastewater from most other items defined as industrial laundry items in the proposed rule, and the characteristics of the clean room wastewater were similar to linen wastewater. Thus, the data support the removal of clean room items from the definition of industrial textile items, which excludes laundering of clean room items from the scope of the industry. The clean room data are presented in Section 17 of the Industrial Laundries Administrative Record.

EPA also excluded on-site laundries from the applicability of the rule. The focus of the rulemaking effort was industrial laundries that function independently of other industrial activities that generate wastewater. EPA believes it is more appropriate to address on-site laundry discharges at industrial facilities as part of the effluent controls from the facility as a whole, for several reasons. First, many such facilities commingle laundry wastewater with wastewater from other processes. Second, EPA anticipates that contaminants removed from laundered items can best be treated with process wastewater containing similar contaminants. EPA has already established categorical effluent guidelines and standards for 51 industries, as listed in Appendix B of this document. These regulations generally apply to process-contaminated wastewaters generated from the facility operations, including on-site laundering. For example, the OCPSF effluent guidelines control discharges from garment laundering at OCPSF facilities. For industries not yet covered by effluent limitations guidelines and standards, EPA will examine these industries and their wastewater treatment processes in the context of the entire industrial facility, not just the laundering portion of the facility. Addressing on-site laundering discharges along with other industrial discharges in an industry allows EPA to examine all of the production and processing equipment used by the industry, all of the discharges in an industry, all the potential wastewater treatment applicable to the industry, and all of the economic impacts of any such national regulation for the industrial category (or subcategory) as a whole.

Based on these analyses, EPA developed the following definition of industrial laundries:

> An *industrial laundry* is any facility that launders industrial textile items from off site as a business activity (i.e., launders industrial textile items for other business entities for a fee or through a cooperative agreement). Either the industrial laundry or the off-site customer may own the industrial textile items. This definition includes textile rental companies that perform laundering operations. *Laundering* in this definition means washing with water, including water washing following dry cleaning. Laundering exclusively through dry cleaning and oil cleaning of mops in a process that does not use any water are not included in this definition of laundering, even if these operations are conducted by an industrial laundry. *Industrial textile* items include, but are not limited to: industrial shop towels, printer towels/rags, furniture towels, rags, uniforms, mops, mats, rugs,

tool covers, fender covers, dust-control items, gloves, buffing pads, absorbents, and filters. If any of these items are used at hotels, hospitals, or restaurants, they are not considered industrial items.

A facility that performs any laundering of industrial textile items is classified as an industrial laundry, even if the facility also performs activities that are not defined as industrial laundering. EPA does not include the following within the scope of the industrial laundries industry: on-site laundering at industrial facilities (e.g., a chemical manufacturer that washes employee uniforms on site), laundering of industrial textile items originating from the same business entity (e.g., a chain of auto repair shops that operates a central laundry for items from individual shops), and exclusively laundering linen items, clean room items, denim prewash items, new items (i.e., items directly from the textile manufacturer, not yet used for their intended purpose), hospital, hotel, and restaurant items or any combination of these items. However, EPA does consider hotels, hospitals, or restaurants to be within the scope of the industrial laundries industry if they launder industrial textile items originating from industrial facilities. Linen items are sheets, pillow cases, blankets, bath towels and washcloths, hospital gowns and robes, tablecloths, napkins, tableskirts, kitchen textile items, continuous roll towels, laboratory coats, household laundry (such as clothes, but not industrial uniforms), executive wear, mattress pads, incontinence pads, and diapers. EPA intends this to be an all-inclusive list of linen items.

4.9 References

1. U.S. Environmental Protection Agency. Statistical Support Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category. EPA-821-R-97-006, Washington, DC, November 1997.

2. K. Koepper. “Don’t Count Out More Public Company Acquisitions.” Industrial Launderer. August 1997: page 24.

CHAPTER 5

WATER USE, WASTEWATER CHARACTERIZATION, AND POLLUTANTS OF CONCERN

5.1 Introduction

This chapter discusses water use practices for the industrial laundries industry and presents raw wastewater characterization data for item-specific and total wastewater streams at industrial laundries. This chapter also presents pollutants analyzed and pollutants of concern for the industrial laundries industry. The water use data presented in this chapter are from 193 facilities responding to the 1994 Industrial Laundries Industry Questionnaire (detailed questionnaire) that were considered in scope for the proposed rule. These facilities include three clean room facilities that are out of scope for the final action (the industry definition is presented in Chapter 4 of this document). Where appropriate, these data have been extrapolated using statistically-derived survey weights to represent the entire industry. The wastewater characterization data presented in this chapter are from EPA sampling episodes and facility self monitoring data from the Detailed Monitoring Questionnaire (DMQ).

The remainder of this chapter is presented as follows:

- Section 5.2 discusses the sources of industrial laundry service water and the uses of service water within the industry;
- Section 5.3 discusses wastewater volume by type of discharge;
- Section 5.4 discusses water conservation measures implemented by some industrial laundries;
- Section 5.5 discusses the pollutants analyzed in industrial laundry wastewater;
- Section 5.6 identifies the pollutants of concern for the industrial laundries industry;
- Section 5.7 discusses characterization of raw wastewater by item laundered;
- Section 5.8 discusses characterization of total, heavy, and light raw wastewater streams; and
- Section 5.9 presents the characterization of EPA Method 1664 constituents.
- Section 5.10 presents the references used in this chapter.

5.2 Sources of Service Water and Water Use

This section provides information on sources of service water and water use breakdown as reported by industrial laundries responding to the detailed questionnaire.

5.2.1 Sources of Service Water at Industrial Laundries

Service water in the industrial laundries industry refers to any water used at a facility, ranging from sanitary water to laundry process water. The primary source of service water at industrial laundries is a water authority or municipal source. Well water is also used as service water at some facilities. None of the industrial laundries that responded to the detailed questionnaire reported surface water as the direct intake source of their service water. Table 5-1 presents the sources of service water for the industrial laundries industry; these data have been extrapolated to represent the entire industry.

5.2.2 Use of Service Water at Industrial Laundries

Industrial laundries use service water for a variety of purposes. Table 5-2 presents the various uses of service water, the number of facilities reporting each use, and the percentage of the total industry service water represented by each use. These amounts are based on the first use of the service water. Water recycle/reuse is not included in Table 5-2. Table 5-2 is based on available data from the detailed questionnaire extrapolated to represent the entire industrial laundries industry.

Laundry Process Water Use

The majority of service water is used for laundry processes. As discussed in Chapter 4 of this document, the laundering processes that use water and generate wastewater include:

- Water washing;
- Dual-phase washing; and
- Dust control mop treatment (water washing of mops followed by oil treatment).

Facilities use varying amounts of laundry process water per pound of laundry processed due to the following factors:

- Type of items laundered;
- Customers;
- Soil loading on items;
- Laundering chemicals used in wash formulas; and
- Laundry processing equipment used.

Table 5-1

Service Water Sources

Service Water Source	Estimated Number of Facilities By Source[1]	Estimated Percentage of Total Facilities By Source
Water Authority/Municipal Source Only	1,572	90
Private Well Only	1	< 1
Water Authority/Municipal Source and Private Well	174	10
Surface Water (Directly)	0	0
Total	**1,747**	**100**

[1]Based on responses to the detailed questionnaire from the 193 facilities that were in scope for the proposed rule (including three clean room facilities determined to be out of scope for the final action), extrapolated to represent the entire industrial laundries industry.
Source: 1994 Industrial Laundries Industry Questionnaire.

Table 5-2

Service Water Use

Service Water Use	Estimated Number of Facilities By Use[1]	Estimated Percentage of Total Service Water By Use
Laundry Process Water	1,745	92.1
Sanitary Water	1,670	3.1
Floor/Equipment Washing	956	<1
Boiler Water	599	1.8
Vehicle Washing	584	<1
Noncontact Cooling Water	490	1.4
Water Softener Regeneration Water	94	<1
Other Uses Not Reported	72	<1
Wastewater Treatment	37	<1
Air Conditioning	26	<1
Landscaping	25	<1
Dish Washing	22	<1
Irrigation	1	<1
Total	-	**100**

[1]Number of facilities reporting water use is based on the responses to the detailed questionnaire from 193 facilities that were in scope for the proposed rule (including three clean room facilities determined to be out of scope for the final action), extrapolated to represent the entire industrial laundries industry. The number of facilities reporting each service water use is based on the first use of the service water; recycle/reuse is not included in Table 5-2. One facility reported using service water first as noncontact cooling water, then as process water. This facility has a survey weight of 2.

Source: 1994 Industrial Laundries Industry Questionnaire.

The amount of process water used at a facility is most directly related to the quantity of items laundered. Figure 5-1 shows the distribution of facilities by amount of laundry process water used per pound of laundry processed. Water used in laundry processing comprises the service water that is allocated to laundry processing, the process water that is reused before and/or after wastewater treatment, and the water from other processes that is reused as laundry process water (e.g., noncontact cooling water). This water use was normalized to account for all laundry production from processes that generate wastewater. The average amount of wastewater discharged per pound of laundry processed is 2.74 gallons per pound. Over 86 percent of the industry uses between 1 and 4 gallons of process water per pound of laundry that is water-washed.

Water use is also related to type of item laundered. An analysis of item-specific water use per pound of laundry processed (gal/lb) was conducted using data from facility responses to the detailed questionnaire. Table 5-3 presents the item-specific water use in gallons of water per pound of laundry (gal/lb) by process. These amounts were calculated from information provided in the wash formulas reported by facilities in the detailed questionnaire. For most items, EPA calculated a median water use ranging from 2.40 to 3.30 gal/lb. Denim prewashing of new items requires the highest use of water with a median value of 5.40 gal/lb. Water washing of buffing pads requires the least amount of water (0.50 gal/lb), but this amount is based on information from only one facility.

Other Industrial Laundry Water Uses

Although most of the incoming service water used at industrial laundries (92.1 percent) is used as laundry process water, there are a number of other service water uses, as presented in Table 5-2. After laundry process water, sanitary water accounts for the second largest amount (3.1 percent) of total service water used at industrial laundries. Boiler water accounts for the third most significant use of service water (1.8 percent), followed by noncontact cooling water (1.4 percent). Noncontact cooling water includes water used in evaporative coolers and other heat exchangers. Approximately 95 percent of the facilities that reported noncontact cooling water use recycle their noncontact cooling water. In many instances, the recycled water is used as laundry process water. Other uses of service water at industrial laundries include vehicle washing, floor/equipment washing, and water used in wastewater treatment systems. These uses each represent less than one percent of the total service water used at industrial laundry facilities.

5.3 Wastewater Volume by Type of Discharge

All of the 193 facilities responding to the detailed questionnaire were considered in scope for the proposed rule. None of the facilities reported discharging laundry process wastewater or noncontact cooling water directly to surface water. Residual wastewater found in the sludge and oil wastes generated during wastewater pretreatment is also not discharged directly, but disposed of off site or land applied. Table 5-4 presents process wastewater discharge practices reported by the facilities that responded to the detailed questionnaire.

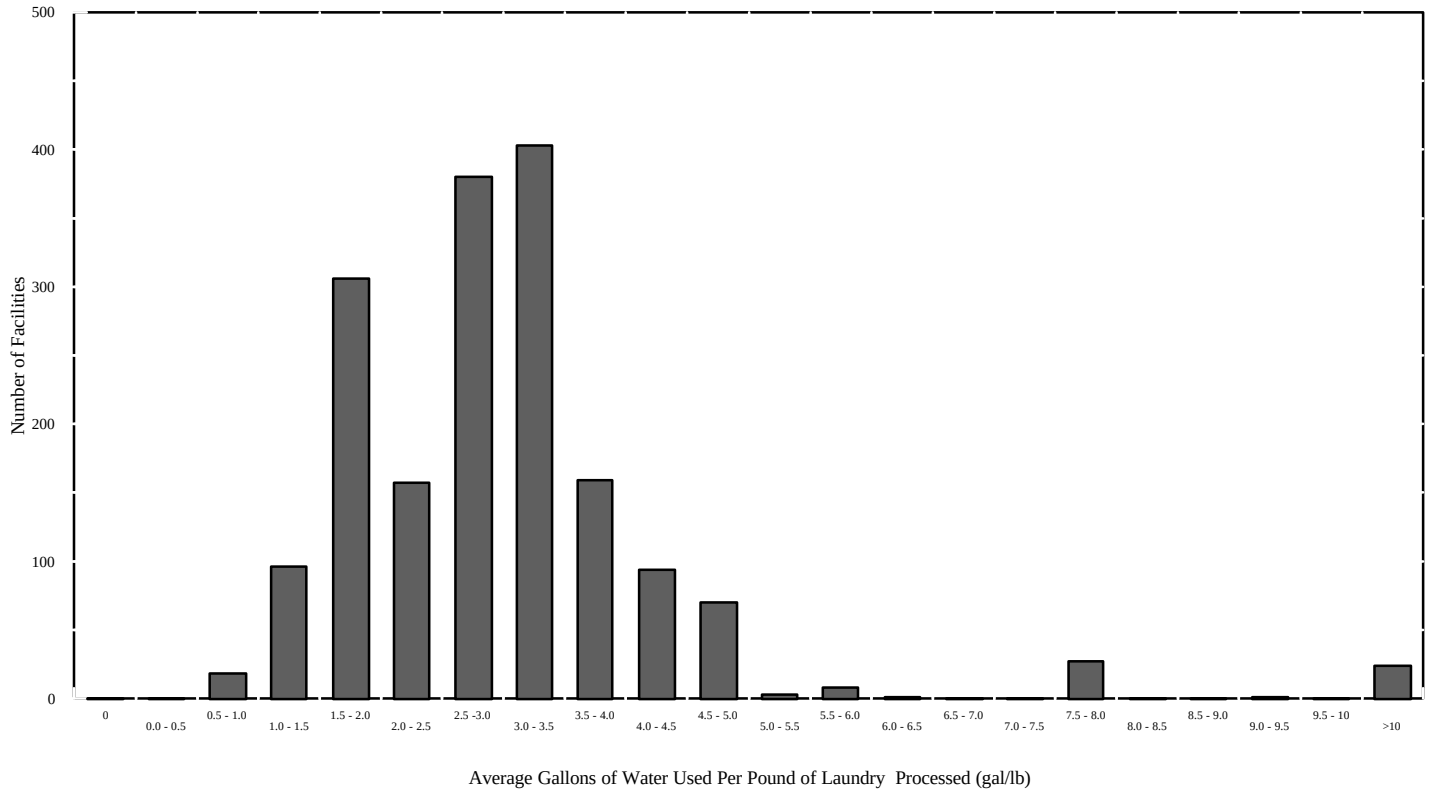

Figure 5-1. Distribution of Facilities by Production-Normalized Laundry Process Water Use[1]

[1]Based on responses to the detailed questionnaire from the 193 facilities that were in scope for the proposed rule (including three clean room facilities determined to be out of scope for the final action), extrapolated to represent the entire industrial laundries industry.

Table 5-3

Item-Specific Water Use[1]

Item[2]	Process[3]	Mean (gal/lb)	Median (gal/lb)	Standard Deviation (gal/lb)	Estimated Number of Facilities in Calculations
Industrial Garments (B01)	A01	2.66	2.40	1.47	148
	A02	3.73	2.80	2.46	3
Shop Towels (B02)	A01	4.18	3.10	8.73	126
Printer Towels (B03)	A01	4.12	3.60	2.32	65
	A02	3.70	3.80	0.29	3
Floor Mats (B04)	A01	1.87	1.60	0.98	163
	A02	2.10	2.10	---	1
Mops, Dust Cloths, Tool Covers, etc. (B05)	A01	3.00	2.80	1.57	83
	A07	3.03	2.90	1.58	45
Linen Supply Garments (B06)	A01	3.51	3.30	1.62	99
Linen Flatwork/Full Dry (B07)	A01	3.03	2.80	1.34	121
Health-Care Items (B08)	A01	2.53	2.40	1.02	67
Fender Covers (B09)	A01	3.55	2.70	3.65	65
Continuous Roll Towels (B10)	A01	2.88	2.40	4.32	79
Clean Room Garments (B11)	A01	2.93	3.00	0.52	9
Other (B13)	A01	4.00	4.00	---	1
Laundry Bags (B14)	A01	1.45	1.45	0.45	2
Family Laundry (B15)	A01	3.35	3.05	1.28	6

Table 5-3 (Continued)

Item[2]	Process[3]	Mean (gal/lb)	Median (gal/lb)	Standard Deviation (gal/lb)	Estimated Number of Facilities in Calculations
New Items (B17)	A01	3.00	2.75	1.17	6
	A13	5.63	5.40	1.76	3
Executive Wear (B18)	A01	4.74	2.90	4.67	5
Miscellaneous NOG (Not Our Goods) (B19)	A01	3.00	3.00	---	1
Rewashed Items (B20)	A01	2.18	2.10	0.77	5
Filters (B23)	A01	4.20	4.20	1.20	2
Buffing Pads (B24)	A01	0.50	0.50	---	1

[1] The process/item gallon-per-pound ratios were calculated from water-washing formula data provided in Table C of the detailed questionnaire. This analysis was performed using data from 193 facilities that were in scope for the proposed rule (including three clean room facilities determined to be out of scope for the final action); the data were not extrapolated to represent the entire industry. The ratios for each formula at a facility were calculated and the ratios were averaged for each item/process combination at individual facilities. The number of times the formula was used per day was taken into account. The facility-specific ratios were then used to calculate an industry mean and median gallon/pound ratio for each item/process combination. There were no usable data to calculate the water use requirements for absorbents, clean wipes, or airline carpet and seat covers.

[2] The codes in parentheses reflect the item codes used in the detailed questionnaire.

[3] Process codes used in the detailed questionnaire:

A01 - Water Washing
A02 - Dual Phase Washing: Petroleum solvent wash followed by water washing
A07 - Dust Control Mop Treatment: Water washing followed by oil treatment
A13 - Denim Prewash.

Source: 1994 Industrial Laundries Industry Questionnaire.

Table 5-4

Discharge Practices of Industrial Laundries[1]

Discharge Practice	Estimated Number of Facilities Discharging Laundry Process Wastewater (Percent of Facilities)	Estimated Number of Facilities Discharging Noncontact Cooling Water (Percent of Facilities)
Discharge to POTW	1,747 (100%)	313 (18%)
Off-Site Disposal	221 (13%)	0 (0%)
Land Application	84 (5%)	0 (0%)
Discharge to Surface Water	0 (0%)	0 (0%)

[1]Based on responses to the detailed questionnaire from 193 facilities that were in scope for the proposed rule (including three clean room facilities that were determined to be out of scope for the final action), extrapolated to represent the entire industrial laundries industry.
Source: 1994 Industrial Laundries Industry Questionnaire

Figure 5-2 shows the distribution of facilities by amount of laundry process wastewater discharged per pound of laundry processed. The total wastewater discharged comprises the laundry process wastewater that is discharged to a POTW, the laundry process wastewater that is land applied, and the laundry process wastewater that is shipped off site for disposal. This calculated wastewater discharge was normalized for all laundry production from processes that generate wastewater. Over 60 percent of the facilities discharge between 1.5 and 3.5 gallons of process wastewater per pound of laundry that is water-washed.

A comparison of the values in Figures 5-1 and 5-2 shows that more laundry process water is used than is discharged. This difference is due to evaporation losses and laundry process wastewater recycle/reuse before and after wastewater treatment. (The average evaporation loss reported by facilities in the detailed questionnaire was approximately 10 percent. For 81 percent of the facilities, the difference between laundry process water use and discharge is less than 0.5 gal/lb. Most of the reported amounts of laundry process wastewater discharged are estimates; less than 15 percent of the facilities measure the amount of wastewater that is discharged at their facilities.

5.4 Water Conservation Measures

Approximately 85 percent of the facilities that responded to the detailed questionnaire reported performing some type of water conservation practice. Table 5-5 presents activities that were reported as standard water conservation techniques at industrial laundries. Table 5-5 also presents the reported water use reduction due to implementation of these conservation practices. As shown in the table, prompt attention to faulty equipment, leaks, and other problems is practiced by the greatest number of laundries, followed by routine monitoring of water use. Chapter 6 provides additional information on wastewater recycle/reuse.

5.5 Pollutants Analyzed in Industrial Laundry Wastewater

EPA collected data to determine the conventional, priority, and nonconventional pollutants to be regulated for the industrial laundries proposed rule. Conventional pollutant parameters are defined in section 304(a)(4) of the Clean Water Act (CWA) and in 40 CFR Part 401.16 and include biochemical oxygen demand (BOD_5), total suspended solids (TSS), total recoverable oil and grease, pH, and fecal coliform. These pollutants are subject to regulation as specified in sections 301(b)(2)(E) and 304(b)(4)(B) of the CWA. Toxic or priority pollutants are defined in section 307(a)(1) of the CWA. The list of priority pollutants, presented in Table C-1 in Appendix C of this document, consists of 126 specific pollutants listed in 40 CFR Part 423, Appendix A. Sections 301(b)(2)(C) and 304(b)(2)(B) of the CWA authorize EPA to regulate priority pollutants. Nonconventional pollutants are those that are neither priority pollutants or conventional pollutants. Sections 301(b)(2)(F), 301(g), and 304(b)(2)(B) of the CWA give EPA the authority to regulate nonconventional pollutants.

EPA considered four conventional, 98 priority, and 213 nonconventional organic, metal, and elemental pollutant parameters for potential control for the industrial laundries industry. Three hundred twelve (312) of these pollutants are listed in The Industrial

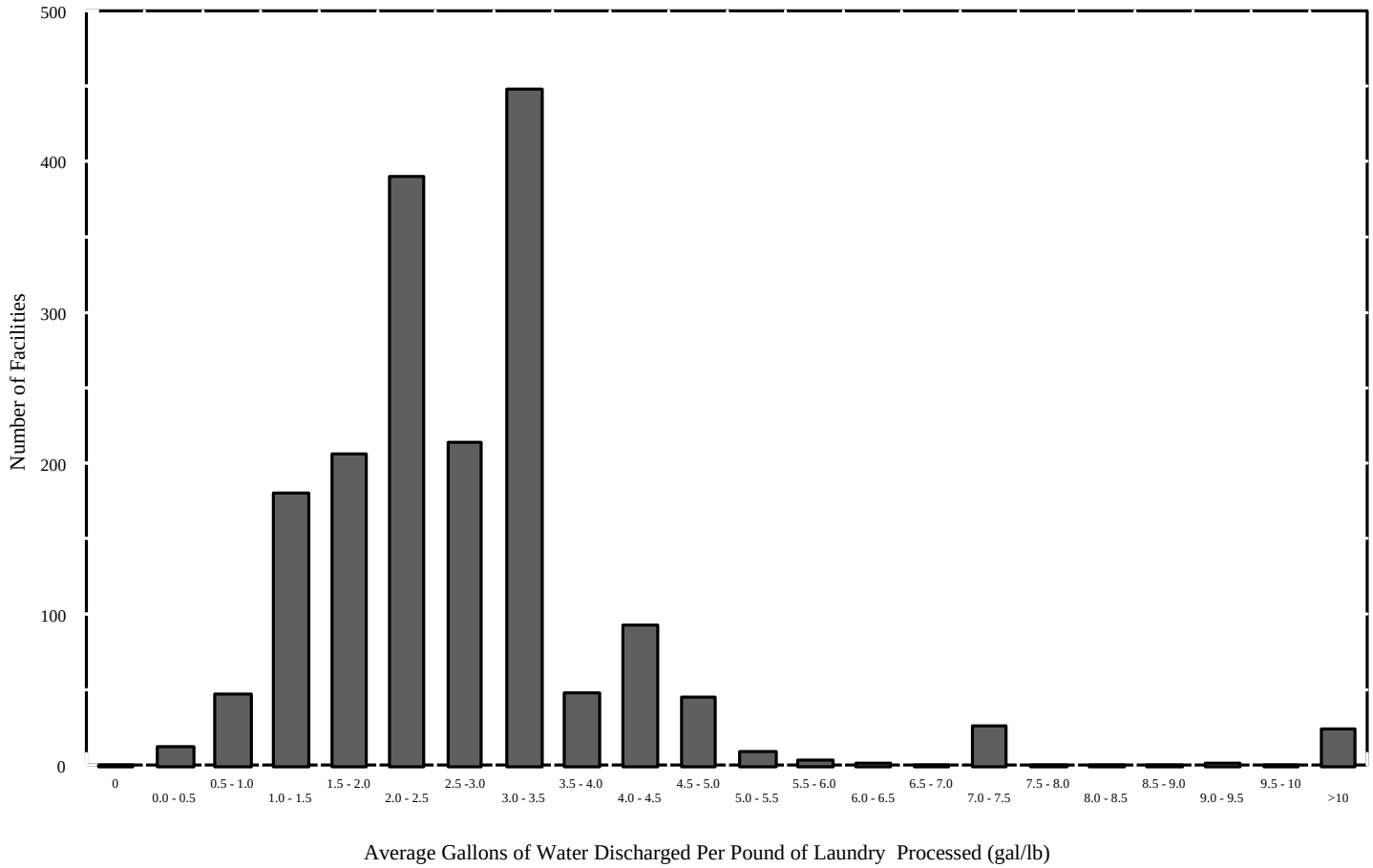

Figure 5-2. Distribution of Facilities by Production-Normalized Laundry Process Wastewater Discharge[1]

[1]Based on responses to the detailed questionnaire from the 193 facilities that were in scope for the proposed rule (including three clean room facilities determined to be out of scope for the final action), extrapolated to represent the entire industrial laundries industry.

Table 5-5

Water Conservation Practices and Water Use Reduction

Water Conservation Practice	Water Reduction Range (gal/day)	Estimated Number of Facilities With This Practice[1]	Percentage of Total Facilities With This Practice[1]
Prompt Attention to Faulty Equipment, Leaks, and Other Problems	0 - 25,000	1,180	68%
Routine Monitoring of Water Use	0 - 57,693	996	57%
Installation of Laundering Equipment That Uses Less Water	16 - 165,000	266	15%
Implementation of Alternative Laundry Wash Formulas That Require Less Water	6 - 26,000	261	15%
Reuse of Noncontact Cooling Water as Process Makeup Water	150 - 31,623	246	14%
Recycling/Reuse of Laundry Wastewater Before Treatment	60 - 53,000	155	9%
Implementation of Alternative Production Processes That Require Less Water	82 - 20,000	44	2%
Other Practices	200 - 6,000	19	1%
Installation of Automatic Monitoring and Alarm Systems on In-plant Discharges	500 - 7,985	17	1%
Recycle/Reuse of Laundry Wastewater After Treatment	3,000 - 29,000	13	1%
Reuse of Nonlaundry Wastewater as Laundry Process Water	8,967	4	<1%

[1]Based on responses to the detailed questionnaire from 193 facilities that were in scope for the proposed rule, extrapolated to represent entire industry.

Source: 1994 Industrial Laundries Industry Questionnaire.

Technology Division List of Analytes, which was derived from the List of Lists (1). Three pollutants not on this list were also considered for regulation. EPA analyzed industrial laundry wastewater for these 315 pollutants during the industrial laundries sampling program, which is discussed in Chapter 3 of this document. Table C-2 in Appendix C lists the 315 pollutants analyzed by EPA in industrial laundry wastewater during this sampling program. EPA used data collected from seven industrial laundries during the period of 1993-1996 for selecting pollutants of concern.

EPA used EPA Method 1664 to analyze oil and grease and total petroleum hydrocarbons because the other approved methods (EPA Methods 413.1, 413.2, and 415.1) use freon, which is being phased out of use in EPA's CWA and RCRA programs. Method 1664 measures oil and grease as hexane extractable material (HEM) and measures TPH as silica gel treated hexane extractable material (SGT-HEM)[2].

Several conventional and priority pollutants were not considered for regulation for the industrial laundries industry based on the following: information collected during the 1985-1987 industrial laundries sampling program, described in Chapter 3; information collected from the Detailed Monitoring Questionnaire (DMQ), described in Chapter 3; and EPA's knowledge of industrial laundry wastewater. The DMQ was sent to 37 facilities selected from respondents to the 1994 Industrial Laundries Industry Questionnaire. The DMQ recipients submitted monitoring data collected at their facility during 1993.

EPA did not consider the following conventional and priority pollutants for regulation for the industrial laundries industry:

- Fecal coliform;
- Asbestos;
- 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD);
- Twenty-five (25) pesticides and PCBs (pollutants 89 through 113 on Table C-1 in Appendix C); and
- Cyanide.

EPA does not expect fecal coliform bacteria to be present in industrial laundry wastewaters because the laundering chemicals added to laundry process water and the temperature of the water will likely destroy fecal coliform that may have been present on laundered items.

[2]In Method 1664 (promulgated at 64 FR 263125 on May 14, 1999), EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Record, EPA refers to SGT-HEM as TPH.

EPA does not expect asbestos to be present in industrial laundry wastewaters because it is not expected to be present on items laundered by industrial laundries or generated during the washing process.

EPA does not expect dioxins and furans, including 2,3,7,8-TCDD, to be present on industrial laundry items and EPA does not expect dioxins and furans to be formed during industrial laundry processes. Dioxins and furans were not detected in available industrial laundry wastewater samples collected during three sampling episodes during the 1985-1987 sampling program (dioxins and furans were not analyzed for during the other two episodes). One facility responding to the DMQ questionnaire submitted data for 2,3,7,8-TCDD; this compound was not detected at the facility. A review of POTW permits for 92 industrial laundries indicated that none of the permits includes limits for dioxins and furans.

EPA did not consider PCBs for regulation because PCBs were not detected in available industrial laundry wastewater samples from four sampling episodes during the 1985-1987 sampling program (PCBs were not analyzed for during one other episode). Four facilities responding to the DMQ submitted data for up to seven PCBs; PCBs were not detected at any of the four facilities. A review of publicly owned treatment works (POTW) permits for 92 industrial laundries indicated that only one of the permits includes limits for PCBs.

EPA did not consider any pesticides for regulation because most of the priority pollutant pesticides were detected in less than 10 percent of available industrial laundry wastewater samples and the presence of pesticides in industrial laundry wastewater is a site-specific issue related to a particular customer base. Pesticides are best addressed through case-by-case review of specific circumstances rather than a national regulation. Industrial laundry wastewater was analyzed for pesticides at four facilities during the 1985-1987 sampling program. In addition, 10 DMQ facilities submitted pesticide data. Of the 18 priority pollutant pesticides, the following three pesticides were detected in 10 percent or greater of industrial laundry wastewater samples:

- Heptachlor (10 percent);
- delta-BHC (14 percent); and
- Endosulfan sulfate (14 percent).

Heptachlor was detected at 2 facilities (sampled at 14 facilities), delta-BHC was detected at 2 facilities (sampled at 11 facilities), and endosulfan sulfate was detected at 4 facilities (sampled at 11 facilities). Endosulfan sulfate and dieldrin were the only priority pollutant pesticides detected at concentrations greater than 0.1 mg/L, and detections at these concentrations occurred at only one facility of 11 facilities sampled for each pesticide. Also, review of POTW permits for 92 industrial laundries indicated that only one of the permits includes limits for pesticides.

EPA did not consider cyanide for regulation because cyanide was detected at most facilities at insignificant concentrations. Cyanide was analyzed at five facilities during the 1985-1987 sampling program, and 16 DMQ facilities submitted cyanide data. Only two of these facilities reported detected concentrations of cyanide greater than 1 mg/L and only one of these

facilities had an average detected concentration greater than 1 mg/L. Cyanide was not detected at five facilities, and cyanide was detected at average concentrations of less than 0.1 mg/L at eight facilities. The maximum contaminant level for cyanide, as established in the National Primary Drinking Water Regulations (40 CFR Part 141), is 0.2 mg/L, as free cyanide. Only one DMQ facility reported an average cyanide concentration greater than 0.2 mg/L. This facility did not report the analytical method used. Two facilities from the 1985-1987 sampling program had average cyanide concentrations greater than 0.2 mg/L, but these concentrations were measured as total cyanide.

5.6 Identification of Pollutants of Concern

In assessing the 315 pollutant parameters analyzed during the 1993-1996 industrial laundries sampling program, EPA used the following criteria to identify pollutant parameters of concern. EPA reduced the list of 315 pollutants to 72 pollutants for further consideration using the following criteria:

- Pollutants never detected in any samples collected during seven sampling episodes during the 1993-1996 industrial laundries sampling program. Table 5-6 lists the 175 pollutants meeting this criterion.

- Pollutants detected in less than 10 percent of samples collected during seven sampling episodes during the 1993-1996 industrial laundries sampling program. Table 5-7 lists the 50 pollutants meeting this criterion.

- Pollutants identified during screening, but not quantified due to a lack of an acceptable analytical method. EPA used analytical Method 1620 (ICP) to quantitate certain metals and elemental pollutants. Eight metal and elemental pollutants that were detected in industrial laundry samples greater than 10 percent of the time were not analyzed in a quantitative manner. Analyses for these pollutants were not subject to the quality assurance/quality control (QA/QC) procedures required by analytical Method 1620. These results were used for screening purposes only and the metals and elements detected were excluded from the pollutants of concern because they are not quantified. Table 5-8 lists these metal pollutants.

- Pollutants detected in source water at comparable concentrations to industrial laundry raw wastewater. Three nonconventional metal pollutants (calcium, magnesium, and sodium) were excluded because EPA believes that these pollutants are not present in industrial laundry wastewater at significant levels.

Table 5-6

Pollutants Not Detected in Any Samples Analyzed during the 1993-1996 Industrial Laundries Sampling Program

Pollutant	Class Code	Pollutant	Class Code
Acenaphthene	TXO	Vinyl Chloride	TXO
Acenaphthylene	TXO	1,1,2-Trichloroethane	TXO
Anthracene	TXO	1,2-Dichlorobenzene	TXO
Benzidine	TXO	1,2-Dichloropropane	TXO
Benzo(a)anthracene	TXO	1,2,4-Trichlorobenzene	TXO
Benzo(a)pyrene	TXO	1,3-Dichlorobenzene	TXO
Benzo(b)fluoranthene	TXO	1,4-Dichlorobenzene	TXO
Benzo(ghi)perylene	TXO	2-Chloronaphthalene	TXO
Benzo(k)fluoranthene	TXO	2,4-Dinitrotoluene	TXO
Bis(2-chloroisopropyl)ether	TXO	3,3'-Dichlorobenzidine	TXO
Bromomethane	TXO	4-Bromophenyl Phenyl Ether	TXO
Chloroethane	TXO	4-Chlorophenylphenyl Ether	TXO
Chloromethane	TXO	Aniline, 2,4,5-Trimethyl	NCO
Chrysene	TXO	Aramite	NCO
Di-n-propylnitrosamine	TXO	Benzanthrone	NCO
Dibenzo(a,h)anthracene	TXO	Benzenethiol	NCO
Fluoranthene	TXO	Benzonitrile, 3,5-dibromo-4-hydroxy-	NCO
Fluorene	TXO	Beta-Naphthylamine	NCO
Hexachlorobenzene	TXO	Biphenyl, 4-Nitro	NCO
Hexachlorobutadiene	TXO	Carbazole	NCO
Hexachlorocyclopentadiene	TXO	Carbon Disulfide	NCO
Hexachloroethane	TXO	Chloroacetonitrile	NCO
Indeno(1,2,3-cd)pyrene	TXO	cis-1,3-Dichloropropene	NCO
N-Nitrosodimethylamine	TXO	Crotonaldehyde	NCO
Nitrobenzene	TXO	Crotoxyphos	NCO
Pyrene	TXO	Dibenzothiophene	NCO
Tribromomethane	TXO	Dibromomethane	NCO
Diethyl Ether	NCO	Phenacetin	NCO
Diphenyldisulfide	NCO	Phenothiazine	NCO

Table 5-6 (Continued)

Pollutant	Class Code	Pollutant	Class Code
Ethane, Pentachloro-	NCO	Pronamide	NCO
Ethyl Cyanide	NCO	Pyridine	NCO
Ethyl Methacrylate	NCO	Resorcinol	NCO
Ethyl Methanesulfonate	NCO	Squalene	NCO
Ethylenethiourea	NCO	Thianaphthene	NCO
Hexachloropropene	NCO	Thioacetamide	NCO
Iodomethane	NCO	Thioxanthe-9-one	NCO
Isosafrole	NCO	Toluene, 2,4-diamino	NCO
Longifolene	NCO	Trans-1,4-dichloro-2-butene	NCO
Malachite Green	NCO	Triphenylene	NCO
Mestranol	NCO	Vinyl Acetate	NCO
Methapyrilene	NCO	1-Bromo-2-chlorobenzene	NCO
Methyl Methanesulfonate	NCO	1-Bromo-3-chlorobenzene	NCO
N-Nitrosodi-N-butylamine	NCO	1-Chloro-3-nitrobenzene	NCO
N-Nitrosodiethylamine	NCO	1-Naphthylamine	NCO
N-Nitrosomethylethylamine	NCO	1-Phenylnaphthalene	NCO
N-Nitrosomethylphenylamine	NCO	1,1,1,2-Tetrachloroethane	NCO
N-Nitrosopiperidine	NCO	1,2-Dibromo-3-chloropropane	NCO
N,N-Dimethylformamide	NCO	1,2-Dibromoethane	NCO
o-Anisidine	NCO	1,2,3-Trichlorobenzene	NCO
o-Toluidine	NCO	1,2,3-Trichloropropane	NCO
o-Toluidine, 5-Chloro-	NCO	1,2,3-Trimethoxybenzene	NCO
p-Chloroaniline	NCO	1,2,4,5-Tetrachlorobenzene	NCO
p-Dimethylaminoazobenzene	NCO	1,2,3,4-Diepoxybutane	NCO
p-Nitroaniline	NCO	1,3-Butadiene, 2-Chloro	NCO
Pentachlorobenzene	NCO	1,3-Dichloro-2-propanol	NCO
Perylene	NCO	1,3-Dichloropropane	NCO
1,3,5-Trithiane	NCO	Bismuth	NCM
1,4-Dinitrobenzene	NCO	Cerium	NCM
1,4-Naphthoquinone	NCO	Dysprosium	NCM
1,5-Naphthalenediamine	NCO	Erbium	NCM
2-(Methylthio)benzothiazole	NCO	Europium	NCM

Table 5-6 (Continued)

Pollutant	Class Code	Pollutant	Class Code
2-Isopropylnaphthalene	NCO	Gadolinium	NCM
2-Methylbenzothioazole	NCO	Gallium	NCM
2-Nitroaniline	NCO	Germanium	NCM
2-Phenylnaphthalene	NCO	Gold	NCM
2-Picoline	NCO	Hafnium	NCM
2-Propen-1-ol	NCO	Holmium	NCM
2-Propenenitrile, 2-Methyl-	NCO	Indium	NCM
2,3-Benzofluorene	NCO	Lanthanum	NCM
2,3-Dichloronitrobenzene	NCO	Lutetium	NCM
2,3,4,6-Tetrachlorophenol	NCO	Neodymium	NCM
2,6-Di-tert-butyl-p-benzoquinone	NCO	Niobium	NCM
2,6-Dichloro-4-nitroaniline	NCO	Osmium	NCM
2,6-Dichlorophenol	NCO	Palladium	NCM
3-Chloropropene	NCO	Platinum	NCM
3-Methylcholanthrene	NCO	Praseodymium	NCM
3-Nitroaniline	NCO	Rhenium	NCM
3,3'-Dimethoxybenzidine	NCO	Rhodium	NCM
3,6-Dimethylphenanthrene	NCO	Ruthenium	NCM
4-Aminobiphenyl	NCO	Samarium	NCM
4-Chloro-2-nitroaniline	NCO	Scandium	NCM
4,4'-Methylenebis(2-chloroaniline)	NCO	Tantalum	NCM
4,5-Methylene Phenanthrene	NCO	Tellurium	NCM
5-Nitro-o-toluidine	NCO	Terbium	NCM
7,12-Dimethylbenz(a)anthracene	NCO	Thorium	NCM
Thulium	NCM	Ytterbium	NCM
Tungsten	NCM	Zirconium	NCM
Uranium	NCM		

NCM - Nonconventional metal or element.
NCO - Nonconventional organic.
TXO - Toxic organic.

Table 5-7

Pollutants Detected in Less Than 10 Percent of Samples Analyzed During the 1993-1996 Industrial Laundries Sampling Program

Priority Organics	Nonconventional Organics
Acrylonitrile	Acetophenone
Benzene	Aniline
Bis(2-chloroethoxy)methane	Biphenyl
Bis (2-chloroethyl)ether	Dibenzofuran
Bromodichloromethane	2,3-Dichloroaniline
2-Chloroethylvinyl ether	Dimethyl sulfone
2-Chlorophenol	1,4-Dioxane
Dibromochloromethane	Diphenylamine
1.1-Dichloroethane	Diphenyl ether
1,2-Dichloroethane	2-Hexanone
1,1-Dichloroethene	Isobutyl alcohol
2,4-Dichlorophenol	1-Methylfluorene
Diethyl phthalate	1-Methylphenanthrene
2,4-Dimethylphenol	Methyl methacrylate
Dimethyl phthalate	N-Nitrosomorpholine
2,4-Dinitrophenol	o-Cresol
2,6-Dinitrotoluene	Safrole
2-Nitrophenol	Styrene
4-Nitrophenol	Trichlorofluoromethane
N-Nitrosodiphenylamine	2,3,6-Trichlorophenol
Pentachlorophenol	2,4,5-Trichlorophenol
Phenanthrene	Tripropyleneglycol methyl ether
Phenol,2-Methyl-4,6-Dinitro-	
2-Propenal	
1,1,2,2-Tetrachloroethane	
Tetrachloromethane	
Trans-1,3-Dichloropropene	
2,4,6-Trichlorophenol	

Table 5-8

Semiquantitative Metal and Elemental Pollutants Excluded from the Pollutants of Concern for the Industrial Laundries Industry

Nonconventional Metals and Elements
Iodine
Iridium
Lithium
Phosphorus
Potassium
Silicon
Strontium
Sulfur

- Pollutants likely to be regulated on a case-by-case basis by POTWs. The following six pollutants were eliminated from the pollutant-of-concern list:

  – pH: this pollutant is typically regulated as necessary by POTWs. pH is not considered for national regulation for the industrial laundries industry.

  – Total orthophosphate, total phosphorous, and total hydrolyzable phosphate: Table 5-9 presents the average influent concentrations, effluent concentrations, and percent removals for these pollutants by both the dissolved air flotation (DAF) and chemical precipitation treatment technologies (based on six sampling episodes between 1993-1998). These pollutants were not considered for national regulation for the industrial laundries industry since they would be removed incidentally by the DAF and chemical precipitation treatment technologies.

  – Surfactants (nonionic (CTAS) and anionic (MBAS)): Table 5-9 presents the average influent concentrations, effluent concentrations, and percent removals for these pollutants by both the dissolved air flotation and chemical precipitation treatment technologies (based on six sampling episodes between 1993-1998). These pollutants were analyzed to evaluate the effect of emulsions on treatment technologies for the industrial laundries industry. Surfactants are not considered for national regulation for the industrial laundries industry since they would be removed incidentally by the DAF and chemical precipitation treatment technologies.

In addition to the pollutants above, EPA eliminated total solids from further consideration. Total solids is a measure of total dissolved solids and total suspended solids. Industrial laundry wastewater contains both total suspended solids and total solids. Because the measurement of total solids includes total suspended solids and because the treatment technologies under consideration as the bases of the regulation are designed to remove the total suspended solids but not the dissolved solids, EPA eliminated total solids from further consideration.

Of the 315 pollutants considered for regulation, 72 were identified as pollutant parameters of concern, including 31 priority pollutants (18 organic pollutants and 13 metal and elemental pollutants), three conventional pollutants, and 38 nonconventional pollutants (24 organic pollutants, 11 metal and elemental pollutants, and three other nonconventional pollutants). Table 5-10 presents these 72 pollutants, along with the number of times each pollutant was analyzed and detected in untreated industrial laundry wastewater, and the corresponding mean, minimum, and maximum concentrations based on data collected between 1993 and 1996 (seven facilities).

Table 5-9

Average Influent Concentrations, Effluent Concentrations, and Removals for Phosphorous and Surfactants by Chemical Precipitation or Dissolved Air Flotation Technologies

Pollutant	Average Influent (mg/L)	Average Effluent (mg/L)	Average Percent Removal
Chemical Precipitation			
Total Hydrolyzable Phosphorous	75.6	9.43	88
Total Orthophosphate	2.80	1.70	39
Total Phosphorous	30.8	6.83	78
Surfactants (anionic)	12.0	6.23	48
Surfactants (nonionic)	149	116	22
Dissolved Air Flotation			
Total Hydrolyzable Phosphorous	10.8	5.15	52
Total Orthophosphate	6.88	2.95	57
Total Phosphorous	21.4	8.94	58
Surfactants (anionic)	7.64	0.818	89
Surfactants (nonionic)	446	202	55

Table 5-10

Pollutants of Concern for the Industrial Laundries Industry[1]

Pollutant of Concern	Number of Times Analyzed	Number of Times Detected	Percent Detected (%)	Concentration in Untreated Wastewater (mg/L)		
				Minimum	Maximum	Mean
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	46	46	100.00	218.00	9810.00	2343.50
Oil and Grease (measured as HEM)	48	48	100.00	71.50	11790.00	1943.92
Total Suspended Solids (TSS)	46	45	97.83	4.00	7000.00	1773.93
Priority Organics						
1,1,1-Trichloroethane	48	22	45.83	0.01	156.64	4.01
1,2-Diphenylhydrazine	47	5	10.64	0.02	41.32	1.14
4-Chloro-3-methylphenol	47	8	17.02	0.01	2.06	0.14
Bis(2-ethylhexyl) Phthalate	47	43	91.49	0.04	42.01	6.80
Butyl Benzyl Phthalate	47	20	42.55	0.01	74.42	2.69
Chlorobenzene	48	8	16.67	0.01	1.41	0.08
Chloroform	48	25	52.08	0.01	1.19	0.07
Di-*n*-butyl Phthalate	47	20	42.55	0.01	9.98	0.73
Di-*n*-octyl Phthalate	47	25	53.19	0.01	2.61	0.30
Ethylbenzene	48	38	79.17	0.01	18.74	1.24
Isophorone	47	5	10.64	0.01	1.00	0.12
Methylene Chloride	48	25	52.08	0.01	16.26	0.63
Naphthalene	47	42	89.36	0.01	18.75	2.59
Phenol	47	23	48.94	0.01	0.96	0.15
Tetrachloroethene	48	35	72.92	0.01	46.22	1.97
Toluene	48	44	91.67	0.01	90.97	6.72
trans-1,2-Dichloroethene	48	1	2.08	0.01	0.10	0.03
Trichloroethene	48	7	14.58	0.01	20.00	0.48

Table 5-10 (Continued)

Pollutant of Concern	Number of Times Analyzed	Number of Times Detected	Percent Detected (%)	Concentration in Untreated Wastewater (mg/L)		
				Minimum	Maximum	Mean
Nonconventional Organics						
2-Butanone	48	32	66.67	0.05	272.29	9.07
2-Methylnaphthalene	47	32	68.09	0.01	2.24	0.41
2-Propanone	48	46	95.83	0.05	603.15	20.95
4-Methyl-2-pentanone	48	26	54.17	0.05	65.27	2.65
∝-Terpineol	47	17	36.17	0.01	5.20	0.33
Benzoic Acid	47	34	72.34	0.05	12.23	1.77
Benzyl Alcohol	47	21	44.68	0.01	12.52	0.81
Hexanoic Acid	47	14	29.79	0.01	1.81	0.12
m-Xylene	48	40	83.33	0.01	25.29	2.29
n-Decane	47	41	87.23	0.01	712.40	51.60
n-Docosane	47	31	65.96	0.01	3.04	0.35
n-Dodecane	47	40	85.11	0.01	105.57	14.37
n-Eicosane	47	43	91.49	0.01	84.57	4.06
n-Hexacosane	47	27	57.45	0.01	3.73	0.36
n-Hexadecane	47	43	91.49	0.01	91.57	6.70
n-Octacosane	47	21	44.68	0.01	1.44	0.19
n-Octadecane	47	42	89.36	0.01	19.36	1.92
n-Tetracosane	47	25	53.19	0.01	8.34	0.46
n-Tetradecane	47	37	78.72	0.01	41.58	4.39
n-Triacontane	47	29	61.70	0.01	1.00	0.19
o-&*p*-Xylene	48	40	83.33	0.01	17.80	1.59
p-Cresol	47	1	2.13	0.01	0.20	0.06
p-Cymene	47	16	34.04	0.01	19.81	1.43
Pentamethylbenzene	47	11	23.40	0.01	2.33	0.22

Table 5-10 (Continued)

Pollutant of Concern	Number of Times Analyzed	Number of Times Detected	Percent Detected (%)	Concentration in Untreated Wastewater (mg/L)		
				Minimum	Maximum	Mean
Priority Metals and Elements						
Antimony	47	34	72.34	0.01	8.24	0.26
Arsenic	47	15	31.91	0.010	0.18	0.02
Beryllium	47	18	38.30	0.010	0.02	0.003
Cadmium	47	44	93.62	0.010	0.70	0.10
Chromium	47	45	95.74	0.010	7.31	0.46
Copper	47	47	100.00	0.04	14.90	3.17
Lead	47	45	95.74	0.03	23.80	1.71
Mercury	47	28	59.57	0.010	0.01	0.001
Nickel	47	45	95.74	0.01	2.87	0.27
Selenium	47	12	25.53	0.010	0.26	0.03
Silver	47	24	51.06	0.010	0.17	0.02
Thallium	47	6	12.77	0.010	0.13	0.01
Zinc	47	46	97.87	0.010	29.40	5.02
Nonconventional Metals and Elements						
Aluminum	47	47	100.00	0.03	20.99	7.96
Barium	47	47	100.00	0.03	6.26	1.51
Boron	47	36	76.60	0.03	37.20	2.31
Cobalt	47	37	78.72	0.000	3.10	0.24
Iron	47	47	100.00	0.06	96.60	27.70
Manganese	47	47	100.00	0.02	1.77	0.56
Molybdenum	47	43	91.49	0.010	5.17	0.53
Tin	47	32	68.09	0.02	0.58	0.11
Titanium	47	45	95.74	0.01	1.32	0.23
Vanadium	47	31	65.96	0.010	0.19	0.04
Yttrium	47	15	31.91	0.010	0.04	0.01

Table 5-10 (Continued)

Pollutant of Concern	Number of Times Analyzed	Number of Times Detected	Percent Detected (%)	Concentration in Untreated Wastewater (mg/L)		
				Minimum	Maximum	Mean
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	47	47	100.00	80.00	212000.00	12730.57
Total Organic Carbon (TOC)	47	47	100.00	106.00	37800.00	2208.32
Total Petroleum Hydrocarbon (measured as SGT-HEM)	43	43	100.00	7.00	4543.00	880.86

[1]Results are based on sampling data collected between 1993 and 1996 from seven industrial laundries facilities.

5.7 Characterization of Raw Wastewater by Item Laundered

As discussed in Chapter 4 of this document, items laundered at industrial laundries can have significantly different pollutant loads based on item type and customer. This section presents raw wastewater characterization data for specific items laundered for the 72 pollutants of concern detected in industrial laundry wastewater. Table 5-11 presents for the 72 pollutants the mean pollutant concentration by item type. Table C-3 in Appendix C of this document presents for the 72 pollutants the minimum, maximum, and mean concentrations, as well as the number of times each pollutant was analyzed, the number of times the pollutant was detected, and the percentage of times the pollutant was detected, by item type based on sampling data from nine facilities and DMQ data.

5.8 Characterization of Total, Heavy, and Light Raw Wastewater Streams

This section presents raw wastewater characterization data for total, heavy, and light raw wastewater streams at industrial laundries. The heavy and light wastewater streams were designated as such by the sampled facilities; generally, the heavy wastewater stream is generated from laundering items with high pollutant loadings and the light wastewater stream is generated from laundering items with low pollutant loadings. At some facilities, the heavy stream is generated from wastewater from the first several breaks of laundering a variety of items. The heavy stream is typically treated and combined with the untreated light stream prior to discharge to a POTW.

EPA sampling program data and detailed monitoring questionnaire (DMQ) data from facilities that do not split their heavy and light wastewater streams were used to characterize total raw wastewater streams. The total stream is then discharged, with or without treatment, to a POTW. EPA sampling program data from facilities that split their wastewater streams were used to characterize heavy and light wastewater streams.

Tables 5-12 through 5-14 present for 72 pollutants of concern the mean concentrations for heavy, light, and total raw wastewater streams based on data collected through EPA's sampling program (nine facilities) and data from the detailed monitoring questionnaire. Table C-4 in Appendix C of this document presents for the 72 pollutants of concern the minimum, maximum, and mean concentrations, as well as the number of times the pollutant was analyzed, the number of times the pollutant was detected, and the percentage of times the pollutant was detected. In general, the concentrations of pollutants in heavy wastewater streams are greater than the concentrations of pollutants in total wastewater streams, and the concentrations of pollutants in total wastewater streams are greater than the concentrations of pollutants in light wastewater streams.

5.9 Characterization of Method 1664 Constituents

In response to comments on the proposed rule, EPA conducted a characterization study on wastewater generated at industrial laundries to determine the specific constituents of oil and grease and TPH, measured using EPA Method 1664. EPA collected influent and effluent

Table 5-11

Wastewater Characterization for Item-Specific Wastewater at Industrial Laundries

Pollutant of Concern	Mean Concentration (mg/L)[1]			
	Industrial Garments	Shop Towels	Printer Towels	Mats
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD_5)	350	2,780	3,940	179
Oil and Grease (measured as HEM)	149	3,250	5,890	105
Total Suspended Solids (TSS)	304	4,450	1,250	690
Priority Organics				
1,1,1-Trichloroethane	0.0400	4.13	4.50	0.860
1,2-Diphenylhydrazine	0.110	1.07	1.00	0.0200
4-Chloro-3-methylphenol	0.130	0.795	0.433	0.0100
Bis(2-ethylhexyl) Phthalate	0.838	3.63	19.0	1.70
Butyl Benzyl Phthalate	0.111	1.46	5.55	0.0350
Chlorobenzene	0.0400	0.252	0.467	0.0100
Chloroform	0.0400	0.292	0.370	0.0100
Di-*n*-butyl Phthalate	0.0736	0.558	3.20	0.114
Di-*n*-octyl Phthalate	0.0583	0.538	1.24	0.0369
Ethylbenzene	0.104	5.27	13.2	0.147
Isophorone	0.194	9.58	0.500	0.186
Methylene Chloride	0.0406	4.22	0.614	0.226
Naphthalene	0.107	2.91	9.64	0.0172
Phenol	0.0544	0.310	0.500	0.0134
Tetrachloroethene	0.0400	8.92	3.92	0.0676
Toluene	0.0486	5.33	20.5	0.654
trans-1,2-Dichloroethene	0.0400	0.367	0.371	0.0100
Trichloroethene	0.0400	0.247	0.476	0.0100
Nonconventional Organics				
2-Butanone	0.200	5.40	3.09	0.314
2-Methylnaphthalene	0.102	0.826	0.836	0.0100
2-Propanone	0.226	3.98	49.7	1.10
4-Methyl-2-pentanone	0.200	1.88	2.07	0.254
∝-Terpineol	0.0550	0.956	1.07	0.0463
Benzoic Acid	0.353	2.55	3.30	0.156
Benzyl Alcohol	0.132	9.26	0.500	0.0520
Hexanoic Acid	0.0962	0.305	0.433	0.0611
m-Xylene	0.0100	2.12	1.44	0.265
n-Decane	0.807	42.2	90.6	0.995
n-Docosane	0.271	1.10	0.668	0.0175
n-Dodecane	1.26	19.1	23.1	0.0654
n-Eicosane	0.471	25.1	1.29	0.0206
n-Hexacosane	0.117	1.40	2.01	0.0211
n-Hexadecane	0.602	10.0	9.51	0.0206
n-Octacosane	0.0821	0.858	0.402	0.0134

Table 5-11 (Continued)

Pollutant of Concern	Mean Concentration (mg/L)[1]			
	Industrial Garments	Shop Towels	Printer Towels	Mats
Nonconventional Organics (Continued)				
n-Octadecane	0.445	11.2	2.43	0.0160
n-Tetracosane	0.281	1.95	0.605	0.0394
n-Tetradecane	0.612	15.0	7.89	0.0145
n-Triacontane	0.123	0.719	0.626	0.0292
o-&*p*-Xylene	0.0100	1.47	1.08	0.151
p-Cresol	0.0417	0.305	0.433	0.0100
p-Cymene	0.0873	2.05	12.4	0.0100
Pentamethylbenzene	0.0550	0.534	0.500	0.0100
Priority Metals and Elements				
Antimony	0.312	0.198	0.0556	0.0204
Arsenic	0.00907	0.0224	0.00313	0.00905
Beryllium	0.000605	0.000890	0.00100	0.000775
Cadmium	0.0269	0.358	0.0253	0.0147
Chromium	0.0959	0.490	2.65	0.167
Copper	0.688	6.48	11.0	1.31
Lead	0.238	6.52	8.91	0.711
Mercury	0.000395	0.00183	0.000230	0.00142
Nickel	0.0999	0.599	0.101	0.152
Selenium	0.00767	0.0145	0.0177	0.00305
Silver	0.0146	0.139	0.207	0.0168
Thallium	0.00293	0.00390	0.00767	0.00680
Zinc	1.50	13.5	3.62	2.42
Nonconventional Metals and Elements				
Aluminum	4.85	13.1	8.22	10.3
Barium	0.273	4.08	4.53	0.376
Boron	0.187	1.99	0.670	0.0818
Cobalt	0.0134	0.288	0.614	0.0184
Iron	10.9	55.8	8.51	24.7
Manganese	0.148	1.09	0.898	0.318
Molybdenum	0.0213	0.382	2.10	0.0321
Tin	0.0722	0.370	0.0990	0.0938
Titanium	0.150	0.232	0.184	0.364
Vanadium	0.00707	0.0420	0.00900	0.0273
Yttrium	0.00178	0.00794	0.00570	0.00675
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	1,170	13,300	16,900	515
Total Organic Carbon (TOC)	367	2,030	2,740	111
Total Petroleum Hydrocarbon (measured as SGT-HEM)	47.4	1,760	1,730	48.5

Table 5-11 (Continued)

Constituent Name	Mean Concentration (mg/L)[1]			
	Mops	Steam-Tumbled Printer Towels	Items Dry Cleaned Prior to Water Washing	Linen Supply Items
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD_5)	1,150	1,440	113	881
Oil and Grease (measured as HEM)	286	1,720	NA	108
Total Suspended Solids (TSS)	1,100	1,320	82	269
Priority Organics				
1,1,1-Trichloroethane	1.04	0.0118	NA	0.00833
1,2-Diphenylhydrazine	0.200	0.0800	NA	0.0200
4-Chloro-3-methylphenol	0.100	0.0400	NA	0.0100
Bis(2-ethylhexyl) Phthalate	1.10	8.77	NA	0.574
Butyl Benzyl Phthalate	0.895	0.366	NA	0.0944
Chlorobenzene	0.0550	0.0100	NA	0.00833
Chloroform	0.0565	0.0100	NA	0.889
Di-*n*-butyl Phthalate	0.434	0.117	NA	0.0306
Di-*n*-octyl Phthalate	0.108	0.325	NA	0.0572
Ethylbenzene	0.0550	0.0100	0.0458	0.00833
Isophorone	0.100	0.0400	NA	0.0100
Methylene Chloride	0.0767	0.0100	NA	0.0112
Naphthalene	0.471	0.226	NA	0.108
Phenol	0.100	0.0432	NA	0.0674
Tetrachloroethene	0.0550	0.0100	NA	0.00833
Toluene	0.0597	0.0436	0.225	0.0241
trans-1,2-Dichloroethene	0.0550	0.0100	NA	0.00833
Trichloroethene	0.0550	0.0100	NA	0.00833
Nonconventional Organics				
2-Butanone	1.13	0.0500	NA	0.0500
2-Methylnaphthalene	0.432	0.0400	NA	0.0164
2-Propanone	2.22	0.681	NA	0.0607
4-Methyl-2-pentanone	0.275	0.0500	NA	0.0500
∝-Terpineol	0.100	0.0400	NA	0.0339
Benzoic Acid	2.35	0.977	NA	0.150
Benzyl Alcohol	0.610	0.819	NA	0.202
Hexanoic Acid	0.216	0.384	NA	0.0279
m-Xylene	0.100	0.0151	NA	0.0100
n-Decane	0.965	0.499	NA	2.63
n-Docosane	0.157	0.131	NA	0.0392
n-Dodecane	8.07	2.65	NA	0.270
n-Eicosane	0.291	3.05	NA	0.0862
n-Hexacosane	0.210	0.0904	NA	0.0267
n-Hexadecane	1.07	91.6	NA	0.160

Table 5-11 (Continued)

Constituent Name	Mean Concentration (mg/L)[1]			
	Mops	Steam-Tumbled Printer Towels	Items Dry Cleaned Prior to Water Washing	Linen Supply Items
Nonconventional Organics (Continued)				
n-Octacosane	0.221	0.0633	NA	0.0212
n-Octadecane	0.875	1.48	NA	0.0720
n-Tetracosane	0.100	0.0724	NA	0.0630
n-Tetradecane	1.47	12.8	NA	0.140
n-Triacontane	0.163	0.0587	NA	0.0551
o-&*p*-Xylene	0.100	0.0146	NA	0.0100
p-Cresol	0.100	0.0400	NA	0.0100
p-Cymene	0.100	0.0400	NA	0.108
Pentamethylbenzene	0.100	0.0400	NA	0.0100
Priority Metals and Elements				
Antimony	0.0294	0.0261	NA	0.114
Arsenic	0.0102	0.00380	0.00500	0.156
Beryllium	0.00100	0.00100	NA	0.00100
Cadmium	0.0212	0.0358	0.0825	0.0219
Chromium	0.101	0.275	0.0933	0.0492
Copper	1.97	4.86	0.668	0.527
Lead	0.903	0.957	0.519	0.151
Mercury	0.00466	0.000200	0.000150	0.00165
Nickel	0.106	0.0372	0.0200	0.0771
Selenium	0.0123	0.0230	NA	0.151
Silver	0.0111	0.0653	0.00500	0.0291
Thallium	0.00620	0.0120	NA	0.00700
Zinc	3.00	2.10	0.450	0.381
Nonconventional Metals and Elements				
Aluminum	9.78	2.80	NA	3.08
Barium	0.571	1.63	NA	0.301
Boron	0.190	0.0500	NA	0.0970
Cobalt	0.0360	0.202	NA	0.00990
Iron	17.9	2.62	NA	3.26
Manganese	0.358	0.277	NA	0.0812
Molybdenum	0.0612	2.64	NA	0.0263
Tin	0.0785	0.0761	NA	0.0290
Titanium	0.184	0.0178	NA	0.0654
Vanadium	0.0220	0.0221	NA	0.00990
Yttrium	0.004500	0.00500	NA	0.00470

Table 5-11 (Continued)

Constituent Name	Mean Concentration (mg/L)[1]			
	Mops	Steam-Tumbled Printer Towels	Items Dry Cleaned Prior to Water Washing	Linen Supply Items
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	5,410	9,000	638	844
Total Organic Carbon (TOC)	518	1,770	NA	401
Total Petroleum Hydrocarbon (measured as SGT-HEM)	111	468	NA	12

[1]The detection limit concentration was used in calculations for data points reported as nondetects.
NA - Not available. No data were available for this constituent.

Table 5-12

Wastewater Characterization Data for Heavy Wastewater Streams at Industrial Laundries

Pollutant of Concern	Mean Concentration[1] (mg/L)
Conventionals	
Biochemical Oxygen Demand 5-Day (BOD_5)	4,160
Oil and Grease (measured as HEM)	2,950
Total Suspended Solids (TSS)	2,320
Priority Organics	
1,1,1-Trichloroethane	1.16
1,2-Diphenylhydrazine	2.60
4-Chloro-3-methylphenol	0.260
Bis(2-ethylhexyl) Phthalate	11.3
Butyl Benzyl Phthalate	8.89
Chlorobenzene	0.271
Chloroform	0.296
Di-*n*-butyl Phthalate	1.30
Di-*n*-octyl Phthalate	0.599
Ethylbenzene	3.65
Isophorone	0.207
Methylene Chloride	0.854
Naphthalene	4.76
Phenol	0.303
Tetrachloroethene	1.79
Toluene	9.69
trans-1,2-Dichloroethene	0.271
Trichloroethene	1.27
Nonconventional Organics	
2-Butanone	25.5
2-Methylnaphthalene	0.892
2-Propanone	8.49
4-Methyl-2-pentanone	5.82
∝-Terpineol	0.379

Table 5-12 (Continued)

Pollutant of Concern	Mean Concentration[1] (mg/L)
Nonconventional Organics (Continued)	
Benzoic Acid	3.36
Benzyl Alcohol	1.56
Hexanoic Acid	0.210
m-Xylene	4.47
n-Decane	86.5
n-Docosane	0.504
n-Dodecane	29.5
n-Eicosane	4.28
n-Hexacosane	0.354
n-Hexadecane	9.11
n-Octacosane	0.370
n-Octadecane	4.00
n-Tetracosane	0.289
n-Tetradecane	7.23
n-Triacontane	0.366
o-&*p*-Xylene	3.59
p-Cresol	0.204
p-Cymene	3.16
Pentamethylbenzene	0.412
Priority Metals and Elements	
Antimony	0.788
Arsenic	0.0125
Beryllium	0.00142
Cadmium	0.121
Chromium	0.296
Copper	5.37
Lead	1.60
Mercury	0.000816
Nickel	0.266
Selenium	0.0174
Silver	0.199

Table 5-12 (Continued)

Pollutant of Concern	Mean Concentration[1] (mg/L)
Priority Metals and Elements (Continued)	
Thallium	0.00989
Zinc	7.79
Nonconventional Metals and Elements	
Aluminum	9.97
Barium	3.63
Boron	4.93
Cobalt	0.449
Iron	42.1
Manganese	1.51
Molybdenum	0.668
Tin	0.130
Titanium	0.344
Vanadium	0.0381
Yttrium	0.0101
Bulk Nonconventionals	
Chemical Oxygen Demand (COD)	13,700
Total Organic Carbon (TOC)	2,790
Total Petroleum Hydrocarbon (measured as SGT-HEM)	1,440

[1]The detection limit concentration was used in calculations for data points reported as nondetects.

Table 5-13

Wastewater Characterization Data for Light Wastewater Streams at Industrial Laundries

Pollutant of Concern	Mean Concentration[1] (mg/L)
Conventionals	
Biochemical Oxygen Demand 5-Day (BOD_5)	568
Oil and Grease (measured as HEM)	154
Total Suspended Solids (TSS)	344
Priority Organics	
1,1,1-Trichloroethane	0.0160
1,2-Diphenylhydrazine	0.220
4-Chloro-3-methylphenol	0.0411
Bis(2-ethylhexyl) Phthalate	1.10
Butyl Benzyl Phthalate	0.0690
Chlorobenzene	0.0160
Chloroform	0.0455
Di-*n*-butyl Phthalate	0.104
Di-*n*-octyl Phthalate	0.0667
Ethylbenzene	0.0620
Isophorone	0.0400
Methylene Chloride	0.0213
Naphthalene	0.358
Phenol	0.105
Tetrachloroethene	0.0977
Toluene	0.0553
trans-1,2-Dichloroethene	0.0160
Trichloroethene	0.0160
Nonconventional Organics	
2-Butanone	0.147
2-Methylnaphthalene	0.0566
2-Propanone	0.518
4-Methyl-2-pentanone	0.240
∝-Terpineol	0.123

Table 5-13 (Continued)

Pollutant of Concern	Mean Concentration[1] (mg/L)
Nonconventional Organics (Continued)	
Benzoic Acid	0.306
Benzyl Alcohol	0.102
Hexanoic Acid	0.0557
m-Xylene	0.0555
n-Decane	0.354
n-Docosane	0.0591
n-Dodecane	0.973
n-Eicosane	0.124
n-Hexacosane	0.0465
n-Hexadecane	0.330
n-Octacosane	0.0432
n-Octadecane	0.0850
n-Tetracosane	0.0680
n-Tetradecane	0.103
n-Triacontane	0.0492
o-&*p*-Xylene	0.0765
p-Cresol	0.0400
p-Cymene	0.0473
Pentamethylbenzene	0.0787
Priority Metals and Elements	
Antimony	1.32
Arsenic	0.00653
Beryllium	0.000938
Cadmium	0.0211
Chromium	0.113
Copper	0.858
Lead	0.348
Mercury	0.000715
Nickel	0.101
Selenium	0.0133
Silver	0.00432

Table 5-13 (Continued)

Pollutant of Concern	Mean Concentration[1] (mg/L)
Priority Metals and Elements (Continued)	
Thallium	0.00313
Zinc	1.47
Nonconventional Metals and Elements	
Aluminum	4.65
Barium	0.421
Boron	0.391
Cobalt	0.0264
Iron	10.3
Manganese	0.184
Molybdenum	0.0357
Tin	0.0625
Titanium	0.206
Vanadium	0.0138
Yttrium	0.00313
Bulk Nonconventionals	
Chemical Oxygen Demand (COD)	1,410
Total Organic Carbon (TOC)	338
Total Petroleum Hydrocarbon (measured as SGT-HEM)	85

[1]The detection limit concentration was used in calculations for data points reported as nondetects.

Table 5-14

Wastewater Characterization Data for Total Raw Wastewater Streams at Industrial Laundries

Pollutant	Mean Concentration[1] (mg/L)
Conventionals	
Biochemical Oxygen Demand 5-Day (BOD_5)	933
Oil and Grease (measured as HEM)	1,670
Total Suspended Solids (TSS)	1,200
Priority Organics	
1,1,1-Trichloroethane	0.283
1,2-Diphenylhydrazine	0.0918
4-Chloro-3-methylphenol	0.0684
Bis(2-ethylhexyl) Phthalate	4.99
Butyl Benzyl Phthalate	0.140
Chlorobenzene	0.131
Chloroform	0.0359
Di-*n*-butyl Phthalate	0.245
Di-*n*-octyl Phthalate	0.0910
Ethylbenzene	0.634
Isophorone	0.154
Methylene Chloride	0.366
Naphthalene	1.47
Phenol	0.0777
Tetrachloroethene	3.91
Toluene	2.64
trans-1,2-Dichloroethene	0.0204
Trichloroethene	0.0346
Nonconventional Organics	
2-Butanone	2.51
2-Methylnaphthalene	0.166
2-Propanone	10.9
4-Methyl-2-pentanone	1.67
∝-Terpineol	0.258

Table 5-14 (Continued)

Pollutant	Mean Concentration[1] (mg/L)
Nonconventional Organics (continued)	
Benzoic Acid	0.648
Benzyl Alcohol	0.143
Hexanoic Acid	0.125
m-Xylene	4.35
n-Decane	73.6
n-Docosane	0.659
n-Dodecane	6.16
n-Eicosane	1.97
n-Hexacosane	0.413
n-Hexadecane	4.76
n-Octacosane	0.0853
n-Octadecane	1.78
n-Tetracosane	1.51
n-Tetradecane	4.44
n-Triacontane	0.144
o-&*p*-Xylene	2.48
p-Cresol	0.0585
p-Cymene	0.138
Pentamethylbenzene	0.242
Priority Metals and Elements	
Antimony	0.0913
Arsenic	0.0183
Beryllium	0.00598
Cadmium	0.0641
Chromium	0.315
Copper	1.74
Lead	0.955
Mercury	0.00128
Nickel	0.305
Selenium	0.0550
Silver	0.0316

Table 5-14 (Continued)

Pollutant	Mean Concentration[1] (mg/L)
Priority Metals and Elements (continued)	
Thallium	0.0190
Zinc	2.85
Nonconventional Metals and Elements	
Aluminum	8.24
Barium	1.31
Boron	0.689
Cobalt	0.169
Iron	39.5
Manganese	0.627
Molybdenum	0.363
Tin	0.278
Titanium	0.251
Vanadium	0.0678
Yttrium	0.0199
Bulk Nonconventionals	
Chemical Oxygen Demand (COD)	6,090
Total Organic Carbon (TOC)	1,160
Total Petroleum Hydrocarbon (measured as SGT-HEM)	682

[1]The detection limit concentration was used in calculations for data points reported as nondetects.

samples from six facilities that operate DAF or chemical precipitation and that were previously sampled by EPA. See Chapter 3 of this document for a description of EPA's Method 1664 Characterization Study.

For the study, EPA analyzed wastewater samples for HEM, SGT-HEM, volatile organics, and semivolatile organics. EPA also analyzed extracts from the HEM and SGT-HEM procedures for volatile organics and semivolatile organics. The data from this study are in the Industrial Laundries Administrative Record.

Volatile organics were only detected in the HEM extracts at one facility; the only volatile organics detected in the HEM extracts were o-xylene and m-&p-xylene. Semivolatile organics were detected in all HEM and SGT-HEM extracts. Tables 5-15 and 5-16 show, for influent and effluent samples, respectively, the semivolatile organics detected in the extracts and the number of detects and average concentration of the detects in the wastewater, HEM extract, and SGT-HEM extract samples. Tables 5-15 and 5-16 also show the HEM and SGT-HEM concentrations. For one facility, no effluent concentrations are reported because there were zero percent recoveries in the matrix spike/matrix spike duplicate samples. The effluent results for this facility were excluded due to matrix interference.

The analytes that were detected in the influent samples for both the HEM and SGT-HEM extracts were 2-methylnaphthalene, bis(2-ethylhexyl) phthalate, *n*-decane, *n*-docosane, *n*-dodecane, *n*-eicosane, *n*-hexacosane, *n*-hexadecane, *n*-octacosone, *n*-octadecane, *n*-tetracosane, *n*-tetradecane, and naphthalene. The highest concentrations detected in the influent samples for both the HEM and SGT-HEM extracts were for bis(2-ethylhexyl) phthalate, *n*-decane, *n*-dodecane, *n*-hexadecane, *n*-octadecane, and *n*-tetradecane. Only bis(2-ethylhexyl) phthalate, *n*-eicosane, *n*-hexadecane, *n*-octadecane, and *n*-tetradecane were detected in the effluent samples for both the HEM and SGT-HEM extracts. These analytes were detected in lower concentrations in the effluent samples than in the influent samples.

Based on the characterization study, EPA was able to identify several constituents measured as part of the SGT-HEM (TPH) parameter. Most of the constituents identified in the influent samples were *n*-alkanes, as well as naphthalene, bis(2-ethylhexyl) phthalate and 2-methylnaphthalene. The identified constituents, however, represent only a small portion of the total SGT-HEM (TPH) measurement.

5.10 References

1. U.S. Environmental Protection Agency. List of Lists: A Catalog of Analytes and Methods. 121W-4005. Washington, DC, August 1991.

Table 5-15

Summary of the Semivolatile Organic Pollutants Detected in Influent Samples during the EPA Method 1664 Characterization Study

Pollutant	Total Number of Wastewater Samples	Total Number of Nondetects for Pollutant in Wastewater Samples	Average Concentration in Wastewater Sample[1] (ug/L)	Total Number of HEM Extract Samples	Total Number of Nondetects for Pollutants in HEM Extracts	Average Concentration in HEM Extracts[1] (ug/L)	Total Number of SGT-HEM Extract Samples	Total Number of Nondetects for Pollutants in SGT-HEM Extracts	Average Concentration in SGT-HEM Extracts[1] (ug/L)
HEM	6	0	1,920,000	NA	NA	NA	NA	NA	NA
SGT-HEM	6	0	391,000	NA	NA	NA	NA	NA	NA
1,2-Diphenylhydrazine	6	3	2,380	6	5	299	6	6	222
2-Methylnaphthalene	6	4	1,180	6	3	173	6	4	109
4-Chloro-3-methylphenol	6	3	420	6	6	111	6	6	111
Acetophenone	6	5	1,360	6	6	111	6	6	111
α-Terpineol	6	0	340	6	3	224	6	6	111
Aniline	6	6	1,340	6	6	111	6	6	111
Benzoic Acid	6	2	2,270	6	6	556	6	6	556
Benzyl Alcohol	6	2	1,090	6	6	111	6	6	111
Bis(2-ethylhexyl) Phthalate	6	1	4,780	6	0	1,400	6	1	321
Butyl Benzyl Phthalate	6	0	299	6	1	139	6	6	111
Di-*n*-butyl Phthalate	6	0	912	6	3	363	6	6	111
Di-*n*-octyl Phthalate	6	5	1,390	6	4	232	6	6	111
Diethyl Phthalate	6	5	1,340	6	6	111	6	6	111
Diphenylamine	6	4	1,350	6	6	111	6	6	111
Fluoranthene	6	5	1,180	6	6	111	6	6	111
Fluorene	6	5	1,180	6	6	111	6	6	111

Table 5-15 (Continued)

Pollutant	Total Number of Wastewater Samples	Total Number of Nondetects for Pollutant in Wastewater Samples	Average Concentration in Wastewater Sample[1] (ug/L)	Total Number of HEM Extract Samples	Total Number of Nondetects for Pollutants in HEM Extracts	Average Concentration in HEM Extracts[1] (ug/L)	Total Number of SGT-HEM Extract Samples	Total Number of Nondetects for Pollutants in SGT-HEM Extracts	Average Concentration in SGT-HEM Extracts[1] (ug/L)
Hexanoic Acid	6	3	539	6	6	111	6	6	111
Isophorone	6	4	1,520	6	5	117	6	6	111
n-Decane	6	0	26,800	6	0	2,330	6	3	1150
n-Docosane	6	0	1,660	6	1	240	6	0	210
n-Dodecane	6	0	20,500	6	0	1,590	6	0	1180
n-Eicosane	6	0	3,720	6	0	777	6	0	705
n-Hexacosane	6	2	1,400	6	2	206	6	3	193
n-Hexadecane	6	0	9,750	6	0	1,290	6	0	1220
n-Nitrosodiphenylamine	6	4	2,680	6	6	222	6	6	222
n-Tetradecane	6	0	6,320	6	0	1,570	6	0	1400
Naphthalene	6	0	1,240	6	2	583	6	2	217
o-Cresol	6	4	1,450	6	6	111	6	6	111
p-Cresol	6	6	507	6	6	111	6	6	111
p-Cymene	6	2	793	6	4	296	6	6	111
Phenanthrene	6	2	212	6	6	111	6	6	111
Phenol	6	0	91.8	6	6	111	6	6	111
Pyrene	6	3	1,180	6	6	111	6	6	111
Tripropyleneglycol Methyl Ether	6	1	182,000	6	6	1,100	6	6	1100

[1]The detection limit concentration was used in calculations for data points reported as nondetects.

NA - Not applicable.
HEM - Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.

Table 5-16

Summary of the Semivolatile Organic Pollutants Detected in Effluent Samples during the EPA Method 1664 Characterization Study

Pollutant	Total Number of Wastewater Samples	Total Number of Nondetects for Pollutant in Wastewater Samples	Average Concentration in Wastewater Sample[1] (ug/L)	Total Number of HEM Extract Samples	Total Number of Nondetects for Pollutants in HEM Extracts	Average Concentration in HEM Extracts[1] (ug/L)	Total Number of SGT-HEM Extract Samples	Total Number of Nondetects for Pollutants in SGT-HEM Extracts	Average Concentration in SGT-HEM Extracts[1] (ug/L)
HEM	5	0	45,900	NA	NA	NA	NA	NA	NA
SGT-HEM	4	0	11,000	NA	NA	NA	NA	NA	NA
1,2-Diphenylhydrazine	5	3	27.5	5	5	48	5	5	48
2-Methylnaphthalene	5	5	10	5	5	24	5	5	24
4-Chloro-3-methylphenol	5	1	99.2	5	5	24	5	5	24
Acetophenone	5	5	10	5	5	24	5	5	24
α-Terpineol	5	0	274	5	1	25.4	5	5	24
Aniline	5	3	13.8	5	5	24	5	5	24
Benzoic Acid	5	0	1,130	5	5	120	5	5	120
Benzyl Alcohol	5	2	292	5	5	24	5	5	24
Bis(2-ethylhexyl) Phthalate	5	1	154	5	1	67.4	5	3	29.1
Butyl Benzyl Phthalate	5	3	10.2	5	4	26	5	5	24
Di-*n*-butyl Phthalate	5	5	10	5	5	24	5	5	24
Di-*n*-octyl Phthalate	5	4	10.2	5	5	24	5	5	24
Diethyl Phthalate	5	5	10	5	5	24	5	5	24
Diphenylamine	5	5	10	5	5	24	5	5	24
Fluoranthene	5	5	10	5	5	24	5	5	24
Fluorene	5	5	10	5	5	24	5	5	24
Hexanoic Acid	5	1	331	5	5	24	5	5	24
Isophorone	5	1	289	5	4	42	5	5	24

Table 5-16 (Continued)

Pollutant	Total Number of Wastewater Samples	Total Number of Nondetects for Pollutant in Wastewater Samples	Average Concentration in Wastewater Sample[1] (ug/L)	Total Number of HEM Extract Samples	Total Number of Nondetects for Pollutants in HEM Extracts	Average Concentration in HEM Extracts[1] (ug/L)	Total Number of SGT-HEM Extract Samples	Total Number of Nondetects for Pollutants in SGT-HEM Extracts	Average Concentration in SGT-HEM Extracts[1] (ug/L)
n-Decane	5	1	502	5	4	30.1	5	5	24
n-Docosane	5	1	38	5	5	24	5	5	24
n-Dodecane	5	1	250	5	4	38.5	5	5	24
n-Eicosane	5	1	67.2	5	4	28.3	5	4	27
n-Hexacosane	5	1	53.9	5	5	24	5	5	24
n-Hexadecane	5	1	116	5	3	47.2	5	4	36.2
n-Nitrosodiphenylamine	5	5	20	5	5	48	5	5	48
n-Octacosane	5	5	10	5	5	24	5	5	24
n-Octadecane	5	2	90.5	5	3	34.8	5	4	30.7
n-Tetracosane	5	1	37.1	5	5	24	5	5	24
n-Tetradecane	5	1	134	5	4	37.8	5	4	27.3
Naphthalene	5	0	90.3	5	4	25.1	5	5	24
o-Cresol	5	1	120	5	5	24	5	5	24
p-Cresol	5	2	24.5	5	5	24	5	5	24
p-Cymene	5	3	13.1	5	5	24	5	5	24
Phenanthrene	5	5	10	5	5	24	5	5	24
Phenol	5	0	175	5	5	24	5	5	24
Pyrene	5	5	10	5	5	24	5	5	24
Tripropyleneglycol Methyl Ether	5	1	11,800	5	5	238	5	5	238

[1]The detection limit concentration was used in calculations for data points reported as nondetects.

NA - Not applicable.
HEM - Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.

CHAPTER 6

POLLUTION PREVENTION, RECYCLING, TREATMENT, AND DISPOSAL TECHNOLOGIES EMPLOYED BY THE INDUSTRIAL LAUNDRIES INDUSTRY

6.1 Introduction

The Pollution Prevention Act of 1990 and EPA's 1991 Pollution Prevention Strategy established an environmental management hierarchy that includes (in order of highest priority) pollution prevention, recycling, treatment, and disposal or release. Presented in this chapter are the pollution control technologies applicable to the industrial laundries industry for each step of the environmental management hierarchy. This chapter presents the following discussions:

- Section 6.2 discusses the environmental management hierarchy established by the Pollution Prevention Act;
- Section 6.3 discusses the pollution prevention measures used in the industrial laundries industry;
- Section 6.4 discusses the waste recycling measures used in the industrial laundries industry;
- Section 6.5 discusses the major wastewater treatment technologies used by the industry;
- Section 6.6 discusses the waste disposal measures used by the industrial laundries industry; and
- Section 6.7 presents the references used.

At the time of proposal, EPA considered 193 facilities that responded to the 1994 Industrial Laundries Industry Questionnaire (detailed questionnaire) to be in scope, including three facilities that process only clean room items. After proposal, EPA determined that clean room items should not be classified as industrial laundry items (see Section 4.8 of this document) and the three clean room facilities are no longer considered to be in scope. Information in this chapter on the pollution prevention, recycling, wastewater treatment, and disposal practices reported by the industry are presented on the basis of 190 in-scope facilities.

6.2 The Environmental Management Hierarchy

As it applies to industry, the environmental management hierarchy (outlined in Figure 6-1) stipulates that:

I. Source Reduction

A. Product Changes
1. Design for Less Environmental Impact
2. Increased Product Life

B. Process Changes

1. Input Material Changes
- Material Purification
- Substitution of Less Toxic Materials

2. Technology Changes
- Layout Changes
- Increased Automation
- Improved Operating Conditions
- Improved Equipment
- New Technology

3. Improved Operating Practices
- Operating and Maintenance Procedures
- Management Practices
- Stream Segregation
- Material Handling Improvements
- Production Scheduling
- Inventory Control
- Training
- Waste Segregation

II. Recycling

A. Reuse

B. Reclamation

III. Treatment

Reference: United State EPA, Office of Research and Development. Facility Pollution Prevention Guide, EPA/600/R-92/088, May 1992.

Figure 6-1. Environmental Management Options Hierarchy

Facilities should reduce pollution at the source whenever feasible;

- Facilities should recycle waste materials that cannot be reduced in an environmentally safe manner whenever feasible;

- Facilities should treat pollution that cannot be reduced or recycled in an environmentally safe manner whenever feasible; and

- Facilities should only dispose or release pollutants into the environment as a last resort. Facilities should conduct this practice in an environmentally safe manner.

EPA examined pollution prevention, recycling, treatment and disposal practices applicable to the industrial laundries industry in an effort to incorporate the environmental management hierarchy into the industrial laundries regulatory options development process. As part of the Industrial Pollution Prevention Project (IP3) (1), a joint effort of EPA, state agencies, local agencies, and industrial laundries, EPA determined that industrial laundries can best identify pollution prevention and recycling opportunities by identifying all sources of pollution at their facilities, including hazardous wastes, solid wastes, air emissions, and water discharges. Then facility personnel and their customers can work together to find solutions which reduce or eliminate the generation of the wastes through source reduction, reuse, and recycling. Specific waste reduction opportunities at industrial laundries identified by EPA during the IP3 are presented in Sections 6.3 and 6.4 of this document. The information EPA collected on pollution prevention, recycling, treatment and disposal practices as part of the industrial laundries regulatory development process and the IP3 is presented in Sections 6.3 through 6.6 of this document.

6.3 Pollution Prevention/Source Reduction in the Industrial Laundries Industry

Pollution prevention, established as the most desirable pollution control option in the environmental management hierarchy, is defined as the use of materials, processes, or practices that reduce or eliminate the generation of pollutants or wastes at the source. Also known as source reduction, pollution prevention includes practices that reduce the use of hazardous and nonhazardous materials, energy, water, or other natural resources. End-of-pipe pollution control and waste-handling measures (including waste treatment, off-site recycling, volume reduction (e.g., sludge dewatering), dilution, and transfer of constituents to another environmental medium) are not considered pollution prevention because such measures are applied only after wastes are generated. With the Pollution Prevention Act of 1990, Congress established pollution prevention as a national goal, declaring that the generation of pollutants should be prevented or reduced during the production cycle whenever feasible.

In the detailed questionnaire, EPA asked industrial laundries to provide information on the types of pollution prevention activities performed at their facilities during the 1993 operating year. Of the 190 in-scope industrial laundries and three clean room item laundries responding to the detailed questionnaire (in-scope facilities are those that meet the definition of an industrial laundry as presented in Chapter 4 of this document), 44 industrial

laundries reported having a pollution prevention policy (42 of these facilities attached copies of the plans to the questionnaire), and 53 industrial laundries stated that they planned to implement additional pollution prevention activities in the near future.

A total of 105 in-scope industrial laundries reported conducting pollution prevention activities prior to the laundering process (preprocess activities), during the laundering process (in-process activities), or both. The information reported by the facilities for preprocess and in-process pollution prevention activities is presented in Sections 6.3.1 and 6.3.2 of this document.

6.3.1 Preprocess Pollution Prevention Activities

Seventy-nine in-scope industrial laundries responding to the detailed questionnaire reported conducting some type of preprocess pollution prevention activities during the 1993 operating year. Table 6-1 presents the number of industrial laundries, by production category, that reported preprocess pollution prevention activities. EPA analyzed the data in the questionnaire responses to determine if facility size was a factor in the performance of preprocess pollution prevention activities. For each production category, EPA calculated the percentage of industrial laundries that reported these activities by dividing the number of industrial laundries reporting activities by the total number of industrial laundries listed in that production category. As shown in Table 6-1, the performance of preprocess pollution prevention activities does not appear to be related to facility size, with approximately 30 to 50 percent of the facilities in each production category reporting preprocess pollution prevention activities.

Table 6-2 lists all of the preprocess pollution prevention activities reported by industrial laundries in the detailed questionnaire. The most common preprocess pollution prevention activities reported were the refusal of items with free liquids (68 percent) and the refusal of certain items (52 percent). The items most often refused by the industrial laundries were shop and printer towels/rags. Sixteen industrial laundries reported other preprocess activities, including centrifugation of items to remove liquids, dry cleaning of items before water washing, presorting of items to remove trash/objects, and steam/air stripping of volatiles from items. During the IP3, EPA identified preprocess pollution prevention practices that could be implemented by industrial laundries. In addition to the preprocess pollution prevention activities already presented in this section, EPA determined that industrial laundries could reduce the amount of solid waste generated at their facilities by having laundering/dry cleaning/wastewater treatment chemicals shipped to the facilities in bulk containers or in drums that could be returned to the chemical manufacturers.

Centrifugation, steam/air stripping, and dry cleaning are used to remove liquid solvents and volatile organic compounds (VOCs) from items prior to water washing. These technologies facilitate the recovery and recycle of solvents and other materials contained on heavily soiled items, such as shop and printer towels/rags. Although these technologies are

Table 6-1

Number of Industrial Laundries, by Production Category, Reporting Preprocess Pollution Prevention Activities in the Detailed Questionnaire for the 1993 Operating Year

Production Category (lb/yr)	Number of Facilities Reporting Activities	Total Number of Facilities in Production Category	Percentage of Facilities Reporting Activities in Production Category	Total Production for Facilities Reporting Activities (lb/yr)	Percentage of Total Production for Facilities Reporting Activities
< 1,000,000	9	19	47%	5,810,000	1%
1,000,000 to < 3,000,000	14	37	38%	27,900,000	6%
3,000,000 to < 6,000,000	23	58	40%	102,000,000	21%
6,000,000 to < 9,000,000	17	33	52%	123,000,000	25%
9,000,000 to < 15,000,000	10	25	40%	115,000,000	23%
≥ 15,000,000	6	18	33%	118,000,000	24%
Total	79	190	---	492,000,000	100%

Table 6-2

Types of Preprocess Pollution Prevention Activities Reported in the Detailed Questionnaire for the 1993 Operating Year

Activity	Number of Facilities Performing Activity	Percentage of Total Number of Facilities Reporting Preprocess Activities[1]
Refusal of Items with Free Liquids	54	28%
Refusal of Certain Items	41	22%
Centrifugation of Items to Remove Liquids	6[2]	3%
Items Dry-Cleaned Before Water Washing	5[3]	3%
Items Presorted to Remove Objects	3	2%
Steam/Air Stripping of Volatile Organics from Items	1[4]	1%

[1]Percentages are based on 190 in-scope industrial laundries.
[2]Some of these facilities reported that their customers were "pressing," "squeezing," "extracting," or "centrifuging" the items prior to sending them to the laundry.
[3]Three of these facilities did not report dry cleaning before water washing as a preprocess pollution prevention activity. This information was obtained from their reported laundering processes. One additional facility dry cleans items before water washing, but the industrial laundry did not include this information in its detailed questionnaire. EPA obtained this information during a site visit to the facility.
[4]One additional facility reported steam/air stripping of volatile organics from items; however, the particular activities reported at this facility do not meet the definition of steam/air stripping.

actually waste recycling techniques with treatment, they were presented in the detailed questionnaire as preprocess pollution prevention techniques. For this reason, the information provided by the industry on these technologies in the detailed questionnaire are included in this section. Centrifugation, steam/air stripping, dry cleaning, and other waste recycling/treatment technologies are discussed in greater detail in Section 6.4 of this document.

