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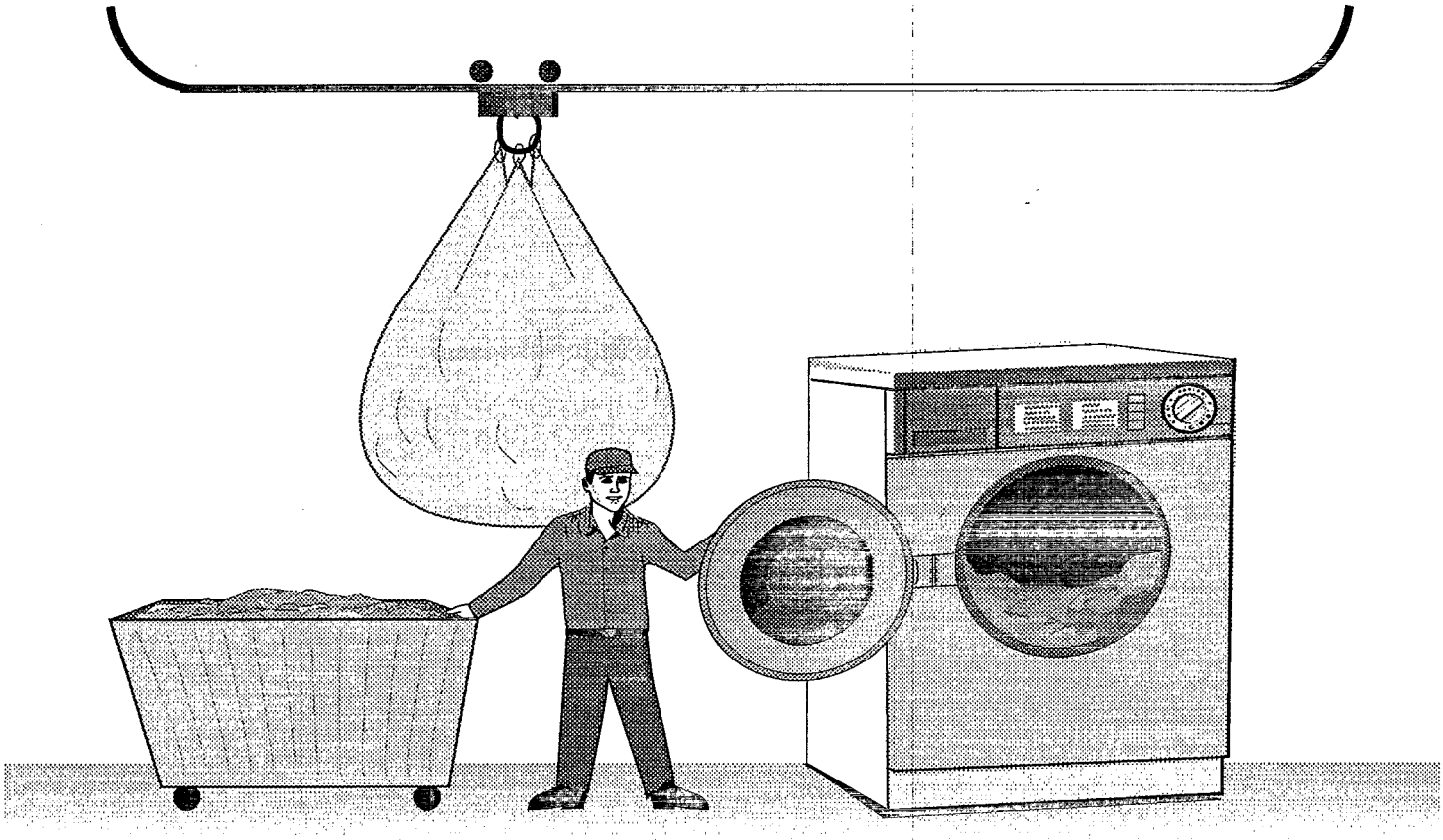

TECHNICAL DEVELOPMENT DOCUMENT FOR PROPOSED PRETREATMENT STANDARDS FOR EXISTING AND NEW SOURCES FOR THE INDUSTRIAL LAUNDRIES POINT SOURCE CATEGORY

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FOREWORD

This document delineates the development of the proposed pretreatment standards for the Industrial Laundries Point Source Category. 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 16 a glossary of commonly used acronyms and definitions of terms used throughout the document.

TABLE OF CONTENTS

PAGE

CHAPTER 1 BACKGROUND 1-1

1.1 Introduction 1-1
1.2 Legal Authority 1-1
1.3 Background 1-1
1.3.1 Clean Water Act 1-1
1.3.2 Pollution Prevention Act (PPA) 1-4
1.3.3 Regulatory Flexibility Act (RFA) as Amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA) 1-4
1.3.4 Prior Regulation of the Industrial Laundries Point Source Category 1-5

CHAPTER 2 SUMMARY 2-1

2.1 Introduction 2-1
2.2 Overview of the Industrial Laundries Industry 2-1
2.3 Scope of the Proposed Regulation 2-2
2.4 Exclusion 2-3
2.5 Pretreatment Standards for Existing Sources (PSES) 2-3
2.6 Pretreatment Standards for New Sources (PSNS) 2-3
2.7 Effluent Limitations Guidelines for Direct Dischargers 2-5

CHAPTER 3 DATA COLLECTION METHODOLOGY AND INFORMATION SOURCES 3-1

3.1 Introduction 3-1
3.2 Summary of Data Collection Prior to 1992 3-2
3.2.1 1971 Survey 3-2
3.2.2 1975 Data Collection 3-2
3.2.3 1977 Data Collection Portfolio (DCP) 3-3
3.2.4 1978 Sampling Program 3-3
3.2.5 1979 Laundries Survey 3-4

TABLE OF CONTENTS (Continued)

Page

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) 3-5
3.3 Summary of Industrial Laundries Questionnaire Activity Since 1992 3-6
3.3.1 Screener Questionnaires 3-6
3.3.2 1994 Industrial Laundries Industry Questionnaire (Detailed Questionnaire) 3-9
3.3.3 Detailed Monitoring Questionnaire 3-12
3.4 Summary of EPA's Site Visit Program (1993-1997) 3-13
3.4.1 Criteria for Site Visit Selection 3-13
3.4.2 Types of Information Collected 3-14
3.5 Summary of EPA's Sampling Program (1993-1996) 3-14
3.5.1 Criteria for Sampling Site Selection 3-14
3.5.2 Information Collected 3-15
3.5.3 Sample Collection and Analysis 3-15
3.6 Other Industry-Supplied Data 3-16
3.7 POTW Data 3-17
3.8 Summary of Literature Searches 3-18
3.9 Summary of Other Data Sources 3-20
3.9.1 Risk Reduction Engineering Laboratory Treatability Database 3-20
3.9.2 Fate of Priority Pollutants in Publicly Owned Treatment Works Database 3-20
3.9.3 The Domestic Sewage Study 3-21
3.9.4 Canadian Studies 3-21
3.9.5 Industrial Pollution Prevention Project 3-22
3.10 References 3-22

CHAPTER 4 INDUSTRY PROFILE 4-1

4.1 Introduction 4-1

TABLE OF CONTENTS (Continued)

		Page
4.2	Overview of the Industry	4-1
4.2.1	Geographic Distribution of Facilities	4-2
4.2.2	SIC Codes Reported	4-2
4.2.3	Facility Size	4-2
4.2.4	Items Laundered	4-8
4.2.5	Customers	4-8
4.3	Laundering Processes	4-15
4.3.1	Water-Using/Wastewater-Generating Processes	4-15
4.3.2	Non-Water-Using/Non-Wastewater-Generating Processes	4-17
4.3.3	Chemicals Used in Industrial Laundries	4-19
4.4	Facilities and Equipment	4-22
4.4.1	Washers, Extractors, and Washer-Extractors	4-22
4.4.2	Tunnel Washers	4-24
4.4.3	Dry-Cleaning Units	4-24
4.4.4	Equipment Use and Age	4-24
4.5	Pollution Prevention Activities	4-24
4.6	Trends in the Industry	4-29
4.6.1	Trend Away from Dry Cleaning	4-29
4.6.2	Trend of Small Facilities Being Purchased by Larger Firms	4-29
4.6.3	Trends in Equipment and Technologies	4-30
4.7	Treatment Technologies in Use	4-30
4.8	References	4-30
CHAPTER 5	**WATER USE AND WASTEWATER CHARACTERIZATION**	**5-1**
5.1	Introduction	5-1
5.2	Sources of Service Water and Water Use	5-1
5.2.1	Sources of Service Water at Industrial Laundries	5-1
5.2.2	Use of Service Water at Industrial Laundries	5-2
5.3	Wastewater Volume by Type of Discharge	5-6
5.4	Water Conservation Measures	5-11

TABLE OF CONTENTS (Continued)

Page

5.5 Characterization of Raw Wastewater by Item Laundered 5-11
5.6 Characterization of Total, Heavy, and Light Raw Wastewater Streams 5-11

CHAPTER 6 INDUSTRY SCOPE AND SUBCATEGORIZATION 6-1

6.1 Introduction 6-1
6.2 Regulatory Background 6-1
6.3 Industry Scope 6-2
6.4 Subcategorization Analysis 6-7
6.4.1 Disproportionate Economic Impacts 6-7
6.4.2 Laundry Processes and Water Use Practices 6-8
6.4.3 Plant Age 6-8
6.4.4 Plant Location 6-8
6.4.5 Plant Size 6-9
6.4.6 Raw Materials 6-10
6.4.7 Non-water Quality Environmental Impacts 6-10
6.4.8 Type of Item Laundered and Wastewater Characteristics 6-10
6.5 References 6-11

CHAPTER 7 POLLUTANTS SELECTED FOR REGULATION 7-1

7.1 Introduction 7-1
7.2 Pollutants Considered for Regulation 7-1
7.3 Identification of Pollutants of Concern 7-4
7.4 Pollutants Selected for Regulation 7-10
7.4.1 Elimination of Parameters that Comprise TPH 7-16
7.4.2 Elimination of Treatment Chemicals 7-16
7.4.3 Elimination of Pollutants Not Treated or Below Treatable Concentrations 7-16
7.4.4 Elimination of Pollutants that Do Not Pass Through or Otherwise Interfere with POTWs 7-18

TABLE OF CONTENTS (Continued)

Page

7.4.5 Selection of Regulated Pollutants 7-30
7.5 References 7-36

CHAPTER 8 POLLUTION PREVENTION, RECYCLING, TREATMENT, AND DISPOSAL TECHNOLOGIES EMPLOYED BY THE INDUSTRIAL LAUNDRIES INDUSTRY 8-1

8.1 Introduction 8-1
8.2 The Environmental Management Hierarchy 8-1
8.3 Pollution Prevention/Source Reduction in the Industrial Laundries Industry 8-3
8.3.1 Preprocess Pollution Prevention Activities 8-4
8.3.2 In-Process Pollution Prevention Activities 8-7
8.4 Pollution Recycling/Resource Conservation and the Industrial Laundries Regulatory Development Process 8-11
8.4.1 Wastewater Conservation in the Industrial Laundries Industry 8-12
8.4.2 Energy Conservation in the Industrial Laundries Industry 8-12
8.5 Wastewater Treatment Technologies in the Industrial Laundries Industry 8-12
8.5.1 Gravity Settling 8-13
8.5.2 Stream Splitting 8-15
8.5.3 Screening 8-16
8.5.4 Equalization 8-18
8.5.5 Chemical Emulsion Breaking 8-19
8.5.6 Chemical Precipitation 8-23
8.5.7 Dissolved Air Flotation (DAF) 8-25
8.5.8 Sludge Dewatering 8-29
8.5.9 pH Adjustment 8-33
8.5.10 Ultrafiltration/Microfiltration 8-34
8.5.11 Centrifugation 8-34
8.5.12 Volatile Organic Compound (VOC) Removal Technologies 8-35
8.5.13 Oil/Water Separation 8-38
8.5.14 Media Filtration 8-39

TABLE OF CONTENTS (Continued)

Page

8.6 Pollution Disposal Practices in the Industrial Laundries Industry 8-39
8.7 References 8-40

CHAPTER 9 TREATMENT PERFORMANCE DATA USED FOR THE DEVELOPMENT OF LONG-TERM AVERAGES, VARIABILITY FACTORS, AND STANDARDS 9-1

9.1 Introduction 9-1
9.2 Sources of Treatment Technology Performance Data From Well-Designed and Well-Operated Treatment Systems 9-2
9.2.1 Industrial Laundry Sampling Program Data 9-2
9.2.2 Detailed Monitoring Questionnaire (DMQ) Data 9-4
9.3 Evaluation of Treatment Performance Data 9-5
9.3.1 Assessment of Treatment System Performance and Identification of Process Upsets 9-6
9.3.2 Identification of Pollutants Not Treated by the Treatment Technology 9-6
9.3.3 Identification of Pollutants Not Present in Influent Samples at Sufficient Concentrations to Evaluate Treatment Effectiveness 9-7
9.3.4 Identification of Treatment Performance Data With Inconsistent Detection Limits 9-7
9.3.5 Identification of Data Considered a Lower Limit of the Actual Value 9-7
9.4 Long-Term Average Concentrations for the Pollutants of Concern 9-7
9.5 Long-Term Average Concentrations, Variability Factors, and Standards for the Pollutants Proposed for Regulation 9-8
9.6 Identification of Data Used to Calculate the Long-Term Average Concentrations for the Prelaundering Technology Group 9-25

TABLE OF CONTENTS (Continued)

		Page
9.7	Mass-Based Standards	9-26
9.8	References	9-26
CHAPTER 10	**DEVELOPMENT OF REGULATORY OPTIONS**	**10-1**
10.1	Introduction	10-1
10.2	Pretreatment Standards for Existing Sources (PSES)	10-1
10.2.1	Initial Technology Options Considered	10-1
10.2.2	Inclusion of Pollution Prevention in the Technology Options	10-12
10.2.3	Exclusion of Wastewater Recycling Activities from the Technology Options	10-12
10.2.4	Initial Technology Options Not Further Considered	10-13
10.2.5	Additional Technology Options Considered	10-13
10.2.6	Technology Options Eliminated from Further Consideration	10-16
10.2.7	Regulatory Options Further Considered for PSES	10-17
10.3	Pretreatment Standards for New Sources (PSNS)	10-17
10.4	References	10-18
CHAPTER 11	**POLLUTANT LOADING AND REMOVAL ESTIMATES**	**11-1**
11.1	Introduction	11-1
11.2	Data Sources	11-2
11.3	Methodology Used to Estimate Pollutant Loadings and Removals	11-3
11.3.1	Methodology Used to Estimate Untreated Pollutant Loadings	11-4
11.3.2	Methodology Used to Estimate Baseline and Postcompliance Wastewater Loadings	11-7
11.3.3	Methodology Used to Estimate Pollutant Removals	11-12

TABLE OF CONTENTS (Continued)

Page

11.4 Pollutant Loadings and Removals 11-17

CHAPTER 12 COSTS OF TECHNOLOGY BASES FOR REGULATIONS . 12-1

12.1 Introduction 12-1
12.2 Costing Methodology 12-2
12.2.1 Cost Model Development and Structure 12-4
12.2.2 Components of the Cost of Compliance 12-5
12.2.3 Treatment-in-Place Credit Methodology 12-11
12.3 Cost Modeling 12-14
12.3.1 Cost Model Driver 12-14
12.3.2 Stream Splitting 12-15
12.3.3 Pumps 12-16
12.3.4 Screening 12-18
12.3.5 Equalization 12-19
12.3.6 Dissolved Air Flotation 12-20
12.3.7 Chemical Precipitation 12-22
12.3.8 Sludge Dewatering 12-24
12.3.9 pH Adjustment 12-26
12.3.10 Treatment System Building 12-27
12.3.11 Contact Haul In Lieu of Treatment 12-28
12.3.12 Compliance Monitoring 12-29
12.4 Engineering Costs by Regulatory Option 12-30
12.5 References 12-30

CHAPTER 13 REGULATORY OPTIONS SELECTION 13-1

13.1 Introduction 13-1
13.2 Regulatory Options Considered 13-1
13.2.1 Pretreatment Standards for Existing Sources (PSES) 13-1
13.2.2 Pretreatment Standards for New Sources (PSNS) 13-2
13.3 Final Regulatory Options Selection 13-3
13.3.1 Pretreatment Standards for Existing Sources (PSES) 13-3

TABLE OF CONTENTS (Continued)

Page

13.3.2 Pretreatment Standards for New Sources (PSNS) 13-4
13.3.3 Direct Dischargers 13-4

CHAPTER 14 NON-WATER QUALITY ENVIRONMENTAL IMPACTS . . 14-1

14.1 Introduction 14-1
14.2 Non-Water Quality Environmental Impacts of the CP-IL and DAF-IL Regulatory Options Considered as the Basis for PSES 14-1
14.2.1 Energy Consumption Impacts 14-2
14.2.2 Air Emissions Impacts 14-2
14.2.3 Solid Waste Impacts 14-9
14.3 Non-Water Quality Environmental Impacts of the Regulatory Options Considered for PSNS 14-11
14.4 References 14-11

CHAPTER 15 PRETREATMENT STANDARDS FOR EXISTING SOURCES (PSES) AND PRETREATMENT STANDARDS FOR NEW SOURCES (PSNS) 15-1

15.1 Introduction 15-1
15.2 Summary of the Proposed PSES and PSNS 15-2
15.2.1 Regulated Facilities 15-2
15.2.2 POTW Pass-Through Analysis 15-2
15.2.3 Regulated Pollutants 15-3
15.2.4 PSES and PSNS 15-3
15.3 Implementation of the PSES and PSNS 15-6
15.3.1 Point of Application 15-6
15.3.2 Permit Limitations 15-6
15.3.3 Monitoring and Compliance 15-11
15.4 References 15-11

CHAPTER 16 GLOSSARY OF TERMS 16-1

Appendix A - Tables Referenced in Chapter 3
Appendix B - Tables Referenced in Chapter 5
Appendix C - Tables Referenced in Chapter 6
Appendix D - Tables Referenced in Chapter 7

LIST OF TABLES

		Page
Table 2-1	Proposed PSES and PSNS for the Industrial Laundries Industry	2-4
Table 4-1	Geographic Distribution of Industrial Laundries by State and Region	4-4
Table 4-2	Industrial Laundry Size Distribution	4-7
Table 4-3	Types of Items Laundered	4-9
Table 4-4	Typical Customers for Each Type of Item Laundered	4-11
Table 4-5	Laundering Processes Reported in the Detailed Questionnaire	4-16
Table 4-6	Industrial Laundering Wash Formula Chemicals Reported in the Detailed Questionnaire	4-20
Table 4-7	Amounts of Detergent Added Per Pound of Laundry for Items Most Often Laundered	4-21
Table 4-8	Age of Facilities and Start of Laundry/Dry-Cleaning Operations (Estimated Percentage of Total Facilities in Each Time Period)	4-23
Table 4-9	Types of Laundry Processing Equipment Reported in the Detailed Questionnaire	4-25
Table 4-10	Age of Laundry Processing Equipment Reported in the Detailed Questionnaire (Percentage of Equipment Type Installed in Each Time Period)	4-26
Table 4-11	Pre-Process Pollution Prevention Activities	4-27
Table 4-12	In-Process Pollution Prevention Activities	4-28
Table 5-1	Service Water Sources	5-3
Table 5-2	Service Water Use	5-4
Table 5-3	Item-Specific Water Use	5-7
Table 5-4	Discharge Practices of Industrial Laundries	5-9
Table 5-5	Water Conservation Practices and Water Use Reduction	5-12
Table 5-6	Wastewater Characterization for Item Specific Wastewater at Industrial Laundries	5-13
Table 5-7	Wastewater Characterization Data for Heavy Wastewater Streams at Industrial Laundries	5-20
Table 5-8	Wastewater Characterization Data for Light Wastewater Streams at Industrial Laundries	5-23
Table 5-9	Wastewater Characterization Data for Total Raw Wastewater Streams at Industrial Laundries	5-26
Table 6-1	Comparison of Linen Facility and Industrial Laundry Facility Mean Pollutant Log Concentrations	6-4

LIST OF TABLES (Continued)

Page

Table 6-2 Comparison of Linen Facility and Denim Prewash Facility Mean Pollutant Log Concentrations 6-5

Table 7-1 Pollutants Not Detected in Any Samples Analyzed during the 1993-1996 Industrial Laundries Sampling Program 7-5
Table 7-2 Pollutants Detected in Less Than 10 Percent of Samples Analyzed During the 1993-1996 Industrial Laundries Sampling Program 7-8
Table 7-3 Semiquantitative Metal and Elemental Pollutants Excluded from the Pollutants of Concern for the Industrial Laundries Industry 7-9
Table 7-4 Average Influent Concentrations, Effluent Concentrations, and Removals for Phosphorous and Surfactants 7-11
Table 7-5 Pollutants of Concern for the Industrial Laundries Industry 7-12
Table 7-6 Pollutants Selected for Proposed Regulation in the Industrial Laundries Industry 7-17
Table 7-7 Pollutants Eliminated from Consideration for Regulation for the Industrial Laundries Industry for Chemical Precipitation Options 7-19
Table 7-8 Pollutants Eliminated from Consideration for Regulation for the Industrial Laundries Industry for Dissolved Air Flotation Options 7-21
Table 7-9 Comparison of the Chemical Precipitation Treatment Technology and POTW Percent Removals for the Industrial Laundries Pass-Through Analysis 7-23
Table 7-10 Comparison of the DAF Treatment Technology and POTW Percent Removals for the Industrial Laundries Pass-Through Analysis 7-25
Table 7-11 Generic Removal for *n*-Alkanes 7-31
Table 7-12 Pollutants Considered for Regulation for Chemical Precipitation and DAF after the Pass-Through Analysis 7-32

Table 8-1 Number of Industrial Laundries, by Production Category, Reporting Preprocess Pollution Prevention Activities in the Detailed Questionnaire . 8-5
Table 8-2 Types of Preprocess Pollution Prevention Activities Reported in the Detailed Questionnaire 8-6
Table 8-3 Number of Industrial Laundries, by Production Category, Reporting In-Process Pollution Prevention Activities in the Detailed Questionnaire 8-8
Table 8-4 Types of In-Process Pollution Prevention Activities Reported in the Detailed Questionnaire 8-9
Table 8-5 Number of Facilities Responding to Detailed Questionnaire Using Wastewater Treatment Technologies 8-14

LIST OF TABLES (Continued)

		Page
Table 9-1	Overall Long-Term Average (LTA) Concentrations for the Five Postlaundering Treatment Technology Groups for the Pollutants of Concern	9-9
Table 9-2	Episode Long-Term Average (LTA) Concentrations and Variability Factors (VF) for Chemical Emulsion Breaking Treatment of Heavy Wastewater for the Pollutants Proposed for Regulation	9-13
Table 9-3	Summary of Long-Term Averages (LTA), Variability Factors (VF), and Standards for Chemical Emulsion Breaking Treatment of Heavy Wastewater	9-14
Table 9-4	Episode Long-Term Average (LTA) Concentrations and Variability Factors (VF) for DAF Treatment of Heavy Wastewater for Pollutants Proposed for Regulation	9-15
Table 9-5	Summary of Long-Term Averages (LTA), Variability Factors (VF), and Standards for DAF Treatment of Heavy Wastewater	9-16
Table 9-6	Episode Long-Term Average (LTA) Concentrations and Variability Factors (VF) for Chemical Precipitation Treatment of Heavy Wastewater for the Pollutants Proposed for Regulation	9-17
Table 9-7	Summary of Long-Term Averages (LTA), Variability Factors (VF), and Standards for Chemical Precipitation Treatment of Heavy Wastewater	9-18
Table 9-8	Episode Long-Term Average (LTA) Concentrations and Variability Factors (VF) for DAF Treatment of All Facility Process Wastewater for the Pollutants Proposed for Regulation	9-19
Table 9-9	Summary of Long-Term Averages (LTV), Variability Factors (VF), and Standards for DAF Treatment of All Facility Process Wastewater	9-21
Table 9-10	Episode Long-Term Average (LTA) Concentrations and Variability Factors (VF) for Chemical Precipitation Treatment of All Facility Process Wastewater for the Pollutants Proposed for Regulation	9-22
Table 9-11	Summary of Long-Term Averages (LTA), Variability Factors (VF), and Standards for Chemical Precipitation Treatment of All Facility Process Wastewater	9-24
Table 9-12	Target Effluent Concentrations for Steam Tumbling of Heavy Items Before Water Washing for the Pollutants of Concern	9-27
Table 10-1	Technology Options Initially Considered for the Industrial Laundries Proposed Rule	10-2
Table 10-2	Definitions of Additional Technology Options Considered for PSES	10-14
Table 11-1	Pollutant Loadings per Pound of Item Processed (mg Pollutant/lb Laundry)	11-5
Table 11-2	Analytical Data Transfers	11-6

LIST OF TABLES (Continued)

		Page
Table 11-3	Methodology Used to Estimate Baseline Loadings for the Industrial Laundries Industry	11-8
Table 11-4	Target Average Concentrations for DAF-IL and CP-IL for the Pollutants of Concern	11-9
Table 11-5	Methodology Used to Estimate Postcompliance Loadings for DAF-IL for the Industrial Laundries Industry	11-13
Table 11-6	Methodology Used to Estimate Postcompliance Loadings for CP-IL for the Industrial Laundries Industry	11-14
Table 11-7	Methodology Used to Estimate Postcompliance Loadings for Combo-IL for the Industrial Laundries Industry	11-15
Table 11-8	Methodology Used to Estimate Postcompliance Loadings for Combo-IL-2LIM for the Industrial Laundries Industry	11-16
Table 11-9	Summary of Pollutant Loadings and Removals for the Entire Industrial Laundries Industry for OC-Only	11-18
Table 11-10	Summary of Pollutant Loadings and Removals for the Entire Industrial Laundries Industry for DAF-IL	11-23
Table 11-11	Summary of Pollutant Loadings and Removals for the Entire Industrial Laundries Industry for CP-IL	11-28
Table 11-12	Summary of Pollutant Loadings and Removals for the Entire Industrial Laundries Industry for Combo-IL	11-33
Table 11-13	Summary of Pollutant Loadings and Removals for the Excluded Industrial Laundries (141 Facilities) for OC-Only	11-38
Table 11-14	Summary of Pollutant Loadings and Removals for the Excluded Industrial Laundries (141 Facilities) for DAF-IL	11-43
Table 11-15	Summary of Pollutant Loadings and Removals for the Excluded Industrial Laundries (141 Facilities) for CP-IL	11-48
Table 11-16	Summary of Pollutant Loadings and Removals for the Excluded Industrial Laundries (141 Facilities) for Combo-IL	11-53
Table 12-1	Operation and Maintenance Unit Costs Used by the Cost Model	12-7
Table 12-2	Capital Unit Costs Used by the Cost Model	12-9
Table 12-3	Components of Total Capital Investment	12-12
Table 12-4	Summary of PSES Engineering Costs	12-31
Table 12-5	Summary of PSES Annualized Engineering Costs for Industrial Laundries Included in the Proposed Regulation	12-32
Table 14-1	Incremental Energy Increases Associated With Implementation of the CP-IL and DAF-IL Regulatory Options	14-3
Table 14-2	Fugitive Air Emissions of Organic Pollutants From Industrial Laundry Wastewater -- Analysis of a Worst-Case Scenario	14-6

LIST OF TABLES (Continued)

Page

Table 14-3 Incremental Sludge Generation Increases Associated With Implementation of the CP-IL and DAF-IL Regulatory Options 14-10

Table 15-1 Pollutants Proposed to be Regulated Under PSES and PSNS 15-4
Table 15-2 Proposed PSES and PSNS for the Industrial Laundries Industry 15-5
Table 15-3 Alternative Concentration-Based Limits for Example Facilities 15-9
Table 15-4 EPA-Approved Analytical Methods for Analyzing the Regulated Pollutants 15-12

LIST OF FIGURES

		Page
Figure 4-1	Geographic Distribution of Industrial Laundry Facilities	4-3
Figure 5-1	Distribution of Facilities by Production Normalized Laundry Process Water Use	5-5
Figure 5-2	Distribution of Facilities by Production Normalized Laundry Process Water Discharge	5-10
Figure 8-1	Environmental Management Options Hierarchy	8-2
Figure 8-2	Shaker Screen	8-17
Figure 8-3	Batch Chemical Emulsion Breaking Unit	8-21
Figure 8-4	Continuous CEB Unit with Coalescing Plates	8-22
Figure 8-5	Batch Chemical Precipitation System	8-24
Figure 8-6	Continuous Chemical Precipitation System	8-26
Figure 8-7	Dissolved Air Flotation Unit	8-28
Figure 8-8	Rotary Vacuum Filter	8-31
Figure 8-9	Filter Press	8-32
Figure 8-10	Fixed Bed Activated Carbon Adsorption Column	8-37
Figure 10-1	CEB-Heavy Option: Chemical Emulsion Breaking of Heavy Industrial Laundry Wastewater	10-6
Figure 10-2	DAF-Heavy, DAF-IL, and DAF-TWL Options: Dissolved Air Flotation of a Portion of a Facility's Process Wastewater	10-7
Figure 10-3	CP-Heavy, CP-IL, and CP-TWL Options: Chemical Precipitation of a Portion of a Facility's Process Wastewater	10-8

LIST OF FIGURES (Continued)

Page

Figure 10-4 DAF-All Option: Dissolved Air Flotation of Total Facility Process Wastewater 10-9

Figure 10-5 CP-All Option: Chemical Precipitation of Total Facility Process Wastewater 10-10

Figure 10-6 OC-Only Option: In-Process Organics Control 10-11

CHAPTER 1

BACKGROUND

1.1 Introduction

This chapter presents background information supporting the development of effluent limitations guidelines and standards for the Industrial Laundries Point Source Category. Section 1.2 presents the legal authority to regulate the industrial laundries industry. Section 1.3 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.

1.2 Legal Authority

This regulation for the Industrial Laundries Point Source Category is being proposed 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 by the Clean Water Act of 1977, Pub. L. 95-217, and the Water Quality Act of 1987, Pub. L. 100-4), also referred to as "the CWA" or "the Act."

1.3 Background

1.3.1 Clean Water Act

The Federal Water Pollution Control Act Amendments of 1972 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 304(a)(4) 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 and thus a need for categorical standards 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.

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.

1.3.2 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; pollution that cannot be prevented should be recycled or reused in an environmentally safe manner wherever feasible; pollution 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)). This proposed regulation for the Industrial Laundries Point Source Category was reviewed for its incorporation of pollution prevention as part of EPA's effort. Chapter 8 of this document describes the results of this effort.

1.3.3 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 SBREFA, EPA generally is required to conduct an initial regulatory flexibility analysis (IFRA) describing the impact of the proposed rule on small entities. Under section 605(b) of the RFA, if the Administrator certifies that the rule will not have a significant impact on a substantial number of small entities, EPA is not required to prepare the IFRA.

Although this proposed rule minimizes impacts on small businesses through an exclusion, EPA conducted an IFRA pursuant to section 603(b) of the RFA addressing:

- The need for, objectives of, and legal basis for the rule.
- A description of, and where feasible, an estimate of the number of small entities to which the rule would apply.
- The projected reporting, recordkeeping, and other compliance requirements of the rule, including an estimate of the classes of small

entities that would be subject to the 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 the proposed rule.

- A description of any significant regulatory alternatives to the proposed rule which accomplish the stated objectives of applicable statutes and which minimize any significant economic impact of the proposed rule on small entities. Consistent with the stated objectives of the CWA, the analysis discusses 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 the rule, or any part thereof, for such small entities. Based on the IRFA and other factors, this proposed rule incorporates an exclusion to eliminate disproportionate impacts on small businesses and also reduces the number of small businesses affected by the proposed rule.

Pursuant to the RFA as amended by SBREFA, EPA convened a Small Business Advocacy Review Panel. The Panel is comprised of 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 RFA, and collected the advice and recommendations of small entity representatives. For this proposed rule, the small entity representatives included owners of small industrial laundries and trade association representatives. The Panel prepared a report (available in the administrative record for this rulemaking) that summarizes their outreach to small entities and the comments submitted by the small entity representatives. The Panel's report also presents their findings on issues related to the elements of an IRFA.

1.3.4 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 subsequently 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 (screening and verification study). However, in 1982, 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, the Agency 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 most recent Effluent Guidelines Plan update was published on February 26, 1997 (62 FR 8726). This plan requires, 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.

CHAPTER 2

SUMMARY

2.1 Introduction

The proposed regulations for the industrial laundries industry include pretreatment standards for the control of wastewater pollutants. This chapter presents a summary of the proposed rule. Section 2.2 presents a brief overview of the industry, Section 2.3 discusses the scope of the proposed rule, Section 2.4 describes the proposed exclusion to the rule, and Sections 2.5 through 2.7 summarize the proposed pretreatment standards and effluent limitations guidelines.

2.2 Overview of the Industrial Laundries Industry

The industrial laundries industry includes facilities that launder or dry clean 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 facilities covered by the proposed rule also wash other items not classified as industrial laundry items, such as linen supply garments, linen flatwork, health-care items, and miscellaneous other items.

Industrial laundry facilities 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 IV. Most of the laundering facilities are situated in large urban areas. EPA estimates that there are 1,747 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 corresponding 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 launder most items using water washing. Water washing involves washing items in water. Some facilities launder items using dry cleaning, 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. 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.

Facilities water-wash nearly 97 percent of their items using a standard process. Approximately one percent of laundered items are dry-cleaned, including some 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).

Based on data collected by EPA for this rulemaking, 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. Chemicals frequently used in industrial laundry operations include alkaline solutions, detergents, bleach, antichlor, sours, softeners, and starch. A variety of other items that are added to some wash formulas include enzymes, builders, oil treatment chemicals, water conditioners, dyes, stain treatment chemicals, and bactericides. The primary pollutants discharged by industrial laundries are all of the conventional pollutants except fecal coliform (oil and grease, biochemical oxygen demand (BOD_5), and total suspended solids (TSS)), 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. All of the industrial laundries identified by EPA discharge their process wastewater to publicly owned treatment works (POTWs).

2.3 Scope of the Proposed Regulation

The proposed pretreatment standards apply to process wastewater discharges from new and existing industrial laundries. EPA is proposing 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 laundered textile items. This definition includes textile rental companies that perform laundering operations. Laundering means washing with water, including water washing following dry cleaning. This rule would not apply to laundering exclusively through dry cleaning. Industrial textile items include, but are 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, filters, and clean room items. If any of these items are used for hotels, hospitals, or restaurants, they are not industrial items.

The proposed rule would not apply to discharges from on-site laundering at industrial facilities, laundering of industrial textile items originating from the same business entity, and facilities that exclusively launder linen items, denim prewash items, new items (i.e., items directly from the textile manufacturer, not yet used for their intended purpose), any other laundering of hotel, hospital, or restaurant items, or any combination of these items.

This proposed rule would apply to hotel, hospital, or restaurant laundering of industrial textile items. In addition, this rule would not apply to discharges from the oil-only treatment of mops. 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).

For facilities covered under the industrial laundry definition, wastewater from all water-washing operations would be covered, including the washing of linen items, as long as these items do not constitute 100 percent of the items washed.

2.4 Exclusion

Under Pretreatment Standards for Existing Sources (PSES), EPA is proposing to exclude existing facilities that launder less than one million pounds of incoming laundry per calendar year and less than 255,000 pounds of shop and/or printer towels/rags per calendar year. EPA proposes this exclusion to eliminate the unacceptable economic impacts on these smaller facilities. The excluded facilities would be disproportionately adversely impacted relative to all facilities covered by this rule. Most of the excluded facilities are small entities under the Small Business Administration (SBA) definition of small entity. The excluded facilities account for less than three percent of the pollutant removals from U.S. waters than would occur if the rule were implemented without the exclusion.

Under Pretreatment Standards for New Sources (PSNS), EPA is proposing no exclusions for new sources since the economic projections indicate that there would be no barrier to entry as a result of the proposed new source standards.

2.5 Pretreatment Standards for Existing Sources (PSES)

EPA is proposing PSES numerical limitations based on chemical precipitation technology treatment of industrial laundry wastewater for 11 priority and nonconventional pollutants. The pretreatment standards are applicable to all process wastewater discharged by facilities that are within the scope of the rule. Industrial laundries laundering less than one million pounds per year of industrial laundry and less than 255,000 pounds per year of shop and/or printer towels/rags are excluded from regulation under PSES. PSES are presented in Table 2-1.

2.6 Pretreatment Standards for New Sources (PSNS)

EPA is proposing PSNS based on chemical precipitation of industrial laundry wastewater for 11 priority and nonconventional pollutants. The new source standards are applicable to all process wastewater discharged by industrial laundries that meet the definition of a new source. PSNS are presented in Table 2-1.

Table 2-1

Proposed PSES and PSNS for the Industrial Laundries Industry

Pollutant or Pollutant Property	Proposed PSES and PSNS for End-of-Pipe Monitoring Points	
	Maximum for any 1 day (mg/L)	Monthly Average (mg/L)
Copper	0.24	---[1]
Lead	0.27	---[1]
Zinc	0.61	---[1]
Bis(2-ethylhexyl) Phthalate	0.13	---[1]
Ethylbenzene	1.64	---[1]
Naphthalene	0.23	---[1]
Tetrachloroethene	1.71	---[1]
Toluene	2.76	---[1]
m-Xylene[2]	1.33	---[1]
o-&*p*-Xylene[2]	0.95	---[1]
TPH (as SGT-HEM)[3]	27.5	15.4

[1]EPA is not proposing monthly average limitations for these pollutants.
[2]EPA is proposing the use of EPA Methods 1624 and 624 for the analysis of xylenes, even though xylenes are not specifically listed as an analyte in either of these methods (promulgated at 40 CFR Part 136). EPA used data obtained from the analysis of xylenes by these two methods in the development of the proposed industrial laundry standards.
[3]TPH (as SGT-HEM) is total petroleum hydrocarbons measured by the silica gel treated-hexane extractable material analytical method proposed January 23, 1996 (Method 1664).

2.7 Effluent Limitations Guidelines for Direct Dischargers

EPA has not identified any direct dischargers in the industrial laundries industry or any candidate indirect dischargers, or transfer of performance data from facilities in other industries or from pilot-scale test results for determining the appropriate level of performance to set limitations for direct discharging new sources; therefore, EPA has not developed effluent limitations guidelines for direct wastewater discharges to surface waters. As a result, the Agency is reserving effluent limitations guidelines and standards for the following levels of control for the Industrial Laundries Point Source Category: Best Practicable Control Technology Currently Available (BPT), Best Conventional Pollutant Control Technology (BCT), Best Available Technology Economically Achievable (BAT), and New Source Performance Standards (NSPS).

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 industry. EPA collected information necessary for the development of this rule 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 and applicability of the regulation. Throughout this chapter, the term "laundry" is used to indicate that information was collected from industrial laundries as well as other laundry facilities. The scope and applicability of the proposed regulation are discussed in detail in Chapter 6.

This chapter summarizes the information collection activities undertaken and the information sources used for this proposed rulemaking, as follows:

- Section 3.2 summarizes data collection efforts prior to 1992;
- Section 3.3 discusses the questionnaire activities conducted since 1992;
- Section 3.4 summarizes EPA's site visit program conducted from 1993 through 1997;
- Section 3.5 discusses EPA's sampling program conducted from 1993 through 1996;
- Section 3.6 presents other industry-collected data efforts;
- Section 3.7 discusses data collected from publicly owned treatment works (POTWs);
- Section 3.8 summarizes literature searches performed on the industrial laundries industry;
- Section 3.9 summarizes other sources of data on the industrial laundries industry; and
- Section 3.10 presents the references used in this section.

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 studying 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 collected sampling data for conventional and nonconventional pollutants and some metals at a small number of facilities.

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 Consent Decree (see Section 1.3.4 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 influent and effluent. EPA also sampled an industrial laundry using a dissolved air flotation (DAF) treatment system over a one-month period to obtain data on the variability of this type of treatment system.

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.

In 1981, EPA chose not to establish effluent limitations for the Auto and Other Laundry Point Source Category, of which industrial laundries was 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 3.9.3).

At the industrial laundry sampled in 1985, EPA collected composite samples of the final effluent after a settling basin over the course of one operating day. EPA collected wastewater samples from untreated wastewater streams and final effluent wastewater streams 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 dissolved air flotation systems, one ultrafiltration system, and a settling basin.

EPA analyzed the samples for conventional pollutants, priority and nonconventional organic pollutants, priority and nonconventional metal pollutants, and other nonconventional pollutants, which later comprised the "ITD List of Analytes".

Other sources of 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 this time period was used to prepare the Preliminary Data Summary for the Industrial Laundries Industry (1) and formed the basis for EPA's decision to develop effluent limitations guidelines and standards for the Industrial Laundries Point Source Category.

3.3 Summary of Industrial Laundries Questionnaire Activity Since 1992

EPA's first step in developing the current proposed 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 sent four screener questionnaires to different segments of the laundry industry between 1993 and 1995 to collect 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 sent a detailed questionnaire to a subset of identified laundry facilities. Based on the responses to the detailed questionnaire, EPA sent a monitoring questionnaire to a subset of the facilities that had received a detailed questionnaire. These data-gathering efforts are described in more detail below. Additional details on the data-gathering efforts are found in the Statistical Support Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category (2). Copies of nonconfidential questionnaires are contained in the administrative record for this rulemaking.

3.3.1 Screener Questionnaires

EPA conducted four separate mailings of slightly different screener questionnaires to develop the scope of the regulation, 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 that 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 8 of this document. The four different screener questionnaires and their mailings are discussed in the following sections.