Facilities responding to the detailed questionnaire reported initiating preprocess pollution prevention activities primarily in the late 1980s and early 1990s. However, several facilities initiated refusal of certain items and the refusal of items with free liquids many years before (the late 1950s and early 1980s, respectively). Facilities that reported these two practices tended to refuse the same items, as shown in the following table:

Items refused	Percentage of Facilities Refusing Items	
	Facilities Refusing Items with Free Liquids	Facilities Refusing Certain Items
Shop towels	48%	27%
Printer towels/rags	28%	32%
Industrial garments	15%	12%

Of the six facilities that reported centrifugation to remove liquids, four performed this activity on shop or printer towels/rags (the centrifugation technology is discussed in greater detail in Section 6.4.5 of this document). Likewise, both of the facilities that reported steam/air stripping of volatile organics from items performed this activity on shop or printer towels/rags. None of the facilities that presorted items to remove trash/objects or dry cleaned items before water washing reported performing these activities on shop or printer towels/rags.

In the detailed questionnaire, EPA asked facilities to report whether performing preprocess pollution prevention activities had a negative impact on the quality of their service. The facilities reported a negative impact most frequently for steam/air stripping of volatile organics from items (100 percent), the refusal of items with free liquids (65 percent), and the refusal of certain items (54 percent). These negative impacts generally included the following:

- Increased burden and costs for the facility (e.g., training of customers, installation of equipment);
- Increased burden and costs for the customers (e.g., purchase of equipment, restricted use of certain items, payment of penalty fees);
- Delayed service; and
- Loss of business/limits to growth.

EPA collected analytical data on two preprocess pollution prevention technologies, dry cleaning prior to water washing and steam stripping (steam tumbling), during site visit and sampling activities. EPA collected additional information on air stripping, centrifugation, and hydraulic

pressing from vendors of the equipment. Section 6.4 of this document discusses these technologies and their application in the industry in more detail.

6.3.2 In-Process Pollution Prevention Activities

Fifty industrial laundries reported conducting some type of in-process pollution prevention activities during the 1993 operating year. Table 6-3 presents the number of industrial laundry facilities, by production category, that reported in-process pollution prevention activities. EPA analyzed the data in the questionnaire database to determine if facility size was a factor in the performance of in-process pollution prevention activities. For each production category, EPA calculated the percentage of facilities that reported activities by dividing the number of facilities reporting activities by the total number of facilities listed in that production category. As shown in Table 6-3, the performance of in-process pollution prevention activities does not appear to be related to facility size, with 15 to 35 percent of the facilities in each production category reporting in-process pollution prevention activities.

Table 6-4 lists all in-process pollution prevention activities reported by industrial laundries in the detailed questionnaire for the 1993 operating year. The most common types of in-process pollution prevention activities reported by the industrial laundries were:

- A change in the use of laundering/dry-cleaning chemicals (11 percent);
- Improved training of employees (i.e., chemical safety, proper handling of equipment) (10 percent); and
- Installation of a liquid injection system to add the exact amount of wash chemicals required by the wash formula (10 percent).

A smaller number of facilities reported other in-process activities (improved housekeeping, water softening, implementation of water reuse/reduction, equipment modifications/installations, recycling of laundry materials, removal of lint before air venting to atmosphere, and reduced fuel consumption). During the IP3, EPA identified in-process pollution practices that could be implemented by industrial laundries. In addition to the in-process pollution prevention activities already presented in this section, EPA determined that industrial laundries could also technically implement the following in-process practices:

- Use calcium extracted from incoming water during water softening to replace the lime used in wastewater treatment/sludge dewatering operations;
- Separate nonhazardous and hazardous waste streams;
- Improve standard operating procedures;
- Establish an inventory control system;

Table 6-3

Number of Industrial Laundries, by Production Category, Reporting In-Process Pollution Prevention Activities in the Detailed Questionnaire for the 1993 Operating Year

Production Category (lb/yr)	Number of Facilities Reporting Activities	Total Number of Facilities in Production Category	Percentage of Facilities Reporting Activities in Production Category	Total Production for this Category for Facilities Reporting Activities (lb/yr)	Percentage of Total Production for Facilities Reporting Activities
< 1,000,000	5	19	26%	3,280,000	1%
1,000,000 to < 3,000,000	13	37	35%	23,000,000	7%
3,000,000 to < 6,000,000	14	58	24%	62,300,000	20%
6,000,000 to < 9,000,000	10	33	30%	76,700,000	25%
9,000,000 to < 15,000,000	4	25	16%	51,100,000	17%
≥ 15,000,000	4	18	22%	93,100,000	30%
Total	50	190	---	309,000,000	100%

Table 6-4

Types of In-Process Pollution Prevention Activities Reported in the Detailed Questionnaire for the 1993 Operating Year

Activity	Number of Facilities Performing Activity	Percentage of Total Number of Facilities Reporting In-Process Activities[1]
Change in Laundering/Dry Cleaning Chemicals Used	20	11%
Improved Training of Employees	19	10%
Liquid Injection System for Wash Chemical Addition	18	10%
Improved Housekeeping	10	5%
Water Softening	6	3%
Equipment Modifications/Installations	3	2%
Recycling of Laundry Materials	1	1%
Removal of Lint Before Air Venting to Atmosphere	1	1%
Reduced Fuel Consumption	1	1%

[1]Percentages are based on 190 industrial laundries.

- Perform routine and preventative maintenance on facility equipment;
- Utilize waste exchange programs; and
- Reuse solvent from dry-cleaning operations.

Facilities responding to the detailed questionnaire reported initiating most in-process pollution prevention activities primarily in the late 1980s and early 1990s. However, one facility reported initiating improved training of employees in 1983.

All of the in-process pollution prevention activities reported by the facilities reduce pollution and reduce operating costs by optimizing facility operations. The installation of alternative washers and automated liquid injection systems for washers, the use of alternative washing chemicals, the use of water softening, and the implementation of water reuse/reduction all can reduce the amount of water and/or chemicals that a facility uses. A significant number of facilities have improved employee training and housekeeping standards; these activities can also decrease water and chemical use. In addition, changes in laundering chemicals were reported to improve treatability of the wastewater by forming emulsions that are more easily broken.

In the detailed questionnaire, EPA asked facilities to report whether performing pollution prevention activities had a negative impact on the quality of their service. While most of the industrial laundries reported no negative impacts for the in-process activities, several facilities did report a negative impact on their quality of service from in-process pollution prevention activities. These negative impacts generally included the following:

- Increased burden and costs for the facility (e.g., training of employees, purchase of more expensive liquid chemicals, installation of equipment/ processes, disposal of recovered materials);
- Increased costs to the customers (i.e., increased facility costs were passed on to customers); and
- Decreased quality of service (e.g., graying of clothes).

The in-process pollution prevention activities were more widely practiced on the different items laundered than were the preprocess pollution prevention activities. Since most of the in-process activities affect all washing operations, this wide distribution among all of the item types is to be expected. For example, in-process activities such as liquid injection usually apply to all laundry operations and item types at a facility.

6.4 Waste Recycling/Resource Conservation and the Industrial Laundries Regulatory Development Process

As established in the environmental management hierarchy, if the generation of waste materials cannot be prevented or reduced in an environmentally safe manner, these materials should be recycled whenever feasible. Waste recycling conducted in an environmentally safe manner shares many of the advantages of pollution prevention/source reduction. Waste recycling helps to conserve natural resources, such as energy and water. In addition, pollution recycling reduces the need for end-of-pipe treatment or disposal, the two least desirable pollution control measures in the environmental management hierarchy.

During the IP3, EPA determined that most industrial laundries use heat exchangers to conserve energy. But, EPA determined that many industrial laundries do not recycle any process water. As part of the industrial laundries regulatory development process, EPA asked industrial laundries receiving the detailed questionnaire and the 1993 Screener Questionnaire for the Industrial Laundries Industry to provide information on the types of pollution recycling/resource conservation activities performed at their facilities. The information reported by the facilities for water reuse and energy reuse is summarized in Sections 6.4.1 and 6.4.2 of this document. Also included in this section is information pertaining to technologies used to remove liquid solvents and VOCs from items prior to water washing (Sections 6.4.3 through 6.4.6). These technologies facilitate the recovery and recycle of solvents and other materials contained on heavily soiled items, such as shop and printer towels/rags. The recovered materials may then be reused by the industrial laundry customers or blended into fuel.

6.4.1 Water Conservation in the Industrial Laundries Industry

Industrial laundries have a variety of opportunities to recycle/reuse water at their facilities. Industrial laundries can recycle or reuse the following sources of water used at the facility as process water or cooling water: laundry wastewater before treatment, laundry wastewater after treatment, noncontact cooling water, contact cooling water, and nonlaundry wastewater.

Forty-five of the 190 in-scope industrial laundries (24 percent) responding to the detailed questionnaire reported reusing a portion of the water used by the facility as process makeup water. Twenty-seven industrial laundries (60 percent) reported reusing noncontact cooling water as process makeup water. Nineteen facilities (42 percent) reported reusing laundry wastewater in the water-washing process before the wastewater had been treated. One of the industrial laundries reported reusing the final rinse from the water-washing process as noncontact cooling water. The noncontact cooling water was then reused at the first rinse in the water-washing process. Eight facilities (18 percent) reported recycling/reusing laundry wastewater back into the water-washing process after the wastewater had been treated. One facility (2 percent) reported reusing nonlaundry wastewater as laundry process water. This facility did not specify the source of the nonlaundry wastewater. No facilities responding to the detailed questionnaire reported reusing contact cooling water.

6.4.2 Energy Conservation in the Industrial Laundries Industry

EPA asked facilities to indicate in the screener questionnaire whether they conserve energy by operating a heat reclaimer. Heat reclaimers at industrial laundries typically operate by transferring heat from the process waste stream to preheat incoming service water. The service water that has been preheated is then used in the wash process. Six hundred sixty-three of the 1,500 facilities responding to the screener questionnaire (44 percent) reported operating a heat reclaimer at their facility.

6.4.3 Dry Cleaning of Solvent Laden Items Prior to Water Washing

General Description

Dry cleaning effectively removes volatile organic compounds (VOCs) from laundry items prior to water washing, thereby reducing the introduction of VOCs into industrial laundry wastewater. Dry cleaning involves cleaning soiled items with an organic-based solvent that removes VOCs as well as heavy organic pollutants (e.g., oil and grease). The pollutants usually are separated from the solvent through distillation and are then disposed. The distilled solvent may then be reused in subsequent dry cleaning processes. Depending on the purity of the pollutants removed from the cleaning solvent, there may be a potential for recycling these for reuse by the customer or for fuel blending.

Industry Application

Five of the 190 in-scope industrial laundries responding to the detailed questionnaire (three percent) reported dry cleaning items before water washing. Four of these facilities reported that they dispose of residual solvent as hazardous waste (one facility did not include this information in its detailed questionnaire response). Three of the four facilities reported that they were large-quantity generators (disposing of greater than 1,000 kilograms of waste per month) and the other facility reported that it was a small-quantity generator (disposing of between 100 and 1,000 kilograms of waste per month).

One of the facilities reuses a significant portion of its cleaning solvent by reusing the solvent from the final rinse from one load as the initial rinse in a subsequent load. In addition, the facility reclaims much of the used solvent by fractionating it in an on-site distillation column. The facility collects the mid-range fractions for reuse and disposes of the light and heavy ends to a hazardous waste incinerator (2).

6.4.4 Steam/Air Tumbling of Solvent Laden Items Prior to Water Washing

General Description

Steam or air tumbling is used to remove VOCs from laundry items prior to water washing to reduce the amount of VOCs introduced into the laundry wastewater. In steam tumbling, soiled items are agitated within a modified washer/extractor while steam is injected into the extractor chamber. The heat from the steam causes the VOCs to evaporate from the

surfaces of the items. The steam and volatilized VOCs are then removed from the tumbler chamber. The steam and volatilized VOCs are sent to a condensing unit where the steam is condensed and the VOCs are recovered through a phase separation. Air tumbling works similarly to steam tumbling, except hot air is used as the source of heat to evaporate the VOCs and phase separation is not required. The VOCs are simply condensed out of the hot air stream. Depending on the purity of the VOC (solvent) recovered from the steam or air tumbling operation, it may be reused by the customer or sent away for fuel blending.

One equipment manufacturer estimates that 90 to 95 percent of the VOC solvent is recovered using its equipment and claims that some customers have achieved a removal efficiency of 98 percent (3). EPA also collected samples of wastewater discharged after processing a load of printer towels/rags that was steam-tumbled prior to water washing and from a load that was not steam-tumbled prior to water washing.

EPA used these samples to identify pollutants removed by steam tumbling by comparing the pollutant concentrations in the washer wastewater from non-steam-tumbled towels/rags to that of towels/rags that were steam tumbled prior to washing to demonstrate changes in the untreated wastewater characteristics from steam tumbling. The data are presented in Table 6-5. All volatile organic pollutants for which a removal could be calculated (pollutant removals for seven volatile organics could not be calculated because the pollutant was not detected in the influent) had greater than 90 percent removal. Therefore, EPA considered organic pollutants with greater than 90 percent removal to be removed by steam tumbling. Based on this criterion, EPA considered all volatile organic pollutants (14 of the 72 pollutants of concern) to be removed by steam tumbling. Ten semivolatile organic pollutants from the list of 72 pollutants of concern for which a removal could be calculated (pollutant removals for eight semivolatile organic pollutants could not be calculated because the pollutant was not detected in the influent) also had greater than 90 percent removal. EPA considered these 10 semivolatile organic pollutants to be removed by steam tumbling. A more detailed discussion of the steam tumbler treatment performance data can be found in Chapter 9 of the Technical Development Document for the proposal rule (4).

However, this data are limited in its usefulness because it is not a direct comparison of the pollutants contained on the printer towels/rags before and after processing them in the steam tumbler. In addition, the results of this comparison show that although steam tumbling removes volatile and semivolatile pollutants, it does not effectively remove nonvolatile pollutants, as evidenced by only 10 percent removal of total petroleum hydrocarbon (measured by SGT-HEM)[1].

[1]Silica gel treated-hexane extractable material (SGT-HEM) is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

Table 6-5

Steam Stripping Performance Data Collected from a Sampled Facility Processing Printer Towels in a Steam Tumbler Prior to Water Washing

Pollutant of Concern	Printer Towel/Rag Raw Wastewater Concentration (mg/L)	Steam Tumbled Printer Towel/Rag Raw Wastewater Concentration (mg/L)	Percent Removal
Bulk Nonconventionals			
Total Petroleum Hydrocarbon (measured as SGT-HEM[1])	519	468	10%
Total Organic Carbon	2480	1770	29%
Priority Organics			
1,1,1-Trichloroethane	4.24	0.0118	100%
Butyl Benzyl Phthalate	6.30	0.366	94%
Chlorobenzene	< 0.1	< 0.01	90%
Chloroform	< 0.1	< 0.01	90%
Ethylbenzene	9.78	< 0.01	100%
Methylene Chloride	0.161	< 0.01	94%
Naphthalene	3.73	0.226	94%
Tetrachloroethene	3.21	< 0.01	100%
Toluene	14.2	0.0436	100%
trans-1,2-Dichloroethene	< 0.1	< 0.01	90%
Trichloroethene	< 0.1	< 0.01	90%
Nonconventional Organics			
2-Butanone	2.24	< 0.05	98%
2-Methylnaphthalene	0.699	< 0.04	94%
2-Propanone	23.4	0.681	97%
4-Methyl-2-pentanone	< 0.5	< 0.05	90%
∝-Terpineol	1.58	< 0.04	97%
m-Xylene	< 0.1	0.0151	85%
n-Decane	158	0.499	100%
n-Dodecane	41.8	2.65	94%
n-Hexacosane	1.30	0.0904	93%
n-Octacosane	1.01	0.0633	94%

Table 6-5 (Continued)

Pollutant of Concern	Printer Towel/Rag Raw Wastewater Concentration (mg/L)	Steam Tumbled Printer Towel/Rag Raw Wastewater Concentration (mg/L)	Percent Removal
Nonconventional Organics (Continued)			
n-Triacontane	0.777	0.0587	92%
o-&*p*-Xylene	< 0.1	0.0146	85%
p-Cymene	19.8	< 0.04	100%

[1]Silica gel treated-hexane extractable material (SGT-HEM) is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

Industry Application

One of the 190 in-scope industrial laundries responding to the detailed questionnaire reported steam tumbling printer towels/rags before water-washing. This facility reported that it was a large-quantity hazardous waste generator (disposing of greater than 1,000 kilograms of waste per month) and that the hazardous waste residuals collected from the steam tumbler were disposed to fuel blending. Another facility (as noted in Table 6-2) reported "airing out" wet items prior to water washing, however, EPA does not consider this to be acceptable air stripping technology because the VOCs removed from the items are not collected.

EPA sampled the facility that steam-tumbled its printer towels/rags. Table 6-5 compares the pollutant concentrations in the washer wastewater (i.e., raw wastewater) from non-steam-tumbled towels to that of towels that were steam tumbled prior to washing.

6.4.5 Centrifuging of Solvent Laden Items Prior to Water Washing

General Description

Centrifugation is used to remove VOCs from laundry items before water washing. In centrifugation, items to be laundered are placed in a mesh bag or perforated basket. The bag or basket is placed in a centrifuge chamber, which is designed to spin around a central axis. The centrifugal forces generated by the spinning chamber act on both the laundry items and the solvent in the items. The bag or basket retains the laundry items while the solvent is forced through the mesh or perforations. The recovered solvent may be reused or recycled, depending on its purity.

In a test performed by EPA on an industrial centrifuge, the solvent removal efficiency ranged from 88 to 99 percent (5). Variables that affected removal efficiency during the test were the vapor pressure and boiling point of the solvent, the type of towel or wiper, and the presence of ink, water, dirt, oil, and other contaminants in the solvent. Additionally, vendor literature indicates 85 to 95 percent removal efficiency for centrifugation (6).

In a case study conducted by EPA, a printing facility centrifuged its towels before they were sent to the laundry, between 2.5 and 3.5 gallons of solvent were recovered for every 220 wipers (7). The facility used the recovered solvent to clean press ink trays. Solvent recovered from the cleaning operation was sent to a fuel blender.

Industry Application

None of the industrial laundries responding to the detailed questionnaire reported using centrifugation to remove VOCs from laundry items prior to water washing and the extent of its use in the industrial laundry industry is not known at this time. However, available information indicates that centrifugation is used in the printing industry to remove solvents from printer towels/rags before they are sent to a laundry (8). As noted in Table 6-2, there are six industrial laundries that reported washing centrifuged items (these items were sometimes

reported as “extracted,” “pressed,” or “squeezed”). Most of these facilities reported that this activity was performed by their customers.

6.4.6 Pressing Solvent Laden Items Prior to Water Washing

General Description

Another way in which industrial laundries can remove excess liquid solvent and VOCs from items prior to water washing is by using a hydraulic ram extractor. Solvent laden items are placed into a perforated chamber. The items are then squeezed by a hydraulic ram that is actuated to compress the items within the chamber. The excess liquid solvents contained on the items flow through the perforations and into a collection system. As described previously, the recovered solvents may be processed for reuse or disposed by the laundry.

Industry Application

EPA knows of two facilities that use hydraulic presses to remove excess liquids from towels and adsorbents prior to water washing. One facility, sampled by EPA, disposes of the collected liquids with other waste oil collected from its wastewater treatment system to a hazardous waste fuel blender (9). The other facility, visited by EPA, also sends its extracted material to a fuel blender. This facility estimates that 30 to 70 pounds (5.5 gallons on average) of material is extracted for each 350-pound load of towels (10).

6.5 Wastewater Treatment Technologies in the Industrial Laundries Industry

This section describes major wastewater treatment technologies used in the industrial laundries industry, based on responses to the detailed questionnaire. Sections 6.5.1 through 6.5.15 of this document describe the wastewater treatment technologies used in the industry, as reported in the detailed questionnaire. These treatment technologies include:

- Gravity settling (Section 6.5.1);
- Stream splitting (Section 6.5.2);
- Screening (Section 6.5.3);
- Equalization (Section 6.5.4);
- Chemical emulsion breaking (Section 6.5.5);
- Chemical precipitation (Section 6.5.6);
- Dissolved air flotation (DAF) (Section 6.5.7);
- Sludge dewatering (Section 6.5.8);
- pH adjustment (Section 6.5.9);
- Ultrafiltration (Section 6.5.10);
- Centrifugation (Section 6.5.11);
- Oil/water separation (Section 6.5.12);
- Media filtration (Section 6.5.13);
- Carbon adsorption (Section 6.5.14); and
- Air stripping (Section 6.5.15).

Each technology section includes a general description of how the technology works, the types of pollutants the technology treats, and the application of the technology in the industrial laundries industry as of 1993. Table 6-6 presents the total number of facilities out of 190 in-scope facilities responding to the detailed questionnaire that reported using each of these technologies. Section 6.5.16 of this document presents updated information on the wastewater treatment technologies currently used by the industrial laundries industry that was collected in 1998 by the industrial laundries trade associations.

6.5.1 Gravity Settling

General Description

Gravity settling, or sedimentation, is primarily used to remove suspended solids from industrial laundry process wastewater. The wastewater is typically collected in a catch basin where the water is detained for a period of time, allowing solids with a higher specific gravity to settle to the bottom of the tank and solids with a lower specific gravity to float to the surface. The effectiveness of solids settling depends upon the characteristics of the laundry wastewater and the length of time the wastewater is held in the catch basin. Properly designed and operated settling tanks are capable of achieving significant reductions of suspended solids and 5-day biochemical oxygen demand (BOD_5) (11).

The solids that settle out or float to the surface may be removed from the basin continuously using automated rakes or augers that scrape the solids into a collection unit for subsequent dewatering or disposal. Alternatively, the basins may be periodically shut down and the solids pumped out and collected for disposal.

Industry Application

It was assumed that a facility reporting a catch basin with an amount of solids removed had gravity settling. Although only 51 percent of in-scope industrial laundries responding to the detailed questionnaire (97 of 190) reported treating their wastewater through gravity settling, every facility visited by EPA has a settling basin in place. Therefore, EPA believes all industrial laundries have settling basins in place and can incorporate gravity settling and solids removal as part of their treatment train without modification of their wastewater treatment equipment. The gravity settling units used at these 97 facilities have an average residence time of 2.3 hours. Ten industrial laundries add chemicals to their gravity settling unit, most frequently sulfuric acid (added by six facilities) and polymer (added by two facilities).

6.5.2 Stream Splitting

General Description

Segregating process wastewater streams provides a means of treating a portion of the total process wastewater generated at industrial laundries. Stream splitting may be used to isolate and treat a stream with a high pollutant load, while a stream with a lower load is either

Table 6-6

Number of In-Scope Facilities Responding to Detailed Questionnaire Using Wastewater Treatment Technologies in the 1993 Operating Year

Technology	Number of Facilities Using Technology	Percentage of Total Number of Industrial Laundries Responding to the Detailed Questionnaire[1]
Gravity Settling	97	51%
Stream Splitting	20	11%
Screening	146	77%
Equalization	98	52%
Chemical Emulsion Breaking	9	5%
Chemical Precipitation	21	11%
Dissolved Air Flotation	35	18%
Sludge Dewatering	52	27%
pH Adjustment	42	22%
Ultrafiltration	2	1%
Centrifugation	6	3%
VOC Removal Technologies	12	6%
Oil/Water Separation	24	13%
Media Filtration	10	5%

[1]Percentages are based on the 190 in-scope industrial laundries that responded to the detailed questionnaire.

recycled and reused or discharged directly to the publicly owned treatment works (POTW) without treatment. This segregation allows a facility to install a smaller treatment system than would be necessary if the total process wastewater stream was treated. In addition, facilities can reduce overall process water use if they can reuse the less concentrated wastewater in place of a portion of fresh service water.

A divided trench and sump system is used to split process wastewater streams. This system is installed as two completely separate trenches and/or sumps, or an existing system may be modified to accommodate two separate wastewater streams. One modification to an existing system entails placing a dividing wall down the center of the existing trench and/or sump. This wall may be constructed of concrete, coated metal plates, or other impervious material. Alternatively, one stream may be hard piped to a specific treatment unit or collection tank while the other stream flows through the existing trench and sump. Pipe made of polyvinyl chloride (PVC) is generally used because of its compatibility with industrial laundry process wastewater pH and temperatures. Facilities often need to install additional collection tanks and transfer pumps to accommodate the two process wastewater streams (12).

In addition to splitting the facility's process wastewater trench and sump system, the washer, extractor, and/or washer-extractor machines must either be capable of releasing process wastewater into separate conduits or be used as dedicated machines for washing a specific item or group of items so the wastewater discharge can be directed to the appropriate trench. Machines can be purchased having multiple water discharge ports and control valves to allow each process break or rinse to be released to a separate location according to the wash formula. For example, the operator may program the washer/extractor to release the initial wash breaks containing the dirtier water to the treatment system to be treated and discharged, while routing the final rinses to a storage tank to be recycled in subsequent washing processes or to be discharged without treatment. Existing machines that do not currently have this capability can be retrofitted with control and discharge valves. Another method of segregating process wastewater is to identify items that generate the more polluted water and those that generate cleaner water. The facility may then designate certain machines to wash a specific group of items and direct all of the process wastewater from those machines to the desired location.

Industry Application

Eleven percent of in-scope industrial laundries responding to the detailed questionnaire (20 of 190) reported segregating their process wastewater streams to treat a portion of the total process wastewater generated at their facilities. One additional facility responding to the detailed questionnaire reported having the capability to segregate its process wastewater stream but did not report treating any portion of this process wastewater.

6.5.3 Screening

General Description

Wastewater is often screened prior to subsequent treatment to remove grit and suspended solids that may potentially damage or clog process equipment located downstream.

Coarse screening is often performed using a bar screen, constructed of flat steel bars welded together in a grid pattern. The bar screen is designed to allow free flow of effluent while removing large objects from the wastewater stream (13). Bar screens can be automatically or manually cleaned to remove the entrapped objects. If performed on a regular basis, manually cleaned bar screens are often the most cost-efficient (14).

Fine screening is performed using lint screens. These screens are constructed of wire mesh or perforated metal plates and are often installed downstream from bar screens. Lint screens are designed to remove lint and other particles, such as sand or grit, from wastewater (13). Hydrosieve or static screens are installed in the process wastewater line and trap the entrained particles as the water passes through the screen. Static screens must be routinely cleaned or changed out to prevent excessive clogging of the wastewater line. This task is often performed manually. The static screen is relatively inexpensive to maintain and operate.

Shaker and rotary screens are mechanically equipped to remove the entrained solids from the screen apparatus to ensure continuous operation. Shaker or vibratory screens operate by intermittently vibrating about the center of mass, forcing the solids from the screen surface, outward toward the periphery, and around to a port through which the solids are removed and collected in a sack or bin. These screens may also include accessories, such as brushes, rakes, and water sprayers, to remove solids and to enhance the performance of the continuous screen cleaning mechanism (15). Figure 6-2 presents a diagram of a shaker screen.

A rotary screen consists of a cylindrical screen that rotates within a chamber. The wastewater passes through the screen as it rotates and the solids are collected on the surface of the screen. The solids are removed from the screen surface by means similar to those of shaker screens (i.e., brushes or water sprays). The rotary screen can be operated either by passing the water from the outside of the rotating screen toward the center of the chamber, with solids collection on the exterior surface, or by passing the wastewater from the center of the chamber toward the exterior, with solids collection on the interior surface of the screen (11).

Most screens are placed at the beginning of the wastewater treatment train. Bar screens, in particular, are most often located at the end of the wastewater trenches that carry the water discharged from the wash room to the treatment system (if present) and the final discharge point. As stated in Section 6.5.1 of this document, EPA believes that all facilities have an initial catch/settling basin located at the end of the trench. Fine screening (either static or mechanical) may be performed either before or after the water is collected in the catch basin. The advantage to screening the water before initial collection is that the amount of solids that will settle and accumulate within the catch basin is reduced, lowering the maintenance costs associated with periodic cleaning of the catch basin.

Industry Application

The majority of in-scope industrial laundries (77 percent) perform at least one screening operation before discharging their wastewater (146 out of 190 in-scope facilities responding to the detailed questionnaire reported having a screen(s)). Thirteen facilities perform coarse screening only, using a bar screen.

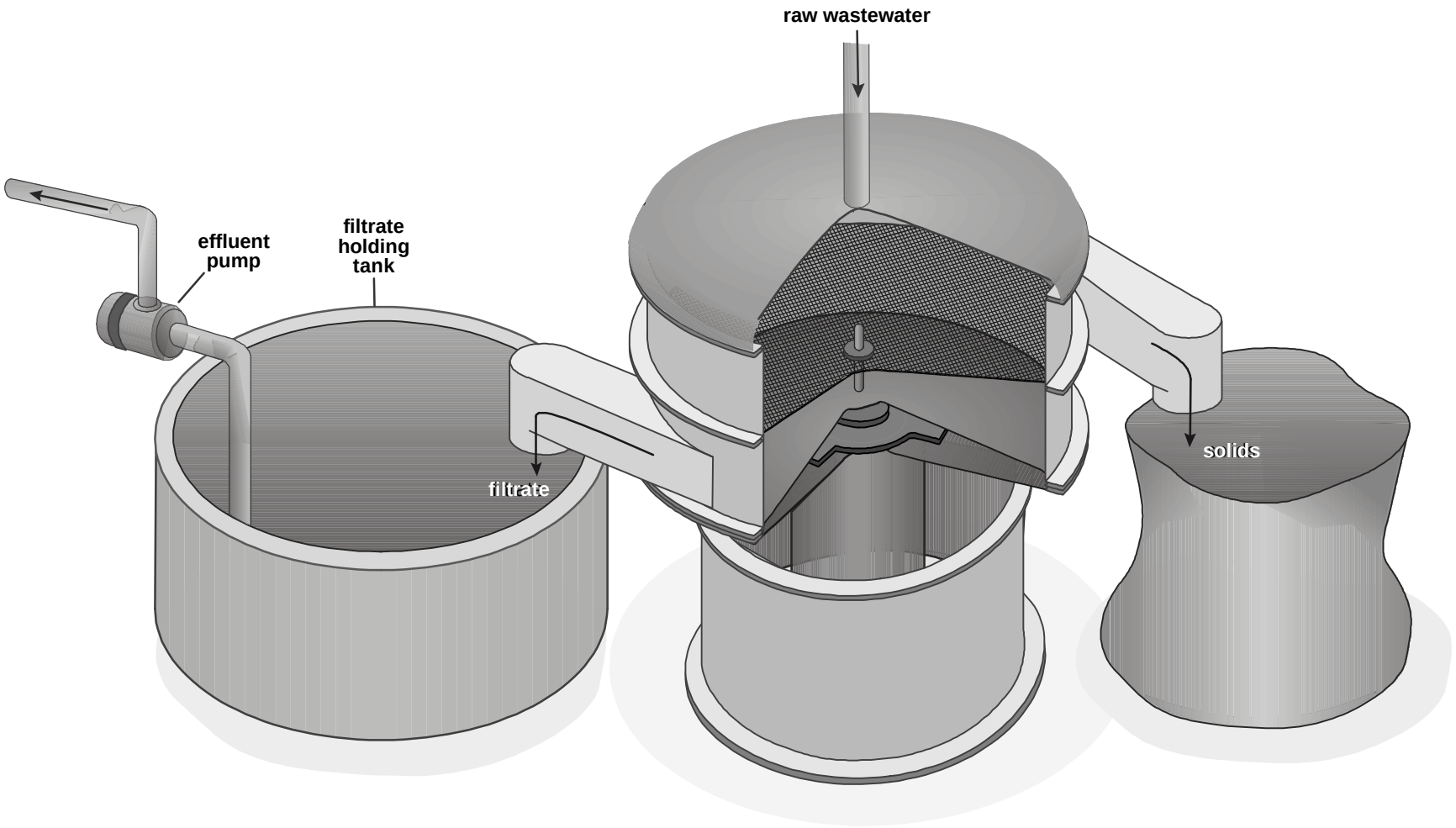

Figure 6-2. Shaker Screen

Forty-three facilities reported at least one type of static screen (e.g., lint screen, box screen, or strainer). The most prevalently used fine screen is the lint screen (reported by 38 facilities); box screen and strainer use was reported much less frequently.

More than half (52 percent) of the facilities reporting a screening operation have at least one mechanical screen. Ninety-two facilities reported having a shaker screen, six facilities reported having a rotary screen, and one facility reported having both types of mechanical screens

Five facilities use coarse screening with a static fine screen; six facilities use coarse screening with a mechanical fine screen; five facilities use both static and mechanical fine screening; and two facilities use all three types of screens: coarse, static fine, and mechanical fine screening.

6.5.4 Equalization

General Description

Equalization is used to control fluctuations in flow and pollutant loadings in process wastewater prior to treatment to overcome operational problems that may result from the fluctuations, reduce the size and cost of the downstream treatment units, and improve the overall performance of these units. Equalization systems are typically designed to eliminate variations in the wastewater, (e.g., flow, pollutant load, and pH) by retaining the wastewater until it can be discharged at a constant rate having uniform characteristics. In this way, facilities can size and operate the downstream treatment units on a continuous-flow basis with minimal disruption in the treatment conditions. The amount of time required to achieve optimum effects depends upon the specific characteristics and daily flow patterns of the wastewater. Equalization units are often equipped with agitators (e.g., impeller mixers and air spargers) to further mix the wastewater and to prevent excessive solids settling at the bottom of the unit. Chemicals may also be added to the equalization units to adjust the pH and otherwise prepare the wastewater for further treatment (16). Section 6.5.9 of this document (pH Adjustment) discusses equalization units that use pH-adjusting chemicals.

Industry Application

It was assumed that a facility reporting at least one vessel from which no solids are collected and to which no chemicals were added had equalization. Fifty-two percent of the in-scope industrial laundries responding to the detailed questionnaire (98 of 190) reported treating their wastewater through equalization. Thirty percent of these facilities reported using at least one mixer to agitate the wastewater. The equalization units reported in the detailed questionnaire have an average residence time of 7.6 hours.

6.5.5 Chemical Emulsion Breaking

General Description

Chemical emulsion breaking is used primarily to remove oil and grease, as well as other related pollutants, from process wastewater streams. Chemical emulsion breaking is effective in treating wastewater streams having stable oil-in-water emulsions. In a stable emulsion, oil is dispersed within the water by way of attractive electrical charges that exist, often as a result of other constituents (e.g., emulsifying agents and surfactants) present in the water. These emulsions require acid addition to lower the pH of the wastewater and neutralize the electrical charges between the oil and water, enabling the oil to form a distinct and separate phase within the water. Chemical emulsion breaking units add demulsifying agents to aid in forming the oil phase and subsequently remove it from the wastewater stream.

Various reactive cations are effective as demulsifying agents to break emulsions (e.g., hydrogen (H +1), aluminum (Al +3), and iron (Fe +3)). Sources of these cations include acids, alum, ferrous salts, and various cationic polymers. The demulsifier is added to the wastewater stream and allowed to react with the water long enough to cause the oil to agglomerate to form a distinct oil phase. Mechanical mixing increases the effectiveness of the demulsifier by dispersing the chemical into the water rapidly and uniformly. Mixing also aids demulsification by causing molecular collisions that help agglomerate oil droplets and subsequently help to break the emulsion.

In batch-mode units, the treated wastewater is allowed to stand long enough to allow the oil droplets, having a lower specific gravity, to rise and form a layer on the surface. This layer may be removed by controlling the water level within the unit, such that the oil layer is raised above a weir and overflows into the collection unit while water underflows the weir. The oil layer may also be removed by manually or mechanically raking the surface over a weir with a skimming device.

Skimming devices typically work by continuously contacting the oil with a material, usually an oleophilic belt or rope, onto which the oil readily adheres. As the material passes through the oil layer, the oil coats the surface of the material. The oil-coated material then passes through a mechanism that scrapes the oil from the material into an oil-collection unit. This process uses a motorized drive to continuously remove oil from the wastewater surface. Figure 6-3 presents a diagram of a batch chemical emulsion breaking unit. Batch chemical emulsion breaking systems can remove significant amounts of oil and grease from process wastewater, if they are designed with optimized residence times and the oil-removal devices are properly operated and maintained.

Continuous chemical emulsion breaking units are equipped with various hydrodynamic structures that physically separate entrained oil droplets from wastewater and pump them to a collection unit while allowing the water to pass through without interruption. These units usually comprise a series of corrugated and/or inclined plates arranged parallel to one another and transverse to the flow of water. They are often built of materials that attract oil away from the water. As the oil droplets impinge on the surfaces of the plates, they coalesce into a

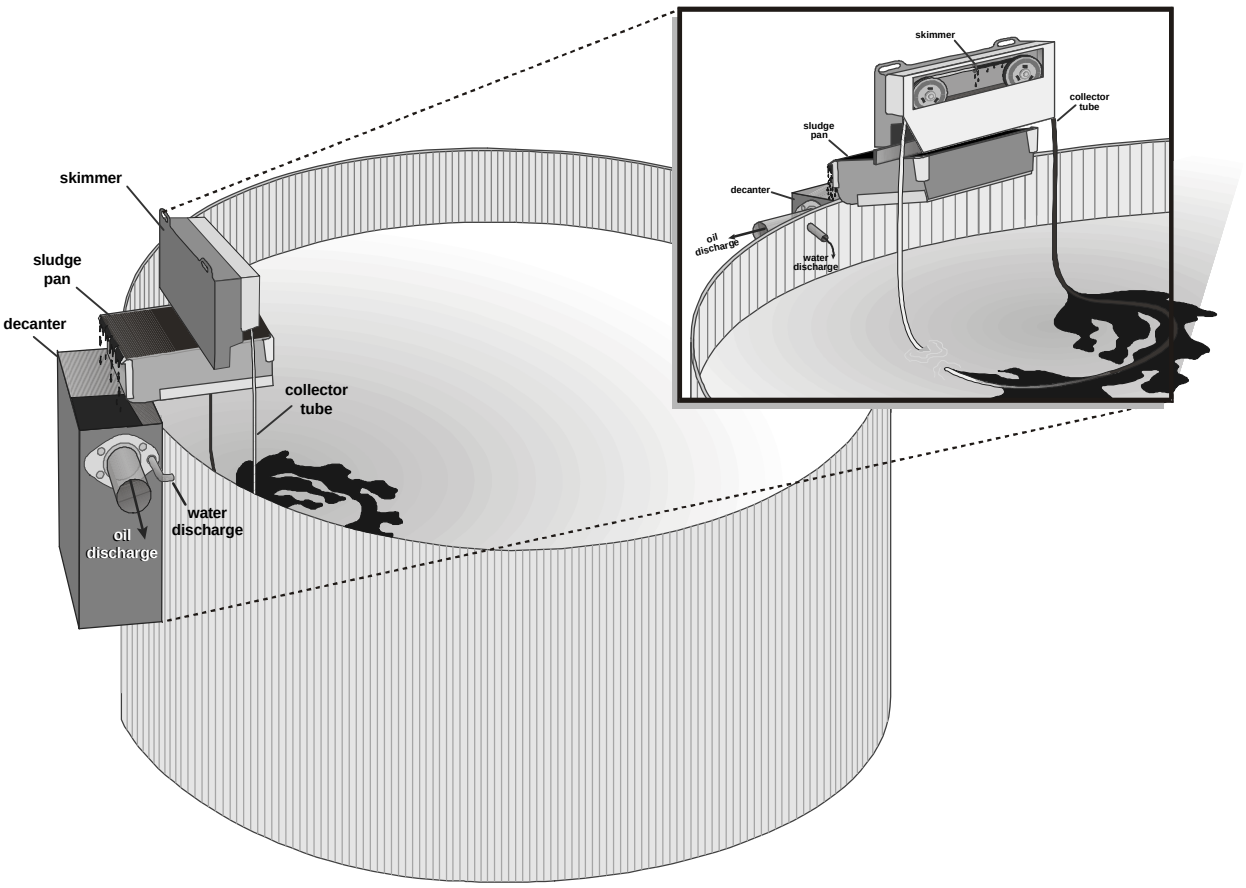

Figure 6-3. Batch Chemical Emulsion Breaking Unit

layer of oil that flows or is pumped from the unit. Figure 6-4 presents a diagram of a continuous chemical emulsion breaking unit with coalescing plates.

Continuous chemical emulsion breaking units do not require long residence times, as do batch systems, and thus are more compact and space efficient. However, they do require uniform wastewater conditions in terms of flow rate and oil and grease loads, which may not be easily achieved in some wastewater treatment systems. In addition, the plates often require routine maintenance to ensure proper operation and to prevent clogging. The effectiveness of batch or continuous systems is highly dependent upon the specific characteristics of the process wastewater (17).

Industry Application

Nine of the 190 in-scope industrial laundry facilities responding to the detailed questionnaire reported treating their wastewater through chemical emulsion breaking and adding acid as a demulsifying agent. Rope skimmers, decant tanks, and gravity separation were reported most frequently (at six of the facilities) to collect the demulsified oil from the surface of wastewater. These six facilities demulsify the oil in a batch process with a median residence time of seven hours. The remaining three facilities run chemical emulsion breaking continuously, using coalescing plates or plate separators. These continuous-process chemical emulsion breaking units have a much lower median residence time (less than one hour). Six of the facilities demulsify all of their process wastewater, and three demulsify only heavy wastewater (the portion of the wastewater with the highest concentration of contaminants). Chemical emulsion breaking is often used as a pretreatment to other technologies; four of the nine facilities reported using chemical emulsion breaking as a pretreatment to either dissolved air flotation (three facilities) or chemical precipitation (three facilities). Eight of the nine facilities that use chemical emulsion breaking reported disposing of the demulsified oil at an oil reclaimer.

Some facilities responding to the detailed questionnaire reported using oil/water separation technologies without adding demulsifying agents to their wastewater. Oil/water separation and the facilities performing this treatment are described in Section 6.5.12 of this document.

6.5.6 Chemical Precipitation

General Description

Chemical precipitation is one of the most commonly used processes in water treatment (18). Specifically, chemical precipitation is used to remove organics, oils, and dissolved pollutants from process wastewater. Precipitation aids, such as lime, work by reacting with the cations (e.g., metals) and some anions to convert them into an insoluble form (e.g., metal hydroxides). The pH of the wastewater affects how much pollutant mass is precipitated, as various pollutants will precipitate only within specific pH ranges. Therefore, the pH of the wastewater is often increased to facilitate maximum pollutant precipitation. Lime and other caustic materials increase the pH of the wastewater stream and react with the dissolved ions to form insoluble compounds, making them good precipitation aids (17).

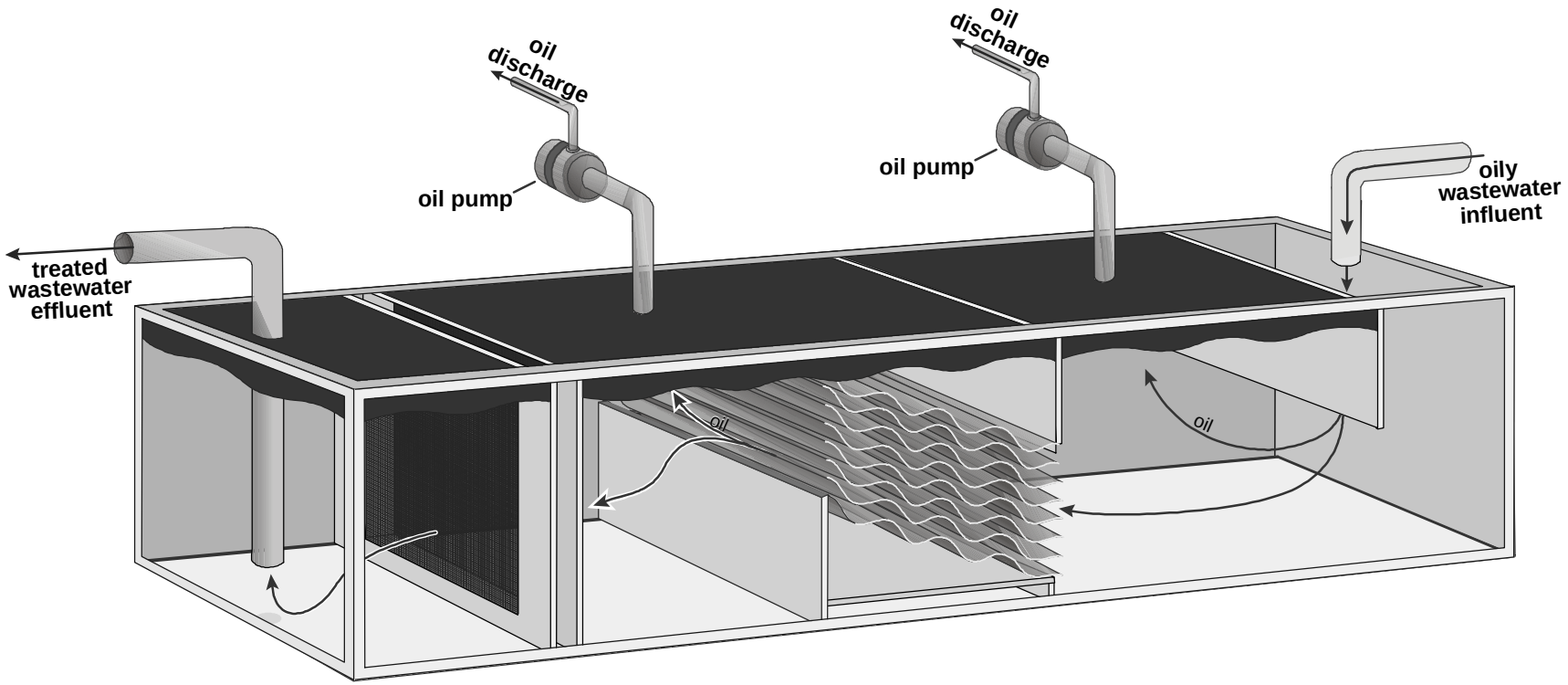

Figure 6-4. Continuous Chemical Emulsion Breaking Unit with Coalescing Plates

In chemical precipitation units, coagulation and flocculation aids are usually added to facilitate the formation of large agglomerated particles that are simpler to remove from the wastewater. The precipitants as well as other suspended solids often have like or neutral surface charges that repel one another. Coagulants bind to the particles in the wastewater stream and essentially convert the surface charges; as a result, opposite charges form between the particles, which causes them to agglomerate. Examples of coagulants include cationic polymers and various inorganic salts, such as ferric chloride ($FeCl_3$), and aluminum sulfate or alum ($Al_2(SO_4)_3 \bullet 18\ H_2O$). Flocculent aids, typically anionic polymers, are added to further enhance the agglomeration of the particles (16).

Like chemical emulsion breaking units, chemical precipitation units may use various mechanisms to remove the agglomerated floc from the wastewater. In batch chemical precipitation systems, the treated wastewater is held in the unit long enough to allow the solids to settle out. The water is then pumped from the unit, and the remaining sludge is removed for further dewatering and subsequent disposal. Figure 6-5 presents a diagram of a batch chemical precipitation system. In a batch system, chemical addition and residence time are easily adjusted based on the particular conditions of the process wastewater. Batch systems usually require the use of two water-holding units connected in parallel (i.e., one is used to treat the process wastewater while the other collects the wastewater to be treated in the next batch) and therefore generally require more space than continuous systems.

Continuous units often use hydrodynamic structures that push the solids downward as the water flows past. These structures usually comprise a series of parallel plates arranged tangentially to the flow of water. As the water flows between them, the heavy particles impinge against the plates and lose enough momentum that they are forced to sink to the bottom of the unit. Continuous units also include pumps or augers that remove the settled solids from the unit. Because of their single unit design and relatively short required retention time, continuous chemical precipitation units are space efficient. However, the performance of continuous systems can be disrupted if wastewater conditions are varied. Figure 6-6 presents a diagram of a continuous chemical precipitation system.

Industry Application

Eleven percent of the in-scope industrial laundry facilities responding to the detailed questionnaire (21 of 190) reported treating their wastewater using chemical precipitation. These can be divided into two groups: facilities that use chemical precipitation to treat their entire wastewater stream (16 facilities) and facilities that use chemical precipitation to treat only a portion of the wastewater stream generated from laundering of heavily soiled items such as shop towels (5 facilities).

Chemicals added during chemical precipitation include lime, anionic polymers, and cationic polymers. Facilities using chemical precipitation fall into two categories, or “schemes,” depending on the chemicals added during chemical precipitation.

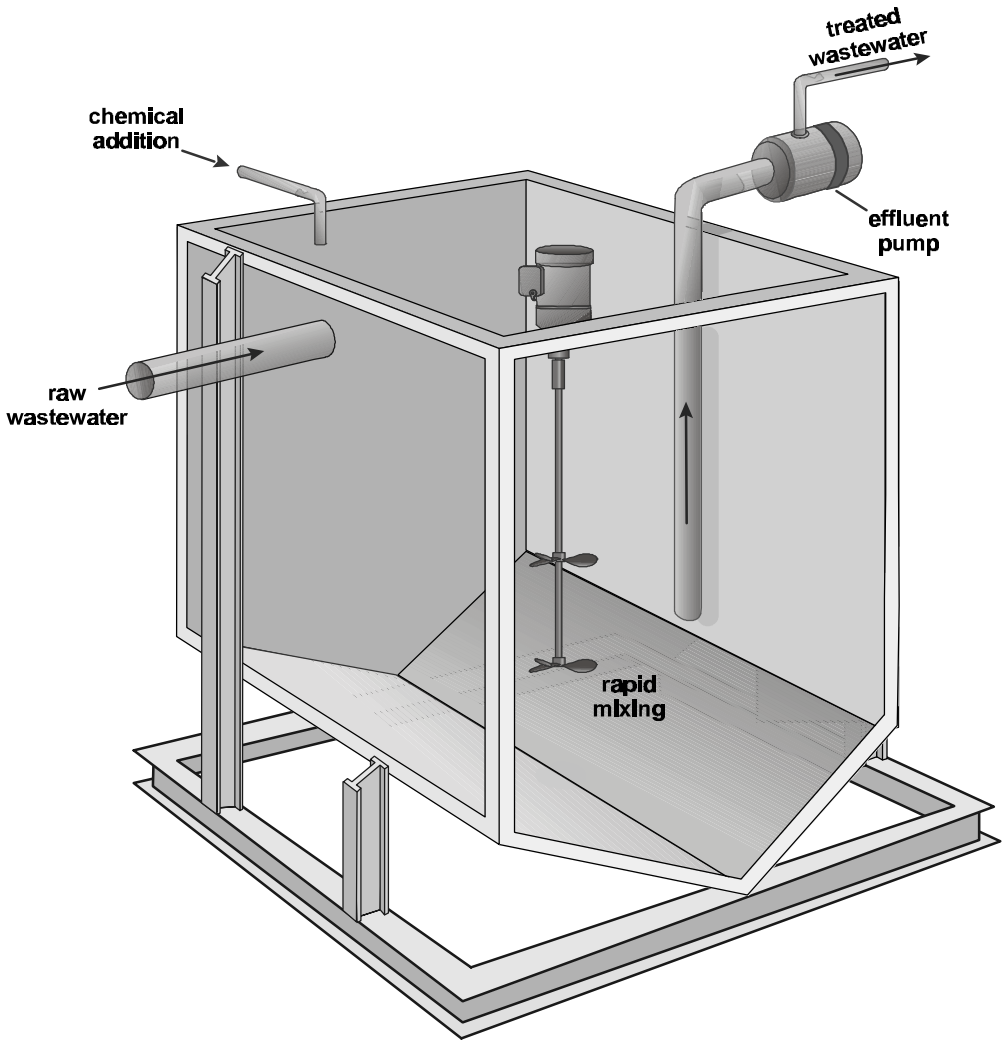

Figure 6-5. Batch Chemical Precipitation System

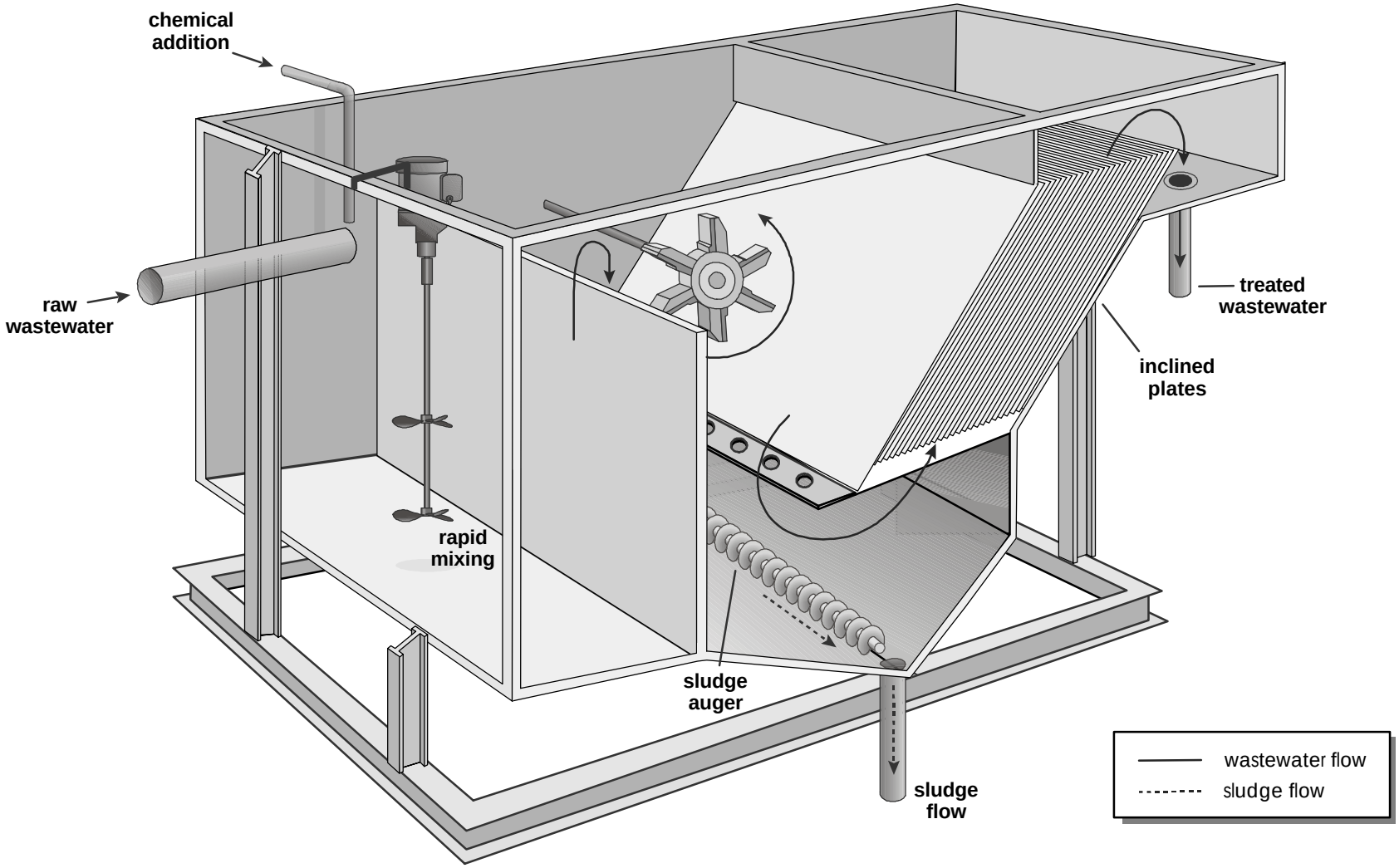

Figure 6-6. Continuous Chemical Precipitation System

The following table shows the distribution of facilities within each scheme that either treat only the portion of their wastewater stream generated from laundering heavily soiled items or their entire wastewater stream.

Scheme	Chemicals Added	Number of Facilities Treating Only Heavy Waste Stream	Number of Facilities Treating Entire Waste Stream
Scheme A	Polymer, lime	4 (13%)	6 (29%)
Scheme B	Polymer	1 (5%)	10 (48%)

There are 18 facilities using chemical precipitation that reported operating a continuous treatment unit. Three facilities reported using a batch chemical precipitation operation.

6.5.7 Dissolved Air Flotation (DAF)

General Description

Dissolved air flotation (DAF) is used to remove suspended solids, emulsified oil, and some dissolved pollutants from process wastewater. DAF treatment involves coagulating and agglomerating the solids and emulsified oil and floating the resulting floc to the surface using pressurized air injected into the unit. During this process, chemicals such as ferric and aluminum salts, activated silica, and cationic polymers are typically added to alter the repellant surface charges of the particles in the wastewater and cause them to agglomerate (13). Certain dissolved pollutants (e.g., metals) may be precipitated by reacting with the inorganic salts to form insoluble particles that also agglomerate with the floc. Flocculent aids (typically anionic polymers) are also added to DAF treatment systems to further enhance the formation of large particles.

DAF uses a dissolved air stream injected into the bottom of the unit to provide the flotation mechanism. Air is injected into a water tank under sufficient pressure to dissolve the air within the water. As the water is injected into the DAF unit, the pressure is decreased and the air is brought out of solution, creating many small bubbles. The large floc particles attach to the rising bubbles and are brought to the surface of the unit. Injected air flotation (IAF) systems (also referred to as induced air flotation) work in a similar fashion, but do not use pressurized air. Instead, the air is injected directly into the IAF unit. DAF units use rakes that scrape the floc from the surface and into a sludge collection vessel, where it is subsequently pumped to a dewatering unit and later disposed of. Some solids are expected to settle to the bottom of the unit; therefore, some units also have bottom sludge removal rakes or augers (13).

DAF is used in the water treatment industry to remove fat, oils, fibers, and grease from wastewater and algae from nutrient-rich reservoir water. DAF is commonly used to treat water when sedimentation treatment proves ineffective. Water with low turbidity or low alkalinity or colored water may not be effectively treated through sedimentation. DAF units are

typically operated on a continuous basis and incorporate the chemical mix tanks, flotation vessels, and sludge collection into a single unit. Figure 6-7 presents a diagram of a DAF unit.

Industry Application

Eighteen percent of the in-scope industrial laundry facilities responding to the detailed questionnaire (35 of 190) reported treating their wastewater using DAF. All of these facilities add chemicals to the DAF and collect the DAF float sludge. (Two additional facilities that reported using DAF were excluded because they do not collect float sludge.) In addition, 10 of the facilities reported that they also collect bottom sludge.

Chemicals added to the DAF unit include sulfuric acid, inorganic coagulants (metal salts), anionic polymers, cationic polymers, and flocculents. Facilities using DAF fall into four categories, or "schemes," depending on the chemicals added during treatment:

Scheme	Chemicals Added	Number of Facilities Treating Waste Stream
Scheme A	Polymer, inorganic coagulant (e.g., metal salt)	11 (31%)
Scheme B	Polymer	9 (26%)
Scheme C	Polymer, flocculent	7 (20%)
Scheme D	Polymer, flocculent, inorganic coagulant (e.g., metal salt)	6 (17%)

Note: EPA did not receive treatment chemical information for all of the DAF facilities, so the total does not add up to 100 percent.

Thirteen facilities also add sulfuric acid to the wastewater before it enters the DAF unit.

6.5.8 Sludge Dewatering

General Description.

Sludge dewatering processes remove water from sludge that is generated from the wastewater treatment process. Sludge dewatering provides the following benefits to a facility's operations:

- Substantially reduces the costs for sludge disposal by reducing the sludge volume;
- Allows for easier handling than thickened or liquid sludge; dewatered sludge may be transported via manual shoveling, tractors fitted with buckets and blades, and belt conveyors;
- Reduces the requirements for supplemental bulking agents or amendments added to sludge prior to composting;

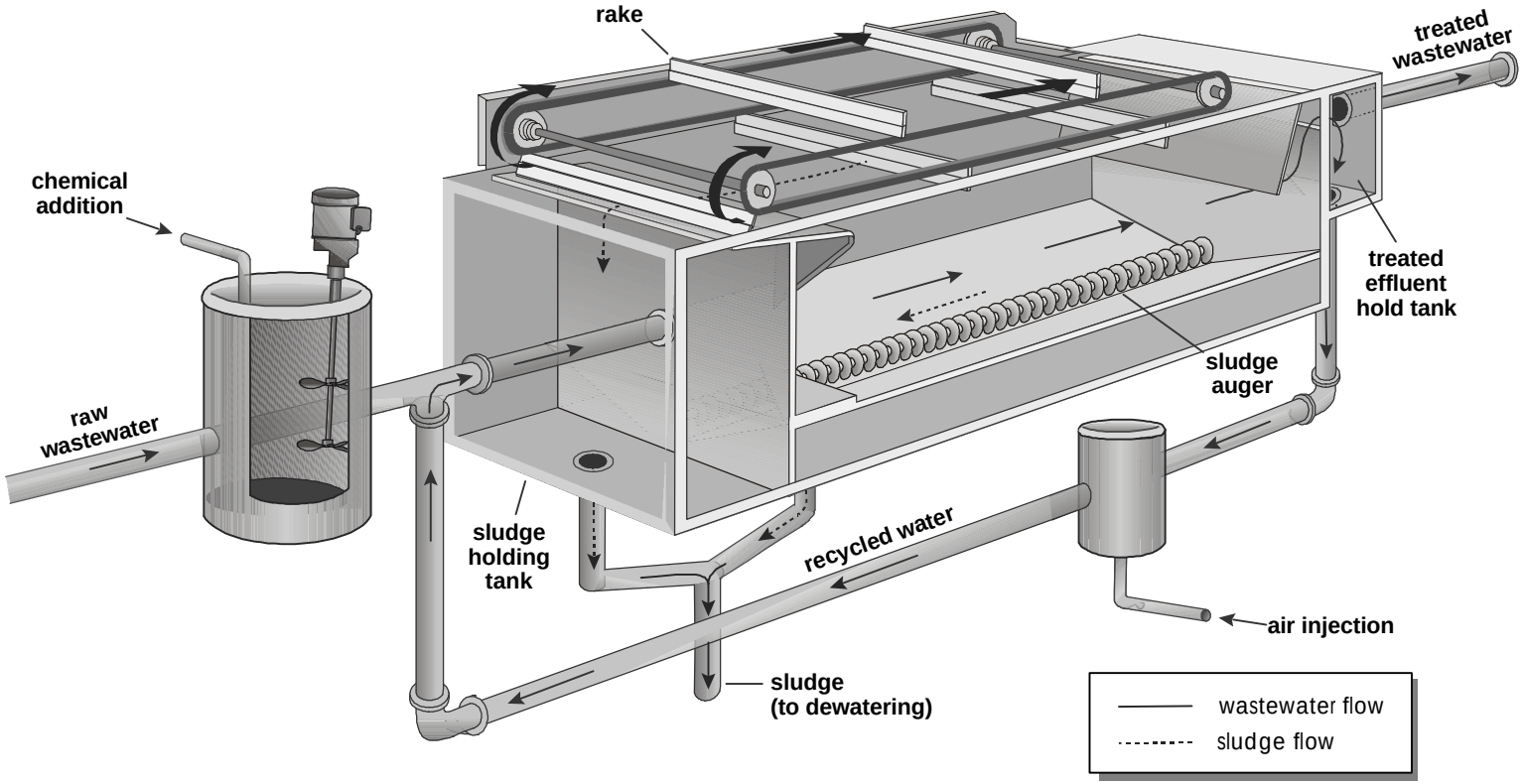

Figure 6-7. Dissolved Air Flotation Unit

- May be a requirement for sludge disposal to render the sludge odorless and nonputrescible; and

- May be a requirement for landfill disposal of sludge to reduce leachate production at the landfill site (11).

Dewatering may involve simple techniques, such as natural evaporation or drying of sludge using heat. Various mechanical techniques may also be used to remove water from sludge more rapidly, such as filtration, squeezing, capillary action, vacuum withdrawal, and centrifugal separation and compaction (11). The two most prevalent mechanical dewatering devices reported in the industrial laundries industry are the rotary vacuum filter and the plate and frame filter press.

The rotary vacuum filter is a cylindrical drum with a filter medium (e.g., natural fiber cloth or screen) around its perimeter. The drum is horizontally suspended within a vessel and is partially submerged in the sludge. The drum is rotated and the drum filter surface contacts the sludge within the vessel while a vacuum is drawn from within. This draws the water through the filter medium from the outside of the drum toward the axis of rotation and discharges it through a filtrate port. The solids become trapped against the filter medium, forming a dewatered filter cake around the outside of the drum. Rotary vacuum filters typically include a knife or a blade, which continuously scrapes the dewatered cake from the outside of the drum and into a collection bin. These types of filters can obtain a reasonably dry cake appropriate for disposal; however filter aid materials (e.g., diatomaceous earth or perlite) are usually required to precoat the filter (11). Figure 6-8 presents a diagram of a rotary vacuum filter.

Filter presses use positive pressure to drive the water through the filter medium. This type of unit comprises a series of recessed plates affixed with a filter medium (e.g., filter cloth) that are stacked together horizontally on a frame. During operation, the plates are forced together by a hydraulic ram or powered screw. The plates form a series of spaces separated by the filter medium and are otherwise sealed to withstand the internal pressures created during the filtration cycle. As the sludge is forced through the system, the water passes through the filter medium and is discharged through the filtrate port while the solids become trapped within the spaces, forming a dewatered cake against the filter medium. When the cycle is over, the plates are separated and the dewatered cake is released into a collection bin. The operator often has to remove the cake from the filter medium manually. Filter presses are usually able to achieve a drier filter cake than rotary drum filters and do not require precoating with a filter aid. The filtrate that results from either of these operations is usually piped back to the beginning of the treatment system or is simply discharged with the effluent water. Figure 6-9 presents a diagram of a filter press.

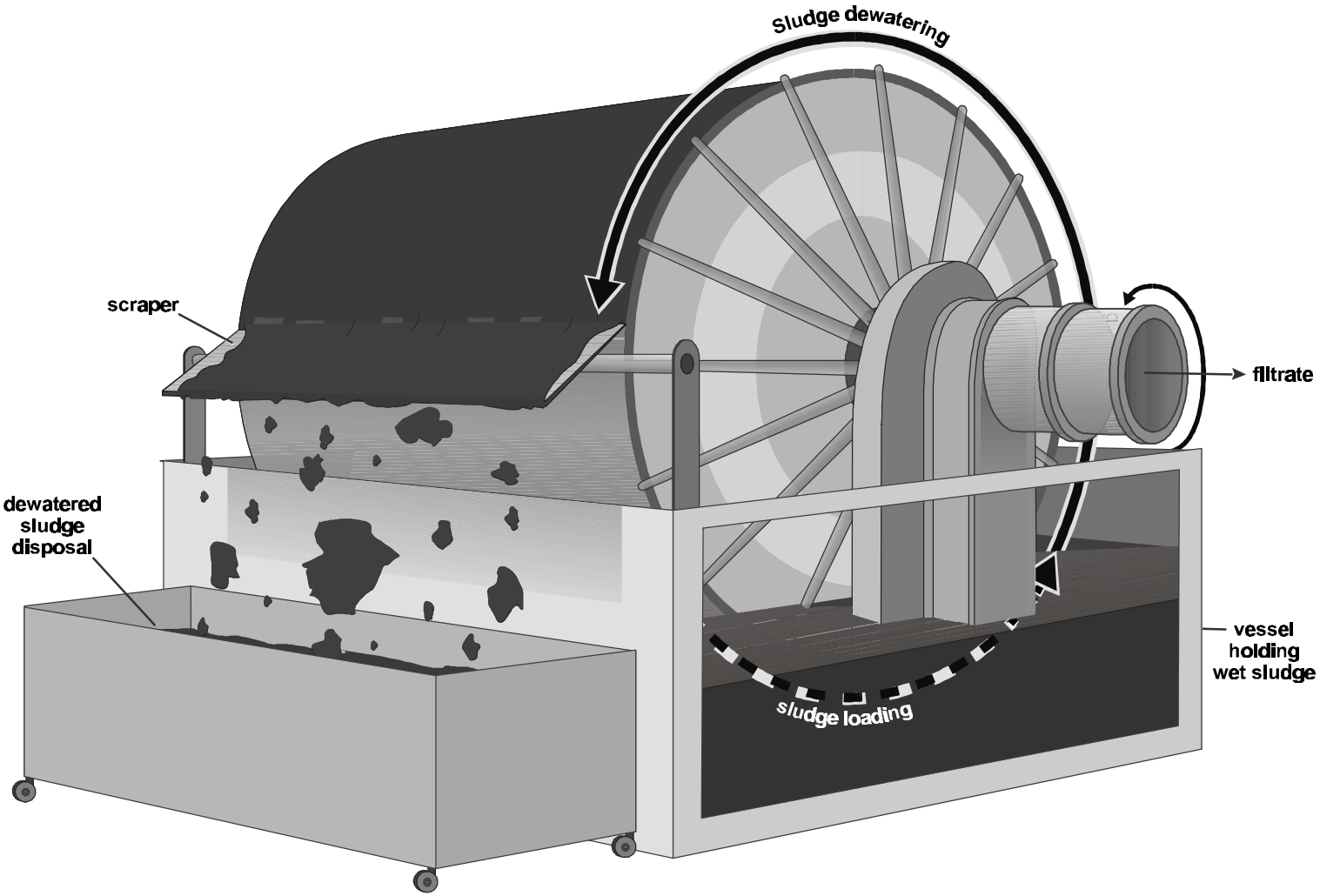

Figure 6-8. Rotary Vacuum Filter

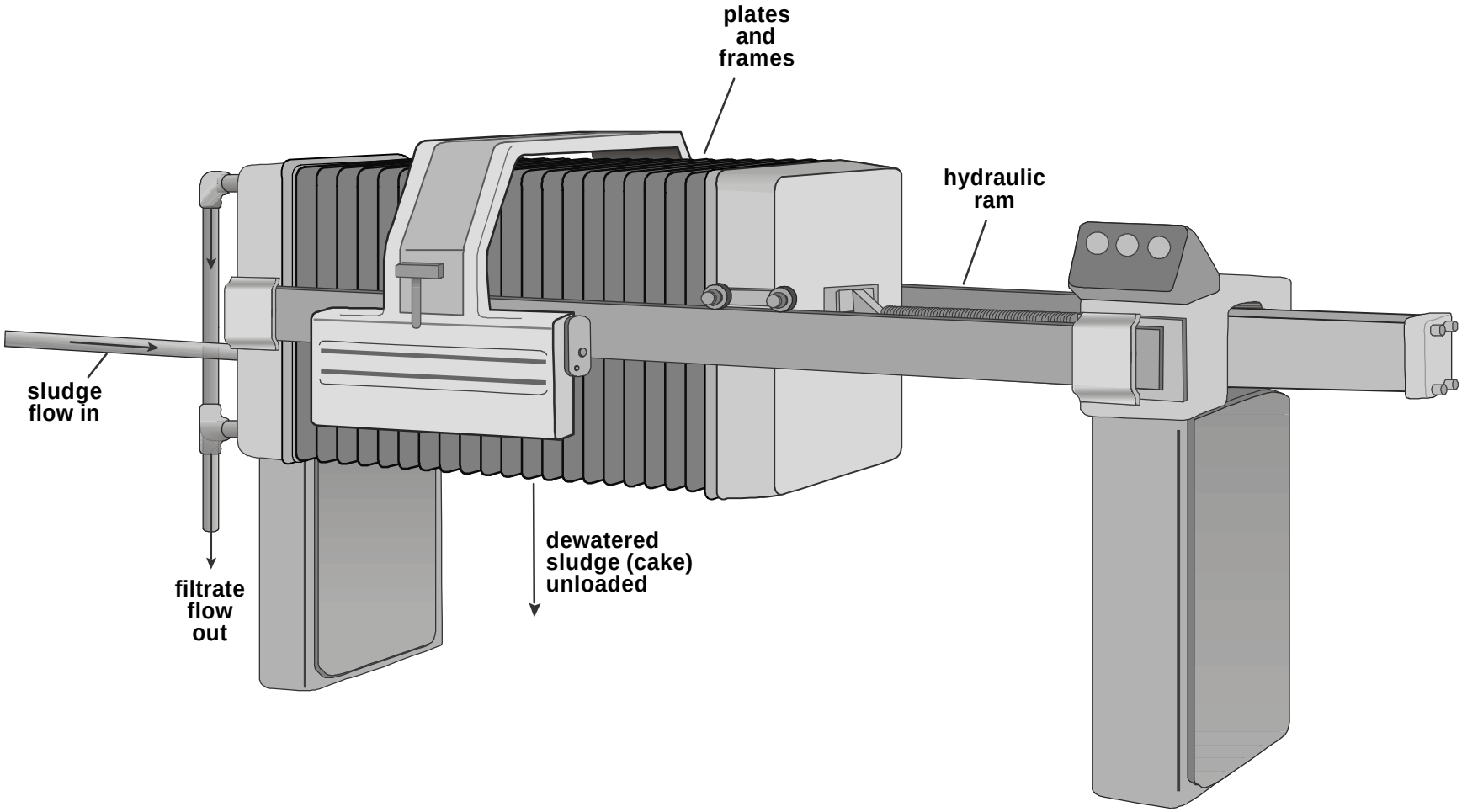

Figure 6-9. Filter Press

Industry Application

Twenty-seven percent of the in-scope industrial laundry facilities responding to the detailed questionnaire (52 of 190) reported dewatering their sludge before disposal. The types of dewatering devices reported include:

Dewatering Device	Number of Facilities
Plate and frame filters	32 facilities (62%)
Rotary vacuum filters	12 facilities (23%)
Sludge dryers	3 facilities (6%)
Bag filters	2 facilities (4%)
Other	4 facilities (8%)

Note: One facility reported both a rotary vacuum filter and a sludge dryer.

In the industrial laundries industry, most of the sludge that is dewatered comes from DAF or chemical precipitation units. More than half of the dewatering devices (27 of 52 facilities) process sludge from a DAF unit. Sixteen dewatering devices process sludge from a chemical precipitation unit. The remaining dewatering devices process sludge from other sources.

Characteristics of industrial laundry sludge are highly dependent on the items washed, water conditions, and upstream treatment. Facilities responding to the detailed questionnaire that generate sludge reported an average solids content of 17 percent for the undewatered sludge. Facilities that dewater a sludge reported an average solids content of 40 percent for the dewatered sludge.

Fifty-four percent of facilities that dewater sludge add one or more chemicals that aid in dewatering. The chemicals commonly added to aid in industrial laundry sludge dewatering are:

Chemical Added	Number of Facilities
Lime	12 (43%)
Polymer	10 (36%)
Diatomaceous earth	5 (18%)
Perlite	5 (18%)
Ferric chloride	3 (11%)

Note that facilities that add more than one chemical are represented twice in the above table.

6.5.9 pH Adjustment

General Description

Because many treatment technologies used in the industrial laundries industry are sensitive to pH fluctuations, pH adjustment may be required as part of an effective treatment system. In addition, the pH of the final effluent from these technologies must often be adjusted prior to discharge to meet POTW regulatory limits. A pH adjustment system normally consists of a small tank in which the wastewater pH is adjusted by chemical addition controlled by a pH meter and mixing. To adjust the pH of the wastewater, either caustics or acids are added to the mixing tank. Some treatment technologies require a high pH (e.g., chemical precipitation), while others require a low pH (e.g., chemical emulsion breaking).

Industry Application

It was generally assumed that facilities reporting at least one vessel into which either acid or base was added had pH adjustment. Twenty-two percent of in-scope facilities responding to the detailed questionnaire (42 of 190) reported treating their wastewater with pH adjustment. Several industrial laundries reported operating more than one pH adjustment unit. Therefore, the facilities responding to the questionnaire reported operating a total of 46 pH adjustment units. Acid (usually sulfuric) is added to the pH adjustment unit most frequently (41 of 46). However, sodium hydroxide (4 of 46), and lime (2 of 46) are also added to the pH adjustment units. Seventy percent of the pH adjustment units discussed in the detailed questionnaire (32 of 46) have one or more mixers. The average residence time of all 46 units at the 41 facilities is 2.1 hours.

6.5.10 Ultrafiltration/Microfiltration

General Description

Ultrafiltration and microfiltration use semipermeable polymeric membranes to separate emulsified or colloidal materials suspended in the process wastewater stream by pressurizing the wastewater so that it permeates the membrane. The membrane of an ultrafilter or a microfilter forms a screen that retains molecular particles based on their differences in size, shape, and chemical structure. The membrane allows solvents and lower molecular weight molecules to pass through.

In an ultrafiltration or microfiltration process, the wastewater is pumped through the membrane. Water and some low-molecular-weight materials pass through the membrane under the applied pressure (e.g., 10 to 100 psig). Emulsified oil droplets and suspended particles are retained, concentrated, and removed continuously (17). Ultrafiltration and microfiltration have the benefit of removing entrained solids and oils from wastewater with lower capital costs than chemical treatment (19). However, the limitations of the technologies include fairly narrow optimum operating conditions in terms of pH and temperature. In addition, if the wastewater has a high concentration of suspended solids, the wastewater will require substantial pretreatment to remove the solids to avoid excessive clogging of the membrane and increased maintenance costs.

Industry Application

One facility responding to the detailed questionnaire reported operating an ultrafiltration unit and one facility reported operating a microfiltration unit (one percent total). EPA has since contacted these facilities to determine the effectiveness of ultrafiltration/ microfiltration in treating industrial laundry wastewater. At the facility reporting use of the ultrafiltration unit, facility personnel reported that the ultrafiltration unit effectively treats wastewater generated at the facility. The filter membrane was changed out after 4.5 years of operation in 1997. Facility personnel did not report difficulties with membrane clogging. The wastewater from the facility is treated with a screen and pH adjustment prior to the ultrafiltration unit. At the facility reporting use of the microfiltration unit, facility personnel reported that they have since discontinued use of the microfiltration unit because the microfilter clogged whenever wastewater containing high levels of oil and grease was treated. Because of this clogging, the facility could not attain the required flow rate through the microfiltration unit.

6.5.11 Centrifugation

General Description

Centrifugation applies centrifugal forces to settle and separate higher density solids from process wastewater. The two most common types of centrifuges are the solid bowl decanter and the basket-type centrifuge. The solid bowl decanter consists of a long bowl, mounted horizontally and tapered at one end. The sludge or wastewater is introduced at one end continuously while the bowl rotates, and solids concentrate on the inner wall of the bowl as a result of the centrifugal forces caused by the bowl's rotation. A helical scroll, spinning at a slightly different speed, moves the accumulated sludge toward the tapered end. The sludge is then discharged. The basket centrifuge operates on a batch basis. The sludge or wastewater is introduced into a vertically mounted spinning bowl. The solids accumulate against the wall of the bowl and the water is decanted by being forced over the bowl's outer lip. When the bowl has reached its capacity in solids collection, the spinning is stopped and a scraper is used to remove the solids. The basket-type centrifuge is well suited for sludges containing fine solids that are difficult to filter or where the nature of the solids varies widely (11).

Centrifugation may be combined with certain wastewater treatment chemicals that act to bring additional pollutants out of solution and form an insoluble floc (e.g., as in chemical precipitation) that is also separated from the wastewater by the centrifugal forces.

Industry Application

Three percent of in-scope industrial laundries responding to the detailed questionnaire (6 of 190) reported treating their wastewater with centrifugation. Two of these facilities treat their wastewater with chemical precipitation and use centrifugation to remove the sludge from the treated wastewater. The remaining four facilities reported using centrifuges to remove lint from their raw wastewater. While only five of the six facilities reported removing sludge generated during centrifugation, EPA believes that all facilities treating their wastewater with centrifugation remove the sludge generated.

6.5.12 Oil/Water Separation

General Description

Like chemical emulsion breaking units, oil/water separators are used primarily to remove oil and grease, as well as other related pollutants, from process wastewater streams. Oil/water separators are similar to batch chemical emulsion breaking units except that no chemicals are added to an oil/water separator to enhance separation.

During oil/water separation, the wastewater is allowed to stand long enough to allow the oil droplets, having a lower specific gravity, to rise and form a layer on the surface. This layer may be removed by controlling the water level within the unit, such that the oil layer is raised above the weir and overflows into the collection unit while water underflows the weir. The oil layer may also be removed by manually or mechanically raking the surface over a weir with a skimming device.

Skimming devices typically work by continuously contacting the oil with a material, usually an oleophilic belt or rope, onto which the oil readily adheres. As the material passes through the oil layer, the oil coats the surface of the material. The oil-coated material then passes through a mechanism that scrapes the oil from the material into an oil-collection unit. This process uses a motorized drive to continuously remove oil from the wastewater surface. The skimming device shown in Figure 6-3 is similar to the type of skimming device used in oil/water separators.

Industry Application

Thirteen percent of industrial laundries responding to the detailed questionnaire (24 of 190) report treating their wastewater through oil/water separation. None of these facilities add demulsifying agents (e.g., acid) to their wastewater and are therefore not considered to treat their wastewater with chemical emulsion breaking, as described in Section 6.5.5 of this document. These facilities employ various devices to remove the oil that has risen to the surface of the wastewater. These include:

- Oil skimmer (63 percent);
- Oil mop (17 percent);
- Coalescer (13 percent); and
- Decanter (4 percent).

The average residence time of the wastewater in the oil/water separation units is 8.5 hours.

6.5.13 Media Filtration

General Description

Media filtration is used primarily to remove suspended solids from process wastewater streams. During the filtration process, wastewater flows through a filter medium causing solids suspended in the water to become trapped in the medium. Filter media are usually beds of granular particles such as sand, anthracite, garnet, or carbon. The speed at which wastewater flows through the filter medium controls the size and number of suspended particles removed from the wastewater stream. To control the wastewater flow rate through the filter medium, the wastewater may flow horizontally or vertically through the filter bed, or the wastewater may be pumped under pressure through the filter bed.

As wastewater flows through the filter medium, suspended solids removed from the wastewater become trapped in the interstitial spaces between the granular particles of the filter bed. Over time, this may cause the filter medium to become clogged. Therefore, some media filtration units may be periodically backwashed to unclog the filter medium.

Industry Application

Ten of the 190 in-scope industrial laundries responding to the detailed questionnaire (five percent) reported operating a media filtration unit. Two of these facilities reported operating two media filtration units, resulting in 12 total media filtration units operated by the in-scope industrial laundries responding to the detailed questionnaire. Sand was the most commonly filter medium reported (7 of 12; 58 percent). Four media filtration units used sand alone (33 percent); three media filtration units operated with sand, anthracite, and garnet as the filter media (25 percent). Seventeen percent of the media filtration units (2 of 12) used cloth as the filter medium. One media filtration unit operated with carbon as the filter medium. Another media filtration unit operated with clay as the medium. The final media filtration unit operated with metal filings as the medium. Ninety-two percent of the media filtration units (11 of 12) operate under pressure. Eight media filtration units are periodically backwashed to prevent clogging of the filter media. All seven sand media filtration units and the metal filings media filtration unit are periodically backwashed. Facilities operating media filtration with backwash reported an average backwash cycle of 10 minutes, which occurs an average of three times per day.

6.5.14 Carbon Adsorption

General Description

Carbon adsorption uses activated carbon to remove dissolved VOCs from process wastewater. Activated carbon consists of an amorphous form of carbon that has been specifically treated with an oxidizing gas to form a highly porous structure having a large internal surface area. Granulated forms of this carbon are often used in a fixed-bed column. The wastewater is admitted into the unit from the top and is allowed to flow downward though a bed of the granulated activated carbon that is held in place within the column. As the water comes in

contact with the activated carbon, the dissolved VOCs adsorb onto the surface of the activated carbon. Figure 6-10 presents a diagram of a fixed-bed activated carbon adsorption column.

As the activated carbon becomes increasingly saturated with VOCs, the effectiveness of the unit decreases and the carbon must be regenerated. In this process, the spent activated carbon is oxidized which removes the adsorbed VOCs from the surfaces. This process may destroy some of the activated carbon and decrease the performance of the rest. Therefore, the activated carbon must be periodically replaced for the adsorption unit to continue to operate effectively.

To maximize the performance and life of the activated carbon bed, all materials contained in the wastewater (e.g., suspended particles and heavy organics) that may foul the bed by "clogging" the pores of the carbon particles must be removed prior to this treatment process. In addition, the performance of the units may be improved by periodically backflushing the units. Fixed-bed carbon adsorption units may be operated singly, in series, or in parallel.

Industry Application

Two of the 190 industrial laundries (one percent) reported operating activated carbon adsorption columns to remove VOCs from their process wastewater.

6.5.15 Air Stripping

General Description

Air stripping is usually performed in a countercurrent, packed tower or tray tower column. The wastewater is introduced at the top of the column and allowed to flow downward through the packing material or trays. Air is simultaneously introduced at the bottom of the column and blows upward through the water stream. Volatile organics are stripped from the water stream, transferred to the air stream, and carried out of the top of the column with the air. The treated water is discharged out of the bottom of the column. Because the air stream now contains the VOCs, an air emission control device (e.g., a carbon adsorption unit) may be required to remove the VOCs before the air is released to the atmosphere.

Industry Application

Three of the 190 in-scope industrial laundries responding to the detailed questionnaire (two percent) reported operating air strippers to remove VOCs from their process wastewater. However, through site visits EPA is aware that one of these facilities does not operate its air stripper.

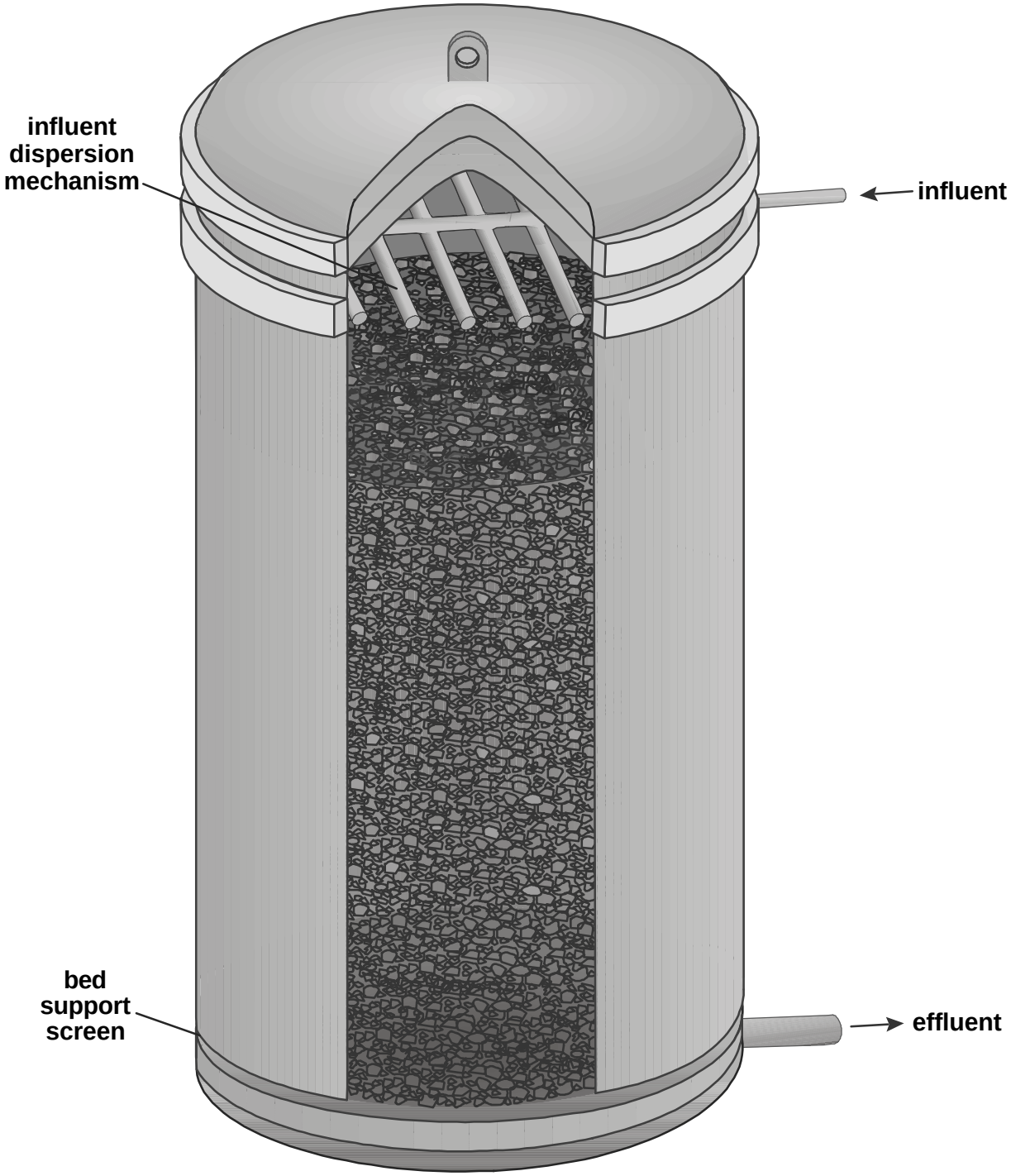

Figure 6-10. Fixed-Bed Activated Carbon Adsorption Column

6.5.16 Wastewater Treatment Technologies Used by the Industrial Laundries Industry in 1998

As discussed in Section 3.7.2, the industrial laundries trade associations (the Uniform and Textile Service Association (UTSA) and the Textile Rental Services Association (TRSA)) solicited updated data on wastewater treatment practices from industrial laundries sent EPA's detailed questionnaire. Of the 190 in-scope facilities, 162 responded to the UTSA/TRSA survey. Table 6-7 summarizes the difference in the use of each major type of wastewater treatment (e.g., chemical emulsion breaking, DAF, and chemical precipitation) reported in the detailed questionnaire for the 1993 operating year and in the UTSA/TRSA survey for the 1993 operating year.

Because the treatment system descriptions reported in the survey often did not include design parameters or the portion of wastewater treated, EPA made several assumptions in order to use the data provided by the trade associations. EPA determined that 18 facilities that did not have treatment at the time of the detailed questionnaire subsequently installed wastewater treatment for all or part of their wastewater flow. Most facilities that have installed treatment since 1993 (13 of the 18) have installed DAF. Other types of treatment installed include chemical emulsion breaking (at two facilities), chemical precipitation (at two facilities), and biological treatment (at one facility) (20).

In addition, some facilities changed their main treatment technology since 1993: four facilities changed from chemical precipitation to DAF, one facility changed from chemical emulsion breaking to DAF, and one facility changed from microfiltration to chemical emulsion breaking (20).

6.6 Pollution Disposal Practices in the Industrial Laundries Industry

This section presents information on the various types of wastewater, solvent, and sludge wastes that may be generated at industrial laundries and the disposal practices reported in the detailed questionnaire or observed by EPA during site visits and sampling episodes.

6.6.1 Wastewater Disposal

All 190 in-scope industrial laundries responding to the detailed questionnaire reported discharging their wastewater to a publicly owned treatment works (POTW), a privately owned treatment works (PrOTW), a federally owned treatment works (FOTW), or a centralized treatment works (CTW). Three percent of the facilities discharging wastewater (5 of 190) also reported disposing of a portion of their wastewater by land application.

Contract hauling of facility wastewater, in lieu of on-site treatment, may be a cost-effective and technically feasible option for some industrial laundries. Wastewater to be hauled off site could be stored in above ground storage tanks and hauled off site in 5,000 gallon increments, which is the capacity of most vacuum tankers used to haul the wastewater.

Table 6-7

Comparison Between Treatment Technologies Reported in 1993 and 1998

Major Wastewater Treatment Unit Used and Portion of Wastewater Treated	Number of Facilities from EPA's 1994 Detailed Questionnaire	Number of Facilities from UTSA/TRSA's 1998 Survey
Chemical Emulsion Breaking	5	7
Chemical Precipitation of part of the facility's wastewater	5	4
Chemical Precipitation of all facility wastewater	12	11
Dissolved Air Flotation of part of the facility's wastewater	2	8
Dissolved Air Flotation of all facility wastewater	30	42
Microfiltration of part of the facility's wastewater	1	0
Ultrafiltration of all facility wastewater	1	1
No treatment	106	89[1]

[1]One facility from the UTSA/TRSA survey may be operating biological treatment.