The 1993 Industrial Laundries Industry Screener Questionnaire

In 1993, EPA developed and mailed out the two-page 1993 Industrial Laundries Industry Screener Questionnaire to a large number of industrial laundries to solicit updated information on the industry. The purpose of this screener questionnaire was to characterize the industry and to determine which facilities may be in-scope for the proposed rule. 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 administrative record for this rulemaking.

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 mailout of the screener questionnaires 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.

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 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.

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 was used to determine the industrial laundry industry population.

1995 Industrial Laundries Industry Screener 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 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 Industrial Laundries Detailed 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 and its annual production, 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 proposed regulations. Of the 100 screener questionnaires mailed, EPA received 86 responses.

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 laundry facilities selected from the 1993 Industrial Laundries Industry Screener Questionnaire database (screener questionnaire database) and from the Dun & Bradstreet database. 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, along with copies of the nonconfidential portions of the completed detailed questionnaires, are contained in the administrative record for this rulemaking.

Detailed Questionnaire Recipient Selection and Mailing

EPA mailed the detailed questionnaire in June and July 1994 to 250 selected laundry facilities. 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 develop the proposed rule.	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 1994. EPA received eight pretest questionnaire responses.

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 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 facilities 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 of Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category (4).

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. The engineering review also included coding responses to questions 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.

Compilation of Respondent Data

EPA compiled information reported in the detailed questionnaire and summaries of this information are located in Chapters 4, 5, and 8 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 received the detailed questionnaire. 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 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 regulatory options; and
- Facilities that had no treatment (or that have gravity settling and screens only) to characterize industrial laundry raw wastewater.

The DMQ requested that facilities submit analytical data identified 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.

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.

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 the standards for the industrial laundries industry, as presented in Chapter 9 of this document and the Statistical Support Document (2).

3.4 Summary of EPA's Site Visit Program (1993-1997)

EPA conducted 32 site visits to industrial laundry facilities between 1993 and 1997 to collect information about industrial laundries 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). In general, EPA visited sites to encompass a range of industrial laundry facilities and other facilities, such as linen facilities, hospital cooperative laundries, and denim prewash facilities, to determine the scope of the regulation.

3.4.1 Criteria for Site Visit Selection

EPA based site selection on information in responses to the screener and detailed questionnaires. 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 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. 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 (1993-1996)

EPA conducted sampling episodes at eight facilities between 1993 and 1996 to obtain data on the characteristics of industrial laundry wastewaters and to assess the following: the loading of pollutants to POTWs from industrial laundries; the effectiveness of technologies designed to reduce and remove pollutants from industrial laundries 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 technology option development.

After selecting a site for sampling, EPA prepared a detailed sampling and analysis plan, based on the information contained in the site visit report and follow-up correspondence with the site contact. 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 for each sampled site; the sampling episode reports are contained in the administrative record for this rulemaking. 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) and the Industrial Laundries Quality Assurance Project Plan (QAPP). These documents are contained in the administrative record for this rulemaking.

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 five-day consecutive 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 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 list the metal and organic pollutants, respectively, analyzed using these methods. The laboratories analyzed oil and grease and total petroleum hydrocarbons (TPH) using the proposed Method 1664 (11). Method 1664 measures oil and grease as hexane extractable material (HEM) and measures TPH as silica gel treated-hexane extractable material (SGT-HEM). Method 1664 measures a different fraction of oil and grease and TPH than is measured by the currently approved methods, which use freon. Table A-3 in Appendix A lists other parameters analyzed during the sampling program and the methods by which they were analyzed (12, 13).

Quality control 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 an 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.

3.6 Other Industry-Supplied Data

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 maximal pollutant loadings. These are maximal 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 maximal 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 maximal 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 maximal 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. Unfortunately, several of the facilities sampled experienced difficulties with their treatment system during the sampling days. Also, the production normalized pollutant loading levels were based on average production levels instead of actual production levels, which were used in the first part of the study.

3.7 POTW Data

The Association of Metropolitan Sewerage Agencies (AMSA), in an effort to assist EPA in collecting data for the development of effluent 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);
- 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 can be found in the administrative record for this rulemaking.

3.8 Summary of Literature Searches

EPA has conducted several searches of the open literature throughout the development of this proposed regulation to provide information on the industrial laundries industry. The sources searched have 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 other literature searches in 1993 to gather publicly available information on the industrial laundries industry. EPA conducted one literature search to obtain information about industrial laundries 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 search 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
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 has conducted regular reviews of these journals during the development of this regulation.

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).

3.9 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 industrial laundries rulemaking are discussed below.

3.9.1 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 percent removals of various pollutants.

3.9.2 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 (14), 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 percent removals of various pollutants.

3.9.3 The Domestic Sewage Study

In February 1986, EPA issued the Report to Congress on the Discharge of Hazardous Wastes to Publicly Owned Treatment Works (15), referred to as the Domestic Sewage Study (DSS). This report, which was based in part on the 50 POTW Study, revealed a significant number of sites discharging pollutants to POTWs that are a threat to the treatment capability of these POTWs and were not regulated by national categorical pretreatment regulations. Among the unregulated sources were industrial laundries, which tend 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 Point Source Category (1).

3.9.4 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 laundries associations conducted a survey of Canadian industrial laundries to assess the amount of oil and grease and other pollutants that were being discharged into the sewer systems. The survey was conducted to obtain an overview of the industrial laundries industry, the sources of contamination, and the treatment used to reduce the pollutant loads to the 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

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 comprises the following entities: Ontario Ministry of Environment and Energy, Metro Toronto, 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.

3.9.5 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 included as 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 (16), 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 (17), and Pollution Prevention at Industrial Laundries: A Collaborative Approach in Southern California (18). 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 the proposed rule, a number of potential pollution prevention practices and technology applications were identified. Section VI of the preamble to the proposed rule and Chapters 8 and 10 of this document discuss the pollution prevention technologies and practices and their uses with respect to this proposed rule.

3.10 References

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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. Most of the data presented in this chapter are from facility responses to the 1994 Industrial Laundries Industry Detailed 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. EPA defined 193 of these facilities as being in scope (industry scope is discussed in detail in Chapter 6). The percentages and number of facilities performing various processes discussed in this section were estimated based on the responses from the 193 in-scope facilities, and then extrapolated to represent the industry population of 1,747 facilities, using appropriate survey weights. 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; and
- Section 4.8 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 comprises 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 were identified by trade association mailing lists. Only industrial laundries that reported generating laundry process wastewater and discharged that 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 a smaller 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.

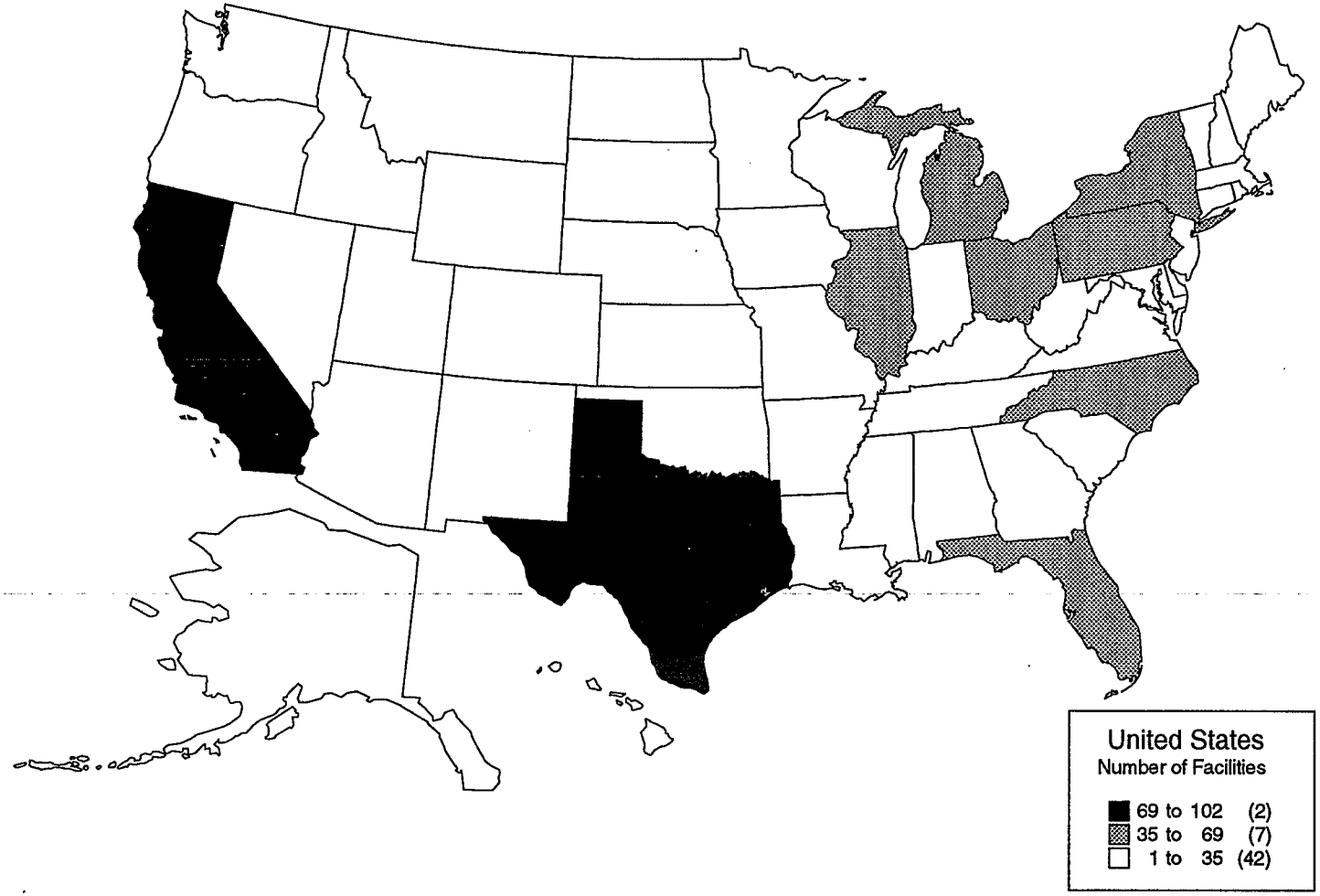

Figure 4-1
Geographic Distribution of Industrial Laundries

Table 4-1

Geographic Distribution of Industrial Laundries by State and Region

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

Table 4-1 (Continued)

Region/State	Number of Facilities in Region/State[1]
North Carolina	35
South Carolina	13
Tennessee	16
Region V	**203**
Illinois	42
Indiana	33
Michigan	36
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

Table 4-1 (Continued)

Region/State	Number of Facilities in Region/State[1]
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 discharged 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 based on the 193 in-scope facilities, extrapolated to represent the entire industry.
Source: 1994 Industrial Laundries Industry Detailed Questionnaire

4.2.4 Items Laundered

As reported by the in-scope facilities, industrial laundries wash a variety of items. The three primary categories 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.

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.

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)	-	-	-

Table 4-3 (Continued)

Item Type[1]	Estimated Number of Facilities Laundering Item	Estimated Percentage of Total Facilities	Estimated Percentage of Total Production[2]
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.
[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 Detailed Questionnaire

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

Table 4-4 (Continued)

Item Type[1]	Customers[1]	Percentage of Total Production of Item from Customer[2]
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
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

Table 4-4 (Continued)

Item Type[1]	Customers[1]	Percentage of Total Production of Item from Customer[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
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

Table 4-4 (Continued)

Item Type[1]	Customers[1]	Percentage of Total Production of Item from Customer[2]
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 were greater than 5 percent.
Source: 1994 Industrial Laundries Industry Detailed 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. (Chapter 6 discusses the scope of the industry under this proposed regulation.) 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, 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.

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.

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

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, 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 Detailed Questionnaire

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.

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.

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 Non-Water-Using/Non-Wastewater-Generating Processes

Several laundering processes generate little if any wastewater. Processes that generate small amounts of wastewater include various methods of dry cleaning (charged system, fresh soap added to each load, and no soap added). 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.

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 tranferred 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.

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;
- Bleach - to brighten the items;
- Antichlor - to remove excess bleach from the items;
- Sour - to reduce the pH of the water to prevent yellowing of the items;
- 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 pound 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.

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. Quantities listed are additive, not inclusive.
[2]This category includes chemicals such as pH adjustors, lubricants, fabric coatings, emulsifiers, dispersants, and desizers.
Source: 1994 Industrial Laundries Industry Detailed Questionnaire

Table 4-7
Amounts of Detergent Added Per Pound of Laundry for Items Most Often Laundered

Item[1]	Average Gallons of Detergent Added per Pound of Laundry[2]	Average Pounds of Detergent Added per Pound of Laundry[2]
Industrial Garments (B01)	0.00166	0.0235
Shop Towels, Industrial Wipers, etc. (B02)	0.0112	0.0322
Printer Towels (B03)	0.0237	0.0355
Floor Mats (B04)	0.000393	0.00537
Mops, Dust Cloths, Tool Covers, etc. (B05)	0.00259	0.0213
Linen Garments (B06)	0.00223	0.0212
Linen Flatwork/Full Dry (B07)	0.00177	0.0228
Health-Care Items (B08)	0.000575	0.00898
Fender Covers (B09)	0.00189	0.0230
Continuous Roll Towels (B10)	0.00123	0.0142
Clean Room Garments (B11)	0.00299	0.0123
Other (B13)	0.000500	---
Laundry Bags (B14)	---	0.0202
Family Laundry (B15)	0.000667	0.0124
New Items (B17)	0.000696	0.00605
Executive Wear (B18)	0.00136	0.00865
Miscellaneous NOG (not our goods) (B19)	0.00771	---
Rewash Items (B20)	---	0.0314
Filters (B23)	---	0.0486
Buffing Pads (B24)	0.0489	---

[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. Quantities listed are additive, not inclusive.
Source: 1994 Industrial Laundries Industry Detailed Questionnaire

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 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 deposited 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. The equipment 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.

Table 4-8

Age of Facilities and Start 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.
[2]Totals may not equal 100% due to rounding.
Source: 1994 Industrial Laundries Industry Detailed Questionnaire

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 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 Prevention Activities

Based on the detailed questionnaire responses, extrapolated to represent the entire industry, 503 facilities have a written pollution prevention policy. Seven hundred forty (740) facilities of the 1,747 extrapolated facilities conduct pollution prevention activities prior to the laundering process (pre-process 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 pre-process and in-process pollution prevention activities, respectively, reported in responses to the detailed questionnaire. Chapter 8 discusses these activities in greater detail. Although the detailed questionnaire specifically requested that wastewater treatment and water reuse/reduction information not be reported in

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	95.47
Separate Washers (D01)	737	42.20
Separate Extractors (D03)	740	42.36
Dry-Cleaning Units (D04)	252	14.40
Tunnel Washers (D05)	39	2.23
Continuous Roll Towel (CRT) Washers (D07)	35	2.00
Closed-Loop Oil Washers (D08)	34	1.98
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 190 in-scope facilities that responded to the question, extrapolated using appropriate survey weights to represent 1,743 facilities.
Source: 1994 Industrial Laundries Industry Detailed 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 Detailed Questionnaire

Table 4-11

Pre-Process Pollution Prevention 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	60
Certain Items Refused	273	37
Miscellaneous Activities	26	4
Items Centrifuged to Remove Liquids	6	1
Items Sent to Another Site with Wastewater Treatment	67	9
Steam/Air Stripping of Volatile Organics from Items	2	<1
Items Dry-Cleaned Before Water Washing	24	3
Items Presorted to Remove Objects	32	4

[1]Percentages are estimated based on a total of 740 extrapolated facilities (responses of in-scope facilities that reported pre-process pollution prevention activities).
Source: 1994 Industrial Laundries Industry Detailed Questionnaire

Table 4-12

In-Process Pollution Prevention 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	28
Liquid Injection System for Wash Chemical Addition[2]	109	23
Wastewater Treatment	79	17
Improved Housekeeping[2]	49	10
Improved Training of Employees[2]	149	31
Water Softening[2]	46	10
Equipment Modifications/Installations	43	9
Removal of Lint Before Air Venting to Atmosphere	26	5
Miscellaneous Activities	25	5
Reduced Fuel Consumption	6	1
Recycling of Laundry Materials	3	1

[1]Percentages are estimated based on the extrapolated responses of 473 extrapolated facilities (responses of in-scope facilities that reported in-process pollution prevention activities).
[2]Data for these specific in-process pollution prevention activities were specifically requested in the detailed questionnaire.
Source: 1994 Industrial Laundries Industry Detailed Questionnaire

response to these 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 8).

Table 4-11 shows that the pre-process 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.

The detailed questionnaire requested data for five specific in-process pollution prevention activities. Facilities were requested to report any additional in-process pollution prevention 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. As shown in Table 4-12, the two most common in-process pollution reduction activities were change in laundering/dry-cleaning chemicals used and the use of a liquid injection system for wash chemical addition.

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

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. The largest percentage (45%) of dry-cleaning units was purchased in the 1980s; only 39% 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 (1). 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 cleanroom 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 recent analysis showed that the largest five firms control about 55 percent of the market (1).

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 pre-process 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, and the installation of more sophisticated wastewater treatment systems. Chapter 8 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 8 discusses wastewater treatment technologies used by the industry in greater detail.

4.8 References

1. K. Koepper. "Don't Count Out More Public Company Acquisitions." Industrial Launderer. August 1997: page 24.

CHAPTER 5

WATER USE AND WASTEWATER CHARACTERIZATION

5.1 Introduction

This chapter discusses water use practices for the industrial laundries industry and presents a raw wastewater characterization of item-specific and total wastewater streams at industrial laundries. The water use data presented in this chapter are from the 193 in-scope facilities responding to the 1994 Industrial Laundries Industry Detailed Questionnaire (in-scope facilities are those that meet the definition of an industrial laundry as presented in Chapter 6, regardless of annual production). Where appropriate, these data have been extrapolated using statistically-derived survey weights to represent the entire industry.

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 the industrial laundries industry;
- Section 5.5 discusses characterization of raw wastewater by item laundered; and
- Section 5.6 discusses characterization of total, heavy, and light raw wastewater streams.

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, 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.

Process water use 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.

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 in-scope facilities, extrapolated to represent the entire industrial laundries industry.
Source: 1994 Industrial Laundries Industry Detailed 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 in-scope facilities, 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. 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 Detailed Questionnaire

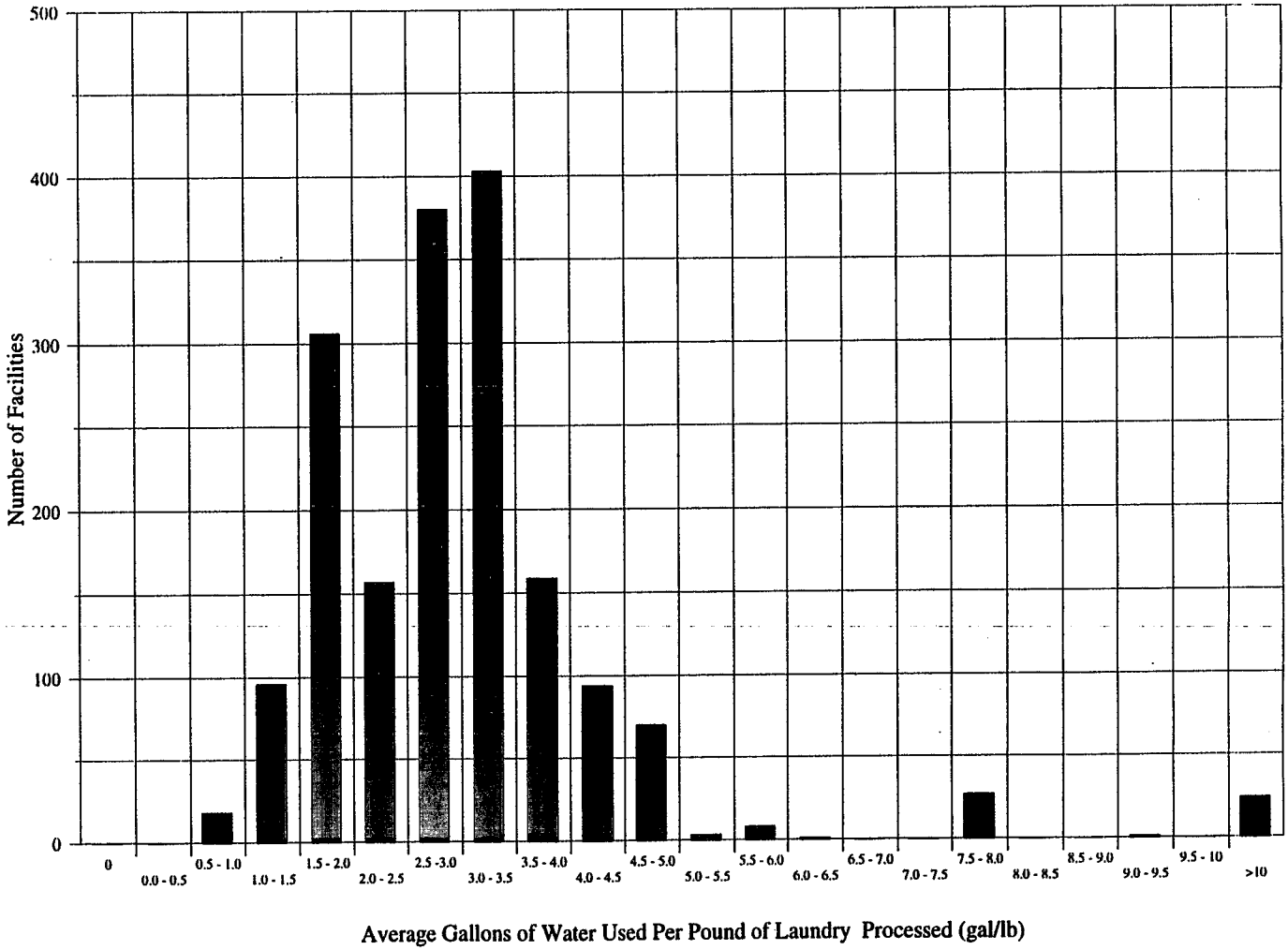

Figure 5-1. Distribution of Facilities by Production Normalized Laundry Process Water Use[1]

[1]**Based on responses to the detailed questionnaire from the 193 in-scope facilities, extrapolated to represent the entire industry.**

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 as reported by the 193 in-scope facilities responding to the detailed questionnaire. These amounts were calculated from information provided in the wash formulas reported by facilities. 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 closely 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 in-scope facilities that responded to the detailed questionnaire discharge laundry wastewater to a POTW. Some facilities also discharge some of their process wastewater to off-site disposal or land application. 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 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 5-2 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

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	0.00	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	0.00	1
Laundry Bags (B14)	A01	1.45	1.45	0.45	2

Table 5-3 (Continued)

Item[2]	Process[3]	Mean (gal/lb)	Median (gal/lb)	Standard Deviation (gal/lb)	Estimated Number of Facilities in Calculations
Family Laundry (B15)	A01	3.35	3.05	1.28	6
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	0.00	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	0.00	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 the 193 in-scope facilities; 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 Detailed 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 the 193 in-scope facilities, extrapolated to represent the entire industry. Some facilities reported more than one discharge practice.
Source: 1994 Industrial Laundries Industry Detailed Questionnaire

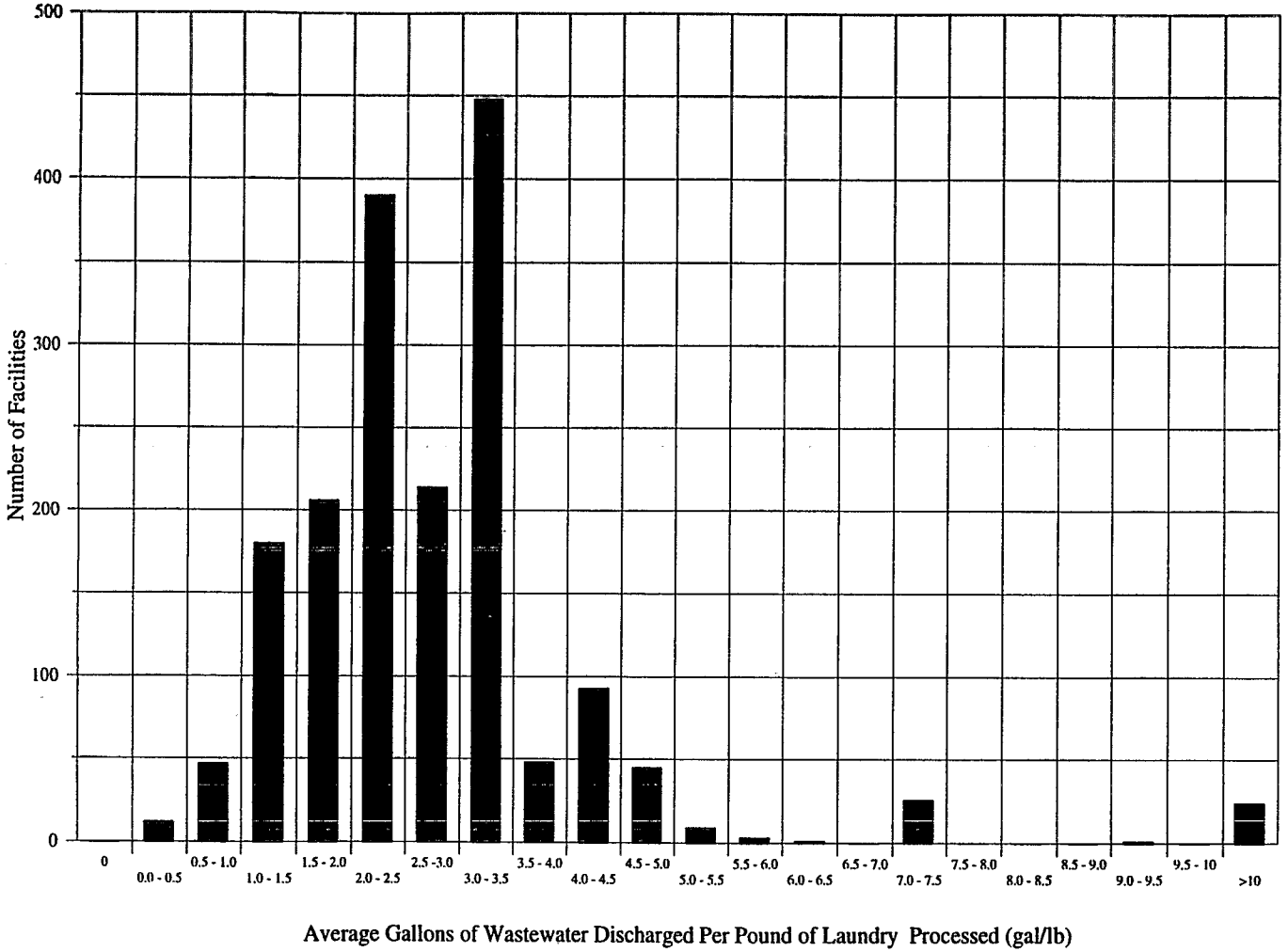

Figure 5-2. Distribution of Facilities by Production Normalized Laundry Process Wastewater Discharge[1]

[1]**Based on responses to the detailed questionnaire from the 193 in-scope facilities extrapolated to represent the entire industry.**

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 8 provides additional information on wastewater recycle/reuse.

5.5 Characterization of Raw Wastewater by Item Laundered

As discussed in Chapter 4, 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 most frequently detected in industrial laundry wastewater. Table 5-6 presents for the 72 pollutants the mean pollutant concentration by item type. Table B-1 in Appendix B 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.

5.6 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. EPA sampling program data and detailed monitoring questionnaire (DMQ) data from facilities that do not split their wastewater stream 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. 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

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, extrapolated to represent entire industry. Only 1,468 extrapolated facilities responded to this question. Percentages are based on the entire estimated industry of 1,747.
Source: 1994 Industrial Laundries Industry Detailed Questionnaire

Table 5-6

Wastewater Characterization for Item Specific Wastewater at Industrial Laundries

Constituent Name	Mean Concentration (mg/L)[1]			
	Industrial Garments	Shop Towels	Printer Towels	Mats
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD_5)	386	2,060	3,940	248
Oil and Grease (measured as HEM)	91	2,550	5,890	84
Total Suspended Solids (TSS)	348	4,590	1,250	365
Priority Organics				
1,1,1-Trichloroethane	0.0550	5.16	4.50	1.60
1,2-Diphenylhydrazine	0.110	1.36	1.00	0.0200
4-Chloro-3-methylphenol	0.178	1.03	0.433	0.0100
Bis(2-ethylhexyl) Phthalate	0.224	3.30	19.0	2.02
Butyl Benzyl Phthalate	0.0550	0.678	5.55	0.0197
Chlorobenzene	0.0550	0.313	0.467	0.0100
Chloroform	0.0550	0.370	0.370	0.0100
Di-*n*-butyl Phthalate	0.0550	0.678	3.20	0.0100
Di-*n*-octyl Phthalate	0.0600	0.678	1.24	0.0494
Ethylbenzene	0.151	6.25	13.2	0.283
Isophorone	0.0550	0.678	0.500	0.361
Methylene Chloride	0.0558	5.28	0.614	0.442
Naphthalene	0.0550	2.88	9.64	0.0244
Phenol	0.0702	0.381	0.500	0.0100
Tetrachloroethene	0.0550	8.03	3.92	0.125
Toluene	0.0666	4.81	20.5	1.29
trans-1,2-Dichloroethene	0.0550	0.456	0.371	0.0100
Trichloroethene	0.0550	0.294	0.476	0.0100
Nonconventional Organics				
2-Butanone	0.275	1.92	3.09	0.579
2-Methylnaphthalene	0.0550	0.946	0.836	0.0100
2-Propanone	0.313	3.98	49.7	2.11
4-Methyl-2-pentanone	0.275	1.88	2.07	0.458
∝-Terpineol	0.0550	0.874	1.07	0.0825
Benzoic Acid	0.450	3.23	3.30	0.231
Benzyl Alcohol	0.0699	0.678	0.500	0.0724
Hexanoic Acid	0.0885	0.373	0.433	0.0737
m-Xylene	0.0100	1.69	1.44	0.520
n-Decane	0.0550	49.5	90.6	1.98
n-Docosane	0.0632	0.949	0.668	0.0130
n-Dodecane	0.0630	18.2	23.1	0.121

Table 5-6 (Continued)

Constituent Name	Mean Concentration (mg/L)[1]			
	Industrial Garments	Shop Towels	Printer Towels	Mats
n-Eicosane	0.0694	29.8	1.29	0.0166
n-Hexacosane	0.130	1.83	2.01	0.0197
n-Hexadecane	0.0759	9.85	9.51	0.0305
n-Octacosane	0.0956	1.11	0.402	0.0100
n-Octadecane	0.0471	11.4	2.43	0.0152
n-Tetracosane	0.0679	0.831	0.605	0.0100
n-Tetradecane	0.0634	16.9	7.89	0.0190
n-Triacontane	0.0620	0.926	0.626	0.0306
o-&*p*-Xylene	0.0100	0.563	1.08	0.291
p-Cresol	0.0550	0.373	0.433	0.0100
p-Cymene	0.0764	2.54	12.4	0.0100
Pentamethylbenzene	0.0550	0.678	0.500	0.0100
Priority Metals and Elements				
Antimony	0.454	0.211	0.0556	0.0203
Arsenic	0.0116	0.0238	0.00313	0.00380
Beryllium	0.000758	0.00100	0.00100	0.00100
Cadmium	0.0246	0.391	0.0253	0.00950
Chromium	0.0936	0.478	2.65	0.0806
Copper	0.672	6.65	11.0	0.220
Lead	0.214	7.34	8.91	0.307
Mercury	0.000408	0.00122	0.000230	0.000430
Nickel	0.103	0.600	0.101	0.0543
Selenium	0.0102	0.0138	0.0177	0.00460
Silver	0.00710	0.174	0.207	0.0171
Thallium	0.00360	0.00467	0.00767	0.0120
Zinc	1.47	13.9	3.62	1.06
Nonconventional Metals and Elements				
Aluminum	5.19	11.3	8.22	3.42
Barium	0.254	3.98	4.53	0.214
Boron	0.195	1.81	0.670	0.0500
Cobalt	0.0171	0.336	0.614	0.0135
Iron	9.70	55.2	8.51	6.87
Manganese	0.139	1.18	0.898	0.115
Molybdenum	0.0213	0.351	2.10	0.0240
Tin	0.0922	0.270	0.0990	0.0439
Titanium	0.148	0.199	0.184	0.0100
Vanadium	0.00700	0.0433	0.00900	0.00920
Yttrium	0.00215	0.00810	0.00570	0.00500

Table 5-6 (Continued)

Constituent Name	Mean Concentration (mg/L)[1]			
	Industrial Garments	Shop Towels	Printer Towels	Mats
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	1,740	14,000	16,900	80
Total Organic Carbon (TOC)	359	1,950	2,740	186
Total Petroleum Hydrocarbon (measured as SGT-HEM)	47	1,630	1,730	33

Table 5-6 (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

Table 5-6 (Continued)

Constituent Name	Mean Concentration (mg/L)[1]			
	Mops	Steam-Tumbled Printer Towels	Items Dry Cleaned Prior to Water Washing	Linen Supply Items
n-Hexadecane	1.07	91.6	NA	0.160
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	0.0556	0.0261	NA	0.114
Arsenic	0.0178	0.00380	0.00500	0.156
Beryllium	0.00100	0.00100	NA	0.00100
Cadmium	0.0373	0.0358	0.0825	0.0219
Chromium	0.184	0.275	0.0933	0.0492
Copper	3.52	4.86	0.668	0.527
Lead	1.76	0.957	0.519	0.151
Mercury	0.00840	0.000200	0.000150	0.00165
Nickel	0.195	0.0372	0.0200	0.0771
Selenium	0.00460	0.0230	NA	0.151
Silver	0.0160	0.0653	0.00500	0.0291
Thallium	0.00240	0.0120	NA	0.00700
Zinc	5.32	2.10	0.450	0.381
Nonconventional Metals and Elements				
Aluminum	17.3	2.80	NA	3.08
Barium	0.953	1.63	NA	0.301
Boron	0.327	0.0500	NA	0.0970
Cobalt	0.0620	0.202	NA	0.00990
Iron	31.9	2.62	NA	3.26
Manganese	0.638	0.277	NA	0.0812
Molybdenum	0.0940	2.64	NA	0.0263
Tin	0.128	0.0761	NA	0.0290
Titanium	0.307	0.0178	NA	0.0654
Vanadium	0.0320	0.0221	NA	0.00990
Yttrium	0.00500	0.00500	NA	0.00470

Table 5-6 (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 non-detects.
NA - Not Available. No data were available for this constituent.

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.

Tables 5-7 through 5-9 present for 72 pollutants the mean concentrations for heavy, light, and total raw wastewater streams. Table B-2 in Appendix B of this document presents for the 72 pollutants 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.

Table 5-7

Wastewater Characterization Data for Heavy Wastewater Streams at Industrial Laundries

Pollutant	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	11.6
Butyl Benzyl Phthalate	8.96
Chlorobenzene	0.271
Chloroform	0.296
Di-*n*-butyl Phthalate	1.45
Di-*n*-octyl Phthalate	0.599
Ethylbenzene	3.65
Isophorone	0.207
Methylene Chloride	0.854
Naphthalene	5.07
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

Table 5-7 (Continued)

Pollutant	Mean Concentration[1] (mg/L)
∝-Terpineol	0.379
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	4.41
n-Hexacosane	0.354
n-Hexadecane	9.49
n-Octacosane	0.370
n-Octadecane	4.00
n-Tetracosane	0.316
n-Tetradecane	7.23
n-Triacontane	0.366
o-&*p*-Xylene	3.59
p-Cresol	0.204
p-Cymene	3.55
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

Table 5-7 (Continued)

Pollutant	Mean Concentration[1] (mg/L)
Silver	0.199
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 non-detects.

Table 5-8

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

Table 5-8 (Continued)

Pollutant of Concern	Mean Concentration[1] (mg/L)
∝-Terpineol	0.123
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

Table 5-8 (Continued)

Pollutant of Concern	Mean Concentration[1] (mg/L)
Silver	0.00432
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 non-detects.

Table 5-9

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)	879
Oil and Grease (measured as HEM)	1,450
Total Suspended Solids (TSS)	849
Priority Organics	
1,1,1-Trichloroethane	0.334
1,2-Diphenylhydrazine	0.0984
4-Chloro-3-methylphenol	0.070
Bis(2-ethylhexyl) Phthalate	5.42
Butyl Benzyl Phthalate	0.139
Chlorobenzene	0.155
Chloroform	0.0344
Di-*n*-butyl Phthalate	0.273
Di-*n*-octyl Phthalate	0.103
Ethylbenzene	0.681
Isophorone	0.0790
Methylene Chloride	0.390
Naphthalene	1.72
Phenol	0.0861
Tetrachloroethene	3.69
Toluene	2.49
trans-1,2-Dichloroethene	0.0230
Trichloroethene	0.0211
Nonconventional Organics	
2-Butanone	2.98
2-Methylnaphthalene	0.157
2-Propanone	12.8
4-Methyl-2-pentanone	1.89

Table 5-9 (Continued)

Pollutant	Mean Concentration[1] (mg/L)
∝-Terpineol	0.326
Benzoic Acid	0.779
Benzyl Alcohol	0.0753
Hexanoic Acid	0.0854
m-Xylene	5.56
n-Decane	97.0
n-Docosane	0.680
n-Dodecane	6.75
n-Eicosane	2.12
n-Hexacosane	0.529
n-Hexadecane	5.57
n-Octacosane	0.103
n-Octadecane	1.82
n-Tetracosane	1.63
n-Tetradecane	5.08
n-Triacontane	0.160
o-&*p*-Xylene	3.02
p-Cresol	0.0713
p-Cymene	0.143
Pentamethylbenzene	0.313
Priority Metals and Elements	
Antimony	0.0945
Arsenic	0.0185
Beryllium	0.00752
Cadmium	0.0574
Chromium	0.263
Copper	1.36
Lead	0.809
Mercury	0.00110
Nickel	0.165
Selenium	0.0648

Table 5-9 (Continued)

Pollutant	Mean Concentration[1] (mg/L)
Silver	0.0278
Thallium	0.0248
Zinc	2.16
Nonconventional Metals and Elements	
Aluminum	5.86
Barium	1.18
Boron	0.701
Cobalt	0.184
Iron	30.9
Manganese	0.504
Molybdenum	0.386
Tin	0.176
Titanium	0.166
Vanadium	0.0710
Yttrium	0.0127
Bulk Nonconventionals	
Chemical Oxygen Demand (COD)	5,290
Total Organic Carbon (TOC)	1,440
Total Petroleum Hydrocarbon (measured as SGT-HEM)	530

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

CHAPTER 6

INDUSTRY SCOPE AND SUBCATEGORIZATION

6.1 Introduction

This chapter discusses the scope and applicability of the proposed rule and the subcategorization analysis for the Industrial Laundries Point Source Category. The purpose of the scope and applicability is to define the type of facilities that will be covered by the proposed rule. The purpose of subcategorization is to group together, if appropriate, facilities of similar characteristics so that pretreatment standards representative of each group can be developed. This provides each subcategory with a uniform set of pretreatment standards that consider technological achievability and economic impacts unique to that subcategory.

After examining data collected on the industry, EPA has determined that subcategorization of the Industrial Laundries Point Source Category is not appropriate, as discussed in this chapter.

The following sections discuss the following topics:

- Section 6.2 discusses the regulatory background of the industrial laundries industry;
- Section 6.3 discusses the scope of the industry;
- Section 6.4 presents the subcategorization analysis; and
- Section 6.5 presents the references used.

6.2 Regulatory Background

As discussed in Chapter 2, the Auto and Other Laundries Category, of which industrial laundries was a subcategory, was mandated for study and possible effluent limitations guidelines and standards development by the 1976 Settlement Agreement. However, in 1982, the 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 publicly owned treatment works (POTWs) and that did not pass through, interfere with, or otherwise prove incompatible with the operation of POTWs.

After gathering additional information about the industrial laundries industry, EPA published its 1986 Domestic Sewage Study (DSS), which identified industrial laundries as potential contributors of large amounts of hazardous pollutants to POTWs. In its 1990 Effluent Guidelines Plan (55 FR 80), EPA listed the industrial laundries industry as a new

category to be studied for possible effluent limitations guidelines and standards development. The Natural Resources Defense Council (NRDC) and Public Citizen, Inc. filed suit against EPA, charging that EPA's plan did not meet the requirements of 304(m) of the Clean Water Act. A Consent Decree was entered by the Court in January 31, 1992 (57 FR 19748); as modified in 1994, the Consent Decree requires that EPA promulgate effluent limitations guidelines and standards for the Industrial Laundries Point Source Category in 1998 (59 FR 25859). In 1997, EPA negotiated new proposal and promulgation deadlines with the NRDC; as a result, EPA must now promulgate the rule for the industrial laundries industry by June 1999 (62 FR 8726).

6.3 Industry Scope

One of the steps in developing pretreatment standards for the industrial laundries industry was determining 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 and applicability of the regulation.

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 rule. Based on the data collected by EPA, 97 percent of all laundering performed by industrial laundries is water washing. As discussed in Chapters 4 and 5, industrial laundry treated by oil-only dust control mop treatment generates no wastewater. Therefore, oil-only dust control mop treatment is proposed to be excluded from regulation under the proposed rule. Industrial laundry treated by dry cleaning generates little wastewater, which typically contains very low concentrations of pollutants. Because this process generates an insignificant amount of wastewater, it is proposed to be excluded from regulation under the proposed rule. Only water-washing laundering processes are included in the scope of the rule. 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 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.