The frequency of bulk wastewater pickups would depend on the amount of time required to generate 5,000 gallons of wastewater. The wastewater, handled as nonhazardous waste, may be hauled off site for treatment to a Treatment, Storage, and Disposal Facility (TSDF) or to a Centralized Waste Treater (CWT) (21). There were an additional 13 percent (25 of 190) that reported a very small portion of wastewater being shipped off site for disposal. However, it is believed that this wastewater is contained in the sludge collected from the treatment system and disposed off site.

6.6.2 Waste Organic Material Disposal

Some industrial laundries generate waste organic material that is either collected from incoming items or from the wastewater treatment system. Facilities that generate this type of waste launder heavily soiled items (e.g., shop towels, printer towels/rags, and furniture towels) as a large portion of their total production. By water washing these items, the organic material that was contained on them is transferred to the process wastewater. One method of collecting the waste organic material from the wastewater is through phase separation in equipment that is designed to collect the organic phase from the water. The wastewater may also be treated with chemicals that aid in removing emulsified organic material from the water. Many of these techniques were described previously in Sections 6.5.5 and 6.5.12 of this document. Some facilities also collect waste organic material that floats to the top of sludge collected from the wastewater treatment system (e.g., DAF or chemical precipitation). In some cases, industrial laundries may remove this waste organic material from the items prior to water washing, as described in Section 6.4 of this document.

Most industrial laundries dispose of the collected waste organic material by shipping it to off site hazardous waste disposal facilities for incineration or for fuel blending. In fuel blending, the waste organic material is mixed with other materials and used as a fuel. Theoretically, the incineration or fuel combustion process destroys the waste organic material.

In some cases, depending on the customer source and use of the items, the collected waste organic material may be pure enough to be reused, especially that collected from the items prior to water washing. Material that cannot be reused directly may need further processing in a distillation unit where the organic material is separated from other contaminating pollutants. The distillation is often performed by a commercial recycler but can also be performed on site at the industrial laundry facility. After distillation, the organic material may be reused by the industrial laundries' customers that use the items.

6.6.3 Sludge Disposal

Industrial laundries generate sludge from a variety of sources. These sources include trenches, catch basins, settling pits, or other structures that retain the process wastewater prior to discharge; shaker or rotary screens; and wastewater treatment units such as DAF or chemical precipitation that are designed to remove solids.

EPA believes that all laundries have trenches and at least one catch basin that receive the wastewater from the wash room prior to treatment (if present) or discharge.

Depending on the retention time of the wastewater within these structures, solids will almost always accumulate over time. These solids may include large objects, sand, grit, and some lint that is removed from the items during the water washing. Laundries will periodically will clean this sludge from the catch basin and dispose of it, usually in a nonhazardous landfill.

Many industrial laundries (77 percent of the 190 in-scope facilities) also screen their wastewater prior to discharge. Lint is collected from these screens regularly and is disposed, usually in a nonhazardous landfill.

Some facilities (29 percent of the 190 in-scope facilities) treat their wastewater with either DAF or chemical precipitation prior to discharge. These technologies coagulate and agglomerate of organic and metal pollutants to remove them from the wastewater. The agglomerate (or floc) is removed from the treatment unit and collected as sludge (the sludge collection for each of these units was described in Sections 6.5.6 and 6.5.7 of this document). This sludge comprises some lint and other particles from the wastewater, metal compounds that were precipitated from the wastewater, and agglomerated organic materials. Chemical precipitation typically uses lime as a coagulant, which contributes to the sludge amount that is removed from these units. Based on available data, EPA estimates that DAF units generate a median of 0.031 pounds of sludge per gallon of wastewater and chemical precipitation units generate a median of 0.039 pounds of sludge per gallon of wastewater (22). This sludge is not usually considered to be hazardous waste, although some municipalities require it to be disposed within an industrial waste landfill. Depending upon the facility's item mix, this sludge may contain a significant amount of organic material that makes the sludge suitable for incineration or fuel blending.

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CHAPTER 7

TREATMENT PERFORMANCE DATA USED FOR THE DEVELOPMENT OF CANDIDATE PRETREATMENT STANDARDS

7.1 Introduction

This chapter discusses the treatment performance data available to EPA for use in developing candidate pretreatment standards for the pollutants of concern. Chapter 5 of this document discusses the pollutants of concern. The following information is presented in this chapter:

- Section 7.2 describes the sources of the treatment performance data from well-operated and well-designed treatment systems used by EPA in the calculation of the long-term averages, variability factors, and candidate pretreatment standards and classifies these sources into five postlaundering treatment options;
- Section 7.3 describes the data-editing procedures used to identify data points considered appropriate for calculating long-term averages, variability factors, and candidate pretreatment standards for the five postlaundering treatment options;
- Section 7.4 presents the long-term averages for the five postlaundering treatment options for the pollutants of concern;
- Section 7.5 presents the methodology for determining pollutants of concern selected for candidate pretreatment standards development and the pass through analysis;
- Section 7.6 presents the long-term average concentrations and variability factors developed for the five treatment options for the pollutants of concern, which can be used to develop local limits based on best engineering judgement;
- Section 7.7 presents EPA's analysis on the development of candidate mass-based standards; and
- Section 7.8 presents the references used.

7.2 Sources of Treatment Technology Performance Data From Well-Designed and Well-Operated Treatment Systems

EPA used three sources of treatment performance data to calculate the long-term average concentrations, variability factors, and candidate pretreatment standards for industrial laundries wastewater treatment options: 1) EPA industrial laundry sampling data, 2) Detailed

Monitoring Questionnaire (DMQ) data, and 3) other industry-supplied data. Chapter 3 of this document describes these sources. EPA first considered sampling data it had collected from industrial laundries with well-designed and well-operated treatment systems representing the various treatment options. Chapter 6 of this document describes the treatment technologies used by the industrial laundries industry. EPA also considered DMQ and other industry-supplied data from facilities using treatment technologies equivalent to the treatment technologies sampled by EPA. Sections 7.2.1, 7.2.2, and 7.2.3 discuss the EPA industrial laundry sampling data, the DMQ data, and the other industry-supplied data used to develop candidate pretreatment standards.

7.2.1 Industrial Laundry Sampling Program Data

EPA considered industrial laundry wastewater data from two Agency sampling programs for use in calculating long-term average concentrations, variability factors, and candidate pretreatment standards: 1) the 1985-1987 Industrial Technology Division (ITD)/Resource Conservation and Recovery Act (RCRA) Sampling Program and 2) the EPA Office of Water 1993-1998 sampling program. EPA did not use data from the 1985-1987 ITD/RCRA Sampling Program to calculate long-term averages, variability factors, and candidate pretreatment standards. Instead, EPA did use data from the 1993-1998 sampling program in these calculations. The identification of sampling data representative of well-designed and well-operated treatment systems from these sampling programs is presented below.

7.2.1.1 1985-1987 ITD/RCRA Sampling Program

EPA collected wastewater samples from five industrial laundries between 1985 and 1987 as part of the ITD/RCRA Sampling Program. EPA reviewed the ITD/RCRA Sampling Program data to identify facilities with well-designed and well-operated treatment systems representative of wastewater treatment technologies used as the basis for the candidate pretreatment. EPA determined that none of the ITD/RCRA Sampling Program data could be used to calculate long-term average concentrations, variability factors, or candidate pretreatment standards, for the following reasons. One facility used a dissolved air flotation unit that was not operating properly during the sampling episode. EPA decided that the sampling data from this facility could not be used because the treatment system was not well operated. At a second facility, grab sample water was added to some of the composite samples to make up for insufficient volume of the composite samples. EPA decided that sampling data for this facility were not representative of the wastewater from the facility. A third facility used microfiltration as its main treatment technology. EPA does not consider microfiltration to be an easily operated treatment technology for industrial laundry wastewater because the filter is easily clogged from oil and grease in the wastewater. This is supported by several industrial laundries that tried using microfiltration without the appropriate pretreatment of oil and grease and total suspended solids (TSS), and have subsequently replaced the microfilter with a different technology. The final two facilities used only settling basins; however, EPA does not consider settling basins to represent effective treatment for the pollutants of concern in industrial laundry wastewater. Therefore, EPA decided that sampling data from these five facilities could not be used to develop candidate pretreatment standards.

7.2.1.2 1993-1998 EPA Sampling Program

EPA collected wastewater samples from nine industrial laundries between 1993 and 1998 as part of the data-gathering effort for development of an effluent guideline for the industrial laundries industry. Facilities for sampling were selected based on site visits and responses to the 1994 Industrial Laundries Industry Questionnaire (detailed questionnaire). One sampling episode was performed at each facility. The sampling data collected by EPA included both influent and effluent wastewater data representing the major treatment technology used by each facility. At each facility, EPA collected pollutant concentration data for all of the pollutants of concern. The nine sampled industrial laundries used at least one of the following major wastewater treatment technologies as part of their overall treatment system:

- Chemical emulsion breaking;
- Dissolved air flotation (DAF);
- Chemical precipitation;
- Ultrafiltration;
- Vacuum degassing; and
- Organics control (steam tumbling).

EPA classified the data from the nine sampled facilities by the treatment technology used by the facility and the type of wastewater treated by the treatment technology. Some of the sampled facilities treated all of their process wastewater while others treated only heavy wastewater (i.e., wastewater from the washing of heavily soiled items (e.g., shop and printer towels/rags) or wastewater containing high pollutant concentrations from certain breaks in the washing cycle).

EPA's sampling data for microfiltration represent one day of treatment of wastewater from laundering of only printer towels. In addition, as discussed earlier in this section, microfilters are easily clogged from oil and grease in industrial laundry wastewater. The data obtained by EPA during a sampling episode at an industrial laundry using vacuum degassing do not demonstrate effective treatment of industrial laundry wastewater. Vacuum degassing is used to remove volatile organics from wastewater. The sampling data for vacuum degassing did not demonstrate effective removal of volatile organics. Because vacuum degassing were not found to be effective in treating industrial laundry wastewater, and EPA did not have enough data for microfiltration to evaluate treatment performance and because of operational complexities, EPA did not calculate long-term average concentrations, variability factors, or candidate pretreatment standards for these treatment technologies.

EPA had limited data available for steam tumbling, from one load of steam-tumbled printer towels and from one load of non-steam-tumbled printer towels. EPA developed target effluent concentrations for this prelaundering treatment technology instead of long-term averages, variability factors, and candidate pretreatment standards. Chapter 6 of this document presents the treatment performance data for steam tumbling.

The remaining sampling data represented the following five treatment options based on the treatment technology used by the facility and whether the facility sampled was treating all of its process wastewater or only heavy wastewater:

- Chemical emulsion breaking treatment of heavy wastewater;
- DAF treatment of heavy wastewater;
- Chemical precipitation treatment of heavy wastewater;
- DAF treatment of all facility process wastewater; and
- Chemical precipitation treatment of all facility process wastewater.

Sampling data from the seven facilities representing these five treatment options were used to calculate long-term average concentrations, variability factors, and candidate pretreatment standards. The number of sampled facilities representing each treatment option is presented in the following table.

Number of EPA Sampled Facilities Representing Each Treatment Option				
Chemical Emulsion Breaking Treatment of Heavy Wastewater	**DAF Treatment of Heavy Wastewater**	**Chemical Precipitation of Heavy Wastewater**	**DAF Treatment of All Facility Process Wastewater**	**Chemical Precipitation of All Facility Process Wastewater**
1	1	1	2	2

7.2.2 Detailed Monitoring Questionnaire (DMQ) Data

In 1995, EPA developed and mailed the DMQ to 37 industrial laundries throughout the United States (as described in Chapter 3 of this document). In response to this questionnaire, these industrial laundries provided EPA with all available 1993 facility monitoring data. DMQ data generally represented fewer pollutants than were analyzed for during the sampling program, and most of the data provided were for final effluent only, without corresponding influent data to evaluate treatment system pollutant removals. EPA reviewed the DMQ data to determine if the data could be used to represent any of the five treatment options sampled by EPA.

EPA determined that 17 of the 37 DMQ facilities did not provide data representative of the treatment technologies that were considered bases for candidate pretreatment standards. Facility diagrams for the remaining 20 facilities using one of these three treatment technologies were examined to determine if the sampling points for which data were reported represent final effluent from the treatment technology. EPA determined that data from 9 of the 20 facilities did not meet this criterion. The remaining 11 facilities provided data representing wastewater effluent concentrations for either DAF treatment of all facility process wastewater (five facilities) or chemical precipitation treatment of all facility process wastewater (six facilities). One of the five DAF facilities did not provide any data for pollutants of concern and one of the six chemical precipitation facilities only provided two data points for each pollutant of concern; therefore, data from these facilities were not used to calculate long-term averages, variability factors, or candidate pretreatment standards. Data from four DAF facilities

and five chemical precipitation facilities were used in conjunction with EPA's sampling data to calculate long-term average concentrations, variability factors, and candidate pretreatment standards. For the four DAF facilities, three operated induced air flotation (IAF) systems.

7.2.3 Other Industry-Supplied Data

Based on an analysis on all treatment performance data submitted in comments and gathered through EPA's data collection activities (excluding the DMQ), EPA determined that data from one facility were adequate to incorporate into EPA's loading estimates. Facilities that did not provide production amounts and types, portion of wastewater stream treated by the technology, the type of wastewater treatment technology operated, or total flow at the facility were determined to have not submitted enough data for EPA to perform a proper analysis of the data.

The data EPA used were from a towel only facility operating IAF. The final effluent data from this facility were used in conjunction with data previously gathered to represent treatment performance for facilities operating DAF and only treating wastewater from the water-washing of shop and or printer towels/rags.

7.3 Evaluation of Treatment Performance Data

After identifying available treatment performance data, EPA identified specific data points that could not be used to evaluate treatment system performance. These data were not used to calculate long-term averages, variability factors, and candidate pretreatment standards. The following criteria were used to identify these data points:

- Assessment of the treatment system performance at facilities identified above, including identification of process upsets during sampling that impacted the performance of the treatment system;
- Identification of pollutants not treated by the treatment technology;
- Identification of pollutants not present in influent samples at sufficient concentrations to evaluate treatment effectiveness of the treatment technology;
- Identification of treatment performance data with inconsistent detection limits; and
- Identification of data considered a lower limit of the actual value.

These criteria are further described in Sections 7.3.1 through 7.3.5 of this document.

7.3.1 Assessment of Treatment System Performance and Identification of Process Upsets

EPA reviewed the available data to determine if the treatment systems for which effluent data were available were well operated at the time samples were collected. Data that did not meet this evaluation criterion were flagged as unusable. To determine good system operation, EPA used the following parameters, which are indicative of proper operation of the three major treatment technologies for which data were available:

- Chemical Emulsion Breaking: proper pH and removal of oil and grease;
- DAF: removal of TSS and oil and grease; and
- Chemical Precipitation: removal of TSS and oil and grease.

For EPA sampling episodes, EPA reviewed sampling episode reports to determine if any process upsets occurred during one or more days of each sampling episode and if the treatment systems showed good performance based on removal of the parameters listed above. For DMQ and industry-supplied data, EPA used the following design and operating criteria to evaluate treatment system performance:

- Chemical Emulsion Breaking--pH of wastewater is adjusted with acid and an oil removal mechanism is in place.
- DAF--flocculation and coagulation chemicals are added, and an air injection mechanism and a removal system for float sludge are in place.
- Chemical Precipitation--flocculation and coagulation chemicals are added and a settling mechanism is in place.

Pollutant removals from DMQ and industry-supplied data could not be calculated because none of the facilities representing one of the three major wastewater treatment technologies provided paired influent and effluent data.

7.3.2 Identification of Pollutants Not Treated by the Treatment Technology

EPA reviewed the data for each EPA sampling episode to identify pollutants that were not treated by the treatment technology sampled. If the average concentration of the pollutant in the effluent samples from a facility was greater than or equal to the average concentration of the pollutant in the influent samples, the data were flagged as unusable. The DMQ and industry-supplied data could not be evaluated using this criterion because no paired influent and effluent data were provided.

7.3.3 Identification of Pollutants Not Present in Influent Samples at Sufficient Concentrations to Evaluate Treatment Effectiveness

EPA reviewed the data for each EPA sampling episode to determine if a pollutant was not detected in sufficient concentrations to evaluate treatment effectiveness. If the pollutant was never detected in influent samples at a facility or if the average concentration of a pollutant in the influent samples collected from a facility was less than 10 times the method detection level for that pollutant, the data for that pollutant at that facility were flagged as unusable for calculating long-term averages, variability factors, and candidate pretreatment standards. For calculating the target average concentrations used to determine pollutant loadings and removals, EPA did not use the 10 times method detection level criterion. The DMQ and industry-supplied data could not be evaluated using this criterion because no facilities provided paired influent and effluent data.

7.3.4 Identification of Treatment Performance Data With Inconsistent Detection Limits

EPA reviewed the data for each pollutant at each sampling episode to identify results showing inconsistent detection limits. If an analytical method used for a pollutant during a particular episode gave inconsistent detection limits due to laboratories having different instruments to measure pollutant concentrations, the data for this pollutant and episode were flagged as unusable. EPA identified data from three sampling episodes for four organic pollutants (toluene, naphthalene, tetrachloroethene, and ethylbenzene) that showed inconsistent detection limits. EPA did not use these data in calculating long-term averages and variability factors.

7.3.5 Identification of Treatment Performance Data Considered a Lower Limit of the Actual Value

EPA reviewed the sampling data to identify pollutant concentrations qualified with a greater than (>) sign. For these pollutants, EPA considered the reported concentration value to be a lower limit of the actual concentration value. EPA did not use the data from these samples to calculate long-term averages and variability factors.

7.4 Calculation of Long-Term Average Concentrations for the Pollutants of Concern

EPA used the data meeting the review criteria presented in Section 7.3 of this document to calculate long-term average concentrations for the 72 pollutants of concern for each of the five postlaundering treatment options. Long-term averages for each pollutant of concern for each sampling episode were calculated using equations derived from an adapted delta-lognormal model that accounts for effluent samples with a pollutant concentration at the detection limit. The detection limit concentration was used in calculations for data points reported as nondetects. The Statistical Support Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category (1) presents the methodology used to calculate long-term averages. EPA calculated the overall long-term

average concentrations for each pollutant of concern by finding the median of the episode long-term average concentrations. When sampling, DMQ, and industry-supplied data met the data review criteria for a specific pollutant for a treatment technology group, EPA used these data to calculate long-term average concentrations. When only EPA sampling data met the data review criteria, EPA used only data from EPA-sampled facilities to calculate long-term average concentrations. When only DMQ and/or industry-supplied data met the data review criteria, EPA did not calculate long-term average concentrations for that pollutant for that treatment technology group because no facilities provided raw waste data. Therefore, EPA could not determine if the pollutant was present in the raw wastewater.

Table 7-1 presents the long-term average concentrations for each pollutant of concern for each of the five treatment options. The treatment technology options listed in Table 7-1 are defined as follows:

- CEB-Heavy represents data from facilities using chemical emulsion breaking treatment of heavy wastewater;
- DAF-Heavy represents data from facilities using DAF treatment of heavy wastewater;
- CP-Heavy represents data from facilities using chemical precipitation treatment of heavy wastewater;
- DAF-All represents data from facilities using DAF treatment of all facility process wastewater; and
- CP-All represents data from facilities using chemical precipitation treatment of all facility process wastewater.

7.5 Methodology for Determining Pollutants of Concern Selected for Candidate Pretreatment Standards Development

This section presents the methodology used to select pollutant parameters for which candidate pretreatment standards were calculated for the Industrial Laundries Point Source Category. These parameters were chosen from the list of 72 pollutants of concern presented in Chapter 5 of this document . Although all 72 pollutants of concern were used to estimate pollutant loading and pollutant reductions, only certain parameters were selected for calculating candidate pretreatment standards. Because monitoring for all 72 pollutants of concern is not necessary to ensure that industrial laundry wastewater pollutants are adequately controlled, EPA chose a subset of the 72 pollutants since a number of the pollutants do not pass through POTWs and many of the rest of the pollutants originate from similar sources and have similar properties and would be incidently removed by control of a smaller number of pollutants. EPA selected the pollutants for which candidate pretreatment standards were calculated to represent the entire population of the pollutants of concern; they include metals, organic compounds, and SGT-HEM

Table 7-1

Long-Term Average (LTA) Effluent Concentrations for the Five Treatment Options for the Pollutants of Concern

Pollutant of Concern	Median LTA (mg/L)[1]				
	CEB-Heavy[2]	DAF-Heavy[3]	CP-Heavy[4]	DAF-All[5]	CP-All[6]
Conventionals					
Biochemical Oxygen Demand 5-Day (BOD_5)	1,040	1,310	1,390	497	399
Oil and Grease (measured as HEM)	268	230	38.2	37.8	28.5
Total Suspended Solids (TSS)	259	487	56.3	85.5	117
Priority Organics					
1,1,1-Trichloroethane	---	---	---	0.0277	0.471
1,2-Diphenylhydrazine	---	---	45.2	---	---
4-Chloro-3-methylphenol	0.205	---	---	0.220	---
Bis(2-ethylhexyl) Phthalate	0.462	0.604	0.0469	0.144	0.0691
Butyl Benzyl Phthalate	---	---	0.0100	---	0.0100
Chlorobenzene	---	---	---	0.0280	---
Chloroform	---	---	---	0.185	---
Di-*n*-butyl Phthalate	0.0100	0.173	0.0100	0.125	---
Di-*n*-octyl Phthalate	0.0307	---	---	0.236	0.0342
Ethylbenzene	0.305	1.37	0.0931	0.189	0.154
Isophorone	---	---	---	---	0.297
Methylene Chloride	---	---	---	0.546	---
Naphthalene	0.104	0.803	0.114	0.0764	0.0583
Phenol	---	---	---	0.211	---
Tetrachloroethene	0.286	---	0.127	0.250	0.421
Toluene	0.543	6.35	0.818	0.711	0.973
trans-1,2-Dichloroethene	---	---	---	---	---
Trichloroethene	---	---	0.0529	---	0.0363
Nonconventional Organics					
2-Butanone	---	4.68	---	17.4	3.23
2-Methylnaphthalene	0.0458	0.129	0.0100	0.116	0.0114
2-Propanone	1.21	7.42	---	13.6	1.54
4-Methyl-2-pentanone	0.0722	9.55	---	0.595	1.96
∝-Terpineol	0.0100	0.471	---	0.472	---
Benzoic Acid	---	---	---	1.58	---
Benzyl Alcohol	---	---	---	---	0.342
Hexanoic Acid	0.128	---	---	---	0.203
m-Xylene	0.366	---	0.104	0.595	0.241
n-Decane	0.279	1.26	0.0240	0.469	0.0873
n-Docosane	0.0347	0.110	0.0120	0.0232	0.0113

Table 7-1 (Continued)

Pollutant of Concern	Median LTA (mg/L)[1]				
	CEB-Heavy[2]	DAF-Heavy[3]	CP-Heavy[4]	DAF-All[5]	CP-All[6]
Nonconventional Organics (Continued)					
n-Dodecane	0.574	---	0.0100	0.195	1.46
n-Eicosane	0.0779	0.148	0.0382	0.0477	0.150
n-Hexacosane	0.0100	---	0.0122	0.0195	0.0144
n-Hexadecane	0.0417	0.489	0.0315	0.0842	0.0413
n-Octacosane	0.0100	---	0.0100	---	0.0168
n-Octadecane	0.0560	0.422	0.0100	0.0694	0.0308
n-Tetracosane	---	---	0.0329	0.0219	0.0121
n-Tetradecane	0.116	0.979	0.612	0.0754	0.0394
n-Triacontane	---	---	0.0341	0.0100	0.0138
o-&*p*-Xylene	0.359	---	0.0940	0.271	0.197
p-Cresol	---	---	---	---	---
p-Cymene	---	0.608	0.0208	0.0700	0.0100
Pentamethylbenzene	---	---	0.0100	---	---
Priority Metals and Elements					
Antimony	0.195	---	---	0.0800	---
Arsenic	---	---	---	---	---
Beryllium	---	---	---	---	---
Cadmium	0.132	---	0.00500	0.0161	0.00774
Chromium	0.153	0.0715	0.0147	0.0695	0.0463
Copper	0.437	1.45	0.534	0.478	0.270
Lead	0.914	0.237	0.0473	0.175	0.0993
Mercury	---	---	---	---	0.000329
Nickel	0.255	---	---	0.0544	0.0436
Selenium	---	---	---	0.0524	---
Silver	---	0.0846	---	---	---
Thallium	---	---	---	---	---
Zinc	6.78	0.903	0.0637	0.837	0.303
Nonconventional Metals and Elements					
Aluminum	6.33	1.34	0.0804	1.31	1.33
Barium	---	0.702	0.145	---	---
Boron	1.64	---	11.4	---	---
Cobalt	---	---	---	---	---
Iron	47.3	19.0	0.366	2.79	1.78
Manganese	0.596	0.884	0.00768	0.0340	0.0318
Molybdenum	0.205	---	0.774	0.119	0.275
Tin	---	---	---	0.0972	0.0495
Titanium	0.0818	0.0927	0.00453	0.0192	0.0461
Vanadium	---	---	---	---	---

Table 7-1 (Continued)

Pollutant of Concern	Median LTA (mg/L)[1]				
	CEB-Heavy[2]	DAF-Heavy[3]	CP-Heavy[4]	DAF-All[5]	CP-All[6]
Nonconventional Metals and Elements (Continued)					
Yttrium	---	---	---	---	---
Bulk Nonconventionals					
Chemical Oxygen Demand (COD)	2,460	3,320	2,510	998	1,270
Total Organic Carbon (TOC)	626	1610	910	326	310
Total Petroleum Hydrocarbon (measured as SGT-HEM)[7]	200	42.1	7.20	13.7	10.2

[1]LTAs for these pollutants of concern, for all options, were not calculated for one or more of the following reasons: the pollutant was not treated by the technology; the pollutant was detected below treatable concentrations in the wastewater influent; the pollutant was not detected in the influent wastewater; there was a process upset at the time samples were collected; the treatment performance data had inconsistent detection limits, or data considered a lower limit of the actual value. See Section 7.3 of this chapter for more details related to the data editing criteria.
[2]CEB-Heavy represents data from facilities using chemical emulsion breaking treatment of heavy wastewater.
[3]DAF-Heavy represents data from facilities using DAF treatment of heavy wastewater.
[4]CP-Heavy represents data from facilities using chemical precipitation treatment of heavy wastewater.
[5]DAF-All represents data from facilities using DAF treatment of all facility process wastewater.
[6]CP-All represents data from facilities using chemical precipitation treatment of all facility process wastewater.
[7]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

HEM-Hexane Extractable Material.
SGT-HEM - Silica Gel Treated-Hexane Extractable Material.

(TPH)[1] (as an overall indicator pollutant of effective control). Table 7-2 presents the selected pollutants of concern. The rationale for selecting these pollutants is discussed below.

7.5.1 Elimination of Treatment Chemicals

EPA eliminated aluminum and iron from the list of selected pollutants for candidate pretreatment standards development because aluminum and iron are commonly added to wastewater as treatment chemicals in the industrial laundries industry. Potential regulation of aluminum and iron could interfere with their beneficial use as wastewater treatment additives.

7.5.2 Elimination of Pollutants Not Treated or Below Treatable Concentrations

EPA eliminated pollutants from the list of pollutants of concern when they were not removed by the treatment technologies that were the bases for the technology options. EPA also eliminated pollutants when the pollutants were present below treatable concentrations in wastewater influent to the treatment systems, and therefore would not be substantially removed by the treatment technologies under consideration. For the purposes of this analysis, EPA used only influent data greater than 10 times the method detection level for each pollutant to reliably evaluate treatment effectiveness within the consistent operating range of the main treatment technologies considered.

EPA considered two main technologies as the bases for the regulatory options (see Chapter 8 of this document for a description of the regulatory options). The two technologies are chemical precipitation and DAF. Pollutants were not selected for candidate pretreatment standards development if they were not detected or were detected below treatable concentrations in either DAF or chemical precipitation influent wastewater. Table 7-3 presents these pollutants and the reasons the pollutants were eliminated.

7.5.3 Elimination of Pollutants that Do Not Pass Through or Otherwise Interfere with Publicly Owned Treatment Works (POTWs)

Section 307(b) of the Clean Water Act authorizes EPA to promulgate pretreatment standards for indirect dischargers to control pollutants that pass through, interfere with, or are incompatible with the operation of POTWs. Pollutants shown to pass through a POTW may be regulated by categorical pretreatment standards. This section presents a brief background of EPA's guidance and methods used for evaluating pass through, and the results of the pass-through evaluation.

[1]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

Table 7-2

Selected Pollutants of Concern for Treatment Options Considered in Developing Long-Term Averages and Variability Factors

Pollutant
Priority Organics
Ethylbenzene
Tetrachloroethene
Nonconventional Organics
m-Xylene
o-&*p*-Xylene
Priority Metals
Copper
Zinc
Bulk Nonconventionals
Total Petroleum Hydrocarbon (measured as SGT-HEM)[1]

[1] SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

SGT-HEM - Silica Gel Treated-Hexane Extractable Material

Table 7-3

Pollutants Eliminated from Further Consideration From the Pass-Through Analysis Because They Are Not Treated or They Are Below Treatable Concentrations

Pollutant	Reason Excluded
Priority Organics	
1,2-Diphenylhydrazine	Pollutant not detected in CP and DAF influents.
4-Chloro-3-methylphenol	Pollutant detected below treatable concentrations in CP influent.
Butyl Benzyl Phthalate	Pollutant detected below treatable concentrations in DAF influent.
Chlorobenzene	Pollutant detected below treatable concentrations in CP influent.
Chloroform	Pollutant detected below treatable concentrations in CP influent.
Di-*n*-butyl Phthalate	Pollutant detected below treatable concentrations in CP influent.
Isophorone	Pollutant not detected in DAF influent.
Methylene Chloride	Pollutant detected below treatable concentrations in CP influent.
Phenol	Pollutant not treated by CP technology.
trans-1,2-Dichloroethene	Pollutant not detected in CP influent and pollutant not treated by DAF technology.
Trichloroethene	Pollutant not treated by DAF technology.
Nonconventional Organics	
∝ -Terpineol	Pollutant detected below treatable concentrations in CP influent.
Benzoic Acid	Pollutant not treated by CP technology.
Benzyl Alcohol	Pollutant not treated by DAF technology.
Hexanoic Acid	Pollutant not detected in DAF influent.
n-Octacosane	Pollutant detected below treatable concentrations in DAF influent.
p-Cresol	Pollutant not detected in CP influent and pollutant detected below treatable concentrations in DAF influent.
Pentamethylbenzene	Pollutant not detected in CP and DAF influents.
Priority Metals and Elements	
Antimony	Pollutant detected below treatable concentrations in CP influent.
Arsenic	Pollutant detected below treatable concentrations in CP and DAF influents.
Beryllium	Pollutant detected below treatable concentrations in CP influent and pollutant not detected in DAF influent.
Mercury	Pollutant detected below treatable concentrations in DAF influent.
Selenium	Pollutant detected below treatable concentrations in CP influent.
Silver	Pollutant detected below treatable concentrations in CP and DAF influents.
Thallium	Pollutant not detected in CP influent and pollutant detected below treatable concentrations in DAF influent.

Table 7-3 (Continued)

Pollutant	Reason Excluded
Nonconventional Metals and Elements	
Barium	Pollutant detected below treatable concentrations in CP and DAF influents.
Boron	Pollutant detected below treatable concentrations in CP and DAF influents.
Cobalt	Pollutant detected below treatable concentrations in CP and DAF influents.
Vanadium	Pollutant detected below treatable concentrations in CP and DAF influents.
Yttrium	Pollutant detected below treatable concentrations in CP and DAF influents.

Source: Industrial Laundries Treatment Performance Data.
CP - Chemical Precipitation
DAF - Dissolved Air Flotation

7.5.3.1 Background

To promulgate pretreatment standards for a specific industry, EPA examines whether the pollutants discharged by the industry pass through a POTW to waters of the U.S. or interfere with POTW operation or sludge disposal practices. Generally, in determining whether 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 candidate meeting best available technology (BAT) or pretreatment technology options.

For specific pollutants, such as volatile organic compounds or highly biodegradable compounds, EPA may use other means to determine if POTWs provide effective treatment. For volatile compounds, a volatile override test based on the Henry's Law Constant is used to determine pass through. For the volatile compounds that are also highly biodegradable, the pass-through determination may be conducted using engineering modeling, such as WATER8, to determine biodegradation rates representing POTW treatment.

For the industrial laundries industry, where only pretreatment standards are being considered (since EPA has not identified any direct dischargers) EPA compared the POTW pollutant removal efficiency with pollutant removal efficiencies estimated using the candidate PSES technology representing BAT factors. EPA finds that a pollutant passes through when the average removal efficiency achieved nationwide by well-operated POTWs (those meeting secondary treatment requirements) is less than the average removal efficiencies achieved by facilities meeting the candidate PSES for that pollutant, considering the factors listed in Sections 301 and 304 of the Clean Water Act.

For this final action, EPA determined that a pollutant that has a Henry's Law Constant greater than 1×10^{-5} atm-m^3/mol will be sufficiently volatile such that a significant portion of the compound would not be treated by the POTW because a significant portion of the compound volatilizes to the air. EPA further determined the extent to which pollutants are degraded at POTWs. For such volatile compounds, EPA determined POTW percent removal based on the POTW removal model for the pollutant with the most similar Henry's Law Constant, as presented in the Development Document for the Pharmaceutical Manufacturing Industry Effluent Limitations Guidelines and Standards (63 FR 50388) using a combination of POTW empirical data and the WATER8 biodegradation model as described in Section 7.5.4.7 of this chapter.

EPA eliminated three conventional pollutants, biochemical oxygen demand (BOD_5), total suspended solids (TSS), and oil and grease (measured as HEM), from consideration for the pass-through analysis without conducting the percent removal comparison because POTWs are designed to treat these parameters. EPA does not consider these three conventional pollutants to pass through. EPA also eliminated TPH (measured as SGT-HEM) from consideration, because instead of examining TPH, EPA conducted a pass-through analysis of the individual compounds (*n*-alkanes and several others) that were found to compose TPH from the EPA Method 1664 Characterization Study data. For the pass-through analysis, EPA

evaluated 39 pollutants from the list of 72 pollutants of concern. Tables 7-4 and 7-5 present the POTW removals used in the pass-through analysis. The following sections present the methodology and results from the pass-through analysis performed for both chemical precipitation and DAF candidate pretreatment technology options.

7.5.3.2 Methodology for Determining Treatment Technology Percent Removals

Industrial laundry wastewater treatment performance data for chemical precipitation and dissolved air flotation were obtained during the industrial laundries sampling program. EPA obtained influent and effluent data from two chemical precipitation facilities and from two DAF facilities. EPA used these data to determine whether a pollutant passes through a POTW. For conducting the pass-through analysis, EPA edited the data as described in Section 7.3 of this chapter for calculating the long-term average concentrations. This editing included excluding influent and the corresponding effluent data that were associated with treatment or process upsets, excluding data for pollutants that were never detected in influents to treatment systems, excluding data for pollutants not treated by the treatment technology, and excluding data with influent concentrations less than 10 times the method detection level. Using these editing criteria allowed for the possibility that low percent removals reflected low influent concentrations, not poor treatment technology performance.

After editing the data, EPA used the following methodology to calculate a percent removal:

1) The remaining influent data and effluent data for a sampled facility were averaged for each pollutant, to give an average influent concentration and an average effluent concentration for each pollutant.

2) EPA calculated percent removals from the average influent and average effluent concentrations for each pollutant for a sampled facility using the following equation:

$$\text{Percent Removal} = \frac{\text{Influent}_{avg} - \text{Effluent}_{avg}}{\text{Influent}_{avg}} \times 100$$

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

7.5.3.3 Methodology for Determining POTW Percent Removals

The primary source of the POTW percent removals data was the Fate of Priority Pollutants in Publicly Owned Treatment Works (50 POTW Study) (2). However, the 50 POTW Study did not contain data for all pollutants for which the pass-through analysis was to be performed. Therefore, EPA obtained additional data from the Risk Reduction Engineering Laboratory (RREL) Treatability Database (3). Biodegradation data estimated using WATER8 were obtained from the Final POTW Pass-Through Analysis for the Pharmaceutical Manufacturing Point Source Category (4). Additional information on these sources is presented

Table 7-4

Comparison of the Chemical Precipitation Treatment Technology and POTW Percent Removals for the Industrial Laundries Pass-Through Analysis

Pollutant	(Median) Chemical Precipitation Percent Removal	(Median) Percent POTW Removal	Source of POTW Removals	Chemical Precipitation Removal Greater than POTW Removal?	Henry's Law Constant Greater than $1.0x10^{-5}$ atm-m^3/mol?	Pass Through?
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	88	82	50 POTW (10XDL)	Yes	NA	Yes
Total Organic Carbon (TOC)	45	71	50 POTW (10XDL)	No	NA	No
Priority Organics						
1,1,1-Trichloroethane	35	24	WATER8	Yes	Yes	Yes
Bis(2-ethylhexyl) Phthalate	98	60	50 POTW (10XDL)	Yes	No	Yes
Di-*n*-octyl Phthalate	94	33	WATER8	Yes	Yes	Yes
Ethylbenzene	69	33	WATER8	Yes	Yes	Yes
Naphthalene	88	18	WATER8	Yes	Yes	Yes
Tetrachloroethene	85	33	WATER8	Yes	Yes	Yes
Toluene	45	33	WATER8	Yes	Yes	Yes
Nonconventional Organics						
2-Butanone	8	18	WATER8	No	Yes	No
2-Methylnaphthalene	96	28	RREL 5 (All WW)	Yes	No	Yes
2-Propanone	15	85	WATER8	No	Yes	No
4-Methyl-2-pentanone	21	18	WATER8	Yes	Yes	Yes
n-Decane	98	33	WATER8	Yes	Yes	Yes
n-Docosane	96	94	Generic Removal	Yes	No	Yes
n-Dodecane	84	33	WATER8	Yes	Yes	Yes

Table 7-4 (Continued)

Pollutant	(Median) Chemical Precipitation Percent Removal	(Median) Percent POTW Removal	Source of POTW Removals	Chemical Precipitation Removal Greater than POTW Removal?	Henry's Law Constant Greater than $1.0x10^{-5}$ atm-m^3/mol?	Pass Through?
Nonconventional Organics (Continued)						
n-Eicosane	98	33	WATER8	Yes	Yes	Yes
n-Hexacosane	92	94	Generic Removal	No	No	No
n-Hexadecane	98	33	WATER8	Yes	Yes	Yes
n-Octadecane	94	33	WATER8	Yes	Yes	Yes
n-Tetracosane	98	94	Generic Removal	Yes	No	Yes
n-Tetradecane	98	33	WATER8	Yes	Yes	Yes
n-Triacontane	91	94	Generic Removal	No	No	No
m-Xylene	80	33	WATER8	Yes	Yes	Yes
o-&*p*-Xylene	71	33	WATER8	Yes	Yes	Yes
p-Cymene[1]	92	99	RREL5 (All WW)	No	NA	No
Priority Metals and Elements						
Cadmium	94	91	50 POTW (10XDL)	Yes	NA	Yes
Chromium	93	91	50 POTW (10XDL)	Yes	NA	Yes
Copper	94	84	50 POTW (10XDL)	Yes	NA	Yes
Lead	96	92	50 POTW (10XDL)	Yes	NA	Yes
Nickel	97	52	50 POTW (10XDL)	Yes	NA	Yes
Zinc	96	77	50 POTW (10XDL)	Yes	NA	Yes

Table 7-4 (Continued)

Pollutant	(Median) Chemical Precipitation Percent Removal	(Median) Percent POTW Removal	Source of POTW Removals	Chemical Precipitation Removal Greater than POTW Removal?	Henry's Law Constant Greater than 1.0×10^{-5} atm-m^3/mol?	Pass Through?
Nonconventional Metals and Elements						
Manganese	97	41	RREL5 (All WW)	Yes	NA	Yes
Molybdenum	46	52	RREL5 (Dom WW)	No	NA	No
Tin	92	65	RREL5 (All WW)	Yes	NA	Yes
Titanium	90	69	RREL5 (All WW)	Yes	NA	Yes

[1]Henry's Law Constant data were not available for this pollutant.
WATER8 - Percent biodegradation calculated because pollutant has a Henry's Law Constant greater than 1.0×10^{-5} atm-m^3/mol.
50 POTW (10XDL) - 50 POTW Study, using 10 times the method detection level editing criterion.
RREL5 (All WW) - RREL Treatability Database Version 5.0, using domestic and industrial wastewater editing criterion.
RREL5 (Dom WW) - RREL Treatability Database Version 5.0, using domestic wastewater editing criterion.
Generic Removal - Based on reported POTW removal values for two n-alkanes, *n*-Dodecane and *n*-Eicosane.
NA - Not applicable.

Table 7-5

Comparison of the DAF Treatment Technology and POTW Percent Removals for the Industrial Laundries Pass-Through Analysis

Pollutant	(Median) DAF Percent Removal	(Median) Percent POTW Removal	Source of POTW Removals	DAF Removal Greater than POTW Removal?	Henrys Law Constant Greater than $1.0x10^{-5}$ atm-m^3/mol?	Pass Through?
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	82	82	50 POTW (10XDL)	No	NA	No
Total Organic Carbon (TOC)	66	71	50 POTW (10XDL)	No	NA	No
Priority Organics						
1,1,1-Trichloroethane	75	24	WATER8	Yes	Yes	Yes
Bis(2-ethylhexyl) Phthalate	>99	60	50 POTW (10XDL)	Yes	No	Yes
Di-*n*-octyl Phthalate	91	33	WATER8	Yes	Yes	Yes
Ethylbenzene	94	33	WATER8	Yes	Yes	Yes
Naphthalene	93	18	WATER8	Yes	Yes	Yes
Tetrachloroethene	74	33	WATER8	Yes	Yes	Yes
Toluene	48	33	WATER8	Yes	Yes	Yes
Nonconventional Organics						
2-Butanone	29	18	WATER8	Yes	Yes	Yes
2-Methylnaphthalene	97	28	RREL 5 (All WW)	Yes	No	Yes
2-Propanone	36	85	WATER8	No	Yes	No
4-Methyl-2-pentanone	48	18	WATER8	Yes	Yes	Yes
n-Decane	99	33	WATER8	Yes	Yes	Yes
n-Docosane	91	94	Generic Removal	No	No	No
n-Dodecane	99	33	WATER8	Yes	Yes	Yes
n-Eicosane	98	33	WATER8	Yes	Yes	Yes

Table 7-5 (Continued)

Pollutant	(Median) DAF Percent Removal	(Median) Percent POTW Removal	Source of POTW Removals	DAF Removal Greater than POTW Removal?	Henrys Law Constant Greater than $1.0x10^{-5}$ atm-m^3/mol?	Pass Through?
Nonconventional Organics (Continued)						
n-Hexacosane	98	94	Generic Removal	Yes	No	Yes
n-Hexadecane	99	33	WATER8	Yes	Yes	Yes
n-Octadecane	97	33	WATER8	Yes	Yes	Yes
n-Tetracosane	98	94	Generic Removal	Yes	No	Yes
n-Tetradecane	98	33	WATER8	Yes	Yes	Yes
n-Triacontane	94	94	Generic Removal	No	No	No
m-Xylene	95	33	WATER8	Yes	Yes	Yes
o-&*p*-Xylene	66	33	WATER8	Yes	Yes	Yes
p-Cymene[1]	94	99	RREL5 (All WW)	No	NA	No
Priority Metals and Elements						
Cadmium	87	91	50 POTW (10XDL)	No	NA	No
Chromium	92	91	50 POTW (10XDL)	Yes	NA	Yes
Copper	91	84	50 POTW (10XDL)	Yes	NA	Yes
Lead	92	92	50 POTW (10XDL)	No	NA	No
Nickel	87	52	50 POTW (10XDL)	Yes	NA	Yes
Zinc	90	77	50 POTW (10XDL)	Yes	NA	Yes

Table 7-5 (Continued)

Pollutant	(Median) DAF Percent Removal	(Median) Percent POTW Removal	Source of POTW Removals	DAF Removal Greater than POTW Removal?	Henrys Law Constant Greater than $1.0x10^{-5}$ atm-m^3/mol?	Pass Through?
Nonconventional Metals and Elements						
Manganese	92	41	RREL5 (All WW)	Yes	NA	Yes
Molybdenum	52	52	RREL5 (Dom WW)	No	NA	No
Tin	73	65	RREL5 (All WW)	Yes	NA	Yes
Titanium	93	69	RREL5 (All WW)	Yes	NA	Yes

[1]Henry's Law Constant data were not available for this pollutant.
WATER8 - Percent biodegradation calculated because pollutant has a Henry's Law Constant greater than 1.0×10^{-5} atm-m^3/mol.
50 POTW (10XDL) - 50 POTW Study, using 10 times the method detection level editing criterion.
RREL5 (All WW) - RREL Treatability Database Version 5.0, using domestic and industrial wastewater editing criterion.
RREL5 (Dom WW) - RREL Treatability Database Version 5.0, using domestic wastewater editing criterion.

Generic Removal - Based on reported POTW removal values for two n-alkanes, *n*-Dodecane and *n*-Eicosane.
NA - Not applicable.

below. EPA gave these data sources the following priority in determining the percentage removal of pollutants by POTWs nationwide:

1) 50 POTW Study;
2) RREL Treatability Database; and
3) Generic pollutant group removal.

7.5.3.4 50 POTW Study

EPA edited the 50 POTW Study data to eliminate influent and the corresponding effluent data where the average influent concentration at a POTW was less than 10 times the method detection level, to allow for the possibility that low percent removals reflected low influent concentrations, not POTW treatment technology performance. EPA used the method detection levels reported at the time of the 50 POTW Study to edit the data.

In cases where no data remained after conducting the ten times the method detection level edit, EPA used less stringent editing criteria. In these cases, influent data and the corresponding effluent data were eliminated where the influent concentrations were less than 20 µg/L or less than the method detection level for pollutants where the method detection level is greater than 20 µg/L. EPA selected 20 µg/L because, for pollutants with low influent concentrations (i.e., less than 20 µg/L or the method detection limit), the effluent concentrations were consistently below the method detection level and could not be precisely quantified.

After editing the POTW data, EPA used the following methodology to calculate POTW percent removal:

1) The remaining influent data and effluent data for each POTW were averaged for each pollutant to give an average influent concentration and an average effluent concentration for each pollutant. EPA determined that the minimum concentration at which a pollutant can be accurately measured is the method detection level. Therefore, if the average effluent concentration was less than the method detection level, EPA set the average effluent concentration to the method detection level before calculating the average effluent concentration.

2) Percent removals were calculated from the average influent and average effluent concentrations for each pollutant for the POTW using the equation in Section 7.5.3.2 of this document.

3) The median percent removal was calculated for each pollutant from the POTW-specific percent removals.

7.5.3.5 RREL Treatability Database

If the POTW percent removal for a pollutant could not be calculated using the 50 POTW Study data, EPA used data from the RREL Treatability Database to determine the POTW

percent removal. Because individual influent/effluent pairs were not provided in the database, the data-editing criteria used for the 50 POTW Study could not be used. EPA edited the RREL Treatability Database using the following criteria:

1) Only data pertaining to domestic wastewater were used, unless there were less than three data points available.

2) If there were less than three data points available using the domestic wastewater edit, a combination of domestic wastewater and industrial wastewater data was used.

3) Only full-scale and pilot-scale data were used; bench-scale data were not used.

4) Only data from a peer-reviewed journal, a government report, or a government database were used. However, data from the 50 POTW Study (a government report) reported in the RREL Treatability Database were not used. These data points were not used because if the RREL Treatability Database was being examined, it meant that the data for a pollutant did not meet the editing criteria for the 50 POTW Study, as outlined above.

5) Only data from treatment technologies representing secondary treatment of wastewater were used. These technologies included activated sludge, aerated lagoon, sedimentation followed by activated sludge, and activated sludge followed by activated sludge treatment.

After applying these editing criteria, EPA calculated percent removals for each data source for each pollutant, using the equation in Section 7.5.3.2 of this document. EPA then took the median of the percent removals for each pollutant to obtain a median POTW percent removal from the RREL Treatability Database.

7.5.3.6 Generic Removal

After the editing of the 50 POTW Study and RREL Treatability Database, data for some of the *n*-alkanes were still not available. In order to determine an appropriate POTW percent removal for these pollutants, the available data for the 72 pollutants of concern were reviewed. EPA determined that one source of POTW removal data for specific *n*-alkanes would be the generic group removal of the *n*-alkanes for which data were available. Table 7-6 presents this source of *n*-alkanes removal data which were used to calculate the percent removal for

specific *n*-alkanes without POTW percent removal data. The percent removal for *n*-decane in this database was excluded from this analysis because it reported only a minimum percent removal. The generic percent removal of 94 percent was obtained from *n*-dodecane and *n*-eicosane. This percentage removal was transferred to four other alkanes, *n*-docosane, *n*-hexacosane, *n*-tetracosane, and *n*-triacontane. Because the *n*-dodecane and *n*-eicosane were

Table 7-6

Generic Removal for *n*-Alkanes

Pollutant	POTW Removal (%)	Source of Data
n-Decane	> 9[1]	RREL Treatability Database - Domestic and Industrial Wastewater Edit
n-Dodecane	95	RREL Treatability Database - Domestic and Industrial Wastewater Edit
n-Eicosane	92	RREL Treatability Database - Domestic and Industrial Wastewater Edit
Average Group Removal	**94**	

[1]The POTW percent removal for *n*-decane was not used in calculating the average group removal because the removal represents a reported minimum value only; the actual removal may be between nine and >99 percent.

subsequently determined to be volatile organic compounds (see Section 7.5.3.7 below), and therefore POTW removal for them did not represent POTW removal for nonvolatile *n*-alkanes. EPA estimated POTW removal for the nonvolatile *n*-alkanes based on the 74 percent removal of TPH discussed in the NODA. Since the four alkanes using the transferred removals were determined to be non-volatile alkanes, and were identified as constituents of TPH, a POTW removal of greater than 74 percent was identified, based on the removal of TPH in comments to the proposal. Thus, the removal of the four alkanes were evaluated based on a removal range of 74 to 94 percent. A comparison of the differences in pollutant removals (in pounds and toxic weighted pounds) based on the two removal rates is shown in Table 7-7. These results show very minimal changes (less than one percent in pounds; only one toxic pound equivalent) in the loadings. The magnitude of these changes would not affect the overall decision that no national regulation is warranted.

7.5.3.7 Biodegradation Rates for Volatile Organics

EPA's pass-through analysis for industrial laundries included a volatility analysis. At proposal, pollutants that had a Henry's Law Constant greater than 2.4×10^{-5} atm-m^3/mol were determined to volatilize prior to reaching the POTW and therefore were considered to pass through the POTW. No credit was given for the biodegradation of these compounds and the POTW percent removal was set to zero. Based on comments and additional data gathered by EPA through other rulemaking activities, EPA determined that a portion of all the volatile compounds is biodegraded at the POTWs. In addition, EPA determined for the final action that pollutants with Henry's Law Constants greater than 1×10^{-5} atm-m^3/mol are considered volatile.

The primary source of the biodegradation data is based on the methodology incorporating empirical data with WATER8 modeling results for primary and secondary treatment at a POTW. During the Pharmaceuticals Manufacturing Point Source Category Effluent Limitations, Guidelines, and Standards rulemaking (63 FR 50388) data concerning volatility and biodegradation were gathered for seven pollutants; four of these pollutants overlapped with pollutants of concern for the industrial laundries (chloroform, 2-propanone[2], methylene chloride, and toluene). EPA also obtained data for three additional pollutants (methanol, ethanol, and isopropanol). These data were based on pharmaceutical sampling data and modeling information to determine the overall percent biodegradation for these pollutants.

EPA adopted this analysis approach in the pharmaceuticals rulemaking and for the industrial laundries final action in order to be consistent with the MACT standards which consider water soluble compounds less likely to volatilize than compounds that are partially soluble. The following data sources were used in this analysis:

- EPA and Pharmaceutical Research and Manufacturers Association (PhRMA) wastewater samples collected from the primary treatment works at the Barceloneta POTW in Barceloneta, Puerto Rico;

[2]For the pharmaceuticals manufacturing point source category, 2-propanone was referred to as acetone.

Table 7-7

POTW Pollutant Removals Based on a Revised POTW Removal Efficiency for Nonvolatile *n*-Alkanes[1] (Entire Industry - No Cutoff)

Pollutant group	Pollutant Removal with 94%	Pollutant Removal with 74%	Toxic Weighted Pollutant Removal with 94%	Toxic Weighted Pollutant Removal with 74%
DAF-IL				
Total Nonconventional Organics[2]	519,692	529,450	2,248	2,249
Total Pollutants[3]	857,876	867,633	35,245	35,245
CP-IL				
Total Nonconventional Organics[3]	528,732	538,808	2,321	2,321
Total Pollutants[3]	894,618	904,695	42,917	42,918

[1]Pollutants that changed percent removal from 94% to 74% include *n*-docosane, *n*-hexacosane, *n*-tetracosane, *n*-triacontane.
[2]The nonconventional organic group is the only pollutant group where the pollutant removal changed.
[3]The total does not include bulk conventionals and bulk nonconventionals.

- WATER8 air emissions modeling of the Barceloneta POTW;
- A pharmaceutical industry submitted literature study evaluating volatilization potential in sewers; and
- A pharmaceutical industry submitted study evaluating volatilization potential in an enclosed equalization tank.

EPA and PhRMA conducted sampling at the Barceloneta POTW to obtain data on the removal of several volatile organic compounds (chloroform, methylene chloride, 2-propanone, and toluene) and certain alcohols (methanol, ethanol, and isopropanol) in the primary treatment works of a POTW. The Barceloneta POTW was selected for sampling because the influent wastewater to this POTW was known to contain measurable quantities of VOCs and alcohols and other pollutants for which pharmaceutical industries pretreatment standards were proposed in May 1995.

Samples were collected in the influent and effluent from treatment units. Percent loss across the treatment units was calculated from the influent and effluent mass from the unit. Percent losses were assumed to be due to two major fate pathways: biodegradation and volatilization. Knowing the overall percentage loss and the loss estimated to be attributed to biodegradation (both aerobic and anoxic), EPA estimated the percent of loss attributed to volatilization. The sampling results shown in Table 7-8 indicate the range of percent loss of alcohols in the primary treatment units due to volatilization.

In addition, EPA performed WATER8 air emissions modeling of the Barceloneta POTW using the sampled pollutant influent concentrations in order to obtain an estimate of how much volatilization of volatile organic pollutants occurs throughout the entire POTW system. The results of the modeling study shown in Table 7-9 show less volatilization in the primary treatment portion than the measured data from the Barceloneta POTW sampling episode suggests.

EPA also evaluated an industry submitted study evaluating sewer losses for water soluble compounds. The results of this study indicate that volatilization of methanol and ethanol in closed sewers is expected to be minimal with maximum emission rates of 0.03 and 0.19 percent being projected under most sewer conditions, respectively. However, under open sewer conditions, volatilization percentages of methanol and ethanol could be as high as 6.5 and 20 percent, respectively.

Based on these biodegradation rates, EPA determined that the POTWs do treat volatile pollutants to some degree. These percent removals were transferred to the industrial laundries pollutants of concern based on an analysis of Henry's Law Constants. Pollutants with similar constants were assigned the same overall percent biodegradation rate.

Table 7-10 presents the industrial laundries pollutants of concern that were found to volatilize, their respective Henry's Law Constants, their assigned overall percent biodegradation, and the data source for the percent biodegradation.

Table 7-8

EPA and PhRMA Sampling Results for Primary Treatment at Barceloneta POTW Data from Method 1671

Pollutant	1996 Primary Treatment Data (Aerated Grit Chamber and Primary Clarifier) Percent Loss	1996 Primary Clarifier Only Data Percent Loss
Methanol	19.1	8.1
Ethanol	25.3	15.2
Isopropanol	11.4	5.9
Chloroform	44.2	45.6
Toluene	29.0	22.4
Methylene	27.8	20.8
2-Propanone	10.3	14.7

Table 7-9

WATER8 Modeling Results for Primary and Secondary Treatment at Barceloneta Wastewater Treatment Plant

Pollutant	Percent Volatilization in Primary %	Percent Biodegradation in Primary %	Percent Volatilization in Secondary %	Percent Biodegradation in Secondary %	Percent Overall Volatilization %	Percent Overall Biodegradation %
Methanol	2.1	0.0	2.0	90.8	4.0	90.5
Ethanol	2.2	0.0	0.5	97.7	2.7	92.9
Isopropanol	4.2	0.0	10.8	74.0	14.3	77.0
2-Propanone[1]	8.0	0.0	3.2	94.9	10.7	84.8
Chloroform	40.9	0.0	58.7	40.5	71.2	23.9
Methylene Chloride	38.9	0.0	70.4	28.6	78.2	17.8
Toluene	46.1	0.0	36.9	62.7	60.4	32.4

[1]2-Propanone was referred to as acetone in the PhRMA data.
Note: Volatilization and biodegradation percentages may not add up to 100% since some of the compound remains in the effluent and some goes out with the sludge.

Table 7-10

Percent Biodegradation for Industrial Laundries Pollutants of Concern Found to Be Volatile

Analyte	Henry's Law Constant	Overall Percent Biodegradation	Data Source for Percent Biodegradation
1,1,1-Trichloroethane	3.67×10^{-3}	24	Transferred from chloroform.
2-Propanone	2.10×10^{-5}	85	Pharms pass-through analysis[1]
Di-n-Octyl Phthalate	1.37×10^{-1}	33	Transferred from toluene.
Ethylbenzene	8.44×10^{-3}	33	Transferred from toluene.
Naphthalene	4.83×10^{-4}	18	Transferred from methylene chloride.
Tetrachlorethene	1.56×10^{-2}	33	Transferred from toluene.
Toluene	5.90×10^{-3}	33	Pharms pass-through analysis[1]
2-Butanone	2.70×10^{-5}	18	Transferred from methylene chloride.
4-Methyl-2-Pentanone	4.95×10^{-5}	18	Transferred from methylene chloride.
n-Decane	6.90	33	Transferred from toluene.
n-Dodecane	7.40	33	Transferred from toluene.
n-Eicosane	1.5×10^{-3}	33	Transferred from toluene.
n-Hexadecane	1.28×10^{-1}	33	Transferred from toluene.
n-Octadecane	1.44×10^{-2}	33	Transferred from toluene.
n-Tetradecane	7.14×10^{-1}	33	Transferred from toluene.
m-Xylene[2]	7.00×10^{-3}	33	Transferred from toluene.
o&p-Xylene[2]	7.00×10^{-3}	33	Transferred from toluene.
$\propto$ -Terpineol	6.09×10^{-5}	18	Transferred from methylene chloride.

[1]Based on the Final POTW Pass-Through Analysis for the Pharmaceutical Manufacturing Point Source Category (4) (WATER8 Modeling Results for Primary and Secondary Treatment at Barceloneta Wastewater Treatment Plant).
[2]Henry's Law Constant provided for total xylenes.

7.5.3.8 Results of the POTW Pass-Through Analysis

Tables 7-4 and 7-5 present a comparison of the treatment technology percent removal with the POTW percent removal for chemical precipitation and DAF, respectively. If the treatment technology percent removal is greater than the POTW percent removal, the pollutant is considered to pass through the POTW. A pollutant with a Henry's Law Constant greater than 1×10^{-5} atm-m^3/mol was determined to pass through if its percent biodegradation was less than the removal obtained by the treatment technology. For chemical precipitation, 31 of the 39 pollutants analyzed passed through. For DAF, 29 of the 39 pollutants analyzed passed through.

7.5.4 Pollutants of Concern Selected for Candidate Pretreatment Standards Development

Based on the results of the pass-through analysis, EPA considered the pollutants shown in Table 7-11 as pollutants for candidate pretreatment standards development for the chemical precipitation and DAF technologies. To further streamline permitting and monitoring requirements, EPA considered using regulating "indicator" pollutants to control a broader set of pollutants. Because many of the pollutants originate from similar sources and have similar treatability properties, EPA concluded that indicator pollutants are appropriate for controlling discharges from industrial laundries to POTWs. In selecting indicator pollutants to reflect control of a broader set of pollutants, EPA chose pollutants that were detected most frequently, detected in the higher concentrations, and are most toxic. The following paragraphs describe the rationale for selecting the pollutants for regulation.

EPA considered three bulk parameters, TPH (measured as SGT-HEM), TOC, and COD, for candidate pretreatment standards development. EPA believes that controlling one bulk parameter in industrial laundries wastewater is sufficient to ensure the appropriate level of control of the effluent from industrial laundries. TPH is a measure of the mineral oil fraction of carbon-containing compounds and mineral oils are treated less effectively by POTWs than many other carbon-containing compounds; therefore, EPA has selected TPH for regulation. Because TPH measures a variety of organic compounds, as demonstrated by the EPA Method 1664 Characterization Study, it can also serve as an indicator pollutant for other organic pollutants shown on Table 7-11.

EPA is not specifically controlling the following ten straight chain alkane (*n*-alkanes) pollutants or two semivolatile compounds because EPA's TPH study indicated that these pollutants comprise a portion of TPH, measured as SGT-HEM, and thus would be controlled by EPA's regulation of TPH:

- *n*-Decane;
- *n*-Docosane;
- *n*-Dodecane;
- *n*-Eicosane;
- *n*-Hexacosane;
- *n*-Hexadecane;

Table 7-11

Pollutants Considered for Regulation for Chemical Precipitation and DAF after the Pass-Through Analysis

Pollutant	Passes Through for Chemical Precipitation	Passes Through for DAF
Bulk Nonconventionals		
Chemical Oxygen Demand (COD)	X	
Total Organic Carbon (TOC)		
Total Petroleum Hydrocarbon (TPH)[1]	---	---
Priority Organics		
1,1,1-Trichloroethane	X	X
Bis(2-ethylhexyl) Phthalate	X	X
Di-*n*-octyl Phthalate	X	X
Ethylbenzene	X	X
Naphthalene	X	X
Tetrachloroethene	X	X
Toluene	X	X
Nonconventional Organics		
2-Butanone		X
2-Methylnaphthalene	X	X
2-Propanone		
4-Methyl-2-pentanone	X	X
n-Decane	X	X
n-Docosane	X	
n-Dodecane	X	X
n-Eicosane	X	X
n-Hexacosane		X
n-Hexadecane	X	X
n-Octadecane	X	X
n-Tetracosane	X	X
n-Tetradecane	X	X
n-Triacontane		
m-Xylene	X	X
o-&*p*-Xylene	X	X
p-Cymene		

Pollutant	Passes Through for Chemical Precipitation	Passes Through for DAF
Priority Metals and Elements		
Cadmium	X	
Chromium	X	X
Copper	X	X
Lead	X	
Nickel	X	X
Zinc	X	X
Nonconventional Metals and Elements		
Manganese	X	X
Molybdenum		
Tin	X	X
Titanium	X	X

[1]TPH was considered for regulation, although a pass-through analysis was not performed for this pollutant (a pass-through analysis was performed on the individual compounds that compose TPH).

- *n*-Octadecane;
- *n*-Tetracosane;
- *n*-Tetradecane;
- *n*-Triacontane;
- Bis (2-ethylhexyl) Phthalate; and
- Naphthalene.

EPA also believes that controlling TPH will also control the remaining semivolatile organic pollutants shown on Table 7-11.

EPA believes that controlling the following volatile organic pollutants will control the remaining volatile organic pollutants shown on Table 7-11 to some extent. However, the most effective way to treat items containing solvents, which contain these volatile organic compound, is to pretreat the items prior to the water washing process.

- Ethylbenzene;
- Tetrachloroethene;
- *m*-Xylene; and
- *o*-&*p*-Xylene.

These pollutants represent a cross-section of chlorinated and aromatic compounds that are the majority of the volatile pollutants on Table 7-11.

EPA believes that controlling the following metal pollutants that pass through will control the remaining metal and elemental pollutants on Table 7-11:

- Copper; and
- Zinc.

These metals were selected because the minimum solubilities of their associated metal hydroxides span a pH range sufficient to control the other pollutants within this pH range. Most metals will be treated by chemical precipitation or DAF within this range. These metals were also selected because they were detected most frequently (in nearly 100 percent of untreated wastewater samples) and in the highest concentrations.

7.6 Long-Term Average and Variability Factors for the Five Technology Options

EPA collected analytical sampling data for the purpose of evaluating treatment performance of several technology options. The data were collected from the following three sources:

1. The EPA wastewater sampling effort;
2. The self-monitoring data submitted by the facilities in response to the detailed monitoring questionnaire; and
3. Other industry-supplied data.

EPA used all of the data representative of well-designed and well-operated treatment systems to calculate long-term averages and variability factors for facilities with Chemical Emulsion Breaking (CEB), Dissolved Air Flotation of heavy wastewater (DAF-Heavy), Dissolved Air Flotation of all process wastewater (DAF-All), Chemical Precipitation of heavy wastewater (CP-Heavy), and Chemical Precipitation of all process wastewater (CP-All). EPA applied the data-editing procedures described in Section 7.3. The long-term averages and variability factors can be used to calculate local limits based on best engineering judgement.

EPA calculated the long-term average of a pollutant for each facility based on either an arithmetic average or the expected value of the distribution of the samples, depending on the number of total samples and the number of detected samples for the pollutant at that facility.

EPA calculated variability factors by fitting a statistical distribution to the data. The distribution was based on an assumption that the furthest excursion from the LTA that a well-operated facility using the given technology could be expected to make on a daily basis was a point below which 99% of the data for that facility falls, under the assumed distribution. The daily variability factor (1-day VF) for each pollutant at each facility is the ratio of the estimated 99^{th} percentile of the distribution of the daily pollutant concentration values divided by the expected value of the distribution of the daily values.

EPA also calculated 4-day variability factors based on an assumption that the furthest excursion from the LTA that a well-operated facility using the given technology could be expected to make on a monthly basis was a point below which 95 percent of the data for that facility falls, under the assumed distribution. The 4-day variability for each pollutant at each facility is the ratio of the estimated 95^{th} percentile of the distribution of monthly pollutant concentration values divided by the expected value of the distribution of the monthly values. (The monthly values were based on an assumed monitoring frequency of 4 times per month.)

By accounting for these reasonable excursions above the LTA, EPA's use of variability factors results in standards that are generally well above the actual LTAs. Thus if a facility operates its treatment system to meet the relevant LTA, EPA expects the facility to be able to meet the standards. Variability factors assure that normal fluctuations in a facility's treatment are accounted for in the standards.

The methodology used for calculating candidate pretreatment standards for industrial laundries consists of a daily maximum for all pollutants and an additional monthly average for TPH . The daily maximum limitation was the product of the pollutant long-term average and the pollutant 1-day variability factor. The monthly average limitation (for pollutants assumed to be monitored 4 times per month) was a product of the pollutant long-term average and the pollutant 4-day variability factor. The pollutant long-term average and the pollutant variability factor were both defined as the median of all of the well-operated facilities using that treatment technology.

For a more complete description of the data review, data aggregation, and the estimation of the long-term averages and variability factors under the modified delta-lognormal model, please refer to Appendix D.

In Tables 7-12 to 7-16 below, we present facility-level statistics for each of the five treatment technologies for the following eight pollutants: TPH (measured as SGT-HEM or non-polar material), ethylbenzene, tetrachloroethene, *m*-xylene, *o*-&*p*-xylene, copper, lead, and zinc. These same statistics can be found for all 72 pollutants of concern in Appendix D.

These tables provide influent and effluent information for individual facilities as well as a median value for long-term averages and variability factors for all facilities of that treatment type for each of the eight pollutants. No additional data have been added to the record since the Notice of Data Availability (NODA); therefore, this is the same data used to calculate the pretreatment standards in the public record at the time EPA published the NODA (DCN L14000). The only change reflected in the Tables 7-12 to 7-16 is the elimination of toluene based on the lack of data demonstrating effective treatment by the DAF or CP technology, and the elimination of naphthalene and bis(2-ethylhexyl)phthalate because they comprise a portion of TPH (measured as SGT-HEM).

7.7 Mass-Based Standards

EPA considered mass-based standards for the industrial laundries industry. A mass-based standard is the product of the concentration-based standards and a wastewater flow rate divided by a production rate. Mass-based standards require information about flow and production both to set the standards and to enforce them, but have the advantage of encouraging flow reduction. Two methodologies were considered for developing mass-based standards. One methodology bases the mass-based standards on an average number of gallons of wastewater discharged per pound of laundry washed for the total wastewater flow and total production from facilities. The other methodology bases the standards on an average number of gallons of water used per pound of laundry washed calculated from individual item data. EPA used annual data provided in the detailed questionnaire to evaluate these approaches.

Based on total wastewater flow and total production, EPA identified the seventy-fifth percentile and the ninetieth percentile production-normalized flows as potentially appropriate for calculating mass-based standards. The seventy-fifth percentile production-normalized flow is 3.13 gallons of wastewater per pound of production and the ninetieth percentile production normalized flow is 4.06 gallons of wastewater per pound of production. However, EPA found no strong relationship between gallons of wastewater used per pound of laundry and items washed, total production, or the amount of recycle/reuse that could be used as a basis for developing mass-based standards. Therefore, EPA decided not to develop mass-based candidate pretreatment standards for the industrial laundries industry.

Table 7-12

Chemical Emulsion Breaking (CEB)

Analyte	Episode	Inf # Obs	Inf# ND	Inf Est. LTA (mg/l)	Eff # Obs	Eff# ND	Eff Est. LTA (mg/l)	Eff 1-Day VF	Eff 4-Day VF
Copper	S1	5	0	4.4	4	0	0.44	1.76	1.23
Ethylbenzene	S1	5	0	0.87	4	0	0.31	4.74	1.91
Lead	S1	5	0	2.49	4	0	0.91	1.32	1.1
m-Xylene	S1	5	0	2.52	4	0	0.37	1.61	1.19
o-&*p*-Xylene	S1	5	0	2.59	4	0	0.36	1.72	1.22
Tetrachloroethene	S1	5	1	3.3	4	0	0.29	2.91	1.51
Total Petroleum Hydrocarbon (as SGT-HEM)	S1	5	0	3090	4	0	200	3.51	1.64
Zinc	S1	5	0	8.71	4	0	6.78	1.33	1.11

Inf # Obs - The total number of influent samples.
Inf # ND - The total number of nondetected values in the influent.
Inf Est. LTA - The estimated influent long-term average.
Eff # Obs - The total number of effluent samples.
Eff # ND - The total number of nondetected values in the effluent.
Eff Est. LTA - The estimated effluent long-term average.
Eff 1-day VF - The estimated 1-day effluent variability factor.
Eff 4-day VF - The estimated 4-day effluent variability factor.

Table 7-13

Dissolved Air Flotation - Heavy (DAF-Heavy)

Analyte	Episode	Inf# Obs	Inf # ND	Inf Est. LTA (mg/l)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/l)	Eff 1-Day VF	Eff 4-Day VF
Copper	S2	5	0	8.03	4	0	1.45	1.9	1.27
Ethylbenzene	Q10	NA	NA	NA	9	0	1.18	2.59	1.43
	S2	5	0	5.82	4	1	1.56	2.86	1.48
	Median	NA	NA	5.82	.	.	1.37	2.73	1.46
Lead	Q10	NA	NA	NA	9	0	0.11	2.69	1.46
	S2	5	0	1.83	4	0	0.36	6.18	2.23
	Median	NA	NA	1.83	.	.	0.24	4.43	1.84
Tetrachloroethene	Q10	NA	NA	NA	4	3	0.14	.	.
Total Petroleum Hydrocarbon (as SGT-HEM)	S2	5	0	263	4	0	42.1	2.31	1.37
Zinc	S2	5	0	6.45	4	0	0.9	2.68	1.45

Inf # Obs - The total number of influent samples.
Inf # ND - The total number of nondetected values in the influent.
Inf Est. LTA - The estimated influent long-term average.
Eff # Obs - The total number of effluent samples.
Eff # ND - The total number of nondetected values in the effluent.
Eff Est. LTA - The estimated effluent long-term average.
Eff 1-day VF - The estimated 1-day effluent variability factor.
Eff 4-day VF - The estimated 4-day effluent variability factor.

Table 7-14

Chemical Precipitation - Heavy (CP-Heavy)

Analyte	Episode	Inf # Obs	Inf # ND	Inf Est. LTA (mg/l)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/l)	Eff 1-Day VF	Eff 4-Day VF
Copper	S3	5	0	3.42	5	0	0.53	4.06	1.76
Ethylbenzene	S3	5	1	0.96	5	1	0.09	4.37	1.8
Lead	S3	5	0	1.55	5	4	0.05	.	.
m-Xylene	S3	5	0	1.36	5	1	0.1	2.66	1.42
o-&*p*-Xylene	S3	5	0	1.24	5	0	0.09	3.63	1.67
Tetrachloroethene	S3	4	0	2.06	5	2	0.13	4.48	1.9
Total Petroleum Hydrocarbon (as SGT-HEM)	S3	5	0	2330	5	4	7.2	.	.
Zinc	S3	5	0	9.03	5	0	0.06	6.19	2.23

Inf # Obs - The total number of influent samples.
Inf # ND - The total number of nondetected values in the influent.
Inf Est. LTA - The estimated influent long-term average.
Eff # Obs - The total number of effluent samples.
Eff # ND - The total number of nondetected values in the effluent.
Eff Est. LTA - The estimated effluent long-term average.
Eff 1-day VF - The estimated 1-day effluent variability factor.
Eff 4-day VF - The estimated 4-day effluent variability factor.

Table 7-15

Dissolved Air Flotation - All (DAF-All)

Analyte	Episode	Inf # Obs	I nf # ND	Inf Est. LTA (mg/l)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/l)	Eff 1-Day VF	Eff 4-Day VF
Copper	Q1	NA	NA	NA	15	0	0.67	6.4	2.28
	Q2	NA	NA	NA	13	1	0.59	4.52	1.87
	Q3	NA	NA	NA	5	0	0.57	6.95	2.4
	Q4	NA	NA	NA	8	0	0.39	3.15	1.56
	S4	5	0	3.4	5	0	0.36	3.07	1.54
	S5	5	0	2.14	5	0	0.17	1.59	1.18
	Median	NA	NA	2.77	.	.	0.48	3.83	1.72
Ethylbenzene	Q2	NA	NA	NA	13	10	0	3.54	1.9
	S5	5	0	7.05	5	0	0.37	4.16	1.78
	Median	NA	NA	7.05	.	.	0.19	3.85	1.84
Lead	Q1	NA	NA	NA	15	1	0.22	5.05	1.99
	Q2	NA	NA	NA	14	3	0.23	2.99	1.57
	Q3	NA	NA	NA	4	2	0.32	1.55	1.47
	Q4	NA	NA	NA	8	8	0.1	.	.
	S4	5	0	1.46	5	2	0.14	3.72	1.75
	S5	5	0	0.76	5	2	0.06	1.39	1.13
	Median	NA	NA	1.11	.	.	0.18	2.99	1.57
m-Xylene	S5	5	0	16.1	5	0	0.6	3.55	1.65
o-&p-Xylene	S4	5	0	0.18	5	0	0.12	3.15	1.56
	S5	5	0	11.8	5	0	0.42	4.07	1.76
	Median	NA	NA	5.99	.	.	0.27	3.61	1.66
Tetrachloroethene	Q1	NA	NA	NA	6	2	25.1	15.4	3.87
	Q2	NA	NA	NA	13	4	0.02	4.97	2
	S4	5	0	0.14	5	0	0.07	3.08	1.54
	S5	5	1	9.58	5	0	0.43	5.87	2.16
	Median	NA	NA	4.86	.	.	0.25	5.42	2.08

Table 7-15 (Continued)

Analyte	Episode	Inf # Obs	I nf # ND	Inf Est. LTA (mg/l)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/l)	Eff 1-Day VF	Eff 4-Day VF
Total Petroleum Hydrocarbon (as SGT-HEM)	S4	5	0	318	5	1	11.4	3.64	1.68
	S5	5	0	683	5	0	16	2.62	1.44
	Median	NA	NA	500	.	.	13.7	3.13	1.56
Zinc	Q1	NA	NA	NA	15	0	0.9	7.34	2.49
	Q2	NA	NA	NA	12	0	1.22	5.11	1.99
	Q3	NA	NA	NA	5	0	0.91	6.27	2.25
	Q4	NA	NA	NA	8	0	0.78	2.96	1.52
	S4	5	0	4.69	5	0	0.51	3.17	1.57
	S5	5	0	3.07	5	0	0.27	1.58	1.18
	Median	NA	NA	3.88	.	.	0.84	4.14	1.78

Inf # Obs - The total number of influent samples.
Inf # ND - The total number of nondetected values in the influent.
Inf Est. LTA - The estimated influent long-term average.
Eff # Obs - The total number of effluent samples.
Eff # ND - The total number of nondetected values in the effluent.
Eff Est. LTA - The estimated effluent long-term average.
Eff 1-day VF - The estimated 1-day effluent variability factor.
Eff 4-day VF - The estimated 4-day effluent variability factor.

Table 7-16

Chemical Precipitation - All (CP-All)

Analyte	Episode	Inf # Obs	Inf # ND	Inf Est. LTA (mg/l)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/l)	Eff 1-Day VF	Eff 4-Day VF
Copper	Q5	NA	NA	NA	16	0	0.14	1.71	1.22
	Q6	NA	NA	NA	7	0	0.4	1.56	1.17
	S6	5	0	3.13	4	0	0.06	3.57	1.65
	S7	5	0	4.85	5	0	0.44	2.37	1.38
	Median	NA	NA	3.99	.	.	0.27	2.04	1.3
Ethylbenzene	Q7	NA	NA	NA	3	1	0.04	.	.
	Q9	NA	NA	NA	4	0	0.34	9.68	3.05
	S6	5	1	0.51	4	0	0.27	2.47	1.41
	S7	5	0	0.31	5	0	0.04	2.72	1.46
	Median	NA	NA	0.41	.	.	0.15	2.72	1.46
Lead	Q5	NA	NA	NA	16	11	0.1	1.29	1.07
	Q6	NA	NA	NA	7	0	0.28	1.52	1.16
	Q7	NA	NA	NA	11	5	0.03	3.89	1.77
	Q8	NA	NA	NA	4	1	0.2	2.66	1.55
	S6	5	0	1.5	4	2	0.06	5.29	2
	S7	5	0	2.14	5	0	0.1	5.22	2.02
	Median	NA	NA	1.82	.	.	0.1	3.27	1.66
m-Xylene	S6	5	1	4.39	4	1	0.35	3.84	1.83
	S7	5	0	0.75	5	0	0.14	1.89	1.26
	Median	NA	NA	2.57	.	.	0.24	2.87	1.54
o-&*p*-Xylene	S6	5	2	2.88	4	1	0.23	4.12	1.87
	S7	5	0	0.9	5	0	0.16	1.92	1.27
	Median	NA	NA	1.89	.	.	0.2	3.02	1.57
Tetrachloroethene	Q9	NA	NA	NA	4	0	0.08	7.56	2.55
	S6	5	1	1.68	4	0	0.44	5.65	2.11
	S7	5	0	5.13	5	0	0.42	2.1	1.32
	Median	NA	NA	3.4	.	.	0.42	5.65	2.11

Table 7-16 (Continued)

Analyte	Episode	Inf # Obs	Inf # ND	Inf Est. LTA (mg/l)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/l)	Eff 1-Day VF	Eff 4-Day VF
Total Petroleum Hydrocarbon (as SGT-HEM)	S6	5	0	164	4	0	10.8	2.54	1.42
	S7	5	0	991	5	0	9.51	1.76	1.23
	Median	NA	NA	578	.	.	10.2	2.15	1.32
Zinc	Q5	NA	NA	NA	16	0	0.1	3.96	1.74
	Q6	NA	NA	NA	7	0	1.72	2.14	1.33
	Q8	NA	NA	NA	4	0	0.3	6.94	2.4
	S6	5	0	3.71	4	0	0.05	1.79	1.24
	S7	5	0	8.45	5	0	0.52	3.08	1.54
	Median	NA	NA	6.08	.	.	0.3	3.08	1.54

Inf # Obs - The total number of influent samples.
Inf # ND - The total number of nondetected values in the influent.
Inf Est. LTA - The estimated influent long-term average.
Eff # Obs - The total number of effluent samples.
Eff # ND - The total number of nondetected values in the effluent.
Eff Est. LTA - The estimated effluent long-term average.
Eff 1-day VF - The estimated 1-day effluent variability factor.
Eff 4-day VF - The estimated 4-day effluent variability factor.

7.8 References

1. U.S. Environmental Protection Agency. Statistical Support Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category. EPA 821-R-97-006, Washington, DC, November 1997.

2. U.S. Environmental Protection Agency. Fate of Priority Pollutants in Publicly Owned Treatment Works (50 POTW Study). EPA-440/1-82/303. Washington, DC, September 1982.

3. U.S. Environmental Protection Agency. The Risk Reduction Engineering Laboratory (RREL) Treatability Database. Version 5.0., Cincinnati, OH.

4. U.S. Environmental Protection Agency. Final POTW Pass-Through Analysis for the Pharmaceutical Manufacturing Point Source Category.

CHAPTER 8
DEVELOPMENT OF TECHNOLOGY CONTROL OPTIONS

8.1 Introduction

This chapter presents the regulatory options considered by EPA as the basis for the candidate Pretreatment Standards for Existing Sources (PSES) and Pretreatment Standards for New Sources (PSNS) for the industrial laundries industry. This chapter presents the following information:

- Section 8.2 presents the initial technology control options considered as the bases for the candidate PSES and PSNS;
- Section 8.3 discusses the inclusion of pollution prevention in the technology control options;
- Section 8.4 discusses the exclusion of wastewater recycling activities from the technology control options;
- Section 8.5 presents the subcategorization analysis of the industrial laundries industry;
- Section 8.6 presents initial technology control options considered but rejected before the final action;
- Section 8.7 presents additional technology control options considered;
- Section 8.8 presents technology control options eliminated from further consideration;
- Section 8.9 presents regulatory control options considered for the final action; and
- Section 8.10 presents the references used.

8.2 Initial Technology Control Options Considered

EPA considered the same set of technology control options as potential bases for both PSES and PSNS. As described in Chapter 7, EPA had data available for three major postlaundering wastewater treatment technologies used at industrial laundries. As described in Chapter 6, EPA had data available for one prelaundering treatment technology used by industrial laundries, along with general information on pollution prevention activities at industrial laundries. The data for the postlaundering treatment technologies represented five different treatment options. These five different postlaundering treatment options and the one prelaundering treatment technology, in addition to the general application of the pollution prevention activities, formed the basis for EPA's six initial technology control options considered for the proposed rule.

The following sections further discuss each of these initial technology control options.

Table 8-1 summarizes the six initial technology control options and the number of detailed questionnaire facilities that have equivalent or better treatment currently in place.

8.2.1 Postlaundering Wastewater Treatment Technology Control Options

The five initial postlaundering wastewater treatment technology control options considered by EPA are:

- CEB-Heavy -- chemical emulsion breaking treatment of heavy wastewater;
- DAF-Heavy -- dissolved air flotation (DAF) treatment of heavy wastewater;
- CP-Heavy -- chemical precipitation treatment of heavy wastewater;
- DAF-All -- DAF treatment of all facility process wastewater; and
- CP-All -- chemical precipitation treatment of all facility process wastewater.

The treatment train for each of the postlaundering wastewater treatment technology control options includes the major wastewater treatment technology (i.e., chemical emulsion breaking, DAF, or chemical precipitation), as well as other ancillary equipment. Based on responses to the 1994 Industrial Laundries Industry Questionnaire (detailed questionnaire) and EPA site visits to industrial laundries, EPA assumed that every facility has an initial catch basin in which gravity settling occurs. Each option includes screening and equalization followed by the major wastewater treatment technology. Although they do not directly impact final effluent concentrations, screening and equalization are included in the technology control options because they are necessary to remove solids and control fluctuations in the process wastewater flow, respectively. They were also reported in the detailed questionnaire by most facilities that currently treat their wastewater. Based on information obtained through site visits, EPA determined that these technologies ensure proper operation of subsequent treatment technologies. The options in which DAF and chemical precipitation are used also include dewatering of the sludge generated.

Based on detailed questionnaire and sampling data from industrial laundries that use chemical emulsion breaking and chemical precipitation, as well as information on facilities' local discharge limits, EPA expects that the pH of the treated wastewater streams from these

Table 8-1

Technology Control Options Initially Considered for the Industrial Laundries Proposed Rule

Technology Control Option	Description	Basis of Standards[1]	Number of Facilities with Equivalent Treatment In Place[2]
CEB-Heavy	Chemical emulsion breaking of heavy wastewater	CEB-Heavy	5
DAF-Heavy	Dissolved air flotation of heavy wastewater	DAF-Heavy	2
CP-Heavy	Chemical precipitation of heavy wastewater	CP-Heavy	6[3]
DAF-All	Dissolved air flotation of all facility process wastewater	DAF-All	33
CP-All	Chemical precipitation of all facility process wastewater	CP-All	17[4]
OC-Only	Organics control (steam tumbling) of heavy industrial textile items	OC-Only	0[5]

[1]Pollutant concentration data representing each treatment option is presented in Chapter 7 of this document.
[2]Data obtained from 190 in-scope facilities that responded to the detailed questionnaire. In-scope facilities are those that meet the definition of an industrial laundry as presented in Chapter 4.
[3]One of these facilities operates a microfiltration unit to treat a portion of its process wastewater. Since microfiltration, when operated properly, can achieve lower final effluent pollutant concentrations than chemical precipitation (1), this facility is considered to have better treatment in place than the CP-Heavy option.
[4]One of these facilities operates an ultrafiltration unit to treat all of its process wastewater. Since ultrafiltration, when operated properly, can achieve lower final effluent concentrations than chemical precipitation (1), this facility is considered to have better treatment in place than the CP-All option.
[5]Data from one facility were available for OC-Only, but this facility steam tumbles printer towels/rags only, not all heavy industrial textile items.

technologies will be outside of facilities' locally permitted discharge range. Therefore, the CEB and chemical precipitation options also include pH adjustment of the final effluent prior to discharge. Technology control options in which a portion of the facility's wastewater is treated with CEB or chemical precipitation also include combining the treated and untreated streams prior to final pH adjustment and discharge. The effluent from DAF is expected to be within facilities' locally permitted discharge range for pH, because most facilities operating DAF adjust the pH to within a range acceptable for discharge, based on detailed questionnaire and sampling data. Therefore, the DAF treatment options do not include final pH adjustment. Technology control options in which a portion of the facility's wastewater is treated with DAF also include combining the treated and untreated streams prior to discharge.

The five initial wastewater treatment technology control options treat either the wastewater generated from washing "heavy" industrial laundry items only (i.e., those items with a relatively high pollutant load) or the total facility process wastewater. EPA modeled the raw wastewater treated in each option by considering the total raw wastewater flow reported by each facility in the detailed questionnaire to consist of three streams, as follows:

- Heavy industrial;
- Light industrial; and
- Nonindustrial.

The heavy industrial stream includes wastewater generated from water washing the following items:

- Shop towels;
- Printer towels/rags;
- Mops;
- Fender covers; and
- Filters.

The light industrial stream includes wastewater generated from water washing the following items:

- Industrial garments;
- Floor mats;
- Laundry bags; and
- Buffing pads;

and wastewater generated from dry cleaning followed by water washing or dual-phase washing of the following items:

- Industrial garments;
- Shop towels;
- Printer towels/rags;
- Mats;
- Mops;

- Fender covers;
- Laundry bags;
- Filters; and
- Buffing pads.

The nonindustrial stream includes wastewater generated from water washing or denim prewashing the following items (dry cleaning followed by water washing and dual-phase washing were not reported for nonindustrial textile items):

- Linen supply garments;
- Linen flatwork/full dry;
- Health-care items;
- Continuous roll towels;
- Clean room garments;
- Family laundry;
- New items;
- Executive wear; and
- Miscellaneous not our goods (items not owned by the laundry).

The wastewater generated from the washing of heavy industrial textile items ("heavy" wastewater) contains higher concentrations of most pollutants than the wastewater generated from the washing of light industrial and nonindustrial textile items ("light" wastewater). Figures 8-1, 8-2, and 8-3 illustrate the CEB-Heavy, DAF-Heavy, and CP-Heavy technology options, respectively. Only heavy wastewater is treated in these options. Figures 8-4 and 8-5 illustrate the DAF-All and CP-All technology options, respectively. Total facility process wastewater is treated in these options.

EPA obtained specific performance data on the treatment of heavy industrial laundry wastewater through wastewater sampling at industrial laundries, as discussed in Chapter 7 of this document. Estimated performance of the heavy options is based on pollutant concentrations obtained from the treated heavy wastewater, prior to combining with the light wastewater stream, as shown in Figures 8-1, 8-2, and 8-3. Figures 8-1 through 8-3 also show options discussed in Section 8.7 of this document. Estimated performance of the options treating total facility wastewater is based on pollutant concentrations obtained at the point of discharge from treatment of the entire wastewater stream, as shown in Figures 8-4 and 8-5.

8.2.2 Prelaundering Organics Control (OC-Only) Technology Control Option

The Prelaundering Organics Control (OC-Only) option, shown in Figure 8-6, consists of steam tumbling treatment of facilities' heavy industrial laundry items to remove organics prior to water washing of the items. EPA obtained data from one facility that could be used to estimate the performance of steam tumbling of printer towels/rags; these data are

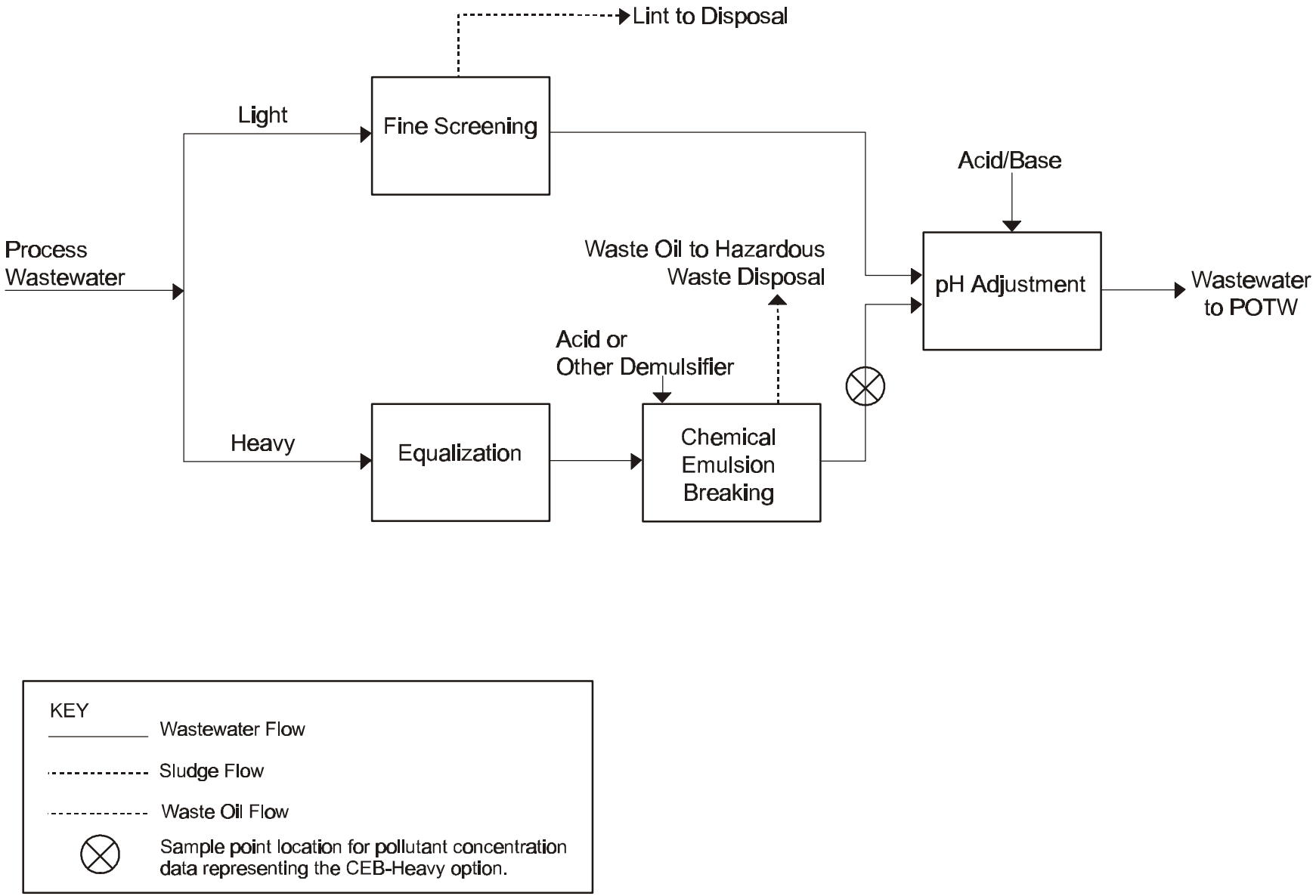

Figure 8-1. CEB-Heavy Option: Chemical Emulsion Breaking of Heavy Industrial Laundry Wastewater

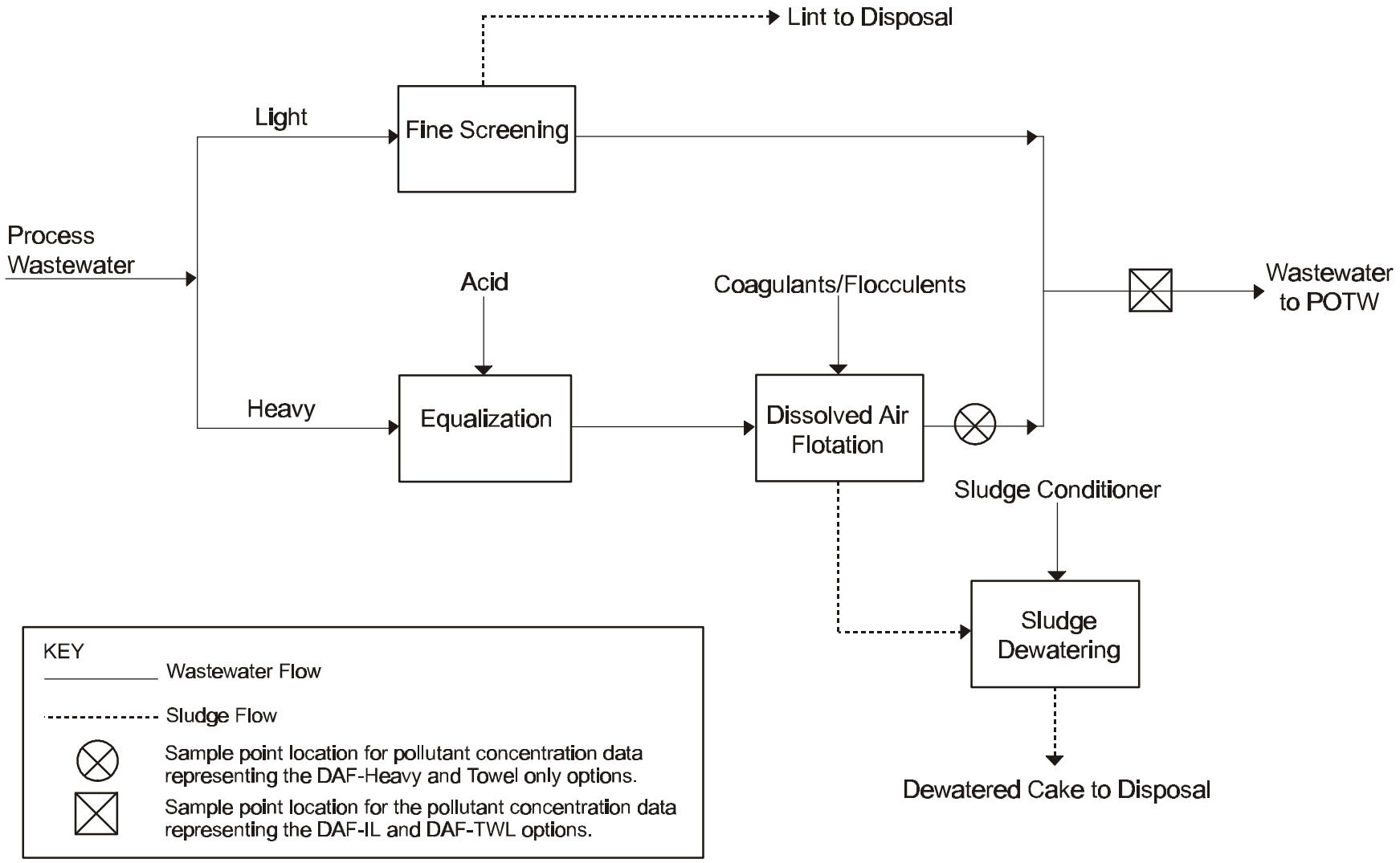

Figure 8-2. DAF-Heavy, DAF-IL, DAF-TWL, and Towel Only Options: Dissolved Air Flotation of a Portion of a Facility's Process Wastewater

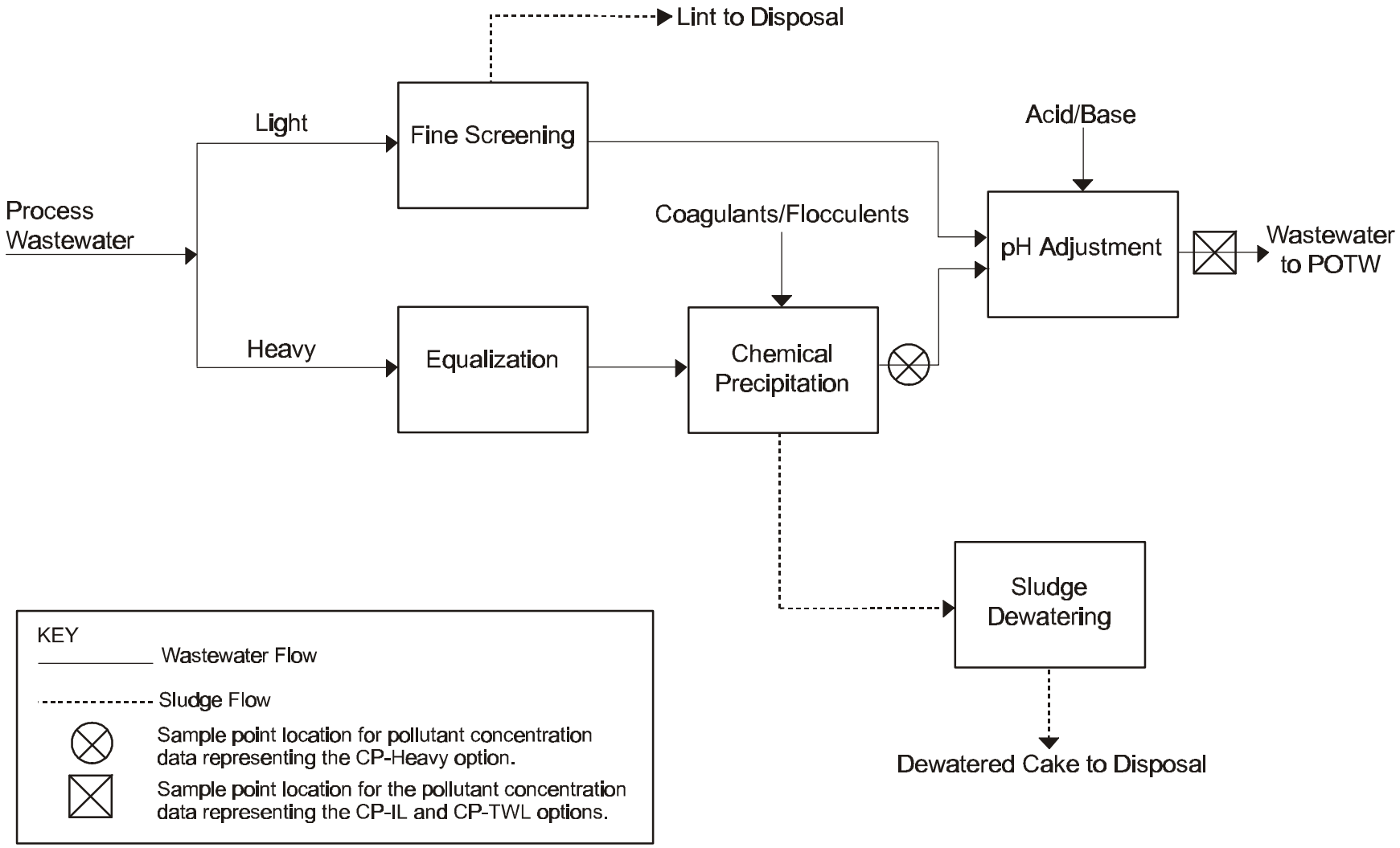

Figure 8-3. CP-Heavy, CP-IL, and CP-TWL Options: Chemical Precipitation of a Portion of a Facility's Process Wastewater

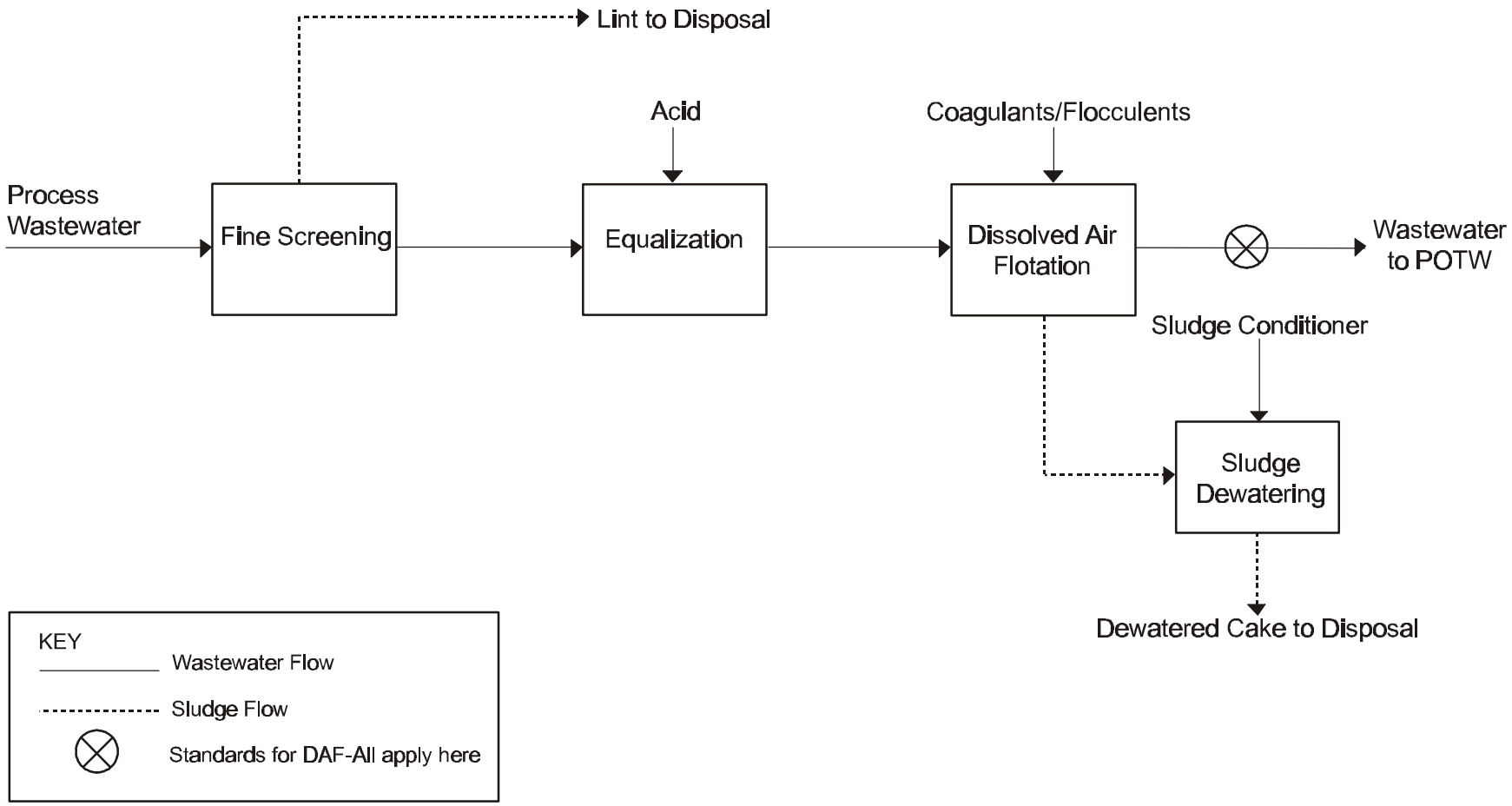

Figure 8-4. DAF-All Option: Dissolved Air Flotation of Total Facility Process Wastewater

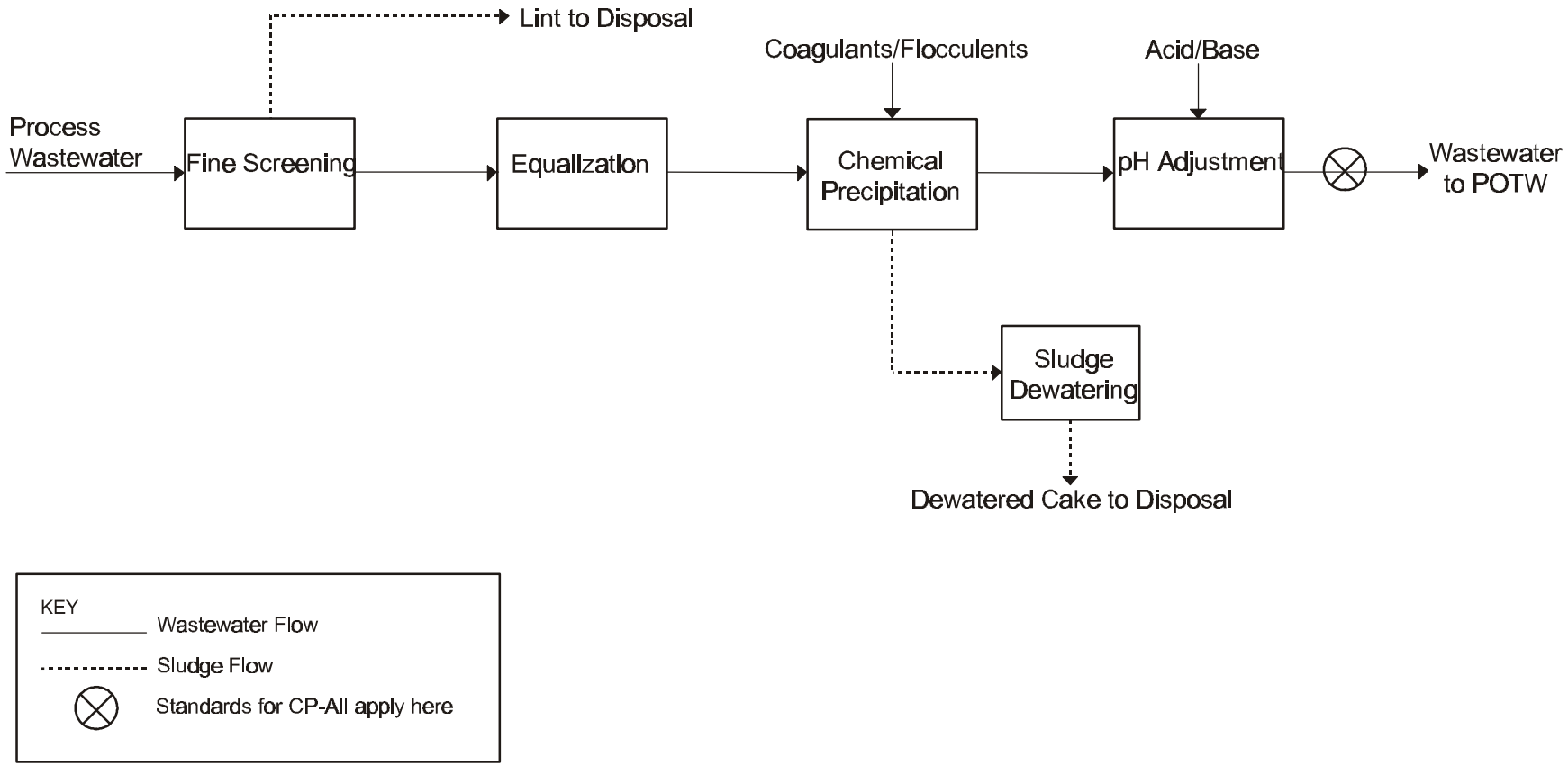

Figure 8-5. CP-All Option: Chemical Precipitation of Total Facility Process Wastewater

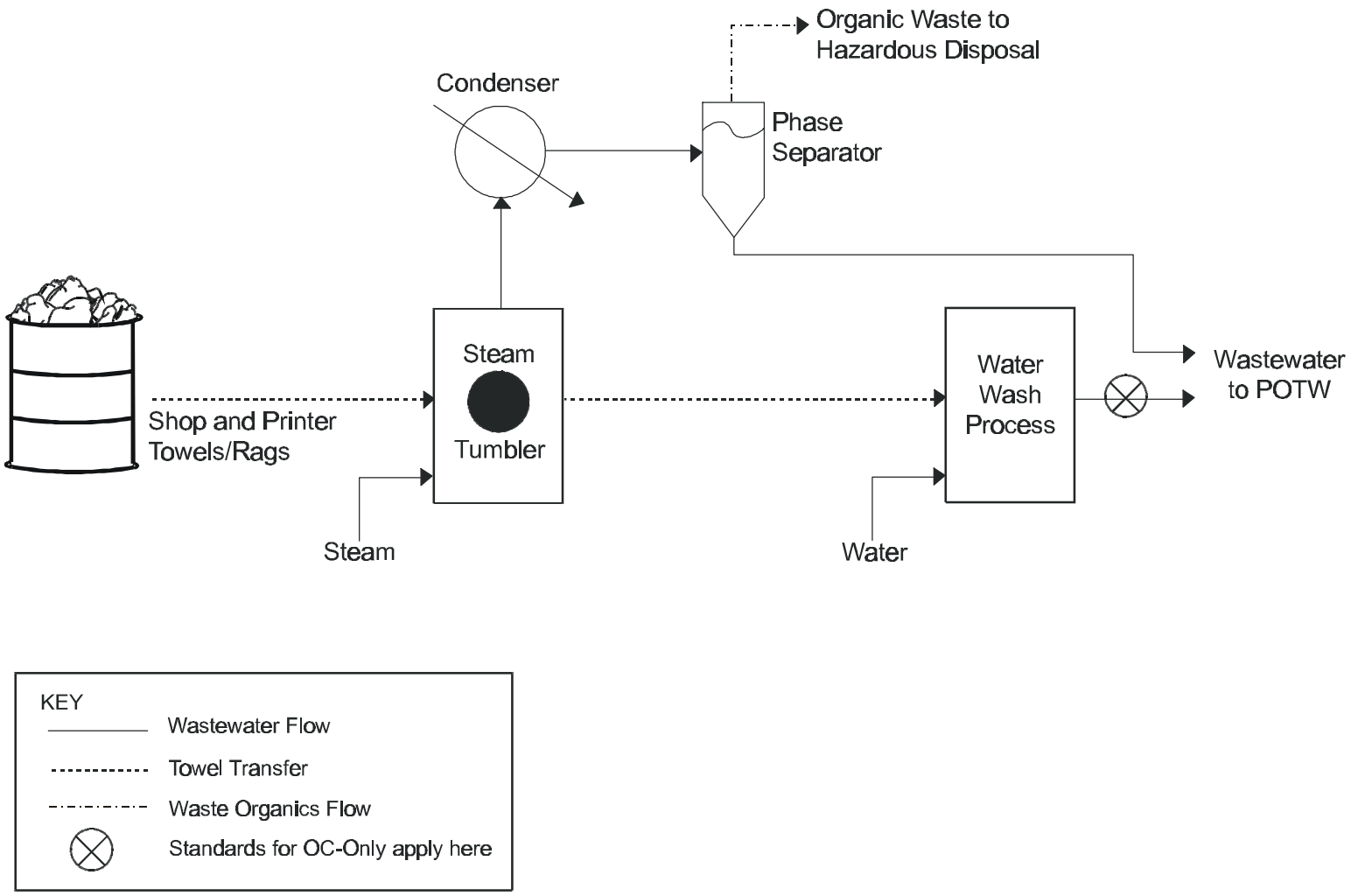

Figure 8-6. OC-Only Option: Prelaundering Organics Control

presented in Chapter 6. The standards for the OC-Only option would be based on pollutant concentrations obtained from the raw wastewater discharged from a load of steam-tumbled printer towels/rags, as shown in Figure 8-6.

8.3 Inclusion of Pollution Prevention in the Technology Control Options

Most of the preprocess pollution prevention activities reported in the detailed questionnaire involve good operating practices that any industrial laundry can technically implement. The two most commonly reported activities, refusal of items containing free liquids and refusal of certain items, require that laundries work with their customers to reduce pollutant loads. This presents a challenge to laundries to maintain their customer base while still controlling the amount of contaminants they take in. Another commonly reported preprocess activity viewed as a good operating practice is the reduction of free liquids in laundry items by centrifugation before the items are water-washed. After centrifugation, the liquid removed from the items is reused by the customer or disposed of as hazardous waste. Either the customer or the industrial laundry technically could perform this preprocess activity.

All of the in-process pollution prevention activities reported by industrial laundries reduce pollution at the facilities that implement them and reduce operating costs by optimizing laundry operations. The installation of alternative washers and automated liquid injection systems for washers, the use of alternative washing chemicals and water softening, and the implementation of water reuse/reduction all can reduce the amount of water and/or chemicals that a laundry uses. A significant number of industrial laundries have improved employee training and housekeeping standards, which can also decrease water and chemical use. In addition, changes in laundering chemicals were reported to improve treatability of the wastewater by forming emulsions that are more easily broken.

Most of the industrial laundries from which EPA has gathered data used for the development of DAF and chemical precipitation pretreatment standards practice refusal of items containing free liquids to some degree. Therefore, EPA has included this preprocess pollution prevention practice as a component of the technology options involving DAF or chemical precipitation treatment of process wastewater. EPA evaluated the use of steam stripping as a stand-alone technology for the OC-only technology control option, discussed in Section 8.2.2 of this document. Use of the other preprocess and in-process pollution prevention practices, described in Chapter 6 of this document, as stand-alone technology control options were considered, but reasonably rejected. These options were rejected because the practices varied too greatly among individual facilities to construct an acceptable regulatory framework and because the available data were insufficient to identify specific pollutant loading reductions and costs associated with the use of these practices. In addition, EPA did not have sufficient facility-specific information to evaluate how many facilities could afford to implement these preprocess or in-process practices.

8.4 Exclusion of Wastewater Recycling Activities from the Technology Control Options

Some industrial laundries reported that they have incorporated wastewater recycling activities into their processes, as described in Section 6.4 of this document. EPA has found that the use of wastewater recycling largely depends upon customer demands on product quality, the facility's product mix, and the level of wastewater treatment at the facility. In addition, EPA has limited data that show wastewater recycling activities in the industrial laundries industry do not necessarily result in a facility using less process water than a facility that does not recycle, due to facility-specific factors (2). EPA concluded that it does not have sufficient data to completely analyze the effects of wastewater recycling on costs or pollutant loadings. Therefore, EPA did not incorporate wastewater recycling activities into the technology options.

8.5 Subcategorization Analysis

EPA typically assesses several factors to determine whether segmenting or subcategorizing an industrial category and considering different technology control options for those segments or subcategories would be appropriate. These factors were assessed for the Industrial Laundries Point Source Category and are listed below:

- Disproportionate economic impacts;
- Laundry processes and water use practices;
- Plant age;
- Plant location;
- Plant size;
- Raw materials;
- Non-water quality environmental impacts (energy usage, air emissions, and solid waste generation); and
- Type of item laundered and wastewater characteristics.

Based on the results of this examination, EPA determined that the Industrial Laundries Point Source Category warrants no formal subcategorization other than regulatory exclusions for certain smaller production facilities. Because costs of options may be dependent on all of the above factors, consideration of these factors is incorporated into the costing analysis for the final action. EPA did find that disproportionate economic impacts on small facilities warrant exclusion of some of those facilities from the technology control options. Also, as discussed in Chapter 4 of this document, EPA used laundry processes and water use practices and type of

item laundered as the basis for defining the scope of the industry. The remainder of this section discusses EPA's analysis of each of the factors listed above.

8.5.1 Disproportionate Economic Impacts

EPA looked at production as a means of defining applicability of pretreatment standards for this industry; EPA used production as a good indicator of size for industrial laundries because it is easily measured and closely tracked by the industry. In examining production levels, EPA determined that larger industrial laundries have an advantage over small facilities: they enjoy economy of scale in treating their wastewater and generally have more economic resources than small facilities. Because of these differences in economy of scale and economic resources, a disproportionate amount of negative economic impacts would occur at small facilities from implementation of national pretreatment standards. EPA evaluated three exclusions based on production level for small facilities in conjunction with the final technology control options and candidate pretreatment standards. The Economic Assessment document (3) and the Cost-Effectiveness Analysis (4) present EPA's rationale for these exclusions. The exclusions evaluated are:

- 1 Million/255 K - Facilities processing less than 1,000,000 pounds of incoming laundry and less than 255,000 pounds of industrial towels annually would be excluded.

- 3 Million/120 K - Facilities processing less than 1,000,000 pounds of incoming laundry and less than 255,000 pounds of industrial towels annually and facilities processing less than 3,000,000 pounds of incoming laundry and less than 120,000 pounds of industrial towels annually would be excluded.

- 5 Million/255 K - Facilities processing less than 5,000,000 pounds of incoming laundry and less than 255,000 pounds of industrial towels annually would be excluded.

8.5.2 Laundry Processes and Water Use Practices

EPA looked at laundering processes and water use practices in terms of a possible basis for subcategorization. As discussed in Section 4.8 of this document, EPA examined laundry operations and wastewater characteristics in defining the scope of the industry. EPA examined operations that generate wastewater and those that do not, and excluded those operations that do not generate wastewater. EPA then evaluated the wastewater characteristics for all water-washing operations, which includes dry cleaning followed by water washing. Based on the evaluation, EPA determined that wastewater characteristics are similar for all laundry water-washing operations, and therefore do not provide an adequate basis for subcategorization. Wastewater characteristics are primarily a function of the types of items laundered, and not the facility's laundering processes.

8.5.3 Plant Age

The age of an industrial laundry is an indefinite parameter primarily because of the upgrading and modernization that most facilities do to remain competitive, as discussed in Chapter 4 of this document. EPA therefore did not consider plant age as a basis for subcategorization.

8.5.4 Plant Location

Industrial laundries are located throughout the United States and are not generally limited to any one geographical location, as discussed in Chapter 4 of this document. EPA did not subcategorize based on geographical location because location would not affect the ability of industrial laundries to comply with national pretreatment standards.

8.5.5 Plant Size

In analyzing plant size as a basis for subcategorization and also as part of the analysis to minimize any disproportionate economic impacts, EPA examined the following factors to determine if any of them would be appropriate as a basis of subcategorization: number of employees, wastewater discharge flow rate, and production. The analysis of each of these factors is discussed below.

8.5.5.1 Number of Employees

Raw materials, laundering processes, and wastewater characteristics are independent of the number of employees at a facility. It is difficult to correlate the number of employees to wastewater generation due to variations in laundry staffing. Fluctuations can occur for many reasons, including shift differences, clerical and administrative support staff, maintenance workers, efficiency of site operations, and market fluctuations. For these reasons, EPA did not subcategorize by number of employees.

8.5.5.2 Wastewater Discharge Flow Rate

EPA did not subcategorize by wastewater discharge flow rate because the wastewater characteristics for a facility are independent of the overall wastewater discharge flow rate from a facility. Wastewater characteristics are primarily a function of the types of items laundered at a facility, and not the facility's overall wastewater discharge flow rate. For example, a facility laundering 100 pounds of laundry and discharging 300 gallons per year of wastewater would have wastewater characteristics similar to a facility processing 100,000 pounds of laundry and discharging 300,000 gallons of wastewater per year, provided the facilities are laundering similar items.

EPA also considered wastewater flow rate per pound of laundry processed as a potential basis for subcategorization of the industry. As shown in Figure 5-1 in Chapter 5 of this document, most facilities in the industry have production-normalized water use of between 1.5

and 3.5 gallons per pound of laundry processed. Because of the narrow range of production-normalized water use amounts, EPA did not subcategorize by this parameter.

8.5.5.3 Production

As with wastewater discharge flow rate, wastewater characteristics for a facility are independent of the overall production volume at a facility. Wastewater characteristics are primarily a function of the types of items laundered at a facility, and not the facility's overall production, as shown in the example discussed in the previous paragraph of this section.

However, as discussed in Section 8.5.1 of this document, EPA looked at production in determining the applicability of the candidate pretreatment standards to the industry. EPA evaluated several exclusions with regard to production; these exclusions were discussed in Section 8.5.1 of this document.

8.5.6 Raw Materials

The raw materials used in the industrial laundries industry primarily consist of chemicals used in the laundering process. Chemicals that are frequently used in the industry include alkaline solutions, detergent, bleach, antichlor, sour, softener, and starch; other chemicals used include enzymes, builders, oil treatment chemicals, water conditioners, dyes, stain treatment chemicals, and bactericides. The chemicals most commonly used across the industry and on a variety of laundry items are detergent, bleach, and sour. Chemical usage varies from wash cycle to wash cycle depending on product mix and equipment used for laundering. Waste load and wastewater treatability are not directly correlated to chemicals used in laundering. Because of the wide variety of chemicals and wash formulas used in the industry and the complexities involved in laundering chemistry, EPA determined it was not appropriate to subcategorize based on chemicals used in the laundering process.

8.5.7 Non-Water Quality Environmental Impacts

Non-water quality environmental impacts for the industrial laundries industry include wastewater treatment residual and sludge disposal, air emissions, and energy requirements. As discussed in Chapter 10 of this document, EPA estimates that minimal non-water quality impacts would result from implementation of the final technology control options considered. Therefore, EPA determined that these non-water quality environmental impacts are not an adequate basis for subcategorizing the industrial laundries industry.

8.5.8 Type of Item Laundered and Wastewater Characteristics

As discussed in Section 4.8 of this document, the types of items laundered by facilities in the scope of this industry as defined by EPA include, but are not limited to, the following industrial textile items: shop towels, printer towels/rags, furniture towels, rags, uniforms, mops, mats, rugs, tool covers, fender covers, dust-control items, gloves, buffing pads, and absorbents. Laundering of nonindustrial textile items is also covered when industrial textile items are laundered at the same facility.

EPA examined type of item as a possible basis of subcategorization, as wastewater characteristics differ depending on items laundered. As presented in Chapter 5 of this document, printer towels/rags, shop towels, and mops generally have concentrations of pollutants that are greater than the concentrations for floor mats and industrial garments. EPA determined that laundering of printer towels/rags and shop towels generates 34 percent of the toxic-weighted wastewater pollutant load from the total industry production and 60 percent from total industrial laundry production, although these items represent only 5 percent of the total industry production and 10 percent of the total industrial laundry production (see Section 17.8 of the Industrial Laundries Administrative Record).

EPA considered requiring different wastewater standards for wastewater generated from laundering printer towels/rags, shop towels, and mops than for wastewater generated from laundering other items. However, laundries typically clean a variety of items and typically combine wastewater from all items laundered. Thus, subcategorizing the industry by type of item laundered with different standards for different types of items would require segregation and separate treatment of waste streams. Most industrial laundries with wastewater treatment currently operate only one treatment system, and monitor their effluent at only one discharge point. Because of the cost and recordkeeping burden that would be involved if the industry was subcategorized by item type, EPA decided that item type is not a reasonable basis for subcategorizing the industry.

However, EPA did consider item type as a basis for reduced applicability of pretreatment standards. As discussed in this chapter, EPA considered technology control options that would cover only facilities processing industrial textile items, heavy items, or industrial towels as part of the overall analysis of technology control options. EPA considered these options in order to evaluate the costs and economic impacts of controlling only the most concentrated sources of wastewater pollutants.

8.6 Initial Technology Control Options Not Further Considered

EPA eliminated the Heavy options from further consideration because EPA determined that, in these options, the untreated light wastewater stream at some facilities has higher concentrations of pollutants than the treated heavy wastewater stream. In addition, for these technology options, standards would be applicable to only a portion of a facility's wastewater flow. This presents a significant difficulty for the permitting authorities and regulated facilities in that these options would require an in-plant monitoring point. This also would be coupled with a need for detailed record keeping by the facility and information collection by the permitter regarding production and flow rates associated with specific laundry items to assure compliance with standards developed for the Heavy options. EPA ultimately concluded that in-plant standards and this level of detailed data collection present an unacceptable compliance burden and cost to the industrial laundries industry that is not warranted, and would be more difficult to enforce by POTWs than the options covering all of the facility's wastewater.

8.7 Additional Technology Control Options Considered

EPA considered additional alternative technology control options, which were variations on the initial DAF and chemical precipitation technology options presented above, to find the most effective option for the industry. These additional options involve treating different portions of the total facility process wastewater, then combining the treated and untreated wastewater prior to monitoring and final discharge. These additional options are described in the sections below.

Table 8-2 summarizes the 12 additional technology control options considered for PSES and PSNS.

8.7.1 Industrial Laundry Wastewater (IL) Technology Control Options

The IL wastewater technology control options, DAF-IL and CP-IL, are similar to the DAF-Heavy and CP-Heavy technology control options shown in Figures 8-2 and 8-3, respectively, in that they treat a portion of the facility's wastewater stream. However, in the IL options, wastewater from both heavy and light industrial textile items is treated. The treated stream is combined with the untreated nonindustrial wastewater stream prior to monitoring and discharge. Thus, in Figures 8-2 and 8-3, the heavy and light industrial wastewater streams are represented by the "heavy" stream in the diagram and the nonindustrial wastewater stream is represented by the "light" stream in the diagram. The standards applied to the combined streams would be based on treatment performance data for the DAF-All technology option (in the DAF-IL option) and the CP-All technology option (in the CP-IL option).

EPA has determined that the wastewater generated from laundering of nonindustrial textile items has pollutant concentrations generally lower than the standards developed from both DAF and chemical precipitation treatment of the total facility process wastewater stream. Therefore, pollutant concentrations in the combined streams prior to final discharge for the IL options would be lower than the standards based on treatment of the total process wastewater stream (DAF-All and CP-All). EPA concluded that nonindustrial wastewater does not need treatment to meet those standards. EPA developed the IL wastewater technology control options to treat the majority of pollutants in a facility's process wastewater (the pollutants generated from industrial laundry) with a lower-cost treatment system than the All options.

8.7.2 Towel (TWL) Technology Control Options

The TWL wastewater technology control options are nearly identical to the DAF-Heavy and CP-Heavy technology options shown in Figures 8-2 and 8-3, respectively, including treatment of wastewater generated from washing heavy industrial laundry items, as defined in Section 8.2.1 of this document. Light industrial and nonindustrial wastewater is discharged without treatment. Thus, in Figures 8-2 and 8-3, the heavy industrial wastewater stream is represented by the "heavy" stream in the diagram and the light industrial and nonindustrial wastewater streams are represented by the "light" stream in the diagram. However, the TWL options incorporate standards that are applied to the combined untreated and treated streams prior

to discharge and that are based on treatment performance data for the DAF-All and CP-All technology control options.

8.7.3 Combination (Combo) Technology Control Options

EPA also considered technology control options in which standards would be based on a combination of the DAF-IL and CP-IL standards. The combination options were developed to provide industry with increased flexibility in the treatment technologies used, resulting in more cost-effective technology options. These combination options, Combo-IL and Combo-IL-2LIM, are described below.

Table 8-2

Definitions of Additional Technology Control Options Considered for PSES and PSNS

Technology Control Option	Description	Basis of Standards[1]
DAF-IL	Dissolved air flotation of wastewater from industrial laundry items.	DAF-All
CP-IL	Chemical precipitation of wastewater from industrial laundry items.	CP-All
Combo-IL	Dissolved air flotation or chemical precipitation of wastewater from industrial laundry items. Facilities without treatment are costed for the less expensive technology on an annualized basis.	The higher LTA between DAF-All and CP-All
Combo-IL-2LIM	Dissolved air flotation or chemical precipitation of wastewater from industrial laundry items. Facilities without treatment are costed for chemical precipitation.	DAF-All or CP-All, based on technology costed
DAF-TWL	Dissolved air flotation of wastewater from heavy industrial laundry items.	DAF-All
CP-TWL	Chemical precipitation of wastewater from heavy industrial laundry items.	CP-All
Combo-TWL	Dissolved air flotation or chemical precipitation of wastewater from heavy industrial laundry items. Facilities without treatment are costed for the less expensive technology on an annualized basis.	The higher LTA between DAF-All and CP-All
Combo-TWL-2LIM	Dissolved air flotation or chemical precipitation of wastewater from heavy industrial laundry items. Facilities without treatment are costed for chemical precipitation.	DAF-All or CP-All, based on technology costed
Combo-All	Dissolved air flotation or chemical precipitation of all facility process wastewater. Facilities without treatment are costed for the less expensive technology on an annualized basis.	The higher LTA between DAF-All and CP-All
Combo-All-2LIM	Dissolved air flotation or chemical precipitation of all facility process wastewater. Facilities without treatment are costed for chemical precipitation.	DAF-All or CP-All, based on technology costed
Towel Only	Dissolved air flotation of wastewater from industrial towels.	DAF-Heavy
No Regulation	No national categorical pretreatment standards.	---

[1]Pollutant concentration data representing each treatment option are presented in Chapter 7 of this document.

The Combo-IL technology control option combines both the DAF-IL and CP-IL standards into one set of standards for the industrial laundries industry. These standards would be established based on the less stringent of the standards for the two technology control options for each pollutant. EPA's data show that, overall, chemical precipitation performs slightly better than DAF in treating industrial laundry process wastewater. However, many industrial laundries have already installed DAF systems. Having one set of standards allows flexibility for facilities with either technology currently in place to meet those standards. In developing cost estimates for this option, industrial laundries that already have DAF or chemical precipitation treatment systems with enough capacity to treat the heavy wastewater stream (as defined above in the IL Technology Options section) were assumed to continue to treat their wastewater using their existing technology. Industrial laundries with little or no treatment (including facilities that treat their wastewater with chemical emulsion breaking) were costed for the least expensive technology control option (based on a comparison of DAF-IL and CP-IL annualized costs) to treat their industrial laundry wastewater.

The Combo-IL-2LIM technology control option is similar to the Combo-IL option. In this option, the standards for the DAF-IL option would apply to facilities using DAF to treat their wastewater and the standards for the CP-IL option would apply to all other facilities. This option also allows flexibility for facilities with DAF treatment in place (DAF is the most common treatment in the industry) to comply with DAF-based standards, but requires all other facilities to comply with slightly more stringent standards based on chemical precipitation. In developing cost estimates for this option, industrial laundries that already have DAF or chemical precipitation treatment systems with enough capacity to treat the heavy wastewater steam (as defined above in the IL Technology Control Options section) were assumed to continue to treat their wastewater using their existing technology. Industrial laundries with little or no treatment (including facilities that treat their wastewater with chemical emulsion breaking) were costed for the CP-IL technology control option to treat their industrial laundry wastewater.

EPA also considered Combo options in which all process wastewater would be treated (Combo-All and Combo-All-2LIM). These options were modeled in a manner similar to the Combo-IL and Combo-IL-2LIM options described above, but resulted in higher compliance costs.

As in the IL options, EPA also considered additional TWL technology options (Combo-TWL and Combo-TWL-2LIM). In these options, standards are based on a combination of the DAF-TWL and CP-TWL standards to allow for increased flexibility in the technologies used by industry to treat their heavy industrial laundry wastewater, allowing for a more cost-effective technology option.

8.7.4 Towel Only Technology Control Option

Some commenters on the proposed rule indicated that EPA should consider regulating only facilities that launder shop and printer towels/rags, because these items have the highest pollutant loadings of all items laundered by industrial laundries. As a result of the comments, EPA evaluated a modified heavy option that would require only facilities that launder shop towels, printer towels, furniture towels, or other industrial towels/rags to meet the proposed

standards. EPA referred to this option as the Towel Only option. The Towel Only option is based on treating only the wastewater from laundering industrial towels, then mixing the treated wastewater with wastewater from laundering all other items prior to monitoring and discharge from the facility. The modified option is based on DAF technology because EPA does not have treatment performance data characterizing chemical precipitation treatment of only shop and printer towels/rags. EPA presented the Towel Only option in the Notice of Data Availability (NODA) published December 23, 1998 (63 FR 71054).

8.7.5 No Regulation Option

EPA also considered a no regulation option, which entails having no national categorical pretreatment standards. Facilities would only need to comply with applicable local standards. EPA assumed there would be no compliance costs or pollutant removals associated with this option.

8.8 Technology Control Options Eliminated from Further Consideration

Based on technical and economic analyses, EPA eliminated the following technology control options from further consideration for the proposed rule:

- DAF-TWL;
- CP-TWL;
- Combo-TWL;
- Combo-TWL-2LIM;
- DAF-All;
- CP-All;
- Combo-All; and
- Combo-All-2LIM.

The reasons for eliminating these options from further consideration are presented below.

EPA eliminated the TWL options from further consideration because some of the pollutant concentrations in the untreated light industrial and nonindustrial wastewater streams can be found at higher concentrations than the standards for these technology options.

EPA eliminated the All options, shown above, from further consideration because, although these options can achieve the same effluent pollutant concentrations as the DAF-IL and CP-IL options, the costs to treat the total facility process wastewater in these All options are higher than the costs for the IL options.

The following five technology control options were considered for the industrial laundries proposed rule:

- DAF-IL;
- CP-IL;
- Combo-IL;

- Combo-IL-2LIM; and
- OC-Only.

These options became regulatory options considered as the basis for the proposed PSES. EPA performed detailed analyses of costs, pollutant removals, and economic impacts for these options as described in Chapter 12 of the proposed Technical Development Document (5) and the proposed Economic Assessment (EA) (6).

After proposal, EPA eliminated the OC-Only option from further consideration because of the small amount of nonvolatile pollutant removals achieved by the option relative to the cost, and because of the limited data available to support the option. EPA eliminated the Combo-IL and Combo-IL-2LIM options from further consideration because they did not remove as many pollutants as the CP-IL option and had overall higher costs than the CP-IL option. The DAF-IL option was retained because of the predominance of DAF treatment in the industry and the pollutant removals achieved by DAF, even though the DAF costs were high relative to the other options.

Based on comments on the NODA, EPA decided that the Towel Only option was complicated to implement and enforce and could result in significantly increased monitoring costs. Facilities might be required to monitor one portion of their effluent for compliance with the categorical standards and to monitor the remainder of their effluent for compliance with local limits. In addition, there was limited treatment performance data available from facilities treating Towel Only wastewater. Therefore, EPA eliminated the Towel Only option from further consideration.

8.9 Regulatory Control Options Considered for the Final Action

The regulatory control options considered by EPA for the final action were:

CP-IL - Chemical precipitation of wastewater from industrial laundry items;

DAF-IL - Dissolved air flotation of wastewater from industrial laundry items; and

No Regulation - No national categorical pretreatment standards for the industry.

For the CP-IL and DAF-IL options, EPA also considered three exclusions, as discussed in Section 8.5.1 of this document. Chapters 9 and 11 of this document, respectively, discuss pollutant removals and costs for the regulatory options.

8.10 References

1. Bartman, Gary H. Crossflow Microfiltration, A Cost Effective Approach to Treat Metals, Oil and Grease in the Industrial Laundries and Metal Finishing Industries, EPOC Filtration and Separation Systems, Fresno, CA, February, 1993.

2. Memorandum: Preliminary Data for Calculating Mass-Based Limitations for the Industrial Laundries Industry, August 15, 1997.

3. U.S. Environmental Protection Agency. Economic Assessment for the Final Action Regarding Pretreatment Standards for the Industrial Laundries Point Source Category (Revised February 2000). EPA-821-R-00-004, Washington, DC, February 2000.

4. U.S. Environmental Protection Agency. Cost-Effectiveness Analysis for the Final Action Regarding Pretreatment Standards for the Industrial Laundries Point Source Category (Revised February 2000). EPA-821-R-00-005, Washington, DC, February 2000.

5. U.S. Environmental Protection Agency. Technical Development Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category. EPA-821-R-97-007, Washington, DC, November 1997.

6. U.S. Environmental Protection Agency. Economic Assessment for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category. EPA-821-R-97-005, Washington, DC, November 1997.

CHAPTER 9

POLLUTANT LOADING AND REMOVAL ESTIMATES

9.1 Introduction

This chapter presents annual pollutant loading and removal estimates for the industrial laundries industry for each of the regulatory options considered for the final action. A number of additional technology control options considered for development of a rule is described in Chapter 8 of this document. Information on these options was contained in the Technical Development Document for the proposed rule (1) and in the record for the Notice of Data Availability (NODA) (63 FR 71054; December 23, 1998). The estimated pollutant loadings and removals for these options can be found in the Industrial Laundries Administrative Record.

EPA estimated the pollutant loadings and removals from industrial laundries to evaluate the effectiveness of the treatment technologies, to estimate benefits gained from the removal of pollutants discharged through publicly owned treatment works (POTWs) to surface water, and to evaluate the cost effectiveness of the regulatory options in reducing the pollutant loadings. The regulatory options considered for the final action include dissolved air flotation of industrial laundry wastewater (DAF-IL) and chemical precipitation of industrial laundry wastewater (CP-IL). In addition, EPA evaluated three exclusion scenarios for both of these regulatory options, as described in Chapter 8 of this document.

Untreated, baseline, and postcompliance pollutant loadings and pollutant removals for the industry were estimated for 72 pollutants of concern using data obtained from the industry. Data on wastewater treatment in place and production and wastewater flows were reported for the 1993 operating year in the 1994 Industrial Laundries Industry Questionnaire (detailed questionnaire). Untreated, baseline, and postcompliance pollutant loadings are defined as follows:

- Untreated loadings -- pollutant loadings in industrial laundry raw wastewater. These loadings do not account for wastewater treatment reported in the detailed questionnaire.

- Baseline loadings -- pollutant loadings in industrial laundry wastewater being discharged to POTWs in 1993. These loadings do account for wastewater treatment reported in the detailed questionnaire.

- Postcompliance loadings -- pollutant loadings in industrial laundry wastewater after implementation of a rule. These loadings were calculated assuming that all industrial laundries would operate the wastewater treatment technologies and meet the long-term averages (LTAs) for the pollutants contained in each of the regulatory options.

The following information is presented in this chapter:

- Section 9.2 presents the data sources that were used to estimate pollutant loadings and removals;
- Section 9.3 discusses the methodology used to estimate pollutant loadings and pollutant removals;
- Section 9.4 presents the pollutant loadings and removals for each regulatory option, including untreated, baseline, and postcompliance pollutant loadings and removals of pollutants from baseline levels to postcompliance levels;
- Section 9.5 presents the pollutant baseline and postcompliance loadings and pollutant removals for each regulatory option estimated from updated wastewater treatment information provided in a 1998 survey conducted by the industrial laundries trade associations; and
- Section 9.6 presents the references used.

9.2 Data Sources

EPA used data from several sources to estimate untreated, baseline, and postcompliance loadings for industrial laundry wastewater. These sources included EPA site visits and sampling episodes at industrial laundries, detailed monitoring questionnaires (DMQ), the Preliminary Data Summary (PDS), and data received in comments on the proposed rule. Chapter 3 of this document discusses these data sources in detail.

To estimate *untreated pollutant loadings* for the industrial laundries industry, EPA estimated pollutant concentrations and loadings for 72 pollutants at 190 in-scope industrial laundries that submitted sufficient information in response to the detailed questionnaire (in-scope facilities meet the definition of an industrial laundry as presented in Chapter 4 of this document). In addition, EPA estimated the untreated loadings for three exclusion scenarios for each regulatory option (discussed in Chapter 8 of this document). EPA then extrapolated the loadings to the entire industry based on the survey weights developed for each facility. The untreated pollutant concentrations and loadings for each facility were estimated using analytical data obtained by EPA for specific laundering processes and item types, and the process/item-specific production reported in the detailed questionnaire.

EPA collected data for specific process/item combinations for individual loads laundered at a facility or for an entire stream generated from the same process/item combination. EPA used the following process/item data to estimate untreated pollutant loadings:

- Water washing of industrial garments -- data from three loads of pants and three loads of shirts collected during three sampling episodes;

- Water washing of shop towels -- data from four loads of shop towels collected during four sampling episodes and two days of data collected for EPA's PDS from a shop-towel-only stream at a facility sampled between 1985 and 1987;

- Water washing of printer towels/rags -- data from three loads of printer towels/rags collected during three sampling episodes;

- Water washing of mats -- data from three loads of mats collected during two sampling episodes;

- Water washing of mops -- data from two loads of mops (with either no oil treatment or oil added outside of the washer) collected during two sampling episodes;

- Steam tumbling followed by water washing of printer towels/rags -- data from one load collected during a sampling episode;

- Water washing of linen items -- three days of data for a linen-only stream collected during a sampling episode and DMQ data for three facilities that launder greater than 93 percent linen; and

- Dry cleaning followed by water washing of shop towels, printer towels/rags, and gloves -- facility-collected data obtained during a site visit from a wastewater stream generated from dry cleaning followed by water washing.

EPA estimated *baseline loadings* for individual facilities from untreated or treated loadings, based on the wastewater treatment in place reported by the facility in the detailed questionnaire. The data that were used to calculate untreated loadings are described above. EPA estimated treated loadings from the data presented in Sections 7.2.1, 7.2.2, and 7.2.3 of this document for the five treatment options for which EPA had data. These treatment options were used to develop the technology control options discussed in Chapter 8 of this document.

Postcompliance loadings were estimated for the regulatory options and exclusions thereof. These regulatory options were developed using the data obtained for two of the treatment options, as discussed in Chapters 7 and 8 of this document.

Section 9.3 of this document presents details on the methodology used to estimate the pollutant loadings and removals.

9.3 Methodology Used to Estimate Pollutant Loadings and Removals

This section presents the methodology used to estimate untreated, baseline, and postcompliance pollutant loadings and removals of pollutants from baseline levels to postcompliance levels.

9.3.1 Methodology Used to Estimate Industry Untreated Pollutant Loadings

EPA estimated untreated pollutant loadings for each of the 190 in-scope facilities using the process/item-specific data discussed in Section 9.2 of this document, and extrapolated these loadings to represent the entire industry using the appropriate survey weights. Untreated pollutant loadings do not account for pollutant removals by wastewater treatment technologies in place at industrial laundries in 1993, as reported in the detailed questionnaire.

The amount of pollutant generated per pound of laundry was estimated from the process/item-specific data. EPA estimated the pollutant loadings per pound of item laundered for each process/item combination using the following equation:

$$\text{Concentration (mg/L, for process/item data)} \times \frac{\text{Flow (L, for process/item)}}{\text{Production (lbs, for process/item)}} = \text{Amount of pollutant generated per pound of laundry (mg/lb)}$$

EPA calculated the pollutant loading per pound of item for each item-specific stream for which data were available. If data from more than one load or more than one facility represented a process/item combination, an average of the individual load or facility's pollutant loadings was calculated. If a specific pollutant was never detected or never analyzed for on a particular item, the pollutant loading for that process/item/pollutant combination was set to zero milligrams of pollutant per pound of laundry. Table 9-1 presents the pollutant loading generated per pound of item for several pollutants and groups of pollutants (e.g., toxic organic pollutants) for the process/item combinations presented in Section 9.2 of this document.

Pollutant concentration data were not obtained for all of the process/item combinations reported by the 190 in-scope facilities in the detailed questionnaires. To estimate the pollutant loadings for all facilities, EPA transferred pollutant concentration data from the process/item combinations with data available to other process/item-specific combinations for which data were not available. Table 9-2 presents these data transfers. The process/item-specific pollutant concentrations were transferred to items having similar customers and/or uses, similar degrees of pollutant loadings, and being laundered with similar types of chemicals.

For each of the 190 in-scope facilities, EPA then calculated the untreated wastewater pollutant concentrations and loadings from the amount of pollutant generated per pound of laundry for each process/item combination and process/item-specific production and flow data. The production and flow data were obtained from the information reported by each facility in the detailed questionnaire. The following equation was used to calculate the pollutant concentrations for each facility:

$$\text{Amount of pollutant generated per pound of laundry (mg/lb)} \times \frac{\text{Production (lbs of process/item at facility)}}{\text{Flow (L, for process/item at facility)}} = \text{Facility untreated concentration (mg/L, for process/item)}$$

Table 9-1

Pollutant Loadings per Pound of Item Processed (mg Pollutant/lb Laundry)

Pollutant	Industrial Garments	Shop Towels	Printer Towels/Rags	Steam Tumbled Printer Towels/Rags	Mats	Mops	Linen Items	Items Dry Cleaned Prior to Water Washing
BOD_5	2,578	20,293	51,581	12,998	544	13,646	7,237	1,605
O&G (measured as HEM)	932	23,160	94,464	15,535	314	3,378	1,295	NA
TPH (measured as SGT-HEM)[1]	326	12,845	30,828	4,226	145	1,316	147	NA
TSS	2,160	36,709	14,735	11,915	2,050	13,152	2,241	1,165
COD	12,281	111,985	222,981	81,240	1,515	64,242	9,376	9,011
TOC	2,627	16,110	33,168	15,977	340	6,192	4,817	NA
TXM	21	235	326	75	14	73	15	26
TXO	11	350	1,045	89	12	53	25	14
NCM	114	602	298	93	107	348	83	107
NCO	35	1,341	2,707	1,041	11	247	54	14

[1]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as TPH.

BOD_5 - Biochemical oxygen demand.
O&G - Oil and grease.
HEM - Hexane extractable material.
NA - Not available.
TPH - Total petroleum hydrocarbon.
SGT-HEM - Silica gel treated-hexane extractable material.
TSS - Total suspended solids.
COD - Chemical oxygen demand.
TOC - Total organic carbon.
TXM - Total priority metals and elements.
TXO - Total priority organics.
NCM - Nonconventional metals.
NCO - Nonconventional organics.

Table 9-2

Analytical Data Transfers

Analytical Data Transfers for Water-Washed Items[1]		
Item	**Item-Specific Data to be Transferred**	**Basis of Data Transfer**
Health-Care Items (B08)	Linen (B06, B07)	Customer and Use
Family Laundry (B15)	Linen (B06, B07)	Customer and Use
Executive Wear (B18)	Linen (B06, B07)	Customer and Use
Continuous Roll Towels (B10)	Linen (B06, B07)	Customer
Miscellaneous Not Our Goods (NOG) (B19)	Linen (B06, B07)	Customer
New Items (B17)	Linen (B06, B07)	Pollutant Loading
Clean Room Garments (B11)	Linen (B06, B07)	Pollutant Loading
Laundry Bags (B14)	Industrial Garments (B01)	Customer and Chemical Use
Fender Covers (B09)	Shop Towels (B02)	Customer and Use
Filters (B23)	Shop Towels (B02)	Customer and Use
Other (unspecified) (B13)	Floor Mats (B04)	Chemical Use
Buffing Pads (B24)	Floor Mats (B04)	Customer and Use
Analytical Data Transfers for Processes		
Process	**Process Data to be Transferred**	**Basis of Data Transfer**
Denim Prewash	Water Washing of Linen Items	Pollutant Loading
Dual-Phase Processing	Dry Cleaning Followed by Water Washing[2]	Chemical Use and Pollutant Loading

[1]Codes in parenthesis refer to codes used in the detailed questionnaire.
[2]If data were not available for a specific pollutant, data were transferred from water washing of mats.

From the facility-specific concentration, the annual pollutant loading for each facility process/item was calculated using the following equation:

$$\text{Facility untreated concentration (mg/L, for process/item)} \times \text{Facility annual flow (L/yr, for process/item)} \times \frac{1\text{ lb}}{453{,}600\text{ mg}} = \text{Facility untreated annual loading (lbs/yr, for process/item)}$$

To estimate the total untreated wastewater pollutant loading for a facility, EPA summed the loadings calculated from each process/item combination for each pollutant.

9.3.2 Methodology Used to Estimate Industry Baseline Wastewater Loadings

Industry baseline loadings represent the industry pollutant loadings after accounting for removal of pollutants from untreated wastewater by treatment technologies in place at industrial laundries. Chapter 11 of this document discusses the assessment of treatment in place for industrial laundries. Based on information provided in the detailed questionnaire for the 1993 operating year, the treatment technologies in use at industrial laundries included chemical emulsion breaking, dissolved air flotation, chemical precipitation, microfiltration, and ultrafiltration. Some facilities use these technologies to treat their entire process wastewater stream, while other facilities treat only part of their process wastewater.

Table 9-3 presents the various treatment-in-place scenarios for the 190 in-scope facilities. EPA calculated baseline pollutant loadings based on the reported capacity of each facility's treatment system (i.e., the amount of treated wastewater discharged) and the appropriate set of target average concentrations chosen for each facility. The set of target average concentrations was chosen based on an approximation of the type of treated wastewater that is generated from the facility's treatment system.

The baseline pollutant loadings for facilities with no treatment in place are equivalent to the facilities' untreated pollutant loadings, as discussed in Section 9.3.1 of this document. The baseline pollutant loadings for facilities that have treatment in place were estimated by applying the appropriate set of target average concentrations to the annual facility treated wastewater discharge flow as shown in the following equation:

$$\text{Target average concentration for treatment in place (mg/L)} \times \text{Facility annual treated discharge flow (L/yr)} \times \frac{1\text{ lb}}{453{,}600\text{ mg}} = \text{Facility baseline annual loading for treated wastewater (lbs/yr)}$$

The baseline pollutant loadings for a facility treating a portion of their wastewater are the sum of the facility baseline annual loading for the treated portion of the wastewater (as calculated above) and the annual pollutant loading for the untreated portion of wastewater (calculated as described in Section 9.3.1 of this document).

Table 9-3

Treatment-In-Place Scenarios for Model Facilities

Treatment In Place	Definition	Source of Target Average Concentrations for Treated Baseline Loadings	Number of In-Scope Facilities with Treatment In Place
None	No treatment present at the facility	NA	127[1]
CEB-Heavy	Chemical emulsion breaking of sufficient capacity to treat wastewater generated from laundering heavy industrial textile items	CEB-Heavy	5[2]
<DAF-IL	Dissolved air flotation of insufficient capacity to treat wastewater generated from laundering industrial textile items	DAF-IL	1
DAF-IL	Dissolved air flotation of sufficient capacity to treat wastewater generated from laundering industrial textile items	DAF-IL	1
DAF-All	Dissolved air flotation of sufficient capacity to treat all facility process wastewater	DAF-All	33
<CP-Heavy	Chemical precipitation of insufficient capacity to treat wastewater generated from laundering heavy industrial textile items	CP-Heavy	4
<CP-IL	Chemical precipitation of insufficient capacity to treat wastewater generated from laundering industrial textile items	CP-IL	1[3]
CP-IL	Chemical precipitation of sufficient capacity to treat wastewater generated from laundering industrial textile items	CP-IL	1
CP-All	Chemical precipitation of sufficient capacity to treat all facility process wastewater	CP-All	17[4]

[1]Three of these facilities process the majority of their industrial laundry items with a dry-cleaning followed by water-washing process. EPA assumed these facilities would meet the limitations for the DAF-IL and CP-IL regulatory options without installing these treatment technologies.
[2]Three facilities reported CEB treatment of the total wastewater stream. EPA does not have data representing CEB treatment of the total wastewater stream; the baseline pollutant loadings for these facilities were estimated assuming they are only treating heavy industrial laundry wastewater.
[3]This facility operates a microfiltration unit. Since microfiltration can achieve lower final effluent pollutant concentrations than chemical precipitation when operated properly (2), this facility is considered to have better treatment in place than the CP-Heavy option.
[4]One of these facilities operates an ultrafiltration unit. Since ultrafiltration can achieve lower final effluent pollutant concentrations than chemical precipitation when operated properly (2), this facility is considered to have better treatment in place than the CP-All option.

NA - Not applicable.

EPA calculated target average concentrations used in estimating the baseline pollutant loadings from the analytical data described in Section 7.2 of this document. Prior to calculating the target average concentrations, the data were edited using procedures described in Chapter 7 of this document for calculating long-term averages, variability factors, and candidate pretreatment standards with one exception. As described in Section 7.3.3 of this document, if the average concentration of a pollutant in the influent samples collected from a facility was less than ten times the method detection level for that pollutant, EPA did not use the data for that pollutant at that facility to calculate long-term averages, variability factors, and candidate pretreatment standards, but did use the data to calculate the target average concentrations used to estimate pollutant loadings. Table 9-4 summarizes the target average concentrations that were used to estimate the baseline loadings for facilities with treatment in place.

As stated previously, baseline pollutant loadings for facilities with treatment in place were calculated based on the reported treatment system, type, hydraulic capacity, and the set of target average concentrations chosen for each facility's treated wastewater type. Each facility was given a treatment-in-place designation for their equipment type and hydraulic capacity with respect to the seven technology control options and corresponding target average concentrations shown in Table 9-4. By applying the appropriate set of target average concentrations to each facility's treated discharge flow, EPA estimated the baseline pollutant loadings from these facilities' treatment systems.

For most of the facilities that reported treating their wastewater, the target average concentrations chosen were based on pollutant concentration data from treatment systems equivalent to what each facility has in place. For example, the facilities that reported treating all of their process wastewater with DAF or chemical precipitation received a treatment-in-place designation of DAF-All and CP-All, respectively, based on their equipment type and hydraulic capacity. In addition, the set of target average concentrations chosen for these facilities are based on pollutant concentration data collected from DAF and CP systems treating total facility process wastewater streams, respectively (DAF-All and CP-All, as shown in Table 9-4). Similarly, facilities that reported DAF or chemical precipitation system hydraulic capacities that were sufficient to treat the wastewater generated from the laundering of their industrial textile items were given a treatment-in-place designation of DAF-IL and CP-IL, respectively. The target average concentrations were also chosen from the sets for DAF-IL and CP-IL, as shown in Table 9-4.

There were six facilities that reported treatment system capacities that were larger than required for one technology control option, but insufficient for another technology control option treating the next larger portion of wastewater with the same technology. For example, one facility shown in Table 9-3 reported having a chemical precipitation system that treats an amount of wastewater that is greater than that generated by laundering its heavy industrial textile items, but less than that its total industrial laundry wastewater. Since the facility has a treatment system larger than the CP-Heavy technology control option, but smaller than the CP-IL technology control option, it was given a treatment-in-place designation of "less than" (<) CP-IL. Further, since this facility reported treating wastewater generated from the laundering of items other than just its heavy industrial textile items, it was assumed that the treatment system effluent pollutant concentrations would be represented by the CP-IL set of target average concentrations

Table 9-4

Overall Target Average Concentrations for the Seven Technology Control Options for the Pollutants of Concern Used as the Bases for Calculation of Baseline Pollutant Loadings

Pollutant of Concern	Median Target Average Concentration (mg/L)[1]				
	CEB-Heavy[2]	Towel Only[3]	CP-Heavy[4]	DAF-IL/ DAF-All[5]	CP-IL/ CP-All[6]
Conventionals					
Biochemical Oxygen Demand 5-Day (BOD_5)	1,040	1,310	1,390	497	399
Oil and Grease (measured as HEM)	268	230	38.2	37.8	28.5
Total Suspended Solids (TSS)	259	487	56.3	85.5	117
Priority Organics					
1,1,1-Trichloroethane	---	---	---	0.0100	0.390
1,2-Diphenylhydrazine	---	---	45.2	---	---
4-Chloro-3-methylphenol	0.205	---	---	0.151	0.0416
Bis(2-ethylhexyl) Phthalate	0.462	0.600	0.0469	0.144	0.0691
Butyl Benzyl Phthalate	---	---	0.0100	0.216	0.0100
Chlorobenzene	---	---	---	0.0280	0.0336
Chloroform	---	---	0.0527	0.185	0.0373
Di-*n*-butyl Phthalate	0.0100	0.170	0.0100	0.125	0.0100
Di-*n*-octyl Phthalate	0.0307	---	---	0.0280	0.0342
Ethylbenzene	0.305	1.37	0.0931	0.0605	0.154
Isophorone	---	---	---	---	0.300
Methylene Chloride	0.0360	---	---	0.546	0.126
Naphthalene	0.104	0.800	0.114	0.0764	0.0583
Phenol	---	---	---	0.211	---
Tetrachloroethene	0.286	---	0.127	0.250	0.421
Toluene	0.543	6.35	0.818	0.711	0.973
trans-1,2-Dichloroethene	---	---	---	---	---
Trichloroethene	---	---	0.0529	---	0.0363
Nonconventional Organics					
2-Butanone	0.113	4.68	0.421	17.4	1.68
2-Methylnaphthalene	0.0458	0.129	0.0100	0.116	0.0114
2-Propanone	1.21	7.42	---	13.6	1.54
4-Methyl-2-pentanone	0.0722	9.55	0.256	0.595	1.96
∝-Terpineol	0.0100	0.471	---	0.472	0.0464
Benzoic Acid	---	---	---	1.58	---
Benzyl Alcohol	---	---	---	---	0.342
Hexanoic Acid	0.128	---	---	---	0.203
m-Xylene	0.366	---	0.104	0.327	0.241
n-Decane	0.279	1.26	0.0240	0.469	0.0873
n-Docosane	0.0347	0.110	0.0120	0.0232	0.0113

Table 9-4 (Continued)

Pollutant of Concern	Median Target Average Concentration (mg/L)[1]				
	CEB-Heavy[2]	Towel Only[3]	CP-Heavy[4]	DAF-IL/ DAF-All[5]	CP-IL/ CP-All[6]
Nonconventional Organics (Continued)					
n-Dodecane	0.574	---	0.0100	0.195	1.46
n-Eicosane	0.0779	0.150	0.0382	0.0477	0.0150
n-Hexacosane	0.0100	---	0.0122	0.0195	0.0131
n-Hexadecane	0.0417	0.490	0.0315	0.0842	0.0413
n-Octacosane	0.0100	---	0.0100	0.0100	0.0168
n-Octadecane	0.0560	0.422	0.0100	0.0694	0.0308
n-Tetracosane	---	---	0.0329	0.0219	0.0121
n-Tetradecane	0.116	0.979	0.612	0.0754	0.0394
n-Triacontane	---	---	0.0341	0.0100	0.0119
o-&*p*-Xylene	0.359	---	0.0940	0.271	0.197
p-Cresol	---	---	---	0.117	---
p-Cymene	---	0.610	0.0208	0.0700	0.0100
Pentamethylbenzene	---	---	0.0100	---	---
Priority Metals and Elements					
Antimony	0.195	0.0438	0.0246	0.0593	0.0343
Arsenic	---	0.00866	0.00820	0.0259	0.0121
Beryllium	0.00208	---	0.00100	---	0.000650
Cadmium	0.132	0.00650	0.00500	0.0145	0.00774
Chromium	0.153	0.0715	0.0147	0.0695	0.0463
Copper	0.437	1.45	0.534	0.478	0.270
Lead	0.914	0.237	0.0473	0.175	0.0993
Mercury	0.000200	---	0.000206	0.000242	0.000329
Nickel	0.255	0.0225	0.0307	0.0406	0.0396
Selenium	---	---	0.0157	0.0524	0.00313
Silver	---	0.0846	0.00400	0.0188	0.00769
Thallium	---	---	---	0.00294	---
Zinc	6.78	0.903	0.0637	0.837	0.303
Nonconventional Metals and Elements					
Aluminum	6.33	1.34	0.0804	1.31	1.33
Barium	0.339	0.702	0.145	0.0584	0.155
Boron	1.64	---	11.4	0.522	0.383
Cobalt	---	0.0885	0.0149	0.0381	0.0195
Iron	47.3	19.0	0.366	2.79	1.78
Manganese	0.596	0.884	0.00768	0.0340	0.0318
Molybdenum	0.205	---	0.774	0.119	0.275
Tin	0.0642	0.0336	0.0300	0.0631	0.0299
Titanium	0.0818	0.0927	0.00453	0.0112	0.0461
Vanadium	0.0114	0.0162	0.0100	0.00700	0.00757
Yttrium	---	0.00410	0.00300	0.00208	0.00344

Table 9-4 (Continued)

Pollutant of Concern	Median Target Average Concentration (mg/L)[1]				
	CEB-Heavy[2]	Towel Only[3]	CP-Heavy[4]	DAF-IL/ DAF-All[5]	CP-IL/ CP-All[6]
Bulk Nonconventionals					
Chemical Oxygen Demand (COD)	2,460	3,320	2,510	998	1,270
Total Organic Carbon (TOC)	626	1,610	910	326	310
Total Petroleum Hydrocarbon (measured as SGT-HEM)[7]	200	42.1	7.20	13.7	10.2

[1]LTAs for these pollutants of concern were not calculated for all options for one or more of the following reasons: the pollutant was not treated by the technology; the pollutant was not detected in the influent wastewater; there was a process upset at the time samples were collected; the treatment performance data had inconsistent detection limits; or data considered a lower limit of the actual value. See Section 7.3 of this chapter for more details related to the data editing criteria.
[2]CEB-Heavy represents data from facilities using chemical emulsion breaking treatment of heavy wastewater.
[3]Towel Only represents data from facilities using DAF treatment of heavy wastewater.
[4]CP-Heavy represents data from facilities using chemical precipitation treatment of heavy wastewater.
[5]DAF-IL and DAF-All represent data from facilities using DAF treatment of all facility process wastewater.
[6]CP-IL and CP-All represent data from facilities using chemical precipitation treatment of all facility process wastewater.
[7]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

HEM-Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.

in estimating this facility's baseline pollutant loading. A similar assessment was performed for the remaining four facilities that reported chemical precipitation treatment of wastewater generated from fewer items than their heavy industrial textile items (<CP-Heavy) and one facility that reported DAF treatment of wastewater generated from more items than industrial towels, but fewer than all of its industrial textile items (<DAF-IL).

Table 9-5 summarizes the methodology used to estimate the baseline pollutant loadings for each model facility. EPA estimated baseline pollutant loadings for facilities with microfiltration or ultrafiltration treatment systems using the data for chemical precipitation treatment of industrial laundry and/or all process wastewater, as noted in the table.

9.3.3 Methodology Used to Estimate Industry Postcompliance Wastewater Loadings

Postcompliance pollutant loadings for each regulatory option represent the total industry wastewater pollutant loadings after implementation of a rule. Postcompliance pollutant loadings were estimated from the target average concentrations for each of the two regulatory options (i.e., DAF-IL and CP-IL) and the annual facility wastewater discharge flow for each of the 190 in-scope facilities as shown in the following equation:

$$\text{Postcompliance target average concentration (mg/L)} \times \text{Facility annual discharge flow (L/yr)} \times \frac{1\ \text{lb}}{453{,}600\ \text{mg}} = \text{Facility postcompliance annual loading (lbs/yr)}$$

EPA calculated target average concentrations used in estimating the postcompliance pollutant loadings from the analytical data described in Section 7.2 of this document. Prior to calculating the target average concentrations, the data were edited as discussed in Section 9.3.2 of this document. Table 9-4 presents the target average concentrations used to calculate postcompliance pollutant loadings for the regulatory options DAF-IL and CP-IL.

To estimate postcompliance loadings for facilities with treatment in place, EPA ranked the treatment technologies in use by their performance. Based on data and information collected during the development of the regulatory options, EPA determined that, when operated properly, ultrafiltration, microfiltration, and chemical precipitation generally achieve lower pollutant concentrations in treated wastewater than dissolved air flotation, and that dissolved air flotation achieves lower pollutant concentrations in treated wastewater than chemical emulsion breaking. Tables 9-6 and 9-7 present the methodologies used to estimate the postcompliance loadings for the DAF-IL and CP-IL regulatory options, based on the facility's treatment-in-place designation.

Table 9-5

Methodology Used to Estimate Baseline Loadings for the Industrial Laundries Industry

Treatment In Place	Source of Target Average Concentrations for Treated Baseline Loadings	Number of Model Facilities with Treatment In Place	Basis for Baseline Pollutant Loadings
None	NA	127[1]	Estimated from untreated wastewater concentrations
CEB-Heavy	CEB-Heavy	5[2]	Heavy industrial laundry stream loading estimated from target average concentrations for CEB-Heavy and light industrial laundry stream loading estimated from untreated wastewater concentrations
<DAF-IL	DAF-IL	1	Part of industrial laundry stream loading estimated from target average concentrations for DAF-IL and remaining industrial laundry and linen stream loading estimated from untreated wastewater concentrations
DAF-IL	DAF-IL	1	Industrial laundry stream loading estimated from the target average concentrations for DAF-IL and linen stream loading estimated from untreated wastewater concentrations
DAF-All	DAF-All	33	Total process stream loading estimated from target average concentrations for DAF-All[3]
<CP-Heavy	CP-Heavy	4	Part of heavy industrial laundry stream loading estimated from target average concentrations for CP-Heavy and remaining heavy industrial laundry and light industrial laundry stream loading estimated from untreated wastewater concentrations
<CP-IL	CP-IL	1[4]	Part of industrial laundry stream loading estimated from target average concentrations for CP-IL and remaining industrial laundry and linen stream loading estimated from untreated wastewater concentrations
CP-IL	CP-IL	1	Industrial laundry stream loading estimated from target average concentrations for CP-IL and linen stream loading estimated from untreated wastewater concentrations

Table 9-5 (Continued)

Treatment In Place	Source of Target Average Concentrations for Treated Baseline Loadings	Number of Model Facilities with Treatment In Place	Basis for Baseline Pollutant Loadings
CP-All	CP-All	17[5]	Total process stream loading estimated from target average concentrations for CP-All[6]

[1]Three of these facilities process the majority of their industrial laundry items with a dry-cleaning followed by water-washing process. EPA assumed these facilities would meet the limitations for the DAF-IL and CP-IL regulatory options without installing these treatment technologies. For the purposes of modeling, EPA estimated their baseline pollutant loadings from the target average concentrations calculated for the CP-IL regulatory option.
[2]Three facilities reported CEB treatment of the total wastewater stream. EPA does not have data representing CEB treatment of the total wastewater stream; the baseline pollutant loadings for these facilities were estimated assuming they are only treating heavy industrial laundry wastewater.
[3]The DAF-All target average concentrations are equivalent to the DAF-IL target average concentrations and are applied to the facilities' entire process wastewater annual flows.
[4]This facility operates a microfiltration unit. Since microfiltration can achieve lower final effluent pollutant concentrations than chemical precipitation when operated properly (2), this facility is considered to have better treatment in place than the CP-Heavy option.
[5]One of these facilities operates an ultrafiltration unit. Since ultrafiltration can achieve lower final effluent pollutant concentrations than chemical precipitation when operated properly (2), this facility is considered to have better treatment in place than the CP-All option.
[6]The CP-All target average concentrations are equivalent to the CP-IL target average concentrations and are applied to the facilities' entire process wastewater annual flows.

CEB - Chemical emulsion breaking.
CP - Chemical precipitation.
DAF - Dissolved air flotation.
IL - Industrial laundry.
NA - Not applicable.

Table 9-6

Methodology Used to Estimate Postcompliance Loadings for the DAF-IL Regulatory Option for the Industrial Laundries Industry

Treatment In Place	Source of Target Average Concentrations for Treated Baseline Loadings	Number of Model Facilities with Treatment In Place	Basis for Postcompliance Pollutant Loadings	Baseline Loadings Greater Than Postcompliance Loadings for DAF-IL (✓)
None	NA	127[1]	Industrial laundry stream loading estimated from the target average concentrations for DAF-IL and linen stream loading estimated from untreated wastewater concentrations	✓
CEB-Heavy	CEB-Heavy	5[2]		✓
<DAF-IL	DAF-IL	1		✓
DAF-IL	DAF-IL	1		
DAF-All	DAF-All	33	Total process stream loading estimated from target average concentrations for DAF-All[3]	
<CP-Heavy	CP-Heavy	4	Industrial laundry stream loading estimated from the target average concentrations for DAF-IL and linen stream loading estimated from untreated wastewater concentrations	✓
<CP-IL	CP-IL	1[4]		✓
CP-IL	CP-IL	1	Industrial laundry stream loading estimated from target average concentrations for CP-IL and linen stream loading estimated from untreated wastewater concentrations	
CP-All	CP-All	17[5]	Total process stream loading estimated from target average concentrations for CP-All[6]	

[1]Three of these facilities process the majority of their industrial laundry items with a dry-cleaning followed by water-washing process. EPA assumed these facilities would meet the limitations for the DAF-IL and CP-IL regulatory options without installing these treatment technologies. For the purposes of modeling, EPA estimated their baseline and postcompliance pollutant loadings from the target average concentrations calculated for the CP-IL regulatory option. These facilities were estimated to have no pollutant removals.
[2]Three facilities reported CEB treatment of the total wastewater stream. EPA does not have data representing CEB treatment of the total wastewater stream; the baseline pollutant loadings for these facilities were estimated assuming they are only treating heavy industrial laundry wastewater.
[3]The DAF-All target average concentrations are equivalent to the DAF-IL target average concentrations and are applied to the facilities' entire process wastewater annual flows.
[3]This facility operates a microfiltration unit. Since microfiltration can achieve lower final effluent pollutant concentrations than chemical precipitation when operated properly (2), this facility is considered to have better treatment in place than the CP-Heavy option.
[5]One of these facilities operates an ultrafiltration unit. Since ultrafiltration can achieve lower final effluent pollutant concentrations than chemical precipitation when operated properly (2), this facility is considered to have better treatment in place than the CP-All option.
[6]The CP-All target average concentrations are equivalent to the CP-IL target average concentrations and are applied to the facilities' entire process wastewater annual flows.

CEB - Chemical emulsion breaking. CP - Chemical precipitation. DAF - Dissolved air flotation. IL - Industrial laundry. NA - Not applicable.

Table 9-7

Methodology Used to Estimate Postcompliance Loadings for the CP-IL Regulatory Option for the Industrial Laundries Industry

Treatment In Place	Source of Target Average Concentrations for Treated Baseline Loadings	Number of Model Facilities with Treatment In Place	Basis for Postcompliance Pollutant Loadings	Baseline Loadings Greater Than Postcompliance Loadings for CP-IL (✓)
None	NA	127[1]	Industrial laundry stream loading estimated from the target average concentrations for CP-IL and linen stream loading estimated from untreated wastewater concentrations	✓
CEB-Heavy	CEB-Heavy	5[2]		✓
<DAF-IL	DAF-IL	1		✓
DAF-IL	DAF-IL	1		✓
DAF-All	DAF-All	33		✓
<CP-Heavy	CP-Heavy	4		✓
<CP-IL	CP-IL	1[3]		✓
CP-IL	CP-IL	1		
CP-All	CP-All	17[4]	Total process stream loading estimated from target average concentrations for CP-All[5]	

[1]Three of these facilities process the majority of their industrial laundry items with a dry-cleaning followed by water-washing process. EPA assumed these facilities would meet the limitations for the DAF-IL and CP-IL regulatory options without installing these treatment technologies. For the purposes of modeling, EPA estimated their baseline and postcompliance pollutant loadings from the target average concentrations calculated for the CP-IL regulatory option. These facilities were estimated to have no pollutant removals.
[2]Three facilities reported CEB treatment of the total wastewater stream. EPA does not have data representing CEB treatment of the total wastewater stream; the baseline pollutant loadings for these facilities were estimated assuming they are only treating heavy industrial laundry wastewater.
[3]This facility operates a microfiltration unit. Since microfiltration can achieve lower final effluent pollutant concentrations than chemical precipitation when operated properly (2), this facility is considered to have better treatment in place than the CP-Heavy option.
[4]One of these facilities operates an ultrafiltration unit. Since ultrafiltration can achieve lower final effluent pollutant concentrations than chemical precipitation when operated properly (2), this facility is considered to have better treatment in place than the CP-All option.
[5]The CP-All target average concentrations are equivalent to the CP-IL target average concentrations and are applied to the facilities' entire process wastewater annual flows.

CEB - Chemical emulsion breaking.
CP - Chemical precipitation.
DAF - Dissolved air flotation.
IL - Industrial laundry.
NA - Not applicable.

9.3.4 Methodology Used to Estimate POTW Baseline and Postcompliance Wastewater Loadings

POTW baseline pollutant loadings represent the loadings from industrial laundries discharged through POTWs to surface water in 1993, based on POTW removal efficiencies for the pollutants of concern. The POTW baseline loadings account for the removal of pollutants from untreated industrial laundry wastewater by treatment technologies in place at industrial laundries, as previously discussed in Section 9.3.2. The POTW baseline pollutant loadings were calculated for each of the 190 in-scope facilities, as shown in the following equation:

$$\underset{\text{(lbs/yr)}}{\text{Facility baseline annual loading}} \times (1 - \text{POTW pollutant removal efficiency}) = \underset{\text{(lbs/yr)}}{\text{POTW baseline annual loading}}$$

POTW postcompliance pollutant loadings for each of the regulatory options take into account loadings from industrial laundries discharged through POTWs to surface water after implementation of a rule. POTW postcompliance pollutant loadings account for the removal of pollutants from industrial laundry wastewater after implementation of the regulatory options, as previously discussed in Section 9.3.3. The POTW postcompliance pollutant loadings were calculated for each of the 190 in-scope facilities, as shown in the following equation:

$$\underset{\text{(lbs/yr)}}{\text{Facility postcompliance annual loading}} \times (1 - \text{POTW pollutant removal efficiency}) = \underset{\text{(lbs/yr)}}{\text{POTW postcompliance annual loading}}$$

The POTW pollutant removal efficiencies that were used to calculate POTW baseline and postcompliance loadings are shown for each pollutant of concern in Table 9-8. Chapter 7 of this document describes the methods used to estimate the POTW removal efficiencies.

9.3.5 Methodology Used to Estimate Industry and POTW Pollutant Removals

Industry pollutant removals represent the difference between industry baseline loadings and postcompliance loadings for each regulatory option. Because all the identified industrial laundries are indirect dischargers, the removals presented here represent removals of pollutants being discharged to POTWs. EPA calculated the pollutant removals for each facility using the following equation:

$$\underset{\text{(lbs/yr)}}{\text{Facility baseline annual loading}} - \underset{\text{(lbs/yr)}}{\text{Facility postcompliance annual loading}} = \underset{\text{(lbs/yr)}}{\text{Facility pollutant removals}}$$

EPA used the following methodology to estimate pollutant removals:

1) If the facility postcompliance annual loading of a pollutant was higher than the facility baseline annual loading, the facility pollutant removal was set to zero;

Table 9-8

POTW Pollutant Removal Efficiencies for the Pollutants of Concern

Pollutant of Concern	POTW Pollutant Removal Efficiency
Conventionals	
Biochemical Oxygen Demand 5-Day (BOD_5)	91%
Oil and Grease (measured as HEM)	87%
Total Suspended Solids (TSS)	91%
Priority Organics	
1,1,1-Trichloroethane	24%
1,2-Diphenylhydrazine	62%
4-Chloro-3-methylphenol	63%
Bis(2-ethylhexyl) Phthalate	60%
Butyl Benzyl Phthalate	86%
Chlorobenzene	24%
Chloroform	24%
Di-*n*-butyl Phthalate	75%
Di-*n*-octyl Phthalate	33%
Ethylbenzene	33%
Isophorone	62%
Methylene Chloride	18%
Naphthalene	18%
Phenol	95%
Tetrachloroethene	33%
Toluene	33%
trans-1,2-Dichloroethene	33%
Trichloroethene	33%
Nonconventional Organics	
2-Butanone	18%
2-Methylnaphthalene	28%
2-Propanone	85%
4-Methyl-2-pentanone	18%
∝-Terpineol	18%
Benzoic Acid	81%
Benzyl Alcohol	33%
Hexanoic Acid	33%

Table 9-8 (Continued)

Pollutant of Concern	POTW Pollutant Removal Efficiency
Nonconventional Organics (Continued)	
m-Xylene	33%
n-Decane	33%
n-Docosane	94%
n-Dodecane	33%
n-Eicosane	33%
n-Hexacosane	94%
n-Hexadecane	33%
n-Octacosane	94%
n-Octadecane	33%
n-Tetracosane	94%
n-Tetradecane	33%
n-Triacontane	94%
o-&*p*-Xylene	33%
p-Cresol	72%
p-Cymene	99%
Pentamethylbenzene	91%
Priority Metals and Elements	
Antimony	72%
Arsenic	40%
Beryllium	61%
Cadmium	91%
Chromium	91%
Copper	84%
Lead	92%
Mercury	33%
Nickel	52%
Selenium	34%
Silver	80%
Thallium	28%
Zinc	77%
Nonconventional Metals and Elements	
Aluminum	88%
Barium	35%

Table 9-8 (Continued)

Pollutant of Concern	POTW Pollutant Removal Efficiency
Nonconventional Metals and Elements (Continued)	
Boron	14%
Cobalt	4%
Iron	83%
Manganese	41%
Molybdenum	52%
Tin	65%
Titanium	69%
Vanadium	42%
Yttrium	58%
Bulk Nonconventionals	
Chemical Oxygen Demand (COD)	82%
Total Organic Carbon (TOC)	71%
Total Petroleum Hydrocarbon (measured as SGT-HEM)[1]	74%

[1] Silica gel treated-hexane extractable material (SGT-HEM) is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

2) If the pollutant was not present at baseline, the removal was set to zero; and

3) If a target average concentration was not calculated for a pollutant for a regulatory option (i.e., the postcompliance loading for the pollutant could not be calculated), the removal was set to zero.

Each of the facility pollutant removals were extrapolated using the facility survey weights to calculate the total industry pollutant removals for each of the regulatory options.

Similarly, POTW pollutant removals represent the difference between POTW baseline annual loadings and postcompliance annual loadings for each regulatory option. The POTW pollutant removals represent the annual amount of pollutants that would be removed from surface water after implementation of a rule. EPA calculated the POTW pollutant removals for each facility using the following equation:

$$\underset{\text{(lbs/yr)}}{\text{POTW baseline annual loading}} - \underset{\text{(lbs/yr)}}{\text{POTW postcompliance annual loading}} = \underset{\text{(lbs/yr)}}{\text{POTW pollutant removals}}$$

Each of the POTW pollutant removals were extrapolated to calculate the total POTW pollutant removal for the industrial laundries industry for each of the regulatory options.

9.4 Pollutant Loadings and Removals

EPA estimated annual industry untreated, baseline, and postcompliance loadings for each of the regulatory options using the methodology described in Section 9.3 of this document. EPA extrapolated the facility-specific loadings and removals from the 190 in-scope facilities (and subsets of the 190 facilities) to represent the entire industry of 1,742 facilities (and subsets of the industry). In addition, EPA estimated the POTW annual baseline and postcompliance loadings from industrial laundries discharged by POTWs to surface water for each of the regulatory options using the methodology described in Section 9.3.4 of this document. EPA extrapolated the POTW loadings and removals, as described previously. Tables summarizing the loadings and pollutant removals from industrial laundry and POTW effluents for each pollutant of concern are included in Appendix E of this document.

The following tables (presented at the end of this chapter) summarize the industry and POTW baseline and postcompliance pollutant loadings, the POTW pollutant removals, and the POTW toxic-weighted pollutant removals (in total pounds and in pound equivalents) for total priority and nonconventional pollutant groupings:

- Tables 9-9 and 9-10 -- present industry and POTW baseline and postcompliance loadings, the POTW pollutant removals, and the POTW toxic-weighted pollutant removals for all 1,742 facilities for CP-IL and DAF-IL, respectively;

- Tables 9-11 and 9-12 -- present industry and POTW baseline and postcompliance loadings, the POTW pollutant removals, and the POTW toxic-weighted pollutant removals for 1,606 facilities included in the CP-IL and DAF-IL regulatory options under the "1 Million/255 K" exclusion, respectively;

- Tables 9-13 and 9-14 -- present industry and POTW baseline and postcompliance loadings, the POTW pollutant removals, and the POTW toxic-weighted pollutant removals for 1,224 facilities included in the CP-IL and DAF-IL regulatory options under the "3 Million/120 K" exclusion, respectively; and

- Tables 9-15 and 9-16 -- present industry and POTW baseline and postcompliance loadings, the POTW pollutant removals, and the POTW toxic-weighted pollutant removals for 789 facilities included in the CP-IL and DAF-IL regulatory options under the "5 Million/255 K" exclusion, respectively.

EPA estimates toxic-weighted pollutant removals by multiplying pounds of a pollutant removed by an assigned toxic weighting factor to obtain the "pound equivalent" pollutant removals. The assigned toxic weighting factor for each pollutant is based on the pollutant's relative toxicity to copper. The toxic weighting factors assigned to each pollutant of concern can be found in the Industrial Laundries Administrative Record and the Cost-Effectiveness Analysis document (3).

9.5 Pollutant Loadings and Removals Estimated from 1998 Facility Treatment-In-Place Data

The industrial laundries trade associations (the Uniform and Textile Service Association (UTSA) and the Textile Rental Services Association (TRSA)) performed a survey of all industrial laundries that were sent a detailed questionnaire. More information on the types of data collected by the UTSA/TRSA survey is provided in Section 3.7.2 of this document.. The purpose of the survey was to provide EPA with 1998 data on treatment technologies in place at industrial laundries. Of the 190 in-scope facilities, 162 responded to the UTSA/TRSA survey. Section 6.5.16 of this document summarizes the types of equipment that were reported in the survey.

At proposal (62 FR 66181; December 17, 1997), EPA estimated the industry and POTW pollutant removals based on treatment-in-place information reported in the detailed questionnaire for the 1993 operating year. For the Notice of Data Availability (NODA) (63 FR 71054; December 23, 1998); EPA compared the pollutant removals estimated at proposal to the industry and POTW pollutant removals estimated using the treatment-in-place information reported in the UTSA/TRSA survey for the 1998 operating year for the DAF-IL and CP-IL regulatory options with the 1 Million/255 K exclusion. EPA's methodology and the results of the comparison are discussed below.

EPA compared the treatment system description contained in the UTSA/TRSA survey to the treatment system components reported in the detailed questionnaire for each facility. Most facilities did not report the treatment system design parameters of the treatment units reported in the UTSA/TRSA survey. To calculate the changes in the industry and POTW baseline pollutant loadings, EPA made the following assumptions when reviewing the UTSA/TRSA survey data:

- EPA continued to use the flow and production data that was reported in the detailed questionnaire for all facilities.
- For facilities that reported that they treat a portion of their wastewater and did not indicate the percentage of wastewater treated, EPA assumed that they are treating only a small portion of their total wastewater.
- For facilities that reported DAF, chemical precipitation, or chemical emulsion breaking treatment, EPA assumed that the facility is operating these systems in a manner equivalent to the technology control options costed by EPA.
- For facilities that provided treatment system descriptions that were not detailed enough for EPA to make judgement regarding the treatment system, EPA assumed that they are still operating the treatment system reported in the detailed questionnaire.
- For a facility that reported possible biological treatment, EPA assumed that it does not have treatment in place equivalent to any of the technology control options.
- For a denim prewash facility that operated a partial treatment system, EPA assumed that it treats wastewater from all items except for the denim prewash, which is not included in the scope of the rule.
- EPA did not reduce costs to reflect ancillary treatment technologies (e.g., screens, filter presses, equalization tanks) added since those reported in the detailed questionnaire.
- EPA did not make any changes in the compliance costs for ten facilities that reported closing or rebuilding since 1993.
- For facilities that reported that they planned to install treatment systems in the future, EPA assumed that they are still operating the treatment system reported in the detailed questionnaire.
- EPA assumed facilities that did not respond to the UTSA/TRSA survey (28 out of the 190 in-scope facilities) were still operating the treatment system reported in the detailed questionnaire.