EPA then looked at the types of items that were water-washed to determine if any specific items should be excluded from regulation. 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 6-1. Table 6-1 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 higher 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 6-2. Table 6-2 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 proposed rule.

EPA is also proposing to exclude on-site laundries from the applicability of the rule. The focus of this rule is 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 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 C of this document. These regulations generally apply to wastewater generated from these industries, including on-site laundering. For example, the OCPSF effluent guidelines control discharges from garment laundering at OCPSF facilities. For

Table 6-1

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		

Table 6-2

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		

industries not yet covered by effluent limitations guidelines and standards, it makes sense to examine these industries and the wastewater treatment processes at these industrial facilities 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 subcategory as a whole. This is consistent with EPA's efforts to make common-sense regulatory decisions.

EPA has also considered concerns expressed by industrial launderers that by excluding on-site laundering of industrial items, EPA has created an incentive for businesses to switch from using industrial launderers covered by the rule to on-site laundering. EPA does not believe this will happen because the average increased price per pound of laundering as a result of the proposed rule ($0.003 per pound) is so small that the cost of buying the equipment and operating the equipment on site would not be justified. Furthermore, an increase in pollutant loads at the facility may necessitate additional changes in the facility's NPDES permit if it is a direct discharger or its pretreatment permit issued by the local POTW if it is an indirect discharger. Section 8 of the Economic Assessment (2) supporting this proposed rule and the Analysis of Hotels, Hospitals, and Prisons (HHPs) Database memorandum (3) contain additional information on this issue.

Based on these analyses, EPA determined the facilities within the scope of the proposed rule. Industrial laundries that would be in scope include 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 laundered textile items; this includes textile rental companies that perform laundering operations. Laundering in this definition means washing with water, including water washing following dry cleaning. This rule would not apply to laundering exclusively through dry cleaning. Industrial textile items include, but are 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, filters, and clean room items. If any of these items are used by hotels, hospitals, or restaurants, they are not industrial items. For a facility that meets this definition, wastewater from all water-washing operations would be covered by the proposed rule, including wastewater from the washing of linen items, as long as these items do not constitute 100 percent of the items washed.

The proposed rule would not apply to discharges from on-site laundering at industrial facilities, laundering of industrial textile items within the same business entity, and facilities that exclusively launder linen items, denim prewash items, new items (i.e., items directly from the textile manufacturer, not yet used for their intended purpose), any other laundering of hospital, hotel, or restaurant items or any combination of these items. This proposed rule does apply to hotel, hospital, or restaurant laundering of industrial textile items.

In addition, this proposed rule would not apply to the discharges from oil-only treatment of mops. 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.

6.4 Subcategorization Analysis

EPA assessed several factors to determine whether segmenting or subcategorizing the Industrial Laundries Point Source Category is appropriate. These factors 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 has determined that the Industrial Laundries Point Source Category warrants no subcategorization. However, the proposed PSES contain an exclusion for small facilities due to disproportionate economic impacts. The remainder of this section discusses EPA's analysis of each of these factors.

6.4.1 Disproportionate Economic Impacts

EPA looked at production as a means of defining applicability of the rule, since EPA commonly uses production as a good indicator of size 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 following

implementation of this rule. EPA did a breakpoint analysis and determined that disproportionate impacts occur at facilities with production of less than one million pounds per year and less than 255,000 pounds per year of shop and printer towels/rags. Appendix E of the Economic Assessment presents EPA's rationale for this exclusion.

Under Pretreatment Standards for Existing Sources (PSES), EPA is proposing to exclude existing facilities processing less than one million pounds of incoming laundry per calendar year and less than 255,000 pounds of shop towels and/or printer towels/rags per calendar year. EPA proposes this exclusion to eliminate the unacceptable economic impacts on these smaller facilities that would occur without the exclusion. Appendix E of the Economic Assessment contains a more detailed discussion of this exclusion. As a result of this exclusion, there would be a decrease of less than three percent in the pollutant removals achieved under the proposed rule.

Under Pretreatment Standards for New Sources (PSNS), EPA is proposing no exclusions since the economic projections indicate that there would be no barrier to entry as a result of the proposed new source standards.

6.4.2 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 6.3, 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.

6.4.3 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. EPA is therefore not considering plant age as a basis for subcategorization.

6.4.4 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. EPA did not subcategorize based on geographical location because location does not affect the ability of industrial laundries to comply with the proposed rulemaking.

6.4.5 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.

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.

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.

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.

In addition, as discussed in Section 6.4.1, EPA looked at production in determining the applicability of the proposed rule to the industry. As a result, EPA is proposing to exclude from regulation existing facilities that process less than one million pounds of incoming laundry per calendar year and less than 255,000 pounds of shop towels/rags.

6.4.6 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 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.

6.4.7 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 14, EPA estimates that minimal non-water quality impacts would result from implementation of this proposed regulation. Therefore, EPA determined that these non-water quality environmental impacts are not an adequate basis for subcategorizing the industrial laundries industry.

6.4.8 Type of Item Laundered and Wastewater Characteristics

As discussed in Section 6.3 of this document, the types of items laundered by facilities covered under the scope of this rulemaking include, but are not limited to, the following industrial textile items: shop towels, printer towels/rags, furniture towels, rags, mops, mats, rugs, tool covers, fender covers, dust-control items, gloves, buffing pads, absorbents, uniforms, and clean room garments. Laundering of linen items is also covered when industrial items are laundered at the same facility.

EPA examined type of item laundered as a possible basis of subcategorization, as different items cleaned usually generate different wastewater characteristics. As presented in Chapter 5, printer towels/rags, shop towels, and mops generally have concentrations of pollutants that are greater than the concentrations for floor mats and industrial garments. Laundering of printer towels/rags and shop towels generates 67 percent of the toxic-weighted wastewater pollutant load from the industry, although these items represent only 5 percent of the total industry production and 10 percent of the total industrial laundry production.

EPA considered requiring different wastewater limitations 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 limitations for different types of items would require segregation and separate treatment of wastestreams. To be effective, separate limitations for wastewater for specific laundry items would require the use of in-plant limitations. Requiring industrial laundries to segregate wastewater and treat the segregated streams separately adds complexity to the regulation that is unnecessary. In addition, most facilities that reported having treatment in the detailed questionnaire treat all of their wastewater from laundering of all items. Also, most industrial laundries currently sample only their total facility effluent at the point of discharge to the POTW. Implementation of in-plant limits would place an additional recordkeeping burden on both the industry and permit writers and would increase the costs for the industry to comply with the proposed rule.

6.5 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. Economic Assessment for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category. EPA-821-R-97-008, Washington, DC, November 1997.

3. Memorandum: Analysis of Hotels, Hospitals, and Prisons (HHPs) Database, February 21, 1997.

CHAPTER 7

POLLUTANTS SELECTED FOR REGULATION

7.1 Introduction

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 D-1 in Appendix D 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.

This chapter presents the methodology used to select pollutants for regulation under the proposed industrial laundries rule. Section 7.2 discusses the pollutants considered for regulation. Section 7.3 discusses the criteria used to identify pollutants of concern from the list of pollutants considered for regulation. Section 7.4 discusses the criteria used to select pollutants for regulation, including the pass-through analysis, from the pollutants of concern list, and Section 7.5 presents the references used.

7.2 Pollutants Considered for Regulation

EPA considered four conventional, 98 priority, and 213 nonconventional organic, metal, and elemental pollutant parameters for potential regulation for the industrial laundries industry. Three hundred and twelve (312) of these pollutants are listed in The Industrial 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 1993-1996 industrial laundries sampling program, which is discussed in Chapter 3. Table D-2 in Appendix D lists the 315 pollutants analyzed by EPA in industrial laundry wastewater during this sampling program. EPA used data collected from seven industrial laundries for selecting pollutants of concern and regulated pollutants.

For the industrial laundries industry, EPA used the newly proposed EPA Method 1664 to analyze for oil and grease and total petroleum hydrocarbons (TPH) because the currently approved method for analyzing these parameters uses freon, which is being phased out of use. Method 1664 has been proposed to measure oil and grease as hexane

extractable material (HEM) and to measure TPH as silica gel treated-hexane extractable material (SGT-HEM).

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 Detailed Questionnaire. The 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 D-1 in Appendix D); 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.

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 facilities have 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 facilities has limits for PCBs.

EPA did not consider pesticides for regulation because most priority 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. Pesticides were analyzed for at four facilities during the 1985-1987 sampling program, and ten 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 facilities has 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.

7.3 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 7-1 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 7-2 lists the 50 pollutants meeting this criterion.

- Pollutants identified during screening, but not quantified due to a lack of an acceptable analytical method. 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 metals were used for screening purposes only and were excluded from the pollutants of concern because they are not quantified. Table 7-3 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 present in source water at concentrations similar to quantities present on industrial laundry items and generated from industrial laundry processes, based on comparing the concentrations of these pollutants in source water from seven sampling episodes to the concentrations in industrial laundry wastewater.

- 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.

Table 7-1

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 7-1 (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 7-1 (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 7-2

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 7-3

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

— Total orthophosphate, total phosphorous, and total hydrolyzable phosphate: Table 7-4 presents the average influent, concentrations, effluent concentrations, and percent removals for these pollutants by both the dissolved air flotation and chemical precipitation treatment technologies. These pollutants are typically regulated by water quality standards on a case-by-case basis. These pollutants are not considered for national regulation for the industrial laundries industry.

— Surfactants (nonionic (CTAS) and anionic (MBAS)): Table 7-4 presents the average influent concentrations, effluent concentrations, and percent removals for these pollutants by both the dissolved air flotation and chemical precipitation treatment technologies. 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.

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. Total suspended solids and total solids were both detected in industrial laundry wastewater. 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 suspended solids portion, not the dissolved solids portion, 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 7-5 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.

7.4 Pollutants Selected for Regulation

This section presents the pollutant parameters selected for regulation for the proposed rule for the Industrial Laundries Point Source Category. These parameters were chosen from the list of 72 pollutant parameters of concern discussed above. Although all 72 pollutant parameters of concern were used to estimate compliance costs, pollutant loadings, and pollutant reductions, only certain parameters were selected for regulation. Because the list of pollutants of concern is rather large, EPA has chosen to propose a subset of these

Table 7-4

Average Influent Concentrations, Effluent Concentrations, and Removals for Phosphorous and Surfactants

Pollutant	Average Influent (mg/L)	Average Effluent (mgL)	Average Percent Removal
Chemical Precipitation			
Total Hydrolyzable Phosphorous	67.6	0.363	>99
Total Orthophosphate	No Data	No Data	No Data
Total Phosphorous	42.0	0.992	98
Surfactants (anionic)	12.0	6.23	48
Surfactants (nonionic)	109	43.4	60
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 7-5

Pollutants of Concern for the Industrial Laundries Industry

Pollutant	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

Table 7-5 (Continued)

Pollutant	Number of Times Analyzed	Number of Times Detected	Percent Detected (%)	Concentration in Untreated Wastewater (mg/L)		
				Minimum	Maximum	Mean
Priority Organics (Continued)						
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
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

Table 7-5 (Continued)

Pollutant	Number of Times Analyzed	Number of Times Detected	Percent Detected (%)	Concentration in Untreated Wastewater (mg/L)		
				Minimum	Maximum	Mean
Nonconventional Organics (Cont.)						
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
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

Table 7-5 (Continued)

Pollutant	Number of Times Analyzed	Number of Times Detected	Percent Detected (%)	Concentration in Untreated Wastewater (mg/L)		
				Minimum	Maximum	Mean
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
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

pollutants for regulation to streamline the control and compliance process. Moreover, monitoring for all 72 pollutants of concern is not necessary to ensure that industrial laundry wastewater pollutants are adequately controlled, since many of the pollutants originate from similar sources and have similar properties. EPA selected the pollutants for regulation to represent the entire population of the pollutants of concern; they include metals, volatile organics, and semivolatile organics. Table 7-6 presents the pollutants selected for proposed regulation. The rationale for selecting these pollutants is discussed below.

7.4.1 Elimination of Parameters that Comprise TPH

EPA is not specifically controlling the following eleven straight chain alkane (*n*-alkanes) pollutants in the proposed rule because EPA believes 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;
- *n*-Octacosane;
- *n*-Octadecane;
- *n*-Tetracosane;
- *n*-Tetradecane; and
- *n*-Triacontane.

7.4.2 Elimination of Treatment Chemicals

EPA eliminated aluminum and iron from the proposed regulation because aluminum and iron are commonly added to wastewater as treatment chemicals in the industrial laundries industry. Regulation of aluminum and iron could interfere with their beneficial use as wastewater treatment additives.

7.4.3 Elimination of Pollutants Not Treated or Below Treatable Concentrations

EPA eliminated pollutants from the proposed regulation when the pollutants were not removed by the treatment technologies under consideration as the bases for the regulation. EPA also eliminated pollutants when the pollutants were present below treatable concentrations in wastewater influent to the treatment systems sampled, and therefore would not be substantially removed by the treatment technologies under consideration. For the purposes of this proposed rule, EPA only used 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.

Table 7-6

Pollutants Selected for Proposed Regulation in the Industrial Laundries Industry

Pollutant
Priority Organics
Bis(2-ethylhexyl) Phthalate
Ethylbenzene
Naphthalene
Tetrachloroethene
Toluene
Nonconventional Organics
m-Xylene[1]
o-&*p*-Xylene[1]
Priority Metals
Copper
Lead
Zinc
Bulk Nonconventionals
Total Petroleum Hydrocarbon (measured as SGT-HEM)[2]

[1]EPA is proposing the use of EPA Methods 1624 and 624 for the analysis of xylenes, even though xylenes are not specifically listed as an analyte in either of these methods (promulgated at 40 CFR Part 136). EPA used data obtained from the analysis of xylenes by these two methods in the development of the proposed industrial laundry standards.

[2]Total Petroleum Hydrocarbons (measured as SGT-HEM) is total petroleum hydrocarbons measured by the silica gel treated-hexane extractable material (SGT-HEM) analytical method proposed January 23, 1996 (Method 1664).

EPA considered two main technologies as the bases for the regulatory options (see Chapter 10 for a description of the regulatory options). The two technologies arechemical precipitation and dissolved air flotation (DAF). For each of these technologies, EPA eliminated a different set of pollutants from further consideration for regulation based on treatability. For chemical precipitation, EPA eliminated 31 pollutants from further consideration for regulation. Table 7-7 lists these pollutants and the reasons the pollutants were eliminated. For DAF, EPA eliminated 19 pollutants from further consideration for regulation; Table 7-8 lists these pollutants and the reasons the pollutants were eliminated.

7.4.4 Elimination of Pollutants that Do Not Pass Through or Otherwise Interfere with POTWs

Section 307(b) of the Clean Water Act requires EPA to promulgate pretreatment standards for indirect dischargers to ensure removal of pollutants which pass through, interfere with, or are incompatible with the operation of POTWs. Pollutants shown to pass through a POTW may be regulated by 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.

7.4.4.1 Background

Before proposing pretreatment standards, EPA examines whether the pollutants discharged by the industry pass through a POTW to waters of the U.S. or interfere with the POTW operation or sludge disposal practices. Generally, 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 facilities meeting BAT effluent limitations. For the industrial laundries industry, where only pretreatment standards are being considered, EPA compared the POTW removals with removals achieved by indirect dischargers using the candidate technology that satisfies the BAT factors.

For specific pollutants, such as volatile organic compounds or highly biodegradable compounds, EPA may use other means to determine pass through. For volatile compounds, a volatile override test based on the Henry's Law Constant is used to determine pass through. For this proposed rule, EPA has determined that a pollutant that has a Henry's Law Constant greater than 2.4 x 10-5 atm-m^3/mole will be sufficiently volatile such that a significant portion of the compound would not be treated by the POTW and therefore is determined to pass through. For highly biodegradable compounds, the pass-through determination may be conducted using engineering modeling.

For this proposed rule, the percent removal comparison between indirect dischargers using the candidate PSES technology and POTWs and the volatile override test were used to determine pass through. Since EPA has not identified any direct dischargers,

Table 7-7

Pollutants Eliminated from Consideration for Regulation for the Industrial Laundries Industry for Chemical Precipitation Options

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

Table 7-7 (Continued)

Pollutant	Reason Excluded
Nonconventional Metals and Elements	
Barium	Pollutant detected below treatable concentrations.
Boron	Pollutant detected below treatable concentrations.
Cobalt	Pollutant detected below treatable concentrations.
Tin	Pollutant detected below treatable concentrations.
Vanadium	Pollutant detected below treatable concentrations.
Yttrium	Pollutant detected below treatable concentrations.

Table 7-8

Pollutants Eliminated from Consideration for Regulation for the Industrial Laundries Industry for Dissolved Air Flotation Options

Pollutant	Reason Excluded
Priority Organics	
1,2-Diphenylhydrazine	Pollutant not detected.
Butyl Benzyl Phthalate	Pollutant detected below treatable concentrations.
Isophorone	Pollutant not detected.
trans-1,2-Dichloroethene	Pollutant detected below treatable concentrations.
Trichloroethene	Pollutant detected below treatable concentrations.
Nonconventional Organics	
Benzyl Alcohol	Pollutant detected below treatable concentrations.
Hexanoic Acid	Pollutant not detected.
p-Cresol	Pollutant detected below treatable concentrations.
Pentamethylbenzene	Pollutant not detected.
Priority Metals and Elements	
Arsenic	Pollutant detected below treatable concentrations.
Beryllium	Pollutant not detected.
Mercury	Pollutant detected below treatable concentrations.
Silver	Pollutant detected below treatable concentrations.
Thallium	Pollutant detected below treatable concentrations.
Nonconventional Metals and Elements	
Barium	Pollutant detected below treatable concentrations.
Boron	Pollutant detected below treatable concentrations.
Cobalt	Pollutant detected below treatable concentrations.
Vanadium	Pollutant detected below treatable concentrations.
Yttrium	Pollutant detected below treatable concentrations.

EPA used PSES percent removals for evaluating pass through. EPA finds that a pollutant passes through when the average percent removed nationwide by well-operated POTWs(those meeting secondary treatment requirements) is less than the average percent removed by facilities meeting the candidate PSES for that pollutant.

EPA eliminated three conventional pollutants, biochemical oxygen demand (BOD), total suspended solids (TSS), and oil and grease (measured as HEM), from further consideration for regulation 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. For this analysis, EPA evaluated 25 pollutants from the list of 72 pollutants of concern for chemical precipitation and 37 pollutants were evaluated for dissolved air flotation. The POTW removals used in the pass-through analysis are presented in Tables 7-9 and 7-10. The following sections present the methodology and results from the pass-through analysis performed for both the chemical precipitation and DAF.

7.4.4.2 Methodology for Determining Treatment Technology Percent Removals

Treatment performance data for chemical precipitation and dissolved air flotation were obtained during the industrial laundries sampling program. Influent and effluent data for chemical precipitation were obtained from one facility and comparable data for DAF were obtained from two facilities. These data were used to determine whether a pollutant passes through a POTW. For conducting the pass-through analysis, the data were edited as described in Chapter 9 for calculating the long-term average concentrations. This editing included removing data that were associated with treatment or process upsets, removing data for pollutants that were never detected in influents to treatment systems, removing data for pollutants not treated by the treatment technology, and removing data with influent concentrations less than ten times the method detection level and the corresponding effluent data. These editing criteria were used to allow for the possibility that low percent removals reflected low influent concentrations, not treatment technology performance.

After the data were edited, 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:

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

Table 7-9

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

Pollutant	Chem Precip Percent Removal	Percent POTW Removal	Source of POTW Removals	Chem Precip Removal Greater than POTW Removal?	Henry's Law Constant Greater than $2.4x10^{-5}$ atm-m^3/mol?	Pass Through?
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	88	82	50 POTW (10XDL)	Yes	---	Yes
Total Organic Carbon (TOC)	81	71	50 POTW (10XDL)	Yes	---	Yes
TPH (measured as SGT-HEM)	94	65	Average of N-alkanes	Yes	---	Yes
Priority Organics						
1,1,1-Trichloroethane	35	*	*	No	Yes	Yes
Bis(2-ethylhexyl) Phthalate	97	60	50 POTW (10XDL)	Yes	No	Yes
Butyl Benzyl Phthalate	90	86	RREL5 (All WW)	Yes	No	Yes
Di-*n*-octyl Phthalate	94	*	*	Yes	Yes	Yes
Ethylbenzene	50	*	*	No	Yes	Yes
Isophorone	2	62	RREL (Dom WW)	No	No	No
Naphthalene	92	*	*	No	Yes	Yes
Tetrachloroethene	78	*	*	No	Yes	Yes
Toluene	13	*	*	No	Yes	Yes

Table 7-9 (Continued)

Pollutant	Chem Precip Percent Removal	Percent POTW Removal	Source of POTW Removals	Chem Precip Removal Greater than POTW Removal?	Henry's Law Constant Greater than $2.4x10^{-5}$ atm-m^3/mol?	Pass Through?
Nonconventional Organics						
2-Butanone	8	*	*	No	Yes	Yes
2-Methylnaphthalene	96	28	RREL 5 (All WW)	Yes	No	Yes
4-Methyl-2-pentanone	21	*	*	No	Yes	Yes
m-Xylene	78	*	*	Yes	Yes	Yes
o-&*p*-Xylene	61	*	*	No	Yes	Yes
Priority Metals and Elements						
Cadmium	97	91	50 POTW (10XDL)	Yes	---	Yes
Chromium	92	91	50 POTW (10XDL)	Yes	---	Yes
Copper	98	84	50 POTW (10XDL)	Yes	---	Yes
Lead	96	92	50 POTW (10XDL)	Yes	---	Yes
Zinc	98	77	50 POTW (10XDL)	Yes	---	Yes
Nonconventional Metals and Elements						
Manganese	99	41	RREL5 (All WW)	Yes	---	Yes
Molybdenum	22	52	RREL5 (Dom WW)	No	---	No
Titanium	82	69	RREL5 (All WW)	Yes	---	Yes

*Percent removal not calculated because pollutant has a Henry's law Constant greater than 2.4×10^{-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
SGT-HEM - Silica gel treated-hexane extractable material

Table 7-10

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

Pollutant	DAF Percent Removal	Percent POTW Removal	Source of POTW Removals	DAF Removal Greater than POTW Removal?	Henrys Law Constant Greater than $2.4x10^{-5}$ atm-m^3/mol?	Pass Through?
Bulk Nonconventionals						
TPH (measured as SGT-HEM)	98	65	Average of *n*-alkanes	Yes	---	Yes
Chemical Oxygen Demand (COD)	82	82	50 POTW (10XDL)	No	---	No
Total Organic Carbon (TOC)	66	71	50 POTW (10XDL)	No	---	No
Priority Organics						
1,1,1-Trichloroethane	75	*	*	No	Yes	Yes
4-Chloro-3-methylphenol	11	63	RREL5 (All WW)	No	No	No
Bis(2-ethylhexyl) Phthalate	>99	60	50 POTW (10XDL)	Yes	No	Yes
Chlorobenzene	88	*	*	No	Yes	Yes
Chloroform	<1	*	*	No	Yes	Yes
Di-*n*-butyl Phthalate	95	75	50 POTW (>20PPB)	Yes	No	Yes
Di-*n*-octyl Phthalate	91	*	*	Yes	Yes	Yes
Ethylbenzene	94	*	*	No	Yes	Yes
Methylene Chloride	36	*	*	No	Yes	Yes
Naphthalene	93	*	*	No	Yes	Yes
Phenol	3	95	50 POTW (10XDL)	No	No	No
Tetrachloroethene	74	*	*	No	Yes	Yes

Table 7-10 (Continued)

Pollutant	DAF Percent Removal	Percent POTW Removal	Source of POTW Removals	DAF Removal Greater than POTW Removal?	Henrys Law Constant Greater than $2.4x10^{-5}$ atm-m^3/mol?	Pass Through?
Toluene	48	*	*	No	Yes	Yes
Nonconventional Organics						
2-Butanone	29	*	*	No	Yes	Yes
2-Methylnaphthalene	97	28	RREL 5 (All WW)	Yes	No	Yes
2-Propanone	36	84	RREL 5 (All WW)	No	No	No
4-Methyl-2-pentanone	48	*	*	No	Yes	Yes
∝-Terpineol	25	*	*	No	Yes	Yes
Benzoic Acid	5	81	RREL 5 (All WW)	No	No	No
m-Xylene	95	*	*	Yes	Yes	Yes
o-&*p*-Xylene	66	*	*	No	Yes	Yes
p-Cymene	94	99	RREL5 (All WW)	No	---	No
Priority Metals and Elements						
Antimony	79	72	50 POTW (10XDL)	Yes	---	Yes
Cadmium	87	91	50 POTW (10XDL)	No	---	No
Chromium	92	91	50 POTW (10XDL)	Yes	---	Yes
Copper	91	84	50 POTW (10XDL)	Yes	---	Yes
Lead	92	92	50 POTW (10XDL)	No	---	No
Nickel	87	52	50 POTW (10XDL)	Yes	---	Yes
Selenium	5	34	RREL5 (Dom WW)	No	---	No
Zinc	90	77	50 POTW (10XDL)	Yes	---	Yes

Table 7-10 (Continued)

Pollutant	DAF Percent Removal	Percent POTW Removal	Source of POTW Removals	DAF Removal Greater than POTW Removal?	Henrys Law Constant Greater than $2.4x10^{-5}$ atm-m^3/mol?	Pass Through?
Nonconventional Metals and Elements						
Manganese	92	41	RREL5 (All WW)	Yes	---	Yes
Molybdenum	52	52	RREL5 (Dom WW)	No	---	No
Tin	73	65	RREL5 (All WW)	Yes	---	Yes
Titanium	93	69	RREL5 (All WW)	Yes	---	Yes

*Percent removal not calculated because pollutant has a Henry's Law Constant greater than 2.4×10^{-5}atm-m^3/mol.
50 POTW (10 XDL) - 50 POTW Study, using 10 times the method detection level editing criterion
50 POTW (>20PPB) - 50 POTW Study, using data greater than 20ppb 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
SGT-HEM - Silica gel treated-hexane extractable material

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

7.4.4.3 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. Additional information on these sources is presented below. The following priority of data sources was used to determine the percent removal of pollutants by POTWs nationwide:

- 50 POTW Study;
- RREL Treatability Database; and
- Generic pollutant group removal.

7.4.4.4 50 POTW Study

The primary source of the POTW percent removals data was the 50 POTW Study. The POTW data were edited to eliminate influent and the corresponding effluent data where the average influent concentration at a POTW was less than ten times the method detection level edit, 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 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. The effluent data corresponding to these influent data were also eliminated. 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 the POTW data were edited, the following methodology was used 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 7.4.4.2 of this document.

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

7.4.4.5 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 were 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 7.4.4.2 of this document. EPA then took the average of the percent removals for each pollutant to obtain an average POTW percent removal from the RREL Treatability Database.

7.4.4.6 Generic Removal

After the editing of the 50 POTW Study and RREL Treatability Database, data for TPH, measured as SGT-HEM, were still not available. In order to determine an appropriate POTW percent removal for this pollutant, the available data for the 72 pollutants of concern were reviewed. EPA determined that the best source of POTW removal data for TPH would be the generic group removal of the *n*-alkanes. EPA determined that because the *n*-alkanes comprise a portion of TPH, the percent removal from these compounds represents the best available percent removal for TPH. Table 7-11 presents the *n*-alkanes removal data used to calculate the percent removal for TPH.

7.4.4.7 Results of the POTW Pass-Through Analysis

Tables 7-9 and 7-10 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 2.4×10^{-5} atm-m^3/mol was determined to pass through regardless of its percent removal. For chemical precipitation, 23 of the 25 pollutants analyzed passed through. For DAF, 26 of the 37 pollutants analyzed passed through.

7.4.5 Selection of Regulated Pollutants

Based on the results of the pass-through analysis, EPA considered the pollutants shown in Table 7-12 as pollutants for regulation under the proposed rule for the chemical precipitation and DAF technologies. To further streamline the list of pollutants for proposed regulation, EPA considered using "indicator" pollutants to reflect control of 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 11 pollutants for regulation.

EPA considered three bulk parameters, TPH (measured as SGT-HEM), TOC, and COD, for regulation. 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

Table 7-11

Generic Removal for *n*-Alkanes

Pollutant	POTW Removal (%)	Source of Data
n-Decane	9	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	**65**	---

Table 7-12

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

Chemical Precipitation
Bulk Nonconventionals
Chemical Oxygen Demand (COD)
Total Organic Carbon (TOC)
Total Petroleum Hydrocarbons (measured as SGT-HEM)
Priority Volatile Organics
1,1,1-Trichloroethane
Ethylbenzene
Tetrachloroethene
Toluene
Priority Semivolatile Organics
Bis(2-ethylhexyl) Phthalate
Butyl Benzyl Phthalate
Di-*n*-octyl Phthalate
Naphthalene
Nonconventional Volatile Organics
2-Butanone
2-Methyl-2-pentanone
m-Xylene
o-&*p*-Xylene
Nonconventional Volatile Organics
2-Methylnaphthalene
Priority Metals and Elements
Cadmium
Chromium
Copper
Lead
Zinc

Table 7-12 (Continued)

Chemical Precipitation
Nonconventional Metals and Elements
Manganese
Titanium
DAF
Bulk Nonconventionals
Total Petroleum Hydrocarbons (measured as SGT-HEM)
Priority Volatile Organics
1,1,1-Trichloroethane
Chlorobenzene
Chloroform
Ethylbenzene
Methylene Chloride
Tetrachloroethene
Toluene
Priority Semivolatile Organics
Bis(2-ethylhexyl) Phthalate
Di-*n*-butyl Phthalate
Di-*n*-octyl Phthalate
Naphthalene
Nonconventional Volatile Organics
2-Butanone
4-Methyl-2-pentanone
m-Xylene
o-&*p*-Xylene
Nonconventional Semivolatile Organics
2-Methylnaphthalene
∝-Terpineol

Table 7-12 (Continued)

DAF
Priority Metals and Elements
Antimony
Chromium
Copper
Nickel
Zinc
Nonconventional Metals and Elements
Manganese
Tin
Titanium

SGT-HEM - Silica gel treated-hexane extractable material.

compounds and mineral oils are treated less effectively by POTWs than many other carbon-containing compounds; therefore, EPA has selected TPH for proposed regulation. Because TPH measures a variety of organic compounds, it can also serve as an indicator pollutant for other organic pollutants shown on Table 7-12.

EPA believes that controlling the following volatile organic pollutants will control the remaining volatile organic pollutants shown on Table 7-12:

- Ethylbenzene;
- Tetrachloroethene;
- Toluene;
- *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 7-12. As shown in Table 7-5, these pollutants are detected frequently and at relatively high concentrations.

EPA believes that controlling the following semivolatile organic pollutants will control the remaining semivolatile organic and phthalate pollutants shown on Table 7-12:

- Bis(2-ethylhexyl) phthalate; and
- Naphthalene.

EPA selected these pollutants because they are detected frequently, at relatively high concentrations, and are relatively toxic.

EPA believes that controlling the following metal pollutants will control the remaining metal and elemental pollutants on Table 7-12:

- Copper;
- Lead (Note: lead does not pass through for DAF); and
- Zinc.

These metals were selected because the minimum solubilities of their associated metal hydroxides span a pH range of approximately 7 through 12. Controlling the pollutants within this pH range will also control other metal pollutants of concern. Most metals will be treated by chemical precipitation or dissolved air flotation within this range. These metals were also selected because they were detected most frequently (in nearly 100% of untreated wastewater samples) and in the highest concentrations.

7.5 References

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

2. U.S. Environmental Protection Agency. Fate of Priority Pollutants in Publicly Owned Treatment Works, 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.

CHAPTER 8

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

8.1 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 information:

- Section 8.2 discusses the environmental management hierarchy established by the United States Congress and EPA;
- Section 8.3 discusses the pollution prevention measures used in the industrial laundries industry;
- Section 8.4 discusses the pollution recycling measures used in the industrial laundries industry;
- Section 8.5 discusses the major wastewater treatment technologies used by the industry;
- Section 8.6 discusses the pollution disposal measures used by the industrial laundries industry; and
- Section 8.7 presents the references used.

8.2 The Environmental Management Hierarchy

As it applies to industry, the environmental management hierarchy (outlined in Figure 8-1) stipulates that:

- Facilities should reduce pollution at the source whenever feasible;
- Facilities should recycle pollution 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

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

IV. Disposal

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

Figure 8-1. Environmental Management Options Hierarchy

- 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 will be presented in Sections 8.3 and 8.4 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 8.3 through 8.6 of this document.

8.3 Pollution Prevention/Source Reduction in the Industrial Laundries Industry

Pollution prevention, established as the most desirable option of pollution control 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 policy, declaring that the generation of pollutants should be prevented or reduced during the production cycle whenever feasible.

In the 1994 Industrial Laundries Industry Detailed Questionnaire, EPA asked industrial laundries to provide information on the types of pollution prevention activities performed at their facilities. Of the 193 in-scope industrial laundries responding to the detailed questionnaire (in-scope facilities are those that meet the definition of an industrial laundry as presented in Chapter 6, regardless of annual production), 47 industrial laundries reported having a pollution prevention policy (45 of these facilities attached copies of the plans to the questionnaire), and 54 industrial laundries stated that they plan 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 8.3.1 and 8.3.2 of this document.

8.3.1 Preprocess Pollution Prevention Activities

Seventy-nine (79) in-scope industrial laundries responding to the detailed questionnaire reported conducting preprocess pollution prevention activities. Table 8-1 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 8-1, the performance of preprocess pollution prevention activities does not appear to be related to facility size.

Table 8-2 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. Thirteen 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.

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	28%	32%
Industrial garments	15%	12%

Table 8-1

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

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	20	45%	5,810,000	1%
1,000,000 to < 3,000,000	14	39	36%	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	193	---	492,000,000	100%

Table 8-2

Types of Preprocess Pollution Prevention Activities Reported in the Detailed Questionnaire

Activity	Number of Facilities Performing Activity	Percentage of Total Number of Facilities Reporting Pre-Process Activities[1]
Refusal of Items with Free Liquids	54	68%
Refusal of Certain Items	41	52%
Centrifugation of Items to Remove Liquids	6	8%
Steam/Air Stripping of Volatile Organics from Items	2[2]	3%
Items Presorted to Remove Objects	3	4%
Items Dry-Cleaned Before Water Washing	5[3]	6%

[1]Percentages are based on 79 industrial laundries that reported preprocess activities.
[2]One of these facilities 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.
[3]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.

Of the six facilities (in Table 8-2) that reported centrifugation to remove liquids, four performed this activity on shop or printer towels. Likewise, both of the facilities that reported steam/air stripping of volatile organics from items also performed this activity on shop or printer towels. 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.

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 waterwashing and steam stripping (steam tumbling), during site visit and sampling activities. Section 8.3.12 discusses these technologies and their application in the industry in more detail.

8.3.2 In-Process Pollution Prevention Activities

Fifty (50) industrial laundries reported conducting in-process pollution prevention activities. Table 8-3 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 8-3, the performance of in-process pollution prevention activities does not appear to be related to facility size.

Table 8-4 lists all in-process pollution prevention activities reported by industrial laundries. The most common types of in-process pollution prevention activities reported by the industrial laundries were:

Table 8-3

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

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	20	25%	3,280,000	1%
1,000,000 to < 3,000,000	13	39	33%	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	193	---	310,000,000	100%

Table 8-4

Types of In-Process Pollution Prevention Activities Reported in the Detailed Questionnaire

Activity	Number of Facilities Performing Activity	Percentage of Total Number of Facilities Reporting In-Process Activities[1]
Improved Training of Employees	19	38%
Change in Laundering/Dry Cleaning Chemicals Used	20	40%
Liquid Injection System for Wash Chemical Addition	18	36%
Improved Housekeeping	10	20%
Water Softening	6	12%
Equipment Modifications/Installations	3	6%
Recycling of Laundry Materials	1	2%
Removal of Lint Before Air Venting to Atmosphere	1	2%
Reduced Fuel Consumption	1	2%

[1]Percentages are based on 50 industrial laundries that reported in-process pollution prevention activities.

- A change in the use of laundering/dry-cleaning chemicals (40 percent);
- Improved training of employees (i.e., chemical safety, proper handling of equipment) (38 percent); and
- Installation of a liquid injection system to add wash chemicals (36 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 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 non-hazardous and hazardous waste streams;
- Improve standard operating procedures;
- Establish an inventory control system;
- Perform routine and preventative maintenance on facility equipment;
- Incorporate a paper recycling program;
- 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 less refractory emulsions.

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 for 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 (e.g., 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.

8.4 Pollution Recycling/Resource Conservation and the Industrial Laundries Regulatory Development Process

As established in the environmental management hierarchy, pollution that cannot be prevented or reduced in an environmentally safe manner should be recycled whenever feasible. Pollution recycling conducted in an environmentally safe manner shares many of the advantages of pollution prevention/source reduction. Pollution 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 are taking advantage of opportunities to conserve energy through heat exchange. 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 8.4.1 and 8.4.2 of this document.

8.4.1 Wastewater 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-six of the 193 in-scope industrial laundries responding to the detailed questionnaire (24 percent) reported recycling a portion of the water used by the facility as process makeup water. Twenty-seven of these facilities (59 percent) reported reusing noncontact cooling water as process makeup water. Twenty facilities (43 percent) reported recycling/reusing laundry wastewater back into the water-washing process before the wastewater had been treated. One of these facilities 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 (19 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.

8.4.2 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. 663 of the 1500 facilities responding to the screener questionnaire (44 percent) reported operating a heat reclaimer at their facility.

8.5 Wastewater Treatment Technologies in the Industrial Laundries Industry

As established in the environmental management hierarchy, pollution that cannot be prevented or recycled in an environmentally safe manner should be treated whenever feasible. This section describes major wastewater treatment technologies used in the industrial laundries industry, based on responses to the detailed questionnaire. Sections 8.5.1 through 8.5.14 describe the wastewater treatment technologies used in the industry. These treatment technologies include:

- Gravity settling (Section 8.5.1);
- Stream splitting (Section 8.5.2);
- Screening (Section 8.5.3);
- Equalization (Section 8.5.4);
- Chemical emulsion breaking (Section 8.5.5);
- Chemical precipitation (Section 8.5.6);
- Dissolved air flotation (DAF) (Section 8.5.7);
- Sludge dewatering (Section 8.5.8);

- pH adjustment (Section 8.5.9);
- Ultrafiltration (Section 8.5.10);
- Centrifugation (Section 8.5.11);
- VOC removal technologies (Section 8.5.12);
- Oil/water separation (Section 8.5.13); and
- Media filtration (Section 8.5.14).

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 8-5 presents the total number of facilities (out of 193 in-scope facilities responding to the detailed questionnaire) that reported using each of these technologies.

8.5.1 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) (2).

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

Although only fifty-one percent of in-scope industrial laundries responding to the detailed questionnaire (98 of 193) reported treating their wastewater through gravity settling, every facility visited by EPA has a settling basin in place at their facility. Therefore, EPA believes all industrial laundries have settling basins in place at their facilities and can incorporate gravity settling and solids removal as part of their treatment train without modification of their wastewater treatment equipment. All 98 facilities reporting the use of gravity settling also report removing sludge from the gravity settling unit. The gravity settling units used at these 98 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 6 facilities) and polymer (added by 2 facilities).

Table 8-5

Number of Facilities Responding to Detailed Questionnaire Using Wastewater Treatment Technologies

Technology	Number of Facilities Using Technology	Percentage of Total Number of Industrial Laundries Responding to the Detailed Questionnaire[1]
Gravity Settling	98	51%
Stream Splitting	20	10%
Screening	146	76%
Equalization	147	76%
Chemical Emulsion Breaking	11	6%
Chemical Precipitation	19	10%
Dissolved Air Flotation	36	19%
Sludge Dewatering	59	31%
pH Adjustment	42	22%
Ultrafiltration	2	1%
Centrifugation	4	2%
VOC Removal Technologies	12	6%
Oil/Water Separation	28	15%
Media Filtration	10	5%

[1]Percentages are based on the 193 in-scope industrial laundries that responded to the detailed questionnaire.

8.5.2 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 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 recycle or reuse the less concentrated streams.

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 (3).

In addition to the facility's process wastewater trench and sump system being split, 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 and used 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 to enable them to divert the wastewater. 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

Ten percent of in-scope industrial laundries responding to the detailed questionnaire (20 of 193) 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.

8.5.3 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 (4). 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 (5).

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 (4). 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 (6). Figure 8-2 presents a diagram of a shaker screen.