Table 9-17 presents a comparison of the POTW pollutant removals estimated for the proposal and the POTW pollutant removals estimated using the UTSA/TRSA survey data for the CP-IL and DAF-IL regulatory options with the 1 Million/255 K exclusion. Table 9-18 presents this comparison for the industry pollutant removals. The pollutant loadings and removals were calculated using the assumptions and methodologies described previously in this chapter. By incorporating the treatment-in-place information reported in the UTSA/TRSA survey, the baseline pollutant loadings were changed for those facilities that reported adding or changing the treatment technologies reported in the detailed questionnaire. Because the industry and POTW pollutant removals are a function of the baseline pollutant loadings, the pollutant removals also changed. The total POTW pollutant removals were estimated to decrease by 8.9 million pounds and 9.5 million pounds (32 percent and 33 percent) from 1993 to 1998 in the CP-IL and DAF-IL options, respectively. The total industry pollutant removals were estimated to decrease by 50 million pounds and 53 million pounds (32 percent for each) from 1993 to 1998 in the CP-IL and DAF-IL options, respectively. Based on this comparison, EPA estimates that the actual pollutant loadings and removals for the industrial laundries industry to comply with the regulatory options (regardless of the specific exclusion) would be less than the pollutant loadings and removals for the final action, based on the 1993 operating year.

9.6 References

1. U.S. Environmental Protection Agency. Technical Development Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category. EPA-821-R-97-007, Washington, DC, November 1997.

2. Bartram, Gary H., Crossflow Microfiltration, A Cost Effective Approach to Treat Metals, Oil and Grease in the Industrial Laundries and Metal Finishing Industries, EPOC Filtration and Separation Systems, Fresno, CA, February 1993.

3. U.S. Environmental Protection Agency. Cost-Effectiveness Analysis for the Final Action Regarding Pretreatment Standards for the Industrial Laundries Point Source Category (Revised February 2000). EPA-821-R-00-005, Washington, DC, February 2000.

Table 9-9

Summary of Baseline Pollutant Loadings, Postcompliance Pollutant Loadings, and POTW Pollutant Removals from Industrial Laundries Wastewater for CP-IL[1] Entire Industry[2]

Pollutant Group	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	POTW Baseline Wastewater Pollutant Loading (lbs/yr)
Total Priority Organics	683,114	392,545
Total Nonconventional Organics	1,805,347	1,030,225
Total Priority Metals and Elements	487,665	99,114
Total Nonconventional Metals and Elements	2,180,096	414,749
Total Pollutants	**5,156,222**	**1,936,633**
	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	**POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)**
Total Priority Organics	429,496	259,950
Total Nonconventional Organics	893,523	501,493
Total Priority Metals and Elements	226,084	49,517
Total Nonconventional Metals and Elements	1,148,083	231,056
Total Pollutants	**2,697,186**	**1,042,016**
	Total Pollutant Removal from POTW Effluents (lbs/yr)	**Total Toxic Weighted Pollutant Removal from POTW Effluents (lb-equivalents/yr)**
Total Priority Organics	132,595	4,712
Total Nonconventional Organics	528,732	2,321
Total Priority Metals and Elements	49,597	32,200
Total Nonconventional Metals and Elements	183,693	3,685
Total Pollutants	**894,617**	**42,918**

[1]Numbers in this table were calculated using more significant figures than shown.
[2]The entire industrial laundries industry is estimated to consist of 1,742 facilities.

Table 9-10

Summary of Baseline Pollutant Loadings, Postcompliance Pollutant Loadings, and POTW Pollutant Removals from Industrial Laundries Wastewater for DAF-IL[1] Entire Industry[2]

Pollutant Group	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	POTW Baseline Wastewater Pollutant Loading (lbs/yr)
Total Priority Organics	683,114	392,545
Total Nonconventional Organics	1,805,347	1,030,225
Total Priority Metals and Elements	487,665	99,114
Total Nonconventional Metals and Elements	2,180,096	414,749
Total Pollutants	**5,156,222**	**1,936,633**
	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	**POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)**
Total Priority Organics	461,552	262,030
Total Nonconventional Organics	951,992	510,533
Total Priority Metals and Elements	299,142	64,029
Total Nonconventional Metals and Elements	1,223,799	242,167
Total Pollutants	**2,936,485**	**1,078,759**
	Total Pollutant Removal from POTW Effluents (lbs/yr)	**Total Toxic Weighted Pollutant Removal from POTW Effluents (lb-equivalents/yr)**
Total Priority Organics	130,515	4,812
Total Nonconventional Organics	519,692	2,248
Total Priority Metals and Elements	35,086	25,006
Total Nonconventional Metals and Elements	172,582	3,179
Total Pollutants	**857,875**	**35,245**

[1]Numbers in this table were calculated using more significant figures than shown.
[2]The entire industrial laundries industry is estimated to consist of 1,742 facilities.

Table 9-11

Summary of Baseline Pollutant Loadings, Postcompliance Pollutant Loadings, and POTW Pollutant Removals from Industrial Laundries Wastewater for CP-IL[1]

Excluding Facilities with Less than 1 Million Pounds per Year Total Production and Less than 255,000 Pounds per Year Shop and Printer Towel Production[2]

Pollutant Group	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	POTW Baseline Wastewater Pollutant Loading (lbs/yr)
Total Priority Organics	673,848	387,038
Total Nonconventional Organics	1,775,897	1,012,832
Total Priority Metals and Elements	481,921	98,031
Total Nonconventional Metals and Elements	2,161,142	410,917
Total Pollutants	**5,092,808**	**1,908,818**
	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	**POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)**
Total Priority Organics	426,467	258,109
Total Nonconventional Organics	886,592	497,609
Total Priority Metals and Elements	224,544	49,178
Total Nonconventional Metals and Elements	1,140,153	229,447
Total Pollutants	**2,677,756**	**1,034,343**
	Total Pollutant Removal from POTW Effluents (lbs/yr)	**Total Toxic Weighted Pollutant Removal from POTW Effluents (lb-equivalents/yr)**
Total Priority Organics	128,929	4,603
Total Nonconventional Organics	515,223	2,262
Total Priority Metals and Elements	48,852	31,663
Total Nonconventional Metals and Elements	181,470	3,627
Total Pollutants	**874,474**	**42,155**

[1]Numbers in this table were calculated using more significant figures than shown.
[2]136 of the 1,742 total industrial laundries are excluded from compliance under this criterion.

Table 9-12

Summary of Baseline Pollutant Loadings, Postcompliance Pollutant Loadings, and POTW Pollutant Removals from Industrial Laundries Wastewater for DAF-IL[1]

Excluding Facilities with Less than 1 Million Pounds per Year Total Production and Less than 255,000 Pounds per Year Shop and Printer Towel Production[2]

Pollutant Group	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	POTW Baseline Wastewater Pollutant Loading (lbs/yr)
Total Priority Organics	673,848	387,038
Total Nonconventional Organics	1,775,897	1,012,832
Total Priority Metals and Elements	481,921	98,031
Total Nonconventional Metals and Elements	2,161,142	410,917
Total Pollutants	**5,092,808**	**1,908,818**
	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	**POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)**
Total Priority Organics	457,889	260,017
Total Nonconventional Organics	943,083	506,064
Total Priority Metals and Elements	297,093	63,589
Total Nonconventional Metals and Elements	1,215,322	240,470
Total Pollutants	**2,913,387**	**1,070,140**
	Total Pollutant Removal from POTW Effluents (lbs/yr)	**Total Toxic Weighted Pollutant Removal from POTW Effluents (lb-equivalents/yr)**
Total Priority Organics	127,021	4,702
Total Nonconventional Organics	506,768	2,192
Total Priority Metals and Elements	34,442	24,522
Total Nonconventional Metals and Elements	170,447	3,126
Total Pollutants	**838,678**	**34,542**

[1]Numbers in this table were calculated using more significant figures than shown.
[2]136 of the 1,742 total industrial laundries are excluded from compliance under this criterion.

Table 9-13

Summary of Baseline Pollutant Loadings, Postcompliance Pollutant Loadings, and POTW Pollutant Removals from Industrial Laundries Wastewater for CP-IL[1]

Excluding Facilities with Less than 3 Million Pounds per Year Total Production and Less than 120,000 Pounds per Year Shop and Printer Towel Production[2]

Pollutant Group	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	POTW Baseline Wastewater Pollutant Loading (lbs/yr)
Total Priority Organics	631,744	363,259
Total Nonconventional Organics	1,647,212	937,119
Total Priority Metals and Elements	441,515	89,899
Total Nonconventional Metals and Elements	1,971,667	375,981
Total Pollutants	**4,692,138**	**1,766,258**
	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	**POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)**
Total Priority Organics	398,718	241,190
Total Nonconventional Organics	830,949	466,402
Total Priority Metals and Elements	210,022	46,139
Total Nonconventional Metals and Elements	1,071,075	215,162
Total Pollutants	**2,510,764**	**968,893**
	Total Pollutant Removal from POTW Effluents (lbs/yr)	**Total Toxic Weighted Pollutant Removal from POTW Effluents (lb-equivalents/yr)**
Total Priority Organics	122,069	4,245
Total Nonconventional Organics	470,717	2,063
Total Priority Metals and Elements	43,760	28,913
Total Nonconventional Metals and Elements	160,819	3,262
Total Pollutants	**797,365**	**38,483**

[1]Numbers in this table were calculated using more significant figures than shown.
[2]518 of the 1,742 total industrial laundries are excluded from compliance under this criterion. This exclusion includes the 136 facilities under the 1 Million/255K exclusion shown in Table 9-11.

Table 9-14

Summary of Baseline Pollutant Loadings, Postcompliance Pollutant Loadings, and POTW Pollutant Removals from Industrial Laundries Wastewater for DAF-IL[1]

Excluding Facilities with Less than 3 Million Pounds per Year Total Production and Less than 120,000 Pounds per Year Shop and Printer Towel Production[2]

Pollutant Group	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	POTW Baseline Wastewater Pollutant Loading (lbs/yr)
Total Priority Organics	631,744	363,259
Total Nonconventional Organics	1,647,212	937,119
Total Priority Metals and Elements	441,515	89,899
Total Nonconventional Metals and Elements	1,971,667	375,981
Total Pollutants	**4,692,138**	**1,766,258**
	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	**POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)**
Total Priority Organics	429,619	244,426
Total Nonconventional Organics	891,855	478,361
Total Priority Metals and Elements	272,614	58,576
Total Nonconventional Metals and Elements	1,136,150	224,949
Total Pollutants	**2,730,238**	**1,006,312**
	Total Pollutant Removal from POTW Effluents (lbs/yr)	**Total Toxic Weighted Pollutant Removal from POTW Effluents (lb-equivalents/yr)**
Total Priority Organics	118,833	4,335
Total Nonconventional Organics	458,757	1,987
Total Priority Metals and Elements	31,323	22,458
Total Nonconventional Metals and Elements	151,033	2,798
Total Pollutants	**759,946**	**31,578**

[1]Numbers in this table were calculated using more significant figures than shown.
[2]518 of the 1,742 total industrial laundries are excluded from compliance under this criterion. This exclusion includes the 136 facilities under the 1 Million/255K exclusion shown in Table 9-12.

Table 9-15

Summary of Baseline Pollutant Loadings, Postcompliance Pollutant Loadings, and POTW Pollutant Removals from Industrial Laundries Wastewater for CP-IL[1]

Excluding Facilities with Less than 5 Million Pounds per Year Total Production and Less than 255,000 Pounds per Year Shop and Printer Towel Production[2]

Pollutant Group	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	POTW Baseline Wastewater Pollutant Loading (lbs/yr)
Total Priority Organics	524,074	301,652
Total Nonconventional Organics	1,344,436	761,153
Total Priority Metals and Elements	353,460	72,129
Total Nonconventional Metals and Elements	1,563,066	299,886
Total Pollutants	**3,785,036**	**1,434,820**
	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	**POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)**
Total Priority Organics	352,002	196,341
Total Nonconventional Organics	685,436	384,765
Total Priority Metals and Elements	170,841	37,765
Total Nonconventional Metals and Elements	879,286	176,506
Total Pollutants	**2,060,565**	**795,377**
	Total Pollutant Removal from POTW Effluents (lbs/yr)	**Total Toxic Weighted Pollutant Removal from POTW Effluents (lb-equivalents/yr)**
Total Priority Organics	105,310	3,443
Total Nonconventional Organics	376,388	1,646
Total Priority Metals and Elements	34,364	23,713
Total Nonconventional Metals and Elements	123,380	2,601
Total Pollutants	**639,442**	**31,403**

[1]Numbers in this table were calculated using more significant figures than shown.
[2]953 of the 1,742 total industrial laundries are excluded from compliance under this criterion.

Table 9-16

Summary of Baseline Pollutant Loadings, Postcompliance Pollutant Loadings, and POTW Pollutant Removals from Industrial Laundries Wastewater for DAF-IL[1]

Excluding Facilities with Less than 5 Million Pounds per Year Total Production and Less than 255,000 Pounds per Year Shop and Printer Towel Production[2]

Pollutant Group	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	POTW Baseline Wastewater Pollutant Loading (lbs/yr)
Total Priority Organics	524,074	301,652
Total Nonconventional Organics	1,344,436	761,153
Total Priority Metals and Elements	353,460	72,129
Total Nonconventional Metals and Elements	1,563,066	299,886
Total Pollutants	**3,785,036**	**1,434,820**
	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	**POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)**
Total Priority Organics	355,948	202,715
Total Nonconventional Organics	748,338	400,907
Total Priority Metals and Elements	214,235	46,395
Total Nonconventional Metals and Elements	924,266	183,854
Total Pollutants	**2,242,787**	**833,871**
	Total Pollutant Removal from POTW Effluents (lbs/yr)	**Total Toxic Weighted Pollutant Removal from POTW Effluents (lb-equivalents/yr)**
Total Priority Organics	98,937	3,525
Total Nonconventional Organics	360,245	1,563
Total Priority Metals and Elements	25,734	18,488
Total Nonconventional Metals and Elements	116,032	2,199
Total Pollutants	**600,948**	**25,775**

[1]Numbers in this table were calculated using more significant figures than shown.
[2]953 of the 1,742 total industrial laundries are excluded from compliance under this criterion.

Table 9-17

POTW Pollutant Removal Comparison Between the Removals Estimated at Proposal and Removals Incorporating UTSA/TRSA Survey Data for the CP-IL and DAF-IL Regulatory Options[1]

Excluding Facilities with Less than 1 Million Pounds per Year Total Production and Less than 255,000 Pounds per Year Shop and Printer Towel/Rag Production[2]

Pollutant Grouping	POTW Pollutant Removal Estimated for Proposal[3] (1993 lbs/yr)	POTW Pollutant Removal Estimated Based on UTSA/TRSA Survey[4] (1998 lbs/yr)	Percent Decrease in POTW Pollutant Removal
CP-IL			
Total Bulk Conventionals	6,020,955	4,471,490	26%
Total Bulk Nonconventionals	20,226,788	13,226,655	35%
Total Bulk Parameters	**26,247,743**	**17,698,145**	**33%**
Total Priority Organics	157,067	101,571	35%
Total Nonconventional Organics	725,659	504,789	30%
Total Organics	**882,726**	**606,360**	**31%**
Total Priority Metals and Elements	52,263	39,828	24%
Total Nonconventional Metals and Elements	125,516	114,068	9%
Total Metals and Elements	**177,779**	**153,896**	**13%**
Total Pollutants	**27,308,248**	**18,458,401**	**32%**
DAF-IL			
Total Bulk Conventionals	6,149,908	4,559,753	26%
Total Bulk Nonconventionals	21,268,017	13,732,557	35%
Total Bulk Parameters	**27,417,925**	**18,292,310**	**33%**
Total Priority Organics	180,908	110,677	39%
Total Nonconventional Organics	783,871	549,338	30%
Total Organics	**964,779**	**660,015**	**32%**

Table 9-17 (Continued)

Pollutant Grouping	POTW Pollutant Removal Estimated for Proposal[3] (1993 lbs/yr)	POTW Pollutant Removal Estimated Based on UTSA/TRSA Survey[4] (1998 lbs/yr)	Percent Decrease in POTW Pollutant Removal
Total Priority Metals and Elements	34,535	25,063	27%
Total Nonconventional Metals and Elements	135,543	119,054	12%
Total Metals and Elements	**170,078**	**144,117**	**15%**
Total Pollutants	**28,552,782**	**19,096,442**	**33%**

[1]Numbers in this table were calculated using more significant figures than shown.
[2]136 of the 1,742 total industrial laundries are excluded from compliance under this criterion.
[3]The removals estimated for proposal (62 FR 66181; December 17, 1997) are based on treatment-in-place information from the detailed questionnaire for the 1993 operating year.
[4]The removals were estimated based on treatment-in-place information in the UTSA/TRSA survey for the 1998 operating year (presented in the Notice of Data Availability, 63 FR 71054; December 23, 1998).

Table 9-18

Industry Pollutant Removal Comparison Between the Removals Estimated at Proposal and Removals Incorporating UTSA/TRSA Survey Data for the CP-IL and DAF-IL Regulatory Options[1]

Excluding Facilities with Less than 1 Million Pounds per Year Total Production and Less than 255,000 Pounds per Year Shop and Printer Towel/Rag Production[2]

Pollutant Grouping	Industry Pollutant Removal Estimated for Proposal[3] (1993 lbs/yr)	Industry Pollutant Removal Estimated Based on UTSA/TRSA Survey[4] (1998 lbs/yr)	Percent Decrease in Industry Pollutant Removal
CP-IL			
Total Bulk Conventionals	57,702,653	42,466,234	26%
Total Bulk Nonconventionals	98,227,707	64,012,182	35%
Total Bulk Parameters	**155,930,360**	**106,478,416**	**32%**
Total Priority Organics	210,212	172,624	18%
Total Nonconventional Organics	754,444	534,573	29%
Total Organics	**964,656**	**707,197**	**27%**
Total Priority Metals and Elements	272,883	217,645	20%
Total Nonconventional Metals and Elements	703,067	712,265	(1%)
Total Metals and Elements	**975,950**	**929,910**	**5%**
Total Pollutants	**157,870,966**	**108,115,523**	**32%**
DAF-IL			
Total Bulk Conventionals	59,446,266	43,743,855	26%
Total Bulk Nonconventionals	103,854,831	66,935,920	36%
Total Bulk Parameters	**163,301,097**	**110,679,775**	**32%**
Total Priority Organics	221,062	139,853	37%
Total Nonconventional Organics	845,004	604,197	28%
Total Organics	**1,066,066**	**744,050**	**30%**

Table 9-18 (Continued)

Pollutant Grouping	Industry Pollutant Removal Estimated for Proposal[3] (1993 lbs/yr)	Industry Pollutant Removal Estimated Based on UTSA/TRSA Survey[4] (1998 lbs/yr)	Percent Decrease in Industry Pollutant Removal
Total Priority Metals and Elements	183,359	134,461	27%
Total Nonconventional Metals and Elements	732,951	726,346	1%
Total Metals and Elements	**916,310**	**860,807**	**6%**
Total Pollutants	**165,283,473**	**112,284,632**	**32%**

[1]Numbers in this table were calculated using more significant figures than shown.
[2]136 of the 1,742 total industrial laundries are excluded from compliance under this criterion.
[3]The removals estimated for proposal (62 FR 66181; December 17, 1997) are based on treatment-in-place information from the detailed questionnaire for the 1993 operating year.
[4]The removals were estimated based on treatment-in-place information in the UTSA/TRSA survey for the 1998 operating year (presented in the Notice of Data Availability, 63 FR 71054; December 23, 1998).

CHAPTER 10

NON-WATER QUALITY ENVIRONMENTAL IMPACTS

10.1 Introduction

As required by Sections 304(b) and 306 of the Clean Water Act, EPA considered the non-water quality environmental impacts that would be associated with the implementation of the regulatory options considered as the bases for Pretreatment Standards for Existing Sources (PSES) and Pretreatment Standards for New Sources (PSNS) for the Industrial Laundries Point Source Category. Non-water quality environmental impacts are impacts of the regulatory options on the environment that are not directly associated with wastewater. Specifically, EPA evaluated the potential effect of the chemical precipitation of industrial laundry wastewater (CP-IL) and dissolved air flotation of industrial laundry wastewater (DAF-IL) options on energy consumption, air emissions, and generation of solid wastes (oil and sludge). EPA also considered the impacts of the CP-IL and DAF-IL options on water usage and chemical usage. EPA has determined that changes in water usage and chemical usage from the CP-IL and DAF-IL options would be acceptable.

Section 10.2 of this chapter presents the non-water quality environmental impacts of the CP-IL and DAF-IL regulatory options and the methodology used by EPA to evaluate impacts on energy consumption, air emissions, and solid waste generation. Section 10.3 presents the references used.

10.2 Non-Water Quality Environmental Impacts of the CP-IL and DAF-IL Options Considered as the Bases for PSES and PSNS

EPA evaluated the non-water quality environmental impacts that would be associated with implementation of the CP-IL and DAF-IL options considered as the bases for PSES and PSNS for the Industrial Laundries Point Source Category. These options are described in Chapter 8 of this document. Specifically, the following information is presented in this chapter:

- Section 10.2.1 presents the energy consumption impacts that would be associated with PSES;
- Section 10.2.2 presents the air emission impacts that would be associated with PSES;
- Section 10.2.3 presents the solid waste impacts that would be associated with PSES; and
- Section 10.2.4 presents the non-water quality environmental impacts that would be associated with PSNS.

10.2.1 Energy Consumption Impacts

EPA estimates that implementation of a rule would have resulted in a net increase in energy consumption for the industrial laundries industry. The incremental increase is based on electricity used to operate wastewater treatment equipment at facilities that are not currently operating wastewater treatment equipment comparable to the regulatory options.

To calculate incremental energy consumption increases for the industrial laundries industry, EPA examined the wastewater treatment in place at the industrial laundries that would be covered by a regulation. EPA used the industrial laundries cost model, described in Chapter 11 of this document, to calculate the energy that would be required to operate wastewater treatment equipment that would be installed to comply with the regulatory options. EPA used the information provided in the 1994 Industrial Laundries Industry Questionnaire (detailed questionnaire) for the 1993 operating year to determine if a facility would have to install new equipment. If a facility reported operating a treatment system that was not comparable to the regulatory options, EPA estimated the facility's energy consumption for the reported system and subtracted this consumption from the energy requirements of the regulatory options. Facilities that did not report operating a treatment system comparable to the regulatory options received an incremental energy consumption amount equivalent to the amount estimated for each regulatory option.

EPA extrapolated the energy consumption increases to represent the entire industrial laundries industry using the survey weights. Table 10-1 presents the total incremental energy increase and the average incremental energy increase per facility for the 1,742 existing in-scope industrial laundries. Table 10-1 also presents the percentage of total industry energy use and the percentage of the national energy requirements represented by the incremental increase for each regulatory option. Based on a 1996 survey of industrial laundries conducted by the industry, industrial laundries use approximately 31.2 trillion BTUs per year, or 9.1 billion kilowatt hours per year. Approximately 2,805 billion kilowatt hours of electric power were generated in the United States in 1990 (1).

EPA estimates that the incremental energy consumption increases from the CP-IL and DAF-IL options would be a small percentage of the electricity currently used by the industrial laundries industry to operate all washing, drying, and treatment equipment. Based on this analysis, EPA believes that the energy impacts from these regulatory options would have been acceptable. In addition, industrial laundries can offset the energy impacts of installing additional wastewater treatment equipment by reusing treated hot or warm water. This practice results in energy savings in hot water generation. The use of heat reclaimers at industrial laundries for energy conservation is discussed in Chapter 6 of this document.

Table 10-1

Incremental Energy Consumption Increases Associated With Implementation of the CP-IL and DAF-IL Regulatory Options

PSES Regulatory Option[1]	Incremental Energy Increases[2]		Percentage of Total Industry Use[3]	Percentage of National Energy Requirements[4]
	Total Industry Increase (million kilowatt hours)	Average Increase Per Facility (kilowatt hours)		
CP-IL	69.5	39,900	0.76%	0.0025%
DAF-IL	82.8	47,500	0.91%	0.0030%

[1]Regulatory options are presented in Chapter 8 of this document.
[2]Incremental energy increases are based on 1,742 in-scope industrial laundries. This is a conservative estimate since fewer facilities would have been covered under regulatory options with exclusions (e.g., 1,224 facilities under the 3 Million/120 K exclusion). Chapter 8 of this document discusses the exclusions considered for the regulatory options.
[3]The industrial laundries industry energy use is approximately 9.1 billion kilowatt hours per year, as reported by the industrial laundries trade associations.
[4]Approximately 2,805 billion kilowatt hours of electric power were generated in the United States in 1990 (1).

10.2.2 Air Emissions Impacts

Industrial laundry facilities generate wastewater that contains organic compounds, some of which are on the list of Hazardous Air Pollutants (HAPs) in Title 3 of the Clean Air Act Amendments (CAAA) of 1990. Atmospheric exposure of the organic-containing wastewater may result in volatilization of HAPs, including volatile organic compounds (VOCs). HAPs, including VOCs, are emitted from the wastewater beginning at the point where the wastewater first contacts ambient air. Thus, HAPs, including VOCs, may be emitted prior to and during the cycle and immediately after the washing when the wastewater is discharged from the process unit. Air pollutants are also emitted from wastewater collection units such as process drains, manholes, trenches, and sumps, and from wastewater treatment units such as screens, equalization basins, DAF and chemical precipitation units, and any other units where the wastewater is in contact with the air.

EPA believes that emission of air pollutants from industrial laundry wastewater would have been similar before and after implementation of a rule based on DAF or chemical precipitation technologies because the wastewater from all industrial laundries currently has contact with ambient air as it flows to the publicly owned treatment works (POTW). At facilities that do not currently have treatment on site, the wastewater typically flows from the washers to an open or partially open catch basin, then to the sewer and on to the POTW, where the wastewater is typically treated in open aerated basins or lagoons. Emission of air pollutants from the wastewater occur as the wastewater flows from the facility to the POTW. At a facility with treatment, the wastewater would have more contact with air while still at the facility, as it is treated in open units such as equalization basins and DAF or chemical precipitation units prior to flowing through the sewer to the POTW. Air emissions from the treated wastewater occur at the treatment units at the facility, as well as while the wastewater flows to the POTW. Thus, EPA expects that the location of a portion of air emissions from industrial laundry wastewater would shift from the POTW collection and treatment system to the facility treatment system, but can not determine whether the overall amount of air emissions from industrial laundry wastewater would not change. However, EPA believes that the overall amount may decrease slightly with DAF or chemical precipitation treatment at facilities, since some VOCs and HAPs will partition to the oil fraction or chemical solids removed from the wastewater prior to discharge.

EPA examined the total air emissions from one industrial laundry's untreated wastewater stream assuming all volatile pollutants volatilize from that stream. As a worst-case analysis, EPA considered whether this total amount of air emissions would be acceptable assuming it represented incremental air emissions due to implementation of a rule. (EPA does not believe that the total amount of air emissions, as calculated below, represent incremental air emissions since EPA can not determine that there would be any difference before and after implementation of a rule.) EPA's methodology for estimating fugitive air emissions is described below.

EPA collected and analyzed wastewater samples at seven industrial laundries operating treatment systems that effectively treated industrial laundry wastewater; four of these treatment systems are the bases of the DAF-IL and CP-IL options. At all facilities, total raw wastewater samples were collected. EPA selected the facility with the highest raw wastewater

loading of organic pollutants to represent a worst-case scenario. EPA also assumed that all of the organic pollutants in the raw wastewater would volatilize during treatment. EPA believes that this represents a worst-case scenario for the regulatory options because not all of the organic pollutants present in the wastewater are volatile, and those that are volatile would not volatilize completely because they are at least somewhat soluble in water. Based on this methodology, the fugitive air emissions calculated by EPA are much higher than would actually occur at an industrial laundry employing wastewater treatment.

EPA used the following formula to calculate annual fugitive emissions of organic pollutants:

$$Y\frac{Mg}{year} = \left(X\frac{mg}{liter}\right)\left(F\frac{gallons}{day}\right)\left(N\frac{days}{year}\right)\left(3.785\frac{liters}{gallon}\right)\left(\frac{1\ Mg}{1 \times 10^{9}\ mg}\right)$$

where:

Y = megagrams of organic pollutant volatilized per year (Mg/year)
X = average concentration of the organic pollutant in the wastewater (mg/L)
F = average daily wastewater flow rate (gallons/day)
N = average days of operation per year (days/year).

Fugitive emissions were calculated for all volatile and semivolatile organic pollutants of concern. If a pollutant was not detected in the raw wastewater sample, EPA used the detection limit concentration to calculate the fugitive air emissions for that pollutant. Using the average daily flow (203,000 gallons per day), average raw wastewater pollutant concentration, and average days of operation (261 days per year), EPA calculated the fugitive air emission levels presented in Table 10-2. Based on summing the fugitive emissions for each individual HAP, the total annual HAP emissions from this industrial laundry under a worst case analysis would be 14 Mg/year. The total annual emissions for all organics would be 92 Mg/year. The total annual emissions would be 19 Mg/year for volatile organics and 72 Mg/year for semivolatile organics.

EPA estimated the total pounds of carbon dioxide (CO_2) emissions per year based on the incremental energy use to range from 28 million pounds of CO_2 per year (16,000 pounds per year per facility) for the CP-IL option and 33 million pounds of CO_2 per year (19,100 pounds per year per facility) for the DAF-IL option (2). The increased air emissions would be proportional to the increased energy use. As the increase in energy use reflects only a small percentage of the industry's total energy use, these increased emissions are only a small percentage of the emissions from the industry's total energy use. Based on this analysis, EPA believes that the incremental air emissions from the CP-IL and DAF-IL options would have been acceptable. Although emissions from greenhouse gases other than CO_2 result from the burning of natural gas to produce energy, CO_2 is believed to be the most significant in terms of the total emission quantity. In addition, the burning of natural gas releases other types of pollutants, such as criteria pollutants and HAPs. Energy produced from the burning of fuels other than natural gas would produce varying quantities of these types of emissions.

Table 10-2

Fugitive Air Emissions of Organic Pollutants From Industrial Laundry Wastewater—Analysis of a Worst-Case Scenario

Organic Air Pollutant	Hazardous Air Pollutant?	Raw Wastewater Concentration (mg/L)	Amount Volatilized (Mg/year)
Volatile Organics			
1,1-Dichloroethane	Y	0.14	0.03
1,1,1-Trichloroethane	N	0.42	0.08
1,4-Dioxane	Y	2.59	0.52
2-Butanone	N	0.73	0.15
2-Chloroethylvinyl Ether	N	1.30	0.26
2-Propanone	N	35.79	7.18
4-Methyl-2-pentanone	N	1.66	0.33
Chlorobenzene	Y	0.65	0.13
Ethylbenzene	Y	2.40	0.48
m-Xylene	Y	14.27	2.86
Methylene Chloride	Y	1.55	0.31
o-&p-Xylene	Y	6.36	1.28
Tetrachloroethene	N	15.55	3.12
Toluene	Y	13.17	2.64
trans-1,2-Dichloroethene	N	0.04	0.01
Trichloroethene	N	0.04	0.01
Trichlorofluoromethane	N	0.04	0.01
Subtotal for Volatile Organics			**19.40**
Semivolatile Organics			
1,2-Diphenylhydrazine	Y	0.20	0.04
2,3,6-Trichlorophenol	N	0.10	0.02
2,4,5-Trichlorophenol	Y	0.10	0.02
2,4,6-Trichlorophenol	Y	0.10	0.02
2,4-Dichlorophenol	N	0.10	0.02
2,4-Dimethylphenol	N	0.10	0.02
2,4-Dinitrophenol	Y	0.50	0.10
2-Chlorophenol	N	0.10	0.02
2-Methylnapthalene	N	0.10	0.02
2-Nitrophenol	N	0.20	0.04
4-Chloro-3-methylphenol	N	0.16	0.03

Table 10-2 (Continued)

Organic Air Pollutant	Hazardous Air Pollutant?	Raw Wastewater Concentration (mg/L)	Amount Volatilized (Mg/year)
Semivolatile Organics (Continued)			
4-Nitrophenol	Y	0.50	0.10
∝-Terpineol	N	0.10	0.02
Benzoic Acid	N	0.66	0.13
Benzyl Alcohol	N	0.10	0.02
Bis(2-ethylhexyl) Phthalate	Y	19.11	3.83
Bromodichloromethane	N	0.04	0.01
Butyl Benzyl Phthalate	N	0.48	0.10
Diethyl Phthalate	N	0.10	0.02
Dimethyl Phthalate	Y	0.10	0.02
Di-*n*-butyl Phthalate	N	1.23	0.25
Di-*n*-octyl Phthalate	N	0.10	0.02
Hexanoic Acid	N	0.10	0.02
Isophorone	Y	0.10	0.02
Naphthalene	Y	6.43	1.29
n-Decane	N	277.97	55.74
n-Docosane	N	1.74	0.35
n-Dodecane	N	11.13	2.23
n-Eicosane	N	5.13	1.03
n-Hexacosane	N	1.19	0.24
n-Hexadecane	N	13.47	2.70
n-Nitrosomorpholine	Y	0.10	0.02
n-Octadecane	N	4.73	0.95
n-Tetracosane	N	4.14	0.83
n-Tetradecane	N	11.88	2.38
p-Cymene	N	0.19	0.04
Pentachlorophenol	Y	0.50	0.10
Pentamethylbenzene	N	0.84	0.17
Phenol	Y	0.10	0.02
Phenol, 2-Methyl-4, 6-Dinitro	N	0.20	0.04
Styrene	Y	0.17	0.03
Subtotal for Semivolatile Organics			**73.07**
Total for Volatile and Semivolatile HAPs			**13.86**
Total for All Volatiles and Semivolatiles			**92.47**

10.2.3 Solid Waste Impacts

EPA considered regulatory options based on DAF and chemical precipitation technologies followed by dewatering of the sludge generated from these technologies. Based on information collected in the industrial laundries detailed questionnaire and from data submitted in comments, most industrial laundry sludge from chemical precipitation or DAF treatment systems is disposed in nonhazardous landfills. EPA estimated the incremental sludge generation from the CP-IL and DAF-IL options in a manner similar to estimating the energy consumption incremental amounts. EPA estimated that sludge generation would not increase at facilities that reported currently operating a treatment system comparable to the regulatory options. EPA used the cost model to estimate the incremental sludge generation rates for facilities not currently operating wastewater treatment and for facilities operating wastewater treatment not comparable to the regulatory options.

EPA calculated the volume of sludge that would be generated by the 1,742 in-scope industrial laundries after implementation of the CP-IL and DAF-IL options. Table 10-3 presents the incremental increase in sludge generation (in wet sludge and dry solids) from all existing in-scope industrial laundries. Table 10-3 also presents the average incremental increase per industrial laundry and the percentage of the national volume of nonhazardous waste sent to landfills represented by the incremental increase for each regulatory option. Approximately 430 million tons (dry basis) of industrial nonhazardous waste was sent to landfills in the United States in 1990 (3). EPA notes that this volume would be offset somewhat by reducing the volume generated by POTWs. Based on this analysis, EPA believes the solid waste impacts of all of the regulatory options under consideration would have been acceptable.

10.2.4 Non-Water Quality Environmental Impacts of the Regulatory Options Considered for PSNS

EPA considered the non-water quality environmental impacts associated with the implementation of the CP-IL and DAF-IL regulatory options, which were considered for PSNS for the Industrial Laundries Point Source Category. Over a three-year period (1991, 1992, and 1993), according to the detailed questionnaire, only about 80 new laundry facilities began operation (and it is not absolutely clear from the data whether these facilities were new dischargers or were existing dischargers acquired in that year by a different firm). Given the small level of growth in the industrial laundries industry, EPA believes that new sources are primarily replacing production from closing facilities that exit the market. With respect to any new sources that start in the future, the non-water quality environmental impacts of compliance with a rule would not be any greater than those for existing sources. Therefore, EPA has determined that the non-water quality environmental impacts associated with the implementation of the regulatory options considered for PSNS would have been negligible.

Table 10-3

Incremental Sludge Generation Increases Associated With Implementation of the CP-IL and DAF-IL Regulatory Options

PSES Regulatory Option Considered for Proposal[1]	Incremental Sludge Generation Increases[2]				Percentage of National Volume of Waste Disposed to Nonhazardous Industrial Landfills[4]
	Total Industry Increase (Tons of Dewatered Sludge)	Total Industry Increase (Tons of Dry Solids)[3]	Average Facility Increase (Tons of Dewatered Sludge)	Average Facility Increase (Tons of Dry Solids)[3]	
CP-IL	173,000	60,600	99.5	34.8	0.014%
DAF-IL	128,000	70,600	73.7	40.6	0.016%

[1]Regulatory options are presented in Chapter 8 of this document.
[2]Incremental sludge generation increases are based on 1,742 industrial laundries in-scope industrial laundries. This is a conservative estimate since fewer facilities would have been covered under regulatory options with exclusions (e.g., 1,224 facilities under the 1 Million/255 K exclusion). Chapter 8 of this document discusses the exclusions considered for the regulatory options.
[3]Industrial laundries responding to the detailed questionnaire that currently treat their wastewater through DAF or chemical precipitation reported an average solids content of their dewatered sludge of 55% and 35%, respectively.
[4]Approximately 430 million tons (dry basis) of industrial nonhazardous waste was sent to landfills in the United States in 1990 (3).

10.3 References

1. Steam, Its Generation and Uses, 4th Edition, Babcock & Wilcox, Ed Stutz & Kitto, Barberton, Ohio. 1992.

2. U.S. Environmental Protection Agency. AP-42, Fifth Edition, Volume 1, 1998.

3. U.S. Environmental Protection Agency. Subtitle D Study Phase I. EPA 530-SW-86-054. Washington, DC, 1986.

CHAPTER 11

COSTS OF TECHNOLOGY BASES FOR REGULATORY OPTIONS

11.1 Introduction

This chapter describes the methodology used to estimate the costs to implement each of the regulatory options considered for the final action for the Industrial Laundries Point Source Category. Chapters 6 and 8 of this document describe in detail the technologies used as the bases for the regulatory options considered. The cost estimates provide a basis for determining the economic impact of implementing the options on the industry. The results from assessing the economic impact of the regulatory options are found in the Economic Assessment (EA) for the industrial laundries final action (1). The cost estimates, together with the pollutant reduction estimates described in Chapter 9 of this document, also provide a basis for evaluating the cost-effectiveness of the options.

EPA used the following approach in estimating compliance costs for the industrial laundries industry:

- EPA mailed the 1994 Industrial Laundries Industry Questionnaire (detailed questionnaire) to a statistically selected sample of industrial laundries (discussed in Chapter 3 of this document). The information provided for the 1993 operating year from the 190 in-scope facilities that responded was used to determine baseline wastewater treatment system design and operating status. The in-scope facilities are those that launder industrial textile items from off site as a business activity, as discussed in Chapter 4 of this document.

- EPA identified candidate end-of-pipe wastewater treatment technologies and grouped appropriate technologies into technology control options (discussed in Chapters 6 and 8 of this document).

- EPA analyzed data collected from industry to determine untreated wastewater pollutant concentrations and pollutant removal performance of the technology control options (discussed in Chapter 9 of this document).

- EPA developed cost equations for capital and operating and maintenance (O&M) costs for each of the technologies included in the technology control options based on information gathered from industrial laundry facilities, wastewater treatment system vendors, and engineering judgement (discussed in this chapter).

- EPA developed and used a computerized design and cost model, the Industrial Laundries Design and Cost Model (cost model), to calculate

capital and annual compliance costs (presented in this chapter) and pollutant loadings (presented in Chapter 9 of this document) for each technology control option for each facility.

- EPA used output from the cost model to calculate total annualized costs in 1993 dollars for each facility for each regulatory option (presented in the EA).

- EPA compared each facility's annualized cost for each regulatory option to the annualized cost for the facility to contract for off-site wastewater treatment (presented in this chapter). If the cost for off-site treatment was less than the cost to install and operate an on-site treatment system, the off-site treatment cost was used as the facility's cost for compliance.

- EPA used the annualized costs and the pollutant loadings calculated by the cost model to calculate cost-effectiveness and the economic impact of each regulatory option on the industry (presented in the EA).

EPA estimated compliance costs for all technology control options presented in Chapter 8 of this document. These cost estimates may be found in the Industrial Laundries Administrative Record. This chapter presents the methodology, assumptions, and cost estimates for the two regulatory options, DAF-IL and CP-IL. EPA estimated industry-wide costs by estimating compliance costs for the 190 in-scope facilities to purchase, install, and operate each of the options. Using statistically calculated facility weighting factors, EPA then extrapolated the results to the entire industrial laundries industry (1,742 industrial laundries). EPA also estimated industry-wide costs for three exclusions (discussed in Chapter 8 of this document) for each of the two regulatory options.

The following information is discussed in this section:

- Section 11.2 discusses the costing methodology;

- Section 11.3 discusses cost modeling and summarizes cost estimating assumptions and design bases for the technologies that comprise the regulatory options;

- Section 11.4 presents the cost estimates for each regulatory option;

- Section 11.5 presents the cost estimates for each regulatory option estimated from updated wastewater treatment information provided in a 1998 survey conducted by the industrial laundries trade associations; and

- Section 11.6 presents the references used in this chapter.

11.2 Costing Methodology

To determine the impact of pretreatment standards on the industrial laundries industry, EPA estimated costs associated with regulatory compliance. A computerized cost model was developed to estimate compliance costs for each of the regulatory options. EPA used the cost model to estimate costs for the treatment technologies used as the bases for the calculated limitations of each regulatory option. Although the estimated compliance costs were developed based on implementation of these treatment technologies, EPA emphasizes that a regulation would not require that a facility operate these technologies, but only that the appropriate facility effluent standards be met.

EPA selected a facility-by-facility model approach to develop the compliance costs as opposed to a more general modeling approach, because of the variability of processes and resultant wastewaters among industrial laundries. EPA used facility information available from responses to the detailed questionnaire to characterize the wastewater and assess existing treatment technologies at each facility. EPA did not include information from facilities that did not provide sufficient technical and/or economic data to be adequately characterized as to their current operations and/or economic status, respectively. For the purposes of the cost model, a facility was excluded if EPA did not have information on its flow, production, and/or wastewater treatment activities.

In other cases when more specific information was not available, EPA made engineering assumptions regarding facility operations, or used industry average data and various wastewater treatment equipment vendor and consultant information. Thus, for any given facility, the costs estimated may deviate from those that the facility would actually incur. However, because EPA based these assumptions on industry-wide data, the resulting estimates are considered accurate when evaluated on an industry-wide, aggregate basis.

As discussed in Chapter 8 of this document, EPA identified the following regulatory options:

- DAF-IL Option - Dissolved air flotation (DAF) treatment of wastewater generated from the washing of industrial textile items only; the cost model uses target average concentrations calculated from data obtained from the industry for DAF treatment of a facility's total process wastewater stream to calculate pollutant removals for the DAF-IL option.

- CP-IL Option - Chemical precipitation treatment of wastewater generated from the washing of industrial textile items only; the cost model uses target average concentrations calculated from data obtained from the industry for chemical precipitation treatment of a facility's total process wastewater stream to calculate pollutant removals for the CP-IL option.

Also as discussed in Chapter 8 of this document, EPA identified three exclusions for each of the technology options:

- 1 Million/255 K—Facilities processing less than 1,000,000 pounds of incoming laundry and less than 255,000 pounds of industrial towels annually are excluded;

- 3 Million/120 K—Facilities processing less than 3,000,000 pounds of incoming laundry and less than 120,000 pounds of industrial towels annually are excluded (this exclusion also excludes all facilities excluded under the 1 Million/255 K exclusion, above); and

- 5 Million/255 K—Facilities processing less than 5,000,000 pounds of incoming laundry and less than 255,000 pounds of industrial towels annually are excluded.

11.2.1 Cost Model Development and Structure

EPA evaluated the following three existing cost models from other EPA effluent guidelines development efforts to be used as the basis for the industrial laundries cost model:

- Metal Products and Machinery (MP&M) Phase I Industries Design and Cost Model;

- Pharmaceuticals Industry Cost Model; and

- Pesticides Formulating, Packaging, and Repackaging Industry (PFPR) Cost Model.

The MP&M and pharmaceuticals cost models were programmed in FoxPro®. These cost models have treatment technology "modules" designed to calculate the cost of each individual treatment technology. The individual modules are tied together with the cost model "driver," the main program that accesses input data, runs the modules in the appropriate order for each regulatory option, and tracks intermediate and output data. The PFPR cost model was programmed in a spreadsheet, but also designed with individual modules. Because FoxPro® provided a more flexible platform than a spreadsheet on which to build the cost model and because the data for the industrial laundries project were already stored in FoxPro® files, EPA decided to use FoxPro® for the industrial laundries cost model.

The industrial laundries cost model driver was based on the MP&M cost model driver. The major advantage of the MP&M cost model driver over the pharmaceuticals cost model driver is its ability to calculate the baseline pollutant loads and the postcompliance pollutant loads along with the costs for regulatory options. The pharmaceuticals cost model driver was not programmed to calculate pollutant loads.

EPA adapted the MP&M cost model driver for the industrial laundries cost estimation effort with one major modification: any value calculated by the cost model is stored in an output file. This allows the user of the cost model to examine the significance of each calculated value in the cost calculated for each technology module.

The inputs to the industrial laundries cost model include untreated wastewater pollutant concentrations, flow rates, operating schedules, and treatment technologies currently in place for each facility costed. EPA obtained facility information on the flow rates, operating schedules, and treatment technologies in place for the 1993 operating year from the detailed questionnaire response for each facility. As described previously, facilities that did not report flow, production, and/or treatment technology information were not included in the cost estimation effort. If facilities did not report operating days per year or hours per day, facility average data were used. EPA calculated the untreated wastewater pollutant concentrations for each facility costed using wastewater characterization data obtained from the industry and each facility's production data provided in the detailed questionnaire, as described in Chapter 9 of this document. The input information for the cost model was maintained in database files. Section 11.3 of this document discusses the cost model and its operation in more detail.

11.2.2 Components of the Cost of Compliance

EPA adjusted all costs calculated by the cost model to 1993 dollars because all facility-specific information in the detailed questionnaire database is from the 1993 operating year. This adjustment allows direct comparison between financial data reported in the detailed questionnaire and calculated compliance costs for each facility. Costs were adjusted using the Chemical Engineering (CE) Plant Cost 1993 annual index value of 359.2 (2) and the index value for the year in which the costs were originally reported in the following formula:

$$AC = OC\left(\frac{359.2}{OCI}\right)$$

where:

AC = Adjusted cost, 1993 dollars
OC = Original cost, dollars
OCI = Original cost year index.

EPA used the cost model to calculate capital and annual operating and maintenance (O&M) costs for each technology included in the regulatory option and to sum the capital and annual O&M costs for all technologies in the option at each facility.

Capital costs comprise direct and indirect costs associated with the purchase and installation of wastewater treatment equipment. Primary sources of the capital costs were vendor information and literature references. Table 11-1 presents the unit capital costs used by the cost model and includes references for the origin of each cost. Typically, direct capital costs include the following:

- Purchase of treatment equipment and any accessories;
- Purchase of treatment equipment instrumentation (e.g., controllers);
- Installation costs (e.g., labor and rental fees for equipment such as cranes);

Table 11-1

Capital Unit Costs Used by the Cost Model

Capital Costs (includes crane rental)			
Item	**Cost (1993 $s)**	**Module(s)**	**Reference**
Air-operated sludge pump (4 to 60 gpm)	Cost = 571.91 + 37.161 × C - 0.18842 × C^2 per pump (C = Capacity in gpm)	Pump	(8)
Batch chemical precipitation treatment units (100 to 2,500 gallons)	Cost = 23,773 + 19.963 × V - (2.8223×10^{-3}) × V^2 per unit (V = batch size in gallons)	Chemical Precipitation	(16)
Building	$40.32 per square foot	Building	(20)
C-Clamp-mounted agitators (0.25 to 2 hp)	Cost = 3,168.998 + 2965.115 x log(P) per agitator (P = power requirement in hp)	pH Adjustment	(19)
Centrifugal wastewater transfer pumps (> 27 gpm)	Cost = 2,758.989 × $\log_{10}$ (C) - 2,185.941 per pump (C = capacity in gpm)	Pump	(8)
Chemical feed system (0.01 to 3,200 lb/hr)	Cost = 12,421 + 38.142 × C - (3.8125×10^{-3}) × C^2 per unit (C = Capacity in lbs/gal)	DAF, pH Adjustment	(14, 19)
Continuous chemical precipitation treatment units (2 to 150 gpm)	Cost = 47,192 + 1,129.6 × C - (1.3255 × C^2) per unit (C = capacity in gpm)	Chemical Precipitation	(16)
Continuous DAF treatment units (25 to 1,000 gpm)[1]	Cost = 111,370 × $\log_{10}$ (C) - 139,260 per unit (C = capacity in gpm)	DAF	(14)
Covered and flanged fiberglass tanks (110 to 50,000 gallons)	Cost = 2,839.2 + 0.9004 × V per tank (V = volume in gallons)	Contract Haul	(22)
Covered and flanged fiberglass tanks (110 to 50,000 gallons)	Cost = 2,927.1 + 0.9182 × V per tank (V = volume in gallons)	Equalization	(11)
Equipment and labor required for washer modification for split stream capability	$4,096.61 to $7,599.37 per washer	Stream Splitting	(7)
Filter press (5 to 125 ft^3)	Cost = 33,331 x ln(C) - 36,195 per press (C = capacity in ft^3)	Sludge Dewatering	(17)
Flange-mounted agitators (0.25 to 5 hp)	Cost = 4,247.414 + 2,616.527 × $\log_{10}$ (P) per agitator (P = power requirement in hp)	Equalization, pH Adjustment	(11, 19)
Installation labor rate	$25.27 per hour	All	(3)

Table 11-1 (Continued)

Capital Costs (includes crane rental)			
Item	**Cost (1993 $s)**	**Module(s)**	**Reference**
Open polyethylene tank (55 to 6,400 gallons)	Cost = 362.48 + 1.5907 × V - (1.0583 × 10^{-4}) × V^2 per tank (V = Volume in gallons)	Screen, pH Adjustment	(9, 19)
pH controller	$1,554.77 per controller	pH Adjustment	(19)
Positive displacement wastewater transfer pumps (<3 to 27 gpm)	$839.38 to $2,130.04 per pump	Pump	(8)
PVC piping for stream segregation retrofit[2]	$27.08 per foot	Stream Splitting	(7)
Shaker screen unit (48-inch and 60-inch units)	$8,131.76 to $9,542.93 per unit	Screen	(9)
Optimization Cost Allowance			
Item/Activity	**Cost (1993 $s)**	**Module(s)**	**Reference**
Increased equalization capacity	$3,693 to $23,558	---	(6)
Training and consulting	$4,800	---	(6)

[1]The same DAF unit (750 gpm) will be costed for capacities ranging within 750 to 1,000 gpm, as this size unit is capable of treating up to 1,000 gpm of wastewater flow.
[2]An additional $500 per facility was allowed to account for any necessary elbow joints or other connections.

DAF - Dissolved air flotation.

- Construction of buildings or other structures to house major treatment units (e.g., foundation slab, enclosure, containment, lighting, and electricity hook-ups); and

- Purchase of necessary pumps (e.g., for wastewater transfer, chemical addition, sludge handling).

EPA obtained the wage rate for all required labor to properly install the systems associated with the technology bases from The Richardson Rapid System Process Plant Construction Estimating Standards (3) as the average hourly rate for one installation worker. The average rate in 1994 was $25.90 per hour. This rate was scaled back to a 1993 rate of $25.27 per hour using the CE Plant Cost indices.

Indirect capital costs typically include the following:

- Purchase and installation of necessary piping to interconnect treatment system units (e.g., pipe, pipe hangers, fittings, valves, insulation, similar equipment);

- Purchase and installation of electrical equipment (e.g., switches, wire, fittings, grounding, instrument and control wiring, lighting panels);

- Engineering costs (e.g., administrative, legal, process design and general engineering, communications, consultant fees, travel, supervision, and inspection of treatment equipment);

- Site maintenance (e.g., roads, walkways, fences, parking areas, landscaping, site clearing);

- Contingency (e.g., compensation for unpredictable events such as foul weather, price changes, small design changes, and errors in estimates); and

- Contractors' fees.

For each technology, EPA accounted for each required indirect capital cost by using a factor related to purchased and installed capital costs. The total capital investment is obtained by multiplying the direct capital cost by the indirect capital cost factor. Table 11-2 presents the components of the total capital investment, including the indirect capital cost factor used by the cost model.

Table 11-2

Components of Total Capital Investment

Number	Component	Cost
1	Equipment capital costs, including required accessories, installation, delivery, instrumentation, building, containment, pumping	Direct Capital Cost
2	Piping	10% of the Direct Capital Cost
3	Electrical	2% of the Direct Capital Cost
4	Engineering/administrative/legal services	10% of the Direct Capital Cost
5	Total Plant Cost	1.22 × Direct Capital Cost (Sum of Components 1 through 4)
6	Site Work	1.5% of the Total Plant Cost
7	Contingency	13% of the Total Plant Cost
8	Contractor's Fee	5% of the Total Plant Cost
9	**Total Capital Investment**	1.46 × Direct Capital Cost (Sum of Components 5 through 8)

Source: Industrial Laundries Design and Cost Model.

Annual O&M costs comprise all costs related to operating and maintaining the treatment system for a period of one year, including the estimated costs for compliance monitoring of the effluent. Table 11-3 presents the annual O&M unit costs used by the cost model and includes references for the origin of each cost. Annual O&M costs include the following:

- Chemical usage;
- O&M labor and materials;
- Removal, transportation, and disposal of any waste solids, sludges, oils, or other waste products generated by the treatment system; and
- Utilities, such as electricity, required to run the treatment system.

Sources of annual O&M costs primarily included literature references and vendor information. Information from other EPA effluent guidelines development efforts and engineering judgement were used in some instances when estimating O&M labor.

At proposal, assumptions on the number of hours required of a worker to operate a treatment system were made for each piece of equipment included in the treatment system for each regulatory option. EPA also assumed that an industrial laundry treatment system operator received an equivalent rate of pay as an installation worker. However, based on comments received and industry-supplied data, EPA simplified how it estimated the annual O&M labor costs for each option. Annual O&M labor costs were estimated to be equivalent to one full-time operator paid at a rate of $13.77 per hour for each facility that did not report having treatment (4).

EPA obtained the cost for electricity used by various treatment technologies from the Department of Energy's Monthly Energy Review (5). The average cost of electricity for industrial facilities for the year 1993 was $0.049 per kilowatt-hour.

11.2.3 Treatment-in-Place Credit Methodology

EPA evaluated facility responses to the detailed questionnaire to determine which treatment technologies were in place and in operation at each facility in the 1993 operating year. Facilities were given credit for having operational treatment in place; these treatment credits were used to develop cost estimates for system upgrades instead of new systems where appropriate. No compliance costs beyond necessary additional monitoring and an optimization cost allowance (discussed in Section 11.2.4 of this document) were estimated for facilities that were determined to have treatment equivalent to an option currently in use. EPA's methodology for crediting facilities for existing treatment on site is discussed below.

Table 11-3

Operation and Maintenance Unit Costs Used by the Cost Model

Activities			
Activity	**Cost (1993 $s)**	**Module(s)**	**Reference**
Compliance monitoring lab fee	$20,200 per year	Compliance Monitoring	(22)
Contract hauling of bulk wastewater	$537 per full load (5,000 gallons bulk liquid)	Contract Haul	(21)
Monitoring fee for contract hauled wastewater	$200 per year	Contract Haul	(21)
Nonhazardous dewatered sludge disposal	$2.12 per cubic foot	Sludge Dewatering	(17)
Treatment fee for contract hauled wastewater	$0.35 per gallon	Contract Haul	(21)
Chemicals			
Chemical	**Cost (1993 $s)**	**Module(s)**	**Reference**
Anionic polymer	$2.48 per pound	DAF, Chemical Precipitation	(14, 16)
Cationic polymer	$1.34 per pound	DAF, Chemical Precipitation	(14, 16)
Ferric chloride	$0.49 per pound	DAF	(14)
Hydrated lime	$67.50 per ton	Chemical Precipitation	(16)
Perlite	$0.63 per pound	DAF	(14)
Quick lime	$45 per ton	Chemical Precipitation	(16)
Sodium hydroxide (50%)	$0.138 per pound	pH Adjustment	(19)
Sulfuric acid (93%)	$75 per ton	DAF, pH Adjustment	(14, 19)
Equipment			
Equipment	**Cost (1993 $s)**	**Module(s)**	**Reference**
Agitator maintenance and materials cost	3% of the direct capital cost of agitator per year	Equalization, pH Adjustment	(11, 19)
Air-operated sludge pump maintenance and materials cost	1% of the direct capital cost of pump per year	Pump	(8)
Building maintenance and materials cost	3.5% of the direct capital cost of the building per year	Building	(10, 20)
Chemical feed system materials maintenance and cost (0.01 to 3,200 lb/hr)	Cost per year = $201.99 + 0.1329 \times C - (3 \times 10^{-5}) \times C^2$ (C = Capacity in pounds per hour)	DAF, pH Adjustment	(14, 19)

Table 11-3 (Continued)

Equipment (Continued)			
Equipment	**Cost (1993 $s)**	**Module(s)**	**Reference**
Compliance monitoring materials cost	$248.83 per year	Compliance Monitoring	(22)
Continuous/batch chemical precipitation treatment unit maintenance and materials cost	3% of the direct capital cost of the chemical precipitation unit per year	Chemical Precipitation	(16)
Continuous DAF treatment unit maintenance and materials cost	1% of the direct capital cost of the DAF unit per year	DAF	(13, 14)
Positive displacement or centrifugal pump maintenance and materials cost	1% of the direct capital cost of pump per year	Pump	(8)
Reaction tank maintenance and materials cost	3% of direct capital cost of tank per year	Equalization, pH Adjustment	(11, 19)
Replacement pH probe	$276.79 per probe	pH Adjustment	(19)
Replacement plates for 48-inch and 60-inch shaker screen units	$410.22 to $608.25 per plate replaced every two years	Screen	(9)
Replacement porous collection bags for shaker screen lint	$200 per year	Screen	(9)
Replacement screens for 48-inch and 60-inch shaker screen units	$174.46 to $257.45 per screen replaced twice per year	Screen	(9)
Replacement sliders for 48-inch and 60-inch shaker screen units	$94.30 to $141.45 per screen	Screen	(9)
Storage tank maintenance and materials cost	1% of direct capital cost of tank per year	Screen	(9)
Wastewater storage tank maintenance and materials cost	5% of direct capital cost of tank per year	Contract haul	(21)
Optimization Cost Allowance			
Activity	**(Cost (1993 $s)**	**Module(s)**	**Reference**
Increased DAF chemical usage	$406 to $15,519 per year	---	(6)
Increased chemical precipitation chemical usage	$518 to $14,070 per year	---	(6)
Increased sludge disposal	$150 to $4,881 per year	---	(6)
General Costs			
Item	**(Cost (1993 $s)**	**Module(s)**	**Reference**
O&M labor rate	$13.77 per hour	All	(4)
Electricity usage fee	$0.049 per kilowatt-hour	All	(5)

DAF - Dissolved air flotation.

- Stream splitting - EPA gave stream-splitting credit to facilities that indicated that a portion of their wastewater was segregated for treatment, regardless of the specific method used to segregate the stream.

- Mechanical fine screen (i.e., a shaker or rotary screen) - EPA gave full screen credit to facilities that had screens in place that treated at least a portion of the facility's wastewater under the assumption that the screen was adequate to treat a larger amount of wastewater for the purposes of the IL options.

- Adequate equalization capacity - EPA gave facilities the following credits: full credit for mixed tanks having a minimum residence time (two hours); partial credit for unmixed tanks having at least the minimum residence time (costs for agitators were added); no credit to facilities having tanks with less than the minimum residence time; and full credit for an agitator if facilities indicated that they had one on site.

- Key treatment units (i.e., DAF, or chemical precipitation) - EPA gave facilities full option credit if they indicated that they had the respective key treatment unit in place. EPA used certain assumptions and specific criteria to determine the presence of the key treatment units; Section 11.3 of this document discusses these assumptions and criteria further.

- DAF treatment unit (applicable to the CP-IL option) - EPA estimated a salvage value for DAF units currently in place at industrial laundries, based on the reported age of the equipment and estimated capital cost. EPA also estimated the annual DAF O&M cost for each facility. The salvage value and annual cost for the DAF unit were then credited toward the capital and annual costs, respectively, that were calculated for the chemical precipitation unit as part of the costs for compliance under the CP-IL regulatory option.

  A lower indirect capital cost factor was also applied toward the installation of the chemical precipitation unit at these facilities. EPA assumed that facilities that are replacing an existing piece of equipment would not incur some of the site preparation and auxiliary equipment (e.g., piping and electrical hookups) costs that are included in the indirect cost factor, as described in Section 11.2.2 of this document. Section 11.3 further discusses this treatment-in-place cost estimate. Table 11-4 presents the modified components of the total capital investment for facilities with DAF treatment.

Table 11-4

Components of Total Capital Investment Estimated for DAF Facilities in the CP-IL Regulatory Option

Number	Component	Cost
1	Chemical precipitation equipment capital costs including required accessories, installation, delivery, instrumentation, and pumping	Direct Capital Cost
2	Piping	2% of the Direct Capital Cost; assumed a chemical precipitation unit will use existing piping, but some adjustment may be required
3	Electrical	Not included; assumed chemical precipitation unit will use existing connections
4	Engineering/administrative/legal services	10% of the direct capital cost
5	Total Plant Cost	1.12 x Direct Capital Cost (Sum of Components 1 through 4)
6	Site Work	Not included, assumed no additional site work will be required in replacing DAF unit with chemical precipitation unit
7	Contingency	13% of the Total Plant Cost
8	Contractor's Fee	3.25% of the Total Plant Cost; assumed an average fee (rather than a maximum fee, as in Table 11-2) since replacement of an existing treatment unit is less complicated than installation of a new treatment system
9	**Total Capital Investment**	**1.30 x Direct Capital Cost (Sum of Components 5 through 8)**

- Sludge dewatering devices - EPA gave facilities full sludge dewatering credit if they indicated that their sludge dewatering device treated sludge generated by either DAF or chemical precipitation; facilities that indicated that they treat their sludge with a conditioner received full sludge conditioning credit in the DAF-IL regulatory option.

- pH adjustment (applicable to the CP-IL regulatory option only) - EPA gave facilities the following credits: full credit for pH adjustment with no minimum residence time required if they indicated that they have a mixed tank with chemical addition; and partial credit for a tank, an agitator, an acid/base feed system, or some combination of these three components (these facilities were costed only for the missing component(s)).

- Space inside of the facility - EPA costed facilities for a building of adequate size to house the regulatory option equipment only if they indicated that they did not currently have space inside; no partial credit was given.

- Monitoring costs - EPA gave facilities either full or partial credit based on whether the facilities reported that they monitor their wastewater effluent.

11.2.4 Optimization Cost Allowance

In the costing performed for the proposed rule, EPA assumed that facilities with treatment equipment in place equivalent to one of the regulatory options could meet the proposed pretreatment standards without any additional costs other than compliance monitoring costs. Based on comments received on the proposed rule, EPA decided to provide an optimization cost allowance for facilities with full option treatment-in-place credit to allow for the possibility that those facilities may need to make minor capital improvements to the treatment system in order to meet the proposed pretreatment standards. Facilities may incur an increased annual O&M cost for optimizing system performance, as well.

EPA estimated the cost allowance for these facilities based on assumptions about the most common types of upgrades that facilities would need to implement to improve the performance of existing treatment systems. The assumptions are based on EPA's observations from over 35 site visits and nine sampling episodes at industrial laundries, as well as numerous conversations with industrial laundry personnel throughout the development of a regulation. Although EPA used specific cost components to develop the cost allowance, the cost is intended to be an allowance for any type of upgrade that an individual facility would identify as necessary to optimize treatment system performance.

EPA's capital cost allowance is based on: 1) increasing the equalization capacity; 2) additional operator training; and 3) the cost of an engineering consultant to provide advice on optimizing treatment system performance. EPA's estimated annual cost allowance is based on 1) increased chemical addition and 2) increased sludge disposal costs. The cost allowances were

based on the average of the costs calculated for chemical precipitation and DAF and applied to all facilities with either technology in place (6).

11.3 Cost Modeling

11.3.1 Cost Model Driver

As described earlier, EPA developed a computerized design and cost model to estimate compliance costs and pollutant loadings for the industrial laundries technology control options, taking into account each facility's treatment in place. The cost model was programmed with modules that allowed the user to specify various combinations of technologies and practices to be costed as required by each technology control option. In the context of the industrial laundries cost estimation effort, "cost model" refers to the overall computer program and "module" refers to a computer subroutine that generates costs and pollutant loadings for a specific technology or practice (e.g., chemical precipitation, contract hauling). Some modules were adapted from cost models used for previous EPA rulemaking efforts, such as MP&M, while others were developed specifically for this rulemaking.

EPA developed cost modules for the wastewater treatment technologies and practices, as well as auxiliary components of these technologies (e.g., pumps, buildings) included in the industrial laundries technology control options. Chapter 8 of this document discusses in greater detail the specific combinations of these technologies into the technology control options. As stated previously, this chapter discusses the estimation of compliance costs for the two regulatory options, DAF-IL and CP-IL. The technologies, components, and practices that compose the regulatory options are listed below:

- Wastewater and sludge transfer pumps;
- Buildings;
- Stream splitting;
- Mechanical screening;
- Equalization;
- Dissolved air flotation;
- Chemical precipitation;
- Sludge dewatering;
- pH adjustment; and
- Contract hauling of untreated wastewater.

As discussed in Section 11.2.1, EPA developed a cost model driver to organize the treatment technology modules and track the costs for the entire industry. The cost model driver performs the following functions, as applicable, for each technology designed for a facility:

- Locates and opens all necessary input data files;

- Stores input data entered by the user of the cost model;

- Opens and runs each of the technology modules in the appropriate order for each option;

- Calculates and tracks the following types of information generated by each technology module:

  – Total direct capital costs;
  – Total direct annual costs;
  – Electricity used and associated cost;
  – Sludge generation and associated disposal costs;
  – Effluent flow rate; and
  – Effluent pollutant concentrations; and

- Sends tracked costs by regulatory option to a storage file that may be printed or maintained in electronic form for further manipulation.

The following sections list the major technologies included as modules within the cost model and describe the major assumptions and costing methodology used for each.

11.3.2 Stream Splitting

EPA estimated costs for a facility to install and operate a means of segregating wastewater streams generated from washing specific items. Stream splitting was costed in order for each facility to direct all wastewater generated from the washing of industrial textile items to the wastewater treatment system, while allowing the facility to discharge wastewater generated from the washing of nonindustrial textile items (i.e., linen items) to the sewer without treatment. The costs generally comprised the retrofitting of existing washers to include dual valves for discharging wastewater to separate conduits and the costs associated with operating and maintaining these valves. The costs also included a means to divide the facility's existing trench and sump system and direct the wastewater flows to separate locations.

Capital and annual costs for the following equipment were included in the stream-splitting module:

- Retrofitting of existing washers with dual valves and associated control equipment; and

- Piping and pumping of wastewater to be treated to the treatment system.

Direct capital costs were dependent upon the required size for the dual-valve fitting, which was determined based on the facility-reported size of washer(s) and assumptions regarding the number of washers to be retrofitted. EPA assumed that no additional annual costs would be associated with the operation of dual-valves on existing machines. It was assumed that all facilities had in place a trench and sump system, since that is the method used in industrial laundries to transport process wastewater to the sewer. If a facility did not report that it segregates its wastewater, costs were calculated for the required sized valve(s), 200 feet of PVC

piping, and other connections necessary to direct the wastewater to be treated to the first unit of the treatment system (i.e., the equalization tank). If a facility indicated that it segregates its wastewater, the cost model calculated a zero capital and annual cost for stream splitting for that facility.

It was estimated by the equipment vendor that it would take one worker three to four days to install the valves, pipes, and pumps for the stream-splitting process. It was also estimated that another 30 minutes would be required for each washer formula to be programmed (7). Based on site visits, EPA assumed that a typical washer controller contains 15 formulae, amounting to 7.5 hours of programming time per washer. These estimates are included as part of the installation labor cost for stream splitting.

The cost for an air-operated sludge pump to transfer the industrial laundry wastewater to the equalization tank, including the necessary installation and operating labor, was also included as part of the stream-splitting module. If a facility indicated that it was transferring each segregated stream to a treatment unit , it was given credit for having the pump in place. Refer to Section 11.3.3 below for a more detailed description of the pumps cost module.

11.3.3 Pumps

EPA estimated costs for a facility to install and operate pumps, as necessary, to transfer wastewater and sludge from one treatment unit to another within the regulatory control options. A cost for an air-operated positive displacement pump was calculated in situations where the wastewater was presumed to contain a high amount of solids (e.g., wastewater discharged directly from washers and sludge streams). Where wastewater was to be transferred from one treatment unit to another, a cost for a positive displacement pump was calculated for flows up to 27 gpm and a centrifugal pump was costed for flows greater than 27 gpm.

Direct capital and annual costs were calculated based on the required size of each type of transfer pump. Both types of pumps were sized based on the required flow rate calculated by the cost model using mass balances around each treatment unit. EPA developed the convention that costs calculated for each treatment unit module would include the capital and annual costs for an effluent pump. Exceptions to this convention occur in the cost for the shaker screen that included both an influent and effluent pump. Also, a cost was not calculated for an effluent pump in situations where the treatment unit is the last in the option's treatment train (e.g., the DAF or the pH adjustment modules), because it was assumed that the wastewater can flow by gravity into the sewer.

Annual costs included O&M material costs and energy costs. No energy costs were associated with the air-operated positive displacement pumps because EPA assumed that all industrial laundries currently have an air compressor and supply line available to operate the positive displacement pump without incurring any additional costs.

The pump module includes an estimate of installation labor costs, based on the size and type of pump being costed. All labor estimates are based on information obtained from past effluent guidelines costing efforts, as well as engineering judgement. Installation is

estimated to take one worker from 1.5 to 42 hours for various types of positive displacement and centrifugal pumps, up to a 750-gpm capacity (8).

EPA assumed that facilities that reported having two sequential treatment units in place also have the necessary transfer pump in between, and therefore calculated zero capital and annual costs for the transfer pump. All other facilities that did not report having a treatment unit located downstream from the unit costed in the module received capital and annual costs for an effluent transfer pump. For example, a facility that reported having an equalization tank followed by an oil-water separation tank in place received no costs for an effluent pump in the equalization module. However, a facility that reported an equalization tank followed by discharge to the sewer received both capital and annual costs for an equalization tank effluent pump, sized sufficiently to transfer wastewater to the next required treatment unit in the option.

11.3.4 Screening

Mechanical screens are commonly used at industrial laundries to remove lint and other solid constituents from wastewater. Therefore, EPA estimated costs for mechanical screening of a facility's untreated wastewater from the washing of nonindustrial textile items prior to recombination with treated wastewater from the washing of industrial textile items. The module calculates the costs necessary to pump the wastewater to be screened from the sump to the screen; mechanically remove lint suspended in the wastewater; discharge the lint into a collection vessel (e.g., a drum or bag); discharge the screened wastewater into a collection tank; and pump the screened wastewater from the collection tank to the next unit in the option's treatment train.

Capital and annual costs for the following equipment were included in the screening module:

- An influent positive displacement pump;
- A shaker screen;
- A screen effluent holding tank; and
- A centrifugal effluent pump.

Annual costs included O&M material costs, energy costs, and lint disposal costs. The disposal costs were based on the average nonhazardous disposal costs reported by facilities for disposing of collected lint from screens. Both the direct capital and annual costs for screens were based on the required size of the screen, which was determined based on the input flow rate(s) used by the cost model. Based on sampling data, EPA assumed that the flow rate and pollutant loads are unaffected by the screening operation. Therefore, the screen module calculated the flow rate and pollutant loads in the effluent from the screen to be equal to those in the influent.

The screen module includes an estimate of installation labor costs for the screen unit and effluent holding tank. All labor estimates are based on information obtained from equipment vendors, as well as engineering judgement. Installation of the shaker screen unit and holding tank is estimated to take one worker four hours and seven hours, respectively (9).

The annual O&M materials cost associated with the holding tank was not calculated as a separate item, but was included as part of the estimating factor for the total annual cost, based on estimates used in past effluent guidelines (9). The annual O&M materials cost was assumed to be half of the total annual cost for the holding tank (i.e., one percent of the direct capital cost), based on engineering judgement (10).

A cost was calculated for a screen if a facility did not report that it had a mechanical screen in place. Facilities reporting any type of mechanical screening (e.g., shaker screen, rotary screen) in place received zero capital and annual costs for the screen. EPA assumed that a facility reporting that it screens any portion of its wastewater would also be able to screen the wastewater generated from washing its industrial textile items and, therefore, EPA calculated zero capital and annual costs for the screen.

Costs for a maximum of two wastewater pumps to transfer the wastewater to the screen and from the holding tank to the next treatment unit, including the necessary installation labor, were also included as part of the shaker screen module. If a facility indicated that it was screening at least a portion of its wastewater, it was given credit for having the influent pump. If it also indicated that it was transferring the screened water to another treatment unit, it was also given credit for the effluent pump. Refer to Section 11.3.3 of this document for a more detailed description of the pumps cost module.

11.3.5 Equalization

EPA estimated costs for the equalization of a facility's industrial laundry wastewater. The equalization module calculates the costs necessary to equalize the wastewater prior to treatment in a mixed tank sized to absorb fluctuations in flow, pollutant load, and pH and to pump the equalized wastewater to the next unit in the option's treatment train.

Capital and annual costs for the following equipment were included in the equalization module:

- A closed tank;
- A mixer(s); and
- A centrifugal effluent pump.

Annual costs included O&M material costs and energy costs. Both the direct capital and annual costs for the equalization tanks were based on the required size of the tank. The tanks were designed to have a four-hour residence time, based on the median reported residence time for equalization tanks in the detailed questionnaire. The required size of the tanks was therefore calculated from this design parameter and the influent flow rate for each facility. The required mixer size, as well as the number of mixers, was calculated based on the size of the tank using the design parameter of 0.5 mixer hp per 1,000 gallons of tank capacity (11). EPA assumed that the pollutant loads are unaffected by equalization and, therefore, the module calculated the pollutant loads in the effluent from the equalization tank to be equivalent to those in the influent.

The equalization module includes an estimate of installation labor costs for the equalization tank and mixer. All labor estimates are based on information obtained from equipment vendors, as well as past effluent guidelines costing efforts and engineering judgement. Installation for the equalization tank and mixer is estimated to take five workers eight hours and one worker 2.4 hours, respectively (11).

The annual O&M materials cost for the equalization tank and mixer is not calculated as a separate item, but is included as part of the estimating factor for the annual cost, based on estimates used in past effluent guidelines efforts (11). The annual O&M materials costs associated with the equalization tank and mixer were assumed to be more than half of the total annual cost for each (i.e., three percent of the direct capital costs), based on engineering judgement (10).

A cost was calculated for an equalization tank if a facility did not report that it had a large enough tank in place. Facilities that had tanks with a minimum residence time of two hours were given full credit for the equalization tank, and the module calculated zero capital and annual costs for the tank. Likewise, facilities that reported having a mixer on site were given full credit for the mixer.

The costs for the effluent wastewater pump to transfer the wastewater to the next treatment unit, including the necessary installation and operating labor, were also included as part of the equalization module. If a facility indicated that it was transferring the stream to another treatment unit, it was given credit for having the effluent pump in place. Refer to Section 11.3.3 of this document for a more detailed description of the pumps cost module.

11.3.6 Dissolved Air Flotation

EPA estimated costs for DAF treatment of wastewater generated from the washing of industrial textile items in the DAF-IL regulatory option. The DAF module calculates the costs necessary to treat the wastewater with sulfuric acid, ferric chloride, and cationic and anionic polymers to form an agglomerated floc containing pollutants; float the floc to the surface of the unit; remove the floating floc from the wastewater; pump the collected floc to a sludge conditioning tank and treat it with perlite; pump the conditioned sludge to sludge dewatering; and discharge the DAF-treated wastewater to the sewer.

Capital and annual costs for the following equipment were included in the DAF module:

- An acid-feed system;
- A DAF unit, including three chemical addition units, pH controller, chemical premix tanks, and positive displacement sludge transfer pump; and
- An open sludge conditioning tank with a mixer.

Annual costs included O&M material costs, energy costs, and raw material (e.g., sulfuric acid, ferric chloride, cationic polymer, anionic polymer, and perlite) costs. Both the direct capital and annual costs for the DAF unit were based on the required capacity of the unit to treat a continuous flow of wastewater. The required capacity of the unit was calculated based on the influent flow rate(s) in gallons per minute of flow. The chemical addition rates were determined based on average reported amounts of chemical per gallon of wastewater treated. The following chemical addition rates were used by the DAF cost module:

Chemical	Gallons of Chemical per 10,000 Gallons of Industrial Laundry Wastewater Flow
Sulfuric acid	0.8
Ferric chloride	0.9
Cationic polymer	2
Anionic polymer	0.07
Perlite	0.25 pounds per pound of sludge collected from the DAF unit on a dry-solids basis

The recommended amount of perlite added per pound of DAF sludge was provided by a chemical vendor. The DAF module calculated pollutant loads in the treated wastewater effluent using target average concentrations calculated from DAF system sampling and DMQ data. The module calculated a sludge flow rate based on a median sludge generation rate (0.031 pounds of sludge per gallon of wastewater) calculated from data provided by facilities using DAF (12). The module also included the effluent flow rate based on a mass balance around the unit using the influent flow rates of wastewater and chemicals, as well as the amount of sludge removed from the wastewater though DAF treatment.

The DAF module includes an estimate of installation labor costs for the DAF unit. All labor estimates are based on information obtained from equipment vendors, as well as past effluent guidelines costing efforts and engineering judgement. Installation labor for the DAF system is estimated by a vendor to be included in an installation cost factor of six percent of the purchased cost (13).

The annual O&M materials cost for the DAF unit was estimated to be included as part of the total maintenance cost factor of the DAF system capital cost (13). The O&M materials cost associated with the DAF unit was assumed to be half of the total maintenance cost (i.e., one percent of the direct capital cost), based on engineering judgement (10).

The DAF module also includes installation labor costs for the chemical feed system. The installation labor for the chemical feed system was calculated with the total capital cost from the cost curves obtained from past effluent guidelines costing efforts. The labor hours were not broken out as separate items (14).

A cost was calculated for a DAF unit if a facility did not report that it treated its wastewater with DAF. Facilities that had DAF units of sufficient capacity were given full option credit. For example, a facility that reported treating its total wastewater flow with DAF was

given full credit for the DAF-IL option and received only monitoring costs and an optimization cost allowance to comply with a rule under this option. Facilities that reported operating an induced air flotation (IAF) unit of sufficient capacity were also given full option credit. However, a facility that reported treating a portion of its wastewater was evaluated as to whether it had sufficient DAF capacity to treat the industrial laundry wastewater. For example, a facility reported that it treats 35 percent of its wastewater with DAF; 50 percent of its wastewater is industrial laundry wastewater. Under the DAF-IL option, it needs to treat 15 percent more of its wastewater to comply with the option requirements. The facility received capital and annual costs for a DAF unit sized to treat 15 percent of its wastewater flow. This additional unit together with the unit in place can treat the 50 percent industrial laundry wastewater flow.

Based on final long-term average concentrations for chemical precipitation and DAF gathered from sampling and DMQ data, chemical precipitation achieves lower pollutant concentrations in the treated wastewater than DAF. Likewise, when operated properly, ultrafiltration and microfiltration are considered to provide greater pollutant removals than DAF (15). Therefore, facilities with chemical precipitation, ultrafilters, or microfilters with sufficient capacity to treat the wastewater generated from washing industrial textile items received treatment-in-place credit for having a complete DAF system in the DAF-IL option. However, facilities with these technologies that do not have sufficient capacity received capital and annual costs for a DAF unit sized to treat their industrial laundry wastewater.

11.3.7 Chemical Precipitation

EPA estimated costs for chemical precipitation treatment of wastewater generated from washing industrial textile items in the CP-IL regulatory option. The chemical precipitation module calculates the costs necessary to treat the wastewater with lime and cationic and anionic polymers to precipitate and agglomerate pollutants from the wastewater; settle the precipitate to the bottom of the treatment tank in batch systems or continuously remove the precipitate with inclined plates in continuous systems; and pump the chemical precipitation-treated wastewater from the chemical precipitation unit to the next unit in the option's treatment train.

Capital and annual costs for the following equipment were included in the batch chemical precipitation system module:

- A mixed batch treatment tank;
- Three chemical addition units with pH controller;
- A positive displacement sludge transfer pump;
- A sludge holding tank; and
- A centrifugal effluent pump.

Capital and annual costs for the following equipment were included in the continuous chemical precipitation system module:

- A continuous chemical precipitation unit (including three chemical addition units, pH controller, chemical premix tanks and inclined plate settlers);

- A positive displacement sludge transfer pump;
- A sludge holding tank; and
- A centrifugal effluent pump.

Annual costs included O&M material costs, energy costs, and raw material (e.g., lime, cationic polymer, and anionic polymer) costs. Both the direct capital and annual costs were based on the required capacity of the unit to treat either a batch of wastewater or a continuous flow of wastewater, which was calculated based on the influent flow rate(s). Costs were calculated for batch units for facilities with less than 2,500 gallons per day of flow and continuous units for facilities with flows greater than 2,500 gallons per day. The chemical addition rates used by the module were determined based on average amounts of chemical per gallon of wastewater treated that were reported in responses to the detailed questionnaire and by sampled facilities. The following chemical addition rates were used by the chemical precipitation cost module:

Chemical	Amount of Chemical Added per 10,000 Gallons of Industrial Laundry Wastewater Flow
Lime	100 pounds
Cationic Polymer	2 gallons
Anionic Polymer	0.07 gallon

The module calculated pollutant loads in the treated wastewater effluent using target average concentrations calculated from chemical precipitation system sampling and DMQ data. The module calculated a sludge flow rate based on a median sludge generation rate (0.039 pounds of sludge per gallon of wastewater) calculated from data provided by facilities using chemical precipitation (12). The module also calculated the effluent flow rate based on a mass balance around the unit using the influent flow rates of wastewater and chemicals, as well as the amount of solids removed from the wastewater though chemical precipitation treatment.

The chemical precipitation module includes an estimate of installation labor costs for the batch and continuous units. All labor estimates are based on information obtained from an equipment vendor, as well as past effluent guidelines costing efforts and engineering judgement. Installation for the chemical precipitation systems is estimated by the vendor to take one worker 40 hours for the smallest system and two workers 80 hours for the largest system (16).

The annual O&M materials cost for the chemical precipitation unit was estimated to be included as part of the estimating factor for the total annual cost, based on past effluent guidelines costing efforts (16). The annual O&M materials cost was assumed to be more than half of the total annual cost for the chemical precipitation unit (i.e., three percent of the chemical precipitation system capital cost), based on engineering judgement (10).

A cost was calculated for a chemical precipitation unit if a facility did not report that it treated its wastewater with chemical precipitation. Facilities that had chemical precipitation units of sufficient capacity were given full option credit. For example, a facility that reported treating its total wastewater flow with chemical precipitation was given full credit for the DAF-IL and CP-IL regulatory options and received only monitoring costs and a nominal cost allowance to comply with a rule under these options. However, a facility that reported treating a portion of its wastewater with continuous chemical precipitation was evaluated as to whether it had sufficient chemical precipitation capacity to treat the wastewater according to each option, similar to the example presented in Section 11.3.6 for the DAF technology. Most facilities that have a batch chemical precipitation unit in place have a significant amount of untreated wastewater that would require treatment under the IL options, such that a continuous chemical precipitation unit would be required in addition to the batch unit in place. EPA assumed that these facilities would not continue to operate both a batch and continuous chemical precipitation unit simultaneously. Instead, these facilities received no credit toward the CP-IL option and received capital and annual costs to install and operate a new chemical precipitation system appropriately sized to treat the facility's industrial laundry wastewater.

The costs for the effluent wastewater pump to transfer the wastewater to the next treatment unit, including the necessary installation and operating labor, were also included as part of the chemical precipitation module. If a facility indicated that it was currently transferring the stream to another treatment unit, it was given credit for having the effluent pump in place. Refer to Section 11.3.3 of this document for a more detailed description of the pumps cost module.

When operated properly, ultrafiltration and microfiltration are considered to provide greater pollutant removals than chemical precipitation (15). Therefore, facilities with ultrafilters or microfilters of sufficient capacity to treat the wastewater generated from washing industrial textile items received treatment-in-place credit for having a complete chemical precipitation system in the CP-IL option.

Capital and annual costs for a complete chemical precipitation unit were calculated for facilities with DAF systems in the CP-IL option. These facilities received a salvage value credit toward the CP-IL capital costs for replacement of their existing DAF unit. The salvage value was estimated based on the reported age of the unit and the estimated capital cost. It was also assumed that facilities replacing an existing unit would not incur as many indirect capital costs as facilities installing a new treatment system. Therefore, a lower indirect capital cost factor was applied to the estimated capital cost for the chemical precipitation unit. Table 11-4 presents the lower indirect capital cost factors applied in the CP-IL option for the facilities with DAF units in place. An annual cost credit was also applied to the CP-IL annual cost for these facilities. The capital and annual O&M costs for the DAF unit were estimated using the methodology described in Section 11.3.6 of this document for the reported amount of flow treated by the existing DAF unit.

11.3.8 Sludge Dewatering

EPA estimated costs for facilities to dewater the sludge generated by either a DAF or chemical precipitation unit. The sludge dewatering module calculates the costs necessary to pump the sludge through a filter press; remove and dispose of the dewatered cake from the filter; and return the filtrate to the treatment system sump.

Capital and annual costs for the following equipment were included in the sludge dewatering system module:

- A plate and frame filter press system with accessories such as a plate shifter, platform, and cake disposal dumpsters; and
- A positive displacement influent sludge pump.

Annual costs included O&M material costs, energy costs, and dewatered cake disposal cost. The capital and annual costs associated with the filter press were based on the required size of the press, which was calculated based on the influent sludge flow rate, solids concentration, and the dewatered cake solids concentration. EPA based solids concentrations for both the sludge and dewatered cake generated by each technology on filter press vendor test data and facility responses to the detailed questionnaire. The filter press was sized based on the volume of dewatered cake that is generated from the sludge stream. The number of batches per day of dewatering was optimized by the module to minimize the size of the filter press, where possible. The volume of cake and the filtrate flow rate were calculated by the sludge dewatering module from a mass balance using the sludge flow rate and the sludge and cake solids concentrations. The additional costs for the filter press system accessories were dependent upon the required size of the filter press. The dewatered cake disposal costs were based on the average reported nonhazardous dewatered cake disposal costs per volume of cake and the module-calculated volume of dewatered cake per year for each facility. The capital and annual costs for the influent sludge pump were calculated based on the required capacity of the pump, which was based on the sludge influent flow rate.

The module is designed to return the filtrate to the facility's trench and sump system, based on typical operating procedures reported by industrial laundries. EPA assumed that the filtrate would flow by gravity from the filter press to the trench and/or sump and therefore would not require any additional collection tanks or transfer pumps. EPA assumed that the returning filtrate would not affect the raw pollutant concentrations in the untreated wastewater because the filtrate volume represents only a small percentage of the volume of the sump. The cost model adjusts the influent flow rate by a factor to account for this slight increase in influent flow rate.

The sludge dewatering module includes an estimate of installation labor costs for the filter press unit. All labor estimates are based on information obtained from an equipment vendor and engineering judgement. Installation labor for the filter press is estimated by the vendor to be included in an installation cost factor of 75 percent of the purchased cost (17).

A facility received full sludge dewatering credit if it reported having a sludge dewatering device in place to dewater sludge from a system similar to DAF or chemical precipitation. For example, facilities that reported operating a sludge dewatering device to dewater sludge generated by gravity settling were not given credit for the system. EPA assumed that such a system would not have sufficient capacity to treat the amount of sludge generated by DAF or chemical precipitation units.

The costs for the influent sludge pump to transfer the sludge into and through the filter press, including the necessary installation labor, were also included as part of the sludge dewatering module. If a facility indicated that they were dewatering an appropriate amount of sludge, they were given credit for having the influent pump in place. Refer to Section 11.3.3 of this document for a more detailed description of the pumps cost module.

11.3.9 pH Adjustment

EPA estimated costs for facilities to adjust the pH of the effluent wastewater generated by the CP-IL regulatory option. The pH adjustment module calculates the costs necessary to combine untreated linen supply wastewater and treated industrial laundry wastewater; monitor the pH of the effluent stream; and add necessary chemicals to a mixed tank to adjust the pH of the final effluent stream to within a specified range.

Capital and annual costs for the following equipment were included in the pH adjustment module:

- An open, mixed tank;
- A pH controller; and
- A chemical addition system.

Annual costs included O&M material costs, energy cost, and raw material (e.g., sulfuric acid or sodium hydroxide) costs. The capital and annual costs associated with the chemical addition system were based on the required size of the system, which was calculated based on the total influent flow rate and an estimation of the amount of acid or caustic that was required to adjust the final effluent pH to within a specific range. EPA assumed chemical precipitation-treated wastewater to have a pH of 12, based on the average pH observed during sampling episodes. EPA also assumed that untreated light industrial laundry wastewater had a pH of 10, based on sampling data. Based on existing industrial laundry limitations on pH at the point of discharge, EPA assumes that the final effluent pH must be between 5 and 10 upon discharge. Therefore, according to these assumptions, the wastewater generated by the CP-IL regulatory option requires pH adjustment prior to discharge in order for facilities to continue to meet their existing pH limits. EPA assumed DAF-treated wastewater to have a pH of 9, based on sampling data. Since the wastewater generated by the DAF-IL regulatory option is already within the assumed pH limits, pH adjustment costs are not calculated for this option.

The capital and annual costs associated with the pH adjustment tank were based on the required size of the tank, which was calculated, based on the influent flow rate, to have a three-minute residence time for the wastewater. This is the required residence time to achieve a

target pH in a mixed tank with liquid chemical addition (18). The mixer was also costed based on its required size, which was determined based on the size of the pH adjustment tank.

The pH adjustment module calculates the resulting pollutant loads from the combination of the treated and untreated streams. EPA assumed that pH adjustment would not affect the pollutant concentrations in the final effluent. The pH adjustment module calculated the final pollutant loads to be equivalent to those in the pH adjustment influent.

The pH adjustment module includes an estimate of installation labor costs for the pH adjustment tank and mixer. All labor estimates are based on information obtained from equipment vendors, as well as past effluent guidelines costing efforts and engineering judgement. Installation for the pH adjustment tank and mixer is estimated to take one worker seven hours and 2.4 hours, respectively (19).

The annual O&M materials cost for the pH adjustment tank and mixer was not calculated as a separate item, but included as part of the estimating factor for the annual cost, based on estimates used in past effluent guidelines efforts (19). The annual O&M materials costs associated with the pH adjustment tank and mixer were assumed to be more than half of the total annual cost for each (i.e., three percent of the direct capital costs), based on engineering judgement (10).

The pH adjustment module also includes installation labor costs for the chemical feed system. The installation labor for the chemical feed system was included in the total capital cost used from past effluent guidelines costing efforts. The labor hours were not broken out as separate items (19).

A facility received full pH adjustment credit if it reported using some type of pH adjustment. Costs were estimated for facilities that reported having some of the components of the pH adjustment system to add the necessary parts to complete the system. Facilities did not have to meet a minimum residence time requirement and received treatment-in-place credit for any tank that was available to use for pH adjustment.

11.3.10 Treatment System Building

EPA estimated costs for facilities to construct and maintain a building to house the option treatment system using the building module. Capital and annual costs for the following equipment were included in the treatment system building:

- A concrete floor slab;
- A concrete curb around the building perimeter;
- A rectangular-shaped, pre-engineered steel frame building; and
- Utilities (plumbing, HVAC, and electricity).

Annual costs include costs for labor and materials for the yearly maintenance and repair of the building. These costs were estimated to be 3.5 percent of the direct capital cost (10). The capital cost associated with constructing the building was based on the required size of the

building. The square footage requirement of the building was determined for each regulatory option based on the equipment space requirements for a low, medium, and large flow of wastewater. Dimensions of various size equipment pieces were gathered from equipment specifications supplied by vendors. The building square footage was calculated by summing each of the option equipment space requirements, allowing for a five- to ten-foot clearance between equipment pieces and the building walls. The building space design, as well as the capital cost per square foot, were increased since proposal based on comments and industry supplied data (20).