A rotary screen consists of a circular 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

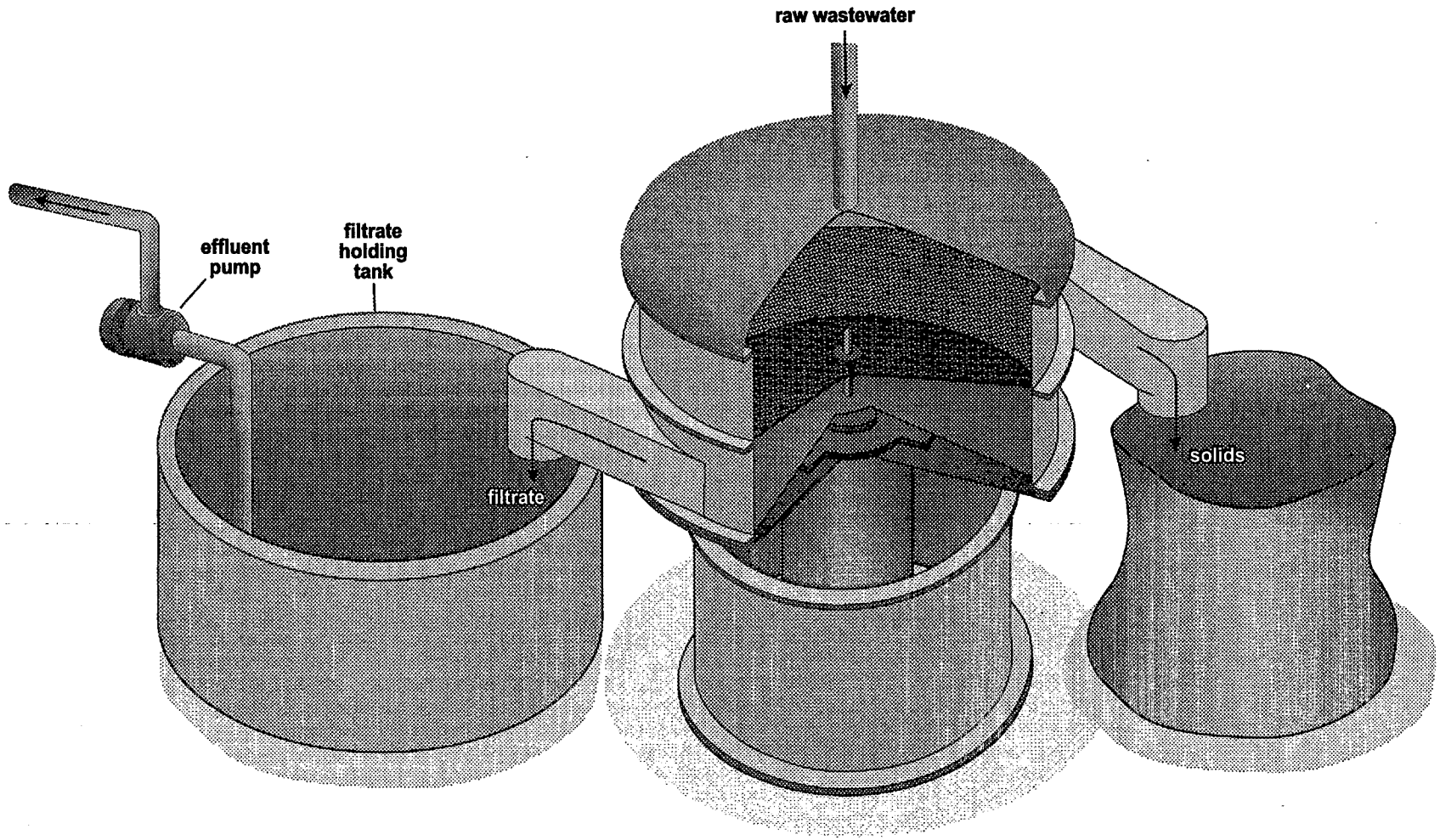

Figure 8-2. Shaker Screen

the chamber toward the exterior, with solids collection on the interior surface of the screen (2).

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 8.5.1, 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 (76 percent) perform at least one screening operation before discharging their wastewater (146 out of 193 in-scope facilities responding to the detailed questionnaire reported having a screen(s)). Twenty-six facilities perform coarse screening only, using a bar 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 (67 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; six facilities use both static and mechanical fine screening; and two facilities use all three types of screens: coarse, static fine, and mechanical fine screening.

8.5.4 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 from 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 (7). Section 8.5.9 (pH Adjustment) discusses equalization units that use pH-adjusting chemicals.

Industry Application

Seventy-six percent of the in-scope industrial laundries responding to the detailed questionnaire (147 of 193) reported treating their wastewater through equalization. None of these facilities reported adding chemicals to their equalization units. None of the facilities treating their wastewater through equalization reported collecting solids from the equalization unit. The majority (66 percent) of the facilities treating their wastewater through equalization 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.

8.5.5 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 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 8-3 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 layer of oil that flows or is pumped from the unit. Figure 8-4 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 (8).

Industry Application

Eleven of the 193 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 are used most frequently (at 5 of the facilities) to collect the demulsified oil from the surface of wastewater. Eight facilities demulsify the oil in a batch process with a median residence time of six 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). Eight 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

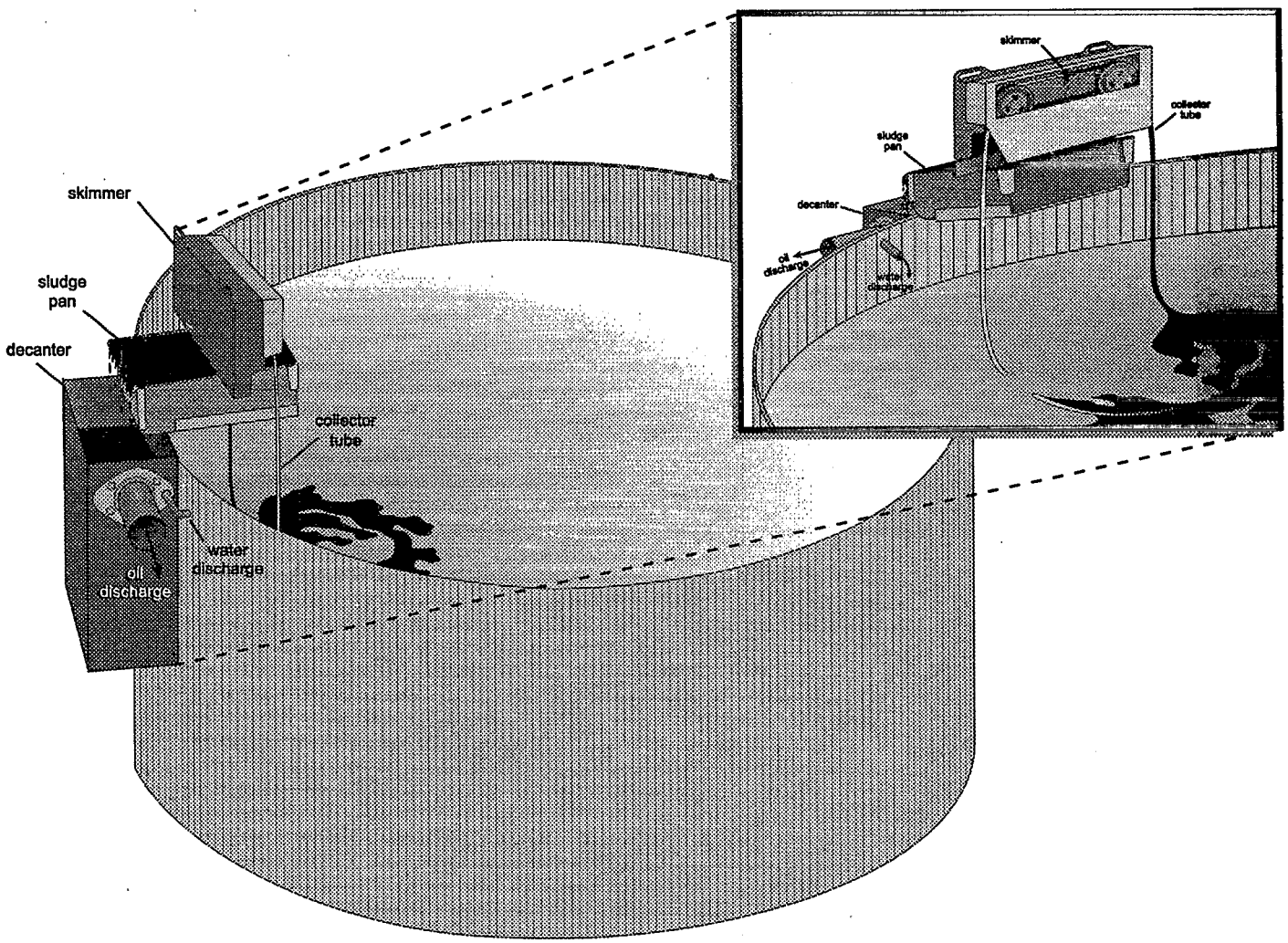

Figure 8-3. Batch Chemical Emulsion Breaking Unit

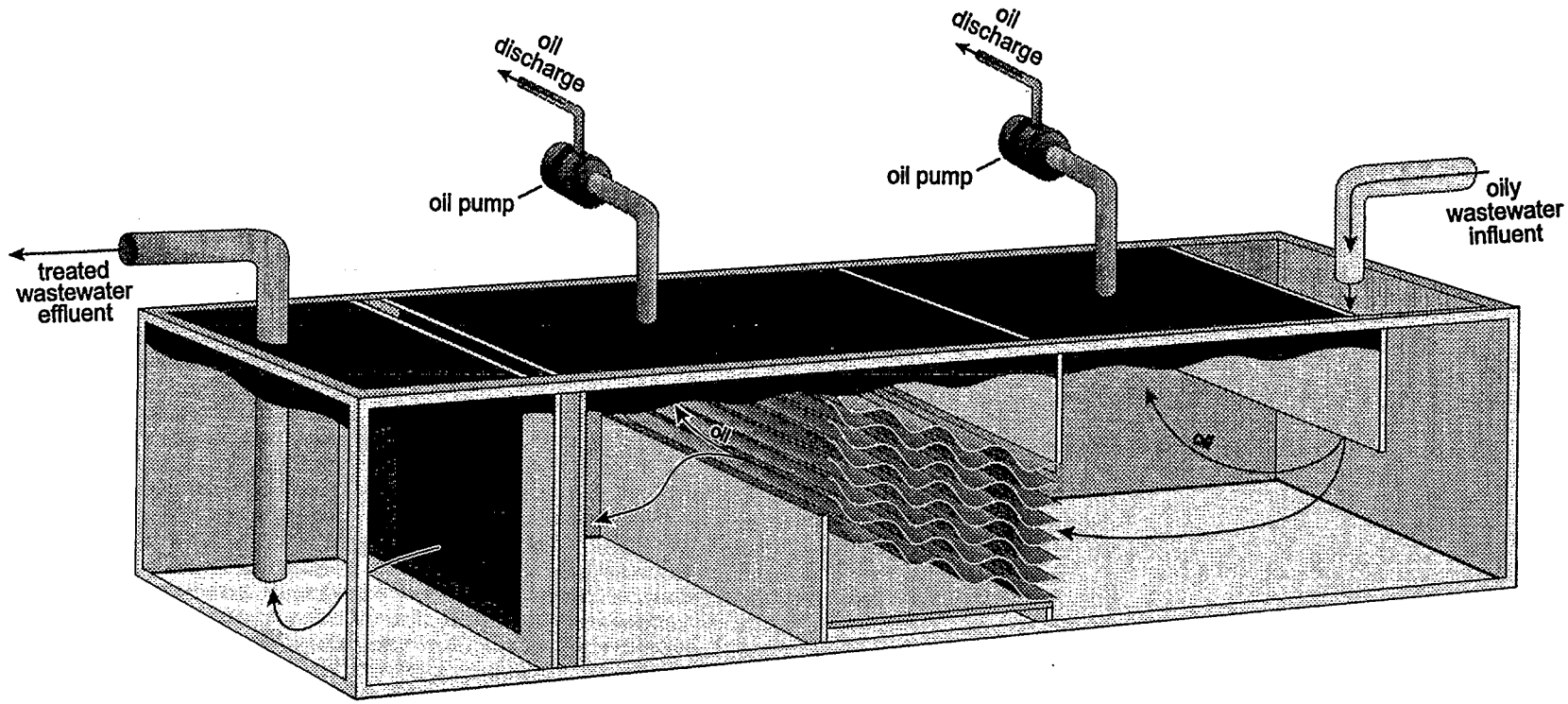

Figure 8-4. Continuous Chemical Emulsion Breaking Unit with Coalescing Plates

often used as a pretreatment to other technologies; six of the eleven facilities reported using chemical emulsion breaking as a pretreatment to either dissolved air flotation (three facilities) or chemical precipitation (three facilities). Ten of the eleven facilities that use chemical emulsion breaking reported disposing of the demulsified oil at an oil reclaimer.

8.5.6 Chemical Precipitation

General Description

Chemical precipitation is one of the most commonly used processes in water treatment (9). 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 (8).

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 ($Al_2(SO_4)_3$*18 H_2O). Flocculent aids, typically anionic polymers, are added to further enhance the agglomeration of the particles (7).

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 resulting sludge is removed for further dewatering and subsequent disposal. Figure 8-5 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

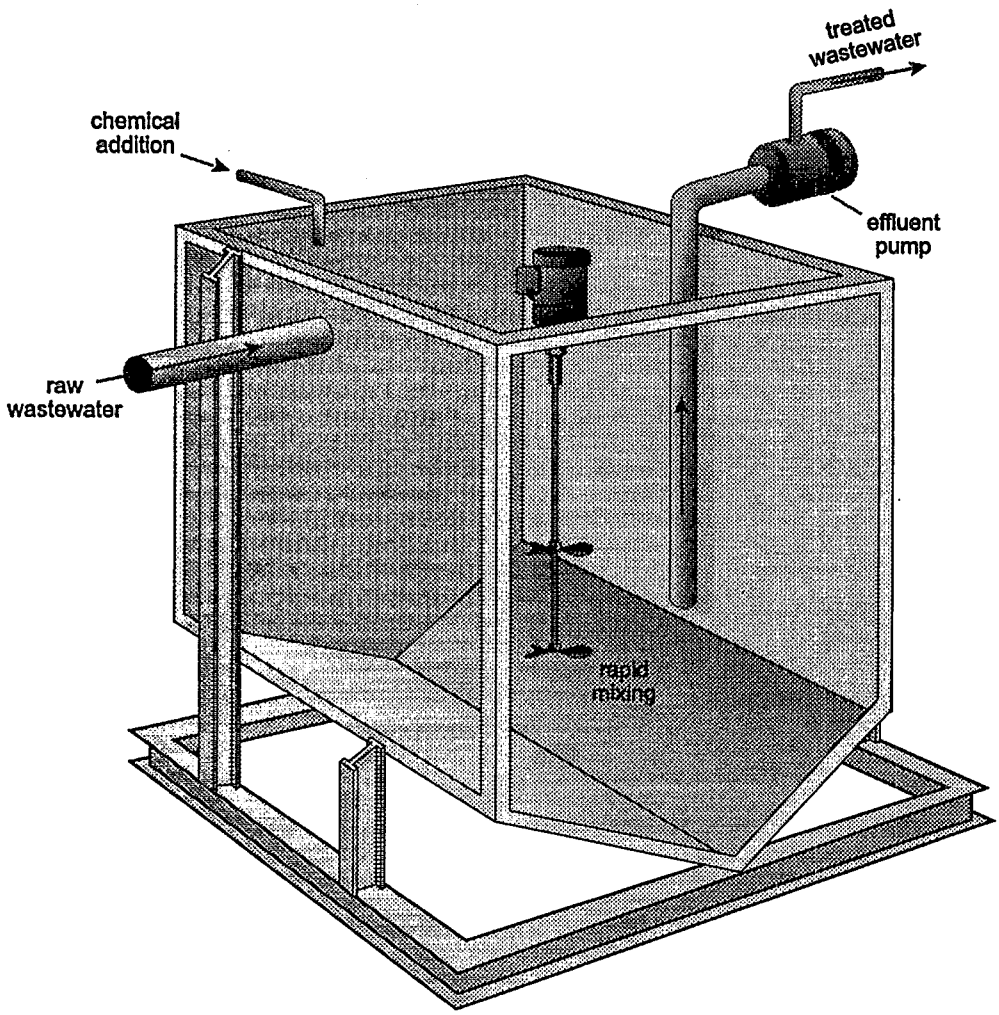

Figure 8-5. Batch Chemical Precipitation System

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 8-6 presents a diagram of a continuous chemical precipitation system.

Industry Application

Ten percent of the in-scope industrial laundry facilities responding to the detailed questionnaire (19 of 193) 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 (14 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. 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 (21%)	4 (21%)
Scheme B	Polymer	1 (5%)	10 (53%)

All 19 facilities using chemical precipitation reported operating a continuous treatment unit. No facilities reported batch chemical precipitation operation.

8.5.7 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

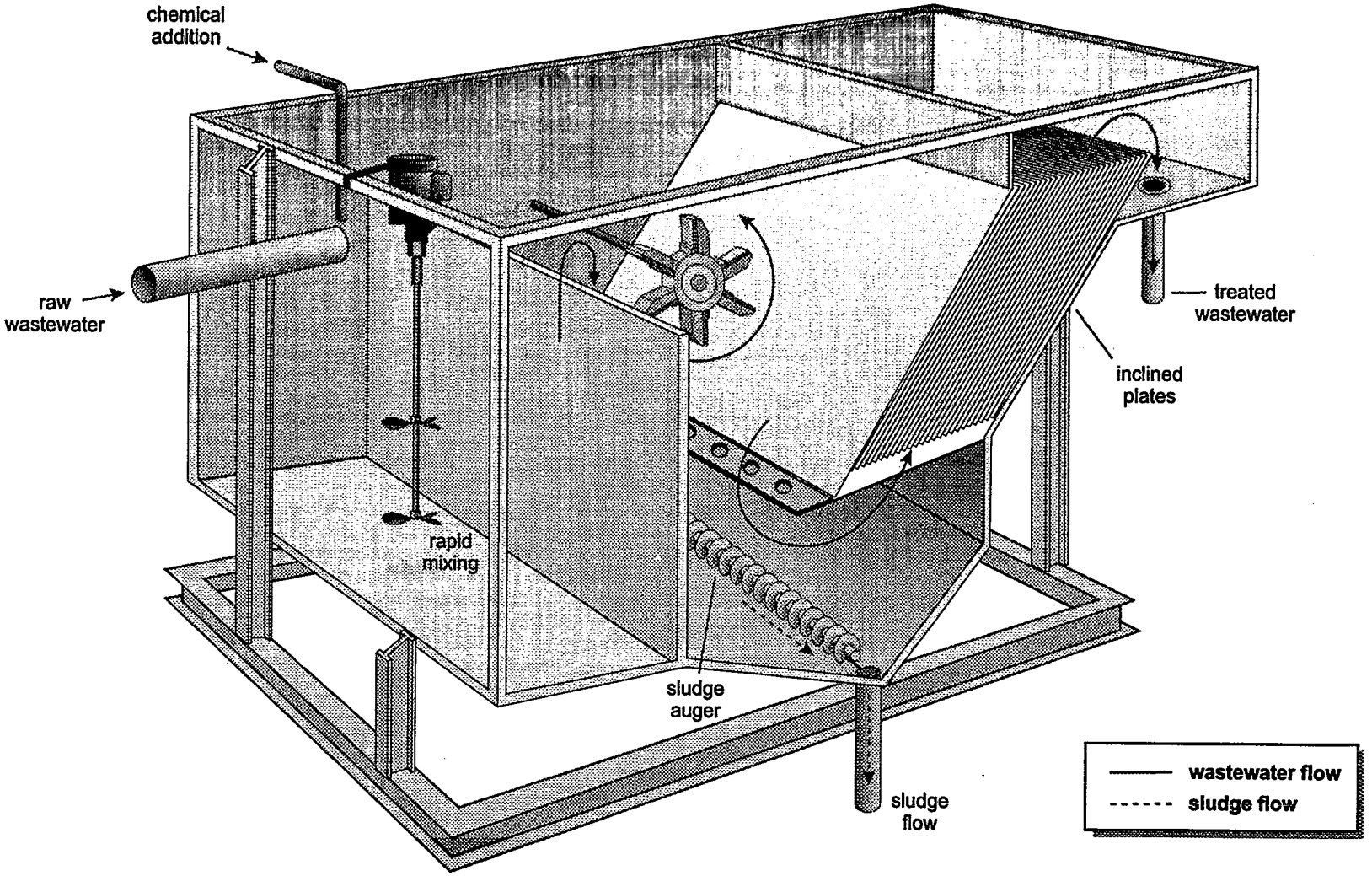

Figure 8-6. Continuous Chemical Precipitation System

(4). 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 (4).

DAF has been applied extensively in the water treatment industry. Specifically, DAF is used 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 8-7 presents a diagram of a DAF unit.

Industry Application

Nineteen percent of the in-scope industrial laundry facilities responding to the detailed questionnaire (36 of 193) reported treating their wastewater using DAF. All of these facilities add chemicals to the DAF and collect the DAF float sludge. (Four additional facilities that reported using DAF were excluded because they do not add chemicals or 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 (metal salt)	14 (39%)
Scheme B	Polymer	14 (39%)
Scheme C	Polymer, flocculent	5 (14%)
Scheme D	Polymer, flocculent, metal salts	3 (8%)

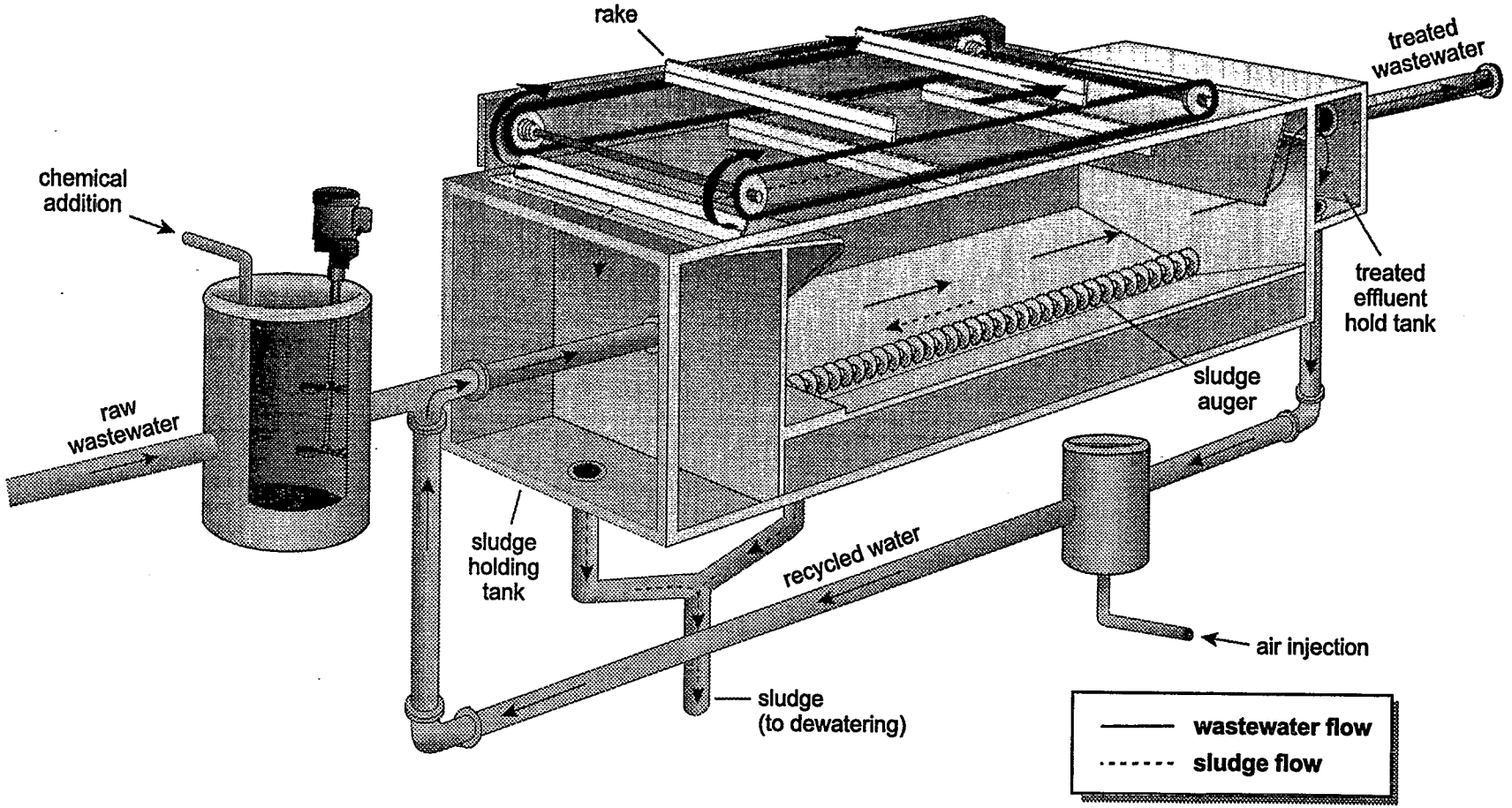

Figure 8-7. Dissolved Air Flotation Unit

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

8.5.8 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;
- 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 (2).

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 (2). 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 (2). Figure 8-8 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 8-9 presents a diagram of a filter press.

Industry Application

Thirty-one percent of the in-scope industrial laundry facilities responding to the detailed questionnaire (59 of 193) reported dewatering their sludge before disposal. The types of dewatering devices reported include:

Plate and frame filters	34 facilities (58%)
Rotary vacuum filters	16 facilities (27%)
Sludge dryers	4 facilities (7%)
Bag filters	2 facilities (5%)
Other	2 facilities (5%)

In the industrial laundries industry, most of the sludge that is dewatered comes from DAF or chemical precipitation units. Nearly half of the dewatering devices (28 of 59 facilities) process sludge from a DAF unit. Fifteen 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 16 percent for the underwatered sludge. Facilities that dewater a sludge reported an average solids content of 62 percent for the dewatered sludge.

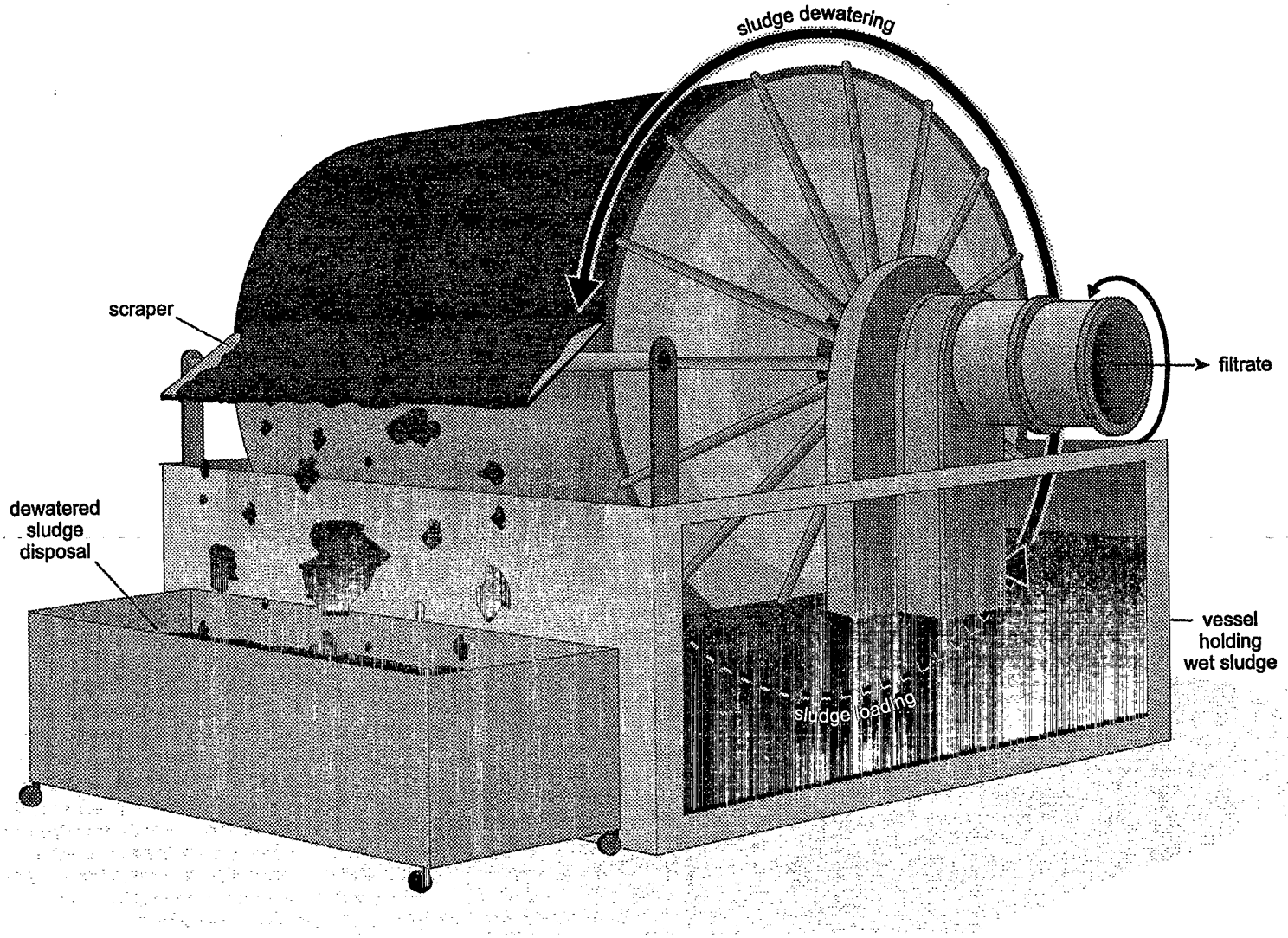

Figure 8-8. Rotary Vacuum Filter

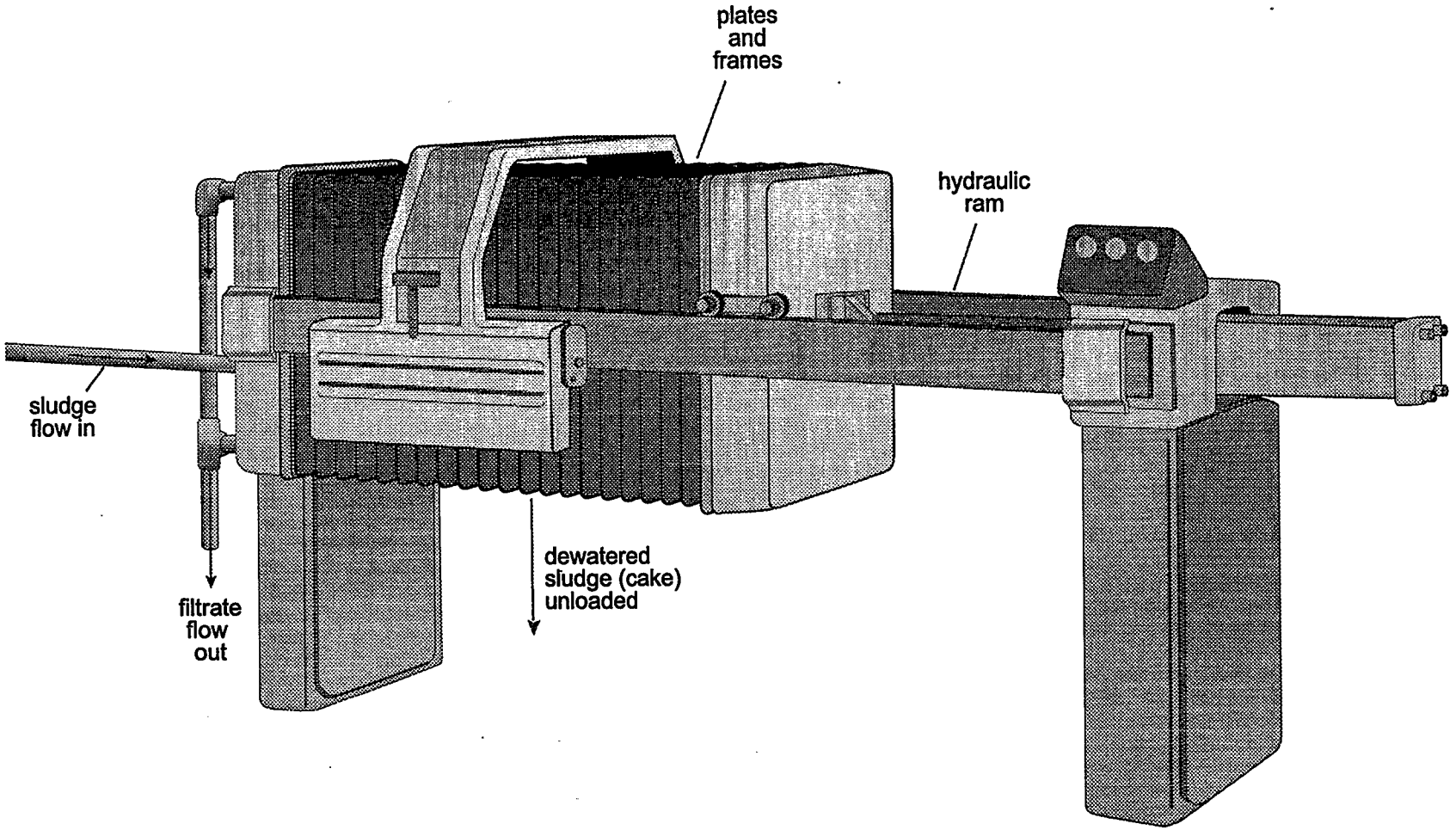

Figure 8-9. Filter Press

Twenty-nine 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	13 (45%)
Polymer	10 (34%)
Diatomaceous earth	5 (17%)
Perlite	5 (17%)
Ferric chloride	4 (14%)

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

8.5.9 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

Twenty-two percent of in-scope facilities responding to the detailed questionnaire (42 of 193) 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 47 pH adjustment units. Acid (usually sulfuric) is added to the pH adjustment unit most frequently (42 of 47). However, sodium hydroxide (4 of 47), and lime (2 of 47) are also added to the pH adjustment units. Sixty-eight percent of the pH adjustment units discussed in the detailed questionnaire (32 of 47) have one or more mixers. The average residence time of all 47 units at the 42 facilities is 2.1 hours.

8.5.10 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 (8). Ultrafiltration and microfiltration have the benefit of removing entrained solids and oils from wastewater with lower capital costs than chemical treatment (10). 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 recently changed out after 4.5 years of operation. 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.

8.5.11 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 (2).

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 by the centrifugal forces.

Industry Application

Two percent of in-scope industrial laundries responding to the detailed questionnaire (4 of 193) reported treating their wastewater with centrifugation. While only three of the four facilities reported removing sludge generated during centrifugation, EPA believes that all facilities treating their wastewater with centrifugation remove the sludge generated.

8.5.12 Volatile Organic Compound (VOC) Removal Technologies

General Description

In-Process Volatile Organic Compound (VOC) Removal

Two in-process VOC removal technologies were investigated for the industrial laundries industry: dry cleaning and steam tumbling. Both dry cleaning and steam tumbling effectively remove 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). These pollutants are recovered from the solvent through distillation and are then disposed. The distilled solvent may be then reused in subsequent dry-cleaning processes. In steam tumbling, soiled items are agitated within a modified washer/ extractor while steam is injected into the chamber. The tumbling items contact the steam, which removes the VOCs. The steam is condensed, and the pollutants are recovered through a phase separation and disposed.

End-Of-Pipe VOC Removal

Two methods of removing VOCs from process wastewater that have been demonstrated in the industrial laundries industry are carbon adsorption and air stripping. 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 8-10 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.

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

In-Process Volatile Organic Compound (VOC) Removal

Two of the 193 in-scope industrial laundries responding to the detailed questionnaire (one percent) reported steam tumbling items before water-washing and five of the 193 facilities (three percent) reported dry cleaning items before water-washing.

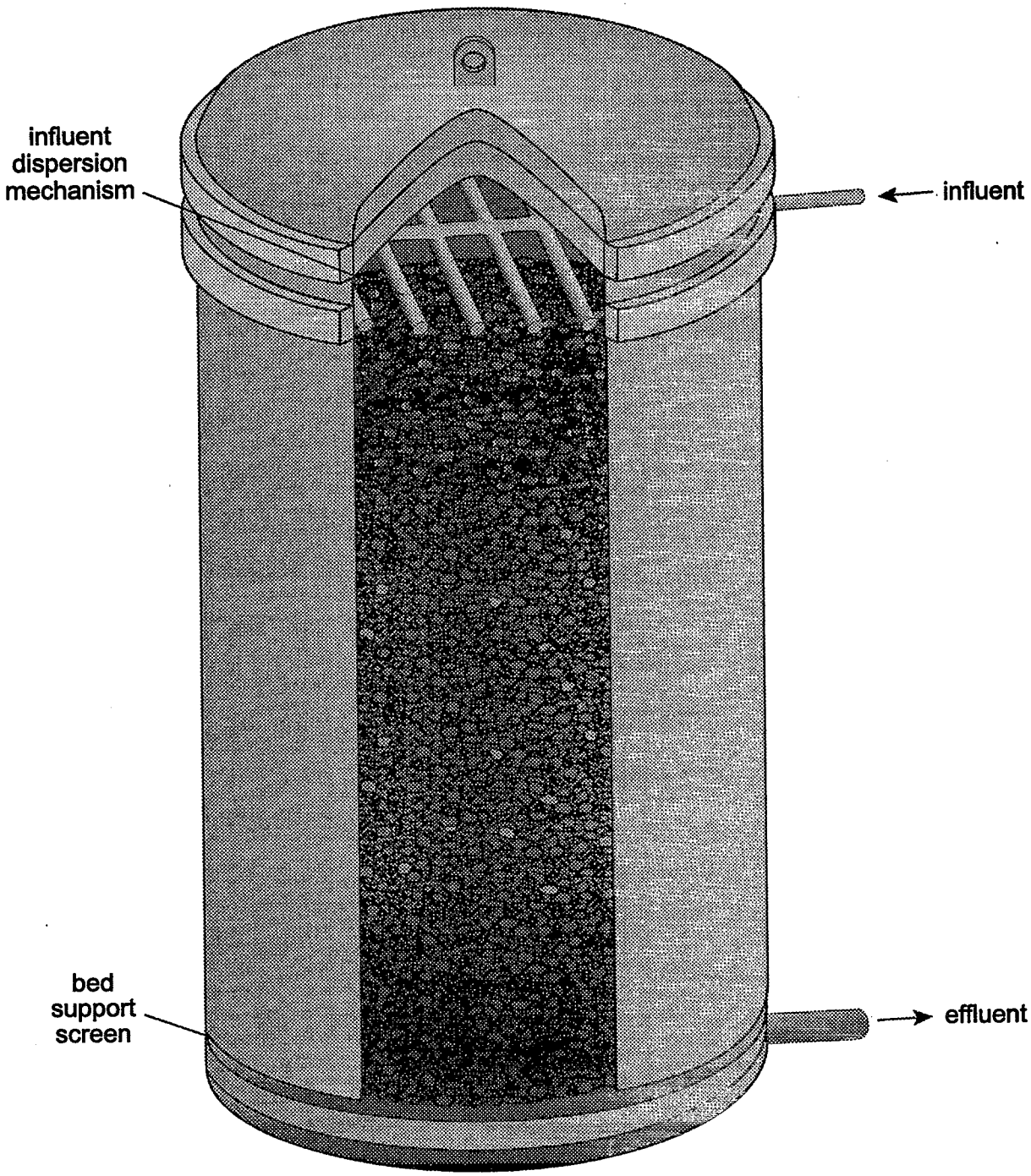

Figure 8-10. Fixed Bed Activated Carbon Adsorption Column

End-Of-Pipe VOC Removal

Three of the 193 in-scope industrial laundries responding to the detailed questionnaire (2 percent) reported operating air strippers to remove VOCs from their process wastewater. However, EPA is aware that one of these facilities does not operate their air stripper. Two of the 193 industrial laundries (one percent) reported operating activated carbon adsorption columns to remove VOCs from their process wastewater.

8.5.13 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 chemical 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 8-3 is similar to the type of skimming device used in oil/water separators.

Industry Application

Fifteen percent of industrial laundries responding to the detailed questionnaire (28 of 193) report treating their wastewater through oil/water separation. These facilities employ various devices to remove the oil that has risen to the surface of the wastewater. These include:

- Oil skimmer (64 percent);
- Oil mop (14 percent);
- Coalescer (11 percent);
- Gravity (7 percent); and
- Decanter (4 percent).

The average residence time of the wastewater in the oil/water separation units is 9.5 hours.

8.5.14 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 that the 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 193 in-scope industrial laundries responding to the detailed questionnaire (19 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). Five media filtration units used sand alone (42 percent); two media filtration units operated with sand, anthracite, and garnet as the filter media (17 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 3 times per day.

8.6 Pollution Disposal Practices in the Industrial Laundries Industry

As established in the environmental management hierarchy, pollution disposal or release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner. All 193 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 193) also reported discharging a portion of their wastewater to land application.

Thirteen percent of these industrial laundries (25 of 193) reported having a portion of their process wastewater contract-hauled off-site for disposal. Facilities contract-hauling a portion of their wastewater off-site store the wastewater to be contract-hauled in above ground storage tanks so that the water can be hauled off-site in bulk. Wastewater is typically hauled off-site in 5,000 gallon increments, which is the capacity of most vacuum tankers used to haul the wastewater. The frequency of bulk wastewater pickups depends on the amount of time required to generate 5,000 gallons of wastewater. The wastewater, handled as non-hazardous waste, may be hauled off-site for treatment to a Treatment Storage Disposal Facility (TSDF) or to a Centralized Waste Treater (CWT) (11). Facilities having only a portion of their wastewater hauled off-site also have stream splitting capability as discussed in Section 8.5.2 of this document.

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CHAPTER 9

TREATMENT PERFORMANCE DATA USED FOR THE DEVELOPMENT OF LONG-TERM AVERAGES, VARIABILITY FACTORS, AND STANDARDS

9.1 Introduction

This chapter discusses the treatment performance data collected by and available to EPA for use in calculating long-term average concentrations for the pollutants of concern and long-term averages, variability factors, and standards for the constituents and pollutant parameters proposed for regulation. The pollutants of concern and the pollutants proposed for regulation are presented in Chapter 7. The following information is presented in this chapter:

- Section 9.2 describes and classifies the sources of the treatment performance data used by EPA in the calculation of the long-term averages, variability factors, and standards into six treatment technology groups;
- Section 9.3 describes the data-editing procedures used to identify data points considered appropriate for calculating long-term averages, variability factors, and standards for the five postlaundering treatment technology groups;
- Section 9.4 presents the long-term averages for the five postlaundering treatment technology groups for the pollutants of concern;
- Section 9.5 presents the long-term average concentrations, variability factors, and concentration-based standards calculated for the five postlaundering treatment technology groups for the pollutants proposed for regulation;
- Section 9.6 presents the methodology used to calculate target effluent concentrations for steam tumbling, the prelaundering treatment technology group;
- Section 9.7 presents EPA's analysis on the development of mass-based standards; and
- Section 9.8 presents the references used.