EPA observed during site visits and sampling episodes that facilities were able to install wastewater treatment equipment in existing space either inside the facility or on their existing property. Based on this information, EPA assumed that a facility would not need to purchase additional land to install wastewater treatment equipment required by the technology control options.

A facility received full credit for a building in place if they reported having sufficient space available in their existing building. These facilities received zero capital and annual costs for a building. Facilities that reported having less than the option's required space or that did not report available space in the detailed questionnaire had costs estimated to construct and maintain a building.

11.3.11 Contract Haul In Lieu of Treatment On Site

EPA estimated the cost of contract hauling wastewater for off-site treatment at a treatment, storage, and disposal facility (TSDF) or a Centralized Waste Treater (CWT) facility. These estimated costs included the cost to transport the wastewater to the off-site treatment facility, and were compared to the cost of on-site treatment. For some industrial laundries with low flow rates, it was less expensive for a facility to contract for off-site treatment and disposal rather than treat the wastewater on site. EPA compared the annualized cost of transportation and off-site treatment with the annualized cost to treat that wastewater on site for each regulatory option.

Capital and annual costs for the following equipment were included in the contract-haul-in-lieu-of-treatment module:

- Stream splitting costs;
- An influent pump; and
- A wastewater storage tank.

Annual costs included O&M labor and material costs, energy cost, tank sampling costs, and transportation fees. The capital and annual costs for the influent pump and wastewater storage tank are dependent upon the required sizes for each. The tank and pump sizes were calculated by the contract haul module based on the flow rate of the wastewater to be collected and hauled. The tank was sized to hold up to one week of wastewater flow. The tank was also 50 percent overdesigned to accommodate fluctuations in facility production. The costs for transportation of the wastewater to the off-site industrial treatment facility were calculated based

on the number of trips per year required to haul the wastewater (assuming wastewater is hauled in one 5,000-gallon tank truck for each trip) and a cost per trip fee provided by a vendor. The cost per gallon to treat the wastewater, as well as the annual tank sampling fee, were also obtained from vendor information.

The contract haul module includes an estimate of installation and O&M labor costs for the wastewater storage tank and installation of stream-splitting components. All labor estimates are based on information obtained from equipment vendors, as well as past effluent guidelines costing efforts and engineering judgement. Installation labor for the storage tank is estimated by the vendor to take five workers eight hours. The annual O&M labor cost for the tank is not calculated as a separate item, but included as part of the estimating factor for the annual cost (i.e., five percent of the direct capital cost of the tank), based on estimates used by past effluent guidelines efforts. In addition, it was estimated that it would take one facility worker two hours to assist in pumping a 5,000-gallon load of wastewater into the tank truck (21). The installation labor required for the stream-splitting components is described in Section 11.3.2 of this document.

A facility received full tank and/or pump credits if it indicated that a sufficiently sized tank or pump was available on site to transfer and store the wastewater to be hauled. These facilities received zero capital and annual costs for the pump and tank. All facilities with or without equipment credits were costed for the annual sampling, transportation, and treatment costs.

The costs for the influent pump to transfer the wastewater into the storage tank, including the necessary installation and operating labor, were also included as part of the contract-haul-in-lieu-of-treatment module. Refer to Section 11.3.3 of this document for a more detailed description of the pumps cost module.

11.3.12 Compliance Monitoring

EPA calculated annual compliance monitoring costs for all industrial laundry facilities that discharge wastewater. These costs included laboratory costs to analyze one sample each of volatile and semivolatile organics and quantitative metals monthly, and to analyze TPH (measured as SGT-HEM)[1] four times per month. The costs for each type of analysis per sample were obtained from a laboratory contracted by EPA on past wastewater sampling efforts. Also included was the cost for glassware and containers needed to package the samples. These costs were obtained from data acquired during the EPA wastewater sampling efforts.

Facilities that reported in the detailed questionnaire that they monitored their wastewater were only costed for the analyses. Otherwise, facilities were costed for the analysis and materials required for the wastewater monitoring (22).

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[1]Silica gel treated-hexane extractable material (SGT-HEM) is measured by Method 1664 promulgated at 64 FR 26315; May 14, 1999. In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

11.4 Engineering Costs for the Regulatory Options

Table 11-5 summarizes estimated engineering costs for the regulatory options. Costs shown include capital and annual O&M (including energy usage) costs totaled for the 190 in-scope facilities extrapolated to represent the entire industrial laundries industry of 1,742 facilities. In addition, the capital and O&M costs are shown for the three exclusions incorporated into each of the regulatory options, as discussed in Chapter 8 of this document. Table 11-6 presents estimated engineering costs on an amortized yearly basis for the regulatory options. The methodology used to calculate the amortized annual costs from the capital and annual option costs calculated by the cost model is presented in the EA for the industrial laundries rulemaking (1).

EPA estimates that chemical precipitation's lower O&M costs make it less expensive to operate on an annualized basis than DAF. Because EPA's performance data show that chemical precipitation achieves better treatment than DAF, facilities operating a DAF unit were assumed to replace that unit with a chemical precipitation unit in order to comply with the CP-IL option pretreatment standards, as described in Section 11.2.3 of this document. In EPA's estimates, facilities that currently operate a DAF would realize an O&M cost savings for operating a chemical precipitation unit compared to operating the DAF unit. Therefore, EPA's estimated costs for the CP-IL option include the O&M cost credit for facilities that currently operate a DAF to replace the DAF unit with a chemical precipitation unit.

11.5 Compliance Costs Estimated from 1998 Facility Treatment-In-Place Data

In 1998, the industrial laundries trade associations (the Uniform and Textile Service Association (UTSA) and the Textile Rental Services Association (TRSA)) surveyed the industrial laundries to which EPA sent a detailed questionnaire in 1994. More information on the types of data collected by the UTSA/TRSA survey is provided in Section 3.7.2 of this document.. The purpose of the survey was to provide EPA with updated information on treatment technologies in place at industrial laundries. Of the 190 in-scope facilities, 162 responded to the UTSA/TRSA survey. Section 6.5.16 of this document summarizes the types of equipment that were reported in the survey.

At proposal (62 FR 66181; December 17, 1997), EPA estimated capital and annual O&M compliance costs based on treatment-in-place information reported in the detailed questionnaire for the 1993 operating year. For the Notice of Data Availability (NODA) (63 FR 71054; December 23, 1998); EPA compared the compliance costs estimated at proposal to the compliance costs estimated using the treatment-in-place information reported in the UTSA/TRSA survey for the 1998 operating year for the DAF-IL and CP-IL regulatory options with the 1 Million/255 K exclusion. EPA's methodology and the results of the comparison are discussed below.

EPA compared the treatment system description contained in the UTSA/TRSA survey to the treatment system components reported in the detailed questionnaire for each

Table 11-5

Summary of Engineering Costs for the Regulatory Options

Option	Capital Cost (Million 1993 $s)	O&M Cost (Million 1993 $s per Year)
Capital and Annual Costs for All Industrial Laundries[1]		
CP-IL	544	124
DAF-IL	451	150
Capital and Annual Costs with the 1 Million/255 K Exclusion[2]		
CP-IL	515	117
DAF-IL	425	142
Capital and Annual Costs with the 3 Million/120 K Exclusion[3]		
CP-IL	395	89.1
DAF-IL	320	122
Capital and Annual Costs with the 5 Million/255 K Exclusion[4]		
CP-IL	242	52.9
DAF-IL	188	69.5

[1]The entire industrial laundries industry is estimated to consist of 1,742 facilities.
[2]There are 136 facilities processing less than 1,000,000 pounds of incoming laundry and less than 255,000 pounds of industrial towels annually that are excluded, leaving a total of 1,606 facilities.
[3]There are 518 facilities processing less than 3,000,000 pounds of incoming laundry and less than 120,000 pounds of industrial towels annually that are excluded (this exclusion also excludes all facilities excluded under the 1 Million/255 K exclusion, above), leaving a total of 1,224 facilities.
[4]There are 953 facilities processing less than 5,000,000 pounds of incoming laundry and less than 255,000 pounds of industrial towels annually that are excluded, leaving a total of 789 facilities.

Source: Output from the Industrial Laundries Design and Cost Model, February 15, 1999.

Table 11-6

Summary of Annualized Engineering Costs for the Regulatory Options

Option	Annualized Cost (Million 1993 $s per Year)
Annualized Post-Tax Cost for All Industrial Laundries[1]	
CP-IL	128
DAF-IL	137
Annualized Post-Tax Cost with the 1 Million/255 K Exclusion[2]	
CP-IL	121
DAF-IL	129
Annualized Post-Tax with the 3 Million/120 K Exclusion[3]	
CP-IL	90.8
DAF-IL	98.8
Annualized Post-Tax Cost with the 5 Million/255 K Exclusion[4]	
CP-IL	53.9
DAF-IL	60.0

[1]The entire industrial laundries industry is estimated to consist of 1,742 facilities.
[2]There are 136 facilities processing less than 1,000,000 pounds of incoming laundry and less than 255,000 pounds of industrial towels annually that are excluded, leaving a total of 1,606 facilities.
[3]There are 518 facilities processing less than 3,000,000 pounds of incoming laundry and less than 120,000 pounds of industrial towels annually that are excluded (this exclusion also excludes all facilities excluded under the 1 Million/255 K exclusion, above), leaving a total of 1,224 facilities.
[4]There are 953 facilities processing less than 5,000,000 pounds of incoming laundry and less than 255,000 pounds of industrial towels annually that are excluded, leaving a total of 789 facilities.

Source: Economic Assessment for the Final Action Regarding Pretreatment Standards for the Industrial Laundries Point Source Category.

facility. In the UTSA/TRSA survey, most facilities did not report the treatment system design parameters. To calculate the changes in the capital and annual O&M compliance costs, EPA made the following assumptions when reviewing the UTSA/TRSA survey data:

- EPA continued to use the flow and production data reported in the detailed questionnaire for all facilities.
- For facilities treating a portion of their wastewater that did not indicate the percentage of wastewater treated, EPA assumed that they are treating only a small portion of their total wastewater.
- For facilities using DAF, chemical precipitation, or chemical emulsion breaking treatment, EPA assumed that the facility is operating these systems in a manner equivalent to the technology control options costed by EPA.
- For facilities providing treatment system descriptions that were not detailed enough for EPA to determine what treatment system was operated, EPA assumed that they are still operating the treatment system reported in the detailed questionnaire.
- For a facility reporting use of biological treatment, EPA assumed that it does not have treatment in place equivalent to any of the technology control options.
- For a denim prewash facility that operated a partial treatment system, EPA assumed that it treats wastewater from all items except for the denim prewash, which is not included in the scope of the rule.
- EPA did not reduce costs to reflect ancillary treatment technologies (e.g., screens, filter presses, equalization tanks) added since those reported in the detailed questionnaire.
- EPA did not make any changes in the compliance costs for ten facilities that reported closing or rebuilding since 1993.
- For facilities that reported that they planned to install treatment systems in the future, EPA assumed that they are still operating the treatment system reported in the detailed questionnaire.
- EPA assumed facilities that did not respond to the UTSA/TRSA survey (28 out of the 190 in-scope facilities) were still operating the treatment system reported in the detailed questionnaire.

Table 11-7 presents a comparison of the compliance capital and annual O&M costs estimated for the proposal and the compliance capital and annual O&M costs estimated

Table 11-7

Capital and Annual O&M Compliance Cost Comparison Between the Costs Estimated at Proposal and Costs Incorporating UTSA/TRSA Survey Data for the DAF-IL and CP-IL Regulatory Options[1]

Excluding Facilities with Less than 1 Million Pounds per Year Total Production and Less than 255,000 Pounds per Year Shop and Printer Towel/Rag Production[2]

Option	Compliance Cost Estimated for Proposal[3] (Million 1993 $s)	Compliance Cost Estimated Based on UTSA/TRSA Survey[4] (Million 1993 $s)	Percent Decrease in Compliance Costs
Capital Cost			
CP-IL	$515	$408	21%
DAF-IL	$425	$299	30%
Annual O&M Cost			
CP-IL	$117 per year	$71.7 per year	39%
DAF-IL	$142 per year	$114 per year	20%

[1]Numbers in this table were calculated using more significant figures than shown.
[2]136 of the 1,742 total industrial laundries are excluded from compliance under this criterion.
[3]The costs estimated for proposal (62 FR 66181; December 17, 1997) are based on treatment-in-place information from the detailed questionnaire for the 1993 operating year.
[4]The costs were estimated based on the treatment-in-place information in the UTSA/TRSA survey for the 1998 operating year (presented in the Notice of Data Availability, 63 FR 71054; December 23, 1998).

using the UTSA/TRSA survey data for the CP-IL and DAF-IL regulatory options with the 1 Million/255 K exclusion. The costs were calculated in 1993 dollars using the assumptions and methodologies described previously in this chapter. The capital costs decreased by 107 million dollars and 126 million dollars (21 percent and 30 percent) from 1993 to 1998 in the CP-IL and DAF-IL options, respectively. The annual O&M costs decreased by 45 million dollars and 28 million dollars (39 percent and 20 percent) from 1993 to 1998 in the CP-IL and DAF-IL options, respectively. Based on this comparison, EPA estimates that the actual costs for the industrial laundries industry to comply with the regulatory options (regardless of the specific exclusion) would be less in both capital and annual O&M costs than the costs calculated for the final action, based on the 1993 operating year.

11.6 References

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20. Eastern Research Group, Inc. Building Cost Module Documentation for the Industrial Laundries Cost Model. Prepared for the U.S. Environmental Protection Agency, Office of Water, Washington, D.C., June 1999.

21. Eastern Research Group, Inc. Contract Haul Cost Module Documentation for the Industrial Laundries Cost Model. Prepared for the U.S. Environmental Protection Agency, Office of Water, Washington, D.C., November 1997.

22. Eastern Research Group, Inc. Monitoring Cost Estimate. Prepared for the U.S. Environmental Protection Agency, Office of Water, Washington, D.C., May 1997.

CHAPTER 12

GLOSSARY OF TERMS

2LIM: A term used by EPA to designate "Combo" technology control options on which the standards are based on either DAF or chemical precipitation treatment technologies, as appropriate. The specific set of standards that are applied is based on which technology was determined to be less expensive to install and operate at a facility or was reported to be in place at the facility.

Absorbents: Substance used to absorb leaks, spills, and sprays around machinery and workstations.

Administrator: The Administrator of the U.S. Environmental Protection Agency.

All: A term used by EPA to designate technology control options that treat the total facility process wastewater stream.

Annually: For purposes of the exclusion, annually would mean per calendar year.

Agency: The U.S. Environmental Protection Agency.

BAT: The best available technology economically achievable, as described in section 304(b)(2) of the Clean Water Act.

BCT: The best conventional pollutant control technology, as described in section 304(b)(4) of the Clean Water Act.

Bench-scale operation: Laboratory testing of materials, methods, or processes on a small scale, such as on a laboratory worktable.

BMP or BMPs: Best management practice(s), as described in section 304(e) of the Clean Water Act or as authorized by section 402 of the CWA.

BOD_5: Five-day biochemical oxygen demand. A measure of biochemical decomposition of organic matter in a water sample. It is determined by measuring the dissolved oxygen consumed by microorganisms to oxidize the organic contaminants in a water sample under standard laboratory conditions of five days and 20°C. BOD_5 is not related to the oxygen requirements in chemical combustion.

BPT: The best practicable control technology currently available, as described in section 304(b)(1) of the Clean Water Act.

Buffing pads: Items used to polish floors.

CAA: Clean Air Act. The Air Pollution Prevention and Control Act (42 U.S.C. 7401 et. seq.), as amended, inter alia, by the Clean Air Act Amendments of 1990 (Public Law 101-549, 104 Stat. 2399).

CEB: Chemical emulsion breaking. A term used by EPA to designate a technology control option on which the standards are based on chemical emulsion breaking treatment of the wastewater generated from laundering of heavy industrial textile items (e.g., shop towels, printer towels/rags, mops, fender covers, and filters).

CFR: Code of Federal Regulations, published by the U.S. Government Printing Office. A codification of the general and permanent rules published in the Federal Register by the Executive departments and agencies of the federal government.

Clean room garments: Used in particle- and static-free environments by computer manufacturing, pharmaceutical, biotechnology, aerospace, and other customers to control contamination in production areas.

CN: Abbreviation for total cyanide.

COD: Chemical oxygen demand - A nonconventional bulk parameter that measures the total oxygen-consuming capacity of wastewater. This parameter is a measure of materials in water or wastewater that are biodegradable and materials that are resistant (refractory) to biodegradation. Refractory compounds slowly exert demand on downstream receiving water resources. Certain of the compounds measured by this parameter have been found to have carcinogenic, mutagenic, and similar adverse effects, either singly or in combination. It is expressed as the amount of oxygen consumed by a chemical oxidant in a specific test.

Combo: A term used by EPA to designate technology control options on which the standards are based on a combination of DAF and chemical precipitation treatment technologies. The set of standards are compiled by taking the higher concentration from either DAF or chemical precipitation treatment of each pollutant.

Contract hauling: The removal of any waste stream from the plant or facility by a company authorized to transport and dispose of the waste, excluding discharges to sewers or surface waters.

Control authority: (1) The POTW if the POTW's submission for its pretreatment program (§403.3(t)(1)) has been approved in accordance with the requirements of §403.11; or (2) the approval authority if the submission has not been approved.

Conventional pollutants: Constituents of wastewater as determined in section 304(a)(4) of the Clean Water Act and the regulations thereunder (i.e., biochemical oxygen demand (BOD_5), total suspended solids (TSS), oil and grease, fecal coliform, and pH).

Cooperative: An enterprise or organization owned by and operated for the benefit of those using its services. For purposes of this rule, a laundry serving like facilities owned by and/or operated for the benefit of those facilities.

CP: Chemical precipitation. A term used by EPA to designate technology control options on which the standards are based on chemical precipitation treatment of all or part of the wastewater.

CWA: Clean Water Act. The Federal Water Pollution Control Act Amendments of 1972 (33 U.S.C. 1251 et seq.).

DAF: Dissolved air flotation. A term used by EPA to designate technology control options on which the standards are based on DAF treatment of all or part of the wastewater.

Daily discharge: The discharge of a pollutant measured during any calendar day or any 24-hour period.

Denim prewash: Washing of denim material or manufactured denim items prior to sale to soften the fabric and/or alter its appearance. This is achieved through use of chemicals and processes such as stone, acid, and ice washing.

Detailed questionnaire: 1994 Industrial Laundries Questionnaire. A questionnaire sent by EPA to collect detailed technical and economic information from industrial laundry and linen facilities for the 1993 operating year, under authority of section 308 of the Clean Water Act. The questionnaire was sent to those facilities likely to be affected by promulgation of effluent limitations guidelines, pretreatment standards, and new source performance standards for their industry.

DMQ: 1995 Detailed Monitoring Questionnaire. A questionnaire sent by EPA to 37 industrial laundries based on responses to the detailed questionnaire that requested available monitoring data for 1993.

Direct discharger: The discharge of a pollutant or pollutants directly to a water of the United States with or without treatment by the discharger.

Dry cleaning: The cleaning of fabrics using an organic-based solvent rather than water-based detergent solution.

Dual-phase washing: The dry cleaning and water washing of laundry items in series without drying the items between the solvent and water phases.

Effluent: Wastewater discharges.

EPA: The U.S. Environmental Protection Agency.

Facility: All contiguous property owned, operated, leased or under control of the same person, or corporate or business entity. The contiguous property may be divided by public or private right-of-way.

Fender covers: Items used in the automobile repair and services industry to protect the fenders of automobiles from oil, grease, dirt, and other damage.

FR: Federal Register, published by the U.S. Government Printing Office, Washington, D.C. A publication making available to the public regulations and legal notices issued by federal agencies.

HAPS: Hazardous air pollutants.

Hazardous waste: Any material that meets the Resource Conservation and Recovery Act definition of "hazardous waste" contained in 40 CFR Part 261.

Health care items: Items such as hospital gowns, linen, and towels used in hospitals, doctors' offices, and dentists' offices.

Heavy: A term used by EPA to designate treatment control options that treat facility wastewater generated from the laundering of heavy industrial textile items (e.g., shop towels, printer towels/rags, mops, fender covers, and filters) and are based on standards developed from wastewater generated from the laundering of heavy industrial textile items.

HEM: Hexane extractable material. A method-defined parameter that measures the presence of relatively nonvolatile hydrocarbons, vegetable oils, animal fats, waxes, soaps, greases, and related material that are extractable in the solvent n-hexane. This parameter does not include materials that volatilize at temperatures below 85°C (see Method 1664, promulgated at 64 FR 26315; May 14, 1999). EPA uses the term “HEM” synonymously with the conventional pollutant oil and grease (O&G).

Household laundry: Items that are "noncommercially" owned or are domestic in nature. These items may range from clothing to small rugs.

Indirect discharge: The discharge of a pollutant or pollutants to a publicly owned treatment works (POTW) with or without pretreatment by the discharger.

Industrial laundry: Any facility that launders industrial textile items from off site as a business activity (i.e., launders industrial textile items for other business entities for a fee or through a cooperative agreement). Either the industrial facility or the off-site customer may own the industrial laundered textile items; this includes textile rental companies that perform laundering operations.

IL: A term used by EPA to designate treatment control options that treat the facility wastewater generated from the laundering of industrial textile items and are based on standards developed from wastewater generated from the laundering of all items.

Industrial textile items: Items such as, but not limited to, industrial: shop towels, printer towels/rags, furniture towels, rags, mops, mats, rugs, tool covers, fender covers, dust-control items, gloves, buffing pads, absorbents, uniforms, and filters.

Industrial towels: Items such as, but not limited to: shop towels, printer towels/rags, and furniture towels.

Inorganic wastewater treatment chemicals: Inorganic chemicals that are commonly used in wastewater treatment systems to aid in the removal of pollutants through physical/chemical technologies such as chemical precipitation, flocculation, neutralization, chemical oxidation, hydrolysis, and/or adsorption.

Laundering: Washing items with water, including water washing following dry cleaning.

Linen: Items such as sheets, pillow cases, blankets, bath towels and washcloths, hospital gowns and robes, tablecloths, napkins, tableskirts, kitchen textile items, continuous roll towels, laboratory coats, family laundry, executive wear, mattress pads, incontinence pads, and diapers. This list is intended to be all-inclusive.

Linen flatwork/full dry: Items such as napkins, tablecloths, and sheets.

LTA: Long-term average. For purposes of the pretreatment standards, average pollutant levels achieved over a period of time by a facility, subcategory, or technology option. LTAs were used in developing the standards in the industrial laundries proposed rule.

Minimum level: The level at which an analytical system gives recognizable signals and an acceptable calibration point.

Miscellaneous not our goods (NOG): Items that are commercially owned by an outside company. Industrial laundries do not always know the breakdown of these items.

New source: As defined in 40 CFR 122.2, 122.29, and 403.3 (k), a new source is any building, structure, facility, or installation from which there is or may be a discharge of pollutants, the construction of which commenced (1) for purposes of compliance with New Source Performance Standards, after the promulgation of such standards under CWA section 306; or (2) for the purposes of compliance with Pretreatment Standards for New Sources, after the publication of proposed standards under CWA section 307(c), if such standards are thereafter promulgated in accordance with that section.

Noncontact cooling water: Water used for cooling which does not come into direct contact with any raw material, intermediate product, by-product, waste product, or finished product. This term is not intended to relate to air conditioning systems.

Non-water quality environmental impact: An environmental impact of a control or treatment technology, other than to surface waters.

Noncontinuous or intermittent discharge: Discharge of wastewaters stored for periods of at least 24 hours and released on a batch basis.

Nonconventional pollutants: Pollutants that are neither conventional pollutants nor toxic pollutants listed at 40 CFR Section 401.

Nondetect value: A concentration-based measurement reported below the minimum level that can reliably be measured by the analytical method for the pollutant.

NPDES: The National Pollutant Discharge Elimination System, a federal program requiring industry dischargers, including municipalities, to obtain permits to discharge pollutants to the nation's water, under section 402 of the CWA.

NPM: Non-polar material. A method-defined parameter that measures the substances that remain after n-hexane extractable material is exposed to silica gel. NPM contains straight and branched chain hydrocarbons and other chemical substances in which there are either no mixture of atoms of different types or these mixtures are "balanced" in the molecule (see Method 1664, promulgated at 64 FR 26315; May 14, 1999). EPA uses the term "NPM" synonymously with silica gel treated-hexane extractable material (SGT-HEM).

NRDC: Natural Resources Defense Council.

NSPS: New source performance standards. This term refers to standards for new sources under section 306 of the CWA.

OC-Only: Prelaundering organics control. A term used by EPA to designate a technology control option that processes industrial towels (e.g., shop towels, printer towels/rags) in an air/steam tumbler to remove volatile organic compounds prior to water washing.

Off site: "Off site" means outside the boundaries of the facility.

On site: "On site" means within the boundaries of the facility.

Oil and grease (O&G): A method-defined parameter that measures the presence of relatively nonvolatile hydrocarbons, vegetable oils, animal fats, waxes, soaps, greases, and related materials that are extractable in Freon 113 (1,1,2-trichloro-1,2,2-trifluoroethane). This parameter does not include materials that volatilize at temperatures below 75°C (see Method 413.1). O&G is a conventional pollutant as defined in section 304(a)(4) of the Clean Water Act and in 40 CFR Part 401.16. O&G is also measured by the hexane extractable material (HEM) method (see Method 1664, promulgated at 64 FR 26315; May 14, 1999).

P2: Pollution prevention.

Pilot-scale: The trial operation of processing equipment which is the intermediate stage between laboratory experimentation and full-scale operation in the development of a new process or product.

PM: Particulate matter.

Point source category: A category of sources of water pollutants that are included within the definition of "point source" in section 502(14) of the CWA.

Pollutant (to water): Dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, certain radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water. See CWA Section 502(6); 40 CFR 122.2.

POTW or POTWs: Publicly owned treatment works. A treatment works as defined by Section 212 of the CWA, which is owned by a state or municipality (as defined by Section 502(4) of the Act). This definition includes any devices and systems used in the storage, treatment, recycling and reclamation of municipal sewage or industrial wastes of a liquid nature. It also includes sewers, pipes, and other conveyances only if they convey wastewater to a POTW Treatment Plant. The term also means the municipality as defined in Section 502(4) of the CWA, which has jurisdiction over the indirect discharges to and the discharges from such a treatment works.

PPA: Pollution Prevention Act of 1990 (42 U.S.C. 13101 et seq., Pub.L. 101-508, November 5, 1990).

PDS: Preliminary Data Summary for the Industrial Laundries Industry. A document that was prepared by EPA summarizing sampling data from five industrial laundries collected between 1985 and 1987.

Pretreatment standard: A regulation specifying industrial wastewater effluent quality required for discharge to a POTW.

Printer towels/rags: Towels used to clean solvents, inks, or soils from various objects or to wipe up spilled solvents and other liquids until they are saturated. They are commonly used in publishing and printing shops.

Priority pollutants: The toxic pollutants listed in 40 CFR Part 423, Appendix A.

Process wastewater collection system: A piece of equipment, structure, or transport mechanism used in conveying or storing a process wastewater stream. Examples of process wastewater collection system equipment include individual drain systems, wastewater tanks, surface impoundments, and containers.

PSES: Pretreatment standards for existing sources of indirect discharges, under section 307(b) of the CWA.

PSNS: Pretreatment standards for new sources of indirect discharges, under section 307(b) and (c) of the CWA.

RCRA: Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6901, et seq.).

RREL: Risk Reduction Engineering Laboratory.

Reuse: The use in laundry operations of all or part of a waste stream produced by an operation which would otherwise be disposed of, whether or not the stream is treated prior to reuse, and whether the reused waste stream is fed to the same operation or to another operation.

RFA: The Regulatory Flexibility Act as amended by SBREFA (5 U.S.C. 60 et seq.).

Rewash items: Items that require a second washing to be in an acceptable state for return to the customer.

Screener questionnaire: Four different two-page questionnaires mailed by EPA to facilities in the laundries industry to develop the scope of the industrial laundries regulation, identify the population of the industrial laundries industry, and select facilities to receive the more detailed questionnaire.

SBA: Small Business Administration.

SBREFA: Small Business Regulatory Enforcement Fairness Act of 1996 (P.L. 104-121, March 29, 1996).

Septic system: A system which collects and treats wastewater, particularly sanitary sewage. The system is usually composed of a septic tank which settles and anaerobically degrades solid waste, and a drainfield which relies on soil to adsorb or filter biological contaminants. Solid wastes are periodically pumped out of the septic tank and hauled to off-site disposal.

SGT-HEM: Silica gel treated-hexane extractable material. A method-defined parameter that measures the presence of mineral oils that are extractable in the solvent n-hexane and not adsorbed by silica gel. This parameter does not include materials that volatilize at temperatures below 85°C (see Method 1664, promulgated at 64 FR 26315; May 14, 1999). EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

Shop towels: Towels used to clean oil and grease or soils from various objects or to wipe up oil and grease and other liquids until they are saturated. They are commonly used in machine shops, automotive repair shops, and gas stations.

SIC: Standard Industrial Classification. A numerical categorization system used by the U.S. Department of Commerce to denote segments of industry. An SIC code refers to the principal product, or group of products, produced or distributed, or to services rendered by an operating

establishment. SIC codes are used to group establishments by the primary activity in which they are engaged.

Small business: Businesses with annual revenues less than $10.5 million. This is the higher of the two Small Business Administration definitions of small businesses for SIC codes 7218 and 7213.

Source reduction: The reduction or elimination of waste generation at the source, usually within a process. Any practice that: 1) reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal; and 2) reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants.

Toxic pollutants: The pollutants designated by EPA as toxic in 40 CFR Part 401.15. Also known as priority pollutants.

TOC: Total organic carbon. A nonconventional bulk parameter that measures the total organic content of wastewater. Unlike five-day biochemical oxygen demand (BOD_5) or chemical oxygen demand (COD), TOC is independent of the oxidation state of the organic matter and does not measure other organically bound elements, such as nitrogen and hydrogen, and inorganics that can contribute to the oxygen demand measured by BOD_5 and COD. TOC methods utilize heat and oxygen, ultraviolet irradiation, chemical oxidants, or combinations of these oxidants to convert organic carbon to carbon dioxide (CO_2). The CO_2 is then measured by various methods.

TPH: Total petroleum hydrocarbon. A method-defined parameter that measures the presence of mineral oils that are extractable in Freon 113 (1,1,2-trichloro-1,2,2-trifluoroethane) and not absorbed by silica gel. This parameter does not include materials that volatilize at temperatures below 70°C (see Method 418.1). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to silica gel treated-hexane extractable material (SGT-HEM) as TPH.

TRSA: Textile Rental Services Association of America.

TSCA: Toxic Substances Control Act (15 U.S.C. 2601 et seq.)

TSS: Total suspended solids.

Towel Only: A term used by EPA to designate a technology control option that treats facility wastewater generated from the laundering of industrial towels (e.g., shop towels and printer towels/rags) with dissolved air flotation (DAF) and is based on standards developed from wastewater generated from the laundering of industrial towels and treated by DAF technology.

TWL: A term used by EPA to designate treatment control options that treat facility wastewater generated from the laundering of heavy industrial textile items (e.g., shop towels, printer

towels/rags, mops, fender covers, and filters) and are based on standards developed from wastewater generated from the laundering of all items.

UTSA: Uniform and Textile Service Association.

Variability factor: The daily variability factor is the ratio of the estimated 99th percentile of the distribution of daily values divided by the expected value, median or mean, of the distribution of the daily data. The monthly variability factor is the estimated 95th percentile of the distribution of the monthly averages of the data divided by the expected value of the monthly averages.

VOCs: Volatile organic compounds.

Water washing: The process of washing laundry items in which water is the solvent used.

Waters of the United States: The same meaning set forth in 40 CFR 122.2.

Wet air pollution or odor pollution control system scrubbers: Any equipment using water or water mixtures to control emissions of dusts, odors, volatiles, sprays, or other air pollutants.

Zero discharge: No discharge of process wastewater pollutants to waters of the United States or to a POTW.

Appendix A

Tables Referenced in Chapter 3

Table A-1

Metal and Elemental Constituents Measured Under the Industrial Laundries Sampling Program
(EPA Method 1620)

Metal and Elemental Constituents		
Aluminum	Cobalt	Selenium
Antimony	Copper	Silver
Arsenic	Iron	Sodium
Barium	Lead	Thallium
Beryllium	Magnesium	Tin
Boron	Manganese	Titanium
Cadmium	Mercury	Vanadium
Calcium	Molybdenum	Yttrium
Chromium	Nickel	Zinc
Additional Metal and Elemental Constituents[1] Not Subject to Rigorous QA/QC Procedures Per Method 1620:		
Bismuth	Lanthanum	Samarium
Cerium	Lithium	Scandium
Dysprosium	Lutetium	Silicon
Erbium	Neodymium	Strontium
Europium	Niobium	Sulfur
Gadolinium	Osmium	Tantalum
Gallium	Palladium	Tellurium
Germanium	Phosphorus	Terbium
Gold	Platinum	Thorium
Hafnium	Potassium	Thulium
Holmium	Praseodymium	Tungsten
Indium	Rhenium	Uranium
Iodine	Rhodium	Ytterbium
Iridium	Ruthenium	Zirconium

[1]Analyses for these metals and elements were used for screening purposes, and the metals were not selected for regulation in this rulemaking.

Table A-2

Organic Constituents Measured Under the Industrial Laundries Sampling Program
(EPA Methods 1624 and 1625)

Volatile Organic Constituents (EPA Method 1624)	
Acrylonitrile	trans-1,4-Dichloro-2-butene
Benzene	Tribromomethane
Bromodichloromethane	Trichloroethene
Bromomethane	Trichlorofluoromethane
Carbon Disulfide	Vinyl Acetate
Chloroacetonitrile	Vinyl Chloride
Chlorobenzene	1,1-Dichloroethane
Chloroethane	1,1-Dichloroethene
Chloroform	1,1,1-Trichloroethane
Chloromethane	1,1,1,2-Tetrachloroethane
Cis-1,3-dichloropropene	1,1,2-Trichloroethane
Crotonaldehyde	1,1,2,2-Tetrachloroethane
Dibromochloromethane	1,2-Dibromoethane
Dibromomethane	1,2-Dichloroethane
Diethyl Ether	1,2-Dichloropropane
Ethyl Cyanide	1,2,3-Trichloropropane
Ethyl Methacrylate	1,3-Butadiene, 2-Chloro
Ethylbenzene	1,3-Dichloropropane
Iodomethane	1,4-Dioxane
Isobutyl Alcohol	2-Butanone
m-Xylene	2-Chloroethyl Vinyl Ether
Methyl Methacrylate	2-Hexanone
Methylene Chloride	2-Propanone
o+p-Xylene	2-Propen-1-ol
Tetrachloroethene	2-Propenal
Tetrachloromethane	2-Propenenitrile, 2-Methyl-
Toluene	3-Chloropropene
trans-1,2-Dichloroethene	4-Methyl-2-pentanone
trans-1,3-Dichloropropene	

Table A-2 (Continued)

Semivolatile Organic Constituents (EPA Method 1625)	
Acenaphthene	Fluoranthene
Acenaphthylene	Hexachlorobenzene
Acetophenone	Hexachlorobutadiene
alpha-Terpineol	Hexachlorocyclopentadiene
Aniline	Hexachloroethane
Aniline, 2,4,5-Trimethyl-	Hexachloropropene
Anthracene	Hexanoic Acid
Aramite	Indeno(1,2,3-Cd)pyrene
Benzanthrone	Isophorone
Benzenethiol	Isosafrole
Benzidine	Longifolene
Benzo(a)anthracene	Malachite Green
Benzo(a)pyrene	Mestranol
Benzo(b)fluoranthene	Methapyrilene
Benzo(ghi)perylene	Methyl Methanesulfonate
Benzo(k)fluoranthene	n-Decane
Benzoic Acid	n-Docosane
Benzonitrile, 3,5-Dibromo-4-hydroxy-	n-Dodecane
Benzyl Alcohol	n-Eicosane
beta-Naphthylamine	n-Hexacosane
Biphenyl	n-Hexadecane
Biphenyl, 4-Nitro	N-Nitrosodi-n-butylamine
Bis(2-Chloroethoxy)methane	N-Nitrosodiethylamine
Bis(2-Chloroethyl) ether	N-Nitrosodimethylamine
Bis(2-Chloroisopropyl) ether	N-Nitrosodiphenylamine
Bis(2-ethylhexyl) phthalate	N-Nitrosomethylethylamine
Butyl benzyl phthalate	N-Nitrosomethylphenylamine
Carbazole	N-Nitrosomorpholine
Chrysene	N-Nitrosopiperidine
Ciodrin	n-Octacosane
Crotoxyphos	n-Octadecane
Di-n-butyl phthalate	n-Tetracosane
Di-n-octyl phthalate	n-Tetradecane
Di-n-Propylnitrosamine	n-Triacontane
Dibenzo(a,h)anthracene	N,N-Dimethylformamide
Dibenzofuran	Naphthalene
Dibenzothiophene	Nitrobenzene
Diethyl Phthalate	o-Anisidine
Dimethyl Phthalate	o-Cresol
Dimethyl Sulfone	o-Toluidine
Diphenyl Ether	o-Toluidine, 5-Chloro-
Diphenylamine	p-Chloroaniline
Diphenyldisulfide	p-Cresol
Ethane, Pentachloro-	p-Cymene
Ethyl Methanesulfonate	p-Dimethylaminoazobenzene
Ethylenethiourea	p-Nitroaniline

Table A-2 (Continued)

Semivolatile Organic Constituents (EPA Method 1625) (Continued)	
Pentachlorobenzene	1,4-Naphthoquinone
Pentachlorophenol	1,5-Naphthalenediamine
Pentamethylbenzene	2-(Methylthio)benzothiazole
Perylene	2-Chloronaphthalene
Phenacetin	2-Chlorophenol
Phenanthrene	2-Isopropylnaphthalene
Phenol	2-Methylbenzothioazole
Phenol, 2-Methyl-4,6-Dinitro-	2-Methylnaphthalene
Phenothiazine	2-Nitroaniline
Pronamide	2-Nitrophenol
Pyrene	2-Phenylnaphthalene
Pyridine	2-Picoline
Resorcinol	2,3-Benzofluorene
Safrole	2,3-Dichloroaniline
Squalene	2,3-Dichloronitrobenzene
Styrene	2,3,4,6-Tetrachlorophenol
Thianaphthene	2,3,6-Trichlorophenol
Thioacetamide	2,4-Dichlorophenol
Thioxanthe-9-one	2,4-Dimethylphenol
Toluene, 2,4-Diamino-	2,4-Dinitrophenol
Triphenylene	2,4-Dinitrotoluene
Tripropyleneglycol Methyl Ether	2,4,5-Trichlorophenol
1-Bromo-2-chlorobenzene	2,4,6-Trichlorophenol
1-Bromo-3-chlorobenzene	2,6-Di-tert-butyl-p-benzoquinone
1-Chloro-3-nitrobenzene	2,6-Dichloro-4-nitroaniline
1-Methylfluorene	2,6-Dichlorophenol
1-Methylphenanthrene	2,6-Dinitrotoluene
1-Naphthylamine	3-Methylcholanthrene
1-Phenylnaphthalene	3-Nitroaniline
1,2-Dibromo-3-chloropropane	3,3'-Dichlorobenzidine
1,2-Dichlorobenzene	3,3'-Dimethoxybenzidine
1,2-Diphenylhydrazine	3,6-Dimethylphenanthrene
1,2,3-Trichlorobenzene	4-Aminobiphenyl
1,2,3-Trimethoxybenzene	4-Bromophenyl Phenyl Ether
1,2,4-Trichlorobenzene	4-Chloro-2-nitroaniline
1,2,4,5-Tetrachlorobenzene	4-Chloro-3-methylphenol
1,2:3,4-Diepoxybutane	4-Chlorophenyl Phenyl Ether
1,3-Dichloro-2-propanol	4-Nitrophenol
1,3-Dichlorobenzene	4,4'-Methylenebis(2-chloroaniline)
1,3,5-Trithiane	4,5-Methylene Phenanthrene
1,4-Dichlorobenzene	5-Nitro-o-toluidine
1,4-Dinitrobenzene	7,12-Dimethylbenz(a)anthracene

Table A-3

Additional Parameters Measured in the Industrial Laundries Sampling Program

Parameter	EPA Method
Biochemical Oxygen Demand (BOD_5)	405.1[1]
Chemical Oxygen Demand (COD)	410.1[1] 410.2[1]
Hexane Extractable Material (oil and grease)	1664 (proposed)[2]
pH	150.1[1]
Phosphorus, Total	365.2[1]
Silica Gel Treated-Hexane Extractable Material (total petroleum hydrocarbons)	1664 (proposed)[2]
Surfacants	5540C, 5540D[3]
Total Solids	160.3[1]
Total Hydrolyzable Phosphorus	365.2[1]
Total Organic Carbon	415.1[1]
Total Orthophosphate	365.2[1]
Total Suspended Solids (TSS)	160.2[1]

[1]U.S. Environmental Protection Agency. Methods for Chemical Analysis of Water and Wastes. EPA-800-4-79-020, Revised March 1983.

[2]U.S. Environmental Protection Agency. Method 1664: N-Hexane Extractable Material (HEM) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM) by Extraction and Gravimetry (Oil and Grease and Total Petroleum Hydrocarbons). EPA-821-B-94-004b, April 1995.

[3]Standard Methods for the Examination of Water and Wastewater. A.D. Eaton, L.S. Clesceri and A.E. Greenberg, eds. 19th Edition. American Public Health Association, Washington, D.C., 1995.

Appendix B

Table Referenced In Chapter 4

Table B-1

Industries for Which EPA Has Established Effluent Limitations Guidelines and Standards

CWA Part	Industry
405	Diary Products Processing
406	Grain Mills
407	Canned and Preserved Fruits and Vegetables Processing
408	Canned and Preserved Seafood Processing
409	Sugar Processing
410	Textile Mills
411	Cement Manufacturing
412	Feedlots
413	Electroplating
414	Organic Chemicals, Plastics and Synthetic Fibers
415	Inorganic Chemical Manufacturing
417	Soap and Detergent Manufacturing
418	Fertilizer Manufacturing
419	Petroleum Refining
420	Iron and Steel Manufacturing
421	Nonferrous Metals Manufacturing
422	Phosphate Manufacturing
423	Steam Electric Power Generating
424	Ferroalloy Manufacturing
425	Leather Tanning and Finishing
426	Glass Manufacturing
427	Asbestos Manufacturing
428	Rubber Manufacturing
429	Timber Products Processing
430	Pulp, Paper and Paperboard
431	The Builders' Paper and Boardmills
432	Meat Products
433	Metal Finishing
434	Coal Mining
435	Oil and Gas Extraction
436	Mineral and Mining Processing

Table B-1 (Continued)

CWA Part	Industry
439	Pharmaceutical Manufacturing
440	Ore Mining and Dressing
443	Paving and Roofing Materials (Tars and Asphalt)
446	Paint Formulating
447	Ink Formulating
454	Gum and Wood Chemicals Manufacturing
455	Pesticide Chemicals
457	Explosives Manufacturing
458	Carbon Black Manufacturing
459	Photographic Processing
460	Hospital
461	Battery Manufacturing
463	Plastics Molding and Forming
464	Metal Molding and Casting
465	Coil Coating
466	Porcelain Enameling
467	Aluminum Forming
468	Copper Forming
469	Electrical and Electronic Components
471	Nonferrous Metals Forming and Metal Powder

Appendix C

Tables Referenced in Chapter 5

Table C-1

Priority Pollutant List[1]

1 Acenaphthene	66 Bis(2-Ethylhexyl) Phthalate
2 Acrolein (2-Propenal)	67 Butyl Benzyl Phthalate
3 Acrylonitrile	68 Di-n-butyl Phthalate
4 Benzene	69 Di-n-octyl Phthalate
5 Benzidine	70 Diethyl Phthalate
6 Carbon Tetrachloride (Tetrachloromethane)	71 Dimethyl Phthalate
7 Chlorobenzene	72 Benzo(a)anthracene (1,2-Benzanthracene)
8 1,2,4-Trichlorobenzene	73 Benzo(a)pyrene (3,4-Benzopyrene)
9 Hexachlorobenzene	74 Benzo(b)fluoranthene (3,4-Benzo fluoranthene)
10 1,2-Dichloroethane	75 Benzo(k)fluoranthene
11 1,1,1-Trichloroethane	76 Chrysene
12 Hexachloroethane	77 Acenaphthylene
13 1,1-Dichloroethane	78 Anthracene
14 1,1,2-Trichloroethane	79 Benzo(ghi)perylene (1,12-Benzoperylene)
15 1,1,2,2-Tetrachloroethane	80 Fluorene
16 Chloroethane	81 Phenanthrene
17 Removed	82 Dibenzo(a,h)anthracene (1,2,5,6-Dibenzanthracene)
18 Bis(2-chloroethyl) Ether	83 Indeno(1,2,3-cd)pyrene (2,3-o-Phenylenepyrene)
19 2-Chloroethyl Vinyl Ether (mixed)	84 Pyrene
20 2-Chloronaphthalene	85 Tetrachloroethylene (Tetrachloroethene)
21 2,4,6-Trichlorophenol	86 Toluene
22 Parachloro-m-cresol (4-Chloro-3-Methylphenol)	87 Trichloroethylene (Trichloroethene)
23 Chloroform (Trichloromethane)	88 Vinyl Chloride (Chloroethylene)
24 2-Chlorophenol	89 Aldrin
25 1,2-Dichlorobenzene	90 Dieldrin
26 1,3-Dichlorobenzene	91 Chlordane (Technical Mixture & Metabolites)
27 1,4-Dichlorobenzene	92 4,4'-DDT (p,p'-DDT)
28 3,3'-Dichlorobenzidine	93 4,4'-DDE (p,p'-DDX)
29 1,1-Dichloroethene	94 4,4'-DDD (p,p'-TDE)
30 1,2-Trans-Dichloroethene	95 Alpha-endosulfan
31 2,4-Dichlorophenol	96 Beta-endosulfan
32 1,2-Dichloropropane	97 Endosulfan Sulfate
33 1,3-Dichloropropylene (1,3-Dichloropropene)	98 Endrin
34 2,4-Dimethylphenol	99 Endrin Aldehyde
35 2,4-Dinitrotoluene	100 Heptachlor
36 2,6-Dinitrotoluene	101 Heptachlor Epoxide
37 1,2-Diphenylhydrazine	102 Alpha-BHC
38 Ethylbenzene	103 Beta-BHC
39 Fluoranthene	104 Gamma-BHC (Lindane)
40 4-Chlorophenyl Phenyl Ether	105 Delta-BHC
41 4-Bromophenyl Phenyl Ether	106 PCB-1242 (Arochlor 1242)
42 Bis(2-Chloroisopropyl) Ether	107 PCB-1254 (Arochlor 1254)
43 Bis(2-Chloroethoxy) Methane	108 PCB-1221 (Arochlor 1221)
44 Methylene Chloride (Dichloromethane)	109 PCB-1232 (Arochlor 1232)
45 Methyl Chloride (Chloromethane)	110 PCB-1248 (Arochlor 1248)
46 Methyl Bromide (Bromomethane)	111 PCB-1260 (Arochlor 1260)
47 Bromoform (Tribromomethane)	112 PCB-1016 (Arochlor 1016)
48 Dichlorobromomethane (Bromodichloromethane)	113 Toxaphene
49 Removed	114 Antimony (total)
50 Removed	115 Arsenic (total)
51 Chlorodibromomethane (Dibromochloromethane)	116 Asbestos (fibrous)
52 Hexachlorobutadiene	117 Beryllium (total)
53 Hexachlorocyclopentadiene	118 Cadmium (total)
54 Isophorone	119 Chromium (total)
55 Naphthalene	120 Copper (total)
56 Nitrobenzene	121 Cyanide (total)
57 2-Nitrophenol	122 Lead (total)
58 4-Nitrophenol	123 Mercury (total)
59 2,4-Dinitrophenol	124 Nickel (total)
60 4,6-Dinitro-o-Cresol (Phenol, 2-methyl-4,6-dinitro)	125 Selenium (total)
61 N-Nitrosodimethylamine	126 Silver (total)
62 N-Nitrosodiphenylamine	127 Thallium (total)
63 N-Nitrosodi-n-propylamine (Di-n-propylnitrosamine)	128 Zinc (total)
64 Pentachlorophenol	129 2,3,7,8-Tetrachlorodibenzo-p-Dioxin
65 Phenol	

[1]Priority pollutants are numbered 1 through 129 but include 126 pollutants since EPA removed three pollutants from the list (Numbers 17, 49, and 50).

Source: 40 CFR Part 423, Appendix A.

Table C-2

Pollutants Considered for Regulation

POLLUTANT	ANALYTICAL METHOD
1,1,1,2-TETRACHLOROETHANE	1624
1,1,1-TRICHLOROETHANE	1624
1,1,2,2-TETRACHLOROETHANE	1624
1,1,2-TRICHLOROETHANE	1624
1,1-DICHLOROETHANE	1624
1,1-DICHLOROETHENE	1624
1,2,3-TRICHLOROBENZENE	1625
1,2,3-TRICHLOROPROPANE	1624
1,2,3-TRIMETHOXYBENZENE	1625
1,2,4,5-TETRACHLOROBENZENE	1625
1,2,4-TRICHLOROBENZENE	1625
1,2-DIBROMO-3-CHLOROPROPANE	1625
1,2-DIBROMOETHANE	1624
1,2-DICHLOROBENZENE	1625
1,2-DICHLOROETHANE	1624
1,2-DICHLOROPROPANE	1624
1,2-DIPHENYLHYDRAZINE	1625
1,2:3,4-DIEPOXYBUTANE	1625
1,3,5-TRITHIANE	1625
1,3-BUTADIENE, 2-CHLORO	1624
1,3-DICHLORO-2-PROPANOL	1625
1,3-DICHLOROBENZENE	1625
1,3-DICHLOROPROPANE	1624
1,4-DICHLOROBENZENE	1625
1,4-DINITROBENZENE	1625
1,4-DIOXANE	1624
1,4-NAPHTHOQUINONE	1625
1,5-NAPHTHALENEDIAMINE	1625
1-BROMO-2-CHLOROBENZENE	1625
1-BROMO-3-CHLOROBENZENE	1625
1-CHLORO-3-NITROBENZENE	1625
1-METHYLFLUORENE	1625

Table C-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
1-METHYLPHENANTHRENE	1625
1-NAPHTHYLAMINE	1625
1-PHENYLNAPHTHALENE	1625
2,3,4,6-TETRACHLOROPHENOL	1625
2,3,6-TRICHLOROPHENOL	1625
2,3-BENZOFLUORENE	1625
2,3-DICHLOROANILINE	1625
2,3-DICHLORONITROBENZENE	1625
2,4,5-TRICHLOROPHENOL	1625
2,4,6-TRICHLOROPHENOL	1625
2,4-DICHLOROPHENOL	1625
2,4-DIMETHYLPHENOL	1625
2,4-DINITROPHENOL	1625
2,4-DINITROTOLUENE	1625
2,6-DI-TERT-BUTYL-P-BENZOQUINONE	1625
2,6-DICHLORO-4-NITROANILINE	1625
2,6-DICHLOROPHENOL	1625
2,6-DINITROTOLUENE	1625
2-(METHYLTHIO)BENZOTHIAZOLE	1625
2-BUTANONE	1624
2-CHLOROETHYLVINYL ETHER	1624
2-CHLORONAPHTHALENE	1625
2-CHLOROPHENOL	1625
2-HEXANONE	1624
2-ISOPROPYLNAPHTHALENE	1625
2-METHYLBENZOTHIOAZOLE	1625
2-METHYLNAPHTHALENE	1625
2-NITROANILINE	1625
2-NITROPHENOL	1625
2-PHENYLNAPHTHALENE	1625
2-PICOLINE	1625
2-PROPANONE	1624
2-PROPEN-1-OL	1624
2-PROPENAL	1624

Table C-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
2-PROPENENITRILE, 2-METHYL-	1624
3,3'-DICHLOROBENZIDINE	1625
3,3'-DIMETHOXYBENZIDINE	1625
3,6-DIMETHYLPHENANTHRENE	1625
3-CHLOROPROPENE	1624
3-METHYLCHOLANTHRENE	1625
3-NITROANILINE	1625
4,4'-METHYLENEBIS(2-CHLOROANILINE)	1625
4,5-METHYLENE PHENANTHRENE	1625
4-AMINOBIPHENYL	1625
4-BROMOPHENYL PHENYL ETHER	1625
4-CHLORO-2-NITROANILINE	1625
4-CHLORO-3-METHYLPHENOL	1625
4-CHLOROPHENYL PHENYL ETHER	1625
4-METHYL-2-PENTANONE	1624
4-NITROPHENOL	1625
5-NITRO-O-TOLUIDINE	1625
7,12-DIMETHYLBENZ(A)ANTHRACENE	1625
ACENAPHTHENE	1625
ACENAPHTHYLENE	1625
ACETOPHENONE	1625
ACRYLONITRILE	1624
ALPHA-TERPINEOL	1625
ALUMINUM	1620
ANILINE	1625
ANILINE, 2,4,5-TRIMETHYL-	1625
ANTHRACENE	1625
ANTIMONY	1620
ARAMITE	1625
ARSENIC	1620
BARIUM	1620
BENZANTHRONE	1625
BENZENE	1624
BENZENETHIOL	1625

Table C-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
BENZIDINE	1625
BENZO(A)ANTHRACENE	1625
BENZO(A)PYRENE	1625
BENZO(B)FLUORANTHENE	1625
BENZO(GHI)PERYLENE	1625
BENZO(K)FLUORANTHENE	1625
BENZOIC ACID	1625
BENZONITRILE, 3,5-DIBROMO-4-HYDROXY-	1625
BENZYL ALCOHOL	1625
BERYLLIUM	1620
BETA-NAPHTHYLAMINE	1625
BIPHENYL	1625
BIPHENYL, 4-NITRO	1625
BIS(2-CHLOROETHOXY)METHANE	1625
BIS(2-CHLOROETHYL) ETHER	1625
BIS(2-CHLOROISOPROPYL) ETHER	1625
BIS(2-ETHYLHEXYL) PHTHALATE	1625
BISMUTH	1620
BOD 5-DAY (CARBONACEOUS)	405.1
BORON	1620
BROMODICHLOROMETHANE	1624
BROMOMETHANE	1624
BUTYL BENZYL PHTHALATE	1625
CADMIUM	1620
CALCIUM	1620
CARBAZOLE	1625
CARBON DISULFIDE	1624
CERIUM	1620
CHEMICAL OXYGEN DEMAND (COD)	410.4
CHLOROACETONITRILE	1624
CHLOROBENZENE	1624
CHLOROETHANE	1624
CHLOROFORM	1624
CHLOROMETHANE	1624

Table C-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
CHROMIUM	1620
CHRYSENE	1625
CIS-1,3-DICHLOROPROPENE	1624
COBALT	1620
COPPER	1620
CROTONALDEHYDE	1624
CROTOXYPHOS	1625
DI-N-BUTYL PHTHALATE	1625
DI-N-OCTYL PHTHALATE	1625
DI-N-PROPYLNITROSAMINE	1625
DIBENZO(A,H)ANTHRACENE	1625
DIBENZOFURAN	1625
DIBENZOTHIOPHENE	1625
DIBROMOCHLOROMETHANE	1624
DIBROMOMETHANE	1624
DIETHYL ETHER	1624
DIETHYL PHTHALATE	1625
DIMETHYL PHTHALATE	1625
DIMETHYL SULFONE	1625
DIPHENYL ETHER	1625
DIPHENYLAMINE	1625
DIPHENYLDISULFIDE	1625
DYSPROSIUM	1620
ERBIUM	1620
ETHANE, PENTACHLORO-	1625
ETHYL CYANIDE	1624
ETHYL METHACRYLATE	1624
ETHYL METHANESULFONATE	1625
ETHYLBENZENE	1624
ETHYLENETHIOUREA	1625
EUROPIUM	1620
FLUORANTHENE	1625
FLUORENE	1625
GADOLINIUM	1620

Table C-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
GALLIUM	1620
GERMANIUM	1620
GOLD	1620
HAFNIUM	1620
HEXACHLOROBENZENE	1625
HEXACHLOROBUTADIENE	1625
HEXACHLOROCYCLOPENTADIENE	1625
HEXACHLOROETHANE	1625
HEXACHLOROPROPENE	1625
HEXANOIC ACID	1625
HOLMIUM	1620
INDENO(1,2,3-CD)PYRENE	1625
INDIUM	1620
IODINE	1620
IODOMETHANE	1624
IRIDIUM	1620
IRON	1620
ISOBUTYL ALCOHOL	1624
ISOPHORONE	1625
ISOSAFROLE	1625
LANTHANUM	1620
LEAD	1620
LITHIUM	1620
LONGIFOLENE	1625
LUTETIUM	1620
M-XYLENE	1624
MAGNESIUM	1620
MALACHITE GREEN	1625
MANGANESE	1620
MERCURY	1620
MESTRANOL	1625
METHAPYRILENE	1625
METHYL METHACRYLATE	1624
METHYL METHANESULFONATE	1625

Table C-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
METHYLENE CHLORIDE	1624
MOLYBDENUM	1620
N,N-DIMETHYLFORMAMIDE	1625
N-DECANE	1625
N-DOCOSANE	1625
N-DODECANE	1625
N-EICOSANE	1625
N-HEXACOSANE	1625
N-HEXADECANE	1625
N-NITROSODI-N-BUTYLAMINE	1625
N-NITROSODIETHYLAMINE	1625
N-NITROSODIMETHYLAMINE	1625
N-NITROSODIPHENYLAMINE	1625
N-NITROSOMETHYLETHYLAMINE	1625
N-NITROSOMETHYLPHENYLAMINE	1625
N-NITROSOMORPHOLINE	1625
N-NITROSOPIPERIDINE	1625
N-OCTACOSANE	1625
N-OCTADECANE	1625
N-TETRACOSANE	1625
N-TETRADECANE	1625
N-TRIACONTANE	1625
NAPHTHALENE	1625
NEODYMIUM	1620
NICKEL	1620
NIOBIUM	1620
NITROBENZENE	1625
O+P XYLENE	1624
O-ANISIDINE	1625
O-CRESOL	1625
O-TOLUIDINE	1625
O-TOLUIDINE, 5-CHLORO-	1625
OIL AND GREASE (measured as HEM)	1664
OSMIUM	1620

Table C-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
P-CHLOROANILINE	1625
P-CRESOL	1625
P-CYMENE	1625
P-DIMETHYLAMINOAZOBENZENE	1625
P-NITROANILINE	1625
PALLADIUM	1620
PENTACHLOROBENZENE	1625
PENTACHLOROPHENOL	1625
PENTAMETHYLBENZENE	1625
PERYLENE	1625
PH	150.1
PHENACETIN	1625
PHENANTHRENE	1625
PHENOL	1625
PHENOL, 2-METHYL-4,6-DINITRO-	1625
PHENOTHIAZINE	1625
PHOSPHORUS	1620
PLATINUM	1620
POTASSIUM	1620
PRASEODYMIUM	1620
PRONAMIDE	1625
PYRENE	1625
PYRIDINE	1625
RESORCINOL	1625
RHENIUM	1620
RHODIUM	1620
RUTHENIUM	1620
SAFROLE	1625
SAMARIUM	1620
SCANDIUM	1620
SELENIUM	1620
SILICON	1620
SILVER	1620
SODIUM	1620

Table C-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
SQUALENE	1625
STRONTIUM	1620
STYRENE	1625
SULFUR	1620
SURFACTANTS (CTAS)	5540D
SURFACTANTS (MBAS)	5540C
TANTALUM	1620
TELLURIUM	1620
TERBIUM	1620
TETRACHLOROETHENE	1624
TETRACHLOROMETHANE	1624
THALLIUM	1620
THIANAPHTHENE	1625
THIOACETAMIDE	1625
THIOXANTHE-9-ONE	1625
THORIUM	1620
THULIUM	1620
TIN	1620
TITANIUM	1620
TOLUENE	1624
TOLUENE, 2,4-DIAMINO-	1625
TOTAL HYDROLYZABLE PHOSPHORUS	365.2
TOTAL ORGANIC CARBON (TOC)	415.1
TOTAL ORTHOPHOSPHATE	365.2
TOTAL PETROLEUM HYDROCARBON (measured as SGT-HEM)	1664
TOTAL PHOSPHORUS	365.2
TOTAL SOLIDS	160.3
TOTAL SUSPENDED SOLIDS	160.2
TRANS-1,2-DICHLOROETHENE	1624
TRANS-1,3-DICHLOROPROPENE	1624
TRANS-1,4-DICHLORO-2-BUTENE	1624
TRIBROMOMETHANE	1624
TRICHLOROETHENE	1624

Table C-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
TRICHLOROFLUOROMETHANE	1624
TRIPHENYLENE	1625
TRIPROPYLENEGLYCOL METHYL ETHER	1625
TUNGSTEN	1620
URANIUM	1620
VANADIUM	1620
VINYL ACETATE	1624
VINYL CHLORIDE	1624
YTTERBIUM	1620
YTTRIUM	1620
ZINC	1620
ZIRCONIUM	1620

Table C-3

Wastewater Characterization for Item-Specific Wastewater at Industrial Laundries

Industrial Garments						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	**Minimum**	**Maximum**	**Mean**			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	218	600	350	6	6	100
Oil and Grease (measured as HEM)	18.8	358	149	6	6	100
Total Suspended Solids (TSS)	129	524	304	6	6	100
Priority Organics						
1,1,1-Trichloroethane	0.0100	0.100	0.0400	6	0	0
1,2-Diphenylhydrazine	0.0200	0.200	0.110	6	0	0
4-Chloro-3-methylphenol	0.0100	0.504	0.130	6	2	33
Bis(2-ethylhexyl) Phthalate	0.100	3.97	0.838	6	5	83
Butyl Benzyl Phthalate	0.0100	0.431	0.111	6	2	33
Chlorobenzene	0.0100	0.100	0.0400	6	0	0
Chloroform	0.0100	0.100	0.0400	6	0	0
Di-*n*-butyl Phthalate	0.0100	0.211	0.0736	6	1	17
Di-*n*-octyl Phthalate	0.0100	0.100	0.0583	6	2	33
Ethylbenzene	0.0100	0.482	0.104	6	1	17
Isophorone	0.0100	0.933	0.194	6	1	17
Methylene Chloride	0.0100	0.100	0.0406	6	1	17
Naphthalene	0.0100	0.415	0.107	6	1	17
Phenol	0.0200	0.127	0.0544	6	5	83
Tetrachloroethene	0.0100	0.100	0.0400	6	0	0
Toluene	0.0100	0.128	0.0486	6	3	50
trans-1,2-Dichloroethene	0.0100	0.100	0.0400	6	0	0
Trichloroethene	0.0100	0.100	0.0400	6	0	0
Nonconventional Organics						
2-Butanone	0.0500	0.500	0.200	6	0	0
2-Methylnaphthalene	0.0100	0.383	0.102	6	1	17
2-Propanone	0.0500	0.5000	0.226	6	1	17
4-Methyl-2-pentanone	0.0500	0.500	0.200	6	0	0

Table C-3 (Continued)

Industrial Garments						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	**Minimum**	**Maximum**	**Mean**			
Nonconventional Organics (Continued)						
∝-Terpineol	0.0100	0.100	0.0550	6	0	0
Benzoic Acid	0.100	0.500	0.353	6	3	50
Benzyl Alcohol	0.0291	0.484	0.132	6	4	67
Hexanoic Acid	0.0471	0.176	0.0962	6	4	67
m-Xylene	0.0100	0.0100	0.0100	4	0	0
n-Decane	0.0100	4.61	0.807	6	1	17
n-Docosane	0.0118	1.35	0.271	6	5	83
n-Dodecane	0.0100	7.32	1.26	6	2	33
n-Eicosane	0.0140	2.52	0.471	6	4	67
n-Hexacosane	0.0190	0.226	0.117	6	6	100
n-Hexadecane	0.0100	3.30	0.602	6	3	50
n-Octacosane	0.0100	0.220	0.0821	6	4	67
n-Octadecane	0.0100	2.46	0.445	6	5	83
n-Tetracosane	0.0188	1.37	0.281	6	4	67
n-Tetradecane	0.0100	3.41	0.612	6	2	33
n-Triacontane	0.0115	0.479	0.123	6	4	67
o-&*p*-Xylene	0.0100	0.0100	0.0100	4	0	0
p-Cresol	0.0100	0.100	0.0417	6	0	0
p-Cymene	0.0100	0.208	0.0873	6	2	33
Pentamethylbenzene	0.0100	0.100	0.0550	6	0	0
Priority Metals and Elements						
Antimony	0.0151	1.57	0.312	6	6	100
Arsenic	0.00110	0.0232	0.00907	6	2	33
Beryllium	0.000300	0.00100	0.000605	6	2	33
Cadmium	0.00500	0.0459	0.0269	6	5	83
Chromium	0.0159	0.161	0.0959	6	6	100
Copper	0.148	1.31	0.688	6	6	100
Lead	0.0460	0.407	0.238	6	5	83
Mercury	0.000200	0.000760	0.000395	6	3	50
Nickel	0.0180	0.164	0.0999	6	5	83

Table C-3 (Continued)

Industrial Garments						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	**Minimum**	**Maximum**	**Mean**			
Priority Metals and Elements (Continued)						
Selenium	0.000500	0.0200	0.00767	6	2	33
Silver	0.00230	0.0431	0.0146	6	3	50
Thallium	0.00100	0.0100	0.00293	6	0	0
Zinc	0.264	3.07	1.50	6	6	100
Nonconventional Metals and Elements						
Aluminum	3.20	8.73	4.85	6	6	100
Barium	0.0404	0.560	0.273	6	6	100
Boron	0.0306	0.369	0.187	6	6	100
Cobalt	0.00230	0.0461	0.0134	6	2	33
Iron	1.42	17.4	10.9	6	6	100
Manganese	0.0732	0.209	0.148	6	6	100
Molybdenum	0.00450	0.0539	0.0213	6	4	67
Tin	0.0246	0.267	0.0722	6	5	83
Titanium	0.0842	0.223	0.150	6	6	100
Vanadium	0.00200	0.0120	0.00707	6	1	17
Yttrium	0.000300	0.00400	0.00178	6	1	17
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	1,070	2,760	1,710	6	6	100
Total Organic Carbon (TOC)	163	540	367	6	6	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	5.00	74.5	47.4	6	5	83

Table C-3 (Continued)

Shop Towels						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	**Minimum**	**Maximum**	**Mean**			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	1,130	5,640	2,780	6	6	100
Oil and Grease (measured as HEM)	2,090	5,360	3,250	4	4	100
Total Suspended Solids (TSS)	2,540	6,730	4,450	4	4	100
Priority Organics						
1,1,1-Trichloroethane	0.0100	38.3	4.13	6	3	50
1,2-Diphenylhydrazine	0.0700	2.00	1.07	4	0	0
4-Chloro-3-methylphenol	0.0200	2.06	0.795	4	1	25
Bis(2-ethylhexyl) Phthalate	0.633	9.44	3.63	5	4	80
Butyl Benzyl Phthalate	0.0350	3.79	1.46	4	1	25
Chlorobenzene	0.0100	1.00	0.252	5	1	20
Chloroform	0.0100	1.00	0.292	4	1	25
Di-*n*-butyl Phthalate	0.0350	1.00	0.558	4	1	25
Di-*n*-octyl Phthalate	0.0350	1.00	0.538	4	1	25
Ethylbenzene	0.556	36.0	5.27	6	6	100
Isophorone	0.0350	36.3	9.58	4	1	25
Methylene Chloride	0.0100	39.9	4.22	6	3	50
Naphthalene	0.329	5.16	2.91	5	4	80
Phenol	0.0350	1.00	0.310	4	1	25
Tetrachloroethene	0.170	55.5	8.92	6	5	83
Toluene	1.11	11.6	5.33	5	5	100
trans-1,2-Dichloroethene	0.0100	1.00	0.367	5	1	20
Trichloroethene	0.0100	1.00	0.247	5	2	40
Nonconventional Organics						
2-Butanone	0.0898	15.8	5.40	4	3	75
2-Methylnaphthalene	0.465	1.21	0.826	4	3	75
2-Propanone	1.00	5.95	3.98	4	3	75
4-Methyl-2-pentanone	0.132	5.00	1.88	4	2	50
∝-Terpineol	0.0350	1.59	0.956	4	2	50
Benzoic Acid	0.301	5.00	2.55	4	2	50
Benzyl Alcohol	0.0350	35.0	9.26	4	1	25

Table C-3 (Continued)

Shop Towels						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	**Minimum**	**Maximum**	**Mean**			
Nonconventional Organics (Continued)						
Hexanoic Acid	0.0200	1.00	0.305	4	0	0
m-Xylene	0.884	2.99	2.12	3	3	100
n-Decane	4.70	154	42.2	5	5	100
n-Docosane	0.313	1.55	1.10	4	3	75
n-Dodecane	13.3	23.7	19.1	4	4	100
n-Eicosane	1.44	84.6	25.1	4	4	100
n-Hexacosane	0.100	4.01	1.40	4	2	50
n-Hexadecane	2.85	17.4	10.0	5	5	100
n-Octacosane	0.100	2.21	0.858	4	2	50
n-Octadecane	1.06	22.1	11.2	5	5	100
n-Tetracosane	0.328	5.30	1.95	4	3	75
n-Tetradecane	6.51	36.8	15.0	4	4	100
n-Triacontane	0.0689	1.71	0.719	4	2	50
o-&*p*-Xylene	0.482	3.27	1.47	3	3	100
p-Cresol	0.0200	1.00	0.305	4	0	0
p-Cymene	0.0350	8.11	2.05	5	2	40
Pentamethylbenzene	0.0350	1.00	0.534	4	0	0
Priority Metals and Elements						
Antimony	0.0973	0.369	0.198	6	6	100
Arsenic	0.00800	0.0511	0.0224	5	4	80
Beryllium	0.000560	0.00100	0.000890	4	1	25
Cadmium	0.105	0.856	0.358	6	6	100
Chromium	0.119	1.17	0.490	6	6	100
Copper	2.44	9.79	6.48	6	6	100
Lead	2.04	20.5	6.52	6	6	100
Mercury	0.000200	0.00425	0.00183	5	3	60
Nickel	0.175	1.61	0.599	6	6	100
Selenium	0.0100	0.0200	0.0145	4	2	50
Silver	0.00270	0.877	0.139	6	3	50
Thallium	0.00100	0.0120	0.00390	4	0	0

Table C-3 (Continued)

Shop Towels						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	Minimum	Maximum	Mean			
Priority Metals and Elements (Continued)						
Zinc	6.82	29.4	13.5	6	6	100
Nonconventional Metals and Elements						
Aluminum	5.57	20.1	13.1	6	6	100
Barium	0.730	10.3	4.08	6	6	100
Boron	0.0500	3.81	1.99	6	5	83
Cobalt	0.0720	0.795	0.288	6	6	100
Iron	24.6	114	55.8	6	6	100
Manganese	0.510	1.95	1.09	6	6	100
Molybdenum	0.153	1.27	0.382	6	6	100
Tin	0.0290	0.808	0.370	6	5	83
Titanium	0.0177	0.574	0.232	6	6	100
Vanadium	0.0106	0.113	0.0420	6	6	100
Yttrium	0.00320	0.0171	0.00794	4	4	100
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	7,700	26,300	13,300	6	6	100
Total Organic Carbon (TOC)	750	2,950	2,030	6	6	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	520	3,410	1,760	4	4	100

Table C-3 (Continued)

Printer Towels						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	**Minimum**	**Maximum**	**Mean**			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	3,360	4,250	3,940	3	3	100
Oil and Grease (measured as HEM)	936	11,800	5,890	3	3	100
Total Suspended Solids (TSS)	810	1,600	1,250	3	3	100
Priority Organics						
1,1,1-Trichloroethane	1.00	8.26	4.50	3	2	67
1,2-Diphenylhydrazine	0.200	2.00	1.00	3	0	0
4-Chloro-3-methylphenol	0.100	1.00	0.433	3	0	0
Bis(2-ethylhexyl) Phthalate	3.83	36.4	19.0	3	3	100
Butyl Benzyl Phthalate	1.00	9.34	5.55	3	2	67
Chlorobenzene	0.100	1.00	0.467	3	1	33
Chloroform	0.0100	1.00	0.370	3	0	0
Di-*n*-butyl Phthalate	0.844	7.75	3.20	3	2	67
Di-*n*-octyl Phthalate	0.100	2.61	1.24	3	1	33
Ethylbenzene	0.521	29.2	13.2	3	3	100
Isophorone	0.100	1.00	0.500	3	0	0
Methylene Chloride	0.140	1.54	0.614	3	3	100
Naphthalene	3.73	12.7	9.64	3	3	100
Phenol	0.100	1.00	0.500	3	0	0
Tetrachloroethene	2.40	6.16	3.92	3	3	100
Toluene	14.1	33.2	20.5	3	3	100
trans-1,2-Dichloroethene	0.0118	1.00	0.371	3	1	33
Trichloroethene	0.100	1.00	0.476	3	1	33
Nonconventional Organics						
2-Butanone	2.05	5.00	3.09	3	2	67
2-Methylnaphthalene	0.100	1.71	0.836	3	2	67
2-Propanone	23.4	96.6	49.7	3	3	100
4-Methyl-2-pentanone	0.500	5.00	2.07	3	1	33
∝-Terpineol	0.100	1.58	1.07	3	2	67
Benzoic Acid	1.50	5.00	3.30	3	2	67
Benzyl Alcohol	0.100	1.00	0.500	3	0	0

Table C-3 (Continued)

Printer Towels						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	**Minimum**	**Maximum**	**Mean**			
Nonconventional Organics (Continued)						
Hexanoic Acid	0.100	1.00	0.433	3	0	0
m-Xylene	0.100	2.79	1.44	2	1	50
n-Decane	10.1	158	90.6	3	3	100
n-Docosane	0.100	1.00	0.668	3	1	33
n-Dodecane	12.9	41.8	23.1	3	3	100
n-Eicosane	1.22	1.38	1.29	3	3	100
n-Hexacosane	1.00	3.73	2.01	3	2	67
n-Hexadecane	4.34	15.4	9.51	3	3	100
n-Octacosane	0.100	1.01	0.402	3	1	33
n-Octadecane	1.73	3.62	2.43	3	3	100
n-Tetracosane	0.100	1.00	0.605	3	1	33
n-Tetradecane	3.08	15.8	7.89	3	3	100
n-Triacontane	0.100	1.00	0.626	3	1	33
o-&*p*-Xylene	0.100	2.05	1.08	2	1	50
p-Cresol	0.100	1.00	0.433	3	0	0
p-Cymene	8.10	19.8	12.4	3	3	100
Pentamethylbenzene	0.100	1.00	0.500	3	0	0
Priority Metals and Elements						
Antimony	0.0200	0.104	0.0556	3	2	67
Arsenic	0.00100	0.00530	0.00313	3	2	67
Beryllium	0.00100	0.00100	0.00100	3	0	0
Cadmium	0.0129	0.0444	0.0253	3	3	100
Chromium	0.278	7.31	2.65	3	3	100
Copper	8.20	14.9	11.0	3	3	100
Lead	1.12	23.8	8.91	3	3	100
Mercury	0.000200	0.000290	0.000230	3	1	33
Nickel	0.0962	0.108	0.101	3	3	100
Selenium	0.0100	0.0230	0.0177	3	0	0
Silver	0.00900	0.555	0.207	3	3	100
Thallium	0.00100	0.0120	0.00767	3	0	0

Table C-3 (Continued)

Printer Towels						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	Minimum	Maximum	Mean			
Priority Metals and Elements (Continued)						
Zinc	2.84	4.21	3.62	3	3	100
Nonconventional Metals and Elements						
Aluminum	3.30	17.4	8.22	3	3	100
Barium	3.14	6.97	4.53	3	3	100
Boron	0.614	0.777	0.670	3	3	100
Cobalt	0.222	0.942	0.614	3	3	100
Iron	5.58	10.0	8.51	3	3	100
Manganese	0.305	1.29	0.898	3	3	100
Molybdenum	0.328	5.17	2.10	3	3	100
Tin	0.0431	0.138	0.0990	3	3	100
Titanium	0.0797	0.313	0.184	3	3	100
Vanadium	0.00700	0.0120	0.00900	3	0	0
Yttrium	0.00400	0.00810	0.00570	3	1	33
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	15,800	19,100	16,900	3	3	100
Total Organic Carbon (TOC)	2,220	3,520	2,740	3	3	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	133	4,540	1,730	3	3	100

Table C-3 (Continued)

Mats						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	**Minimum**	**Maximum**	**Mean**			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	98.0	248	179	3	3	100
Oil and Grease (measured as HEM)	84.3	153	105	3	3	100
Total Suspended Solids (TSS)	365	1,020	690	3	3	100
Priority Organics						
1,1,1-Trichloroethane	0.0100	1.60	0.806	3	1	33
1,2-Diphenylhydrazine	0.0200	0.0200	0.0200	3	0	0
4-Chloro-3-methylphenol	0.0100	0.0100	0.0100	3	0	0
Bis(2-ethylhexyl) Phthalate	1.18	2.02	1.70	3	3	100
Butyl Benzyl Phthalate	0.0100	0.0907	0.0350	3	2	67
Chlorobenzene	0.0100	0.0100	0.0100	3	0	0
Chloroform	0.0100	0.0100	0.0100	3	0	0
Di-*n*-butyl Phthalate	0.0100	0.315	0.114	3	2	67
Di-*n*-octyl Phthalate	0.0192	0.0494	0.0369	3	3	100
Ethylbenzene	0.0100	0.283	0.147	3	1	33
Isophorone	0.0100	0.361	0.186	3	2	67
Methylene Chloride	0.0100	0.442	0.226	3	1	33
Naphthalene	0.0100	0.0244	0.0172	3	1	33
Phenol	0.0100	0.0238	0.0134	3	1	33
Tetrachloroethene	0.0100	0.125	0.0676	3	1	33
Toluene	0.0100	1.29	0.654	3	2	67
trans-1,2-Dichloroethene	0.0100	0.0100	0.0100	3	0	0
Trichloroethene	0.0100	0.0100	0.0100	3	0	0
Nonconventional Organics						
2-Butanone	0.0500	0.579	0.314	3	1	33
2-Methylnaphthalene	0.0100	0.0100	0.0100	3	0	0
2-Propanone	0.0500	2.11	1.10	3	2	67
4-Methyl-2-pentanone	0.0500	0.458	0.254	3	1	33
∝-Terpineol	0.0100	0.0825	0.0463	3	1	33
Benzoic Acid	0.0500	0.231	0.156	3	2	67
Benzyl Alcohol	0.0185	0.0724	0.0520	3	3	100

Table C-3 (Continued)

Mats						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	**Minimum**	**Maximum**	**Mean**			
Nonconventional Organics (Continued)						
Hexanoic Acid	0.0152	0.0817	0.0611	3	3	100
m-Xylene	0.0100	0.520	0.265	3	1	33
n-Decane	0.0100	1.98	0.995	3	1	33
n-Docosane	0.0130	0.0272	0.0175	3	3	100
n-Dodecane	0.0100	0.121	0.0654	3	1	33
n-Eicosane	0.0166	0.0318	0.0206	3	3	100
n-Hexacosane	0.0184	0.0265	0.0211	3	3	100
n-Hexadecane	0.0100	0.0305	0.0206	3	2	67
n-Octacosane	0.0100	0.0168	0.0134	3	2	67
n-Octadecane	0.0112	0.0222	0.0160	3	3	100
n-Tetracosane	0.0100	0.0934	0.0394	3	2	67
n-Tetradecane	0.0100	0.0190	0.0145	3	1	33
n-Triacontane	0.0274	0.0306	0.0292	3	3	100
o-&*p*-Xylene	0.0100	0.291	0.151	3	1	33
p-Cresol	0.0100	0.0100	0.0100	3	0	0
p-Cymene	0.0100	0.0100	0.0100	3	0	0
Pentamethylbenzene	0.0100	0.0100	0.0100	3	0	0
Priority Metals and Elements						
Antimony	0.0200	0.0209	0.0204	3	3	100
Arsenic	0.00380	0.0143	0.00905	3	2	67
Beryllium	0.000540	0.00100	0.000775	3	2	67
Cadmium	0.00950	0.0267	0.0147	3	3	100
Chromium	0.0806	0.303	0.167	3	3	100
Copper	0.220	3.97	1.31	3	3	100
Lead	0.307	1.64	0.711	3	3	100
Mercury	0.000430	0.00392	0.00142	3	3	100
Nickel	0.0543	0.297	0.152	3	3	100
Selenium	0.00150	0.00460	0.00305	3	0	0
Silver	0.0155	0.0176	0.0168	3	3	100
Thallium	0.00160	0.0120	0.00680	3	0	0

Table C-3 (Continued)

Mats						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Priority Metals and Elements (Continued)						
Zinc	1.06	4.31	2.42	3	3	100
Nonconventional Metals and Elements						
Aluminum	3.42	17.4	10.3	3	3	100
Barium	0.214	0.551	0.376	3	3	100
Boron	0.0500	0.123	0.0818	3	2	67
Cobalt	0.0135	0.0256	0.0184	3	3	100
Iron	6.87	47.7	24.7	3	3	100
Manganese	0.115	0.553	0.318	3	3	100
Molybdenum	0.0240	0.0417	0.0321	3	3	100
Tin	0.0439	0.205	0.0938	3	3	100
Titanium	0.0100	0.828	0.364	3	2	67
Vanadium	0.00920	0.0465	0.0273	3	3	100
Yttrium	0.00500	0.00874	0.00675	3	2	67
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	80.0	968	515	3	3	100
Total Organic Carbon (TOC)	33.0	186	111	3	3	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	33.2	72.5	48.5	3	2	67

Table C-3 (Continued)

Mops						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	Minimum	Maximum	Mean			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	140	2,160	1,150	2	2	100
Oil and Grease (measured as HEM)	9	564	286	2	2	100
Total Suspended Solids (TSS)	332	1,860	1,100	2	2	100
Priority Organics						
1,1,1-Trichloroethane	0.0100	2.08	1.04	2	1	50
1,2-Diphenylhydrazine	0.200	0.200	0.200	2	0	0
4-Chloro-3-methylphenol	0.100	0.100	0.100	2	0	0
Bis(2-ethylhexyl) Phthalate	1.08	1.13	1.10	2	2	100
Butyl Benzyl Phthalate	0.166	1.62	0.895	2	2	100
Chlorobenzene	0.0100	0.100	0.0550	2	0	0
Chloroform	0.0130	0.100	0.0565	2	1	50
Di-*n*-butyl Phthalate	0.100	0.768	0.434	2	1	50
Di-*n*-octyl Phthalate	0.100	0.116	0.108	2	1	50
Ethylbenzene	0.0100	0.100	0.0550	2	0	0
Isophorone	0.100	0.100	0.100	2	0	0
Methylene Chloride	0.0100	0.143	0.0767	2	1	50
Naphthalene	0.443	0.500	0.471	2	2	100
Phenol	0.100	0.100	0.100	2	0	0
Tetrachloroethene	0.0100	0.100	0.0550	2	0	0
Toluene	0.0194	0.100	0.0597	2	1	50
trans-1,2-Dichloroethene	0.0100	0.100	0.0550	2	0	0
Trichloroethene	0.0100	0.100	0.0550	2	0	0
Nonconventional Organics						
2-Butanone	0.0500	2.21	1.13	2	1	50
2-Methylnaphthalene	0.100	0.763	0.432	2	1	50
2-Propanone	0.0500	4.40	2.22	2	1	50
4-Methyl-2-pentanone	0.0500	0.500	0.275	2	0	0
∝-Terpineol	0.100	0.100	0.100	2	0	0
Benzoic Acid	1.91	2.78	2.35	2	2	100
Benzyl Alcohol	0.100	1.12	0.610	2	1	50

Table C-3 (Continued)

Mops						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	Minimum	Maximum	Mean			
Nonconventional Organics (Continued)						
Hexanoic Acid	0.185	0.246	0.216	2	2	100
m-Xylene	0.100	0.100	0.100	1	0	0
n-Decane	0.271	1.66	0.965	2	2	100
n-Docosane	0.137	0.178	0.157	2	2	100
n-Dodecane	0.100	16.0	8.07	2	1	50
n-Eicosane	0.246	0.336	0.291	2	2	100
n-Hexacosane	0.207	0.213	0.210	2	2	100
n-Hexadecane	0.286	1.86	1.07	2	2	100
n-Octacosane	0.168	0.275	0.221	2	2	100
n-Octadecane	0.392	1.36	0.875	2	2	100
n-Tetracosane	0.100	0.100	0.100	2	0	0
n-Tetradecane	1.13	1.80	1.47	2	2	100
n-Triacontane	0.0941	0.232	0.163	2	2	100
o-&*p*-Xylene	0.100	0.100	0.100	1	0	0
p-Cresol	0.100	0.100	0.100	2	0	0
p-Cymene	0.100	0.100	0.100	2	0	0
Pentamethylbenzene	0.100	0.100	0.100	2	0	0
Priority Metals and Elements						
Antimony	0.003100	0.0556	0.0294	2	2	100
Arsenic	0.00260	0.0178	0.0102	2	2	100
Beryllium	0.00100	0.00100	0.00100	2	0	0
Cadmium	0.00500	0.0373	0.0212	2	1	50
Chromium	0.0178	0.184	0.101	2	2	100
Copper	0.427	3.52	1.97	2	2	100
Lead	0.0460	1.76	0.903	2	1	50
Mercury	0.000910	0.00840	0.00466	2	2	100
Nickel	0.0180	0.195	0.106	2	1	50
Selenium	0.00460	0.0200	0.0123	2	0	0
Silver	0.00620	0.0160	0.0111	2	2	100
Thallium	0.00240	0.0100	0.00620	2	0	0

Table C-3 (Continued)

Mops						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Priority Metals and Elements (Continued)						
Zinc	0.686	5.32	3.00	2	2	100
Nonconventional Metals and Elements						
Aluminum	2.25	17.3	9.78	2	2	100
Barium	0.189	0.953	0.571	2	2	100
Boron	0.0533	0.327	0.190	2	2	100
Cobalt	0.0100	0.0620	0.0360	2	1	50
Iron	3.90	31.9	17.9	2	2	100
Manganese	0.0783	0.638	0.358	2	2	100
Molybdenum	0.0284	0.0940	0.0612	2	2	100
Tin	0.0290	0.128	0.0785	2	1	50
Titanium	0.0602	0.307	0.184	2	2	100
Vanadium	0.0120	0.0320	0.0220	2	1	50
Yttrium	0.00400	0.00500	0.004500	2	0	0
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	720	10,100	5,410	2	2	100
Total Organic Carbon (TOC)	133	902	518	2	2	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	5	218	111	2	1	50

Table C-3 (Continued)

Steam-Tumbled Printer Towels						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	**Minimum**	**Maximum**	**Mean**			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	1,440	1,440	1,440	1	1	100
Oil and Grease (measured as HEM)	1,720	1,720	1,720	1	1	100
Total Suspended Solids (TSS)	1,320	1,320	1,320	1	1	100
Priority Organics						
1,1,1-Trichloroethane	0.0118	0.0118	0.0118	1	1	100
1,2-Diphenylhydrazine	0.0800	0.0800	0.0800	1	0	0
4-Chloro-3-methylphenol	0.0400	0.0400	0.0400	1	0	0
Bis(2-ethylhexyl) Phthalate	8.77	8.77	8.77	1	1	100
Butyl Benzyl Phthalate	0.366	0.366	0.366	1	1	100
Chlorobenzene	0.0100	0.0100	0.0100	1	0	0
Chloroform	0.0100	0.0100	0.0100	1	0	0
Di-*n*-butyl Phthalate	0.117	0.117	0.117	1	1	100
Di-*n*-octyl Phthalate	0.325	0.325	0.325	1	1	100
Ethylbenzene	0.0100	0.0100	0.0100	1	0	0
Isophorone	0.0400	0.0400	0.0400	1	0	0
Methylene Chloride	0.0100	0.0100	0.0100	1	0	0
Naphthalene	0.226	0.226	0.226	1	1	100
Phenol	0.0432	0.0432	0.0432	1	1	100
Tetrachloroethene	0.0100	0.0100	0.0100	1	0	0
Toluene	0.0436	0.0436	0.0436	1	1	100
trans-1,2-Dichloroethene	0.0100	0.0100	0.0100	1	0	0
Trichloroethene	0.0100	0.0100	0.0100	1	0	0
Nonconventional Organics						
2-Butanone	0.0500	0.0500	0.0500	1	0	0
2-Methylnaphthalene	0.0400	0.0400	0.0400	1	0	0
2-Propanone	0.681	0.681	0.681	1	1	100
4-Methyl-2-pentanone	0.0500	0.0500	0.0500	1	0	0
∝-Terpineol	0.0400	0.0400	0.0400	1	0	0
Benzoic Acid	0.977	0.977	0.977	1	1	100
Benzyl Alcohol	0.819	0.819	0.819	1	1	100

Table C-3 (Continued)

Steam-Tumbled Printer Towels						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	Minimum	Maximum	Mean			
Nonconventional Organics (Continued)						
Hexanoic Acid	0.384	0.384	0.384	1	1	100
m-Xylene	0.0151	0.0151	0.0151	1	1	100
n-Decane	0.499	0.499	0.499	1	1	100
n-Docosane	0.131	0.131	0.131	1	1	100
n-Dodecane	2.65	2.65	2.65	1	1	100
n-Eicosane	3.05	3.05	3.05	1	1	100
n-Hexacosane	0.0904	0.0904	0.0904	1	1	100
n-Hexadecane	91.6	91.6	91.6	1	1	100
n-Octacosane	0.0633	0.0633	0.0633	1	1	100
n-Octadecane	1.48	1.48	1.48	1	1	100
n-Tetracosane	0.0724	0.0724	0.0724	1	1	100
n-Tetradecane	12.8	12.8	12.8	1	1	100
n-Triacontane	0.0587	0.0587	0.0587	1	1	100
o-&*p*-Xylene	0.0146	0.0146	0.0146	1	1	100
p-Cresol	0.0400	0.0400	0.0400	1	0	0
p-Cymene	0.0400	0.0400	0.0400	1	0	0
Pentamethylbenzene	0.0400	0.0400	0.0400	1	0	0
Priority Metals and Elements						
Antimony	0.0261	0.0261	0.0261	1	1	100
Arsenic	0.00380	0.00380	0.00380	1	0	0
Beryllium	0.00100	0.00100	0.00100	1	0	0
Cadmium	0.0358	0.0358	0.0358	1	1	100
Chromium	0.275	0.275	0.275	1	1	100
Copper	4.86	4.86	4.86	1	1	100
Lead	0.957	0.957	0.957	1	1	100
Mercury	0.000200	0.000200	0.000200	1	0	0
Nickel	0.0372	0.0372	0.0372	1	1	100
Selenium	0.0230	0.0230	0.0230	1	0	0
Silver	0.0653	0.0653	0.0653	1	1	100
Thallium	0.0120	0.0120	0.0120	1	0	0

Table C-3 (Continued)

Steam-Tumbled Printer Towels						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	Minimum	Maximum	Mean			
Priority Metals and Elements (Continued)						
Zinc	2.10	2.10	2.10	1	1	100
Nonconventional Metals and Elements						
Aluminum	2.80	2.80	2.80	1	1	100
Barium	1.63	1.63	1.63	1	1	100
Boron	0.0500	0.0500	0.0500	1	0	0
Cobalt	0.202	0.202	0.202	1	1	100
Iron	2.62	2.62	2.62	1	1	100
Manganese	0.277	0.277	0.277	1	1	100
Molybdenum	2.64	2.64	2.64	1	1	100
Tin	0.0761	0.0761	0.0761	1	1	100
Titanium	0.0178	0.0178	0.0178	1	1	100
Vanadium	0.0221	0.0221	0.0221	1	1	100
Yttrium	0.00500	0.00500	0.00500	1	0	0
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	9,000	9,000	9,000	1	1	100
Total Organic Carbon (TOC)	1,770	1,770	1,770	1	1	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	468	468	468	1	1	100

Table C-3 (Continued)

Items Dry Cleaned Prior to Water Washing						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	**Minimum**	**Maximum**	**Mean**			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	110	120	113	3	3	100
Total Suspended Solids (TSS)	70	93	82	3	3	100
Priority Organics						
Ethylbenzene	0.00200	0.232	0.0458	11	8	73
Toluene	0.00200	1.23	0.225	11	8	73
Priority Metals and Elements						
Arsenic	0.00500	0.00500	0.00500	3	0	0
Cadmium	0.0100	0.150	0.0825	4	3	75
Chromium	0.0200	0.1700	0.0933	3	3	100
Copper	0.0600	0.940	0.668	4	4	100
Lead	0.00500	1.50	0.519	3	2	67
Mercury	0.000100	0.000200	0.000150	4	0	0
Nickel	0.0200	0.0200	0.0200	3	0	0
Silver	0.00500	0.00500	0.00500	5	0	0
Zinc	0.350	0.640	0.450	3	3	100
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	528	804	638	3	3	100

Table C-3 (Continued)

Linen Supply Items						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	**Minimum**	**Maximum**	**Mean**			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	50	2,520	881	9	9	100
Oil and Grease (measured as HEM)	72	142	108	3	3	100
Total Suspended Solids (TSS)	35	1,060	269	9	9	100
Priority Organics						
1,1,1-Trichloroethane	0.00500	0.0100	0.00833	5	0	0
1,2-Diphenylhydrazine	0.0200	0.0200	0.0200	3	0	0
4-Chloro-3-methylphenol	0.0100	0.0100	0.0100	3	0	0
Bis(2-ethylhexyl) Phthalate	0.0410	1.49	0.574	3	3	100
Butyl Benzyl Phthalate	0.0100	0.263	0.0944	3	1	33
Chlorobenzene	0.00500	0.0100	0.00833	5	0	0
Chloroform	0.0100	2.58	0.889	5	5	100
Di-*n*-butyl Phthalate	0.0100	0.0717	0.0306	3	1	33
Di-*n*-octyl Phthalate	0.0100	0.130	0.0572	3	2	67
Ethylbenzene	0.00500	0.0100	0.00833	5	0	0
Isophorone	0.0100	0.0100	0.0100	3	0	0
Methylene Chloride	0.0100	0.0130	0.0112	5	2	40
Naphthalene	0.0100	0.304	0.108	3	1	33
Phenol	0.0467	0.104	0.0674	3	3	100
Tetrachloroethene	0.00500	0.0100	0.00833	5	0	0
Toluene	0.00500	0.152	0.0241	5	1	20
trans-1,2-Dichloroethene	0.00500	0.0100	0.00833	5	0	0
Trichloroethene	0.00500	0.0100	0.00833	5	0	0
Nonconventional Organics						
2-Butanone	0.0500	0.0500	0.0500	3	0	0
2-Methylnaphthalene	0.01000	0.0291	0.0164	3	1	33
2-Propanone	0.0500	0.0804	0.0607	3	2	67
4-Methyl-2-pentanone	0.0500	0.0500	0.0500	3	0	0
∝-Terpineol	0.0100	0.0817	0.0339	3	1	33
Benzoic Acid	0.116	0.216	0.150	3	3	100
Benzyl Alcohol	0.0100	0.575	0.202	3	2	67

Table C-3 (Continued)

Linen Supply Items						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	**Minimum**	**Maximum**	**Mean**			
Nonconventional Organics (Continued)						
Hexanoic Acid	0.0100	0.0418	0.0279	3	2	67
m-Xylene	0.0100	0.0100	0.0100	3	0	0
n-Decane	0.0100	7.87	2.63	3	1	33
n-Docosane	0.0100	0.0732	0.0392	3	2	67
n-Dodecane	0.0100	0.513	0.270	3	2	67
n-Eicosane	0.0100	0.209	0.0862	3	2	67
n-Hexacosane	0.0100	0.0598	0.0267	3	2	67
n-Hexadecane	0.0100	0.458	0.160	3	2	67
n-Octacosane	0.0100	0.0436	0.0212	3	1	33
n-Octadecane	0.0100	0.169	0.0720	3	2	67
n-Tetracosane	0.0100	0.128	0.0630	3	2	67
n-Tetradecane	0.0100	0.400	0.140	3	1	33
n-Triacontane	0.0100	0.126	0.0551	3	2	67
o-&*p*-Xylene	0.0100	0.0100	0.0100	3	0	0
p-Cresol	0.0100	0.0100	0.0100	3	0	0
p-Cymene	0.0100	0.305	0.108	3	1	33
Pentamethylbenzene	0.0100	0.0100	0.0100	3	0	0
Priority Metals and Elements						
Antimony	0.00810	0.3130	0.114	3	2	67
Arsenic	0.00880	0.300	0.156	4	3	75
Beryllium	0.00100	0.00100	0.00100	3	0	0
Cadmium	0.00500	0.0500	0.0219	15	2	13
Chromium	0.0100	0.140	0.0492	15	7	47
Copper	0.0500	2.50	0.527	15	14	93
Lead	0.0400	0.500	0.151	15	8	53
Mercury	0.000200	0.00300	0.00165	4	2	50
Nickel	0.0150	0.280	0.0771	15	6	40
Selenium	0.00200	0.300	0.151	4	0	0
Silver	0.00500	0.0700	0.0291	14	6	43
Thallium	0.00100	0.0100	0.00700	3	0	0

Table C-3 (Continued)

Linen Supply Items						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	**Minimum**	**Maximum**	**Mean**			
Priority Metals and Elements (Continued)						
Zinc	0.120	1.10	0.381	17	17	100
Nonconventional Metals and Elements						
Aluminum	1.35	4.70	3.08	3	3	100
Barium	0.0804	0.646	0.301	3	3	100
Boron	0.0310	0.229	0.0970	3	1	33
Cobalt	0.00900	0.0117	0.00990	3	1	33
Iron	1.09	8.93	3.26	5	5	100
Manganese	0.0285	0.147	0.0812	3	3	100
Molybdenum	0.0100	0.0588	0.0263	3	1	33
Tin	0.0290	0.0290	0.0290	3	0	0
Titanium	0.0267	0.105	0.0654	3	3	100
Vanadium	0.00800	0.0133	0.00990	3	2	67
Yttrium	0.00300	0.00810	0.00470	3	1	33
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	197	1,520	844	7	7	100
Total Organic Carbon (TOC)	310	494	401	3	3	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	9	19	12	3	3	100

[1]The detection limit concentration was used in calculations for data points reported as nondetects.