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

EPA used two sources of treatment performance data to calculate the long-term average concentrations, variability factors, and standards for industrial laundries wastewater treatment systems: EPA industrial laundry sampling data and Detailed Monitoring Questionnaire (DMQ) data. Chapter 3 describes these sources. EPA first considered sampling data from industrial laundries with well-designed and well-operated treatment systems representing the various treatment technologies to calculate long-term average concentrations, variability factors, and standards. Chapter 8 describes the treatment technologies used as the basis for the proposed standards. EPA also used DMQ data from facilities using treatment technologies equivalent to the treatment technologies sampled by EPA. Sections 9.2.1 and 9.2.2, respectively, discuss the EPA industrial laundry sampling data and the DMQ data used for standards development.

9.2.1 Industrial Laundry Sampling Program Data

EPA considered industrial laundry wastewater data from the following Agency sampling programs for use in calculating long-term average concentrations, variability factors, and standards: the 1985-1987 Industrial Technology Division (ITD)/Resource Conservation and Recovery Act (RCRA) Sampling Program and the 1993-1996 sampling program. No data from the 1985-1987 ITD/RCRA Sampling Program were used to calculate long-term averages, variability factors, and standards. However, data from the 1993-1996 sampling program were used in these calculations. The identification of sampling data representative of well-designed and well-operated treatment systems from these sampling programs is presented below.

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 data from facilities with well-designed and well-operated treatment systems representative of wastewater treatment technologies used as the basis for the proposed standards. EPA determined that none of the ITD/RCRA Sampling Program data could be used to calculate long-term average concentrations, variability factors, or 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 was not representative of the wastewater from the facility. A third facility used ultrafiltration as its main treatment technology. EPA does not consider ultrafiltration to be an effective treatment 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 have tried using ultrafiltration but have subsequently replaced the ultrafilter 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 for standards development.

1993-1996 EPA Sampling Program

EPA collected wastewater samples from eight industrial laundries between 1993 and 1996 as part of the data-gathering effort for development of the proposed industrial laundries rule. Facilities were selected based on site visits and responses to the 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 data for all of the pollutants of concern. The eight sampled industrial laundries used one of the following major wastewater treatment technologies as part of their overall treatment system (one sampled facility used two major wastewater treatment technologies, chemical precipitation and organics control):

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

In addition to classifying the eight sampled facilities into groups depending on the treatment technology used by the facility, EPA also classified the eight facilities into groups depending on the type of wastewater treated by the treatment technology. Some of the sampled facilities treated all of their process wastewater while others treated only the 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).

One facility sampled by EPA steam-tumbled its shop and printer towels/rags prior to water washing. The quantity and type of data available for steam tumbling were different from the data available for the other treatment technologies. EPA developed target effluent concentrations for this prelaundering treatment technology group instead of long-term averages, variability factors, and standards. Section 9.6 of this document presents the methodology used to calculate the target effluent concentrations for steam tumbling.

The data obtained by EPA during sampling episodes at industrial laundries using ultrafiltration and vacuum degassing do not demonstrate effective treatment of industrial laundry wastewater. EPA's ultrafiltration data represent one day of treatment of wastewater from laundering of only printer towels. In addition, as discussed earlier in this section,

ultrafilters are easily clogged from oil and grease in industrial laundry wastewater. Vacuum degassing, which was sampled at one facility, is used to remove volatile organics from wastewater. The sampling data for vacuum degassing did not demonstrate effective removal of volatile organics. Because ultrafiltration and vacuum degassing were not found to be effective in treating industrial laundry wastewater, EPA did not calculate long-term average concentrations, variability factors, or standards for these treatment technologies.

The remaining sampling data represented the following five treatment groups based on 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 six facilities representing these five postlaundering treatment technology groups were used to calculate long-term average concentrations, variability factors, and standards. The number of sampled facilities representing each postlaundering treatment technology group is presented in the following table.

Number of Sampled Facilities Representing Each Treatment Technology Group				
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	1

9.2.2 Detailed Monitoring Questionnaire (DMQ) Data

In 1995, EPA developed and mailed the DMQ to 37 facilities throughout the United States (as described in Chapter 3). In response to this questionnaire, the 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 wastewater treatment technology groups sampled by EPA.

The wastewater treatment technology groups sampled by EPA include treatment through chemical emulsion breaking, DAF, and chemical precipitation. EPA used the following design and operating criteria to determine whether the DMQ data were representative of one of these three major wastewater treatment technologies sampled:

- 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, an air injection mechanism is in place, and a removal system for float sludge is in place.
- Chemical Precipitation--flocculation and coagulation chemicals are added and a settling mechanism is in place.

EPA determined that 17 of the 37 DMQ facilities did not provide data representative of these treatment technologies sampled by EPA. Facility diagrams for the remaining 20 facilities, which were using one of these three treatment technologies, were then examined to determine if the sampling points for which data were reported represent final effluent from the treatment technology. EPA determined that 9 of the 20 facilities did not meet this criterion. (EPA did not receive paired data for any of the 20 DMQ facilities using one of these three wastewater treatment technologies sampled by EPA. Therefore, the criterion requiring data to be representative of the influent to one of these three treatment technologies could not be used.) The remaining eleven 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). These data were used in conjunction with EPA's sampling data to calculate long-term average concentrations, variability factors, and standards.

9.3 Evaluation of Treatment Performance Data

After identifying available treatment performance data, EPA identified specific data points that were not considered representative of well-designed, well-operated treatment systems. These data points were not used to calculate long-term averages, variability factors, and standards for each of the five wastewater treatment technology groups incorporating chemical emulsion breaking, DAF, or chemical precipitation as the primary treatment unit. The following criteria were used to identify these data points:

- Assessment of performance of the treatment system at the sampled facilities and DMQ 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 9.3.1 through 9.3.4 of this document.

9.3.1 Assessment of Treatment System Performance and Identification of Process Upsets

The available data were reviewed to determine if the treatment systems for which effluent data were available were well operated during the time when samples were collected. The criteria used to determine good system operation are dependent on the treatment technology being evaluated; the following parameters are indicative 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 removal of oil and grease; and
- Chemical Precipitation: removal of TSS and removal of 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 the sampling episode. DMQ data could not be evaluated using this criterion because no facilities representing one of the three major wastewater treatment technologies sampled provided paired influent and effluent data. Data that did not meet the evaluation criterion were flagged as unusable.

9.3.2 Identification of Pollutants Not Treated by the Treatment Technology

The data for each EPA sampling episode were reviewed 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. DMQ data could not be evaluated using this criterion because no paired influent and effluent data were provided.

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

The data for each EPA sampling episode were reviewed to determine if a pollutant of concern 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 ten 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 standards. DMQ data could not be evaluated using this criterion because no paired influent and effluent data were provided.

9.3.4 Identification of Treatment Performance Data With Inconsistent Detection Limits

The data for each pollutant at each sampling episode were reviewed 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. These data were not used in calculating long-term averages, variability factors, and standards, although other data were available to use in calculating values for these pollutants.

9.3.5 Identification of Data Considered a Lower Limit of the Actual Value

The sampling data were reviewed 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, variability factors, and standards.

9.4 Long-Term Average Concentrations for the Pollutants of Concern

The data meeting the review requirements presented in Section 9.3 of this document were used to calculate long-term average concentrations for the 72 pollutants of concern for each of the five postlaundering treatment technology groups. 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 non-detects. The methodology used to calculate long-term averages, variability factors, and standards is presented in the Statistical Support Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category (1). 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 both sampling and DMQ data met the data review criteria for a specific pollutant for a treatment technology group, EPA used data from both sampled and DMQ facilities to calculate long-term average concentrations. When only EPA sampling data met the data review criteria, EPA only used data from EPA sampled facilities to calculate long-term average concentrations. When only DMQ 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 9-1 presents the long-term average concentrations for each pollutant of concern for each of the five postlaundering treatment technology groups. The treatment technology groups listed in Table 9-1 are defined as follows:

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

9.5 Long-Term Average Concentrations, Variability Factors, and Standards for the Pollutants Proposed for Regulation

For the 11 pollutants proposed for regulation, EPA calculated long-term averages, variability factors, and standards for the five postlaundering treatment technology groups. As presented in Section 9.4 of this document, long-term averages were calculated using equations derived from an adapted delta-lognormal model that accounts for effluent samples with a pollutant concentration at the detection limit. Variability factors were also calculated using equations from the adapted delta-lognormal model. Standards were calculated as the product of the long-term average and the variability factor. Section 9.4

Table 9-1

Overall Long-Term Average (LTA) Concentrations for the Five Postlaundering Treatment Technology Groups for the Pollutants of Concern

Pollutant of Concern	Median LTA (mg/L)				
	CEB-Heavy[1]	DAF-Heavy[2]	CP-Heavy[3]	DAF-All[4]	CP-All[5]
Conventionals					
Biochemical Oxygen Demand 5-Day (BOD_5)	1040	1310	1390	497	499
Oil and Grease (measured as HEM)	268	230	38.2	37.8	28.5
Total Suspended Solids (TSS)	259	487	56.3	85.5	119
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	0.852	0.0469	0.144	0.109
Butyl Benzyl Phthalate	---	0.182	0.0100	---	0.0342
Chlorobenzene	---	---	---	0.0280	---
Chloroform	---	---	---	0.185	---
Di-*n*-butyl Phthalate	0.0100	0.647	0.0100	0.125	---
Di-*n*-octyl Phthalate	0.0307	---	---	0.236	0.0342
Ethylbenzene	0.305	1.56	0.0931	0.189	0.269
Isophorone	---	---	---	---	0.297
Methylene Chloride	---	---	---	0.546	---
Naphthalene	0.104	---	0.114	0.0764	0.0583
Phenol	---	---	---	0.211	---
Tetrachloroethene	0.286	---	0.127	0.250	0.259
Toluene	0.543	2.50	0.818	0.711	1.05
trans-1,2-Dichloroethene	---	---	---	---	---
Trichloroethene	---	---	0.0529	---	---
Nonconventional Organics					
2-Butanone	---	4.68	---	17.4	3.23
2-Methylnaphthalene	0.0458	0.129	0.0100	0.116	0.0125
2-Propanone	1.21	7.42	---	13.6	---

Table 9-1 (Continued)

Pollutant of Concern	Median LTA (mg/L)				
	CEB-Heavy[1]	DAF-Heavy[2]	CP-Heavy[3]	DAF-All[4]	CP-All[5]
Nonconventional Organics (Continued)					
4-Methyl-2-pentanone	0.0722	9.55	---	0.595	3.13
∝-Terpineol	0.0100	0.471	---	0.472	---
Benzoic Acid	---	---	---	1.58	---
Benzyl Alcohol	---	---	---	---	---
Hexanoic Acid	0.128	---	---	---	---
m-Xylene	0.366	---	0.104	0.595	0.347
n-Decane	0.279	---	0.0240	0.469	0.104
n-Docosane	0.0347	0.110	0.0120	0.0232	0.0110
n-Dodecane	0.574	---	0.0100	0.195	2.83
n-Eicosane	0.0779	0.373	0.0382	0.0477	0.0167
n-Hexacosane	0.0100	---	0.0122	0.0195	0.0144
n-Hexadecane	0.0417	1.05	0.0315	0.0842	0.0682
n-Octacosane	0.0100	---	0.0100	---	0.0168
n-Octadecane	0.0560	0.422	0.0100	0.0694	0.0309
n-Tetracosane	---	0.125	0.0329	0.0219	0.0107
n-Tetradecane	0.116	0.979	0.612	0.0754	0.0601
n-Triacontane	---	---	0.0341	0.0100	0.0138
o-&*p*-Xylene	0.359	---	0.0940	0.271	0.231
p-Cresol	---	---	---	---	---
p-Cymene	---	0.531	0.0208	0.0700	---
Pentamethylbenzene	---	---	0.0100	---	---
Priority Metals and Elements					
Antimony	0.195	---	---	0.0800	---
Arsenic	---	---	---	---	---
Beryllium	---	---	---	---	---
Cadmium	0.132	---	0.00500	0.0161	0.00691
Chromium	0.153	0.0715	0.0147	0.0695	0.0426
Copper	0.437	1.45	0.534	0.478	0.139
Lead	0.914	0.361	0.0473	0.175	0.100
Mercury	---	---	---	---	---
Nickel	0.255	---	---	0.0544	---

Table 9-1 (Continued)

Pollutant of Concern	Median LTA (mg/L)				
	CEB-Heavy[1]	DAF-Heavy[2]	CP-Heavy[3]	DAF-All[4]	CP-All[5]
Priority Metals and Elements (Continued)					
Selenium	---	---	---	0.0524	---
Silver	---	0.0846	---	---	---
Thallium	---	---	---	---	---
Zinc	6.78	0.903	0.0637	0.837	0.200
Nonconventional Metals and Elements					
Aluminum	6.33	1.34	0.0804	1.31	0.468
Barium	---	0.702	0.145	---	---
Boron	1.64	---	11.4	---	---
Cobalt	---	---	---	---	---
Iron	47.3	19.0	0.366	2.79	4.12
Manganese	0.596	0.884	0.00768	0.0340	0.00877
Molybdenum	0.205	---	0.774	0.119	0.457
Tin	---	---	---	0.0972	---
Titanium	0.0818	0.0927	0.00453	0.0192	0.0179
Vanadium	---	---	---	---	---
Yttrium	---	---	---	---	---
Bulk Nonconventionals					
Chemical Oxygen Demand (COD)	2460	3320	2510	998	1080
Total Organic Carbon (TOC)	626	1610	910	326	342
Total Petroleum Hydrocarbon (measured as SGT-HEM)	200	42.1	7.20	13.7	10.8

[1]CEB-Heavy represents data from facilities using chemical emulsion breaking treatment of heavy wastewater.
[2]DAF-Heavy represents data from facilities using DAF treatment of heavy wastewater.
[3]CP-Heavy represents data from facilities using chemical precipitation treatment of heavy wastewater.
[4]DAF-All represents data from facilities using DAF treatment of all facility process wastewater.
[5]CP-All represents data from facilities using chemical precipitation treatment of all facility process wastewater.
HEM-Hexane Extractable Material.
SGT-HEM - Silica Gel Treated-Hexane Extractable Material.

discusses which data were used to calculate the long-term averages and subsequently the variability factors and standards.

The following tables present the overall and episode long-term averages, variability factors, and standards for the five postlaundering treatment technology groups for the 11 pollutants proposed for regulation:

- Table 9-2 presents the long-term averages and variability factors for chemical emulsion breaking treatment of heavy wastewater for each pollutant proposed for regulation by episode;
- Table 9-3 presents the median of the episode long-term averages, variability factors, and standards for chemical emulsion breaking treatment of heavy wastewater for each pollutant proposed for regulation;
- Table 9-4 presents the long-term averages and variability factors for DAF treatment of heavy wastewater for each pollutant proposed for regulation by episode;
- Table 9-5 presents the median of the episode long-term averages, variability factors, and standards for DAF treatment of heavy wastewater for each pollutant proposed for regulation;
- Table 9-6 presents the long-term averages and variability factors for chemical precipitation treatment of heavy wastewater for each pollutant proposed for regulation by episode;
- Table 9-7 presents the median of the episode long-term averages, variability factors, and standards for chemical precipitation treatment of heavy wastewater for each pollutant proposed for regulation;
- Table 9-8 presents the long-term averages and variability factors for DAF treatment of all facility process wastewater for each pollutant proposed for regulation by episode;
- Table 9-9 presents the median of the episode long-term averages, variability factors, and standards for DAF treatment of all facility process wastewater for each pollutant proposed for regulation;
- Table 9-10 presents the long-term averages and variability factors for chemical precipitation treatment of all facility process wastewater for each pollutant proposed for regulation by episode; and
- Table 9-11 presents the median of the episode long-term averages, variability factors, and standards for chemical precipitation treatment of all facility process wastewater for each pollutant proposed for regulation.

Table 9-2

Episode Long-Term Average (LTA) Concentrations and Variability Factors (VF) for Chemical Emulsion Breaking Treatment of Heavy Wastewater for the Pollutants Proposed for Regulation

Regulated Pollutant	Site Number[1]	LTA (mg/L)	1-Day VF[2] (mg/L)	4-Day VF[3] (mg/L)
Priority Organics				
Bis(2-ethylhexyl) Phthalate	S1	0.462	3.67	NA
Ethylbenzene	S1	0.305	4.74	NA
Naphthalene	S1	0.104	1.82	NA
Tetrachloroethene	S1	0.286	2.91	NA
Toluene	S1	0.543	1.79	NA
Nonconventional Organics				
m-Xylene	S1	0.366	1.61	NA
o-&*p*-Xylene	S1	0.359	1.72	NA
Priority Metals and Elements				
Copper	S1	0.437	1.76	NA
Lead	S1	0.914	1.32	NA
Zinc	S1	6.78	1.33	NA
Bulk Nonconventionals				
Total Petroleum Hydrocarbon (measured as SGT-HEM)	S1	200	3.51	1.64

[1]Facilities with a site number beginning with "S" were sampled by EPA. Facilities with a site number beginning with "Q" provided data in their detailed monitoring questionnaire.
[2]The 1-day VF is defined as the daily variability of pollutant concentrations. EPA used the 1-day VF to calculate daily maximum standards for all pollutants proposed for regulation.
[3]The 4-day variability factor is defined as the monthly variability of pollutant concentrations based on 4 days of sampling per month. EPA used the 4-day VF to calculate a monthly average standard for total petroleum hydrocarbon.
NA - Not analyzed. EPA did not use the 4-day VF to calculate standards for these pollutants.
SGT-HEM - Silica Gel Treated-Hexane Extractable Material.

Table 9-3

Summary of Long-Term Averages (LTA), Variability Factors (VF), and Standards for Chemical Emulsion Breaking Treatment of Heavy Wastewater

Pollutant	# of Sites	Median LTA (mg/L)	1-Day VF[1] (mg/L)	Daily Maximum Standard (mg/L)	4-Day VF[2] (mg/L)	4-Day Monthly Average Standard (mg/L)
Priority Organics						
Bis(2-ethylhexyl) Phthalate	1	0.462	3.67	1.70	NA	NA
Ethylbenzene	1	0.305	4.74	1.45	NA	NA
Naphthalene	1	0.104	1.82	0.190	NA	NA
Tetrachloroethene	1	0.286	2.91	0.833	NA	NA
Toluene	1	0.543	1.79	0.973	NA	NA
Nonconventional Organics						
m-Xylene	1	0.366	1.61	0.590	NA	NA
o-&p-Xylene	1	0.359	1.72	0.619	NA	NA
Priority Metals and Elements						
Copper	1	0.437	1.76	0.772	NA	NA
Lead	1	0.914	1.32	1.20	NA	NA
Zinc	1	6.78	1.33	9.04	NA	NA
Bulk Nonconventionals						
Total Petroleum Hydrocarbon (measured as SGT-HEM)	1	200	3.51	703	1.64	328

[1]The 1-day VF is defined as the daily variability of pollutant concentrations. EPA used the 1-day VF to calculate daily maximum standards for all pollutants proposed for regulation.
[2]The 4-day variability factor is defined as the monthly variability of pollutant concentrations based on 4 days of sampling per month. EPA used the 4-day VF to calculate a monthly average standard for total petroleum hydrocarbon.
NA - Not analyzed. EPA did not use the 4-day VF to calculate standards for these pollutants.
SGT-HEM - Silica Gel Treated-Hexane Extractable Material.

Table 9-4

Episode Long-Term Average (LTA) Concentrations and Variability Factors (VF) for DAF Treatment of Heavy Wastewater for Pollutants Proposed for Regulation[1]

Pollutant	Site Number[2]	LTA (mg/L)	1-Day VF[3] (mg/L)	4-Day VF[4] (mg/L)
Priority Organics				
Bis(2-ethylhexyl) Phthalate	S2	0.852	NC	NA
Ethylbenzene	S2	1.56	2.86	NA
Toluene	S2	2.50	1.96	NA
Priority Metals and Elements				
Copper	S2	1.45	1.90	NA
Lead	S2	0.361	6.18	NA
Zinc	S2	0.903	2.68	NA
Bulk Nonconventionals				
Total Petroleum Hydrocarbon (measured as SGT-HEM)	S2	42.1	2.31	1.37

[1]Insufficient data were available to calculate long-term average pollutant concentrations for all of the pollutants proposed for regulation at each site. This table only includes pollutants proposed for regulation at sites for which a long-term average could be calculated.
[2]Facilities with a site number beginning with "S" were sampled by EPA. Facilities with a site number beginning with "Q" provided data in their detailed monitoring questionnaire.
[3]The 1-day VF is defined as the daily variability of pollutant concentrations. EPA used the 1-day VF to calculate daily maximum standards for all pollutants proposed for regulation.
[4]The 4-day variability factor is defined as the monthly variability of pollutant concentrations based on 4 days of sampling per month. EPA used the 4-day VF to calculate a monthly average standard for total petroleum hydrocarbon.
NA - Not analyzed. EPA did not use the 4-day VF to calculate standards for these pollutants.
NC - Not calculated. Insufficient data were available to calculate this variability factor. Four values, at least two of which must be detected, are necessary to calculate a variability factor.
SGT-HEM - Silica Gel Treated-Hexane Extractable Material.

Table 9-5

Summary of Long-Term Averages (LTA), Variability Factors (VF), and Standards for DAF Treatment of Heavy Wastewater[1]

Pollutant	# of Sites	Median LTA (mg/L)	1-Day VF[2] (mg/L)	Daily Maximum Standard (mg/L)	4-Day VF[3] (mg/L)	4-Day Monthly Average Standard (mg/L)
Priority Organics						
Bis(2-ethylhexyl) Phthalate	1	0.852	NC	NC	NA	NA
Ethylbenzene	1	1.56	2.86	4.47	NA	NA
Toluene	1	2.50	1.96	4.90	NA	NA
Priority Metals and Elements						
Copper	1	1.45	1.90	2.76	NA	NA
Lead	1	0.361	6.18	2.23	NA	NA
Zinc	1	0.903	2.68	2.42	NA	NA
Bulk Nonconventionals						
Total Petroleum Hydrocarbon (measured as SGT-HEM)	1	42.1	2.31	97.4	1.37	57.6

[1]This table does not include all pollutants proposed for regulation. For the pollutants proposed for regulation but not included in this table, no sites made available sufficient data to calculate a long-term average pollutant concentrations.
[2]The 1-day VF is defined as the daily variability of pollutant concentrations. EPA used the 1-day VF to calculate daily maximum standards for all pollutants proposed for regulation.
[3]The 4-day variability factor is defined as the monthly variability of pollutant concentrations based on 4 days of sampling per month. EPA used the 4-day VF to calculate a monthly average standard for total petroleum hydrocarbon.
NA - Not analyzed. EPA did not use the 4-day VF to calculate standards for these pollutants.
NC - Not calculated. Insufficient data were available to calculate this variability factor. Four values, at least two of which must be detected, are necessary to calculate a variability factor.
SGT-HEM - Silica Gel Treated-Hexane Extractable Material.

Table 9-6

Episode Long-Term Average (LTA) Concentrations and Variability Factors (VF) for Chemical Precipitation Treatment of Heavy Wastewater for the Pollutants Proposed for Regulation

Pollutant	Site Number[1]	LTA (mg/L)	1-Day VF[2] (mg/L)	4-Day VF[3] (mg/L)
Priority Organics				
Bis(2-ethylhexyl) Phthalate	S3	0.0469	NC	NA
Ethylbenzene	S3	0.0931	4.37	NA
Naphthalene	S3	0.114	3.14	NA
Tetrachloroethene	S3	0.127	4.48	NA
Toluene	S3	0.818	6.79	NA
Nonconventional Organics				
m-Xylene	S3	0.104	2.66	NA
o-&*p*-Xylene	S3	0.0940	3.63	NA
Priority Metals and Elements				
Copper	S3	0.534	4.06	NA
Lead	S3	0.0473	NC	NA
Zinc	S3	0.0637	6.19	NA
Bulk Nonconventionals				
Total Petroleum Hydrocarbon (measured as SGT-HEM)	S3	7.20	NC	NC

[1]Facilities with a site number beginning with "S" were sampled by EPA. Facilities with a site number beginning with "Q" provided data in their detailed monitoring questionnaire.
[2]The 1-day VF is defined as the daily variability of pollutant concentrations. EPA used the 1-day VF to calculate daily maximum standards for all pollutants proposed for regulation.
[3]The 4-day variability factor is defined as the monthly variability of pollutant concentrations based on 4 days of sampling per month. EPA used the 4-day VF to calculate a monthly average standard for total petroleum hydrocarbon.
NA - Not analyzed. EPA did not use the 4-day VF to calculate standards for these pollutants.
NC - Not calculated. Insufficient data were available to calculate this variability factor. Four values, at least two of which must be detected, are necessary to calculate a variability factor.
SGT-HEM - Silica Gel Treated-Hexane Extractable Material.

Table 9-7

Summary of Long-Term Averages (LTA), Variability Factors (VF), and Standards for Chemical Precipitation Treatment of Heavy Wastewater

Pollutant	# of Sites	Median LTA (mg/L)	1-Day VF[1] (mg/L)	Daily Maximum Standard (mg/L)	4-Day VF[2] (mg/L)	4-Day Monthly Average Standard (mg/L)
Priority Organics						
Bis(2-ethylhexyl) Phthalate	1	0.0469	NC	NC	NA	NA
Ethylbenzene	1	0.0931	4.37	0.407	NA	NA
Naphthalene	1	0.114	3.14	0.357	NA	NA
Tetrachloroethene	1	0.127	4.48	0.567	NA	NA
Toluene	1	0.818	6.79	5.55	NA	NA
Nonconventional Organics						
m-Xylene	1	0.104	2.66	0.276	NA	NA
o-&*p*-Xylene	1	0.0940	3.63	0.342	NA	NA
Priority Metals and Elements						
Copper	1	0.534	4.06	2.17	NA	NA
Lead	1	0.0473	NC	NC	NA	NA
Zinc	1	0.0637	6.19	0.395	NA	NA
Bulk Nonconventionals						
Total Petroleum Hydrocarbon (measured as SGT-HEM)	1	7.20	NC	NC	NC	NC

[1]The 1-day VF is defined as the daily variability of pollutant concentrations. EPA used the 1-day VF to calculate daily maximum standards for all pollutants proposed for regulation.
[2]The 4-day variability factor is defined as the monthly variability of pollutant concentrations based on 4 days of sampling per month. EPA used the 4-day VF to calculate a monthly average standard for total petroleum hydrocarbon.
NA - Not analyzed. EPA did not use the 4-day VF to calculate standards for these pollutants.
NC - Not calculated. Insufficient data were available to calculate this variability factor. Four values, at least two of which must be detected, are necessary to calculate a variability factor.
SGT-HEM - Silica Gel Treated-Hexane Extractable Material.

Table 9-8

Episode Long-Term Average (LTA) Concentrations and Variability Factors (VF) for DAF Treatment of All Facility Process Wastewater for the Pollutants Proposed for Regulation[1]

Pollutant	Site Number[2]	LTA (mg/L)	1-Day VF[3] (mg/L)	4-Day VF[4] (mg/L)
Priority Organics				
Bis(2-ethylhexyl) Phthalate	Q1	0.421	3.43	NA
	S4	0.0334	2.73	NA
	S5	0.144	3.06	NA
Ethylbenzene	Q2	0.00438	3.54	NA
	S5	0.374	4.16	NA
Naphthalene	Q2	0.00304	NC	NA
	S4	0.0764	4.73	NA
	S5	0.180	1.57	NA
Tetrachloroethene	Q2	0.0239	4.97	NA
	Q1	25.1	15.4	NA
	S4	0.0656	3.08	NA
	S5	0.434	5.87	NA
Toluene	Q2	0.0473	13.5	NA
	S4	0.711	7.93	NA
	S5	4.20	2.80	NA
Nonconventional Organics				
m-Xylene	S5	0.595	3.55	NA
o-&*p*-Xylene	S4	0.117	3.15	NA
	S5	0.424	4.07	NA
Priority Metals and Elements				
Copper	Q4	0.387	3.15	NA
	Q3	0.569	6.95	NA
	Q2	0.593	4.52	NA
	Q1	0.668	6.40	NA
	S5	0.173	1.59	NA
	S4	0.360	3.07	NA
Lead	Q4	0.100	NC	NA
	Q1	0.215	5.05	NA
	Q2	0.233	2.99	NA
	Q3	0.320	1.55	NA
	S5	0.0553	1.39	NA
	S4	0.135	3.72	NA

Table 9-8 (Continued)

Pollutant	Site Number[2]	LTA (mg/L)	1-Day VF[3] (mg/L)	4-Day VF[4] (mg/L)
Priority Metals and Elements (Continued)				
Zinc	Q4	0.778	2.96	NA
	Q1	0.897	7.34	NA
	Q3	0.911	6.27	NA
	Q2	1.22	5.11	NA
	S5	0.268	1.58	NA
	S4	0.513	3.17	NA
Bulk Nonconventionals				
Total Petroleum Hydrocarbon (measured as SGT-HEM)	S4	11.4	3.64	1.68
	S5	16.0	2.62	1.44

[1]Insufficient data were available to calculate long-term average pollutant concentrations for all of the pollutants proposed for regulation at each site. This table only includes pollutants proposed for regulation at sites for which a long-term average could be calculated.
[2]Facilities with a site number beginning with "S" were sampled by EPA. Facilities with a site number beginning with "Q" provided data in their detailed monitoring questionnaire.
[3]The 1-day VF is defined as the daily variability of pollutant concentrations. EPA used the 1-day VF to calculate daily maximum standards for all pollutants proposed for regulation.
[4]The 4-day variability factor is defined as the monthly variability of pollutant concentrations based on 4 days of sampling per month. EPA used the 4-day VF to calculate a monthly average standard for total petroleum hydrocarbon.
NA - Not analyzed. EPA did not use the 4-day VF to calculate standards for these pollutants.
NC - Not calculated. Insufficient data were available to calculate this variability factor. Four values, at least two of which must be detected, are necessary to calculate a variability factor.
SGT-HEM - Silica Gel Treated-Hexane Extractable Material.

Table 9-9

Summary of Long-Term Averages (LTV), Variability Factors (VF), and Standards for DAF Treatment of All Facility Process Wastewater

Pollutant	# of Sites	Median LTA (mg/L)	1-Day VF[1] (mg/L)	Daily Maximum Standard (mg/L)	4-Day VF[2] (mg/L)	4-Day Monthly Average Standard (mg/L)
Priority Organics						
Bis(2-ethylhexyl) Phthalate	3	0.144	3.06	0.443	NA	NA
Ethylbenzene	2	0.189	3.85	0.727	NA	NA
Naphthalene	3	0.0764	3.15	0.241	NA	NA
Tetrachloroethene	4	0.250	5.42	1.35	NA	NA
Toluene	3	0.711	7.93	5.63	NA	NA
Nonconventional Organics						
m-Xylene	1	0.595	3.55	2.11	NA	NA
o-&p-Xylene	2	0.271	3.61	0.976	NA	NA
Priority Metals and Elements						
Copper	6	0.478	3.83	1.83	NA	NA
Lead	6	0.175	2.99	0.524	NA	NA
Zinc	6	0.837	4.14	3.47	NA	NA
Bulk Nonconventionals						
Total Petroleum Hydrocarbon (measured as SGT-HEM)	2	13.7	3.13	42.9	1.56	21.3

[1]The 1-day VF is defined as the daily variability of pollutant concentrations. EPA used the 1-day VF to calculate daily maximum standards for all pollutants proposed for regulation.
[2]The 4-day variability factor is defined as the monthly variability of pollutant concentrations based on 4 days of sampling per month. EPA used the 4-day VF to calculate a monthly average standard for total petroleum hydrocarbon.
NA - Not analyzed. EPA did not use the 4-day VF to calculate standards for these pollutants.
SGT-HEM - Silica Gel Treated-Hexane Extractable Material.

Table 9-10

Episode Long-Term Average (LTA) Concentrations and Variability Factors (VF) for Chemical Precipitation Treatment of All Facility Process Wastewater for the Pollutants Proposed for Regulation[1]

Pollutant	Site Number[2]	LTA (mg/L)	1-Day VF[3] (mg/L)	4-Day VF[4] (mg/L)
Priority Organics				
Bis(2-ethylhexyl) Phthalate	Q7	0.148	NC	NA
	S6	0.0691	1.21	NA
Ethylbenzene	Q7	0.0360	NC	NA
	Q9	0.343	9.68	NA
	S6	0.269	2.47	NA
Naphthalene	Q6	0.0582	NC	NA
	Q7	0.0583	NC	NA
	S6	0.0768	3.90	NA
Tetrachloroethene	Q9	0.0795	7.56	NA
	S6	0.438	5.65	NA
Toluene	Q7	0.0370	NC	NA
	Q9	1.05	2.86	NA
	S6	1.58	2.39	NA
Nonconventional Organics				
m-Xylene	S6	0.347	3.84	NA
o-&*p*-Xylene	S6	0.231	4.12	NA
Priority Metals and Elements				
Copper	Q5	0.139	1.71	NA
	Q6	0.400	1.56	NA
	S6	0.0563	3.57	NA
Lead	Q7	0.0264	3.89	NA
	Q5	0.100	1.29	NA
	Q8	0.195	2.66	NA
	Q6	0.279	1.52	NA
	S6	0.0619	5.29	NA
Zinc	Q5	0.0968	3.96	NA
	Q8	0.303	6.94	NA
	Q6	1.72	2.14	NA
	S6	0.0547	1.79	NA

Table 9-10 (Continued)

Pollutant	Site Number[2]	LTA (mg/L)	1-Day VF[3] (mg/L)	4-Day VF[4] (mg/L)
Bulk Nonconventionals				
Total Petroleum Hydrocarbon (measured as SGT-HEM)	S6	10.8	2.54	1.42

[1]Insufficient data were available to calculate long-term average pollutant concentrations for all of the pollutants proposed for regulation at each site. This table only includes pollutants proposed for regulation at sites for which a long-term average could be calculated.
[2]Facilities with a site number beginning with "S" were sampled by EPA. Facilities with a site number beginning with "Q" provided data in their detailed monitoring questionnaire.
[3]The 1-day VF is defined as the daily variability of pollutant concentrations. EPA used the 1-day VF to calculate daily maximum standards for all pollutants proposed for regulation.
[4]The 4-day variability factor is defined as the monthly variability of pollutant concentrations based on 4 days of sampling per month. EPA used the 4-day VF to calculate a monthly average standard for total petroleum hydrocarbon.
NA - Not analyzed. EPA did not use the 4-day VF to calculate standards for these pollutants.
NC - Not calculated. Insufficient data were available to calculate this variability factor. Four values, at least two of which must be detected, are necessary to calculate a variability factor.
SGT-HEM - Silica Gel Treated-Hexane Extractable Material.

Table 9-11

Summary of Long-Term Averages (LTA), Variability Factors (VF), and Standards for Chemical Precipitation Treatment of All Facility Process Wastewater

Pollutant	# of Sites	Median LTA (mg/L)	1-Day VF[1] (mg/L)	Daily Maximum Standard (mg/L)	4-Day VF[2] (mg/L)	4-Day Monthly Average Standard (mg/L)
Priority Organics						
Bis(2-ethylhexyl) Phthalate	2	0.109	1.21	0.132	NA	NA
Ethylbenzene	3	0.269	6.08	1.64	NA	NA
Naphthalene	3	0.0583	3.90	0.228	NA	NA
Tetrachloroethene	2	0.259	6.61	1.71	NA	NA
Toluene	3	1.05	2.63	2.76	NA	NA
Nonconventional Organics						
m-Xylene	1	0.347	3.84	1.33	NA	NA
o-&*p*-Xylene	1	0.231	4.12	0.952	NA	NA
Priority Metals and Elements						
Copper	3	0.139	1.71	0.238	NA	NA
Lead	5	0.100	2.66	0.266	NA	NA
Zinc	4	0.200	3.05	0.610	NA	NA
Bulk Nonconventionals						
Total Petroleum Hydrocarbon (measured as SGT-HEM)	1	10.8	2.54	27.5	1.42	15.4

[1]The 1-day VF is defined as the daily variability of pollutant concentrations. EPA used the 1-day VF to calculate daily maximum standards for all pollutants proposed for regulation.
[2]The 4-day variability factor is defined as the monthly variability of pollutant concentrations based on 4 days of sampling per month. EPA used the 4-day VF to calculate a monthly average standard for total petroleum hydrocarbon.
NA - Not analyzed. EPA did not use the 4-day VF to calculate standards for these pollutants.
SGT-HEM - Silica Gel Treated-Hexane Extractable Material.

9.6 Identification of Data Used to Calculate the Long-Term Average Concentrations for the Prelaundering Technology Group

One of the sampled facilities steam-tumbled printer towels/rags before water-washing them. Steam tumbling is designed to remove organic pollutants from laundry items. Therefore, this treatment technology is not expected to demonstrate pollutant removals for all 72 pollutants of concern. This section presents EPA's methodology used to identify pollutants effectively removed by steam tumbling and to calculate target effluent concentrations for these pollutants.

EPA collected samples of wastewater discharge after processing a load of printer towels/rags that was steam-tumbled before water washing and from a load of printer towels/rags that was not steam-tumbled before water washing. Because both loads contained the same item and because both loads did not contain any free-standing liquids (this facility does not accept printer towels/rags containing free-standing liquids), EPA considered the untreated pollutant loadings from both loads to be equivalent. The raw wastewater samples from the load that was not steam-tumbled were used to represent the untreated influent to the steam-tumbling unit, and the effluent wastewater samples from the steam-tumbled load were used to demonstrate the changes in the untreated wastewater characteristics from steam tumbling. EPA used these data to identify pollutants effectively removed by steam tumbling and to calculate target effluent concentrations for the pollutants removed by steam tumbling.

EPA used these samples to identify pollutants removed by steam tumbling by comparing the untreated influent and the effluent wastewater samples used to demonstrate changes in the untreated wastewater characteristics from steam tumbling. All volatile organic pollutants for which a removal could be calculated (pollutant removals for 7 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 8 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.

Based on this analysis, EPA considered 24 organic pollutants from the list of 72 pollutants of concern to be removed by steam tumbling. Based on EPA analysis and vendor data, EPA determined that shop towels, printer towels/rags, mops, filters, and fender covers would be steam-tumbled in this option. These untreated items typically contain the highest concentrations of pollutants of all items laundered at industrial laundries. EPA determined that steam tumbling items other than shop towels, printer towels/rags, mops, filters, and fender covers does not result in significant pollutant removals because these items do not typically contain high concentrations of organic pollutants.

EPA then identified target effluent concentrations for steam tumbling of shop towels, printer towels/rags, mops, filters, and fender covers for the 24 pollutants effectively removed by steam tumbling. For some of the 24 pollutants, the pollutant concentration on items not treated by steam tumbling (garments, mats, and linen items) was higher than the pollutant concentration for steam tumbling of printer towels/rags. In these cases, EPA selected the highest pollutant concentration from garments, mats, and linen items as the target effluent concentration for that pollutant. Table 9-12 presents the target effluent concentrations for steam tumbling for the 24 organic pollutants effectively removed.

9.7 Mass-Based Standards

EPA considered proposing mass-based standards for the industrial laundry 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. EPA determined that basing the mass-based standards on total wastewater flow and total production data is more appropriate than basing the standards on individual item data. 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.

9.8 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.

Table 9-12

Target Effluent Concentrations for Steam Tumbling of Heavy Items Before Water Washing for the Pollutants of Concern

Pollutant of Concern	Median LTA (mg/L)
Priority Organics	
1,1,1-Trichloroethane	1.60
Butyl Benzyl Phthalate	0.366
Chlorobenzene	0.0550
Chloroform	0.889
Ethylbenzene	0.283
Methylene Chloride	0.442
Naphthalene	0.226
Tetrachloroethene	0.125
Toluene	1.29
trans-1,2-Dichloroethene	0.0550
Trichloroethene	0.0550
Nonconventional Organics	
2-Butanone	0.579
2-Methylnaphthalene	0.0550
2-Propanone	2.11
4-Methyl-2-pentanone	0.500
∝-terpineol	0.0830
m-Xylene	0.520
n-Decane	2.63
n-Dodecane	2.65
n-Hexacosane	0.130
n-Octacosane	0.0960
n-Triacontane	0.0620
o-&*p*-Xylene	0.291
p-Cymene	0.108

CHAPTER 10

DEVELOPMENT OF REGULATORY OPTIONS

10.1 Introduction

This chapter presents the regulatory options considered by EPA as the basis for the proposed 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 10.2 presents the regulatory options considered as the basis for the proposed PSES;
- Section 10.3 presents the regulatory options considered as the basis for the proposed PSNS; and
- Section 10.4 presents the references used.

10.2 Pretreatment Standards for Existing Sources (PSES)

Pretreatment standards for existing sources establish quantitative limits on the indirect discharge of priority and nonconventional pollutants to waters of the United States (i.e., PSES limit industrial discharges to publicly owned treatment works (POTWs)). PSES are designed to prevent the discharge of pollutants that pass through, interfere with, or are otherwise incompatible with the operation of POTWs. The Clean Water Act (CWA) requires pretreatment for pollutants that pass through POTWs in amounts that would exceed direct discharge effluent standards or limit POTW sludge management alternatives, including the beneficial use of sludges on agricultural lands. These limits are based upon the performance of specific technologies, but they do not require the use of any specific technology. PSES are applied to individual facilities and are administered by local permitting authorities (i.e., the government entity controlling the POTW to which the industrial wastewater is discharged). The facility then chooses its own approach to complying with its permit standards.

EPA considered 17 technology options as potential bases for PSES. These options are presented in Sections 10.2.1 and 10.2.2 below.

10.2.1 Initial Technology Options Considered

As described in Chapter 9, EPA had data available for five major postlaundering wastewater treatment technologies and one prelaundering treatment technology used by industrial laundries. These formed the basis for EPA's six initial technology options. The following sections further discuss each of these initial technology options. Table 10-1

Table 10-1

Technology Options Initially Considered for the Industrial Laundries Proposed Rule

Regulatory Option	Description	Basis of Standards	Number of Facilities with Equivalent or Better Treatment In Place[1]
CEB-Heavy	Chemical emulsion breaking of heavy wastewater.	CEB-Heavy	5
DAF-Heavy	Dissolved air flotation of heavy wastewater.	DAF-Heavy	1
CP-Heavy	Chemical precipitation of heavy wastewater.	CP-Heavy	7[2]
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[3]
OC-Only	Organics control (steam tumbling) of heavy industrial laundry items.	OC-Only	0[4]

[1]Data obtained from 193 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 6, regardless of annual production.
[2]One of these facilities operates a microfiltration unit to treat a portion of its process wastewater. Since microfiltration 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.
[3]One of these facilities operates an ultrafiltration unit to treat all of its process wastewater. Since ultrafiltration 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.
[4]Data from one facility were used to develop target average concentrations for OC-Only, but this facility steam tumbles printer towels only, not all heavy industrial items.

summarizes the six initial technology options and the number of detailed questionnaire facilities that have equivalent or better treatment currently in place.

Postlaundering Wastewater Treatment Technology Options

The five initial postlaundering wastewater treatment technology 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 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 detailed questionnaire and EPA site visits to industrial laundries, it was 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 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, it was determined that these units facilitate the operation of subsequent treatment units. 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, it is expected that the pH of the treated wastewater streams from these 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. For technology options in which a portion of the facility's wastewater is treated with chemical emulsion breaking or chemical precipitation, combination of the treated and untreated streams prior to final pH adjustment and discharge is also included. The effluent from DAF is expected to be within facilities' locally permitted

discharge range for pH, based on detailed questionnaire and sampling data. Therefore, the DAF treatment options do not include pH adjustment. For technology options in which a portion of the facility's wastewater is treated with DAF, combination of the treated and untreated streams prior to discharge is included.

The five initial wastewater treatment technology 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 of these options 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
- Linen.

The heavy industrial stream includes wastewater generated from water washing the following items:

- Shop towels;
- Printer towels;
- Mops;
- Fender covers; and
- Filters.

The light industrial stream includes wastewater generated from water washing the following items:

- Industrial Garments;
- Floor Mats;
- Clean Room Garments;
- 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;
- Mats;
- Mops;
- Fender covers;
- Clean Room Garments;

- Laundry Bags;
- Filters; and
- Buffing Pads.

The linen 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 linen items):

- Linen Supply Garments;
- Linen Flatwork/Full Dry;
- Health-Care Items;
- Continuous Roll Towels;
- Family Laundry;
- New Items;
- Executive Wear; and
- Miscellaneous Not Our Goods.

The wastewater generated from the washing of heavy industrial items ("heavy" wastewater) contains higher concentrations of most pollutants than the wastewater generated from the washing of light industrial and linen items ("light" wastewater). Figures 10-1, 10-2, and 10-3 illustrate the CEB-Heavy, DAF-Heavy, and CP-Heavy technology options, respectively. The All options treat the total facility process wastewater. Figures 10-4 and 10-5 illustrate the DAF-All and CP-All technology options, respectively.

EPA obtained specific performance data on the treatment of heavy industrial laundry wastewater through wastewater sampling at industrial laundries, as discussed in Chapter 9. The standards for the Heavy options would be based on pollutant concentrations obtained from the treated heavy wastewater, prior to combining with the light wastewater stream, as shown in Figures 10-1, 10-2, and 10-3. The standards for the All options would be based on pollutant concentrations obtained at the point of discharge from treatment of the entire wastewater stream as shown in Figures 10-4 and 10-5.

Prelaundering Organics Control (OC-Only) Technology Option

The OC-Only option, shown in Figure 10-6, consists of steam tumbling treatment of facilities' heavy industrial laundry items to remove organics prior to water washing of the items. EPA obtained specific performance data from one facility on the steam tumbling of printer towels, as discussed in Chapter 9. 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, as shown in Figure 10-6.

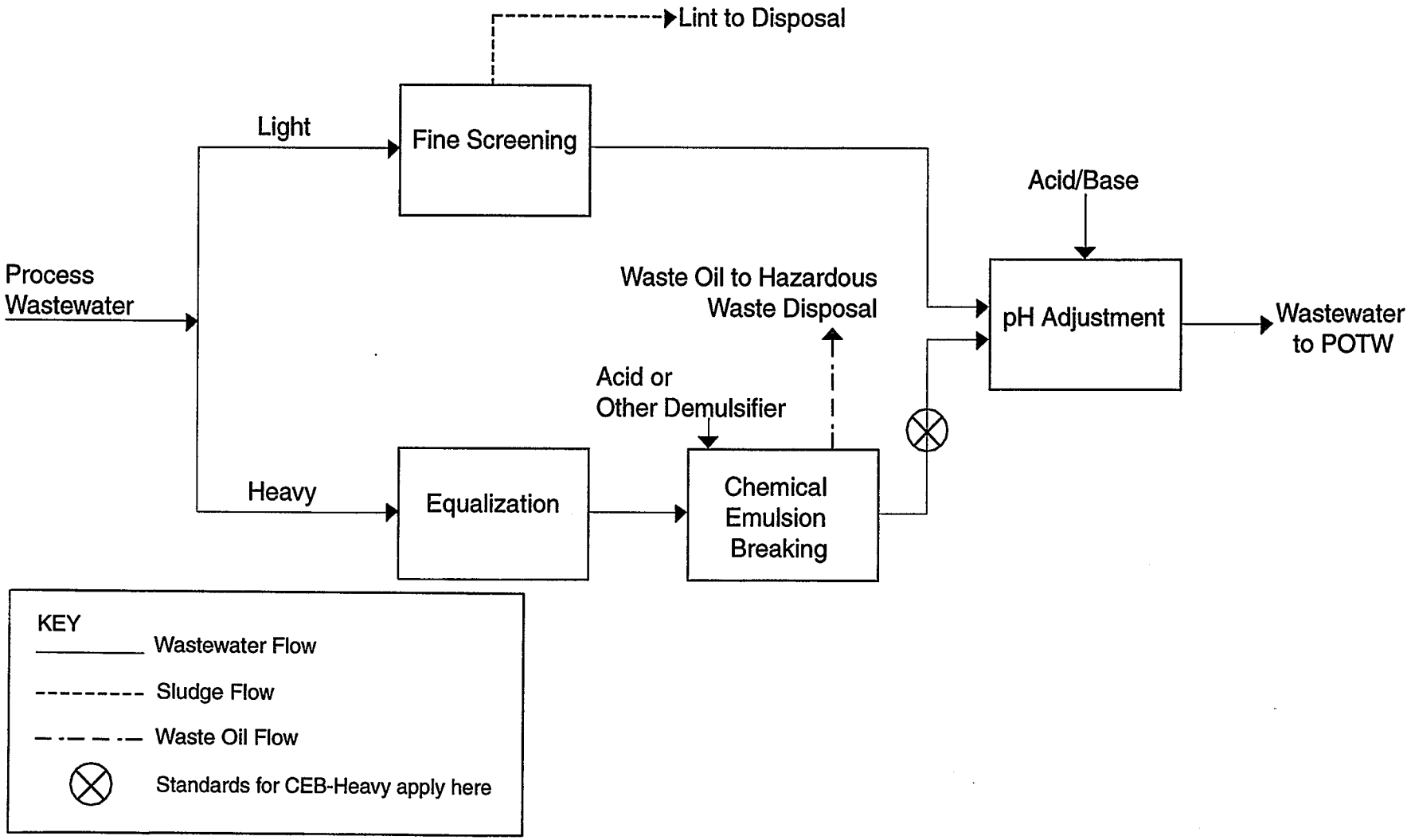

Figure 10-1. CEB-Heavy Option: Chemical Emulsion Breaking of Heavy Industrial Laundry Wastewater

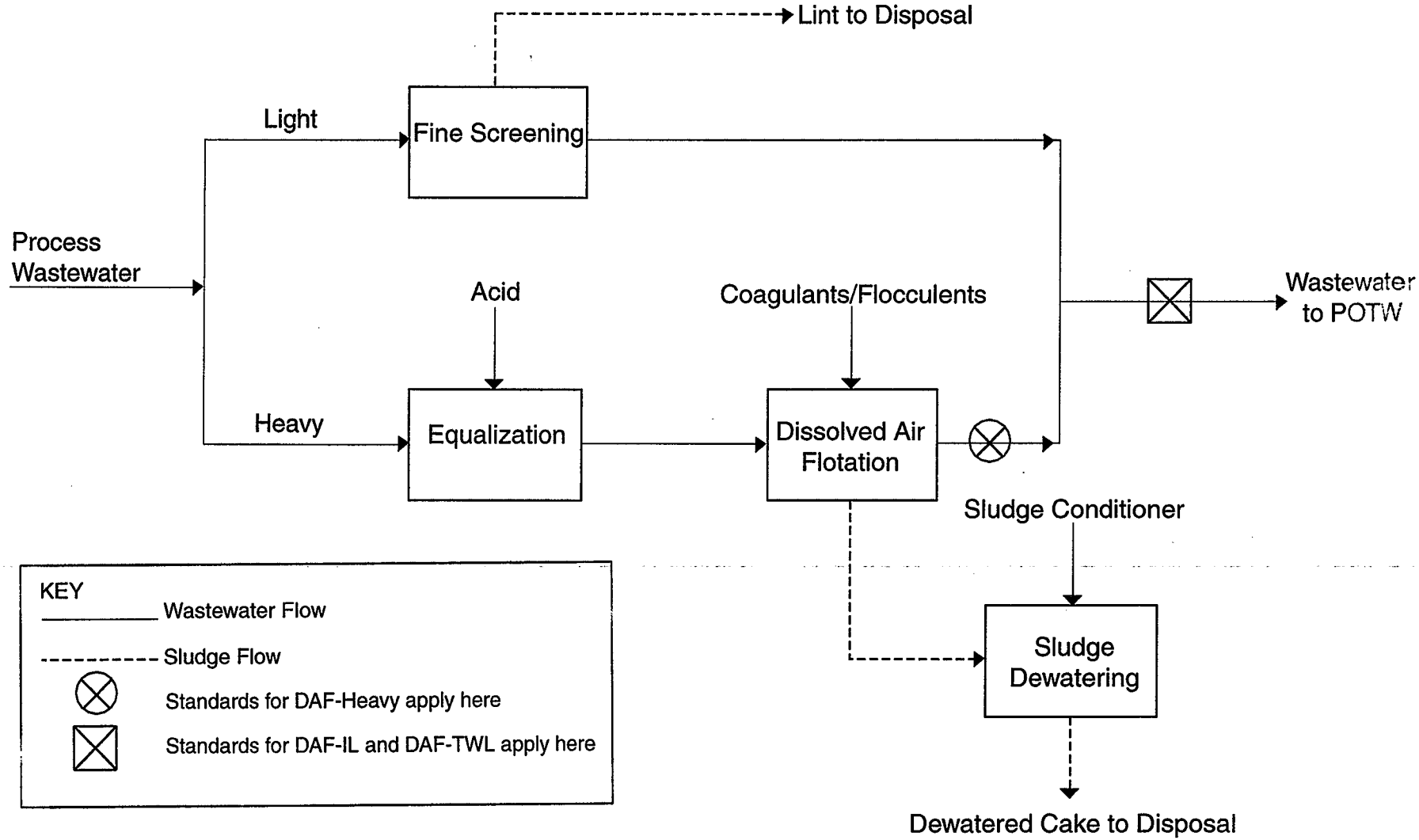

Figure 10-2. DAF-Heavy, DAF-IL, and DAF-TWL Options: Dissolved Air Flotation of a Portion of a Facility's Process Wastewater

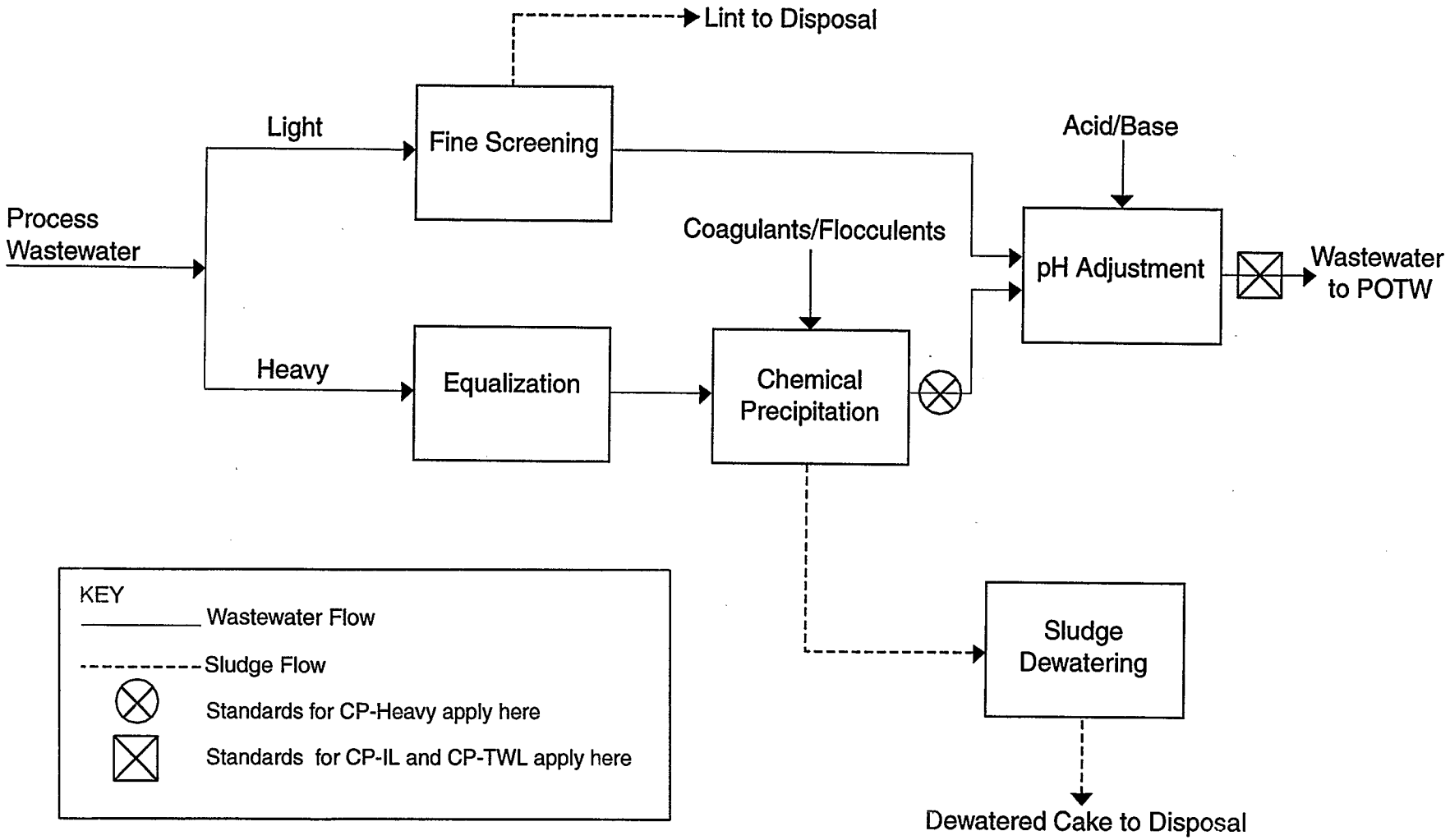

Figure 10-3. CP-Heavy, CP-IL, and CP-TWL Options: Chemical Precipitation of a Portion of a Facility's Process Wastewater

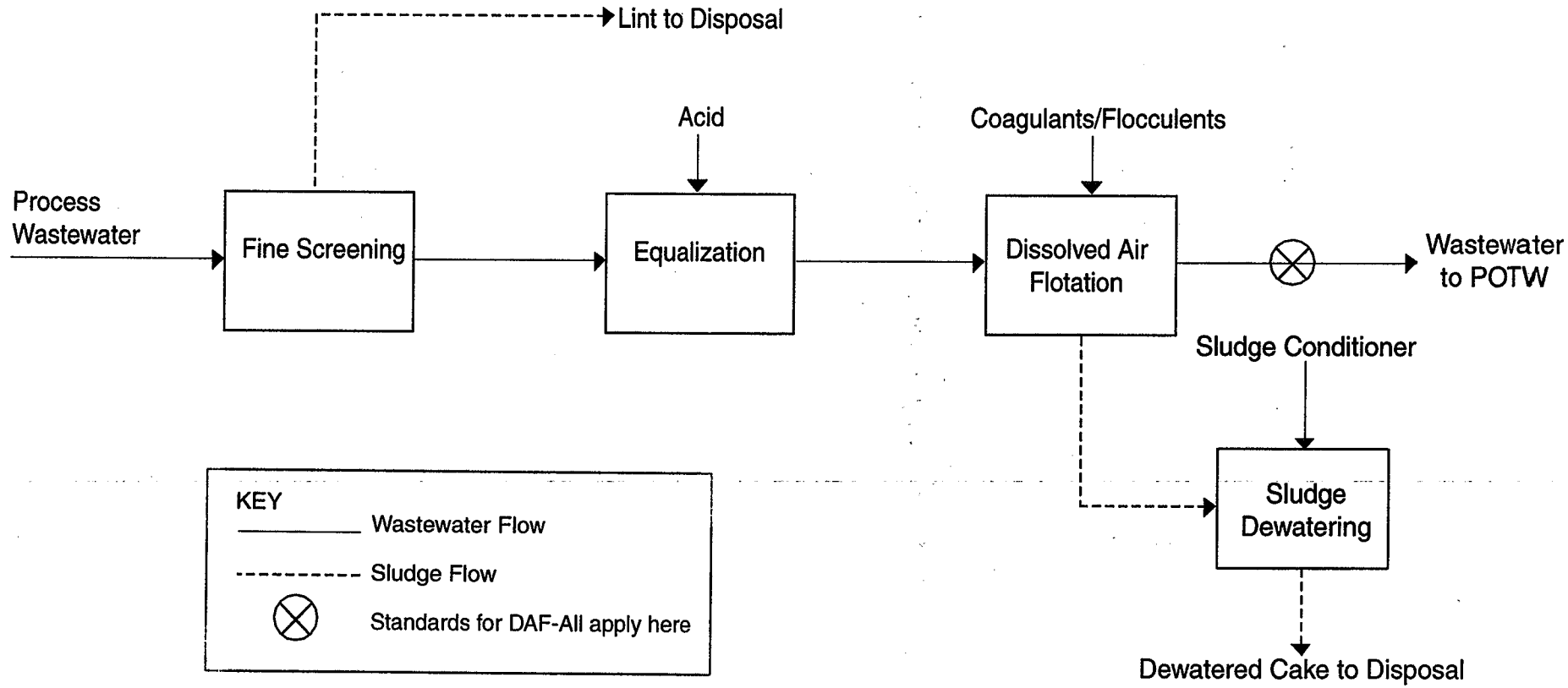

Figure 10-4. DAF-All Option: Dissolved Air Flotation of Total Facility Process Wastewater

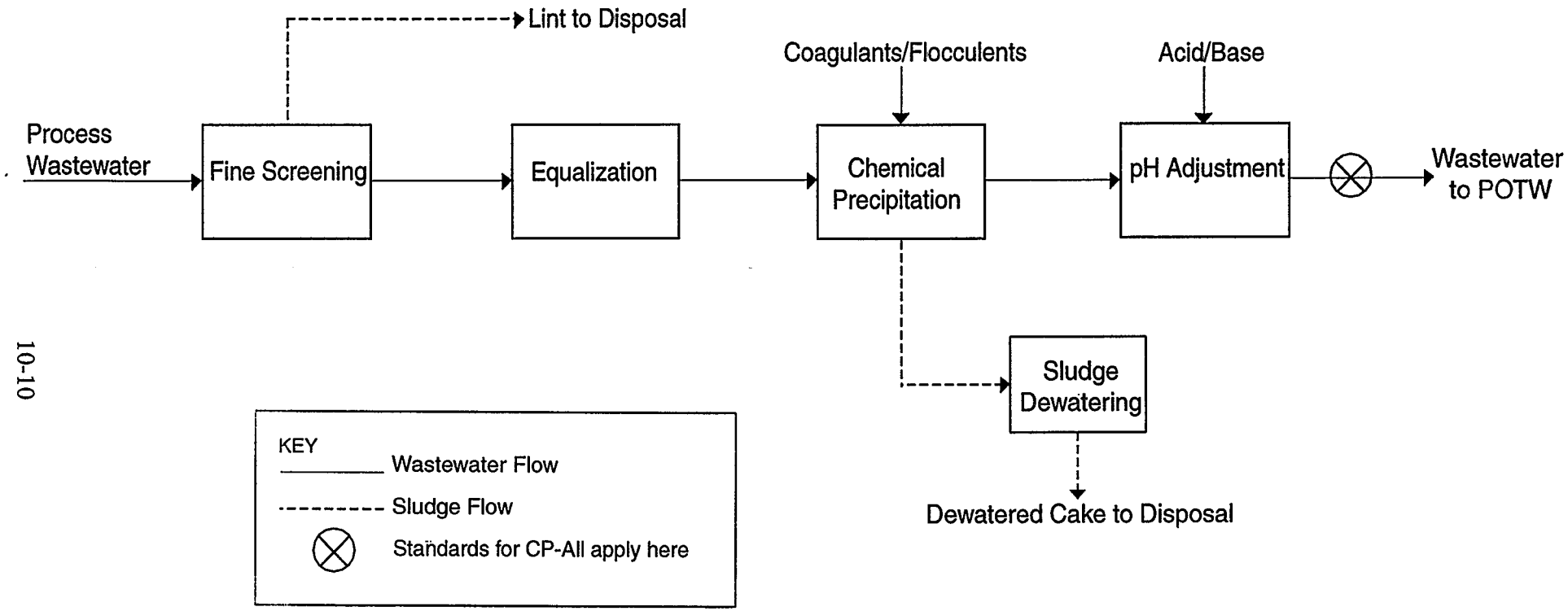

Figure 10-5. CP-All Option: Chemical Precipitation of Total Facility Process Wastewater

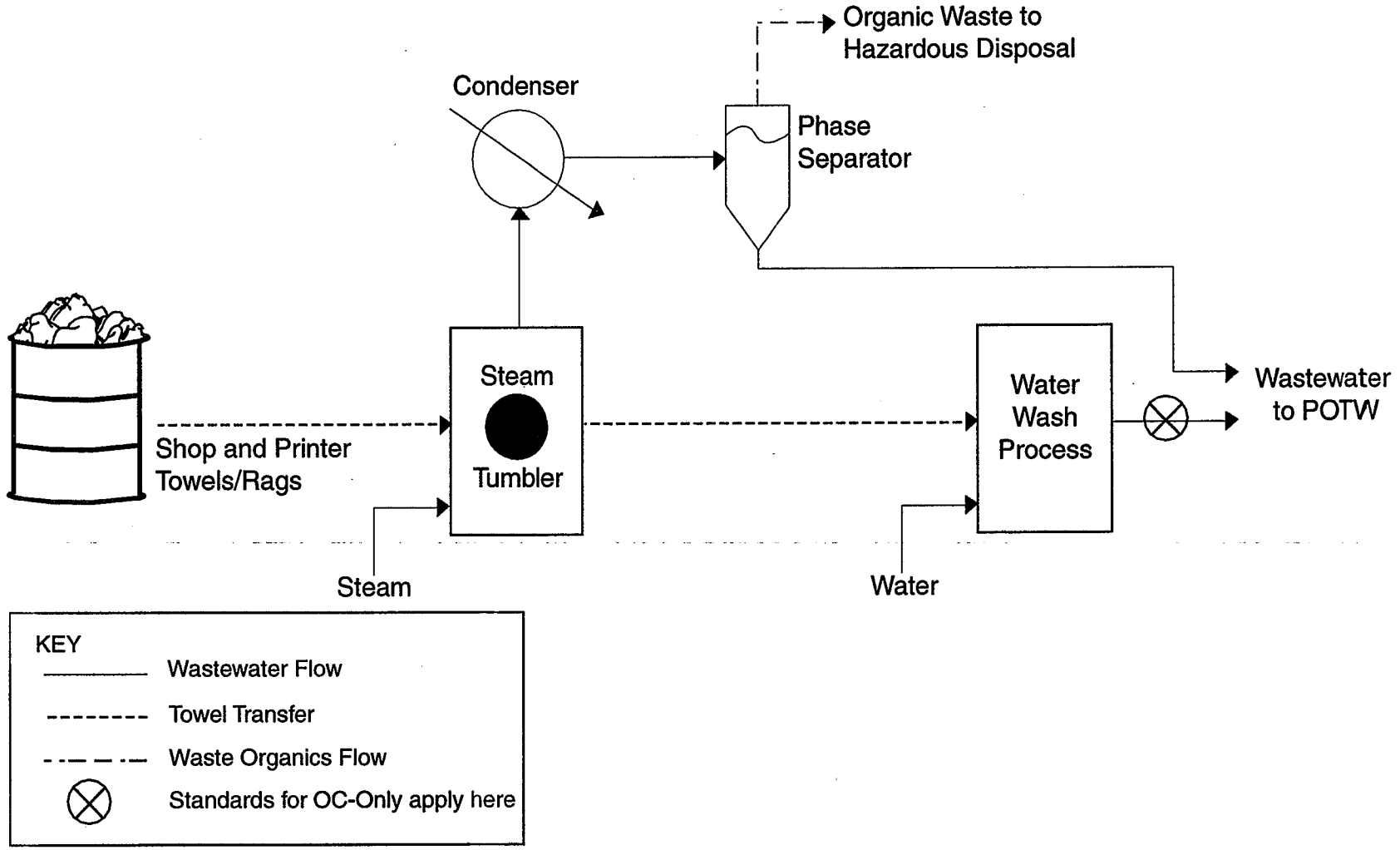

Figure 10-6. OC-Only Option: In-Process Organics Control

10.2.2 Inclusion of Pollution Prevention in the Technology Options

Most of the preprocess pollution prevention activities reported in the detailed questionnaire involve good operating practices that any industrial laundry can 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 facilities 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 can perform this activity.

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 less refractory emulsions.

Most of the facilities from which EPA has gathered data used for the development of DAF and chemical precipitation pretreatment standards practice refusal of items containing free liquids. 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. No other pollution prevention activities were consistently practiced by facilities from which data were obtained to develop pretreatment standards.

10.2.3 Exclusion of Wastewater Recycling Activities from the Technology Options

Some industrial laundries reported that they have incorporated wastewater recycling activities into their processes, as described previously in Section 8.4.1. EPA has found that the implementation of wastewater recycling is a facility-specific issue that is largely dependent 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 being used overall (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.

10.2.4 Initial Technology Options Not Further Considered

EPA eliminated the Heavy options from further consideration because it was 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.

10.2.5 Additional Technology Options Considered

EPA considered additional alternative technology options, which were variations on the initial DAF and chemical precipitation technology options presented above, to find the most cost-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. The standards for these additional technology options are based on performance data obtained from either DAF or chemical precipitation treatment of the total facility process wastewater stream. In other words, the standards for the additional technology options are the same as those for the DAF-All and CP-All initial technology options described previously. These additional regulatory options are described in the sections below.

Table 10-2 summarizes the 10 additional technology options and the number of facilities that have equivalent or better treatment currently in place.

Industrial Laundry Wastewater (IL) Technology Options

The IL wastewater technology options, DAF-IL and CP-IL, are similar to the DAF-Heavy and CP-Heavy technology options shown in Figures 10-2 and 10-3, 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 items is treated. The treated stream is combined with the untreated linen wastewater stream prior to monitoring and discharge. Thus, in Figures 10-2 and 10-3 the heavy and light industrial wastewater streams are represented by the "heavy" stream in the diagram and the linen 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).

Table 10-2

Definitions of Additional Technology Options Considered for PSES

Regulatory Option	Description	Basis of Standards	Number of Facilities with Equivalent or Better Treatment In Place[1]
DAF-IL	Dissolved air flotation of wastewater from industrial laundry items.	DAF-All	1
CP-IL	Chemical precipitation of wastewater from industrial laundry items.	CP-All	1
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	2
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	2
DAF-TWL	Dissolved air flotation of wastewater from heavy industrial laundry items.	DAF-All	1
CP-TWL	Chemical precipitation of wastewater from heavy industrial laundry items.	CP-All	7[2]
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	8[2]
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	8[2]
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	50[3]
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	50[3]

[1]Data obtained from 193 in-scope facilities that responded to the detailed questionnaire. In-scope facilities were those that meet the definition of an industrial laundry as presented in Chapter 6, regardless of annual production.
[2]One of these facilities operates a microfiltration unit to treat a portion of its process wastewater. Since microfiltration can achieve lower final effluent pollutant concentrations than chemical precipitation (1), this facility is considered to have better treatment in place for the CP-Heavy option.
[3]One of these facilities operates an ultrafiltration unit to treat all of its process wastewater. Since ultrafiltration can achieve lower final effluent concentrations than chemical precipitation (1), this facility is considered to have better treatment in place for the CP-All option.
LTA - Long-term average

EPA has determined that the wastewater generated from laundering of linen 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 linen wastewater does not need treatment to meet those standards. EPA developed the IL wastewater technology options to import lower-cost treatment systems to treat a portion of the facility's process wastewater.

Towel (TWL) Technology Options

The TWL wastewater technology options are nearly identical to the DAF-Heavy and CP-Heavy technology options shown in Figures 10-2 and 10-3, respectively, including treatment of wastewater generated from washing heavy industrial laundry items, as defined in Section 10.2.1. Light industrial and linen wastewater is discharged without treatment. Thus, in Figures 10-2 and 10-3 the heavy industrial wastewater stream is represented by the "heavy" stream in the diagram and the light industrial and linen 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 options.

Combination (Combo) Technology Options

EPA also considered technology options in which standards would be based on a combination of the DAF-IL and CP-IL standards in order to allow for increased flexibility in the technologies used by the industry to treat their industrial laundry wastewater, allowing for a more cost-effective technology option. These combination (Combo) options, Combo-IL and Combo-IL-2LIM, are described below.

The Combo-IL technology option combines both the DAF-IL and CP-IL standards into one set of standards for the industrial laundry industry. These standards would be established based on the less stringent of the standards for the two technology options for each pollutant. EPA's data show that, overall, chemical precipitation performs somewhat 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 under 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 option (based on a comparison of DAF-IL and CP-IL annualized costs) to treat their industrial laundry wastewater.

The Combo-IL-2LIM technology option is similar to the Combo-IL option described above. 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 under 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 CP-IL technology 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 similar manner to the Combo-IL and Combo-IL-2LIM options described above, but resulted in higher compliance posts.

As in the IL options, EPA also considered additional TWL technology options (Combo-TWL and Combo-TWL-2LIM) in which standards are based on a combination of the DAF-TWL and CP-TWL standards in order 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.

10.2.6 Technology Options Eliminated from Further Consideration

Based on technical and economic analyses, EPA eliminated the following technology options from further consideration:

- 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 the pollutant concentrations in the untreated light industrial and linen wastewater streams are

higher than the standards for these technology options. The standards for the TWL options would be based on the treatment of total facility process wastewater and EPA determined that these standards could not be met with the treatment schemes of the TWL options.

EPA eliminated the All options from further consideration because although the IL and the All options can achieve the same effluent pollutant concentrations, the costs to treat the total facility process wastewater in the All options are higher than the costs for the IL options.

No Regulation Option

EPA also considered a no regulation option, which entails having no national standards. Facilities would only need to comply with applicable local standards. EPA rejected the No Regulation option because it provides no control of pollutants passing through or interfering with POTW operations. Further, the No Regulation option would not represent best available technology economically achievable or best available demonstrated control technology as those terms are applied for the purpose of setting pretreatment standards.

10.2.7 Regulatory Options Further Considered for PSES

The remaining five technology options further considered for the industrial laundries rule are:

- 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 this document and the Economic Assessment (EA) (3).

10.3 Pretreatment Standards for New Sources (PSNS)

Pretreatment standards for new sources establish quantitative standards on the indirect discharge of priority and nonconventional pollutants to waters of the United States. Industry has the opportunity to design and install the best and most efficient processes and wastewater treatment systems at new facilities. Accordingly, Congress directed EPA to consider the best demonstrated alternative processes, process changes, in-plant control measures, and end-of-pipe wastewater treatment technologies that reduce pollution to the maximum extent feasible. In response to that directive, EPA considered effluent reductions attainable by the most advanced and demonstrated process and treatment technologies at

industrial laundries. EPA considered the five regulatory options evaluated as the basis for the proposed PSES as the basis for the proposed PSNS.

10.4 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 (DCN L04319).

3. 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 11

POLLUTANT LOADING AND REMOVAL ESTIMATES

11.1 Introduction

This chapter presents annual pollutant loading and removal estimates for the industrial laundries industry for each of the regulatory options. 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. Untreated, baseline, and postcompliance pollutant loadings and pollutant removals for the industry were estimated for 72 pollutants of concern using data collected from the industry throughout development of the proposed rule. 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 currently in place at industrial laundries.

- Baseline loadings -- pollutant loadings in industrial laundry wastewater currently being discharged to POTWs. These loadings do account for wastewater treatment currently in place at industrial laundries.

- Postcompliance loadings -- pollutant loadings in industrial laundry wastewater after implementation of the rule. These loadings are calculated assuming that all industrial laundries would operate wastewater treatment technologies equivalent to the technology option.

The following information is presented in this chapter:

- Section 11.2 presents the data sources that were used to estimate pollutant loadings and removals;

- Section 11.3 discusses the methodology used to estimate pollutant loadings and pollutant removals; and

- Section 11.4 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.

11.2 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), and the Preliminary Data Summary (PDS). These data sources are discussed in detail in Chapter 3.

To estimate untreated pollutant loadings for the industrial laundries industry, EPA estimated pollutant concentrations and loadings for 72 pollutants at 193 in-scope industrial laundries that submitted sufficient information in response to the 1993 detailed questionnaire (in-scope facilities meet the definition of an industrial laundry as presented in Chapter 6, regardless of their annual production). EPA then extrapolated the loadings to the entire industry based on the survey weights developed for each facility. The 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 two loads of pants and two loads of shirts collected during two sampling episodes;
- Water washing of shop towels -- data from three loads of shop towels collected during three sampling episodes and two days of PDS data from a shop-towel-only stream at a facility sampled for the PDS.;
- 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 one load of mats collected during a sampling episode;
- 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.

Data submitted by one facility for clean room items and denim prewashing data obtained by EPA during a site visit were not used to estimate pollutant loadings and removals because the data were not available at the time the analysis was completed.

Data used for estimating postcompliance loadings for each regulatory option are presented in Chapters 9 and 10 and are summarized as follows:

- Organics Control (Steam Tumbling) of Heavy Industrial Laundry Items (OC-Only) -- data from one load of steam-tumbled printer towels/rags;

- Dissolved Air Flotation of Industrial Laundry Wastewater (DAF-IL) -- data from two sampled facilities and four DMQ facilities;

- Chemical Precipitation of Industrial Laundry Wastewater (CP-IL) -- data from one sampled facility and five DMQ facilities; and

- Dissolved Air Flotation or Chemical Precipitation of Industrial Laundry Wastewater (Combo-IL and Combo-IL-2LIM) -- for dissolved air flotation, data from two sampled facilities and four DMQ facilities; for chemical precipitation, data from one sampled facility and five DMQ facilities.

Baseline loadings for individual facilities were estimated from untreated or postcompliance loadings, based on the wastewater treatment in place reported by the facility in the detailed questionnaire. Section 11.3 below present details on the methodology used to estimate the pollutant loadings and removals.

11.3 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.

11.3.1 Methodology Used to Estimate Untreated Pollutant Loadings

EPA estimated untreated pollutant loadings for each of the 193 in-scope facilities using the process/item-specific data discussed in Section 11.2 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 currently in place at industrial laundries.

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:

$$\text{Concentration (mg/L, for process/item data)} \times \frac{\text{Flow (L, for process/item)}}{\text{Production (lbs, for process/item)}} = \text{Amount of pollutant generated per pound of laundry (mg/lb)}$$

The pollutant loading per pound of item was calculated 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 11-1 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 11.2 of this document.

Data were not obtained for all the process/item combinations reported by the 193 in-scope facilities in the detailed questionnaires. To estimate the pollutant loadings for all facilities, EPA transferred data from the process/item combinations with data available to other process/item-specific combinations for which data were not available. Table 11-2 presents these data transfers.

For each facility, 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 following equation was used to calculate the pollutant concentrations for each facility:

$$\text{Amount of pollutant generated per pound of laundry (mg/lb)} \times \frac{\text{Production (lbs of process/item at facility)}}{\text{Flow (L, for process/item at facility)}} = \text{Concentration (mg/L for process/item at facility)}$$

Table 11-1
Pollutant Loadings per Pound of Item Processed
(mg Pollutant/lb Laundry)

Pollutant	Industrial Garments	Shop Towels	Printer Towels	Steam Tumbled Printer Towels	Mats	Mops	Linen Items	Items Dry Cleaned Prior to Water Washing
BOD_5	3,099	18,560	51,581	12,998	767	13,646	7,237	1,605
HEM	681	22,256	94,464	15,535	261	3,378	1,295	NA
SGT-HEM	357	13,637	30,828	4,226	102	1,316	147	NA
TSS	2,625	42,494	14,735	11,915	1,128	13,152	2,241	1,165
COD	13,846	127,674	222,981	81,240	247	64,242	9,376	9,011
TOC	2,907	17,315	33,168	15,977	575	6,192	4,817	NA
TXM	24	266	326	75	5	73	15	26
TXO	6	316	1,045	89	19	53	25	18
NCM	119	646	298	93	33	348	83	33
NCO	14	1,507	2,707	1,041	21	247	54	22

BOD_5 - Biochemical oxygen demand
HEM - Oil and grease (measured as hexane extractable material)
SGT-HEM - Total petroleum hydrocarbons (measured as 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
NA - Data not available

Table 11-2

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)	Industrial Garments (B01)	Customer
Laundry Bags (B14)	Industrial Garments (B01)	Customer and Chemical Use
Fender Covers (B09)	Shop Towels (B02)	Use and Customer
Filters (B23)	Shop Towels (B02)	Use and Customer
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 pollutant loading was calculated using the following equation:

$$\text{Facility untreated concentration (mg/L, for process/item)} \times \text{Facility annual flow (L/yr, for process/item)} \times \frac{1\text{ lb}}{453{,}600\text{ mg}} = \text{Facility untreated annual loading (lb/yr)}$$

To estimate the total untreated wastewater pollutant loading for a facility, the loadings calculated from each process/item combination were summed together for each pollutant.

11.3.2 Methodology Used to Estimate Baseline and Postcompliance 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 12 discusses the assessment of treatment in place for industrial laundries. The treatment technologies in use at industrial laundries, based on the detailed questionnaire, included chemical emulsion breaking, dissolved air flotation, chemical precipitation, 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 11-3 shows the methodology used to estimate baseline loadings for each facility. EPA estimated the baseline loadings for facilities with ultrafiltration or microfiltration treatment systems using the data for chemical precipitation treatment systems.

Postcompliance pollutant loadings for each regulatory option represent the total industry wastewater pollutant loadings after implementation of the proposed rule. Postcompliance pollutant loadings were estimated from the target average concentrations and the annual facility wastewater discharge flow for each of the 193 in-scope facilities as shown in the following equation:

$$\text{Postcompliance target average concentration (mg/L)} \times \text{Facility annual discharge flow (L/yr)} \times \frac{1\text{ lb}}{453{,}600\text{ mg}} = \text{Facility postcompliance annual loading (lbs/yr)}$$

Target average concentrations were calculated from the analytical data described in Section 11.2 of this document. The target average concentrations for OC-Only are presented in Chapter 9. Prior to calculating target average concentrations for DAF-IL and CP-IL, the data were edited using procedures described in Chapter 9 for calculating long-term averages, with the exception that the average concentration of a pollutant in the influent samples collected from a facility did not need to be greater than ten times the method detection level for that pollutant. Table 11-4 presents the target average concentrations for DAF-IL and CP-IL. The target effluent concentrations for Combo-IL and Combo-IL-2LIM are derived from DAF-IL and CP-IL, depending on the technology chosen.

Table 11-3

Methodology Used to Estimate Baseline Loadings for the Industrial Laundries Industry

Facility Treatment in Place	Source for Baseline Loadings
No Treatment	Estimated from untreated wastewater concentrations
CEB - partial stream[1,2]	Treated stream loading estimated from target average concentrations for CEB-Heavy and untreated stream loading estimated from untreated wastewater concentrations
DAF - partial stream[1]	Treated stream loading estimated from target average concentrations for DAF-IL and untreated stream loading estimated from untreated wastewater concentrations
CP - partial stream[1]	Treated stream loading estimated from target average concentrations for CP-IL and untreated stream loading estimated from untreated wastewater concentrations
DAF - total stream	Treated stream loading estimated from target average concentrations for DAF-All
CP - total stream	Treated stream loading estimated from target average concentrations for CP-All

[1]For the purposes of estimating baseline loads, EPA assumed that the stream reported as treated by the facility is equivalent to the industrial laundry stream estimated for the IL-Options described in Chapter 10.
[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 loadings for these facilities were estimated assuming they are only treating heavy wastewater.