Table C-4

Wastewater Characterization Data for Wastewater Streams at Industrial Laundries

Wastewater Characterization Data for Heavy Wastewater						
Pollutant of Concern	Concentration (mg/L)[1]			Number of Times Analyzed	Number of Times Detected	Percentage Detected (%)
	Minimum	Maximum	Mean			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	1,600	9,810	4,160	18	18	100
Oil and Grease (measured as HEM)	612	6,410	2,950	18	18	100
Total Suspended Solids (TSS)	213	7,000	2,320	18	18	100
Priority Organics						
1,1,1-Trichloroethane	0.0100	10.3	1.16	18	5	28
1,2-Diphenylhydrazine	0.0200	41.3	2.60	18	3	17
4-Chloro-3-methylphenol	0.0100	1.00	0.260	18	2	11
Bis(2-ethylhexyl) Phthalate	0.0353	42.0	11.3	18	16	89
Butyl Benzyl Phthalate	0.0100	74.4	8.89	18	5	28
Chlorobenzene	0.00992	1.00	0.271	18	0	0
Chloroform	0.0100	1.00	0.296	18	5	28
Di-*n*-butyl Phthalate	0.0100	9.98	1.30	18	12	67
Di-*n*-octyl Phthalate	0.100	1.69	0.599	18	6	33
Ethylbenzene	0.100	18.7	3.65	18	17	94
Isophorone	0.0100	1.00	0.207	18	0	0
Methylene Chloride	0.0100	6.62	0.854	18	7	39
Naphthalene	0.388	18.8	4.76	18	18	100
Phenol	0.0100	1.00	0.303	18	3	17
Tetrachloroethene	0.0100	7.88	1.79	18	11	61
Toluene	0.321	41.8	9.69	18	18	100
trans-1,2-Dichloroethene	0.00992	1.00	0.271	18	0	0
Trichloroethene	0.00992	20.0	1.27	18	1	6
Nonconventional Organics						
2-Butanone	0.0500	272	25.5	18	11	61
2-Methylnaphthalene	0.100	2.24	0.892	18	12	67
2-Propanone	0.552	52.7	8.49	18	16	89
4-Methyl-2-pentanone	0.0500	69.9	5.82	18	11	61

Table C-4 (Continued)

Wastewater Characterization Data for Heavy Wastewater						
Pollutant of Concern	Concentration (mg/L)[1]			Number of Times Analyzed	Number of Times Detected	Percentage Detected (%)
	Minimum	Maximum	Mean			
Nonconventional Organics (Continued)						
∝-Terpineol	0.100	2.26	0.379	18	6	33
Benzoic Acid	0.0500	12.2	3.36	18	9	50
Benzyl Alcohol	0.0100	10.7	1.56	18	4	22
Hexanoic Acid	0.0100	1.00	0.210	18	1	6
m-Xylene	0.0751	25.0	4.47	13	13	100
n-Decane	0.100	419	86.5	18	17	94
n-Docosane	0.100	2.50	0.504	18	7	39
n-Dodecane	0.0459	106	29.5	18	17	94
n-Eicosane	0.100	26.5	4.28	18	17	94
n-Hexacosane	0.100	1.28	0.354	18	5	28
n-Hexadecane	0.269	38.4	9.11	18	18	100
n-Octacosane	0.100	1.44	0.370	18	4	22
n-Octadecane	0.100	13.6	4.00	18	17	94
n-Tetracosane	0.0100	1.00	0.289	18	3	17
n-Tetradecane	0.100	41.6	7.23	18	15	83
n-Triacontane	0.0100	1.00	0.366	18	4	22
o-&*p*-Xylene	0.0438	17.8	3.59	13	13	100
p-Cresol	0.0100	1.00	0.204	18	0	0
p-Cymene	0.0100	12.2	3.16	18	11	61
Pentamethylbenzene	0.0100	1.97	0.412	18	6	33
Priority Metals and Elements						
Antimony	0.0200	8.24	0.788	18	14	78
Arsenic	0.00100	0.0396	0.0125	18	9	50
Beryllium	0.000970	0.00341	0.00142	18	7	39
Cadmium	0.0236	0.331	0.121	18	18	100
Chromium	0.0990	0.726	0.296	18	18	100
Copper	2.08	11.6	5.37	18	18	100
Lead	0.3500	3.78	1.60	18	18	100
Mercury	0.000200	0.00665	0.000816	18	9	50
Nickel	0.0541	0.861	0.266	18	18	100

Table C-4 (Continued)

Wastewater Characterization Data for Heavy Wastewater						
Pollutant of Concern	Concentration (mg/L)[1]			Number of Times Analyzed	Number of Times Detected	Percentage Detected (%)
	Minimum	Maximum	Mean			
Priority Metals and Elements (Continued)						
Selenium	0.000500	0.0451	0.0174	18	7	39
Silver	0.00230	1.25	0.199	18	13	72
Thallium	0.000900	0.0526	0.00989	18	4	22
Zinc	2.54	15.7	7.79	18	18	100
Nonconventional Metals and Elements						
Aluminum	4.10	21.0	9.97	18	18	100
Barium	1.25	7.22	3.63	18	18	100
Boron	0.0310	37.2	4.93	18	17	94
Cobalt	0.0620	3.10	0.449	18	18	100
Iron	6.89	96.6	42.1	18	18	100
Manganese	0.381	6.31	1.51	18	18	100
Molybdenum	0.145	2.29	0.668	18	18	100
Tin	0.0290	0.589	0.130	18	15	83
Titanium	0.0843	1.32	0.344	18	18	100
Vanadium	0.00800	0.0892	0.0381	18	16	89
Yttrium	0.000300	0.0417	0.0101	18	11	61
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	1,620	29,300	13,700	18	18	100
Total Organic Carbon (TOC)	106	6,240	2,790	18	18	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	101	4,120	1,440	18	18	100

Table C-4 (Continued)

Wastewater Characterization Data for Light Wastewater						
Pollutant of Concern	Concentration (mg/L)[1]			Number of Times Analyzed	Number of Times Detected	Percentage Detected (%)
	Minimum	Maximum	Mean			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	120	1,280	568	14	14	100
Oil and Grease (measured as HEM)	14.3	430	154	14	14	100
Total Suspended Solids (TSS)	124	804	344	14	14	100
Priority Organics						
1,1,1-Trichloroethane	0.0100	0.100	0.0160	14	0	0
1,2-Diphenylhydrazine	0.0200	1.62	0.220	14	2	14
4-Chloro-3-methylphenol	0.0100	0.100	0.0411	14	2	14
Bis(2-ethylhexyl) Phthalate	0.116	6.02	1.10	14	14	100
Butyl Benzyl Phthalate	0.0100	0.353	0.0690	14	7	50
Chlorobenzene	0.0100	0.100	0.0160	14	0	0
Chloroform	0.0100	0.100	0.0455	14	12	86
Di-*n*-butyl Phthalate	0.0100	1.04	0.104	14	4	29
Di-*n*-octyl Phthalate	0.0100	0.177	0.0667	14	7	50
Ethylbenzene	0.0100	0.282	0.0620	14	12	86
Isophorone	0.0100	0.100	0.0400	14	0	0
Methylene Chloride	0.0100	0.100	0.0213	14	2	14
Naphthalene	0.0195	1.04	0.358	14	11	79
Phenol	0.0100	0.580	0.105	14	7	50
Tetrachloroethene	0.0100	0.797	0.0977	14	9	64
Toluene	0.0225	0.110	0.0553	14	13	93
trans-1,2-Dichloroethene	0.0100	0.100	0.0160	14	0	0
Trichloroethene	0.0100	0.100	0.0160	14	0	0
Nonconventional Organics						
2-Butanone	0.0500	0.862	0.147	14	4	29
2-Methylnaphthalene	0.0100	0.198	0.0566	14	8	57
2-Propanone	0.0759	2.52	0.518	14	13	93
4-Methyl-2-pentanone	0.0500	2.29	0.240	14	3	21
∝-Terpineol	0.0100	0.449	0.123	14	9	64
Benzoic Acid	0.0500	0.772	0.306	14	5	36
Benzyl Alcohol	0.0100	0.283	0.102	14	8	57

Table C-4 (Continued)

Wastewater Characterization Data for Light Wastewater						
Pollutant of Concern	Concentration (mg/L)[1]			Number of Times Analyzed	Number of Times Detected	Percentage Detected (%)
	Minimum	Maximum	Mean			
Nonconventional Organics (Continued)						
Hexanoic Acid	0.0100	0.103	0.0557	14	4	29
m-Xylene	0.0173	0.143	0.0555	9	9	100
n-Decane	0.0447	1.62	0.354	14	13	93
n-Docosane	0.0100	0.293	0.0591	14	8	57
n-Dodecane	0.0100	10.8	0.973	14	9	64
n-Eicosane	0.0123	0.756	0.124	14	10	71
n-Hexacosane	0.0100	0.102	0.0465	14	5	36
n-Hexadecane	0.0107	1.13	0.330	14	11	79
n-Octacosane	0.0100	0.100	0.0432	14	6	43
n-Octadecane	0.0100	0.253	0.0850	14	11	79
n-Tetracosane	0.0100	0.456	0.0680	14	5	36
n-Tetradecane	0.0100	0.771	0.103	14	8	57
n-Triacontane	0.0100	0.109	0.0492	14	6	43
o-&*p*-Xylene	0.0108	0.241	0.0765	9	9	100
p-Cresol	0.0100	0.100	0.0400	14	0	0
p-Cymene	0.0100	0.100	0.0473	14	2	14
Pentamethylbenzene	0.0100	0.264	0.0787	14	4	29
Priority Metals and Elements						
Antimony	0.0201	13.8	1.32	14	10	71
Arsenic	0.00100	0.0200	0.00653	14	4	29
Beryllium	0.000470	0.00148	0.000938	14	5	36
Cadmium	0.00120	0.0434	0.0211	14	9	64
Chromium	0.0165	0.317	0.113	14	14	100
Copper	0.200	1.95	0.858	14	14	100
Lead	0.0460	0.810	0.348	14	13	93
Mercury	0.000200	0.00141	0.000715	14	9	64
Nickel	0.0180	0.339	0.101	14	11	79
Selenium	0.000500	0.0308	0.0133	14	2	14
Silver	0.00230	0.00820	0.00432	14	4	29
Thallium	0.000900	0.0100	0.00313	14	0	0

Table C-4 (Continued)

Wastewater Characterization Data for Light Wastewater						
Pollutant of Concern	Concentration (mg/L)[1]			Number of Times Analyzed	Number of Times Detected	Percentage Detected (%)
	Minimum	Maximum	Mean			
Priority Metals and Elements (Continued)						
Zinc	0.624	2.79	1.47	14	14	100
Nonconventional Metals and Elements						
Aluminum	1.87	7.43	4.65	14	14	100
Barium	0.108	0.752	0.421	14	14	100
Boron	0.0360	3.07	0.391	14	11	79
Cobalt	0.00230	0.137	0.0264	14	6	43
Iron	2.26	27.5	10.3	14	14	100
Manganese	0.0628	0.353	0.184	14	14	100
Molybdenum	0.0100	0.0868	0.0357	14	11	79
Tin	0.0290	0.211	0.0625	14	10	71
Titanium	0.0404	0.724	0.206	14	14	100
Vanadium	0.00200	0.0393	0.0138	14	4	29
Yttrium	0.00030	0.0114	0.00313	14	1	7
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	500	2,360	1,410	14	14	100
Total Organic Carbon (TOC)	117	540	338	14	14	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	5	282	85	14	12	86

Table C-4 (Continued)

Wastewater Characterization Data for Total Stream Wastewater						
Pollutant of Concern	Concentration (mg/L)[1]			Number of Times Analyzed	Number of Times Detected	Percentage Detected (%)
	Minimum	Maximum	Mean			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	82.0	3,470	933	56	56	100
Oil and Grease (measured as HEM)	558	2,460	1,670	13	13	100
Total Suspended Solids (TSS)	60.0	4,860	1,200	56	56	100
Priority Organics						
1,1,1-Trichloroethane	0.00100	5.56	0.283	23	16	70
1,2-Diphenylhydrazine	0.000025	0.200	0.0918	20	0	0
4-Chloro-3-methylphenol	0.000005	0.315	0.0684	21	6	29
Bis(2-ethylhexyl) Phthalate	0.000420	38.9	4.99	21	21	100
Butyl Benzyl Phthalate	0.000005	1.23	0.140	21	8	38
Chlorobenzene	0.000100	1.41	0.131	23	7	30
Chloroform	0.00200	0.100	0.0359	23	17	74
Di-*n*-butyl Phthalate	0.000005	3.49	0.245	21	7	33
Di-*n*-octyl Phthalate	0.000005	0.493	0.0910	21	5	24
Ethylbenzene	0.00200	3.95	0.634	43	37	86
Isophorone	0.000005	1.77	0.154	21	7	33
Methylene Chloride	0.00500	4.13	0.336	32	16	50
Naphthalene	0.000014	13.6	1.47	21	18	86
Phenol	0.000005	0.464	0.0777	24	9	38
Tetrachloroethene	0.00100	46.2	3.91	23	20	87
Toluene	0.000500	20.9	2.64	52	46	88
trans-1,2-Dichloroethene	0.00500	0.100	0.0204	19	0	0
Trichloroethene	0.000020	0.262	0.0346	23	9	39
Nonconventional Organics						
2-Butanone	0.00500	47.5	2.51	25	17	68
2-Methylnaphthalene	0.0150	0.405	0.166	17	13	76
2-Propanone	0.00500	61.8	10.9	25	23	92
4-Methyl-2-pentanone	0.00500	16.7	1.67	19	14	74
∝-Terpineol	0.0100	2.27	0.258	16	7	50
Benzoic Acid	0.0200	3.13	0.648	17	9	53
Benzyl Alcohol	0.0100	1.29	0.143	17	7	41

Table C-4 (Continued)

Wastewater Characterization Data for Total Stream Wastewater						
Pollutant of Concern	Concentration (mg/L)[1]			Number of Times Analyzed	Number of Times Detected	Percentage Detected (%)
	Minimum	Maximum	Mean			
Nonconventional Organics (Continued)						
Hexanoic Acid	0.0100	0.327	0.125	16	6	38
m-Xylene	0.0393	25.3	4.35	18	18	100
n-Decane	1.31	712	73.6	16	16	100
n-Docosane	0.0200	3.04	0.659	16	13	81
n-Dodecane	1.13	17.5	6.16	16	16	100
n-Eicosane	0.0200	6.41	1.97	16	15	94
n-Hexacosane	0.0200	3.28	0.413	16	14	88
n-Hexadecane	0.0200	22.5	4.76	16	15	94
n-Octacosane	0.0100	0.250	0.0853	16	6	38
n-Octadecane	0.0382	8.97	1.78	16	16	100
n-Tetracosane	0.0200	8.34	1.51	16	14	88
n-Tetradecane	0.236	19.9	4.44	16	16	100
n-Triacontane	0.0296	0.531	0.144	16	11	69
o-&*p*-Xylene	0.125	9.45	2.48	18	18	100
p-Cresol	0.0100	0.100	0.0585	16	0	0
p-Cymene	0.0100	0.360	0.138	16	10	62
Pentamethylbenzene	0.0100	2.33	0.242	16	1	6
Priority Metals and Elements						
Antimony	0.0463	0.144	0.0913	17	13	76
Arsenic	0.00100	0.180	0.0183	36	22	61
Beryllium	0.000880	0.0200	0.00598	17	9	53
Cadmium	0.00300	0.290	0.0641	47	44	94
Chromium	0.00360	3.59	0.315	50	40	80
Copper	0.0357	7.86	1.74	49	49	100
Lead	0.00500	3.26	0.955	50	49	98
Mercury	0.000100	0.00800	0.00128	36	25	69
Nickel	0.0100	3.07	0.305	46	40	87
Selenium	0.00100	0.258	0.0550	30	18	60
Silver	0.000500	0.500	0.0316	53	36	68
Thallium	0.00100	0.130	0.0190	17	2	12

Table C-4 (Continued)

Wastewater Characterization Data for Total Stream Wastewater						
Pollutant of Concern	Concentration (mg/L)[1]			Number of Times Analyzed	Number of Times Detected	Percentage Detected (%)
	Minimum	Maximum	Mean			
Priority Metals and Elements (Continued)						
Zinc	0.139	12.5	2.85	50	50	100
Nonconventional Metals and Elements						
Aluminum	0.441	25.3	8.24	24	24	100
Barium	0.240	2.93	1.31	23	23	100
Boron	0.0500	1.89	0.689	17	15	88
Cobalt	0.0619	0.289	0.169	17	13	76
Iron	13.6	111	39.5	17	17	100
Manganese	0.190	2.19	0.627	20	20	100
Molybdenum	0.110	0.793	0.363	17	17	100
Tin	0.0290	1.12	0.278	17	12	70
Titanium	0.0190	0.747	0.251	17	17	100
Vanadium	0.00820	0.190	0.0678	17	14	82
Yttrium	0.00200	0.0575	0.0199	17	8	47
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	528	10,600	6,090	27	27	100
Total Organic Carbon (TOC)	229	2,700	1,160	17	17	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	139	1,170	682	13	13	100

[1]The detection limit concentration was used in calculations for data points reported as nondetects.

Appendix D

References Used in Chapter 7
Calculations of Long-Term Averages and Variability Factors and Facility Level and Performance Data for Pollutants of Concern

Reference D-1
Description Of Data Conventions

This section discusses the types of data in the IL analytical database and the hierarchy and procedures for aggregating multiple sampling observations within a sampling day.

1.1 Data Review

The EPA wastewater sampling data in the analytical database were thoroughly reviewed and validated by the EPA's Sample Control Center (further discussions of this data are at times referred to as the "SCC" data for this reason). During this review, the integrity of each sample was assessed to ensure that all specifications of the sampling protocol were met. The reviewers determined that some samples should be excluded from the analyses. Samples with flags of "EXCLUDE" or "DETECTED," which indicate a value was detected but the concentration value was not recorded, were excluded from the analyses.

Also during the data review, several samples were qualified with a greater than (>) sign, indicating the reported concentration value is considered a lower limit of the actual value. This is because the reported concentration was outside the range of the analytical method. When possible, these samples are diluted and reanalyzed. Otherwise these samples were handled as right-censored samples and excluded from all calculations.

An engineering review of the database was also conducted and a few additional data values were excluded from the analyses for the reasons summarized in Chapter 9 of the *Technical Development Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category* (EPA Report No. EPA-821-R-97-007). One reason for such an exclusion would be if a pollutant was not detected in sufficient concentrations to evaluate treatment effectiveness.

1.2 Data Types

The IL analytical database (from the SCC and DMQ data) contains the following three different types of samples delineated by certain qualifiers in the database:

- **Noncensored (NC):** a measured value, i.e., a sample measured above the level at which the detection decision was made.

- **Nondetect (ND):** samples for which analytical measurement did not yield a concentration above the sample-specific detection limit.

- **Right-censored (RC):** samples qualified with a greater than (>) sign, signifying that the reported value is considered a lower limit of the actual concentration. All RC values were excluded from the analyses because these values could not be quantified with certainty.

Reference D-1 (Continued)

1.3 Data Aggregation

Data aggregation for the IL analytical data was performed at two levels. This section discusses the different levels and approaches for data aggregation, including multiple grab samples (one or more samples collected for a particular sampling point over time, assigned different sample numbers, and not physically composited) and field duplicates (one or more samples collected for a particular sampling point at approximately the same time, assigned different sample numbers, and flagged as duplicates for a single episode number).

1.3.1 Data Aggregation Across Multiple Grab Samples

The first type of data aggregation performed was for multiple grab samples. Within the SCC database, SGT-HEM was reported as concentrations of multiple grab samples taken during one-day sampling periods. Since long-term averages (LTAs) and limitations were based on daily concentrations, multiple observations on a single day at the same sample point were averaged. When all of the samples in a set were NC, i.e., detected samples, the arithmetic average of the samples was straightforward. However, when one or more of the samples were censored, or ND, multiple grab samples were aggregated within each sampling day/sample point combination using the methods identified in Table 1-1.

Table 1-1
Method for Averaging Multiple Grab Samples

If observations are:	Label of "average"	Value of "average" is:
All NC	NC	$\Sigma NC_i/n$
All ND	ND	Maximum Detection Limit
NC and ND 1. Max. NC > Max. Detection Limit	NC	$(\Sigma NC_i + \Sigma ND_i)/n$
2. Max. NC ≤ Max. Detection Limit	ND	Max. Detection Limit

n=number of grab samples per day.
NC = noncensored values
ND = nondetected values

1.3.2 Aggregation of Field Duplicates

Another type of data aggregation for the IL SCC data was performed due to the identification of field duplicates in the database. The field duplicates are defined as one or more samples collected for a particular sampling point at approximately the same time, assigned different sample numbers, and flagged as duplicates for a single episode number/sampling point. Duplicates were collected for purposes of quality assurance/quality control. Table 1-2 presents the methods used to aggregate duplicates. Note that within the DMQ data no field duplicates

Reference D-1 (Continued)

were labeled, but for a few sample days, two concentrations were reported. Since there were only two concentrations reported within sample day, the aggregation method would be the same regardless of whether they were treated as grab samples or duplicate samples. Thus, these concentrations were classified as duplicate samples and were aggregated according to the methods outlined in Table 1-2.

Table 1-2
Method for Averaging Field Duplicate Samples

If observations are:	Label of "average"	Value of "average" is:
Both NC	NC	$\Sigma NC_i/2$
Both ND	ND	Maximum Detection Limit
NC and ND 1. NC > Detection Limit 2. NC ≤ Detection Limit	 NC ND	 (NC + ND)/2 Detection Limit

NC = noncensored values
ND = nondetected values

If a sample had both multiple grabs and field duplicates, the multiple grabs were aggregated first.

Reference D-2
Statistical Methodology - Modified Delta-Lognormal Model

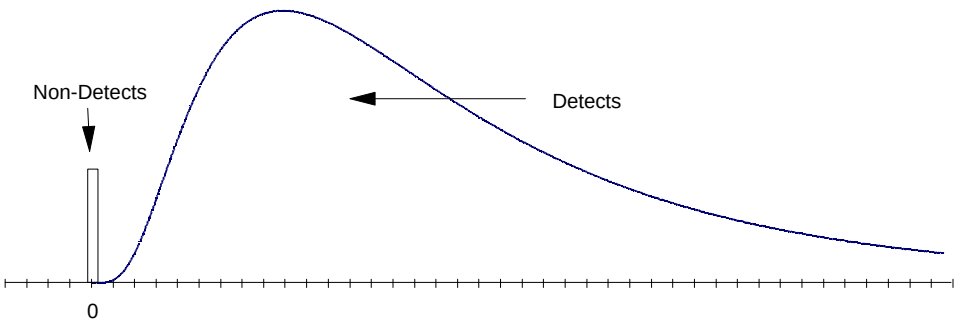
2.1 Basic Overview of Delta-lognormal Distribution

The lognormal distribution is often appropriate for modeling effluent data. However, the presence of ND and very low concentration measurements in the IL effluent data led to the consideration of a modification to the lognormal distribution in modeling such data for several reasons. First, the lognormal model assumes that all concentration values are positively valued. Second, the actual values of NDs are not known, though each ND has a concentration somewhere between zero and the reported detection limit. In this sense, ND measurements represent, in statistical terms, what are known as censored samples.

In general, censored samples are measurements for which the exact value is not known but are bounded either by an upper or lower numerical limit. Nondetects qualify in this framework as left-censored samples, which have an upper bound at the detection limit and a lower bound at zero. To model NDs as left-censored samples under a strictly lognormal density model, it is necessary to assume that the exact (but unknown) values of these measurements follow the same lognormal distributional pattern as the rest of the detected measurements and that they are positively valued (i.e., greater than zero).

Therefore, two reasonably simple modifications to the lognormal density model have been used by the EPA for several years. The first modification is known as the classical delta-lognormal model (Figure 2-1), first used in economic analysis to model income and revenue patterns (see Atchison and Brown, 1955). In this adaptation of the simple lognormal density, the model is expanded to include zero amounts. To do this, all positive (dollar) amounts are grouped together and fit to a lognormal density. Then all zero amounts are segregated into another group of measurements representing a discrete distributional "spike" at zero. The resulting mixed distribution, combining a continuous density portion with a discrete-valued spike, is known as the delta-lognormal distribution. The delta in the name refers to the percentage of the overall distribution contained in the spike at zero, that is, the percentage of zero amounts.

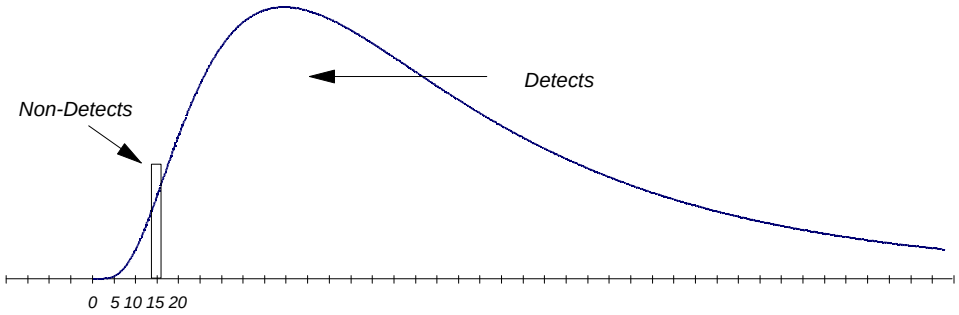
Figure 2-1
Delta-Lognormal Model



Reference D-2 (Continued)

Researchers at the EPA (see Kahn and Rubin, 1989) further adapted the classical delta-lognormal model ("adapted model") to account for ND measurements in the same fashion that zero measurements were handled in the original delta-lognormal. Instead of zero amounts and non-zero (positive) amounts, the data consisted of NDs and detects. Rather than assuming that NDs represented a spike of zero concentrations, these samples were allowed to have a single positive value, usually equal to the minimum level of the analytical method (Figure 2-2). Since each ND was assigned the same positive value, the distributional spike in this adapted model was located not at zero, but at the minimum level. This adaptation is appropriate since it is known that the NDs are some value greater than zero. This adapted model was used in developing limitations for the Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) and pesticides manufacturing rulemaking.

Figure 2-2
Adapted Delta-Lognormal Model



In the adapted delta-lognormal model, the delta again referred to those measurements contained in the discrete spike, this time representing the proportion of ND values observed within the data set. By using this approach, computation of estimates for the population mean and variance could be done easily by hand, and NDs were not assumed to follow the same distributional pattern as the detected measurements. The adapted delta-lognormal model can be expressed mathematically as follows:

$$Pr\ (U \le u) = \begin{cases} (1-\delta)\ \Phi\ [(\log(u)\ -\ \mu)/\sigma] & \text{if} \quad 0 < u < D \\ \delta\ +\ (1-\delta)\ \Phi\ [(\log(D)\ -\ \mu)/\sigma] & \text{if} \quad u = D \\ \delta\ +\ (1-\delta)\ \Phi\ [(\log(u)\ -\ \mu)/\sigma] & \text{if} \quad u > D \end{cases} \qquad (2.1)$$

where δ represents the true proportion of NDs (or the probability that any randomly drawn measurement will be a ND), D equals the minimum level value of the discrete spike assigned to all NDs, $\Phi(\cdot)$ represents the standard normal cumulative distribution function, and μ and σ are the parameters of the lognormal density portion of the model. This model assumes that all nondetected values have a single detection limit D.

It is also possible to represent the adapted delta-lognormal model in another mathematical form, one in which it is particularly easy to derive formulas for the expected value (i.e., LTA) and

Reference D-2 (Continued)

variance of the model. In this case, a random variable distributed according to the adapted delta-lognormal distribution can be represented as the stochastic combination of three other independent random variables. The first of these variables is an indicator variable, I_u, equal to one when the measurement u is a ND and equal to zero when u is a detected value. The second variable, X_D, represents the value of a ND measurement (discrete). In the adapted delta-lognormal, this variable is always a constant equal to the concentration value assigned to each ND (i.e., equal to D in the adapted delta-lognormal model). In general, however, X_D need not be a constant, as will be seen below in the modified delta-lognormal model. The final random variable, X_C, represents the value of a detected measurement, and is distributed according to a lognormal distribution (continuous) with parameters μ and σ.

Using this formulation, a random variable from the adapted delta-lognormal model can be written as:

$$U = I_u X_D + (1 - I_u) X_C \tag{2.2}$$

and the expected value of U is then derived by substituting the expected value of each quantity in the right-hand side of the equation. Because the variables I_u, X_D, and X_C are mutually independent, this leads to the expression:

$$E(U) = \delta E(X_D) + (1 - \delta) E(X_C) = \delta D + (1 - \delta)\exp(\mu + 0.5\sigma^2) \tag{2.3}$$

where again δ is the probability that any random measurement will be ND and the exponentiated expression is the familiar mean of a lognormal distribution. In a similar fashion, the variance of the adapted delta-lognormal model can be established by squaring the expression for U above, taking expectations, and subtracting the square of E(U) to get:

$$Var(U) = E(U^2) - [E(U)]^2 = \delta Var(X_D) + (1 - \delta) Var(X_C) + \delta(1 - \delta)[E(X_D) - E(X_C)]^2. \tag{2.4}$$

Since, in the adapted delta-lognormal formulation, X_D is a constant, this expression can be reduced to the following:

$$Var(U) = (1 - \delta)\exp(2\mu + \sigma^2)[\exp(\sigma^2) - (1 - \delta)] + \delta(1 - \delta) D [D - 2\exp(\mu + 0.5\sigma^2)]. \tag{2.5}$$

In order to estimate the adapted delta-lognormal mean and variance from a set of observed sample measurements, it is necessary to derive sample estimates for the parameters δ, μ, and σ. δ is typically estimated by the observed proportion of NDs in the data set. μ and σ are estimated using the log values of the detected samples where μ is estimated using the arithmetic mean of the log detected measurements and σ is estimated using the standard deviation of these same log values; NDs are not included in the calculations. Once the parameter estimates are obtained, they are used in the formulas above to derive the estimated adapted delta-lognormal mean and variance.

Reference D-2 (Continued)

To calculate effluent limitations and/or standards, it is also necessary to estimate upper percentiles from the underlying data model. Using the delta-lognormal formulation above in equation (2.1), letting U_α represent the $100*\alpha^{th}$ percentile of random variable U, and adopting the standard notation of z_s for the s^{th} percentile of the standard normal distribution, an arbitrary delta-lognormal percentile can be expressed as the following:

$$U_\alpha = \begin{cases} \exp(\mu + \sigma\ z_{\alpha/1-\delta}) & \text{if} \quad (1-\delta)\Phi((\log(D)-\mu)/\sigma) \geq \alpha \\ D & \text{if} \quad \delta + (1-\delta)\Phi((\log(D)-\mu)/\sigma) \geq \alpha \\ \exp(\mu + \sigma\ z_{\alpha-\delta/1-\delta}) & \text{if} \quad \delta + (1-\delta)\Phi((\log(D)-\mu)/\sigma) < \alpha \end{cases} \tag{2.6}$$

The daily maximum limitations are established on the basis of an estimated upper 99^{th} percentile from the underlying data model, so that 0.99 would be substituted for α in the above expression. To derive the daily VF for the 99^{th} percentile based on the adapted delta-lognormal model, divide $U_{.99}$ in the expression above by the previous formula for the LTA, namely $U_{.99}/E(U)$.

2.2 Motivations for Modifications to the Adapted Delta-Lognormal Model

While the adapted delta-lognormal model has been used successfully for years by the EPA in a variety of settings, the model makes two key assumptions about the observed data that are not fully satisfied within the IL analytical database. First, the discrete spike portion of the adapted delta-lognormal model is a fixed, single-valued probability mass associated (typically) with all ND measurements. If all ND samples in the IL database had roughly the same reported detection limit, this assumption would be adequately satisfied. However, the detection limits reported are sample specific and, therefore, varied as a result of factors such as dilution. Because of this variation in detection limits, a single-valued discrete spike could not adequately represent the set of ND measurements observed in the IL database and a modification to the model was considered.

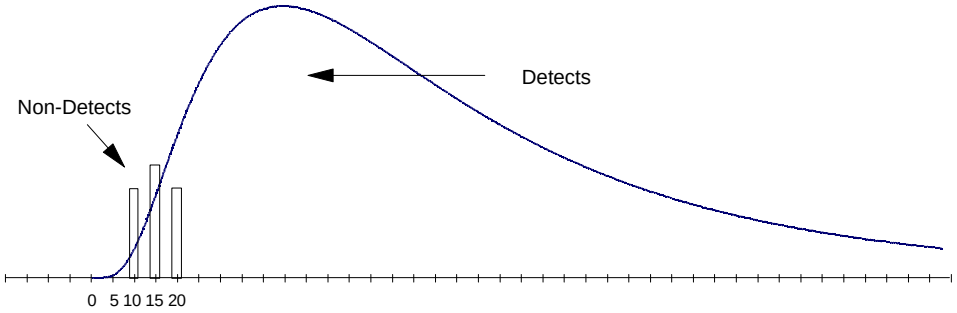
In addition, the adapted delta-lognormal model sets all NC values below the detection to the minimum level of the analytical method. For example, if the minimum level for Toluene was .10 mg/l, then any NC samples reported below .10 mg/l were set to .10 mg/l. There were a few instances in the IL analytical studies where a NC value was reported below the minimum level of the analytical method.

2.2.1 Modification of the Discrete Spike

To appropriately modify the adapted delta-lognormal model for the observed IL database, a modification was made to the discrete, single-valued spike representing ND measurements. Because ND samples have varying detection limits, the spike of the delta-lognormal model has been replaced by a discrete distribution made up of multiple spikes. Each spike in this modification is associated with a distinct detection limit observed in the IL database. Thus, instead of assigning all NDs to a single, fixed value, as in the adapted model, NDs can be associated with multiple values depending on how the detection limits vary (Figure 2-3).

Reference D-2 (Continued)

Figure 2-3
Modified Adapted Delta-Lognormal Model



In particular, because the detection limit associated with a ND sample is considered to be an upper bound on the true value, which could range conceivably from zero up to the detection limit, the modified delta-lognormal model used here assigns each ND sample to its reported detection limit.

Once each ND has been associated with its reported detection limit, the discrete "delta" portion of the modified model is estimated in a way similar to the adapted delta-lognormal distribution, where multiple spikes are constructed and linked to the distinct detection limits observed in the data set. In the adapted model, the parameter δ is estimated by computing the proportion of NDs. In the modified model, δ again represents the proportion of NDs, but is divided into the sum of smaller fractions, δ_i, each representing the proportion of NDs associated with a particular and distinct detection limit. This can be written as:

$$\delta = \sum_i (\delta_i). \tag{2.7}$$

If D_i equals the value of the i^{th} smallest distinct detection limit in the data set, and the random variable X represents a randomly chosen ND sample, then the discrete distribution portion of the modified delta-lognormal model can be mathematically expressed as:

$$Pr(X_D \le x) = \sum_{i:D_i \le x} \delta_i. \tag{2.8}$$

The mean and variance of this discrete distribution can be calculated using the following formulas:

$$E(X_D) = \frac{1}{\delta}\sum_i \delta_i D_i \quad \text{and} \quad Var(X_D) = \frac{1}{\delta^2}\sum_i \sum_{i<j} \sum_j \delta_i \delta_j (D_j - D_i)^2. \tag{2.9}$$

Reference D-2 (Continued)

It is important to recognize that, while replacing the single discrete spike in the adapted delta-lognormal distribution with a more general discrete distribution of multiple spikes increases the complexity of the model, the discrete portion with multiple spikes plays a role in limitations and standards development identically parallel to the single spike case and offers flexibility for handling multiple observed detection limits.

Reference D-3
Estimation Under The Modified Delta-Lognormal Model

Once the modifications to the adapted delta-lognormal distribution are made, it is possible to fit a wide variety of observed effluent data sets to the modified model. Multiple detection limits for NDs can be handled. The same basic framework can be used even if there are no ND values or censored data.

Combining the discrete portion of the model with the continuous portion, the cumulative probability distribution of the modified delta-lognormal model can be expressed as follows, where D_n denotes the largest distinct detection limit observed among the NDs, and the first summation is taken over all those values, D_i, that are less than u:

$$Pr(U \le u) = \begin{cases} \sum_{i:D_i<u} \delta_i + (1-\delta)\Phi\left[(\log(u)-\mu)/\sigma\right] & \text{if } u < D_n \\ \delta + (1-\delta)\Phi\left[(\log(u)-\mu)/\sigma\right] & \text{if } u \ge D_n \end{cases} \tag{3.1}$$

Again combining the discrete and continuous portions of the modified model, the expected value of the random variable U can be derived as a weighted sum of the expected values of the discrete and continuous lognormal portions of the distribution. This follows because the modified delta-lognormal random variable U can be expressed again as a combination of three other independent variables, that is:

$$U = I_u X_D + (1 - I_u) X_C \tag{3.2}$$

where this time X_D represents a random ND from the discrete portion of the model, 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. Then the expected value and variance of U have forms somewhat similar to the standard delta-lognormal model, namely:

$$E(U) = \sum_i \delta_i D_i + (1-\delta)\exp(\mu + 0.5\sigma^2) \tag{3.3}$$

$$\begin{aligned} Var(U) = {} & \frac{\sum_i \sum_{j\ i<j} \delta_i \delta_j (D_i - D_j)^2}{\delta} + (1-\delta)\exp(2\mu+\sigma^2)(\exp(\sigma^2)-1) \\ & + \delta(1-\delta)\left[\frac{\sum_i \delta_i D_i}{\delta} - \exp(\mu + 0.5\sigma^2)\right]^2 \end{aligned} \tag{3.4}$$

where the D_i = detection limit for the i^{th} ND value
D_j = detection limit for the j^{th} ND value, where $i < j$
δ_i = proportion of NDs with detection limit = D_i

Reference D-3 (Continued)

δ_j = proportion of NDs with detection limit = D_j
δ = proportion of all NDs
μ = mean log concentrations of noncensored (NC) values
σ = standard deviation of log NC values.

For example, consider a facility that has 10 samples with the following concentrations:

Sample number	Measurement Type	Concentration (mg/L)
1	ND	10
2	ND	15
3	ND	15
4	ND	20
5	NC	25
6	NC	25
7	NC	30
8	NC	35
9	NC	35
10	NC	40

Then the mean and variance of the log NC values are calculated as follows:

$$\mu = \frac{\sum_{i=1}^{n} \ln(x_i)}{n}$$

$$= \frac{(2*\ln(25) + \ln(30) + 2*\ln(35) + \ln(40))}{6} = 3.44$$

$$\sigma^2 = \frac{1}{n-1} \sum_{i=1}^{n} (\ln(x_i) - \mu)^2$$

$$= \frac{1}{5} (2*(\ln(25)-3.44)^2) + (\ln(30)-3.44)^2 + 2*(\ln(35)-3.44)^2) + (\ln(40)-3.44)^2) = .0376$$

Reference D-3 (Continued)

The ND components of the variance equation are:

$D_1 = 10$, $\delta_1 = 1/10$
$D_2 = 15$, $\delta_2 = 1/5$
$D_3 = 20$, $\delta_3 = 1/10$.

As such, the variance for this example is:

$$Var(x) = \frac{\frac{1}{10}*\frac{1}{5}(10-15)^2 + \frac{1}{10}*\frac{1}{10}(10-20)^2 + \frac{1}{5}*\frac{1}{10}(15-20)^2}{\frac{2}{5}} + \left(1-\frac{2}{5}\right)\exp(2*3.44+.0376)(\exp(.0376)-1) + \frac{2}{5}\left(1-\frac{2}{5}\right)\left[\frac{\left(\frac{1}{10}*10\right)+\left(\frac{1}{5}*15\right)+\left(\frac{1}{10}*20\right)}{\frac{2}{5}} - \exp(3.44+0.5*.0376)\right]^2 = 95.8.$$

3.1 Facility-Specific Estimates

3.1.1 Estimation of Facility-Specific LTAs

For the purposes of estimating facility-specific LTAs (equal to the expected value in the equation (3.3)), the EPA chose to divide the IL data sets into two groups based on their size (number of samples) and the type of samples in the subset because the computations differ for each group. The groups were defined as follows:

Group 1: Less than 2 NC samples or less than 4 total samples.

Group 2: Two or more NC samples or 4 or more total samples.

For Group 1, the LTAs were calculated as the arithmetic average of the samples, since the sample sizes for either the discrete portion or the continuous lognormal portion of the data were too small to allow distributional assumptions to be made. Specifically, Group 1 contained all data subsets with all NDs or only one detect. Sample-specific detection limits were substituted as the values associated with nondetectable samples.

For Group 2, the LTAs were calculated using the procedures outlined in the preceding section using equation (3.3) and the Maximum Likelihood Estimates (MLEs) for μ and σ.

Reference D-3 (Continued)

3.1.2 Estimation of Facility-Specific VFs

After determining estimated LTA values for each pollutant, facility, and option combination, the EPA developed 1-day variability factors (VF1) and/or 4-day variability factors (VF4) depending on the proposed frequency of monitoring, as outlined in Table 3-1.

Table 3-1
EPA Proposed Monitoring Frequencies

Pollutant Category	Frequency of Monitoring
Metals, Organics	Monthly (VF1)
Classicals	Weekly (VF1, VF4)

Similar to the calculations for the LTAs, the data were divided into the same two computation groups based on the number and type of samples in each data subset for purposes of estimating variability factor. These computation groups are defined as follows:

Group 1: Less than 2 NC samples or less than 4 total samples. Upper percentiles and VFs could not be computed using the modified delta-lognormal methodology.

Group 2: Two or more NC samples and 4 or more total samples. The estimates of the parameters for the modified delta-lognormal distribution of the data were calculated using maximum likelihood estimation in the log-domain. Upper percentiles and VFs were calculated using these estimated parameters.

Several data subsets belong in Group 1, and therefore have missing 99th percentiles and VFs.

3.1.2.1 Estimation of Facility-Specific VF1

The VF1 are a function of the LTA, E(U), and the 99th percentile. An iterative approach was used in finding the 99th percentile of each data subset using the modified delta-lognormal methodology by first defining $D_0=0$, $\delta_0=0$, and $D_{k+1} = \infty$ as boundary conditions, where D_i equals the ith smallest detection limit, and δ_i is the associated proportion of NDs at the ith detection limit. 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, is

$$p = \sum_{i=0}^{m} \hat{\delta}_i + (1 - \hat{\delta})\ \Phi\left[\frac{\log(c) - \hat{\mu}}{\hat{\sigma}}\right], \quad D_m \le c < D_{m+1},\ m=0,1,...k \tag{3.5}$$

Reference D-3 (Continued)

where Φ is the standard normal cumulative distribution function. The following steps were completed to compute the estimated 99th percentile of each data subset:

1. k values of p at $c=D_m$, m=1,...k were computed and labeled p_m.

2. The smallest value of m, 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.

3. Computed $p^* = p_j - \delta_j$.

4. If $p^* < 0.99$, then $P_{99} = D_j$,
   else if $p^* \geq 0.99$, then

$$\hat{P}99 = \exp\left[\hat{\mu} + \Phi^{-1}\left[\frac{\left(0.99 - \sum_{i=0}^{j-1} \hat{\delta}_i\right)}{(1-\hat{\delta})}\right]\hat{\sigma}\right]. \quad (3.6)$$

5. If no such m exists, such that $p_m \geq 0.99$ (m=1,...k), then

$$\hat{P}99 = \exp\left[\hat{\mu} + \Phi^{-1}\left[\frac{0.99-\hat{\delta}}{(1-\hat{\delta})}\right]\hat{\sigma}\right]. \quad (3.7)$$

The daily variability factor, VF1, was then calculated as

$$VF1 = \frac{\hat{P}99}{\hat{E}(U)}. \quad (3.8)$$

3.1.2.2 Estimation of Facility-Specific VF4

Since the EPA is assuming for costing purposes that the Classical Pollutant, SGT-HEM, will be monitored weekly (approximately 4 times a month), the EPA calculated a VF for monthly averages based on the distribution of 4-day averages. In order to calculate the VF4, the assumption was made that the approximating distribution of $\bar{U}_4$, the sample mean for a random sample of 4 independent concentration values, is also derived from this modified delta-lognormal distribution, with the same mean as the distribution of the concentration values. The mean of this distribution of 4-day averages is

$$E(\bar{U}_4) = \delta_4 E(\bar{X}_4)_D + (1-\delta_4)E(\bar{X}_4)_C \quad (3.9)$$

Reference D-3 (Continued)

where $(X_4)_D$ denotes the mean of the discrete portion of the distribution of the average of four independent concentration values (i.e., when all observations are not detected), and $(X_4)_C$ denotes the mean of the continuous lognormal portion of the distribution.

First, it is assumed that the probability of detection (δ) on each of the four days is independent of that on the other days, since these samples are not taken on consecutive days and are therefore not correlated such that $\delta_4 = \delta^4$. Also, since

$$E(\bar{X}_4)_D = E(X_D)$$

then

$$E(\bar{U}_4) = \delta^4 \sum_{i=1}^{k} \frac{\delta_i D_i}{\delta} + (1-\delta^4)\exp(\mu_4 + 0.5\sigma^2{}_4) \tag{3.10}$$

and since $E(\bar{U}_4) = E(U)$, then

$$\mu_4 = \log\left[\frac{E(U) - \delta^3 \sum_{i=1}^{k} \delta_i D_i}{(1-\delta^4)}\right] - 0.5\sigma^2{}_4. \tag{3.11}$$

The expression for $\sigma^2{}_4$ was derived from the following relationship:

$$Var(\bar{U}_4) = \delta_4 Var((\bar{X}_4)_D) + (1-\delta_4)Var((\bar{X}_4)_C) + \delta_4(1-\delta_4)[E(\bar{X}_4)_D - E(\bar{X}_4)_C]^2. \tag{3.12}$$

Since

$$Var((\bar{X}_4)_D) = \frac{Var(X_D)}{4}, \quad E(\bar{X}_4)_D = E(X_D), \quad and \quad \delta_4 = \delta^4 \tag{3.13}$$

then

$$Var(\bar{U}_4) = \delta^4 \frac{Var(X_D)}{4} + (1-\delta^4)Var((\bar{X}_4)_C) + \delta^4(1-\delta^4)[E(X_D) - E(\bar{X}_4)_C]^2. \tag{3.14}$$

Reference D-3 (Continued)

This further simplifies to

$$Var(\bar{U}_4) = \frac{\delta^4 \sum_{i=1}^{k} \sum_{i<j}^{k} \sum_{j=1}^{k} \delta_i \delta_j (D_i - D_j)^2}{4\delta^2} + (1-\delta^4)\exp(2\mu_4 + \sigma^2{}_4)[\exp(\sigma^2{}_4) - 1] + \delta^4(1-\delta^4)\left[\sum_{i=1}^{k} \frac{\delta_i D_i}{\delta} - \exp(\mu_4 + 0.5\sigma^2{}_4)\right]^2 \quad (3.15)$$

and furthermore,

$$\exp(\sigma^2{}_4) - 1 = \frac{\left[Var(\bar{U}_4) - \frac{\delta^2 \sum_{i=1}^{k} \sum_{i<j}^{k} \sum_{j=1}^{k} \delta_i \delta_j (D_i - D_j)^2}{4} - \delta^2(1-\delta^4)\left[\sum_{i=1}^{k} \delta_i D_i - \delta \exp(\mu_4 + 0.5\sigma^2{}_4)\right]^2\right]}{(1-\delta_4)\exp(2\mu_4 + \sigma^2{}_4)}. \quad (3.16)$$

Then, from (3.10) above,

$$\exp(\mu_4 + 0.5\sigma^2{}_4) = \frac{(E(\bar{U}_4) - \delta^3 \sum_{i=1}^{k} \delta_i D_i)}{(1-\delta^4)} = \frac{(E(U) - \delta^3 \sum_{i=1}^{k} \delta_i D_i)}{(1-\delta^4)}, \quad \text{since } E(\bar{U}_4) = E(U) \quad (3.17)$$

and letting

$$\eta = E(U) - \delta^3 \sum_{i=1}^{k} \delta_i D_i, \quad \text{then,} \quad \exp(\mu_4 + 0.5\sigma^2{}_4) = \frac{\eta}{(1-\delta^4)}. \quad (3.18)$$

Furthermore,

$$\sigma^2{}_4 = \log\left[1 + \frac{\left[Var(\bar{U}_4) - \frac{\delta^2 \sum_{i=1}^{k} \sum_{i<j}^{k} \sum_{j=1}^{k} \delta_i \delta_j (D_i - D_j)^2}{4} - \delta^2(1-\delta^4)\left(\sum_{i=1}^{k} \delta_i D_i - \frac{\delta\eta}{(1-\delta^4)}\right)^2\right]}{\frac{(1-\delta^4)\eta^2}{(1-\delta^4)^2}}\right]. \quad (3.19)$$

Reference D-3 (Continued)

Since $Var(\bar{U}_4) = Var(U)/4$, then, by rearranging terms,

$$\sigma^2_4 = \log\left[1 + \frac{(1-\delta^4)\,Var(U)}{4\eta^2} - \frac{(1-\delta^4)\,\delta^2 \sum_{i=1}^{k}\sum_{i<j}^{k}\delta_i\delta_j(D_i - D_j)^2}{4\eta^2} - \frac{\delta^2\left[\sum_{i=1}^{k}\delta_i D_i(1-\delta^4) - \delta\eta\right]^2}{\eta^2}\right]. \quad (3.20)$$

Thus, estimates of μ_4 and σ_4 were derived by using estimates of $\delta_1,...\delta_k$ (sample proportion of NDs at observed detection limits $D_1,...D_k$), μ (MLE of logged values), and σ^2 (MLE logvariance with sample bias adjustment) in the equations above.

In finding the estimated 95th percentile of the average of four observations (four NDs, not all at the same detection limit), an average can be generated that is not necessarily equal to D_1, D_2,..., or D_k. Consequently, more than k discrete points exist in the distribution of the 4-day averages. For example, the average of four NDs 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

In general, when all four observations are not detected, and when k detection limits exist, the multinomial distribution can be used to determine associated probabilities, that is,

$$Pr\left[\bar{U}_4 = \frac{\sum_{i=1}^{k} u_i D_i}{4}\right] = \frac{4!}{u_1!\,u_2!\ldots u_k!}\prod_{i=1}^{k}\delta_i^{u_i}. \quad (3.21)$$

The number of possible discrete points, k^*, for k=1,2,3,4, and 5 are given below:

k	k^*
1	1
2	5
3	15
4	35
5	70

Reference D-3 (Continued)

To find the estimated 95th percentile of the distribution of the average of four observations, the same basic steps (described in Section 3.1.2.1) as used for the 99th percentile of the distribution of daily observations were followed with the following changes:

1. Change P_{99} to P_{95}, and 0.99 to 0.95.
2. Change D_m to D_m^*, the weighted averages of the detection limits.
3. Change δ_i to δ_i^*.
4. Change k to k^*, the number of possible discrete points based on k detection limits.
5. Change the estimates of δ, μ, and σ to estimates of δ^4, μ_4, and σ_4, respectively.

Then, the estimate of the 95th percentile 4-day mean VF is:

$$VF4 = \frac{\hat{P}95}{\hat{E}(U)}, \qquad since \quad E(\bar{U}_4) = E(U). \tag{3.22}$$

Reference D-4
Long-Term Averages and Variability Factors
Chemical Emulsion Breaking (CEB)

Analyte	Episode	Inf # Obs	Inf # ND	Inf Est. LTA (mg/L)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/L)	Eff 1-Day VF	Eff 4-day VF
2-METHYLNAPHTHALENE	S1	5	0	1.59	4	0	0.05	3.57	1.65
2-PROPANONE	S1	5	0	3.90	4	0	1.21	1.81	1.24
4-CHLORO-3-METHYLPHENOL	S1	5	4	0.18	4	1	0.21	3.80	1.81
4-METHYL-2-PENTANONE	S1	5	0	2.75	4	2	0.07	1.33	1.25
ALPHA-TERPINEOL	S1	5	4	0.10	4	4	0.01	.	.
ALUMINUM	S1	5	0	16.90	4	0	6.33	1.85	1.25
ANTIMONY	S1	5	0	0.26	4	0	0.20	1.20	1.07
BIS(2-ETHYLHEXYL) PHTHALATE	S1	5	0	312.00	4	0	0.46	3.67	1.68
BOD 5-DAY (CARBONACEOUS)	S1	5	0	2400.00	4	0	1040.00	1.65	1.20
BORON	S1	5	0	1.93	4	0	1.64	1.90	1.26
CADMIUM	S1	5	0	0.20	4	0	0.13	1.24	1.08
CHEMICAL OXYGEN DEMAND (COD)	S1	5	0	11900.00	4	0	2460.00	1.21	1.07
CHROMIUM	S1	5	0	0.59	4	0	0.15	1.41	1.13
COPPER	S1	5	0	4.40	4	0	0.44	1.76	1.23
DI-N-BUTYL PHTHALATE	S1	5	2	4.78	4	4	0.01	.	.
DI-N-OCTYL PHTHALATE	S1	5	2	0.49	4	0	0.03	3.70	1.68
ETHYLBENZENE	S1	5	0	0.88	4	0	0.31	4.74	1.91
HEXANOIC ACID	S1	5	4	0.12	4	1	0.13	1.94	1.52
IRON	S1	5	0	68.70	4	0	47.30	1.45	1.14
LEAD	S1	5	0	2.49	4	0	0.91	1.32	1.10
M-XYLENE	S1	5	0	2.52	4	0	0.37	1.61	1.19
MANGANESE	S1	5	0	0.79	4	0	0.60	1.37	1.12

Reference D-4 (Continued)

Analyte	Episode	Inf # Obs	Inf # ND	Inf Est. LTA (mg/L)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/L)	Eff 1-Day VF	Eff 4-day VF
MOLYBDENUM	S1	5	0	1.12	4	0	0.21	1.80	1.24
N-DECANE	S1	5	0	41.30	4	0	0.28	4.24	1.80
N-DOCOSANE	S1	5	3	0.84	4	0	0.03	3.67	1.68
N-DODECANE	S1	5	0	3220.00	4	3	0.57	.	.
N-EICOSANE	S1	5	0	13.80	4	0	0.08	3.28	1.59
N-HEXACOSANE	S1	5	4	0.34	4	4	0.01	.	.
N-HEXADECANE	S1	5	0	12.00	4	0	0.04	3.42	1.62
N-OCTACOSANE	S1	5	4	0.37	4	4	0.01	.	.
N-OCTADECANE	S1	5	0	4.17	4	2	0.06	10.90	3.18
N-TETRADECANE	S1	5	0	2.87	4	0	0.12	2.87	1.50
NAPHTHALENE	S1	5	0	5.38	4	0	0.10	1.82	1.25
NICKEL	S1	5	0	0.60	4	0	0.26	1.67	1.21
O+P XYLENE	S1	5	0	2.59	4	0	0.36	1.72	1.22
OIL AND GREASE (AS HEM)	S1	5	0	5140.00	4	0	268.00	3.54	1.65
TETRACHLOROETHENE	S1	5	1	3.30	4	0	0.29	2.91	1.51
TITANIUM	S1	5	0	0.52	4	0	0.08	1.28	1.09
TOLUENE	S1	5	0	2.06	4	0	0.54	1.79	1.24
TOTAL ORGANIC CARBON (TOC)	S1	5	0	1260.00	4	0	626.00	1.41	1.13
TOTAL PETROLEUM HYDROCARBON (AS SGT-HEM)	S1	5	0	3090.00	4	0	200.00	3.51	1.64
TOTAL SUSPENDED SOLIDS	S1	5	0	4320.00	4	0	259.00	2.51	1.42
ZINC	S1	5	0	8.71	4	0	6.78	1.33	1.11

Reference D-5
Long-Term Averages and Variability Factors
Dissolved Air Flotation - Heavy (DAF-Heavy)

Analyte	Episode	Inf # Obs	Inf # ND	Inf Est. LTA (mg/L)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/L)	Eff 1-Day VF	Eff 4-day VF
2-BUTANONE	S2	5	4	5.65	4	2	4.68	4.41	1.82
2-METHYLNAPHTHALENE	S2	5	3	0.64	4	2	0.13	3.85	1.71
2-PROPANONE	S2	5	2	8.07	4	0	7.42	2.69	1.46
4-METHYL-2-PENTANONE	S2	5	4	18.00	4	2	9.55	3.94	1.73
ALPHA-TERPINEOL	S2	5	1	1.34	4	3	0.47	.	.
ALUMINUM	S2	5	0	6.58	4	0	1.34	2.12	1.32
BARIUM	S2	5	0	5.44	4	0	0.70	2.65	1.45
BIS(2-ETHYLHEXYL) PHTHALATE	Q10	.	.	.	9	1	0.57	6.72	2.35
	S2	5	0	4.77	4	0	0.64	5.03	1.97
	Median	.	.	4.77	.	.	0.60	5.88	2.16
BOD 5-DAY (CARBONACEOUS)	S2	4	0	3040.00	4	0	1310.00	1.39	1.13
CHEMICAL OXYGEN DEMAND (COD)	S2	5	0	10400.00	4	0	3320.00	1.71	1.22
CHROMIUM	S2	5	0	0.20	4	0	0.07	2.31	1.37
COPPER	S2	5	0	8.03	4	0	1.45	1.90	1.27
DI-N-BUTYL PHTHALATE	S2	5	3	0.79	4	0	0.17	3.80	1.70
ETHYLBENZENE	Q10	.	.	.	9	0	1.18	2.59	1.43
	S2	5	0	5.82	4	1	1.56	2.86	1.48
	Median	.	.	5.82	.	.	1.37	2.73	1.46
IRON	S2	5	0	43.80	4	0	19.00	2.90	1.50
LEAD	Q10	.	.	.	9	0	0.11	2.69	1.46
	S2	5	0	1.83	4	0	0.36	6.18	2.23
	Median	.	.	1.83	.	.	0.24	4.43	1.84
MANGANESE	S2	5	0	3.59	4	0	0.88	3.88	1.72
N-DECANE	S2	2	0	10.40	4	0	1.26	4.98	1.96
N-DOCOSANE	S2	5	4	0.53	4	1	0.11	1.28	1.28

Reference D-5 (Continued)

Analyte	Episode	Inf # Obs	Inf # ND	Inf Est. LTA (mg/L)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/L)	Eff 1-Day VF	Eff 4-day VF
N-EICOSANE	S2	5	0	2.14	4	2	0.15	1.82	1.46
N-HEXADECANE	S2	5	0	9.42	4	0	0.49	4.81	1.93
N-OCTADECANE	S2	5	0	7.21	4	0	0.42	4.45	1.85
N-TETRADECANE	S2	4	0	5.50	4	0	0.98	4.92	1.95
NAPHTHALENE	S2	5	0	1.57	4	0	0.80	4.41	1.84
OIL AND GREASE (AS HEM)	S2	5	0	1090.00	4	0	230.00	3.87	1.72
P-CYMENE	S2	5	0	3.74	4	1	0.61	9.10	2.86
SILVER	S2	5	0	0.78	4	0	0.08	2.48	1.41
TETRACHLOROETHENE	Q10	.	.	.	4	3	0.14	.	.
TITANIUM	S2	5	0	0.24	4	0	0.09	2.85	1.49
TOLUENE	Q10	.	.	.	9	0	10.20	1.80	1.24
	S2	5	0	6.32	4	0	2.50	1.96	1.28
	Median	.	.	6.32	.	.	6.35	1.88	1.26
TOTAL ORGANIC CARBON (TOC)	S2	5	0	3250.00	4	0	1610.00	3.79	1.70
TOTAL PETROLEUM HYDROCARBON (AS SGT-HEM)	S2	5	0	263.00	4	0	42.10	2.31	1.37
TOTAL PETROLEUM HYDROCARBONS	Q10	.	.	.	9	0	43.90	7.32	2.49
TOTAL RECOVERABLE OIL AND GREASE	Q10	.	.	.	9	0	130.00	3.68	1.68
TOTAL SUSPENDED SOLIDS	S2	5	0	1810.00	4	0	487.00	2.51	1.41
ZINC	S2	5	0	6.45	4	0	0.90	2.68	1.45

Reference D-6
Long-Term Averages and Variability Factors
Chemical Precipitation - Heavy (CP-Heavy)

Analyte	Episode	Inf # Obs	Inf # ND	Inf Est. LTA (mg/L)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/L)	Eff 1-Day VF	Eff 4-day VF
1,2-DIPHENYLHYDRAZINE	S3	4	3	10.50	5	3	45.20	6.82	1.03
2-METHYLNAPHTHALENE	S3	5	3	0.20	5	5	0.01	.	.
ALUMINUM	S3	5	0	11.20	5	3	0.08	8.13	2.60
BARIUM	S3	5	0	2.43	5	0	0.15	3.47	1.63
BIS(2-ETHYLHEXYL) PHTHALATE	S3	5	2	1.94	5	4	0.05	.	.
BOD 5-DAY (CARBONACEOUS)	S3	5	0	7850.00	5	0	1390.00	1.83	1.25
BORON	S3	5	0	16.30	5	0	11.40	5.88	2.16
BUTYL BENZYL PHTHALATE	S3	5	3	0.24	5	5	0.01	.	.
CADMIUM	S3	5	0	0.16	5	5	0.01	.	.
CHEMICAL OXYGEN DEMAND (COD)	S3	5	0	15300.00	5	0	2510.00	1.86	1.25
CHROMIUM	S3	5	0	0.26	5	3	0.01	2.64	1.44
COPPER	S3	5	0	3.42	5	0	0.53	4.06	1.76
DI-N-BUTYL PHTHALATE	S3	5	1	0.41	5	5	0.01	.	.
ETHYLBENZENE	S3	5	1	0.96	5	1	0.09	4.37	1.80
IRON	S3	5	0	40.30	5	2	0.37	10.80	3.15
LEAD	S3	5	0	1.55	5	4	0.05	.	.
M-XYLENE	S3	5	0	1.36	5	1	0.10	2.66	1.42
MANGANESE	S3	5	0	1.02	5	3	0.01	10.30	3.02
MOLYBDENUM	S3	5	0	0.82	5	0	0.77	7.49	2.53
N-DECANE	S3	4	1	3.25	5	4	0.02	.	.
N-DOCOSANE	S3	5	4	0.12	5	4	0.01	.	.
N-DODECANE	S3	5	1	8.77	5	5	0.01	.	.

Reference D-6 (Continued)

Analyte	Episode	Inf # Obs	Inf # ND	Inf Est. LTA (mg/L)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/L)	Eff 1-Day VF	Eff 4-day VF
N-EICOSANE	S3	5	1	1.02	5	3	0.04	10.10	3.01
N-HEXACOSANE	S3	5	3	0.54	5	4	0.01	.	.
N-HEXADECANE	S3	5	0	3.26	5	4	0.03	.	.
N-OCTACOSANE	S3	5	3	0.50	5	5	0.01	.	.
N-OCTADECANE	S3	5	1	1.15	5	5	0.01	.	.
N-TETRACOSANE	S3	5	4	0.17	5	4	0.03	.	.
N-TETRADECANE	S3	5	3	1.67	5	4	0.61	.	.
N-TRIACONTANE	S3	5	4	0.25	5	3	0.03	10.10	3.01
NAPHTHALENE	S3	5	0	2.16	5	0	0.11	3.14	1.56
O+P XYLENE	S3	5	0	1.24	5	0	0.09	3.63	1.67
OIL AND GREASE (AS HEM)	S3	5	0	4550.00	5	0	38.20	2.11	1.32
P-CYMENE	S3	5	2	1.73	5	4	0.02	.	.
PENTAMETHYLBENZENE	S3	5	2	0.71	5	5	0.01	.	.
TETRACHLOROETHENE	S3	4	0	2.06	5	2	0.13	4.48	1.90
TITANIUM	S3	5	0	0.56	5	3	0.00	4.92	1.88
TOLUENE	S3	5	0	2.86	5	0	0.82	6.79	2.37
TOTAL ORGANIC CARBON (TOC)	S3	5	0	2680.00	5	0	910.00	2.71	1.46
TOTAL PETROLEUM HYDROCARBON (AS SGT-HEM)	S3	5	0	2330.00	5	4	7.20	.	.
TOTAL SUSPENDED SOLIDS	S3	5	0	2840.00	5	0	56.30	10.70	3.29
TRICHLOROETHENE	S3	4	4	0.06	5	2	0.05	0.43	1.60
ZINC	S3	5	0	9.03	5	0	0.06	6.19	2.23

Reference D-7
Long-Term Averages and Variability Factors
Dissolved Air Flotation - All (DAF-All)

Analyte	Episode	Inf # Obs	Inf # ND	Inf Est. LTA (mg/L)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/L)	Eff 1-Day VF	Eff 4-day VF
1,1,1-TRICHLOROETHANE	Q2	.	.	.	13	12	0.00	.	.
	S5	5	1	0.31	5	1	0.05	4.310	1.94
	Median	.	.	0.31	.	.	0.03	4.310	1.94
1,2-DIPHENYLHYDRAZINE	Q1	.	.	.	5	5	0.22	.	.
2-BUTANONE	S4	5	0	58.60	5	0	33.80	14.900	3.48
	S5	5	0	1.88	5	0	0.99	3.010	1.53
	Median	.	.	30.20	.	.	17.40	8.960	2.50
2-METHYLNAPHTHALENE	Q1	.	.	.	5	5	0.22	.	.
	S4	5	0	0.31	5	3	0.01	1.060	1.02
	Median	.	.	0.31	.	.	0.12	1.060	1.02
2-PROPANONE	S5	5	0	20.90	5	0	13.60	3.580	1.66
4-CHLORO-3-METHYLPHENOL	Q1	.	.	.	5	4	0.45	.	.
	Q2	.	.	.	12	11	0.00	.	.
	S5	4	1	0.33	5	1	0.22	4.560	1.86
	Median	.	.	0.33	.	.	0.22	4.560	1.86
4-METHYL-2-PENTANONE	S4	5	1	1.04	5	1	1.05	12.500	3.59
	S5	5	3	5.23	5	5	0.14	.	.
	Median	.	.	3.14	.	.	0.60	12.500	3.59
ALPHA-TERPINEOL	S4	5	3	0.64	5	0	0.47	14.400	3.86
ALUMINUM	S4	5	0	47.70	5	0	2.41	2.150	1.33
	S5	5	0	2.77	5	0	0.20	2.620	1.44
	Median	.	.	25.20	.	.	1.31	2.380	1.38
ANTIMONY	S4	5	3	0.33	5	5	0.08	.	.
ARSENIC	Q1	.	.	.	14	8	0.00	4.410	1.80
BARIUM	Q1	.	.	.	14	1	0.19	4.690	1.91
BENZOIC ACID	Q1	.	.	.	5	5	0.67	.	.
	S4	5	0	2.65	5	0	2.48	1.340	1.11
BENZOIC ACID	Median	.	.	2.65	.	.	1.58	1.340	1.11
BENZYL ALCOHOL	Q1	.	.	.	5	4	0.45	.	.
BIS(2-ETHYLHEXYL) PHTHALATE	Q1	.	.	.	5	3	0.42	3.430	1.82

Reference D-7 (Continued)

Analyte	Episode	Inf # Obs	Inf # ND	Inf Est. LTA (mg/L)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/L)	Eff 1-Day VF	Eff 4-day VF
	S4	5	1	2.36	5	0	0.03	2.730	1.47
	S5	4	0	38.10	5	1	0.14	3.060	1.52
	Median	.	.	20.20	.	.	0.14	3.060	1.52
BOD 5-DAY (CARBONACEOUS)	Q1	.	.	.	46	0	660.00	3.820	1.71
	Q3	.	.	.	4	0	448.00	2.250	1.35
	S4	5	0	773.00	5	0	545.00	1.780	1.23
	S5	5	0	1490.00	5	0	366.00	1.680	1.21
	Median	.	.	1130.00	.	.	497.00	2.020	1.29
BUTYL BENZYL PHTHALATE	Q1	.	.	.	5	5	0.40	.	.
CADMIUM	Q1	.	.	.	15	14	0.02	.	.
	Q3	.	.	.	4	2	0.01	1.120	1.43
	Q4	.	.	.	8	8	0.01	.	.
	S4	5	0	0.14	5	0	0.02	2.790	1.48
	Median	.	.	0.14	.	.	0.02	1.950	1.45
CHEMICAL OXYGEN DEMAND (COD)	Q2	.	.	.	12	0	715.00	1.680	1.21
	S4	5	0	6320.00	5	0	1400.00	1.630	1.19
	S5	5	0	6730.00	5	0	998.00	1.270	1.09
	Median	.	.	6530.00	.	.	998.00	1.630	1.19
CHLOROBENZENE	Q1	.	.	.	6	6	0.77	.	.
	Q2	.	.	.	13	13	0.00	.	.
	S5	5	0	0.24	5	5	0.03	.	.
	Median	.	.	0.24	.	.	0.03	.	.
CHLOROFORM	Q1	.	.	.	6	6	2.71	.	.
	Q2	.	.	.	13	7	0.03	4.250	1.99
	S4	5	0	0.17	5	0	0.19	10.400	3.23
	Median	.	.	0.17	.	.	0.19	7.350	2.61
CHROMIUM	Q1	.	.	.	15	0	0.13	4.640	1.89
CHROMIUM	Q4	.	.	.	8	2	0.10	2.910	1.52
	S4	5	0	0.58	5	1	0.04	1.190	1.09
	S5	5	0	0.27	5	0	0.03	1.520	1.16
	Median	.	.	0.43	.	.	0.07	2.220	1.34

Reference D-7 (Continued)

Analyte	Episode	Inf # Obs	Inf # ND	Inf Est. LTA (mg/L)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/L)	Eff 1-Day VF	Eff 4-day VF
COPPER	Q1	.	.	.	15	0	0.67	6.400	2.28
	Q2	.	.	.	13	1	0.59	4.520	1.87
	Q3	.	.	.	5	0	0.57	6.950	2.40
	Q4	.	.	.	8	0	0.39	3.150	1.56
	S4	5	0	3.40	5	0	0.36	3.070	1.54
	S5	5	0	2.14	5	0	0.17	1.590	1.18
	Median	.	.	2.77	.	.	0.48	3.830	1.72
DI-N-BUTYL PHTHALATE	Q1	.	.	.	5	5	0.22	.	.
	S5	4	1	0.67	5	5	0.03	.	.
	Median	.	.	0.67	.	.	0.13	.	.
DI-N-OCTYL PHTHALATE	Q1	.	.	.	5	5	0.44	.	.
	S5	4	3	0.30	5	5	0.03	.	.
	Median	.	.	0.30	.	.	0.24	.	.
ETHYLBENZENE	Q2	.	.	.	13	10	0.00	3.540	1.90
	S5	5	0	7.05	5	0	0.37	4.160	1.78
	Median	.	.	7.05	.	.	0.19	3.850	1.84
IRON	S4	5	0	38.00	5	0	0.93	2.660	1.45
	S5	5	0	19.10	5	0	4.65	2.230	1.35
	Median	.	.	28.60	.	.	2.79	2.450	1.40
ISOPHORONE	Q1	.	.	.	5	0	3.60	11.500	3.46
LEAD	Q1	.	.	.	15	1	0.22	5.050	1.99
	Q2	.	.	.	14	3	0.23	2.990	1.57
	Q3	.	.	.	4	2	0.32	1.550	1.47
	Q4	.	.	.	8	8	0.10	.	.
	S4	5	0	1.46	5	2	0.14	3.720	1.75
	S5	5	0	0.77	5	2	0.06	1.390	1.13
	Median	.	.	1.11	.	.	0.18	2.990	1.57
M-XYLENE	S5	5	0	16.10	5	0	0.60	3.550	1.65
MANGANESE	S4	5	0	0.50	5	0	0.02	1.880	1.26
	S5	5	0	0.40	5	0	0.05	1.640	1.20
	Median	.	.	0.45	.	.	0.03	1.760	1.23
MERCURY	Q1	.	.	.	14	14	0.00	.	.
	Q3	.	.	.	5	2	0.00	1.010	1.00
	Q4	.	.	.	8	8	0.00	.	.
	Median	.	.	.	.	.	0.00	1.010	1.00
METHYLENE CHLORIDE	Q1	.	.	.	6	6	1.16	.	.
	Q2	.	.	.	13	13	0.00	.	.

Reference D-7 (Continued)

Analyte	Episode	Inf # Obs	Inf # ND	Inf Est. LTA (mg/L)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/L)	Eff 1-Day VF	Eff 4-day VF
	S5	5	0	0.91	4	0	0.55	7.380	2.50
	Median	.	.	0.91	.	.	0.55	7.380	2.50
MOLYBDENUM	S4	5	0	0.38	5	0	0.16	2.830	1.49
	S5	5	0	0.15	5	0	0.08	1.450	1.14
	Median	.	.	0.26	.	.	0.12	2.140	1.31
N-DECANE	S4	5	1	2.47	5	1	0.03	4.340	1.84
	S5	4	0	140.00	5	1	0.91	2.510	1.54
	Median	.	.	71.30	.	.	0.47	3.430	1.69
N-DOCOSANE	S4	5	2	0.43	5	4	0.01	.	.
	S5	4	0	0.23	5	3	0.04	1.720	1.97
	Median	.	.	0.33	.	.	0.02	1.720	1.97
N-DODECANE	S4	5	0	1.51	5	5	0.01	.	.
	S5	4	0	45.40	5	1	0.38	3.590	1.70
	Median	.	.	23.40	.	.	0.20	3.590	1.70
N-EICOSANE	S4	5	1	1.06	5	3	0.01	2.370	1.32
	S5	4	0	2.16	5	1	0.08	4.340	1.80
	Median	.	.	1.61	.	.	0.05	3.350	1.56
N-HEXACOSANE	S4	5	0	0.66	5	4	0.01	.	.
	S5	4	0	2.50	5	4	0.03	.	.
	Median	.	.	1.58	.	.	0.02	.	.
N-HEXADECANE	S4	5	1	1.15	5	1	0.01	1.800	1.23
	S5	4	0	39.10	5	1	0.16	3.280	1.57
	Median	.	.	20.10	.	.	0.08	2.540	1.40
N-OCTADECANE	S4	5	0	0.37	5	2	0.02	2.200	1.40
	S5	4	0	19.40	5	1	0.12	6.310	2.25
	Median	.	.	9.88	.	.	0.07	4.260	1.82
N-TETRACOSANE	S4	5	0	0.72	5	5	0.01	.	.
	S5	4	0	2.38	5	3	0.03	2.320	2.04
	Median	.	.	1.55	.	.	0.02	2.320	2.04
N-TETRADECANE	S4	5	1	0.66	5	2	0.01	2.340	1.35
	S5	4	0	11.50	5	1	0.14	7.150	2.45
	Median	.	.	6.09	.	.	0.08	4.740	1.90
N-TRIACONTANE	S4	5	0	0.17	5	5	0.01	.	.
NAPHTHALENE	Q2	.	.	.	13	13	0.00	.	.
	S4	5	0	0.66	5	2	0.08	4.730	2.00

Reference D-7 (Continued)

Analyte	Episode	Inf # Obs	Inf # ND	Inf Est. LTA (mg/L)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/L)	Eff 1-Day VF	Eff 4-day VF
	S5	4	0	7.07	5	1	0.18	1.570	1.24
	Median	.	.	3.86	.	.	0.08	3.150	1.62
NICKEL	Q1	.	.	.	15	4	0.03	3.040	1.53
	Q3	.	.	.	5	0	0.07	4.510	1.86
	Q4	.	.	.	8	7	0.04	.	.
	S4	5	0	0.54	5	2	0.07	1.040	1.48
	Median	.	.	0.54	.	.	0.05	3.040	1.53
O+P XYLENE	S4	5	0	0.19	5	0	0.12	3.150	1.56
	S5	5	0	11.80	5	0	0.42	4.070	1.76
	Median	.	.	5.99	.	.	0.27	3.610	1.66
OIL AND GREASE (AS HEM)	S4	5	0	789.00	5	0	24.00	3.300	1.59
	S5	5	0	1530.00	5	0	51.60	2.300	1.36
	Median	.	.	1160.00	.	.	37.80	2.800	1.48
P-CRESOL	Q1	.	.	.	5	4	0.22	.	.
P-CYMENE	S4	5	3	0.12	5	5	0.01	.	.
	S5	4	1	6.93	5	4	0.13	.	.
	Median	.	.	3.52	.	.	0.07	.	.
PHENOL	Q1	.	.	.	5	4	0.61	.	.
	Q2	.	.	.	12	11	0.01	.	.
	S4	5	0	0.22	5	0	0.21	3.090	1.55
	Median	.	.	0.22	.	.	0.21	3.090	1.55
SELENIUM	Q1	.	.	.	14	11	0.01	10.100	3.20
	S4	5	3	0.10	5	3	0.09	0.896	1.85
	Median	.	.	0.10	.	.	0.05	5.490	2.52
SILVER	Q1	.	.	.	15	15	0.02	.	.
	Q3	.	.	.	4	3	0.02	.	.
	Median	.	.	.	.	.	0.02	.	.
TETRACHLOROETHENE	Q1	.	.	.	6	2	25.10	15.400	3.87
	Q2	.	.	.	13	4	0.02	4.970	2.00
	S4	5	0	0.14	5	0	0.07	3.080	1.54
	S5	5	1	9.58	5	0	0.43	5.870	2.16
	Median	.	.	4.86	.	.	0.25	5.420	2.08
TIN	S4	5	3	0.36	5	5	0.10	.	.
TITANIUM	S4	5	0	0.27	5	4	0.02	.	.
TOLUENE	Q2	.	.	.	13	6	0.05	13.500	3.66

Reference D-7 (Continued)

Analyte	Episode	Inf # Obs	Inf # ND	Inf Est. LTA (mg/L)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/L)	Eff 1-Day VF	Eff 4-day VF
	S4	5	0	0.81	5	0	0.71	7.930	2.63
	S5	5	0	37.80	5	0	4.20	2.800	1.48
	Median	.	.	19.30	.	.	0.71	7.930	2.63
TOTAL ORGANIC CARBON (TOC)	S4	5	0	881.00	4	0	456.00	1.780	1.23
	S5	5	0	1100.00	5	0	195.00	1.750	1.23
	Median	.	.	989.00	.	.	326.00	1.770	1.23
TOTAL PETROLEUM HYDROCARBON (AS SGT-HEM)	S4	5	0	318.00	5	1	11.40	3.640	1.68
	S5	5	0	683.00	5	0	16.00	2.620	1.44
	Median	.	.	500.00	.	.	13.70	3.130	1.56
TOTAL SUSPENDED SOLIDS	Q1	.	.	.	48	3	48.70	4.160	1.79
	Q2	.	.	.	12	0	85.50	4.320	1.82
	Q3	.	.	.	5	0	504.00	3.970	1.74
	S4	5	0	2150.00	5	0	147.00	2.090	1.31
	S5	5	0	886.00	5	0	65.80	2.710	1.46
	Median	.	.	1520.00	.	.	85.50	3.970	1.74
TOTAL XYLENES	Q2	.	.	.	13	8	0.01	9.580	2.92
TRANS-1,2-DICHLOROETHENE	Q1	.	.	.	6	4	2.84	0.564	2.35
	Q2	.	.	.	13	13	0.00	.	.
	Median	.	.	.	.	.	1.42	0.564	2.35
TRICHLOROETHENE	Q1	.	.	.	6	6	1.55	.	.
	Q2	.	.	.	13	11	0.37	19.200	3.97
	Median	.	.	.	.	.	0.96	19.200	3.97
ZINC	Q1	.	.	.	15	0	0.90	7.340	2.49
	Q2	.	.	.	12	0	1.22	5.110	1.99
	Q3	.	.	.	5	0	0.91	6.270	2.25
	Q4	.	.	.	8	0	0.78	2.960	1.52
	S4	5	0	4.69	5	0	0.51	3.170	1.57
	S5	5	0	3.07	5	0	0.27	1.580	1.18
	Median	.	.	3.88	.	.	0.84	4.140	1.78

Reference D-8
Long-Term Averages and Variability Factors
Chemical Precipitation - All (CP-All)

Analyte	Episode	Inf # Obs	Inf # ND	Inf Est. LTA (mg/L)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/L)	Eff 1-Day VF	Eff 4-day VF
1,1,1-TRICHLOROETHANE	Q5	.	.	.	4	4	0.39	.	.
	Q7	.	.	.	3	3	0.04	.	.
	Q9	.	.	.	4	0	0.55	9.460	3.00
	S6	5	1	1.53	4	0	1.19	9.670	3.05
	Median	.	.	1.53	.	.	0.47	9.560	3.02
1,2-DIPHENYLHYDRAZINE	Q7	.	.	.	3	3	0.13	.	.
2-BUTANONE	S6	5	1	3.21	4	0	3.23	1.830	1.25
2-METHYLNAPHTHALENE	S6	5	0	0.33	4	0	0.01	1.680	1.21
	S7	4	0	0.22	5	4	0.01	.	.
	Median	.	.	0.27	.	.	0.01	1.680	1.21
2-PROPANONE	S7	5	0	1.81	4	0	1.54	2.240	1.35
4-CHLORO-3-METHYLPHENOL	Q7	.	.	.	3	3	0.06	.	.
4-METHYL-2-PENTANONE	S6	5	2	2.51	4	0	3.13	12.400	3.64
	S7	5	0	1.14	5	0	0.78	7.080	2.43
	Median	.	.	1.82	.	.	1.96	9.730	3.04
ALUMINUM	S6	5	0	11.30	4	0	0.47	4.240	1.80
	S7	5	0	17.90	5	0	2.19	2.580	1.43
	Median	.	.	14.60	.	.	1.33	3.410	1.62
BENZYL ALCOHOL	S7	4	0	0.46	5	0	0.34	6.380	2.27
BIS(2-ETHYLHEXYL) PHTHALATE	Q7	.	.	.	3	2	0.15	.	.
	S6	5	0	2.97	4	0	0.07	1.210	1.07
	S7	4	0	2.96	5	0	0.04	2.960	1.52
	Median	.	.	2.97	.	.	0.07	2.080	1.29
BOD 5-DAY (CARBONACEOUS)	Q8	.	.	.	3	0	623.00	.	.
	S6	5	0	2200.00	4	0	376.00	1.240	1.08
	S7	2	0	1380.00	5	0	399.00	1.660	1.20
	Median	.	.	1790.00	.	.	399.00	1.450	1.14
BUTYL BENZYL PHTHALATE	Q7	.	.	.	3	3	0.06	.	.
BUTYL BENZYL PHTHALATE	S6	5	2	0.13	4	4	0.01	.	.
	S7	4	1	0.16	5	5	0.01	.	.
	Median	.	.	0.14	.	.	0.01	.	.
CADMIUM	Q5	.	.	.	16	14	0.01	3.180	1.55

Reference D-8 (Continued)

Analyte	Episode	Inf # Obs	Inf # ND	Inf Est. LTA (mg/L)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/L)	Eff 1-Day VF	Eff 4-day VF
	Q6	.	.	.	7	0	0.02	2.590	1.43
	S6	5	0	0.07	4	3	0.00	.	.
	S7	5	0	0.11	5	0	0.01	3.280	1.59
	Median	.	.	0.09	.	.	0.01	3.180	1.55
CHEMICAL OXYGEN DEMAND (COD)	Q9	.	.	.	4	0	1270.00	3.190	1.57
	S6	5	0	7540.00	4	0	891.00	1.370	1.12
	S7	5	0	10100.00	5	0	1290.00	1.910	1.27
	Median	.	.	8830.00	.	.	1270.00	1.910	1.27
CHLOROBENZENE	Q5	.	.	.	4	4	0.39	.	.
	Q7	.	.	.	3	3	0.03	.	.
	Q9	.	.	.	4	4	0.02	.	.
	Median	.	.	.	.	.	0.03	.	.
CHLOROFORM	Q5	.	.	.	4	2	0.41	0.509	1.82
	Q7	.	.	.	3	1	0.07	.	.
	Q9	.	.	.	4	4	0.00	.	.
	Median	.	.	.	.	.	0.07	0.509	1.82
CHROMIUM	Q5	.	.	.	16	12	0.04	0.593	1.09
	Q6	.	.	.	7	0	0.05	3.030	1.53
	S6	5	0	0.23	4	0	0.02	4.860	1.94
	S7	5	0	0.75	5	0	0.05	5.150	2.00
	Median	.	.	0.49	.	.	0.05	3.940	1.73
COPPER	Q5	.	.	.	16	0	0.14	1.710	1.22
	Q6	.	.	.	7	0	0.40	1.560	1.17
	S6	5	0	3.13	4	0	0.06	3.570	1.65
	S7	5	0	4.85	5	0	0.44	2.370	1.38
	Median	.	.	3.99	.	.	0.27	2.040	1.30
DI-N-BUTYL PHTHALATE	Q7	.	.	.	3	3	0.06	.	.
DI-N-OCTYL PHTHALATE	Q7	.	.	.	3	3	0.06	.	.
	S6	5	0	0.24	4	4	0.01	.	.
	Median	.	.	0.24	.	.	0.03	.	.
ETHYLBENZENE	Q7	.	.	.	3	1	0.04	.	.
	Q9	.	.	.	4	0	0.34	9.680	3.05
	S6	5	1	0.52	4	0	0.27	2.470	1.41
	S7	5	0	0.31	5	0	0.04	2.720	1.46
	Median	.	.	0.41	.	.	0.15	2.720	1.46
HEXANOIC ACID	S7	4	0	0.25	5	1	0.20	1.810	1.47
IRON	Q6	.	.	.	4	0	7.30	5.710	2.12

Reference D-8 (Continued)

Analyte	Episode	Inf # Obs	Inf # ND	Inf Est. LTA (mg/L)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/L)	Eff 1-Day VF	Eff 4-day VF
	S6	5	0	39.50	4	0	0.93	2.650	1.45
	S7	5	0	66.60	5	0	1.78	7.910	2.63
	Median	.	.	53.00	.	.	1.78	5.710	2.12
ISOPHORONE	Q7	.	.	.	3	3	0.06	.	.
	S6	5	1	0.61	4	0	0.54	7.170	2.46
	Median	.	.	0.61	.	.	0.30	7.170	2.46
LEAD	Q5	.	.	.	16	11	0.10	1.290	1.07
	Q6	.	.	.	7	0	0.28	1.520	1.16
	Q7	.	.	.	11	5	0.03	3.890	1.77
	Q8	.	.	.	4	1	0.20	2.660	1.55
	S6	5	0	1.50	4	2	0.06	5.290	2.00
	S7	5	0	2.14	5	0	0.10	5.220	2.02
	Median	.	.	1.82	.	.	0.10	3.270	1.66
M-XYLENE	S6	5	1	4.39	4	1	0.35	3.840	1.83
	S7	5	0	0.76	5	0	0.14	1.890	1.26
	Median	.	.	2.57	.	.	0.24	2.870	1.54
MANGANESE	S6	5	0	0.78	4	0	0.01	1.630	1.19
	S7	5	0	1.14	5	0	0.05	5.540	2.08
	Median	.	.	0.96	.	.	0.03	3.590	1.64
MERCURY	Q5	.	.	.	16	14	0.00	3.540	1.57
	S7	5	0	0.00	5	5	0.00	.	.
MERCURY	Median	.	.	0.00	.	.	0.00	3.540	1.57
METHYLENE CHLORIDE	Q5	.	.	.	4	2	0.86	9.090	3.61
	Q7	.	.	.	3	3	0.17	.	.
	Q9	.	.	.	4	4	0.01	.	.
	Median	.	.	.	.	.	0.17	9.090	3.61
MOLYBDENUM	S6	5	0	0.58	4	0	0.46	1.910	1.27
	S7	5	0	0.30	5	0	0.09	1.630	1.19
	Median	.	.	0.44	.	.	0.28	1.770	1.23
N-DECANE	S6	5	0	7.55	4	0	0.10	1.530	1.17
	S7	4	0	3.77	5	0	0.07	2.970	1.52
	Median	.	.	5.66	.	.	0.09	2.250	1.34
N-DOCOSANE	S6	5	2	0.15	4	2	0.01	1.220	1.08
	S7	4	0	0.64	5	4	0.01	.	.
	Median	.	.	0.40	.	.	0.01	1.220	1.08
N-DODECANE	S6	5	0	6.79	4	0	2.83	10.400	3.23

Reference D-8 (Continued)

Analyte	Episode	Inf # Obs	Inf # ND	Inf Est. LTA (mg/L)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/L)	Eff 1-Day VF	Eff 4-day VF
	S7	4	0	4.67	5	2	0.09	2.300	1.68
	Median	.	.	5.73	.	.	1.46	6.370	2.45
N-EICOSANE	S6	5	0	0.38	4	0	0.02	1.390	1.12
	S7	4	0	1.71	5	1	0.01	2.220	1.33
	Median	.	.	1.04	.	.	0.02	1.800	1.23
N-HEXACOSANE	S6	5	0	0.20	4	2	0.01	1.560	1.26
N-HEXADECANE	S6	5	0	2.50	4	0	0.07	3.040	1.53
	S7	4	0	2.92	5	1	0.01	2.420	1.38
	Median	.	.	2.71	.	.	0.04	2.730	1.46
N-OCTACOSANE	S6	5	0	0.15	4	1	0.02	1.330	1.21
N-OCTADECANE	S6	5	0	0.39	4	0	0.03	1.430	1.14
	S7	4	0	1.90	5	0	0.03	2.360	1.38
	Median	.	.	1.14	.	.	0.03	1.900	1.26
N-TETRACOSANE	S6	5	0	0.47	4	3	0.01	.	.
	S7	4	0	1.20	5	2	0.01	1.960	1.28
	Median	.	.	0.83	.	.	0.01	1.960	1.28
N-TETRADECANE	S6	5	0	2.12	4	0	0.06	4.230	1.80
	S7	4	0	3.05	5	0	0.02	2.750	1.47
	Median	.	.	2.59	.	.	0.04	3.490	1.63
N-TRIACONTANE	S6	5	0	0.21	4	2	0.01	1.410	1.23
NAPHTHALENE	Q6	.	.	.	3	1	0.06	.	.
	Q7	.	.	.	3	3	0.06	.	.
	S6	5	0	1.53	4	1	0.08	3.900	1.81
	S7	4	0	0.23	5	0	0.04	1.840	1.25
	Median	.	.	0.88	.	.	0.06	2.870	1.53
NICKEL	Q5	.	.	.	16	15	0.04	.	.
	Q6	.	.	.	7	0	0.09	2.770	1.48
	S7	5	0	1.46	5	0	0.04	7.040	2.43
	Median	.	.	1.46	.	.	0.04	4.910	1.95
O+P XYLENE	S6	5	2	2.88	4	1	0.23	4.120	1.87
	S7	5	0	0.90	5	0	0.16	1.920	1.27
	Median	.	.	1.89	.	.	0.20	3.020	1.57
OIL AND GREASE (AS HEM)	S6	5	0	965.00	4	0	28.50	2.540	1.42
	S7	5	0	2100.00	5	0	28.60	1.940	1.27
	Median	.	.	1530.00	.	.	28.50	2.240	1.35

Reference D-8 (Continued)

Analyte	Episode	Inf # Obs	Inf # ND	Inf Est. LTA (mg/L)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/L)	Eff 1-Day VF	Eff 4-day VF
P-CYMENE	S7	4	0	0.14	5	5	0.01	.	.
PHENOL	Q7	.	.	.	3	3	0.06	.	.
SILVER	Q6	.	.	.	7	3	0.03	8.370	2.68
TETRACHLOROETHENE	Q9	.	.	.	4	0	0.08	7.560	2.55
	S6	5	1	1.68	4	0	0.44	5.650	2.11
	S7	5	0	5.13	5	0	0.42	2.100	1.32
	Median	.	.	3.40	.	.	0.42	5.650	2.11
TIN	S7	5	0	0.59	5	0	0.05	2.980	1.52
TITANIUM	S6	5	1	0.12	4	2	0.02	1.540	1.37
	S7	5	0	0.51	5	3	0.07	15.800	3.31
	Median	.	.	0.32	.	.	0.05	8.670	2.34
TOLUENE	Q7	.	.	.	3	1	0.04	.	.
	Q9	.	.	.	4	0	1.05	2.860	1.49
	S6	5	0	2.02	4	0	1.58	2.390	1.39
	S7	5	0	3.90	5	0	0.90	1.670	1.20
	Median	.	.	2.96	.	.	0.97	2.390	1.39
TOTAL ORGANIC CARBON (TOC)	S6	5	0	1700.00	4	0	342.00	1.350	1.11
	S7	5	0	307.00	5	0	277.00	1.310	1.10
	Median	.	.	1000.00	.	.	310.00	1.330	1.11
TOTAL PETROLEUM HYDROCARBON (AS SGT-HEM)	S6	5	0	164.00	4	0	10.80	2.540	1.42
	S7	5	0	991.00	5	0	9.51	1.760	1.23
	Median	.	.	578.00	.	.	10.20	2.150	1.32
TOTAL SUSPENDED SOLIDS	Q8	.	.	.	3	0	282.00	.	.
	Q9	.	.	.	4	0	119.00	5.610	2.10
	S6	5	0	1750.00	4	0	82.10	1.720	1.22
	S7	5	0	4040.00	5	3	114.00	3.560	1.60
	Median	.	.	2900.00	.	.	117.00	3.560	1.60
TOTAL XYLENES	Q9	.	.	.	4	0	1.54	10.500	3.25
TRANS-1,2-DICHLOROETHENE	Q5	.	.	.	4	4	0.39	.	.
	Q7	.	.	.	3	3	0.03	.	.
	Q9	.	.	.	4	4	0.02	.	.
	Median	.	.	.	.	.	0.03	.	.
TRICHLOROETHENE	Q5	.	.	.	4	4	0.39	.	.
	Q7	.	.	.	3	3	0.03	.	.
	Q9	.	.	.	4	4	0.00	.	.