CEB - Chemical emulsion breaking
DAF - Dissolved air flotation
CP - Chemical precipitation
CEB-Heavy - Chemical emulsion breaking of heavy industrial laundry wastewater
DAF-IL - Dissolved air flotation of industrial laundry wastewater
CP-IL - Chemical precipitation of industrial laundry wastewater
DAF-All - Dissolved air flotation of all process wastewater
CP-All - Chemical precipitation of all process wastewater

Table 11-4
Target Average Concentrations for DAF-IL and CP-IL for the Pollutants of Concern[1]

Pollutant of Concern	Target Average Concentration (mg/L)	
	DAF-IL	CP-IL
Conventionals		
Biochemical Oxygen Demand 5-Day (BOD_5)	497	499
Oil and Grease (measured as HEM)	37.8	28.5
Total Suspended Solids (TSS)	85.5	119
Priority Organics		
1,1,1-Trichloroethane	0.0100	0.471
1,2-Diphenylhydrazine	---	---
4-Chloro-3-methylphenol	0.151	0.042
Bis(2-ethylhexyl) Phthalate	0.144	0.109
Butyl Benzyl Phthalate	0.216	0.0342
Chlorobenzene	0.0280	0.0336
Chloroform	0.185	0.0513
Di-*n*-butyl Phthalate	0.125	0.0342
Di-*n*-octyl Phthalate	0.0280	0.0342
Ethylbenzene	0.0605	0.269
Isophorone	---	0.297
Methylene Chloride	0.546	0.126
Naphthalene	0.0764	0.0583
Phenol	0.211	---
Tetrachloroethene	0.250	0.259
Toluene	0.711	1.05
trans-1,2-Dichloroethene	---	---
Trichloroethene	---	---
Nonconventional Organics		
2-Butanone	17.4	3.23
2-Methylnaphthalene	0.116	0.0125
2-Propanone	13.6	---
4-Methyl-2-pentanone	0.595	3.13
∝-Terpineol	0.472	---

Table 11-4 (Continued)

Pollutant of Concern	Target Average Concentration (mg/L)	
	DAF-IL	CP-IL
Nonconventional Organics (Continued)		
Benzoic Acid	1.58	---
Benzyl Alcohol	---	---
Hexanoic Acid	---	---
m-Xylene	0.327	0.347
n-Decane	0.469	0.104
n-Docosane	0.0232	0.0110
n-Dodecane	0.195	2.83
n-Eicosane	0.0477	0.0167
n-Hexacosane	0.0195	0.0144
n-Hexadecane	0.0842	0.0682
n-Octacosane	0.0100	0.0168
n-Octadecane	0.0694	0.0309
n-Tetracosane	0.0219	0.0107
n-Tetradecane	0.0754	0.0601
n-Triacontane	0.0100	0.0138
o-&*p*-Xylene	0.271	0.231
p-Cresol	0.117	---
p-Cymene	0.0700	---
Pentamethylbenzene	---	---
Priority Metals and Elements		
Antimony	0.0593	0.0182
Arsenic	0.0259	0.0197
Beryllium	---	0.00100
Cadmium	0.0145	0.00691
Chromium	0.0695	0.0426
Copper	0.478	0.139
Lead	0.175	0.100
Mercury	0.000242	---
Nickel	0.0406	0.0356
Selenium	0.0524	---
Silver	0.0188	0.0194

Table 11-4 (Continued)

Pollutant of Concern	Target Average Concentration (mg/L)	
	DAF-IL	CP-IL
Priority Metals and Elements (Continued)		
Thallium	0.00294	---
Zinc	0.837	0.200
Nonconventional Metals and Elements		
Aluminum	1.31	0.468
Barium	0.0584	0.261
Boron	0.522	0.238
Cobalt	0.0381	0.0316
Iron	2.79	4.12
Manganese	0.0340	0.00877
Molybdenum	0.119	0.457
Tin	0.0631	0.0103
Titanium	0.0112	0.0179
Vanadium	0.00700	0.0100
Yttrium	0.00208	0.00500
Bulk Nonconventionals		
Chemical Oxygen Demand (COD)	998	1080
Total Organic Carbon (TOC)	326	342
Total Petroleum Hydrocarbon (measured as SGT-HEM)	13.7	10.8

[1]Target average concentrations for OC-Only are presented in Chapter 9. Target average concentrations for Combo-IL and Combo-IL-2LIM are dervived from the target average concentrations for DAF-IL and CP-IL.
HEM - Hexane extractable material.
SGT-HEM - Silica gel treated-hexane extractable material.

To estimate postcompliance loading 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 this proposed rule, EPA determined that 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 11-5 through 11-8 present the methodologies used to estimate the postcompliance loadings for the DAF-IL, CP-IL, COMBO-IL, and COMBO-IL-2LIM regulatory options, based on the facility's treatment in place.

Postcompliance loadings for OC-Only were estimated using the target average concentrations for 24 pollutants of concern considered to be controlled by this technology and the target average concentrations for the applicable treatment system (or untreated concentrations for facilities with no treatment) for the remaining 49 pollutants of concern not controlled by this technology. No facilities have treatment in place equivalent to this regulatory option.

11.3.3 Methodology Used to Estimate Pollutant Removals

Pollutant removals represent the difference between 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:

Baseline Loadings - Postcompliance Loadings = Pollutant Removals

EPA used the following methodology to estimate pollutant removals:

1) If the postcompliance loading of a pollutant was higher than the baseline loading, the removal was set to zero;

2) If the pollutant was not present at baseline, the removal was set to zero; and

3) If a long-term average was not calculated for a pollutant for a technology option (i.e., the postcompliance loading for the pollutant could not be calculated), the removal was set to zero.

Table 11-5

Methodology Used to Estimate Postcompliance Loadings for DAF-IL for the Industrial Laundries Industry

Facility Treatment in Place	Source for Postcompliance Loadings
No Treatment	Industrial laundry stream loading estimated from the target average concentrations for DAF-IL; linen stream loading estimated from untreated wastewater concentrations
CEB - partial stream	Industrial laundry stream loading estimated from the target average concentrations for DAF-IL; linen stream loading estimated from untreated wastewater concentrations
DAF - partial stream	Industrial laundry stream loading estimated from the target average concentrations for DAF-IL; linen stream loading estimated from untreated wastewater concentrations
CP - partial stream	Industrial laundry stream loading estimated from the target average concentrations for CP-IL; linen stream loading estimated from untreated wastewater concentrations
DAF - total stream	Total stream loading estimated from the target average concentrations for DAF-All
CP - total stream	Total stream loading estimated from the target average concentrations for CP-All

CEB - Chemical Emulsion Breaking
DAF - Dissolved Air Flotation
CP - Chemical Precipitation
DAF-IL - Dissolved Air Flotation of Industrial Laundry Wastewater
CP-IL - Chemical Precipitation of Industrial Laundry Wastewater
DAF-All - Dissolved Air Flotation of All Process Wastewater
CP-All - Chemical Precipitation of All Process Wastewater

Table 11-6

Methodology Used to Estimate Postcompliance Loadings for CP-IL for the Industrial Laundries Industry

Facility Treatment in Place	Source for Postcompliance Loadings
No Treatment	Industrial laundry stream loading estimated from the target average concentrations for CP-IL; linen stream loading estimated from untreated wastewater concentrations
CEB - partial stream	Industrial laundry stream loading estimated from the target average concentrations for CP-IL; linen stream loading estimated from untreated wastewater concentrations
DAF - partial stream	Industrial laundry stream loading estimated from the target average concentrations for CP-IL; linen stream loading estimated from untreated wastewater concentrations
CP - partial stream	Industrial laundry stream loading estimated from the target average concentrations for CP-IL; linen stream loading estimated from untreated wastewater concentrations
DAF - total stream	Total stream loading estimated from the target average concentrations for CP-IL; linen stream loading estimated from untreated wastewater concentrations
CP - total stream	Total stream loading estimated from the target average concentrations for CP-All

CEB - Chemical Emulsion Breaking
DAF - Dissolved Air Flotation
CP - Chemical Precipitation
CP-IL - Chemical Precipitation of Industrial Laundry Wastewater
CP-All - Chemical Precipitation of All Process Wastewater

Table 11-7

Methodology Used to Estimate Postcompliance Loadings for Combo-IL for the Industrial Laundries Industry

Facility Treatment in Place	Source for Postcompliance Loadings
No Treatment	Industrial laundry stream loading estimated from the higher target average concentrations between DAF-IL and CP-IL; linen stream loading estimated from untreated wastewater concentrations
CEB - partial stream	Industrial laundry stream loading estimated from the higher target average concentrations between DAF-IL and CP-IL; linen stream loading estimated from untreated wastewater concentrations
DAF - partial stream	Industrial laundry stream loading estimated from the target average concentrations for DAF-IL; linen stream loading estimated from untreated wastewater concentrations
CP - partial stream	Industrial laundry stream loading estimated from the target average concentrations for CP-IL; linen stream loading estimated from untreated wastewater concentrations
DAF - total stream	Total stream loading estimated from the target average concentrations for DAF-ALL
CP - total stream	Total stream loading estimated from the target average concentrations for CP-ALL

CEB - Chemical Emulsion Breaking
DAF - Dissolved Air Flotation
CP - Chemical Precipitation
DAF-IL - Dissolved Air Flotation of Industrial Laundry Wastewater
CP-IL - Chemical Precipitation of Industrial Laundry Wastewater
DAF-All - Dissolved Air Flotation of All Process Wastewater
CP-All - Chemical Precipitation of All Process Wastewater

Table 11-8

Methodology Used to Estimate Postcompliance Loadings for Combo-IL-2LIM for the Industrial Laundries Industry

Facility Treatment in Place	Source for Postcompliance Loadings
No Treatment	Industrial laundry stream loading estimated from the target average concentrations for CP-IL; linen stream loading estimated from untreated wastewater concentrations
CEB - partial stream	Industrial laundry stream loading estimated from the target average concentrations for CP-IL; linen stream loading estimated from untreated wastewater concentrations
DAF - partial stream	Industrial laundry stream loading estimated from the target average concentrations for DAF-IL; linen stream loading estimated from untreated wastewater concentrations
CP - partial stream	Industrial laundry stream loading estimated from the target average concentrations for CP-IL; linen stream loading estimated from untreated wastewater concentrations
DAF - total stream	Total stream loading estimated from the target average concentrations for DAF-All
CP - total stream	Total stream loading estimated from the target average concentrations for CP-All

CEB - Chemical Emulsion Breaking
DAF - Dissolved Air Flotation
CP - Chemical Precipitation
DAF-IL - Dissolved Air Flotation of Industrial Laundry Wastewater
CP-IL - Chemical Precipitation of Industrial Laundry Wastewater
DAF-All - Dissolved Air Flotation of All Process Wastewater
CP-All - Chemical Precipitation of All Process Wastewater

11.4 Pollutant Loadings and Removals

Annual untreated, baseline, and postcompliance loadings were estimated for each of the regulatory options using the methodology described in Section 11.3 of this document. The facility-specific loadings and removals were extrapolated from the 193 in-scope facilities to represent the entire industry of 1,747 facilities. Tables 11-9 through 11-12 present the total untreated, baseline, and postcompliance loadings and the pollutant removals for all 1,747 facilities for DAF-IL, CP-IL, Combo-IL, and OC-Only. Tables 11-13 through 11-16 present the total untreated, baseline, and postcompliance loadings and pollutant removal for the 141 facilities that are excluded from the regulation as discussed in Chapter 6 for DAF-IL, CP-IL, Combo-IL, and OC-Only. Pollutant loadings and removals for Combo-IL-2LIM, which are not presented in this chapter, are similar to Combo-IL and are within the range of the DAF-IL and CP-IL pollutant loadings and removals.

Table 11-9
Summary of Pollutant Loadings and Removals for the Entire Industrial Laundries Industry for OC-Only[1]

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Conventionals					
Biochemical Oxygen Demand 5-Day (BOD_5)	124,988,493	114,274,092	114,274,092	0	0
Oil and Grease (measured as HEM)	61,844,348	36,490,607	36,490,607	0	0
Total Suspended Solids (TSS)	83,724,856	63,680,554	63,680,554	0	0
Priority Organics					
1,1,1-Trichloroethane	76,685	57,276	45,812	11,464	20
1,2-Diphenylhydrazine	0	0	0	0	0
4-Chloro-3-methylphenol	15,381	12,947	12,947	0	0
Bis(2-ethylhexyl) Phthalate	188,855	134,499	134,499	0	0
Butyl Benzyl Phthalate	37,716	30,367	17,583	12,784	42
Chlorobenzene	3,469	2,760	913	1,846	67
Chloroform	130,235	126,244	126,244	0	0
Di-*n*-butyl Phthalate	19,690	10,305	10,305	0	0
Di-*n*-octyl Phthalate	14,264	11,436	11,436	0	0
Ethylbenzene	84,956	45,607	14,491	31,116	68
Isophorone	4,521	4,521	4,521	0	0
Methylene Chloride	46,980	36,140	16,946	19,194	53

Table 11-9 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Naphthalene	71,819	39,453	18,758	20,695	52
Phenol	13,832	13,764	13,764	0	0
Tetrachloroethene	68,481	43,027	3,860	39,167	91
Toluene	133,837	74,200	42,521	31,679	43
trans-1,2-Dichloroethene	3,970	3,970	949	3,021	76
Trichloroethene	3,382	3,382	908	2,474	73
Total Priority Organics	**918,073**	**649,899**	**476,458**	**173,442**	—
Nonconventional Organics					
2-Butanone	33,198	29,032	16,840	12,191	42
2-Methylnaphthalene	12,729	9,449	3,080	6,369	67
2-Propanone	228,072	162,645	81,162	81,483	50
4-Methyl-2-pentanone	23,933	19,565	13,538	6,027	31
∝-Terpineol	14,651	12,681	6,879	5,803	46
Benzoic Acid	82,274	79,119	79,119	0	0
Benzyl Alcohol	32,750	32,750	32,750	0	0
Hexanoic Acid	8,442	8,442	8,442	0	0
m-Xylene	27,456	21,680	14,766	6,914	32
n-Decane	1,107,366	698,528	420,988	277,540	40

Table 11-9 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
n-Docosane	17,087	12,506	12,506	0	0
n-Dodecane	272,875	175,822	83,155	92,667	53
n-Eicosane	272,950	167,717	167,717	0	0
n-Hexacosane	30,489	18,219	10,995	7,225	40
n-Hexadecane	135,916	80,090	80,090	0	0
n-Octacosane	16,541	11,493	8,167	3,326	29
n-Octadecane	108,261	67,988	67,988	0	0
n-Tetracosane	18,713	15,587	15,587	0	0
n-Tetradecane	188,935	114,824	114,824	0	0
n-Triacontane	18,598	15,085	10,573	4,512	30
o-&*p*-Xylene	13,374	10,909	8,001	2,908	27
p-Cresol	0	0	0	0	0
p-Cymene	75,119	58,589	19,250	39,340	67
Pentamethylbenzene	0	0	0	0	0
Total Nonconventional Organics	**2,739,729**	**1,822,720**	**1,276,416**	**546,305**	—
Priority Metals and Elements					
Antimony	37,232	32,331	32,331	0	0
Arsenic	13,461	13,106	13,106	0	0

Table 11-9 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Beryllium	31	31	31	0	0
Cadmium	6,689	5,633	5,633	0	0
Chromium	21,136	14,712	14,712	0	0
Copper	174,499	124,244	124,244	0	0
Lead	111,661	74,719	74,719	0	0
Mercury	184	176	176	0	0
Nickel	16,948	14,928	14,928	0	0
Selenium	100	100	100	0	0
Silver	5,006	4,605	4,605	0	0
Thallium	0	0	0	0	0
Zinc	241,329	196,771	196,771	0	0
Total Priority Metals and Elements	**628,276**	**481,355**	**481,355**	**0**	**—**
Nonconventional Metals and Elements					
Aluminum	767,263	678,952	678,952	0	0
Barium	94,279	72,283	72,283	0	0
Boron	36,650	34,856	34,856	0	0
Cobalt	6,397	5,334	5,334	0	0
Iron	1,314,623	1,123,687	1,123,687	0	0

Table 11-9 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Manganese	29,464	24,207	24,207	0	0
Molybdenum	13,122	9,932	9,932	0	0
Tin	6,921	5,820	5,820	0	0
Titanium	16,299	14,103	14,103	0	0
Vanadium	1,724	1,673	1,673	0	0
Yttrium	667	653	653	0	0
Total Nonconventional Metals and Elements	**2,287,409**	**1,971,499**	**1,971,499**	**0**	—
Bulk Nonconventionals					
Chemical Oxygen Demand (COD)	349,635,773	268,645,034	268,645,034	0	0
Total Organic Carbon (TOC)	90,802,100	81,250,307	81,250,307	0	0
Total Petroleum Hydrocarbon	23,551,331	13,514,535	13,514,535	0	0

[1]Numbers in this table were calculated using more significant figures than shown.
HEM - Hexane extractable material
SGT-HEM - Silica get treated-hexane extractable material

Table 11-10
Summary of Pollutant Loadings and Removals for the Entire Industrial Laundries Industry for DAF-IL[1]

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Conventionals					
Biochemical Oxygen Demand 5-Day (BOD_5)	124,988,493	114,274,092	107,650,388	6,623,704	6
Oil and Grease (measured as HEM)	61,844,348	36,490,607	15,997,585	20,493,021	56
Total Suspended Solids (TSS)	83,724,856	63,680,554	29,939,296	33,741,258	53
Priority Organics					
1,1,1-Trichloroethane	76,685	57,276	3,494	53,782	94
1,2-Diphenylhydrazine	0	0	0	0	0
4-Chloro-3-methylphenol	15,381	12,947	10,792	2,156	17
Bis(2-ethylhexyl) Phthalate	188,855	134,499	85,359	49,140	37
Butyl Benzyl Phthalate	37,716	30,367	20,477	9,891	33
Chlorobenzene	3,469	2,760	1,752	1,008	37
Chloroform	130,235	126,244	126,244	0	0
Di-*n*-butyl Phthalate	19,690	10,305	8,202	2,103	20
Di-*n*-octyl Phthalate	14,264	11,436	9,660	1,777	16
Ethylbenzene	84,956	45,607	6,604	39,004	86
Isophorone	4,521	4,521	4,521	0	0
Methylene Chloride	46,980	36,140	31,899	4,241	12

Table 11-10 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Naphthalene	71,819	39,453	20,270	19,183	49
Phenol	13,832	13,764	13,752	12	0
Tetrachloroethene	68,481	43,027	20,587	22,439	52
Toluene	133,837	74,200	52,013	22,187	30
trans-1,2-Dichloroethene	3,970	3,970	3,970	0	0
Trichloroethene	3,382	3,382	3,382	0	0
Total Priority Organics	**918073**	**649,899**	**422,976**	**226,923**	—
Nonconventional Organics					
2-Butanone	33,198	29,032	29,032	0	0
2-Methylnaphthalene	12,729	9,449	8,337	1,111	12
2-Propanone	228,072	162,645	162,606	39	<1
4-Methyl-2-pentanone	23,933	19,565	19,298	267	1
∝-Terpineol	14,651	12,681	12,655	26	0
Benzoic Acid	82,274	79,119	77,590	1,529	2
Benzyl Alcohol	32,750	32,750	32,750	0	0
Hexanoic Acid	8,442	8,442	8,442	0	0
m-Xylene	27,456	21,680	19,638	2,042	9
n-Decane	1,107,366	698,528	375,418	323,110	46

Table 11-10 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
n-Docosane	17,087	12,506	6,791	5,715	46
n-Dodecane	272,875	175,822	60,274	115,547	66
n-Eicosane	272,950	167,717	14,861	152,856	91
n-Hexacosane	30,489	18,219	4,756	13,463	74
n-Hexadecane	135,916	80,090	27,613	52,477	66
n-Octacosane	16,541	11,493	3,390	8,102	71
n-Octadecane	108,261	67,988	14,885	53,103	78
n-Tetracosane	18,713	15,587	9,607	5,980	38
n-Tetradecane	188,935	114,824	24,519	90,306	79
n-Triacontane	18,598	15,085	7,325	7,760	51
o-&*p*-Xylene	13,374	10,909	10,481	427	4
p-Cresol	0	0	0	0	0
p-Cymene	75,119	58,589	24,097	34,492	59
Pentamethylbenzene	0	0	0	0	0
Total Nonconventional Organics	**2,739,729**	**1,822,720**	**954,366**	**868,355**	**---**
Priority Metals and Elements					
Antimony	37,232	32,331	19,372	12,959	40
Arsenic	13,461	13,106	13,105	1	<1

Table 11-10 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Beryllium	31	31	31	0	0
Cadmium	6,689	5,633	3,592	2,042	36
Chromium	21,136	14,712	10,987	3,725	25
Copper	174,499	124,244	87,514	36,730	30
Lead	111,661	74,719	33,487	41,231	55
Mercury	184	176	158	18	10
Nickel	16,948	14,928	10,709	4,220	28
Selenium	100	100	100	0	0
Silver	5,006	4,605	4,098	507	11
Thallium	0	0	0	0	0
Zinc	241,329	196,771	110,764	86,007	44
Total Priority Metals and Elements	**628,276**	**481,355**	**293,916**	**187,439**	—
Nonconventional Metals and Elements					
Aluminum	767,263	678,952	481,794	197,158	29
Barium	94,279	72,283	43,953	28,331	39
Boron	36,650	34,856	34,211	645	2
Cobalt	6,397	5,334	3,877	1,456	27
Iron	1,314,623	1,123,687	626,124	497,563	44

Table 11-10 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Manganese	29,464	24,207	12,778	11,428	47
Molybdenum	13,122	9,932	9,067	864	9
Tin	6,921	5,820	4,819	1,001	17
Titanium	16,299	14,103	8,922	5,180	37
Vanadium	1,724	1,673	1,630	44	3
Yttrium	667	653	648	6	1
Total Nonconventional Metals and	**2,287,409**	**1,971,499**	**1,227,823**	**743,676**	**---**
Bulk Nonconventionals					
Chemical Oxygen Demand (COD)	349,635,773	268,645,034	180,326,547	88,318,487	33
Total Organic Carbon (TOC)	90,802,100	81,250,307	74,001,266	7,249,041	9
Total Petroleum Hydrocarbon	23,551,331	13,514,535	2,666,593	10,847,942	80

[1]Numbers in this table were calculated using more significant figures than shown.
HEM - Hexane extractable material
SGT-HEM - Silica get treated-hexane extractable material

Table 11-11
Summary of Pollutant Loadings and Removals for the Entire Industrial Laundries Industry for CP-IL[1]

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Conventionals					
Biochemical Oxygen Demand 5-Day (BOD_5)	124,988,493	114,274,092	107,700,574	6,573,518	6
Oil and Grease (measured as HEM)	61,844,348	36,490,607	15,291,642	21,198,965	58
Total Suspended Solids (TSS)	83,724,856	63,680,554	32,355,394	31,325,160	49
Priority Organics					
1,1,1-Trichloroethane	76,685	57,276	31,857	25,419	44
1,2-Diphenylhydrazine	0	0	0	0	0
4-Chloro-3-methylphenol	15,381	12,947	3,541	9,407	73
Bis(2-ethylhexyl) Phthalate	188,855	134,499	82,622	51,877	39
Butyl Benzyl Phthalate	37,716	30,367	14,625	15,742	52
Chlorobenzene	3,469	2,760	1,876	884	32
Chloroform	130,235	126,244	126,243	1	< 1
Di-*n*-butyl Phthalate	19,690	10,305	5,718	4,587	45
Di-*n*-octyl Phthalate	14,264	11,436	10,021	1,415	12
Ethylbenzene	84,956	45,607	20,433	25,174	55
Isophorone	4,521	4,521	4,521	0	0
Methylene Chloride	46,980	36,140	11,908	24,232	67

Table 11-11 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Naphthalene	71,819	39,453	18,963	20,490	52
Phenol	13,832	13,764	13,764	0	0
Tetrachloroethene	68,481	43,027	20,909	22,118	51
Toluene	133,837	74,200	59,589	14,611	20
trans-1,2-Dichloroethene	3,970	3,970	3,970	0	0
Trichloroethene	3,382	3,382	3,382	0	0
Total Priority Organics	**918,073**	**649,899**	**433,942**	**215,957**	—
Nonconventional Organics					
2-Butanone	33,198	29,032	29,032	0	0
2-Methylnaphthalene	12,729	9,449	3,101	6,348	67
2-Propanone	228,072	162,645	162,645	0	0
4-Methyl-2-pentanone	23,933	19,565	19,565	0	0
∝-Terpineol	14,651	12,681	12,681	0	0
Benzoic Acid	82,274	79,119	79,119	0	0
Benzyl Alcohol	32,750	32,750	32,750	0	0
Hexanoic Acid	8,442	8,442	8,442	0	0
m-Xylene	27,456	21,680	19,838	1,842	8.50
n-Decane	1,107,366	698,528	348,561	349,967	51

Table 11-11 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
n-Docosane	17,087	12,506	5,846	6,660	53
n-Dodecane	272,875	175,822	157,306	18,516	11
n-Eicosane	272,950	167,717	12,447	155,270	93
n-Hexacosane	30,489	18,219	4,379	13,840	76
n-Hexadecane	135,916	80,090	26,483	53,607	67
n-Octacosane	16,541	11,493	3,845	7,648	67
n-Octadecane	108,261	67,988	11,908	56,080	82
n-Tetracosane	18,713	15,587	8,770	6,817	44
n-Tetradecane	188,935	114,824	23,368	91,456	80
n-Triacontane	18,598	15,085	7,597	7,488	50
o-&*p*-Xylene	13,374	10,909	10,069	840	8
p-Cresol	0	0	0	0	0
p-Cymene	75,119	58,589	58,589	0	0
Pentamethylbenzene	0	0	0	0	0
Total Nonconventional Organics	**2,739,729**	**1,822,720**	**1,046,340**	**776,379**	**---**
Priority Metals and Elements					
Antimony	37,232	32,331	16,226	16,105	50
Arsenic	13,461	13,106	13,104	2	<1

Table 11-11 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Beryllium	31	31	31	<1	1
Cadmium	6,689	5,633	2,999	2,634	47
Chromium	21,136	14,712	9,056	5,656	38
Copper	174,499	124,244	61,104	63,140	51
Lead	111,661	74,719	27,360	47,359	63
Mercury	184	176	176	0	0
Nickel	16,948	14,928	10,343	4,586	31
Selenium	100	100	100	0	0
Silver	5,006	4,605	4,116	489	11
Thallium	0	0	0	0	0
Zinc	241,329	196,771	59,010	137,761	70
Total Priority Metals and Elements	**628,276**	**481,355**	**203,625**	**277,733**	—
Nonconventional Metals and Elements					
Aluminum	767,263	678,952	416,067	262,885	39
Barium	94,279	72,283	57,445	14,838	21
Boron	36,650	34,856	29,369	5,487	16
Cobalt	6,397	5,334	3,565	1,769	33
Iron	1,314,623	1,123,687	718,241	405,446	36

Table 11-11 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Manganese	29,464	24,207	10,795	13,411	55
Molybdenum	13,122	9,932	9,922	9	<1
Tin	6,921	5,820	907	4,913	84
Titanium	16,299	14,103	9,394	4,709	33
Vanadium	1,724	1,673	1,656	17	1
Yttrium	667	653	653	<1	<1
Total Nonconventional Metals and Elements	**2,287,409**	**1,971,499**	**1,258,014**	**713,485**	—
Bulk Nonconventionals					
Chemical Oxygen Demand (COD)	349,635,773	268,645,034	185,607,168	83,037,866	31
Total Organic Carbon (TOC)	90,802,100	81,250,307	74,623,265	6,627,042	8
Total Petroleum Hydrocarbon	23,551,331	13,514,535	2,432,698	11,081,837	82

[1]Numbers in this table were calculated using more significant figures than shown.
HEM - Hexane extractable material
SGT-HEM - Silica get treated-hexane extractable material

Table 11-12
Summary of Pollutant Loadings and Removals for the Entire Industrial Laundries Industry for Combo-IL[1]

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Conventionals					
Biochemical Oxygen Demand 5-Day (BOD_5)	124,988,493	114,274,092	107,707,041	6,567,051	6
Oil and Grease (measured as HEM)	61,844,348	36,490,607	15,997,585	20,493,021	56
Total Suspended Solids (TSS)	83,724,856	63,680,554	32,355,394	31,325,160	49
Priority Organics					
1,1,1-Trichloroethane	76,685	57,276	31,857	25,419	44
1,2-Diphenylhydrazine	0	0	0	0	0
4-Chloro-3-methylphenol	15,381	12,947	10,792	2,156	17
Bis(2-ethylhexyl) Phthalate	188,855	134,499	85,359	49,140	37
Butyl Benzyl Phthalate	37,716	30,367	20,477	9,891	33
Chlorobenzene	3,469	2,760	1,888	872	32
Chloroform	130,235	126,244	126,244	0	0
Di-*n*-butyl Phthalate	19,690	10,305	8,202	2,103	20
Di-*n*-octyl Phthalate	14,264	11,436	10,021	1,415	12
Ethylbenzene	84,956	45,607	20,435	25,173	55
Isophorone	4,521	4,521	4,521	0	0
Methylene Chloride	46,980	36,140	31,899	4,241	12

Table 11-12 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Naphthalene	71,819	39,453	20,270	19,183	49
Phenol	13,832	13,764	13,752	12	<1
Tetrachloroethene	68,481	43,027	21,133	21,894	51
Toluene	133,837	74,200	59,661	14,539	20
trans-1,2-Dichloroethene	3,970	3,970	3,970	0	0
Trichloroethene	3,382	3,382	3,382	0	0
Total Priority Organics	**918,073**	**649,899**	**473,863**	**176,038**	—
Nonconventional Organics					
2-Butanone	33,198	29,032	29,032	0	0
2-Methylnaphthalene	12,729	9,449	8,337	1,111	12
2-Propanone	228,072	162,645	162,606	39	<1
4-Methyl-2-pentanone	23,933	19,565	19,565	0	0
∝-Terpineol	14,651	12,681	12,655	26	<1
Benzoic Acid	82,274	79,119	77,590	1,529	2
Benzyl Alcohol	32,750	32,750	32,750	0	0
Hexanoic Acid	8,442	8,442	8,442	0	0
m-Xylene	27,456	21,680	20,015	1,666	8
n-Decane	1,107,366	698,528	375,418	323,110	46

Table 11-12 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
n-Docosane	17,087	12,506	6,791	5,715	46
n-Dodecane	272,875	175,822	157,306	18,516	11
n-Eicosane	272,950	167,717	14,861	152,856	91
n-Hexacosane	30,489	18,219	4,756	13,463	74
n-Hexadecane	135,916	80,090	27,613	52,477	66
n-Octacosane	16,541	11,493	3,845	7,648	67
n-Octadecane	108,261	67,988	14,885	53,103	78
n-Tetracosane	18,713	15,587	9,607	5,980	38
n-Tetradecane	188,935	114,824	24,519	90,306	79
n-Triacontane	18,598	15,085	7,597	7,488	50
o-&*p*-Xylene	13,374	10,909	10,481	427	4
p-Cresol	0	0	0	0	0
p-Cymene	75,119	58,589	24,097	34,492	59
Pentamethylbenzene	0	0	0	0	0
Total Nonconventional Organics	**2,739,729**	**1,822,720**	**1,052,768**	**769,952**	—
Priority Metals and Elements					
Antimony	37,232	32,331	19,372	12,959	40
Arsenic	13,461	13,106	13,105	1	<1

Table 11-12 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Beryllium	31	31	31	0	0
Cadmium	6,689	5,633	3,592	2,042	36
Chromium	21,136	14,712	10,987	3,725	25
Copper	174,499	124,244	87,514	36,730	30
Lead	111,661	74,719	33,487	41,231	55
Mercury	184	176	158	18	10
Nickel	16,948	14,928	10,709	4,220	28
Selenium	100	100	100	0	0
Silver	5,006	4,605	4,116	489	11
Thallium	0	0	0	0	0
Zinc	241,329	196,771	110,764	86,007	44
Total Priority Metals and Elements	**628,276**	**481,355**	**293,935**	**187,422**	—
Nonconventional Metals and Elements					
Aluminum	767,263	678,952	481,794	197,158	29
Barium	94,279	72,283	57,445	14,838	21
Boron	36,650	34,856	34,211	645	2
Cobalt	6,397	5,334	3,877	1,456	27
Iron	1,314,623	1,123,687	718,241	405,446	36

Table 11-12 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Manganese	29,464	24,207	12,778	11,428	47
Molybdenum	13,122	9,932	9,922	9	<1
Tin	6,921	5,820	4,819	1,001	17
Titanium	16,299	14,103	9,394	4,709	33
Vanadium	1,724	1,673	1,656	17	1
Yttrium	667	653	653	0	0
Total Nonconventional Metals and Elements	**2,287,409**	**1,971,499**	**1,334,790**	**636,707**	—
Bulk Nonconventionals					
Chemical Oxygen Demand (COD)	349,635,773	268,645,034	185,655,740	82,989,294	31
Total Organic Carbon (TOC)	90,802,100	81,250,307	74,625,706	6,624,600	8
Total Petroleum Hydrocarbon	23,551,331	13,514,535	2,666,593	10,847,942	80

[1]Numbers in this table were calculated using more significant figures than shown.
HEM - Hexane extractable material
SGT-HEM - Silica get treated-hexane extractable material

Table 11-13
Summary of Pollutant Loadings and Removals for the Excluded Industrial Laundries (141 Facilities) for OC-Only[1]

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Conventionals					
Biochemical Oxygen Demand 5-Day (BOD_5)	1,039,528	1,013,533	1,013,533	0	0
Oil and Grease (measured as HEM)	687,931	616,915	616,915	0	0
Total Suspended Solids (TSS)	921,104	887,444	887,444	0	0
Priority Organics					
1,1,1-Trichloroethane	890	818	530	288	35
1,2-Diphenylhydrazine	0	0	0	0	0
4-Chloro-3-methylphenol	173	173	173	0	0
Bis(2-ethylhexyl) Phthalate	1,625	1,479	1,479	0	0
Butyl Benzyl Phthalate	351	303	151	153	50
Chlorobenzene	49	46	16	30	66
Chloroform	892	892	892	0	0
Di-*n*-butyl Phthalate	193	161	161	0	0
Di-*n*-octyl Phthalate	105	97	97	0	0
Ethylbenzene	1,092	987	128	859	87
Isophorone	17	17	17	0	0
Methylene Chloride	660	660	167	493	75

Table 11-13 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Naphthalene	832	740	166	574	78
Phenol	115	115	115	0	0
Tetrachloroethene	1,048	1,001	42	959	96
Toluene	1,463	1,279	458	821	64
trans-1,2-Dichloroethene	61	61	16	44	73
Trichloroethene	48	48	16	32	67
Total Priority Organics	**9,614**	**8,877**	**4,626**	**4,252**	**---**
Nonconventional Organics					
2-Butanone	386	386	195	191	50
2-Methylnaphthalene	173	169	30	139	82
2-Propanone	2,292	2,276	819	1,457	64
4-Methyl-2-pentanone	290	287	162	125	44
∝-Terpineol	170	170	58	112	66
Benzoic Acid	846	846	846	0	0
Benzyl Alcohol	229	229	229	0	0
Hexanoic Acid	53	53	53	0	0
m-Xylene	328	315	171	144	46
n-Decane	12,628	11,605	3,282	8,323	72

Table 11-13 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
n-Docosane	190	181	181	0	0
n-Dodecane	3,631	3,378	1,013	2,365	70
n-Eicosane	4,373	4,205	4,205	0	0
n-Hexacosane	356	327	89	238	73
n-Hexadecane	1,756	1,636	1,636	0	0
n-Octacosane	193	184	67	117	64
n-Octadecane	1,629	1,560	1,560	0	0
n-Tetracosane	190	182	182	0	0
n-Tetradecane	2,751	2,607	2,607	0	0
n-Triacontane	197	188	79	109	58
o-&*p*-Xylene	142	135	95	40	30
p-Cresol	0	0	0	0	0
p-Cymene	820	715	147	568	79
Pentamethylbenzene	0	0	0	0	0
Total Nonconventional Organics	**33,623**	**31,634**	**17,708**	**13,928**	**—**
Priority Metals and Elements					
Antimony	236	230	230	0	0
Arsenic	93	93	93	0	0

Table 11-13 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Beryllium	<1	<1	<1	0	0
Cadmium	73	72	72	0	0
Chromium	197	179	179	0	0
Copper	1,797	1,688	1,688	0	0
Lead	1,355	1,267	1,267	0	0
Mercury	1	1	1	0	0
Nickel	154	151	151	0	0
Selenium	2	2	2	0	0
Silver	47	45	45	0	0
Thallium	0	0	0	0	0
Zinc	2,669	2,600	2,600	0	0
Total Priority Metals and Elements	**6,624**	**6,328**	**6,328**	**0**	—
Nonconventional Metals and Elements					
Aluminum	5,816	5,685	5,685	0	0
Barium	945	892	892	0	0
Boron	386	386	386	0	0
Cobalt	73	69	69	0	0
Iron	12,533	12,211	12,211	0	0

Table 11-13 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Manganese	290	278	278	0	0
Molybdenum	133	121	121	0	0
Tin	60	60	60	0	0
Titanium	121	117	117	0	0
Vanadium	15	15	15	0	0
Yttrium	5	5	5	0	0
Total Nonconventional Metals and Elements	**20,377**	**19,840**	**19,840**	**0**	—
Bulk Nonconventionals					
Chemical Oxygen Demand (COD)	3,621,646	3,447,109	3,447,109	0	0
Total Organic Carbon (TOC)	771,468	753,634	753,634	0	0
Total Petroleum Hydrocarbon	299,226	272,507	272,507	0	0

[1]Numbers in this table were calculated using more significant figures than shown.
HEM - Hexane extractable material
SGT-HEM - Silica get treated-hexane extractable material

Table 11-14
Summary of Pollutant Loadings and Removals for the Excluded Industrial Laundries (141 Facilities) for DAF-IL

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Conventionals					
Biochemical Oxygen Demand 5-Day (BOD_5)	1,039,528	1,013,533	770,389	243,144	24
Oil and Grease (measured as HEM)	687,931	616,915	117,506	499,408	81
Total Suspended Solids (TSS)	921,104	887,444	218,279	669,165	75
Priority Organics					
1,1,1-Trichloroethane	890	818	6	812	99
1,2-Diphenylhydrazine	0	0	0	0	0
4-Chloro-3-methylphenol	173	173	78	95	55
Bis(2-ethylhexyl) Phthalate	1,625	1,479	617	862	58
Butyl Benzyl Phthalate	351	303	152	152	50
Chlorobenzene	49	46	12	34	75
Chloroform	892	892	892	0	0
Di-*n*-butyl Phthalate	193	161	62	100	62
Di-*n*-octyl Phthalate	105	97	69	28	29
Ethylbenzene	1,092	987	45	942	95
Isophorone	17	17	17	0	0
Methylene Chloride	660	660	234	426	65

Table 11-14 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Naphthalene	832	740	137	603	81
Phenol	115	115	115	0	0
Tetrachloroethene	1,048	1,001	124	876	88
Toluene	1,463	1,279	350	929	73
trans-1,2-Dichloroethene	61	61	61	0	0
Trichloroethene	48	48	48	0	0
Total Priority Organics	**9,614**	**8,877**	**3,018**	**5,860**	**—**
Nonconventional Organics					
2-Butanone	386	386	386	0	0
2-Methylnaphthalene	173	169	64	105	62
2-Propanone	2,292	2,276	2,237	39	2
4-Methyl-2-pentanone	290	287	222	65	23
∝-Terpineol	170	170	170	0	0
Benzoic Acid	846	846	729	117	14
Benzyl Alcohol	229	229	229	0	0
Hexanoic Acid	53	53	53	0	0
m-Xylene	328	315	141	173	55
n-Decane	12,628	11,605	2,655	8,949	77

Table 11-14 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
n-Docosane	190	181	51	131	72
n-Dodecane	3,631	3,378	326	3,052	90
n-Eicosane	4,373	4,205	111	4,094	97
n-Hexacosane	356	327	36	291	89
n-Hexadecane	1,756	1,636	199	1,438	88
n-Octacosane	193	184	25	160	87
n-Octadecane	1,629	1,560	107	1,453	93
n-Tetracosane	190	182	71	111	61
n-Tetradecane	2,751	2,607	175	2,432	93
n-Triacontane	197	188	53	135	72
o-&*p*-Xylene	142	135	103	32	24
p-Cresol	0	0	0	0	0
p-Cymene	820	715	143	572	80
Pentamethylbenzene	0	0	0	0	0
Total Nonconventional Organics	**33,623**	**31,634**	**8,284**	**23,352**	—
Priority Metals and Elements					
Antimony	236	230	142	88	38
Arsenic	93	93	93	0	0

Table 11-14 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Beryllium	<1	<1	<1	0	0
Cadmium	73	72	27	45	63
Chromium	197	179	81	98	55
Copper	1,797	1,688	659	1,029	61
Lead	1,355	1,267	246	1,021	81
Mercury	1	1	1	<1	20
Nickel	154	151	80	71	47
Selenium	2	2	2	0	0
Silver	47	45	29	17	37
Thallium	0	0	0	0	0
Zinc	2,669	2,600	890	1,709	66
Total Priority Metals and Elements	**6,624**	**6,328**	**2,249**	**4,080**	—
Nonconventional Metals and Elements					
Aluminum	5,816	5,685	3,583	2,102	37
Barium	945	892	307	585	66
Boron	386	386	280	106	27
Cobalt	73	69	28	42	60
Iron	12,533	12,211	4,633	7,577	62