Reference D-8 (Continued)

Analyte	Episode	Inf # Obs	Inf # ND	Inf Est. LTA (mg/L)	Eff # Obs	Eff # ND	Eff Est. LTA (mg/L)	Eff 1-Day VF	Eff 4-day VF
	S7	5	0	0.10	5	0	0.04	3.990	1.75
	Median	.	.	0.10	.	.	0.04	3.990	1.75
ZINC	Q5	.	.	.	16	0	0.10	3.960	1.74
	Q6	.	.	.	7	0	1.72	2.140	1.33
	Q8	.	.	.	4	0	0.30	6.940	2.40
	S6	5	0	3.71	4	0	0.05	1.790	1.24
	S7	5	0	8.45	5	0	0.52	3.080	1.54
	Median	.	.	6.08	.	.	0.30	3.080	1.54

Appendix E

Tables Referenced In Chapter 9

Table E-1

Summary of POTW Pollutant Loadings and Removals from Industrial Laundry Wastewater for CP-IL[1] Entire Industry[2]

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD_5)	10,004,982	9,230,263	774,718	91%
Oil and Grease (measured as HEM)	5,007,547	1,990,838	3,016,709	87%
Total Suspended Solids (TSS)	5,627,828	2,893,319	2,734,509	91%
Priority Organics				
1,1,1-Trichloroethane	33,709	18,970	14,739	24%
1,2-Diphenylhydrazine	0	0	0	62%
4-Chloro-3-methylphenol	3,718	1,311	2,407	63%
Bis(2-ethylhexyl) Phthalate	57,572	31,709	25,863	60%
Butyl Benzyl Phthalate	5,553	1,844	3,710	86%
Chlorobenzene	1,890	1,298	592	24%
Chloroform	97,422	97,237	186	24%
Di-*n*-butyl Phthalate	4,109	1,197	2,912	75%
Di-*n*-octyl Phthalate	9,134	6,773	2,361	33%
Ethylbenzene	25,491	8,083	17,408	33%
Isophorone	18,156	9,207	8,949	62%
Methylene Chloride	23,961	9,617	14,344	18%
Naphthalene	34,140	15,641	18,499	18%
Phenol	634	634	0	95%
Tetrachloroethene	28,342	18,473	9,869	33%

Table E-1 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Priority Organics (Continued)				
Toluene	44,474	34,529	9,944	33%
trans-1,2-Dichloroethene	2,250	2,250	0	33%
Trichloroethene	1,990	1,177	813	33%
Total Priority Organics	**392,545**	**259,950**	**132,595**	---
Nonconventional Organics				
2-Butanone	30,404	28,756	1,649	18%
2-Methylnaphthalene	8,223	2,179	6,044	28%
2-Propanone	20,956	12,894	8,062	85%
4-Methyl-2-pentanone	13,076	13,076	0	18%
∝-Terpineol	9,566	6,362	3,204	18%
Benzoic Acid	13,079	13,079	0	81%
Benzyl Alcohol	48,148	35,240	12,908	33%
Hexanoic Acid	5,412	5,408	4	33%
m-Xylene	11,867	9,820	2,047	33%
n-Decane	451,359	232,959	218,400	33%
n-Docosane	999	352	647	94%
n-Dodecane	124,810	86,151	38,659	33%
n-Eicosane	98,135	8,255	89,881	33%
n-Hexacosane	965	257	708	94%
n-Hexadecane	59,075	16,292	42,784	33%
n-Octacosane	603	233	370	94%
n-Octadecane	47,990	7,980	40,010	33%
n-Tetracosane	1,376	536	840	94%

Table E-1 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Nonconventional Organics (Continued)				
n-Tetradecane	75,308	14,486	60,821	33%
n-Triacontane	905	447	458	94%
o-&*p*-Xylene	7,444	6,582	861	33%
p-Cresol	0	0	0	72%
p-Cymene	525	149	376	99%
Pentamethylbenzene	0	0	0	91%
Total Nonconventional Organics	**1,030,225**	**501,493**	**528,732**	---
Priority Metals and Elements				
Antimony	7,758	4,932	2,826	72%
Arsenic	7,838	7,830	8	40%
Beryllium	15	14	1	61%
Cadmium	481	277	204	91%
Chromium	1,377	844	534	91%
Copper	21,276	11,671	9,604	84%
Lead	5,874	2,183	3,691	92%
Mercury	122	108	15	33%
Nickel	7,338	5,129	2,208	52%
Selenium	266	163	103	34%
Silver	907	686	221	80%
Thallium	0	0	0	28%
Zinc	45,862	15,680	30,182	77%
Total Priority Metals and Elements	**99,114**	**49,517**	**49,597**	---

Table E-1 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Nonconventional Metals and Elements				
Aluminum	87,795	58,955	28,840	88%
Barium	46,815	32,596	14,219	35%
Boron	30,043	28,407	1,636	14%
Cobalt	4,742	2,697	2,046	4%
Iron	216,813	90,380	126,433	83%
Manganese	14,908	7,565	7,343	41%
Molybdenum	4,580	4,554	26	52%
Tin	2,049	908	1,140	65%
Titanium	5,492	3,613	1,879	69%
Vanadium	1,183	1,057	126	42%
Yttrium	329	324	5	58%
Total Nonconventional Metals and Elements	**414,749**	**231,056**	**183,693**	**---**
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	46,755,318	35,617,305	11,138,013	82%
Total Organic Carbon (TOC)	22,718,738	20,936,851	1,781,887	71%
Total Petroleum Hydrocarbon (measured as SGT-HEM)[5]	3,408,559	618,088	2,790,471	74%

[1]Numbers in this table were calculated using more significant figures than shown.
[2]The entire industrial laundries industry is estimated to consist of 1,742 facilities.
[3]POTW baseline wastewater pollutant loading = industry baseline wastewater pollutant loading × (1-POTW pollutant removal efficiency).
[4]POTW postcompliance wastewater pollutant loading = industry postcompliance wastewater pollutant loading × (1-POTW pollutant removal efficiency).
[5]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

HEM - Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.

Table E-2

Summary of POTW Pollutant Loadings and Removals from Industrial Laundry Wastewater for DAF-IL[1] Entire Industry[2]

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD_5)	10,004,982	9,534,919	470,062	91%
Oil and Grease (measured as HEM)	5,007,547	2,084,632	2,922,915	87%
Total Suspended Solids (TSS)	5,627,828	2,689,166	2,938,663	91%
Priority Organics				
1,1,1-Trichloroethane	33,709	1,807	31,902	24%
1,2-Diphenylhydrazine	0	0	0	62%
4-Chloro-3-methylphenol	3,718	3,465	253	63%
Bis(2-ethylhexyl) Phthalate	57,572	34,075	23,497	60%
Butyl Benzyl Phthalate	5,553	3,622	1,931	86%
Chlorobenzene	1,890	1,228	662	24%
Chloroform	97,422	97,418	4	24%
Di-*n*-butyl Phthalate	4,109	3,016	1,092	75%
Di-*n*-octyl Phthalate	9,134	6,490	2,644	33%
Ethylbenzene	25,491	3,846	21,645	33%
Isophorone	18,156	18,156	0	62%
Methylene Chloride	23,961	22,594	1,367	18%
Naphthalene	34,140	16,766	17,374	18%
Phenol	634	634	0	95%
Tetrachloroethene	28,342	13,743	14,599	33%

Table E-2 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Priority Organics (Continued)				
Toluene	44,474	30,928	13,545	33%
trans-1,2-Dichloroethene	2,250	2,250	0	33%
Trichloroethene	1,990	1,990	0	33%
Total Priority Organics	**392,545**	**262,030**	**130,515**	**---**
Nonconventional Organics				
2-Butanone	30,404	30,404	0	18%
2-Methylnaphthalene	8,223	7,058	1,165	28%
2-Propanone	20,956	20,892	64	85%
4-Methyl-2-pentanone	13,076	12,945	131	18%
∝-Terpineol	9,566	9,547	19	18%
Benzoic Acid	13,079	12,923	156	81%
Benzyl Alcohol	48,148	48,148	0	33%
Hexanoic Acid	5,412	5,412	0	33%
m-Xylene	11,867	11,063	804	33%
n-Decane	451,359	252,676	198,683	33%
n-Docosane	999	409	590	94%
n-Dodecane	124,810	35,065	89,745	33%
n-Eicosane	98,135	10,003	88,133	33%
n-Hexacosane	965	288	677	94%
n-Hexadecane	59,075	18,569	40,506	33%
n-Octacosane	603	203	400	94%
n-Octadecane	47,990	10,084	37,906	33%
n-Tetracosane	1,376	582	794	94%

Table E-2 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Nonconventional Organics (Continued)				
n-Tetradecane	75,308	16,392	58,916	33%
n-Triacontane	905	439	466	94%
o-&*p*-Xylene	7,444	7,235	209	33%
p-Cresol	0	0	0	72%
p-Cymene	525	195	330	99%
Pentamethylbenzene	0	0	0	91%
Total Nonconventional Organics	**1,030,225**	**510,533**	**519,692**	**---**
Priority Metals and Elements				
Antimony	7,758	5,471	2,287	72%
Arsenic	7,838	7,838	0	40%
Beryllium	15	15	0	61%
Cadmium	481	325	156	91%
Chromium	1,377	1,007	370	91%
Copper	21,276	14,383	6,892	84%
Lead	5,874	2,686	3,188	92%
Mercury	122	104	18	33%
Nickel	7,338	5,166	2,172	52%
Selenium	266	266	0	34%
Silver	907	813	94	80%
Thallium	0	0	0	28%
Zinc	45,862	25,955	19,907	77%
Total Priority Metals and Elements	**99,114**	**64,029**	**35,086**	**---**

Table E-2 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Nonconventional Metals and Elements				
Aluminum	87,795	58,738	29,058	88%
Barium	46,815	28,005	18,811	35%
Boron	30,043	29,563	479	14%
Cobalt	4,742	3,555	1,187	4%
Iron	216,813	104,510	112,302	83%
Manganese	14,908	7,664	7,245	41%
Molybdenum	4,580	4,225	355	52%
Tin	2,049	1,727	322	65%
Titanium	5,492	2,831	2,661	69%
Vanadium	1,183	1,038	145	42%
Yttrium	329	311	18	58%
Total Nonconventional Metals and Elements	**414,749**	**242,167**	**172,582**	---
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	46,755,318	32,559,762	14,195,556	82%
Total Organic Carbon (TOC)	22,718,738	21,128,828	1,589,911	71%
Total Petroleum Hydrocarbon (measured as SGT-HEM)[5]	3,408,559	694,530	2,714,029	74%

[1]Numbers in this table were calculated using more significant figures than shown.
[2]The entire industrial laundries industry is estimated to consist of 1,742 facilities.
[3]POTW baseline wastewater pollutant loading = industry baseline wastewater pollutant loading × (1-POTW pollutant removal efficiency).
[4]POTW postcompliance wastewater pollutant loading = industry postcompliance wastewater pollutant loading × (1-POTW pollutant removal efficiency).
[5]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

HEM - Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.

Table E-3

Summary of POTW Pollutant Loadings and Removals from Industrial Laundry Wastewater for CP-IL[1] Excluding Facilities with Less than 1 Million Pounds per Year Total Production and Less than 255,000 Pounds per Year Shop and Printer Towel/Rag Production[2]

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD_5)	9,915,334	9,167,360	747,974	91%
Oil and Grease (measured as HEM)	4,926,141	1,976,984	2,949,157	87%
Total Suspended Solids (TSS)	5,556,819	2,873,356	2,683,463	91%
Priority Organics				
1,1,1-Trichloroethane	33,198	18,841	14,357	24%
1,2-Diphenylhydrazine	0	0	0	62%
4-Chloro-3-methylphenol	3,674	1,304	2,370	63%
Bis(2-ethylhexyl) Phthalate	56,981	31,487	25,494	60%
Butyl Benzyl Phthalate	5,491	1,831	3,660	86%
Chlorobenzene	1,860	1,288	572	24%
Chloroform	96,720	96,551	168	24%
Di-*n*-butyl Phthalate	4,048	1,188	2,860	75%
Di-*n*-octyl Phthalate	9,030	6,726	2,305	33%
Ethylbenzene	24,926	8,030	16,896	33%
Isophorone	17,888	9,156	8,732	62%
Methylene Chloride	23,532	9,554	13,978	18%
Naphthalene	33,550	15,534	18,017	18%
Phenol	629	629	0	95%
Tetrachloroethene	27,683	18,350	9,333	33%

Table E-3 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Priority Organics (Continued)				
Toluene	43,647	34,255	9,392	33%
trans-1,2-Dichloroethene	2,216	2,216	0	33%
Trichloroethene	1,962	1,168	794	33%
Total Priority Organics	**387,038**	**258,109**	**128,929**	**---**
Nonconventional Organics				
2-Butanone	29,922	28,330	1,592	18%
2-Methylnaphthalene	8,109	2,164	5,945	28%
2-Propanone	20,633	12,792	7,841	85%
4-Methyl-2-pentanone	12,863	12,863	0	18%
∝-Terpineol	9,433	6,319	3,114	18%
Benzoic Acid	12,946	12,946	0	81%
Benzyl Alcohol	47,557	35,019	12,537	33%
Hexanoic Acid	5,382	5,378	4	33%
m-Xylene	11,670	9,751	1,919	33%
n-Decane	444,334	231,316	213,018	33%
n-Docosane	988	350	638	94%
n-Dodecane	122,629	85,552	37,076	33%
n-Eicosane	95,866	8,197	87,668	33%
n-Hexacosane	949	255	694	94%
n-Hexadecane	58,025	16,179	41,846	33%
n-Octacosane	594	231	363	94%
n-Octadecane	47,025	7,925	39,100	33%
n-Tetracosane	1,361	532	828	94%

Table E-3 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Nonconventional Organics (Continued)				
n-Tetradecane	73,808	14,386	59,421	33%
n-Triacontane	896	444	451	94%
o-&*p*-Xylene	7,325	6,530	795	33%
p-Cresol	0	0	0	72%
p-Cymene	519	148	371	99%
Pentamethylbenzene	0	0	0	91%
Total Nonconventional Organics	**1,012,832**	**497,609**	**515,233**	**---**
Priority Metals and Elements				
Antimony	7,711	4,898	2,813	72%
Arsenic	7,783	7,775	8	40%
Beryllium	15	14	1	61%
Cadmium	475	275	200	91%
Chromium	1,362	838	524	91%
Copper	21,021	11,592	9,429	84%
Lead	5,783	2,169	3,615	92%
Mercury	121	107	14	33%
Nickel	7,271	5,094	2,177	52%
Selenium	264	162	102	34%
Silver	899	681	218	80%
Thallium	0	0	0	28%
Zinc	45,325	15,573	29,752	77%
Total Priority Metals and Elements	**98,031**	**49,178**	**48,852**	**---**

Table E-3 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Nonconventional Metals and Elements				
Aluminum	87,139	58,547	28,592	88%
Barium	46,263	32,369	13,894	35%
Boron	29,732	28,204	1,527	14%
Cobalt	4,684	2,679	2,005	4%
Iron	214,833	89,764	125,069	83%
Manganese	14,757	7,513	7,244	41%
Molybdenum	4,523	4,509	15	52%
Tin	2,030	902	1,128	65%
Titanium	5,455	3,588	1,867	69%
Vanadium	1,174	1,050	124	42%
Yttrium	326	322	5	58%
Total Nonconventional Metals and Elements	**410,917**	**229,447**	**181,470**	---
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	46,198,588	35,378,302	10,820,286	82%
Total Organic Carbon (TOC)	22,515,816	20,794,885	1,720,931	71%
Total Petroleum Hydrocarbon (measured as SGT-HEM)[5]	3,341,399	613,888	2,727,511	74%

[1]Numbers in this table were calculated using more significant figures than shown.
[2]136 of the 1,742 total industrial laundries are excluded from compliance under this criterion.
[3]POTW baseline wastewater pollutant loading = industry baseline wastewater pollutant loading × (1-POTW pollutant removal efficiency).
[4]POTW postcompliance wastewater pollutant loading = industry postcompliance wastewater pollutant loading × (1-POTW pollutant removal efficiency).
[5]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

HEM - Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.

Table E-4

Summary of POTW Pollutant Loadings and Removals from Industrial Laundry Wastewater for DAF-IL[1] Excluding Facilities with Less than 1 Million Pounds per Year Total Production and Less than 255,000 Pounds per Year Shop and Printer Towel/Rag Production[2]

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD_5)	9,915,334	9,468,820	446,514	91%
Oil and Grease (measured as HEM)	4,926,141	2,070,083	2,856,057	87%
Total Suspended Solids (TSS)	5,556,819	2,670,654	2,886,164	91%
Priority Organics				
1,1,1-Trichloroethane	33,198	1,803	31,396	24%
1,2-Diphenylhydrazine	0	0	0	62%
4-Chloro-3-methylphenol	3,674	3,444	230	63%
Bis(2-ethylhexyl) Phthalate	56,981	33,836	23,146	60%
Butyl Benzyl Phthalate	5,491	3,596	1,895	86%
Chlorobenzene	1,860	1,220	641	24%
Chloroform	96,720	96,716	4	24%
Di-*n*-butyl Phthalate	4,048	2,994	1,054	75%
Di-*n*-octyl Phthalate	9,030	6,445	2,585	33%
Ethylbenzene	24,926	3,822	21,104	33%
Isophorone	17,888	17,888	0	62%
Methylene Chloride	23,532	22,426	1,106	18%
Naphthalene	33,550	16,651	16,900	18%
Phenol	629	629	0	95%
Tetrachloroethene	27,683	13,660	14,023	33%

Table E-4 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Priority Organics (Continued)				
Toluene	43,647	30,709	12,938	33%
trans-1,2-Dichloroethene	2,216	2,216	0	33%
Trichloroethene	1,962	1,962	0	33%
Total Priority Organics	**387,038**	**260,017**	**127,021**	---
Nonconventional Organics				
2-Butanone	29,922	29,922	0	18%
2-Methylnaphthalene	8,109	7,007	1,102	28%
2-Propanone	20,633	20,574	59	85%
4-Methyl-2-pentanone	12,863	12,770	93	18%
∝-Terpineol	9,433	9,415	19	18%
Benzoic Acid	12,946	12,796	150	81%
Benzyl Alcohol	47,557	47,557	0	33%
Hexanoic Acid	5,382	5,382	0	33%
m-Xylene	11,670	10,974	696	33%
n-Decane	444,334	250,890	193,444	33%
n-Docosane	988	406	582	94%
n-Dodecane	122,629	34,847	87,782	33%
n-Eicosane	95,866	9,933	85,933	33%
n-Hexacosane	949	286	664	94%
n-Hexadecane	58,025	18,440	39,585	33%
n-Octacosane	594	202	393	94%
n-Octadecane	47,025	10,014	37,011	33%
n-Tetracosane	1,361	578	783	94%

Table E-4 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Nonconventional Organics (Continued)				
n-Tetradecane	73,808	16,277	57,530	33%
n-Triacontane	896	436	460	94%
o-&*p*-Xylene	7,325	7,166	159	33%
p-Cresol	0	0	0	72%
p-Cymene	519	194	325	99%
Pentamethylbenzene	0	0	0	91%
Total Nonconventional Organics	**1,012,832**	**506,064**	**506,768**	---
Priority Metals and Elements				
Antimony	7,711	5,434	2,277	72%
Arsenic	7,783	7,783	0	40%
Beryllium	15	15	0	61%
Cadmium	475	322	153	91%
Chromium	1,362	1,001	361	91%
Copper	21,021	14,285	6,736	84%
Lead	5,783	2,668	3,115	92%
Mercury	121	103	18	33%
Nickel	7,271	5,131	2,140	52%
Selenium	264	264	0	34%
Silver	899	807	92	80%
Thallium	0	0	0	28%
Zinc	45,325	25,776	19,549	77%
Total Priority Metals and Elements	**98,031**	**63,589**	**34,442**	---

Table E-4 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Nonconventional Metals and Elements				
Aluminum	87,139	58,331	28,809	88%
Barium	46,263	27,811	18,453	35%
Boron	29,732	29,336	396	14%
Cobalt	4,684	3,531	1,153	4%
Iron	214,833	103,792	111,041	83%
Manganese	14,757	7,610	7,147	41%
Molybdenum	4,523	4,192	331	52%
Tin	2,030	1,716	314	65%
Titanium	5,455	2,811	2,644	69%
Vanadium	1,174	1,031	142	42%
Yttrium	326	309	18	58%
Total Nonconventional Metals and Elements	**410,917**	**240,470**	**170,447**	**---**
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	46,198,588	32,339,329	13,859,259	82%
Total Organic Carbon (TOC)	22,515,816	20,984,865	1,530,952	71%
Total Petroleum Hydrocarbon (measured as SGT-HEM)[5]	3,341,399	689,782	2,651,618	74%

[1]Numbers in this table were calculated using more significant figures than shown.
[2]136 of the 1,742 total industrial laundries are excluded from compliance under this criterion.
[3]POTW baseline wastewater pollutant loading = industry baseline wastewater pollutant loading × (1-POTW pollutant removal efficiency).
[4]POTW postcompliance wastewater pollutant loading = industry postcompliance wastewater pollutant loading × (1-POTW pollutant removal efficiency).
[5]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

HEM - Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.

Table E-5

Summary of POTW Pollutant Loadings and Removals from the Industrial Laundry Wastewater for CP-IL[1] Excluding Facilities with Less than 3 Million Pounds per Year Total Production and Less than 120,000 Pounds per Year Shop and Printer Towel/Rag Production[2]

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD_5)	9,370,861	8,627,377	743,484	91%
Oil and Grease (measured as HEM)	4,585,069	1,877,385	2,707,684	87%
Total Suspended Solids (TSS)	5,069,715	2,685,202	2,384,513	91%
Priority Organics				
1,1,1-Trichloroethane	30,753	16,546	14,207	24%
1,2-Diphenylhydrazine	0	0	0	62%
4-Chloro-3-methylphenol	3,274	1,141	2,133	63%
Bis(2-ethylhexyl) Phthalate	53,130	30,162	22,968	60%
Butyl Benzyl Phthalate	5,223	1,756	3,467	86%
Chlorobenzene	1,774	1,202	572	24%
Chloroform	93,291	93,123	168	24%
Di-*n*-butyl Phthalate	3,776	1,127	2,649	75%
Di-*n*-octyl Phthalate	8,434	6,305	2,129	33%
Ethylbenzene	22,852	6,937	15,914	33%
Isophorone	16,533	7,996	8,536	62%
Methylene Chloride	21,561	8,392	13,169	18%
Naphthalene	31,471	14,612	16,859	18%
Phenol	594	594	0	95%
Tetrachloroethene	25,275	16,130	9,146	33%

Table E-5 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Priority Organics (Continued)				
Toluene	41,322	31,963	9,358	33%
trans-1,2-Dichloroethene	2,108	2,108	0	33%
Trichloroethene	1,889	1,095	794	33%
Total Priority Organics	**363,259**	**241,190**	**122,069**	**---**
Nonconventional Organics				
2-Butanone	27,866	26,274	1,592	18%
2-Methylnaphthalene	7,342	2,023	5,320	28%
2-Propanone	19,759	11,936	7,824	85%
4-Methyl-2-pentanone	12,014	12,014	0	18%
∝-Terpineol	8,945	5,866	3,079	18%
Benzoic Acid	12,009	12,009	0	81%
Benzyl Alcohol	44,649	32,259	12,390	33%
Hexanoic Acid	4,899	4,895	4	33%
m-Xylene	10,884	8,973	1,911	33%
n-Decane	418,536	222,769	195,767	33%
n-Docosane	885	332	553	94%
n-Dodecane	111,108	75,061	36,047	33%
n-Eicosane	85,761	7,830	77,931	33%
n-Hexacosane	862	240	622	94%
n-Hexadecane	52,842	15,393	37,449	33%
n-Octacosane	533	215	319	94%
n-Octadecane	42,151	7,483	34,668	33%
n-Tetracosane	1,239	508	731	94%

Table E-5 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Nonconventional Organics (Continued)				
n-Tetradecane	66,629	13,672	52,958	33%
n-Triacontane	825	423	402	94%
o-&*p*-Xylene	6,881	6,086	795	33%
p-Cresol	0	0	0	72%
p-Cymene	499	142	357	99%
Pentamethylbenzene	0	0	0	91%
Total Nonconventional Organics	**937,119**	**466,402**	**470,717**	**---**
Priority Metals and Elements				
Antimony	7,025	4,652	2,373	72%
Arsenic	7,482	7,474	8	40%
Beryllium	13	13	1	61%
Cadmium	440	260	180	91%
Chromium	1,266	774	492	91%
Copper	19,404	10,834	8,570	84%
Lead	5,318	2,028	3,291	92%
Mercury	114	101	13	33%
Nickel	6,707	4,759	1,948	52%
Selenium	232	142	91	34%
Silver	850	645	205	80%
Thallium	0	0	0	28%
Zinc	41,047	14,458	26,589	77%
Total Priority Metals and Elements	**89,899**	**46,139**	**43,760**	**---**

Table E-5 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Nonconventional Metals and Elements				
Aluminum	80,313	55,182	25,131	88%
Barium	43,082	30,380	12,702	35%
Boron	27,728	26,201	1,527	14%
Cobalt	4,411	2,439	1,972	4%
Iron	194,392	84,164	110,228	83%
Manganese	13,563	7,096	6,467	41%
Molybdenum	4,310	4,296	15	52%
Tin	1,796	783	1,013	65%
Titanium	4,980	3,341	1,640	69%
Vanadium	1,096	977	119	42%
Yttrium	310	305	5	58%
Total Nonconventional Metals and Elements	**375,981**	**215,162**	**160,819**	---
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	42,500,624	32,329,719	10,170,905	82%
Total Organic Carbon (TOC)	21,160,935	19,451,423	1,709,511	71%
Total Petroleum Hydrocarbon (measured as SGT-HEM)[5]	3,059,232	570,725	2,488,507	74%

[1]Numbers in this table were calculated using more significant figures than shown.
[2]518 of the 1,742 total industrial laundries are excluded from compliance under this criterion. This exclusion includes the 136 facilities excluded under the 1 Million/255K exclusion shown in Table E-3.
[3]POTW baseline wastewater pollutant loading = industry baseline wastewater pollutant loading × (1-POTW pollutant removal efficiency).
[4]POTW postcompliance wastewater pollutant loading = industry postcompliance wastewater pollutant loading × (1-POTW pollutant removal efficiency).
[5]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

HEM - Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.

Table E-6

Summary of POTW Pollutant Loadings and Removals from Industrial Laundry Wastewater for DAF-IL[1] Excluding Facilities with Less than 3 Million Pounds per Year Total Production and Less than 120,000 Pounds per Year Shop and Printer Towel/Rag Production[2]

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD_5)	9,370,861	8,925,535	445,326	91%
Oil and Grease (measured as HEM)	4,585,069	1,956,843	2,628,226	87%
Total Suspended Solids (TSS)	5,069,715	2,514,180	2,555,535	91%
Priority Organics				
1,1,1-Trichloroethane	30,753	1,714	29,039	24%
1,2-Diphenylhydrazine	0	0	0	62%
4-Chloro-3-methylphenol	3,274	3,045	230	63%
Bis(2-ethylhexyl) Phthalate	53,130	32,168	20,962	60%
Butyl Benzyl Phthalate	5,223	3,340	1,883	86%
Chlorobenzene	1,774	1,135	639	24%
Chloroform	93,291	93,287	4	24%
Di-*n*-butyl Phthalate	3,776	2,735	1,041	75%
Di-*n*-octyl Phthalate	8,434	6,069	2,365	33%
Ethylbenzene	22,852	3,371	19,481	33%
Isophorone	16,533	16,533	0	62%
Methylene Chloride	21,561	20,454	1,106	18%
Naphthalene	31,471	15,569	15,902	18%
Phenol	594	593	0	95%
Tetrachloroethene	25,275	11,940	13,335	33%

Table E-6 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Priority Organics (Continued)				
Toluene	41,322	28,476	12,846	33%
trans-1,2-Dichloroethene	2,108	2,108	0	33%
Trichloroethene	1,889	1,889	0	33%
Total Priority Organics	**363,259**	**244,426**	**118,833**	**---**
Nonconventional Organics				
2-Butanone	27,866	27,866	0	18%
2-Methylnaphthalene	7,342	6,252	1,091	28%
2-Propanone	19,759	19,700	59	85%
4-Methyl-2-pentanone	12,014	11,920	93	18%
∝-Terpineol	8,945	8,926	19	18%
Benzoic Acid	12,009	11,859	150	81%
Benzyl Alcohol	44,649	44,649	0	33%
Hexanoic Acid	4,899	4,899	0	33%
m-Xylene	10,884	10,188	696	33%
n-Decane	418,536	239,478	179,058	33%
n-Docosane	885	381	504	94%
n-Dodecane	111,108	32,676	78,432	33%
n-Eicosane	85,761	9,324	76,438	33%
n-Hexacosane	862	266	595	94%
n-Hexadecane	52,842	17,337	35,505	33%
n-Octacosane	533	190	344	94%
n-Octadecane	42,151	9,287	32,864	33%
n-Tetracosane	1,239	547	692	94%

Table E-6 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Nonconventional Organics (Continued)				
n-Tetradecane	66,629	15,298	51,331	33%
n-Triacontane	825	416	409	94%
o-&*p*-Xylene	6,881	6,722	159	33%
p-Cresol	0	0	0	72%
p-Cymene	499	182	318	99%
Pentamethylbenzene	0	0	0	91%
Total Nonconventional Organics	**937,119**	**478,361**	**458,757**	**---**
Priority Metals and Elements				
Antimony	7,025	5,114	1,911	72%
Arsenic	7,482	7,482	0	40%
Beryllium	13	13	0	61%
Cadmium	440	301	139	91%
Chromium	1,266	915	351	91%
Copper	19,404	13,151	6,253	84%
Lead	5,318	2,458	2,860	92%
Mercury	114	98	16	33%
Nickel	6,707	4,790	1,917	52%
Selenium	232	232	0	34%
Silver	850	759	91	80%
Thallium	0	0	0	28%
Zinc	41,047	23,263	17,784	77%
Total Priority Metals and Elements	**89,899**	**58,576**	**31,323**	**---**

Table E-6 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Nonconventional Metals and Elements				
Aluminum	80,313	54,999	25,314	88%
Barium	43,082	26,533	16,549	35%
Boron	27,728	27,332	396	14%
Cobalt	4,411	3,261	1,150	4%
Iron	194,392	96,236	98,156	83%
Manganese	13,563	7,179	6,384	41%
Molybdenum	4,310	3,979	331	52%
Tin	1,796	1,489	307	65%
Titanium	4,980	2,686	2,294	69%
Vanadium	1,096	962	134	42%
Yttrium	310	292	17	58%
Total Nonconventional Metals and Elements	**375,981**	**224,949**	**151,033**	---
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	42,500,624	29,779,598	12,721,025	82%
Total Organic Carbon (TOC)	21,160,935	19,637,160	1,523,775	71%
Total Petroleum Hydrocarbon (measured as SGT-HEM)[5]	3,059,232	636,199	2,423,033	74%

[1]Numbers in this table were calculated using more significant figures than shown.
[2]518 of the 1,742 total industrial laundries are excluded from compliance under this criterion. This exclusion includes the 136 facilities excluded under the 1 Million/255K exclusion shown in Table E-4.
[3]POTW baseline wastewater pollutant loading = industry baseline wastewater pollutant loading × (1-POTW pollutant removal efficiency).
[4]POTW postcompliance wastewater pollutant loading = industry postcompliance wastewater pollutant loading × (1-POTW pollutant removal efficiency).
[5]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

HEM - Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.

Table E-7

Summary of POTW Pollutant Loadings and Removals from the Industrial Laundry Wastewater for CP-IL[1] Excluding Facilities with Less than 5 Million Pounds per Year Total Production and Less than 255,000 Pounds per Year Shop and Printer Towel/Rag Production[2]

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD_5)	7,870,550	7,194,216	676,334	91%
Oil and Grease (measured as HEM)	3,713,278	1,571,679	2,141,599	87%
Total Suspended Solids (TSS)	4,023,754	2,176,761	1,846,993	91%
Priority Organics				
1,1,1-Trichloroethane	25,408	12,037	13,371	24%
1,2-Diphenylhydrazine	0	0	0	62%
4-Chloro-3-methylphenol	2,549	785	1,764	63%
Bis(2-ethylhexyl) Phthalate	43,102	25,665	17,437	60%
Butyl Benzyl Phthalate	4,497	1,498	2,999	86%
Chlorobenzene	1,560	1,003	557	24%
Chloroform	80,461	80,297	165	24%
Di-*n*-butyl Phthalate	3,057	941	2,116	75%
Di-*n*-octyl Phthalate	6,912	5,141	1,771	33%
Ethylbenzene	18,055	4,612	13,443	33%
Isophorone	13,937	5,688	8,249	62%
Methylene Chloride	17,752	5,928	11,824	18%
Naphthalene	25,700	12,000	13,699	18%
Phenol	499	499	0	95%
Tetrachloroethene	20,338	11,665	8,673	33%

Table E-7 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Priority Organics (Continued)				
Toluene	34,249	25,789	8,460	33%
trans-1,2-Dichloroethene	1,871	1,871	0	33%
Trichloroethene	1,704	921	783	33%
Total Priority Organics	**301,652**	**196,341**	**105,310**	**---**
Nonconventional Organics				
2-Butanone	23,537	21,945	1,592	18%
2-Methylnaphthalene	5,813	1,639	4,174	28%
2-Propanone	16,989	9,694	7,295	85%
4-Methyl-2-pentanone	10,120	10,120	0	18%
∝-Terpineol	7,670	4,715	2,955	18%
Benzoic Acid	9,960	9,960	0	81%
Benzyl Alcohol	38,061	25,949	12,111	33%
Hexanoic Acid	3,861	3,857	4	33%
m-Xylene	9,110	7,297	1,813	33%
n-Decane	346,475	191,400	155,075	33%
n-Docosane	676	278	398	94%
n-Dodecane	86,417	54,358	32,059	33%
n-Eicosane	66,884	6,629	60,255	33%
n-Hexacosane	670	197	473	94%
n-Hexadecane	41,648	12,927	28,721	33%
n-Octacosane	411	171	239	94%
n-Octadecane	32,751	6,193	26,558	33%
n-Tetracosane	985	429	556	94%

Table E-7 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Nonconventional Organics (Continued)				
n-Tetradecane	52,170	11,458	40,712	33%
n-Triacontane	668	355	313	94%
o-&*p*-Xylene	5,840	5,072	768	33%
p-Cresol	0	0	0	72%
p-Cymene	437	121	316	99%
Pentamethylbenzene	0	0	0	91%
Total Nonconventional Organics	**761,153**	**384,765**	**376,388**	**---**
Priority Metals and Elements				
Antimony	5,514	3,892	1,622	72%
Arsenic	6,422	6,415	8	40%
Beryllium	10	9	1	61%
Cadmium	360	215	145	91%
Chromium	1,026	616	411	91%
Copper	15,618	8,801	6,817	84%
Lead	4,277	1,649	2,628	92%
Mercury	95	85	10	33%
Nickel	5,424	3,864	1,560	52%
Selenium	174	99	75	34%
Silver	718	537	181	80%
Thallium	0	0	0	28%
Zinc	32,490	11,583	20,906	77%
Total Priority Metals and Elements	**72,129**	**37,765**	**34,364**	**---**

Table E-7 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Nonconventional Metals and Elements				
Aluminum	64,518	45,533	18,986	88%
Barium	35,172	24,803	10,369	35%
Boron	23,169	21,649	1,520	14%
Cobalt	3,750	1,891	1,859	4%
Iron	152,254	68,808	83,446	83%
Manganese	10,908	5,880	5,028	41%
Molybdenum	3,668	3,655	14	52%
Tin	1,363	543	819	65%
Titanium	3,919	2,688	1,230	69%
Vanadium	903	798	105	42%
Yttrium	261	257	4	58%
Total Nonconventional Metals and Elements	**299,886**	**176,506**	**123,380**	---
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	34,126,011	25,242,072	8,883,939	82%
Total Organic Carbon (TOC)	17,604,176	16,039,154	1,565,022	71%
Total Petroleum Hydrocarbon (measured as SGT-HEM)[5]	2,430,965	458,599	1,972,367	74%

[1]Numbers in this table were calculated using more significant figures than shown.
[2]953 of the 1,742 total industrial laundries are excluded from compliance under this criterion.
[3]POTW baseline wastewater pollutant loading = industry baseline wastewater pollutant loading × (1-POTW pollutant removal efficiency).
[4]POTW postcompliance wastewater pollutant loading = industry postcompliance wastewater pollutant loading × (1-POTW pollutant removal efficiency).
[5]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

HEM - Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.

Table E-8

Summary of POTW Pollutant Loadings and Removals from Industrial Laundry Wastewater for DAF-IL[1] Excluding Facilities with Less than 5 Million Pounds per Year Total Production and Less than 255,000 Pounds per Year Shop and Printer Towel/Rag Production[2]

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD_5)	7,870,550	7,462,737	407,813	91%
Oil and Grease (measured as HEM)	3,713,278	1,623,842	2,089,436	87%
Total Suspended Solids (TSS)	4,023,754	2,069,124	1,954,630	91%
Priority Organics				
1,1,1-Trichloroethane	25,408	1,307	24,101	24%
1,2-Diphenylhydrazine	0	0	0	62%
4-Chloro-3-methylphenol	2,549	2,327	221	63%
Bis(2-ethylhexyl) Phthalate	43,102	26,988	16,114	60%
Butyl Benzyl Phthalate	4,497	2,739	1,758	86%
Chlorobenzene	1,560	939	621	24%
Chloroform	80,461	80,457	4	24%
Di-*n*-butyl Phthalate	3,057	2,163	893	75%
Di-*n*-octyl Phthalate	6,912	4,992	1,920	33%
Ethylbenzene	18,055	2,367	15,688	33%
Isophorone	13,937	13,937	0	62%
Methylene Chloride	17,752	16,695	1,058	18%
Naphthalene	25,700	12,639	13,061	18%
Phenol	499	499	0	95%
Tetrachloroethene	20,338	8,320	12,018	33%

Table E-8 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Priority Organics (Continued)				
Toluene	34,249	22,770	11,479	33%
trans-1,2-Dichloroethene	1,871	1,871	0	33%
Trichloroethene	1,704	1,704	0	33%
Total Priority Organics	**301,652**	**202,715**	**98,937**	---
Nonconventional Organics				
2-Butanone	23,537	23,537	0	18%
2-Methylnaphthalene	5,813	4,839	975	28%
2-Propanone	16,989	16,930	59	85%
4-Methyl-2-pentanone	10,120	10,026	93	18%
∝-Terpineol	7,670	7,651	19	18%
Benzoic Acid	9,960	9,810	150	81%
Benzyl Alcohol	38,061	38,061	0	33%
Hexanoic Acid	3,861	3,861	0	33%
m-Xylene	9,110	8,440	669	33%
n-Decane	346,475	202,368	144,107	33%
n-Docosane	676	310	366	94%
n-Dodecane	86,417	26,268	60,149	33%
n-Eicosane	66,884	7,628	59,256	33%
n-Hexacosane	670	215	455	94%
n-Hexadecane	41,648	14,221	27,427	33%
n-Octacosane	411	156	255	94%
n-Octadecane	32,751	7,412	25,339	33%
n-Tetracosane	985	454	530	94%

Table E-8 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Nonconventional Organics (Continued)				
n-Tetradecane	52,170	12,540	39,630	33%
n-Triacontane	668	351	317	94%
o-&*p*-Xylene	5,840	5,681	158	33%
p-Cresol	0	0	0	72%
p-Cymene	437	148	289	99%
Pentamethylbenzene	0	0	0	91%
Total Nonconventional Organics	**761,153**	**400,907**	**360,245**	**---**
Priority Metals and Elements				
Antimony	5,514	4,201	1,314	72%
Arsenic	6,422	6,422	0	40%
Beryllium	10	10	0	61%
Cadmium	360	243	117	91%
Chromium	1,026	717	309	91%
Copper	15,618	10,410	5,207	84%
Lead	4,277	1,943	2,334	92%
Mercury	95	83	12	33%
Nickel	5,424	3,885	1,539	52%
Selenium	174	174	0	34%
Silver	718	631	88	80%
Thallium	0	0	0	28%
Zinc	32,490	17,676	14,813	77%
Total Priority Metals and Elements	**72,129**	**46,395**	**25,734**	**---**

Table E-8 (Continued)

Pollutant of Concern	POTW Baseline Wastewater Pollutant Loading (lbs/yr)[3]	POTW Postcompliance Wastewater Pollutant Loading (lbs/yr)[4]	Total Pollutant Removal from POTW Effluents (lbs/yr)	POTW Pollutant Removal Efficiency
Nonconventional Metals and Elements				
Aluminum	64,518	45,418	19,100	88%
Barium	35,172	22,383	12,789	35%
Boron	23,169	22,773	396	14%
Cobalt	3,750	2,642	1,109	4%
Iron	152,254	76,959	75,295	83%
Manganese	10,908	5,934	4,975	41%
Molybdenum	3,668	3,362	307	52%
Tin	1,363	1,081	282	65%
Titanium	3,919	2,272	1,647	69%
Vanadium	903	786	117	42%
Yttrium	261	245	16	58%
Total Nonconventional Metals and Elements	**299,886**	**183,854**	**116,032**	**---**
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	34,126,011	23,506,336	10,619,675	82%
Total Organic Carbon (TOC)	17,604,176	16,208,778	1,395,398	71%
Total Petroleum Hydrocarbon (measured as SGT-HEM)[5]	2,430,965	503,145	1,927,820	74%

[1]Numbers in this table were calculated using more significant figures than shown.
[2]953 of the 1,742 total industrial laundries are excluded from compliance under this criterion.
[3]POTW baseline wastewater pollutant loading = industry baseline wastewater pollutant loading × (1-POTW pollutant removal efficiency).
[4]POTW postcompliance wastewater pollutant loading = industry postcompliance wastewater pollutant loading × (1-POTW pollutant removal efficiency).
[5]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

HEM - Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.

Table E-9

Summary of Pollutant Loadings and Removals from Industrial Laundry Wastewater for CP-IL[1] Entire Industry[2]

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD_5)	123,053,210	111,166,461	102,558,482	8,607,980
Oil and Grease (measured as HEM)	64,091,381	38,519,591	15,314,139	23,205,452
Total Suspended Solids (TSS)	80,188,009	62,531,426	32,147,990	30,383,436
Priority Organics				
1,1,1-Trichloroethane	59,729	44,354	24,961	19,393
1,2-Diphenylhydrazine	0	0	0	0
4-Chloro-3-methylphenol	11,265	10,048	3,544	6,504
Bis(2-ethylhexyl) Phthalate	198,773	143,930	79,273	64,656
Butyl Benzyl Phthalate	49,117	39,666	13,169	26,497
Chlorobenzene	3,052	2,487	1,708	779
Chloroform	132,500	128,187	127,943	244
Di-*n*-butyl Phthalate	27,638	16,435	4,787	11,648
Di-*n*-octyl Phthalate	17,710	13,633	10,108	3,524
Ethylbenzene	73,755	38,046	12,064	25,982
Isophorone	48,514	47,778	24,228	23,550
Methylene Chloride	36,366	29,221	11,728	17,493
Naphthalene	73,252	41,634	19,075	22,560
Phenol	12,692	12,686	12,686	1
Tetrachloroethene	66,769	42,301	27,571	14,730

Table E-9 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Priority Organics (Continued)				
Toluene	124,476	66,379	51,536	14,842
trans-1,2-Dichloroethene	3,358	3,358	3,358	0
Trichloroethene	3,033	2,971	1,757	1,214
Total Priority Organics	**941,999**	**683,114**	**429,496**	**253,618**
Nonconventional Organics				
2-Butanone	42,700	37,079	35,068	2,011
2-Methylnaphthalene	14,664	11,420	3,026	8,394
2-Propanone	207,940	139,704	85,958	53,746
4-Methyl-2-pentanone	20,081	15,946	15,946	0
∝-Terpineol	13,811	11,666	7,759	3,907
Benzoic Acid	71,411	68,837	68,837	0
Benzyl Alcohol	73,140	71,863	52,597	19,265
Hexanoic Acid	8,081	8,077	8,072	5
m-Xylene	23,707	17,712	14,657	3,056
n-Decane	1,046,234	673,669	347,700	325,970
n-Docosane	21,935	16,653	5,872	10,780
n-Dodecane	290,183	186,284	128,584	57,700
n-Eicosane	230,589	146,471	12,320	134,150
n-Hexacosane	26,371	16,085	4,279	11,806
n-Hexadecane	142,838	88,172	24,316	63,856
n-Octacosane	13,905	10,047	3,877	6,170
n-Octadecane	109,286	71,627	11,910	59,717
n-Tetracosane	28,108	22,929	8,936	13,993

Table E-9 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Nonconventional Organics (Continued)				
n-Tetradecane	177,656	112,400	21,622	90,778
n-Triacontane	18,215	15,088	7,456	7,632
o-&*p*-Xylene	14,556	11,110	9,824	1,286
p-Cresol	0	0	0	0
p-Cymene	71,555	52,508	14,907	37,601
Pentamethylbenzene	0	0	0	0
Total Nonconventional Organics	**2,666,967**	**1,805,347**	**893,523**	**911,824**
Priority Metals and Elements				
Antimony	30,491	27,706	17,615	10,091
Arsenic	13,446	13,064	13,050	14
Beryllium	39	39	37	2
Cadmium	6,322	5,345	3,077	2,268
Chromium	21,638	15,303	9,375	5,928
Copper	180,093	132,972	72,944	60,028
Lead	108,384	73,428	27,292	46,137
Mercury	196	182	161	22
Nickel	17,258	15,287	10,686	4,601
Selenium	408	403	247	156
Silver	4,958	4,535	3,428	1,107
Thallium	0	0	0	0
Zinc	240,534	199,400	68,172	131,228
Total Priority Metals and Elements	**623,768**	**487,665**	**226,084**	**261,581**

Table E-9 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Nonconventional Metals and Elements				
Aluminum	819,659	731,628	491,296	240,332
Barium	94,028	72,023	50,147	21,876
Boron	36,131	34,933	33,031	1,902
Cobalt	5,856	4,940	2,809	2,131
Iron	1,495,967	1,275,369	531,645	743,724
Manganese	30,505	25,269	12,823	12,446
Molybdenum	13,070	9,542	9,488	54
Tin	6,712	5,854	2,595	3,259
Titanium	20,259	17,716	11,656	6,061
Vanadium	2,169	2,040	1,822	218
Yttrium	814	783	771	11
Total Nonconventional Metals and Elements	**2,525,169**	**2,180,096**	**1,148,083**	**1,032,013**
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	333,560,152	259,751,769	197,873,919	61,877,850
Total Organic Carbon (TOC)	87,454,482	78,340,477	72,196,038	6,144,439
Total Petroleum Hydrocarbon (measured as SGT-HEM)[3]	22,888,698	13,109,842	2,377,260	10,732,581

[1]Numbers in this table were calculated using more significant figures than shown.
[2]The entire industrial laundries industry is estimated to consist of 1,742 facilities.
[3]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

HEM - Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.

Table E-10

Summary of Pollutant Loadings and Removals from Industrial Laundry Wastewater for DAF-IL[1] Entire Industry[2]

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD_5)	123,053,210	111,166,461	105,943,546	5,222,915
Oil and Grease (measured as HEM)	64,091,381	38,519,591	16,035,628	22,483,963
Total Suspended Solids (TSS)	80,188,009	62,531,426	29,879,620	32,651,807
Priority Organics				
1,1,1-Trichloroethane	59,729	44,354	2,377	41,976
1,2-Diphenylhydrazine	0	0	0	0
4-Chloro-3-methylphenol	11,265	10,048	9,364	684
Bis(2-ethylhexyl) Phthalate	198,773	143,930	85,188	58,741
Butyl Benzyl Phthalate	49,117	39,666	25,872	13,795
Chlorobenzene	3,052	2,487	1,616	871
Chloroform	132,500	128,187	128,182	5
Di-*n*-butyl Phthalate	27,638	16,435	12,065	4,370
Di-*n*-octyl Phthalate	17,710	13,633	9,687	3,946
Ethylbenzene	73,755	38,046	5,741	32,305
Isophorone	48,514	47,778	47,778	0
Methylene Chloride	36,366	29,221	27,554	1,667
Naphthalene	73,252	41,634	20,447	21,188
Phenol	12,692	12,686	12,679	7
Tetrachloroethene	66,769	42,301	20,512	21,790

Table E-10 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Priority Organics (Continued)				
Toluene	124,476	66,379	46,162	20,217
trans-1,2-Dichloroethene	3,358	3,358	3,358	0
Trichloroethene	3,033	2,971	2,971	0
Total Priority Organics	**950,999**	**683,114**	**461,552**	**221,562**
Nonconventional Organics				
2-Butanone	42,700	37,079	37,078	0
2-Methylnaphthalene	14,664	11,420	9,803	1,618
2-Propanone	207,940	139,704	139,280	424
4-Methyl-2-pentanone	20,081	15,946	15,786	159
∝-Terpineol	13,811	11,666	11,643	23
Benzoic Acid	71,411	68,837	68,014	823
Benzyl Alcohol	73,140	71,863	71,862	0
Hexanoic Acid	8,081	8,077	8,077	0
m-Xylene	23,707	17,712	16,512	1,200
n-Decane	1,046,234	673,669	377,128	296,541
n-Docosane	21,935	16,653	6,818	9,834
n-Dodecane	290,183	186,284	52,336	133,947
n-Eicosane	230,589	146,471	14,929	131,541
n-Hexacosane	26,371	16,085	4,796	11,289
n-Hexadecane	142,838	88,172	27,715	60,457
n-Octacosane	13,905	10,047	3,383	6,664
n-Octadecane	109,286	71,627	15,051	56,576
n-Tetracosane	28,108	22,929	9,701	13,228

Table E-10 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Nonconventional Organics (Continued)				
n-Tetradecane	177,656	112,400	24,465	87,934
n-Triacontane	18,215	15,088	7,317	7,771
o-&*p*-Xylene	14,556	11,110	10,799	311
p-Cresol	0	0	0	0
p-Cymene	71,555	52,508	19,495	33,013
Pentamethylbenzene	0	0	0	0
Total Nonconventional Organics	**2,666,967**	**1,805,347**	**951,992**	**853,355**
Priority Metals and Elements				
Antimony	30,491	27,706	19,540	8,167
Arsenic	13,446	13,064	13,063	0
Beryllium	39	39	39	0
Cadmium	6,322	5,345	3,607	1,737
Chromium	21,638	15,303	11,193	4,110
Copper	180,093	132,972	89,894	43,078
Lead	108,384	73,428	33,574	39,854
Mercury	196	182	155	28
Nickel	17,258	15,287	10,763	4,524
Selenium	408	403	403	0
Silver	4,958	4,535	4,063	472
Thallium	0	0	0	0
Zinc	240,534	199,400	112,848	86,553
Total Priority Metals and Elements	**623,768**	**487,665**	**299,142**	**188,523**

Table E-10 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Nonconventional Metals and Elements				
Aluminum	819,659	731,628	489,482	242,147
Barium	94,028	72,023	43,084	28,939
Boron	36,131	34,933	34,376	557
Cobalt	5,856	4,940	3,704	1,237
Iron	1,495,967	1,275,369	614,767	660,602
Manganese	30,505	25,269	12,989	12,280
Molybdenum	13,070	9,542	8,803	740
Tin	6,712	5,854	4,934	920
Titanium	20,259	17,716	9,132	8,584
Vanadium	2,169	2,040	1,790	249
Yttrium	814	783	740	42
Total Nonconventional Metals and Elements	**2,525,169**	**2,180,096**	**1,223,799**	**956,297**
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	333,560,152	259,751,769	180,887,567	78,864,203
Total Organic Carbon (TOC)	87,454,482	78,340,477	72,858,026	5,482,451
Total Petroleum Hydrocarbon (measured as SGT-HEM)[3]	22,888,698	13,109,842	2,671,268	10,438,574

[1]Numbers in this table were calculated using more significant figures than shown.
[2]The entire industrial laundries industry is estimated to consist of 1,742 facilities.
[3]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

HEM - Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.

Table E-11

Summary of Pollutant Loadings and Removals from Industrial Laundry Wastewater for CP-IL[1] Excluding Facilities with Less than 1 Million Pounds per Year Total Production and Less Than 255,000 Pounds per Year Shop and Printer Towel/Rag Production[2]

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD_5)	122,032,841	110,170,372	101,859,551	8,310,821
Oil and Grease (measured as HEM)	63,393,214	37,893,390	15,207,566	22,685,824
Total Suspended Solids (TSS)	79,368,559	61,742,432	31,926,179	29,816,253
Priority Organics				
1,1,1-Trichloroethane	58,992	43,682	24,791	18,890
1,2-Diphenylhydrazine	0	0	0	0
4-Chloro-3-methylphenol	11,146	9,930	3,523	6,406
Bis(2-ethylhexyl) Phthalate	197,147	142,454	78,718	63,736
Butyl Benzyl Phthalate	48,625	39,223	13,078	26,146
Chlorobenzene	3,010	2,448	1,695	753
Chloroform	131,575	127,263	127,041	221
Di-*n*-butyl Phthalate	27,364	16,193	4,754	11,440
Di-*n*-octyl Phthalate	17,546	13,478	10,038	3,440
Ethylbenzene	72,813	37,203	11,985	25,217
Isophorone	47,811	47,075	24,095	22,979
Methylene Chloride	35,843	28,698	11,651	17,047
Naphthalene	72,442	40,915	18,944	21,972
Phenol	12,594	12,588	12,588	1
Tetrachloroethene	65,740	41,317	27,387	13,930

Table E-11 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Priority Organics (Continued)				
Toluene	123,062	65,145	51,127	14,018
trans-1,2-Dichloroethene	3,308	3,308	3,308	0
Trichloroethene	2,991	2,929	1,743	1,186
Total Priority Organics	**932,009**	**673,848**	**426,467**	**247,381**
Nonconventional Organics				
2-Butanone	42,112	36,490	34,548	1,942
2-Methylnaphthalene	14,503	11,262	3,006	8,257
2-Propanone	205,792	137,556	85,282	52,274
4-Methyl-2-pentanone	19,822	15,687	15,687	0
∝-Terpineol	13,649	11,504	7,707	3,798
Benzoic Acid	70,709	68,136	68,136	0
Benzyl Alcohol	72,258	70,980	52,268	18,712
Hexanoic Acid	8,037	8,033	8,027	5
m-Xylene	23,401	17,418	14,553	2,865
n-Decane	1,034,766	663,185	345,248	317,937
n-Docosane	21,738	16,466	5,832	10,635
n-Dodecane	286,670	183,028	127,690	55,338
n-Eicosane	227,062	143,083	12,235	130,848
n-Hexacosane	26,081	15,821	4,250	11,572
n-Hexadecane	141,149	86,604	24,147	62,457
n-Octacosane	13,754	9,903	3,850	6,053
n-Octadecane	107,779	70,187	11,828	58,359
n-Tetracosane	27,843	22,677	8,874	13,803

Table E-11 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Nonconventional Organics (Continued)				
n-Tetradecane	175,284	110,160	21,472	88,689
n-Triacontane	18,046	14,928	7,403	7,524
o-&*p*-Xylene	14,372	10,933	9,746	1,186
p-Cresol	0	0	0	0
p-Cymene	70,799	51,855	14,803	37,052
Pentamethylbenzene	0	0	0	0
Total Nonconventional Organics	**2,635,625**	**1,775,897**	**886,592**	**889,305**
Priority Metals and Elements				
Antimony	30,321	27,540	17,494	10,046
Arsenic	13,354	12,972	12,958	14
Beryllium	39	39	37	2
Cadmium	6,258	5,281	3,056	2,226
Chromium	21,450	15,133	9,312	5,821
Copper	178,395	131,381	72,449	58,932
Lead	107,160	72,288	27,106	45,182
Mercury	195	181	160	21
Nickel	17,116	15,148	10,613	4,535
Selenium	406	400	246	154
Silver	4,915	4,494	3,405	1,089
Thallium	0	0	0	0
Zinc	238,137	197,065	67,710	129,355
Total Priority Metals and Elements	**617,745**	**481,921**	**224,544**	**257,377**

Table E-11 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Nonconventional Metals and Elements				
Aluminum	814,053	726,162	487,891	238,270
Barium	93,127	71,175	49,799	21,376
Boron	35,769	34,572	32,796	1,776
Cobalt	5,791	4,879	2,791	2,089
Iron	1,483,962	1,263,722	528,021	735,701
Manganese	30,237	25,012	12,734	12,279
Molybdenum	12,939	9,423	9,393	30
Tin	6,658	5,799	2,578	3,221
Titanium	20,135	17,597	11,575	6,022
Vanadium	2,153	2,024	1,810	214
Yttrium	808	777	766	11
Total Nonconventional Metals and Elements	**2,505,633**	**2,161,142**	**1,140,153**	**1,020,989**
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	330,306,526	256,658,823	196,546,125	60,112,698
Total Organic Carbon (TOC)	86,738,604	77,640,746	71,706,500	5,934,246
Total Petroleum Hydrocarbon (measured as SGT-HEM)[3]	22,604,163	12,851,536	2,361,108	10,490,428

[1]Numbers in this table were calculated using more significant figures than shown.
[2]136 of the 1,742 total industrial laundries are excluded from compliance under this criterion.
[3]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

HEM - Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.

Table E-12

Summary of Pollutant Loadings and Removals from Industrial Laundry Wastewater for DAF-IL[1] Excluding Facilities with Less than 1 Million Pounds per Year Total Production and Less than 255,000 Pounds per Year Shop and Printer Towel/Rag Production[2]

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD_5)	122,032,841	110,170,372	105,209,109	4,961,263
Oil and Grease (measured as HEM)	63,393,214	37,893,390	15,923,719	21,969,671
Total Suspended Solids (TSS)	79,368,559	61,742,432	29,673,939	32,068,493
Priority Organics				
1,1,1-Trichloroethane	58,992	43,682	2,372	41,310
1,2-Diphenylhydrazine	0	0	0	0
4-Chloro-3-methylphenol	11,146	9,930	9,309	621
Bis(2-ethylhexyl) Phthalate	197,147	142,454	84,589	57,865
Butyl Benzyl Phthalate	48,625	39,223	25,686	13,537
Chlorobenzene	3,010	2,448	1,605	843
Chloroform	131,575	127,263	127,257	5
Di-*n*-butyl Phthalate	27,364	16,193	11,978	4,216
Di-*n*-octyl Phthalate	17,546	13,478	9,620	3,858
Ethylbenzene	72,813	37,203	5,705	31,498
Isophorone	47,811	47,075	47,075	0
Methylene Chloride	35,843	28,698	27,348	1,349
Naphthalene	72,442	40,915	20,306	20,609
Phenol	12,594	12,588	12,581	7
Tetrachloroethene	65,740	41,317	20,388	20,929

Table E-12 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Priority Organics (Continued)				
Toluene	123,062	65,145	45,834	19,311
trans-1,2-Dichloroethene	3,308	3,308	3,308	0
Trichloroethene	2,991	2,929	2,929	0
Total Priority Organics	**932,009**	**673,848**	**457,889**	**215,959**
Nonconventional Organics				
2-Butanone	42,112	36,490	36,490	0
2-Methylnaphthalene	14,503	11,262	9,731	1,531
2-Propanone	205,792	137,556	137,160	396
4-Methyl-2-pentanone	19,822	15,687	15,573	114
∝-Terpineol	13,649	11,504	11,482	23
Benzoic Acid	70,709	68,136	67,346	790
Benzyl Alcohol	72,258	70,980	70,980	0
Hexanoic Acid	8,037	8,033	8,033	0
m-Xylene	23,401	17,418	16,380	1,038
n-Decane	1,034,766	663,185	374,463	288,722
n-Docosane	21,738	16,466	6,771	9,696
n-Dodecane	286,670	183,028	52,010	131,018
n-Eicosane	227,062	143,083	14,825	128,258
n-Hexacosane	26,081	15,821	4,763	11,058
n-Hexadecane	141,149	86,604	27,522	59,082
n-Octacosane	13,754	9,903	3,360	6,544
n-Octadecane	107,779	70,187	14,946	55,240
n-Tetracosane	27,843	22,677	9,633	13,044

Table E-12 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Nonconventional Organics (Continued)				
n-Tetradecane	175,284	110,160	24,295	85,866
n-Triacontane	18,046	14,928	7,266	7,662
o-&*p*-Xylene	14,372	10,933	10,696	237
p-Cresol	0	0	0	0
p-Cymene	70,799	51,855	19,359	32,496
Pentamethylbenzene	0	0	0	0
Total Nonconventional Organics	**2,635,625**	**1,775,897**	**943,083**	**832,814**
Priority Metals and Elements				
Antimony	30,321	27,540	19,407	8,132
Arsenic	13,354	12,972	12,972	0
Beryllium	39	39	39	0
Cadmium	6,258	5,281	3,583	1,699
Chromium	21,450	15,133	11,119	4,014
Copper	178,395	131,381	89,281	42,100
Lead	107,160	72,288	33,345	38,943
Mercury	195	181	154	27
Nickel	17,116	15,148	10,689	4,459
Selenium	406	400	400	0
Silver	4,915	4,494	4,035	459
Thallium	0	0	0	0
Zinc	238,137	197,065	112,070	84,995
Total Priority Metals and Elements	**617,745**	**481,921**	**297,093**	**184,828**

Table E-12 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Nonconventional Metals and Elements				
Aluminum	814,053	726,162	486,090	240,072
Barium	93,127	71,175	42,786	28,389
Boron	35,769	34,572	34,111	460
Cobalt	5,791	4,879	3,678	1,201
Iron	1,483,962	1,263,722	610,539	653,182
Manganese	30,237	25,012	12,899	12,114
Molybdenum	12,939	9,423	8,734	690
Tin	6,658	5,799	4,903	897
Titanium	20,135	17,597	9,069	8,528
Vanadium	2,153	2,024	1,778	245
Yttrium	808	777	735	42
Total Nonconventional Metals and Elements	**2,505,633**	**2,161,142**	**1,215,322**	**945,820**
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	330,306,526	256,658,823	179,662,938	76,995,885
Total Organic Carbon (TOC)	86,738,604	77,640,746	72,361,602	5,279,144
Total Petroleum Hydrocarbon (measured as SGT-HEM)[3]	22,604,163	12,851,536	2,653,006	10,198,530

[1]Numbers in this table were calculated using more significant figures than shown.
[2]136 of the 1,742 total industrial laundries are excluded from compliance under this criterion.
[3]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

HEM - Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.

Table E-13

Summary of Pollutant Loadings and Removals from Industrial Laundry Wastewater for CP-IL[1] Excluding Facilities with Less than 3 Million Pounds per Year Total Production and Less than 120,000 Pounds per Year Shop and Printer Towel/Rag Production[2]

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD_5)	115,964,420	104,120,680	95,859,747	8,260,933
Oil and Grease (measured as HEM)	60,754,967	35,269,760	14,441,421	20,828,339
Total Suspended Solids (TSS)	73,909,767	56,330,170	29,835,581	26,494,589
Priority Organics				
1,1,1-Trichloroethane	55,767	40,464	21,771	18,694
1,2-Diphenylhydrazine	0	0	0	0
4-Chloro-3-methylphenol	10,066	8,850	3,084	5,766
Bis(2-ethylhexyl) Phthalate	187,452	132,825	75,404	57,420
Butyl Benzyl Phthalate	46,704	37,307	12,546	24,761
Chlorobenzene	2,897	2,334	1,582	753
Chloroform	127,024	122,751	122,530	221
Di-*n*-butyl Phthalate	26,257	15,102	4,507	10,595
Di-*n*-octyl Phthalate	16,650	12,588	9,410	3,178
Ethylbenzene	69,708	34,107	10,354	23,753
Isophorone	44,243	43,507	21,043	22,464
Methylene Chloride	33,436	26,294	10,235	16,059
Naphthalene	69,883	38,379	17,820	20,559
Phenol	11,878	11,872	11,871	1
Tetrachloroethene	62,141	37,725	24,074	13,650

Table E-13 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Priority Organics (Continued)				
Toluene	119,592	61,674	47,706	13,968
trans-1,2-Dichloroethene	3,146	3,146	3,146	0
Trichloroethene	2,882	2,820	1,634	1,186
Total Priority Organics	**889,726**	**631,744**	**398,718**	**233,026**
Nonconventional Organics				
2-Butanone	39,572	33,983	32,042	1,942
2-Methylnaphthalene	13,425	10,198	2,809	7,389
2-Propanone	199,924	131,729	79,572	52,157
4-Methyl-2-pentanone	18,786	14,651	14,651	0
∝-Terpineol	13,053	10,908	7,153	3,755
Benzoic Acid	65,777	63,203	63,203	0
Benzyl Alcohol	67,918	66,640	48,148	18,492
Hexanoic Acid	7,312	7,312	7,306	5
m-Xylene	22,228	16,244	13,392	2,853
n-Decane	995,988	624,681	332,492	292,189
n-Docosane	20,009	14,748	5,537	9,212
n-Dodecane	269,195	165,833	112,032	53,801
n-Eicosane	211,886	128,002	11,687	116,315
n-Hexacosane	24,606	14,359	3,996	10,363
n-Hexadecane	133,345	78,869	22,975	55,894
n-Octacosane	12,727	8,887	3,577	5,311
n-Octadecane	100,441	62,912	11,169	51,743
n-Tetracosane	25,812	20,654	8,464	12,190

Table E-13 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Nonconventional Organics (Continued)				
n-Tetradecane	164,472	99,447	20,406	79,041
n-Triacontane	16,864	13,750	7,045	6,705
o-&*p*-Xylene	13,709	10,270	9,084	1,186
p-Cresol	0	0	0	0
p-Cymene	68,867	49,931	14,211	35,720
Pentamethylbenzene	0	0	0	0
Total Nonconventional Organics	**2,505,916**	**1,647,212**	**830,949**	**816,263**
Priority Metals and Elements				
Antimony	27,861	25,088	16,613	8,475
Arsenic	12,849	12,470	12,457	14
Beryllium	34	34	32	2
Cadmium	5,861	4,886	2,886	2,000
Chromium	20,386	14,070	8,606	5,464
Copper	168,218	121,275	67,715	53,560
Lead	101,327	66,481	25,349	41,131
Mercury	184	170	151	19
Nickel	15,939	13,973	9,914	4,059
Selenium	357	352	215	137
Silver	4,671	4,250	3,224	1,026
Thallium	0	0	0	0
Zinc	219,505	178,466	62,860	115,606
Total Priority Metals and Elements	**577,192**	**441,515**	**210,022**	**231,493**

Table E-13 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Nonconventional Metals and Elements				
Aluminum	756,848	669,275	459,847	209,428
Barium	88,202	66,280	46,738	19,542
Boron	33,439	32,242	30,466	1,776
Cobalt	5,506	4,594	2,540	2,054
Iron	1,363,427	1,143,483	495,084	648,399
Manganese	28,206	22,988	12,027	10,961
Molybdenum	12,496	8,980	8,949	30
Tin	5,990	5,133	2,238	2,895
Titanium	18,595	16,066	10,776	5,290
Vanadium	2,018	1,890	1,684	205
Yttrium	768	737	726	11
Total Nonconventional Metals and Elements	**2,315,497**	**1,971,667**	**1,071,075**	**900,592**
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	309,627,671	236,114,575	179,609,548	56,505,027
Total Organic Carbon (TOC)	82,060,078	72,968,740	67,073,873	5,894,867
Total Petroleum Hydrocarbon (measured as SGT-HEM)[3]	21,514,802	11,766,277	2,195,097	9,571,180

[1]Numbers in this table were calculated using more significant figures than shown.
[2]518 of the 1,742 total industrial laundries are excluded from compliance under this criterion. This exclusion includes the 136 facilities excluded under the 1 Million/255K exclusion shown in Table E-11.
[3]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

HEM - Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.

Table E-14

Summary of Pollutant Loadings and Removals from Industrial Laundry Wastewater for DAF-IL[1] Excluding Facilities with Less than 3 Million Pounds per Year Total Production and Less than 120,000 Pounds per Year Shop and Printer Towel/Rag Production[2]

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD_5)	115,964,420	104,120,680	99,172,611	4,948,069
Oil and Grease (measured as HEM)	60,754,967	35,269,760	15,052,637	20,217,122
Total Suspended Solids (TSS)	73,909,767	56,330,170	27,935,334	28,394,836
Priority Organics				
1,1,1-Trichloroethane	55,767	40,464	2,255	38,210
1,2-Diphenylhydrazine	0	0	0	0
4-Chloro-3-methylphenol	10,066	8,867	8,229	621
Bis(2-ethylhexyl) Phthalate	187,452	132,825	80,421	52,404
Butyl Benzyl Phthalate	46,704	37,307	23,856	13,451
Chlorobenzene	2,897	2,334	1,493	841
Chloroform	127,024	122,751	122,746	5
Di-*n*-butyl Phthalate	26,257	15,102	10,939	4,163
Di-*n*-octyl Phthalate	16,650	12,588	9,058	3,530
Ethylbenzene	69,708	34,107	5,031	29,076
Isophorone	44,243	43,507	43,507	0
Methylene Chloride	33,436	26,294	24,944	1,349
Naphthalene	69,883	38,379	18,987	19,392
Phenol	11,878	11,872	11,865	7
Tetrachloroethene	62,141	37,725	17,821	19,904

Table E-14 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Priority Organics (Continued)				
Toluene	119,592	61,674	42,501	19,173
trans-1,2-Dichloroethene	3,146	3,146	3,146	0
Trichloroethene	2,882	2,820	2,820	0
Total Priority Organics	**889,726**	**631,744**	**429,619**	**202,126**
Nonconventional Organics				
2-Butanone	39,572	33,983	33,983	0
2-Methylnaphthalene	13,425	10,198	8,683	1,515
2-Propanone	199,924	131,729	131,334	396
4-Methyl-2-pentanone	18,786	14,651	14,537	114
∝-Terpineol	13,053	10,908	10,885	23
Benzoic Acid	65,777	63,203	62,413	790
Benzyl Alcohol	67,918	66,640	66,640	0
Hexanoic Acid	7,312	7,312	7,312	0
m-Xylene	22,228	16,244	15,206	1,038
n-Decane	995,988	624,681	357,429	267,251
n-Docosane	20,009	14,748	6,345	8,403
n-Dodecane	269,195	165,833	48,770	117,063
n-Eicosane	211,886	128,002	13,916	114,086
n-Hexacosane	24,606	14,359	4,438	9,921
n-Hexadecane	133,345	78,869	25,876	52,992
n-Octacosane	12,727	8,887	3,162	5,726
n-Octadecane	100,441	62,912	13,862	49,051
n-Tetracosane	25,812	20,654	9,114	11,540

Table E-14 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Nonconventional Organics (Continued)				
n-Tetradecane	164,472	99,447	22,833	76,614
n-Triacontane	16,864	13,750	6,929	6,821
o-&*p*-Xylene	13,709	10,270	10,033	237
p-Cresol	0	0	0	0
p-Cymene	68,867	49,931	18,155	31,776
Pentamethylbenzene	0	0	0	0
Total Nonconventional Organics	**2,505,916**	**1,647,212**	**891,855**	**755,357**
Priority Metals and Elements				
Antimony	27,861	25,088	18,264	6,824
Arsenic	12,849	12,470	12,470	0
Beryllium	34	34	34	0
Cadmium	5,861	4,886	3,342	1,544
Chromium	20,386	14,070	10,171	3,898
Copper	168,218	121,275	82,192	39,082
Lead	101,327	66,481	30,729	35,752
Mercury	184	170	146	24
Nickel	15,939	13,973	9,979	3,994
Selenium	357	352	352	0
Silver	4,671	4,250	3,793	457
Thallium	0	0	0	0
Zinc	219,505	178,466	101,143	77,323
Total Priority Metals and Elements	**577,192**	**441,515**	**272,614**	**168,901**

Table E-14 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Nonconventional Metals and Elements				
Aluminum	756,848	669,275	458,327	210,948
Barium	88,202	66,280	40,820	25,460
Boron	33,439	32,242	31,782	460
Cobalt	5,506	4,594	3,397	1,198
Iron	1,363,427	1,143,483	566,093	577,390
Manganese	28,206	22,988	12,167	10,821
Molybdenum	12,496	8,980	8,290	690
Tin	5,990	5,133	4,255	878
Titanium	18,595	16,066	8,665	7,400
Vanadium	2,018	1,890	1,659	231
Yttrium	768	737	696	41
Total Nonconventional Metals and Elements	**2,315,497**	**1,971,667**	**1,136,150**	**835,517**
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	309,627,671	236,114,575	165,442,212	70,672,363
Total Organic Carbon (TOC)	82,060,078	72,968,740	67,714,343	5,254,397
Total Petroleum Hydrocarbon (measured as SGT-HEM)[3]	21,514,802	11,766,277	2,446,918	9,319,359

[1]Numbers in this table were calculated using more significant figures than shown.
[2]518 of the 1,742 total industrial laundries are excluded from compliance under this criterion. This exclusion includes the 136 facilities excluded under the 1 Million/255K exclusion shown in Table E-12.
[3]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

HEM - Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.

Table E-15

Summary of Pollutant Loadings and Removals from Industrial Laundry Wastewater for CP-IL[1] Excluded Facilities with Less than 5 Million Pounds per Year Total Production and Less than 255,000 Pounds per Year Shop and Printer Towel/Rag Production[2]

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD_5)	99,192,358	87,450,551	79,935,733	7,514,818
Oil and Grease (measured as HEM)	53,740,259	28,563,674	12,089,837	16,473,837
Total Suspended Solids (TSS)	61,877,538	44,708,381	24,186,232	20,522,150
Priority Organics				
1,1,1-Trichloroethane	48,625	33,432	15,838	17,593
1,2-Diphenylhydrazine	0	0	0	0
4-Chloro-3-methylphenol	8,056	6,888	2,122	4,766
Bis(2-ethylhexyl) Phthalate	161,531	107,755	64,163	43,592
Butyl Benzyl Phthalate	41,313	32,124	10,699	21,425
Chlorobenzene	2,615	2,053	1,320	733
Chloroform	109,927	105,870	105,654	216
Di-*n*-butyl Phthalate	23,258	12,228	3,762	8,465
Di-*n*-octyl Phthalate	14,324	10,317	7,673	2,644
Ethylbenzene	62,226	26,947	6,884	20,064
Isophorone	37,412	36,677	14,969	21,708
Methylene Chloride	28,625	21,649	7,229	14,420
Naphthalene	62,534	31,341	14,635	16,706
Phenol	9,991	9,985	9,985	1
Tetrachloroethene	54,652	30,356	17,410	12,945

Table E-15 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Priority Organics (Continued)				
Toluene	108,899	51,118	38,492	12,626
trans-1,2-Dichloroethene	2,793	2,793	2,793	0
Trichloroethene	2,605	2,543	1,375	1,168
Total Priority Organics	**779,386**	**524,074**	**325,002**	**199,072**
Nonconventional Organics				
2-Butanone	34,293	28,704	26,763	1,942
2-Methylnaphthalene	11,207	8,074	2,277	5,798
2-Propanone	181,455	113,260	64,625	48,634
4-Methyl-2-pentanone	16,476	12,341	12,341	0
∝-Terpineol	11,481	9,354	5,750	3,604
Benzoic Acid	54,993	52,420	52,420	0
Benzyl Alcohol	57,962	56,807	38,730	18,077
Hexanoic Acid	5,762	5,762	5,757	5
m-Xylene	19,580	13,596	10,891	2,706
n-Decane	883,722	517,127	285,672	231,455
n-Docosane	16,395	11,271	4,633	6,638
n-Dodecane	231,406	128,980	81,131	47,849
n-Eicosane	181,967	99,826	9,894	89,933
n-Hexacosane	21,259	11,166	3,280	7,885
n-Hexadecane	115,783	62,162	19,295	42,867
n-Octacosane	10,598	6,844	2,858	3,987
n-Octadecane	85,626	48,883	9,244	39,639
n-Tetracosane	21,409	16,413	7,146	9,267

Table E-15 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Nonconventional Organics (Continued)				
n-Tetradecane	141,678	77,866	17,101	60,765
n-Triacontane	14,145	11,128	5,916	5,212
o-&*p*-Xylene	12,155	8,716	7,570	1,146
p-Cresol	0	0	0	0
p-Cymene	62,378	43,735	12,143	31,593
Pentamethylbenzene	0	0	0	0
Total Nonconventional Organics	**2,191,730**	**1,344,436**	**685,436**	**659,000**
Priority Metals and Elements				
Antimony	22,340	19,694	13,900	5,794
Arsenic	11,063	10,704	10,691	13
Beryllium	26	26	24	2
Cadmium	4,950	4,002	2,393	1,608
Chromium	17,660	11,402	6,840	4,562
Copper	143,842	97,610	55,004	42,605
Lead	87,767	53,467	20,616	32,851
Mercury	154	141	126	15
Nickel	13,210	11,300	8,050	3,251
Selenium	268	264	151	114
Silver	4,002	3,591	2,685	906
Thallium	0	0	0	0
Zinc	180,941	141,259	50,361	90,897
Total Priority Metals and Elements	**486,220**	**353,460**	**170,841**	**182,618**

Table E-15 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Nonconventional Metals and Elements				
Aluminum	622,122	537,651	379,438	158,214
Barium	75,689	54,111	38,159	15,952
Boron	28,138	26,941	25,173	1,767
Cobalt	4,807	3,907	1,970	1,936
Iron	1,107,535	895,613	404,754	490,858
Manganese	23,557	18,489	9,966	8,523
Molybdenum	11,154	7,642	7,614	28
Tin	4,719	3,893	1,552	2,341
Titanium	15,094	12,641	8,672	3,969
Vanadium	1,682	1,556	1,375	181
Yttrium	651	621	612	10
Total Nonconventional Metals and Elements	**1,895,150**	**1,563,066**	**879,286**	**683,780**
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	262,258,089	189,588,950	140,233,731	49,355,219
Total Organic Carbon (TOC)	69,718,257	60,704,055	55,307,428	5,396,627
Total Petroleum Hydrocarbon (measured as SGT-HEM)[3]	18,965,925	9,349,866	1,763,841	7,586,025

[1]Numbers in this table were calculated using more significant figures than shown.
[2]953 of the 1,742 total industrial laundries are excluded from compliance under this criterion.
[3]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

HEM - Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.

Table E-16

Summary of Pollutant Loadings and Removals from Industrial Laundry Wastewater for DAF-IL[1] Excluding Facilities with Less than 5 Million Pounds per Year Total Production and Less than 255,000 Pounds per Year Shop and Printer Towel/Rag Production[2]

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD_5)	99,192,358	87,450,551	82,919,296	4,531,255
Oil and Grease (measured as HEM)	53,740,259	28,563,674	12,491,092	16,072,582
Total Suspended Solids (TSS)	61,877,538	44,708,381	22,990,267	21,718,114
Priority Organics				
1,1,1-Trichloroethane	48,625	33,432	1,719	31,712
1,2-Diphenylhydrazine	0	0	0	0
4-Chloro-3-methylphenol	8,056	6,888	6,290	598
Bis(2-ethylhexyl) Phthalate	161,531	107,755	67,470	40,286
Butyl Benzyl Phthalate	41,313	32,124	19,564	12,560
Chlorobenzene	2,615	2,053	1,236	817
Chloroform	109,927	105,870	105,865	5
Di-*n*-butyl Phthalate	23,258	12,228	8,654	3,574
Di-*n*-octyl Phthalate	14,324	10,317	7,451	2,866
Ethylbenzene	62,226	26,947	3,533	23,414
Isophorone	37,412	36,677	36,677	0
Methylene Chloride	28,625	21,649	20,359	1,290
Naphthalene	62,534	31,341	15,414	15,927
Phenol	9,991	9,985	9,978	7
Tetrachloroethene	54,652	30,356	12,418	17,937

Table E-16 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Priority Organics (Continued)				
Toluene	108,899	51,118	33,985	17,132
trans-1,2-Dichloroethene	2,793	2,793	2,793	0
Trichloroethene	2,605	2,543	2,543	0
Total Priority Organics	**779,386**	**524,074**	**355,948**	**168,127**
Nonconventional Organics				
2-Butanone	34,293	28,704	28,704	0
2-Methylnaphthalene	11,207	8,074	6,721	1,354
2-Propanone	181,455	113,260	112,864	395
4-Methyl-2-pentanone	16,476	12,341	12,227	114
∝-Terpineol	11,481	9,354	9,331	23
Benzoic Acid	54,993	52,420	51,630	790
Benzyl Alcohol	57,962	56,807	56,807	0
Hexanoic Acid	5,762	5,762	5,762	0
m-Xylene	19,580	13,596	12,597	999
n-Decane	883,722	517,127	302,042	215,085
n-Docosane	16,395	11,271	5,173	6,098
n-Dodecane	231,406	128,980	39,205	89,775
n-Eicosane	181,967	99,826	11,384	88,442
n-Hexacosane	21,259	11,166	3,576	7,590
n-Hexadecane	115,783	62,162	21,226	40,936
n-Octacosane	10,598	6,844	2,597	4,247
n-Octadecane	85,626	48,883	11,063	37,820
n-Tetracosane	21,409	16,413	7,574	8,839

Table E-16 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Nonconventional Organics (Continued)				
n-Tetradecane	141,678	77,866	18,716	59,149
n-Triacontane	14,145	11,128	5,843	5,284
o-&*p*-Xylene	12,155	8,716	8,480	237
p-Cresol	0	0	0	0
p-Cymene	62,378	43,735	14,814	28,922
Pentamethylbenzene	0	0	0	0
Total Nonconventional Organics	**2,191,730**	**1,344,436**	**748,338**	**596,098**
Priority Metals and Elements				
Antimony	22,340	19,694	15,002	4,692
Arsenic	11,063	10,704	10,704	0
Beryllium	26	26	26	0
Cadmium	4,950	4,002	2,699	1,303
Chromium	17,660	11,402	7,964	3,438
Copper	143,842	97,610	65,063	32,547
Lead	87,767	53,467	24,289	29,178
Mercury	154	141	123	18
Nickel	13,210	11,300	8,094	3,206
Selenium	268	264	264	0
Silver	4,002	3,591	3,153	438
Thallium	0	0	0	0
Zinc	180,941	141,259	76,854	64,405
Total Priority Metals and Elements	**486,220**	**353,460**	**214,235**	**139,225**

Table E-16 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Postcompliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)
Nonconventional Metals and Elements				
Aluminum	622,122	537,651	378,481	159,170
Barium	75,689	54,111	34,436	19,675
Boron	28,138	26,941	26,481	460
Cobalt	4,807	3,907	2,752	1,155
Iron	1,107,535	895,613	452,699	442,913
Manganese	23,557	18,489	10,057	8,432
Molybdenum	11,154	7,642	7,003	639
Tin	4,719	3,893	3,089	805
Titanium	15,094	12,641	7,330	5,312
Vanadium	1,682	1,556	1,354	202
Yttrium	651	621	584	37
Total Nonconventional Metals and Elements	**1,895,150**	**1,563,066**	**924,266**	**638,800**
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	262,258,089	189,588,950	130,590,755	58,998,195
Total Organic Carbon (TOC)	69,718,257	60,704,055	55,892,337	4,811,719
Total Petroleum Hydrocarbon (measured as SGT-HEM)[3]	18,965,925	9,349,866	1,935,173	7,414,694

[1]Numbers in this table were calculated using more significant figures than shown.
[2]953 of the 1,742 total industrial laundries are excluded from compliance under this criterion.
[3]SGT-HEM is measured by Method 1664 (promulgated at 64 FR 26315; May 14, 1999). In this method, EPA defines SGT-HEM as non-polar material (NPM). Throughout this document and the Industrial Laundries Administrative Record, EPA refers to SGT-HEM as total petroleum hydrocarbon (TPH).

HEM - Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.