Table 11-14 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Manganese	290	278	95	183	66
Molybdenum	133	121	70	51	42
Tin	60	60	39	20	34
Titanium	121	117	64	53	45
Vanadium	15	15	11	4	27
Yttrium	5	5	5	<1	9
Total Nonconventional Metals and Elements	**20,377**	**19,840**	**9,115**	**10,725**	—
Bulk Nonconventionals					
Chemical Oxygen Demand (COD)	3,621,646	3,447,109	1,361,590	2,085,519	61
Total Organic Carbon (TOC)	771,468	753,634	530,744	222,890	30
Total Petroleum Hydrocarbon	299,226	272,507	20,279	252,228	93

[1]Numbers in this table were calculated using more significant figures than shown.
HEM - Hexane extractable material
SGT-HEM - Silica get treated-hexane extractable material

Table 11-15
Summary of Pollutant Loadings and Removals for the Excluded Industrial Laundries (141 Facilities) for CP-IL[1]

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Conventionals					
Biochemical Oxygen Demand 5-Day (BOD_5)	1,039,528	1,013,533	771,110	242,423	24
Oil and Grease (measured as HEM)	687,931	616,915	110,856	506,059	82
Total Suspended Solids (TSS)	921,104	887,444	240,935	646,509	73
Priority Organics					
1,1,1-Trichloroethane	890	818	209	609	74
1,2-Diphenylhydrazine	0	0	0	0	0
4-Chloro-3-methylphenol	173	173	28	145	84
Bis(2-ethylhexyl) Phthalate	1,625	1,479	595	884	60
Butyl Benzyl Phthalate	351	303	101	202	67
Chlorobenzene	49	46	13	33	71
Chloroform	892	892	892	0	0
Di-*n*-butyl Phthalate	193	161	42	120	74
Di-*n*-octyl Phthalate	105	97	71	26	27
Ethylbenzene	1,092	987	141	846	86
Isophorone	17	17	17	0	0
Methylene Chloride	660	660	84	576	87

Table 11-15 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Naphthalene	832	740	129	612	83
Phenol	115	115	115	0	0
Tetrachloroethene	1,048	1,001	127	874	87
Toluene	1,463	1,279	461	819	64
trans-1,2-Dichloroethene	61	61	61	0	0
Trichloroethene	48	48	48	0	0
Total Priority Organics	**9,614**	**8,877**	**3,134**	**5,746**	**—**
Nonconventional Organics					
2-Butanone	386	386	386	0	0
2-Methylnaphthalene	173	169	21	148	88
2-Propanone	2,292	2,276	2,276	0	0
4-Methyl-2-pentanone	290	287	287	0	0
∝-Terpineol	170	170	170	0	0
Benzoic Acid	846	846	846	0	0
Benzyl Alcohol	229	229	229	0	0
Hexanoic Acid	53	53	53	0	0
m-Xylene	328	315	147	168	53
n-Decane	12,628	11,605	2,458	9,146	79

Table 11-15 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
n-Docosane	190	181	42	139	77
n-Dodecane	3,631	3,378	1,269	2,110	62
n-Eicosane	4,373	4,205	89	4,116	98
n-Hexacosane	356	327	32	295	90
n-Hexadecane	1,756	1,636	190	1,446	88
n-Octacosane	193	184	29	155	84
n-Octadecane	1,629	1,560	86	1,474	94
n-Tetracosane	190	182	63	119	65
n-Tetradecane	2,751	2,607	167	2,440	94
n-Triacontane	197	188	55	133	71
o-&*p*-Xylene	142	135	90	45	33
p-Cresol	0	0	0	0	0
p-Cymene	820	715	715	0	0
Pentamethylbenzene	0	0	0	0	0
Total Nonconventional Organics	**33,623**	**31,634**	**9,700**	**21,934**	**--**
Priority Metals and Elements					
Antimony	236	230	116	114	50
Arsenic	93	93	93	<1	<1

Table 11-15 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Beryllium	<1	<1	<1	<1	2
Cadmium	73	72	22	50	70
Chromium	197	179	67	112	62
Copper	1,797	1,688	440	1,248	74
Lead	1,355	1,267	201	1,066	84
Mercury	1	1	1	0	0
Nickel	154	151	76	75	49
Selenium	2	2	2	0	0
Silver	47	45	29	16	37
Thallium	0	0	0	0	0
Zinc	2,669	2,600	432	2,168	83
Total Priority Metals and Elements	**6,624**	**6,328**	**1,480**	**4,851**	**---**
Nonconventional Metals and Elements					
Aluminum	5,816	5,685	2,972	2,713	48
Barium	945	892	411	482	54
Boron	386	386	215	171	44
Cobalt	73	69	25	44	64
Iron	12,533	12,211	5,519	6,692	55

Table 11-15 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Manganese	290	278	77	201	72
Molybdenum	133	121	112	9	8
Tin	60	60	8	52	87
Titanium	121	117	68	48	41
Vanadium	15	15	12	3	20
Yttrium	5	5	5	0	0
Total Nonconventional Metals and Elements	**20,377**	**19,840**	**9,424**	**10,415**	**—**
Bulk Nonconventionals					
Chemical Oxygen Demand (COD)	3,621,646	3,447,109	1,399,219	2,047,890	59
Total Organic Carbon (TOC)	771,468	753,634	536,823	216,811	29
Total Petroleum Hydrocarbon	299,226	272,507	18,171	254,336	93

[1]Numbers in this table were calculated using more significant figures than shown.
HEM - Hexane extractable material
SGT-HEM - Silica get treated-hexane extractable material

Table 11-16
Summary of Pollutant Loadings and Removals for the Excluded Industrial Laundries (141 Facilities) for Combo-IL[1]

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Conventionals					
Biochemical Oxygen Demand 5-Day (BOD_5)	1,039,528	1,013,533	771,110	242,423	24
Oil and Grease (measured as HEM)	687,931	616,915	117,506	499,408	81
Total Suspended Solids (TSS)	921,104	887,444	240,935	646,508	73
Priority Organics					
1,1,1-Trichloroethane	890	818	209	609	74
1,2-Diphenylhydrazine	0	0	0	0	0
4-Chloro-3-methylphenol	173	173	78	95	55
Bis(2-ethylhexyl) Phthalate	1,625	1,479	617	862	58
Butyl Benzyl Phthalate	351	303	152	152	50
Chlorobenzene	49	46	14	33	71
Chloroform	892	892	892	0	0
Di-*n*-butyl Phthalate	193	161	62	100	62
Di-*n*-octyl Phthalate	105	97	71	26	27
Ethylbenzene	1,092	987	141	846	86
Isophorone	17	17	17	0	0
Methylene Chloride	660	660	234	426	65

Table 11-16 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Naphthalene	832	740	137	603	81
Phenol	115	115	115	0	0
Tetrachloroethene	1,048	1,001	128	873	87
Toluene	1,463	1,279	461	819	64
trans-1,2-Dichloroethene	61	61	61	0	0
Trichloroethene	48	48	48	0	0
Total Priority Organics	**9,614**	**8,877**	**3,436**	**5,442**	—
Nonconventional Organics					
2-Butanone	386	386	386	0	0
2-Methylnaphthalene	173	169	64	105	62
2-Propanone	2,292	2,276	2,237	39	2
4-Methyl-2-pentanone	290	287	287	0	0
∝-Terpineol	170	170	170	0	0
Benzoic Acid	846	846	729	117	14
Benzyl Alcohol	229	229	229	0	0
Hexanoic Acid	53	53	53	0	0
m-Xylene	328	315	147	168	53
n-Decane	12,628	11,605	2,655	8,949	77

Table 11-16 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
n-Docosane	190	181	51	131	72
n-Dodecane	3,631	3,378	1,269	2,110	62
n-Eicosane	4,373	4,205	111	4,094	97
n-Hexacosane	356	327	36	291	89
n-Hexadecane	1,756	1,636	199	1,438	88
n-Octacosane	193	184	29	155	84
n-Octadecane	1,629	1,560	107	1,453	93
n-Tetracosane	190	182	71	111	61
n-Tetradecane	2,751	2,607	175	2,432	93
n-Triacontane	197	188	55	133	71
o-&*p*-Xylene	142	135	103	32	24
p-Cresol	0	0	0	0	0
p-Cymene	820	715	143	572	80
Pentamethylbenzene	0	0	0	0	0
Total Nonconventional Organics	**33,623**	**31,634**	**9,306**	**22,330**	**---**
Priority Metals and Elements					
Antimony	236	230	142	88	38
Arsenic	93	93	93	0	0

Table 11-16 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Beryllium	<1	<1	<1	<1	2
Cadmium	73	72	27	45	63
Chromium	197	179	81	98	55
Copper	1,797	1,688	659	1,029	61
Lead	1,355	1,267	246	1,021	81
Mercury	1	1	1	<1	20
Nickel	154	151	80	71	47
Selenium	2	2	2	0	0
Silver	47	45	29	17	37
Thallium	0	0	0	0	0
Zinc	2,669	2,600	890	1,709	66
Total Priority Metals and Elements	**6,624**	**6,328**	**2,250**	**4,080**	—
Nonconventional Metals and Elements					
Aluminum	5,816	5,685	3,583	2,102	37
Barium	945	892	411	482	54
Boron	386	386	280	106	27
Cobalt	73	69	28	42	60
Iron	12,533	12,211	5,519	6,692	55

Table 11-16 (Continued)

Pollutant of Concern	Industry Raw Wastewater Pollutant Loading (lbs/yr)	Industry Baseline Wastewater Pollutant Loading (lbs/yr)	Industry Post-Compliance Wastewater Pollutant Loading (lbs/yr)	Industry Pollutant Removal from Baseline (lbs/yr)	Percentage Removal from Baseline (%)
Manganese	290	278	95	183	66
Molybdenum	133	121	112	9	8
Tin	60	60	39	20	34
Titanium	121	117	68	48	41
Vanadium	15	15	12	3	23
Yttrium	5	5	5	0	0
Total Nonconventional Metals and Elements	**20,377**	**19,840**	**10,151**	**9,688**	**—**
Bulk Nonconventionals					
Chemical Oxygen Demand (COD)	3,621,646	3,447,109	1,399,220	2,047,890	59
Total Organic Carbon (TOC)	771,468	753,634	536,823	216,811	29
Total Petroleum Hydrocarbon	299,226	272,507	20,279	252,228	93

[1]Numbers in this table were calculated using more significant figures than shown.
HEM - Hexane extractable material
SGT-HEM - Silica get treated-hexane extractable material

CHAPTER 12

COSTS OF TECHNOLOGY BASES FOR REGULATIONS

12.1 Introduction

This chapter describes the methodology used to estimate the costs to implement each of the regulatory options under consideration for the Industrial Laundries Point Source Category. Chapters 8 and 10 describe in detail the regulatory options as well as the technologies used as the bases for the options. The cost estimates, together with the pollutant reduction estimates described in Chapter 11, provide a basis for evaluating the options. The cost estimates also provide a basis for determining the economic impact of the proposed regulation on the industry at different pollutant discharge levels. The results from assessing the economic impact of the regulation are found in the Economic Assessment (EA) for the industrial laundries proposed rulemaking (1).

EPA used the following approach in estimating compliance costs for the industrial laundries industry:

- EPA mailed detailed questionnaires to a statistically selected sample of industrial laundries (discussed in Chapter 3). The information from the 193 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 6.

- EPA analyzed field sampling data to determine the pollutant concentrations of untreated wastewater in the industry (discussed in Chapter 11).

- EPA identified candidate end-of-pipe wastewater treatment technologies and grouped appropriate technologies into regulatory options (discussed in Chapters 8, 9, and 10). The regulatory options serve as the bases for compliance cost and pollutant loading calculations.

- EPA analyzed field sampling data and detailed monitoring questionnaire (DMQ) data to determine pollutant removal performance of the technology options (discussed in Chapter 11).

- EPA developed cost equations for capital and operating and maintenance (O&M) costs for each of the technologies included in the regulatory 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 compliance costs (presented in this chapter) and pollutant loadings (presented in Chapter 11) for each option.

- 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 performed an analysis comparing each facility's annualized cost for each regulatory option to the annualized cost for the facility to have their wastewater contract hauled to an off-site treatment facility (presented in this chapter). If the cost for contract hauling was less than the cost to install and operate an on-site treatment system, the contract-hauling 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 industry-wide costs for the five regulatory options by estimating compliance costs for the 193 in-scope facilities to purchase, install, and operate each of the technology options. Using statistically calculated facility weighting factors, EPA then extrapolated the results to the entire industrial laundries industry (1,747 industrial laundries).

The following information is discussed in this section:

- Section 12.2 discusses the costing methodology;

- Section 12.3 discusses cost modeling and summarizes cost estimating assumptions and design bases for the technologies that comprise the regulatory options;

- Section 12.4 presents the cost estimates by regulatory option; and

- Section 12.5 presents the references used in this section.

12.2 Costing Methodology

To accurately determine the impact of the proposed pretreatment standards on the industrial laundries industry, EPA estimated costs associated with regulatory compliance. The 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 basis 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 the proposed regulations do not require that a facility install or possess 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. In some cases, facilities were excluded from being costed if they 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 10, EPA identified the following regulatory options:

- DAF-IL Option - Dissolved air flotation (DAF) treatment of wastewater generated from the washing of industrial laundry items only; the cost model uses long-term averages calculated from sampling data 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 laundry items only; the cost model uses long-term averages calculated from sampling data for chemical precipitation treatment of a facility's total process wastewater stream to calculate pollutant removals for the CP-IL option.

- Combo-IL Option - Either DAF or chemical precipitation treatment of wastewater generated from the washing of industrial laundry items only; the cost model uses a single set of combined long-term averages, based on the higher long-term average calculated for each pollutant from sampling data for either DAF or chemical precipitation treatment of a facility's total process wastewater stream to calculate pollutant removals for the Combo-IL option.

- Combo-IL-2LIM Option - Either DAF or chemical precipitation treatment of wastewater generated from the washing of industrial laundry items only; the cost model uses two sets of long-term averages, based on sampling data for either DAF or chemical precipitation treatment of a facility's total process wastewater stream to calculate pollutant removals for the Combo-IL-2LIM option. For facilities currently operating DAF, the DAF limits are applied; for all other facilities, the chemical precipitation limits are applied.

- OC-Only Option - Steam-tumbling treatment of facilities' heavy industrial laundry items prior to water washing; the cost model uses target concentrations calculated from steam tumbling sampling data to calculate pollutant removals for 24 organic pollutants for the OC-Only option.

12.2.1 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. In addition, the MP&M cost model

driver was designed to handle flow reduction technologies and practices as part of the regulatory options. This allowed pollutant concentrations and flow rates from certain streams to be adjusted as the streams were sent to flow reduction modules. Although flow reduction technologies are currently not part of the proposed regulatory options for industrial laundries, the MP&M cost model driver allows the flexibility to add them to the cost model.

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 importance of each calculated value in the cost calculated for each technology module.

The inputs to the industrial laundries cost model include raw wastewater pollutant concentrations, flow rates, operating schedules, and treatment technologies currently in place for each facility costed. EPA obtained the flow rates, operating schedules, and treatment technologies currently in place 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 raw wastewater pollutant concentrations for each facility costed using sampling and DMQ data based on each facility's production data, as described in Chapter 11. The input information for the cost model was maintained in database files. Section 12.3 of this document discusses the cost model and its operation in more detail.

12.2.2 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 1993. 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 annual operating and maintenance (O&M) and capital costs for each technology and to sum the capital and O&M costs for all technologies at each facility. 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. 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 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. EPA obtained the wage rate for all required labor to properly install, operate, and maintain 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. It was assumed that an industrial laundry treatment system operator would receive an equivalent rate of pay as an installation worker. Assumptions on the number of hours required of a worker to operate a treatment system were made for each piece of equipment that was included in the treatment system for each regulatory option. Section 12.3 of this document discusses these assumptions in detail.

EPA obtained the cost for electricity used by various treatment technologies from the Department of Energy's Monthly Energy Review (4). The average cost of electricity for industrial facilities for the year 1993 was $0.049 per kilowatt-hour.

Table 12-1 presents the O&M unit costs used by the cost model and includes references for the origin of each cost.

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 12-2 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 12-1

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	(19)
Contract hauling of bulk wastewater	537 per full load (5,000 gallons bulk liquid)	Contract Haul	(18)
Monitoring fee for contract hauled wastewater	200 per year	Contract Haul	(18)
Nonhazardous dewatered sludge disposal	2.12 per cubic foot	Sludge Dewatering	(13)
Treatment fee for contract hauled wastewater	0.35 per gallon	Contract Haul	(18)
Chemicals			
Chemical	**Cost (1993 $s)**	**Module(s)**	**Reference**
Anionic polymer	2.48 per pound	DAF, Chemical Precipitation	(10, 12)
Cationic polymer	1.34 per pound	DAF, Chemical Precipitation	(10, 12)
Ferric chloride	0.49 per pound	DAF	(10)
Hydrated lime	67.50 per ton	Chemical Precipitation	(12)
Perlite	0.63 per pound	DAF	(10)
Quick lime	45 per ton	Chemical Precipitation	(12)
Sodium hydroxide (50%)	0.138 per pound	pH Adjustment	(15)
Sulfuric acid (93%)	75 per ton	DAF, pH Adjustment	(10, 15)
Equipment			
Equipment	**Cost (1993 $s)**	**Module(s)**	**Reference**
Agitator maintenance and materials cost	5% of the direct capital cost of agitator per year	Equalization, pH Adjustment	(8, 15)
Air-operated sludge pump maintenance and materials cost	1% of the direct capital cost of pump per year	Pump	(6)
Building maintenance and materials cost	3.5% of the direct capital cost of the building per year	Building	(16, 17)
Chemical feed system materials maintenance and cost (0.01 to 3,200 lb/hr)	Cost per year = $2,868.6 + 4.0721 \times C + (1.7502 \times 10^{-5}) \times C^2$ (C = Capacity in pounds per hour)	DAF, pH Adjustment	(10, 15)

Table 12-1 (Continued)

Equipment (Continued)			
Equipment	**Cost (1993 $s)**	**Module(s)**	**Reference**
Compliance monitoring materials cost	248.83 per year	Compliance Monitoring	(19)
Continuous/batch chemical precipitation treatment unit maintenance and materials cost	5% of the direct capital cost of the chemical precipitation unit per year	Chemical Precipitation	(12)
Continuous DAF treatment unit maintenance and materials cost	2% of the direct capital cost of the DAF unit per year	DAF	(9, 10)
Positive displacement or centrifugal pump maintenance and materials cost	1% of the direct capital cost of pump per year	Pump	(6)
Reaction tank maintenance and materials cost	5% of direct capital cost of tank per year	Equalization, pH Adjustment, Contract Haul	(8, 15, 19)
Replacement pH probe	276.79 per probe	pH Adjustment	(15)
Replacement plates for 48-inch and 60-inch shaker screen units	435.49 to 633.52335.14 per plate replaced every two years	Screen	(7)
Replacement porous collection bags for shaker screen lint	200 per year	Screen	(7)
Replacement screens for 48-inch and 60-inch shaker screen units	180.78 to 263.76 per screen replaced twice per year	Screen	(7)
Replacement sliders for 48-inch and 60-inch shaker screen units	106.94 to 154.09 per screen	Screen	(7)
Storage tank maintenance and materials cost	2% of direct capital cost of tank per year	Screen	(7)
General Costs			
Item	**(Cost (1993 $s)**	**Module(s)**	**Reference**
Electricity usage fee	0.049 per kilowatt-hour	All	(4)
O&M labor rate	25.27 per hour	All	(3)

Table 12-2

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	(6)
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	(12)
Building	19.38 per square foot	Building	(17)
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	(15)
Centrifugal wastewater transfer pumps (> 27 gpm)	Cost = 2,758.989 × long (C) - 2,185.941 per pump (C = capacity in gpm)	Pump	(6)
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	(10, 15)
Concrete slab	8.39 per square foot	Building	(17)
Concrete curb	6.51 per foot	Building	(17)
Continuous chemical precipitation treatment units (2 to 150 gpm)	Cost = 47,192 + 1,129.6 × C - 1.3255 x C^2 per unit (C = capacity in gpm)	Chemical Precipitation	(12)
Continuous DAF treatment units (25 to 1,000 gpm)[1]	Cost = 111,370 × log (C) - 139,260 per unit (C = capacity in gpm)	DAF	(10)
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	(19)
Covered and flanged fiberglass tanks (110 to 50,000 gallons)	Cost = 2,927.1 + 0.9182 × V per tank (V = volume in gallons)	Equalization	(8)
Equipment and labor required for washer modification for split stream capability	4,096.61 to 7,599.38 per washer	Stream Splitting	(5)

Table 12-2 (Continued)

Capital Costs (includes crane rental)			
Item	**Cost (1993 $s)**	**Module(s)**	**Reference**
Filter press (5 to 125 ft^3)	Cost = 33,331 x ln(C) - 36,195 per press (C = capacity in ft^3)	Sludge Dewatering	(13)
Flange-mounted agitators (0.25 to 5 hp)	Cost = 4,247.414 + 2,616.527 × log (P) per agitator (P = power requirement in hp)	Equalization	(8)
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	(7, 15)
pH controller	1,554.77 per controller	pH Adjustment	(15)
Positive displacement wastewater transfer pumps (<3 to 27 gpm)	839.38 to 2130.04 per pump	Pump	(6)
PVC piping for stream segregation retrofit[2]	27.08 per foot	Stream Splitting	(5)
Shaker screen unit (48-inch and 60-inch units)	8,131.76 to 9,542.93 per unit	Screen	(7)
Utility installation and hook up	1.14 per square foot	Building	(17)

[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.

- 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).

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 12-3 presents the components of the total capital investment, including the indirect capital cost factor used by the cost model.

12.2.3 Treatment-in-Place Credit Methodology

EPA evaluated facility responses to the detailed questionnaire to determine which treatment technologies are currently in place and in operation at each facility. 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 were estimated for facilities that were determined to have treatment equivalent to an option currently in use. EPA's methodology for giving credit to facilities for existing treatment on site is discussed below.

Table 12-3

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

- Stream splitting - EPA gave stream-splitting credit to facilities that indicated that a portion of their wastewater was currently being 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 stream under the assumption that the screen was adequate to treat a larger amount of wastewater stream 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 12.3 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 12.2.2 of this document. Section 12.3 further discusses this treatment-in-place cost estimate.

- Sludge dewatering devices - EPA gave facilities full sludge dewatering credit if they indicated that their sludge dewatering device treated sludge being 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 options utilizing chemical precipitation 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; 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)); and full credit in the total stream treatment options only if they indicated that they use in-line pH adjustment.

- Space inside of the facility - EPA costed facilities for a building of adequate size to house the treatment 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 currently monitor their wastewater effluent.

12.3 Cost Modeling

12.3.1 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 regulatory 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 regulatory 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 regulatory options. Chapter 10 discusses in greater detail the specific combinations of these technologies into the regulatory options. These technologies, components, and practices are listed below:

- Organics control via steam tumbling of heavy industrial laundry items;
- 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 12.2.1, 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;
  - 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.

12.3.2 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 for the IL options in order for each facility to direct all wastewater generated from the washing of industrial items to the wastewater treatment system, while allowing the facility to discharge wastewater generated from the washing of nonindustrial 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 currently 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 currently 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 (5). 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 item 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 currently transferring each segregated stream to a treatment unit , it was given credit for having the pump in place. Refer to Section 12.3.3 below for a more detailed description of the pumps cost module.

12.3.3 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 technology

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 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 in the IL options 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 module), because it was assumed that the wastewater can flow by gravity into the sewer.

Direct annual costs included O&M labor and 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 and O&M 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. Typically, the annual operating labor required for each pump is approximately 15 minutes per week and maintenance activities require approximately 15 to 30 minutes per week (6).

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.

12.3.4 Screening

Mechanical screens are commonly used at industrial laundries to remove lint and other solid constituents from wastewater. Therefore, in each of the IL regulatory options, EPA estimated costs for mechanical screening of a facility's untreated wastewater from the washing of nonindustrial laundry items prior to recombination with treated wastewater from the washing of industrial 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.

Direct annual costs included O&M labor and 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 and O&M 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. The annual operating labor required for changing out each drum or sack of collected lint is calculated assuming it takes one worker 10 minutes per sack. The number of drums or sacks that will be changed per year is calculated based on average lint generation rates (gallons of lint removed per gallon of wastewater screened) that were reported by industrial laundry facilities in the detailed questionnaire. Annual maintenance labor for the shaker screen was estimated by the vendor to be 75 minutes per year to regularly replace various parts (e.g., the screen, sliders, and perforated plates) and approximately 30 minutes per week to grease the motor bearings. The annual O&M labor cost for the holding tank is not calculated as a separate item, but is included as part of the estimating factor for the total annual cost (i.e., two percent of the direct capital cost of the tank), based on estimates used in past effluent guidelines efforts (7).

A cost was calculated for a screen if a facility did not report that it currently has 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 currently screens any portion of its wastewater would also be able to screen the wastewater generated from washing its industrial laundry items and, therefore, EPA calculated zero capital and annual costs for the screen in the IL options.

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 and operating labor, were also included as part of the shaker screen module. If a facility indicated that it was currently 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 12.3.3 of this document for a more detailed description of the pumps cost module.

12.3.5 Equalization

EPA estimated costs for the equalization of a facility's industrial laundry wastewater in the IL options. 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.

Direct annual costs included O&M labor and material costs, as well as 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 (8). 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 and O&M 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. The annual O&M labor 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 (i.e., five percent of the direct capital cost of the items), based on estimates used in past effluent guidelines efforts (8).

A cost was calculated for an equalization tank if a facility did not report that it has a large enough tank currently 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 currently transferring the stream to another treatment unit, it was given credit for having the effluent pump in place. Refer to Section 12.3.3 of this document for a more detailed description of the pumps cost module.

12.3.6 Dissolved Air Flotation

EPA estimated costs for DAF treatment of wastewater generated from the washing of industrial laundry items in the DAF-IL, Combo-IL, and Combo-IL-2LIM options. 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.

Direct annual costs included O&M labor and 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 long-term averages calculated from DAF system sampling and DMQ data. The module also calculated effluent and sludge flow rates 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 DAF treatment.

The DAF module includes an estimate of installation and O&M 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. The vendor estimated that the annual operating labor required one worker four hours per day, mostly to condition the sludge prior to dewatering. The maintenance labor for the DAF unit was estimated to be included as part of the total maintenance cost factor of two percent of the DAF system capital cost (9).

The DAF module also includes installation and O&M labor costs for the chemical feed system. The installation and annual maintenance labor for the chemical feed system were calculated with the total capital and annual costs, respectively, from the cost curves obtained from past effluent guidelines costing efforts. The labor hours were not broken out as separate items (10).

A cost was calculated for a DAF unit if a facility did not report that it currently treats 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 all of the IL options and received only monitoring costs to comply with the proposed rule under these options. However, a facility that reported treating a portion of its wastewater was evaluated as to whether it had sufficient DAF capacity to treat the wastewater according to each option. 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 currently 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, ultrafiltration and microfiltration are considered to provide greater pollutant removals than DAF (11). Therefore, facilities with chemical precipitation, ultrafilters, or microfilters received treatment-in-place credit for having a complete DAF system for treatment of all or a portion of their process wastewater, as appropriate.

12.3.7 Chemical Precipitation

EPA estimated costs for chemical precipitation treatment of wastewater generated from washing industrial laundry items in the CP-IL, Combo-IL, and Combo-IL-2LIM options. 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.

Direct annual costs included O&M labor and 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 calculates pollutant loads in the treated wastewater effluent using long-term averages calculated from chemical precipitation system sampling and DMQ data. The module also calculates effluent and sludge flow rates 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 and O&M 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. The O&M labor for the chemical precipitation unit was estimated to be included as part of the estimating factor for the total annual cost (i.e., five percent of the chemical precipitation system capital cost), based on past effluent guidelines costing efforts (12).

A cost was calculated for a chemical precipitation unit if a facility did not report that it currently treats 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 all of the IL options and received only monitoring costs to comply with the proposed 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 12.3.6 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 unit simultaneously. Instead, these facilities received no credit toward the IL options and received capital and annual costs to install and operate a new continuous 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 12.3.3 of this document for a more detailed description of the pumps cost module.

Ultrafiltration and microfiltration are considered to provide greater pollutant removals than chemical precipitation (11). Therefore, facilities with ultrafilters or microfilters received treatment-in-place credit for having a complete chemical precipitation system for treatment of all or a portion of their process wastewater, as applicable.

12.3.8 Sludge Dewatering

EPA estimated costs for facilities to dewater the sludge generated by either a DAF or chemical precipitation unit in the DAF, chemical precipitation and Combo options. 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.

Direct annual costs included O&M labor and 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 and O&M 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. The operating labor required for the filter press is estimated by the vendor to be between 30 and 60 minutes per batch. The vendor also estimated an additional two hours per year for maintenance on the press (mostly for changing the filter cloths) (13).

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 and operating labor, were also included as part of the sludge dewatering module. If a facility indicated that they were currently dewatering an appropriate amount of sludge, they were given credit for having the influent

pump in place. Refer to Section 12.3.3 of this document for a more detailed description of the pumps cost module.

12.3.9 pH Adjustment

EPA estimated costs for facilities to adjust the pH of the effluent wastewater generated by the chemical precipitation options. 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.

Direct annual costs included O&M labor and 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 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 options 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 options is already within the assumed pH limits, pH adjustment costs are not calculated for these options.

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 (14). 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 and O&M 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. The annual O&M labor cost for the equalization tank and mixer 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 items), based on estimates used in past effluent guidelines efforts (15).

The pH adjustment module also includes installation and O&M labor costs for the chemical feed system. The installation labor and the annual maintenance labor for the chemical feed system were included in the total capital and annual costs, respectively, used from past effluent guidelines costing efforts. The labor hours were not broken out as separate items.

A facility received full pH adjustment treatment-in-place credit if it reported currently 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. Facilities that reported using in-line pH adjustment received chemical addition and pH monitoring credit. EPA assumes that adjusting the pH while combining the treated and untreated streams close to the discharge point does not allow for sufficient mixing of the streams and the chemical; thus the target pH would be not be consistently achieved.

12.3.10 Treatment System Building

EPA estimated costs for facilities to construct a building to house the option treatment system. The building module calculates the costs necessary to construct and maintain a building designed to house the option treatment system.

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).

Direct 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 (16). The capital cost associated with constructing the building was based on the required size of the building. The square footage requirement of the concrete slab and building, as well as the perimeter length of curbing, were determined for each 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 three- to six-foot clearance between equipment pieces and the building walls. The costs per foot of curbing and costs per square foot of slab and building were both obtained from vendors. All buildings for which costs were calculated by the module included a 16-foot eave height and one 10-foot by 10-foot overhead bay door. All of the installation cost estimates provided by the vendor include the required labor (17).

A facility received full credit for a building in place if they reported having sufficient space currently 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.

12.3.11 Contact Haul In Lieu of Treatment

EPA assessed 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 compared to the cost of on-site treatment. The equipment included in the industrial laundries treatment options have minimum sizes and capacities. For industrial laundries with low flow rates, it was sometimes found to be less expensive for a facility to have wastewater contract hauled for off-site disposal rather than treat the wastewater on site. To assess contract hauling in lieu of treatment, EPA compared the annualized cost of contract hauling the wastewater to be treated 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;

Direct annual costs included operating and maintenance 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 30 days 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 each trip involves using one 5,000-gallon tank truck to haul the wastewater) 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-in-lieu-of-treatment 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 (18). The installation labor required for the stream-splitting components is described in Section 12.3.2 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 12.3.3 of this document for a more detailed description of the pumps cost module.

12.3.12 Compliance Monitoring

EPA calculated annual compliance monitoring costs for all industrial laundry facilities that discharge wastewater. The annual cost calculated by the cost model for compliance monitoring included laboratory costs to analyze composite samples of volatile and semivolatile organics and quantitative metals monthly, and to analyze total petroleum hydrocarbons (measured as silica gel treated-hexane extractable material) once a month collected as four grab samples. The costs for each type of analysis per sample were obtained from a laboratory contracted by EPA on past wastewater sampling efforts. EPA assumed that one worker would be required to spend eight hours per month to collect the samples for analysis. 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 currently monitor their wastewater were only costed for the analyses. Otherwise, facilities were costed for the analysis, labor, and materials required for the wastewater monitoring. EPA assumed it would take one worker eight hours per month to perform collect the samples (19).

12.4 Engineering Costs by Regulatory Option

Table 12-4 summarizes estimated engineering costs by regulatory option for Pretreatment Standards for Existing Sources (PSES). Costs shown include capital and annual O&M (including energy usage) costs totaled for the 193 in-scope facilities extrapolated to represent the entire industrial laundries industry of 1,747 facilities. In addition, the capital and O&M costs are shown for 21 in-scope facilities (representing 141 facilities in the industry) which are excluded from the proposed regulation, as discussed in Chapter 6.

Table 12-5 summarizes estimated PSES engineering costs on an amortized yearly basis for the 172 in-scope facilities that are included in the proposed regulation, as discussed in Chapter 6. These costs were extrapolated to represent a total of 1,606 facilities included in the regulation. 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 is less expensive to operate on an annualized basis than DAF because of much lower operating and maintenance costs for chemical precipitation than for DAF. EPA's performance data show that chemical precipitation achieves better treatment than DAF. In EPA's estimates, facilities that currently operate a DAF would realize an operating and maintenance cost savings for operating a chemical precipitation unit compared to operating a DAF unit. Therefore, EPA's estimated costs for the CP-IL option include operating and maintenance cost credit for facilities that currently operate a DAF to replace the DAF unit with a chemical precipitation unit. EPA's costing analysis for the Combo-IL and Combo-IL-2LIM options assumed that all facilities that already have DAF installed would continue to operate it if given the choice because of constraints on financing (the limits for these options can be achieved by DAF). Since the cost estimates for Combo-IL and Combo-IL-2LIM do not involve replacement of DAF units, there are no operating and maintenance cost credits in these options. For this reason, the Combo-IL and Combo-IL-2LIM options are estimated to be more expensive on an annualized basis than the CP-IL option.

12.5 References

1. 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.

Table 12-4

Summary of PSES Engineering Costs

Option	Capital Cost (Million 1993 $s)	O&M Cost (Million $/yr (in 1993 $s))
Capital and Annual Costs for All Industrial Laundries		
DAF-IL	349	131
CP-IL	449	83.4
Combo-IL	421	94.1
Combo-IL-2LIM	349 - 449	83.4 - 131
OC-Only	273	32.2
Capital and Annual Costs for the Excluded Industrial Laundries		
DAF-IL	19.5	5.98
CP-IL	24.1	4.98
Combo-IL	22.2	5.03
Combo-IL-2LIM	19.5 - 24.1	4.98 - 5.98
OC-Only	10.3	0.606

Source: Output from the Industrial Laundries Design and Cost Model, July 15, 1997.

Table 12-5

Summary of PSES Annualized Engineering Costs for Industrial Laundries Included in the Proposed Regulation

Option	Annualized Cost (Million $/yr (in 1993 $s))
DAF-IL	107
CP-IL	85.0
Combo-IL	90.0
Combo-IL-2LIM	85.0 - 107
OC-Only	41.6

Source: Economic Assessment for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category. EPA-821-R-97-005, November 1997.

2. "Economic Indicators". Chemical Engineering, March 1994, page 182.

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5. Eastern Research Group, Inc. Stream Splitting Cost Module Documentation for the Industrial Laundries Cost Model. Prepared for the U.S. Environmental Protection Agency, Office of Water, Washington, DC, November 1997.

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8. Eastern Research Group, Inc. Equalization Cost Module Documentation for the Industrial Laundries Cost Model. Prepared for the U.S. Environmental Protection Agency, Office of Water, Washington, DC, November 1997.

9. U.S. Environmental Protection Agency. Guidance Document for Effluent Discharges from the Auto and Other Laundries Point Source Category. Office of Water and Waste Management, February 1982.

10. Eastern Research Group, Inc. Dissolved Air Flotation Cost Module Documentation for the Industrial Laundries Cost Model. Prepared for the U.S. Environmental Protection Agency, Office of Water, Washington, DC, November 1997.

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12. Eastern Research Group, Inc. Chemical Precipitation Cost Module Documentation for the Industrial Laundries Cost Model. Prepared for the U.S. Environmental Protection Agency, Office of Water, Washington, DC, November 1997.

13. Eastern Research Group, Inc. Filter Press Cost Module Documentation for the Industrial Laundries Cost Model. Prepared for the U.S. Environmental Protection Agency, Office of Water, Washington, DC, November 1997.

14. Trimble, D. "Neutralizing Alkaline Wastewaters". Textile Rental, November 1994, pages 80-82.

15. Eastern Research Group, Inc. pH Adjustment Cost Module Documentation for the Industrial Laundries Cost Model. Prepared for the U.S. Environmental Protection Agency, Office of Water, Washington, DC, November 1997.

16. Peters, Max S. et al. Plant Design and Economics for Chemical Engineers, Fourth Edition. McGraw-Hill, Inc., 1991.

17. 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, DC, November 1997.

18. 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, DC, November 1997.

19. Eastern Research Group, Inc. Monitoring Cost Estimate. Prepared for the U.S. Environmental Protection Agency, Office of Water, Washington, DC, May 1997.

CHAPTER 13

REGULATORY OPTIONS SELECTION

13.1 Introduction

This chapter summarizes the regulatory options for Pretreatment Standards for Existing Sources (PSES) and Pretreatment Standards for New Sources (PSNS) considered by EPA as the basis for the proposed rule and discusses the factors considered in determining the selected options for PSES and PSNS. Chapter 10 presents all technology options evaluated for the industrial laundries industry and summarizes the factors considered in eliminating from further consideration some of the technology options for PSES and PSNS. Factors considered in developing and selecting the options include: effectiveness of treatment technology, costs to the industry, age of the equipment and facilities involved, the laundering processes used, process changes required, non-water quality environmental impacts, engineering aspects of the control technologies, energy requirements, and ease of option implementation.

The regulatory options selected provide the technology bases for the pretreatment standards for existing and new sources presented in Section 1.3.1 of this document. Owners or operators of facilities subject to these regulations are not required to use the specific wastewater treatment technologies selected by EPA to establish the standards. Rather, a facility can use any combination of process changes, water use changes, and wastewater treatment to comply with the standards, provided that the standards are not achieved through prohibited dilution.

Section 13.2 summarizes the regulatory options considered by EPA, and Section 13.3 presents the rationale for the options selected under PSES and PSNS.

13.2 Regulatory Options Considered

This section discusses the regulatory options considered by EPA as the basis for the industrial laundries proposed rule. Section 13.2.1 presents the regulatory options considered for PSES, and Section 13.2.2 presents the regulatory options considered for PSNS. As discussed in Chapter 10, EPA is not proposing regulations for direct dischargers at this time.

13.2.1 Pretreatment Standards for Existing Sources (PSES)

Pretreatment standards for existing sources establish quantitative limits on the indirect discharge of priority and nonconventional pollutants to waters of the United States (i.e., PSES limit industrial discharges to publicly owned treatment works (POTWs)). PSES are designed to prevent the discharge of pollutants that pass through, interfere with, or are otherwise incompatible with the operation of POTWs. The Clean Water Act (CWA) requires pretreatment for pollutants that pass through POTWs in amounts that would exceed direct

discharge effluent limitations or limit POTW sludge management alternatives, including the beneficial use of sludges on agricultural lands. These limits are based upon the performance of specific technologies, but they do not require the use of any specific technology. PSES are applied to individual facilities and are administered by local permitting authorities (i.e., the government entity controlling the POTW to which the industrial wastewater is discharged). The facility then chooses its own approach to complying with its permit limitations.

The regulatory options considered for PSES for the proposed industrial laundries rule are presented in Chapter 10. These five options are summarized in the following table:

Definitions of PSES Regulatory Options Considered for the Industrial Laundries Rule

Regulatory Option	Description	Basis of Long-Term Average (LTA) Treatment Performance
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
OC-Only	Organics control (steam tumbling) of heavy items.	OC-only

13.2.2 Pretreatment Standards for New Sources (PSNS)

Pretreatment standards for new sources are designed to prevent the discharge of pollutants that pass through, interfere with, or are otherwise incompatible with the operation of POTWs. The CWA requires pretreatment for pollutants that pass through POTWs or limit POTW sludge management alternatives. The new source has the opportunity to design and install the best and most efficient industrial laundry processes and wastewater treatment facilities. Accordingly, Congress directed EPA to consider the best demonstrated alternative processes, process changes, in-plant control measures, and end-of-pipe wastewater treatment technologies that reduce pollution to the maximum extent feasible. In response to that directive, EPA considered effluent reductions attainable by the most advanced and demonstrated process and treatment technologies at industrial laundries. The factors considered in assessing PSNS include:

- The demonstration status of the process and wastewater treatment technologies;
- The cost of achieving effluent reductions;
- Non-water quality environmental impacts; and
- Energy requirements.

EPA considered the five regulatory options summarized in the previous section for PSES as the basis for PSNS.

13.3 Final Regulatory Options Selection

This section discusses the regulatory options selected for the industrial laundries proposed rule for PSES and PSNS. Levels of control for direct dischargers are also discussed.

13.3.1 Pretreatment Standards for Existing Sources (PSES)

In selecting the regulatory option for PSES, the Agency determined the total pounds of toxic and nonconventional pollutants (excluding TOC and COD) that would be removed from wastewater discharges from industrial laundries covered by PSES for each regulatory option. (Industrial laundries covered by PSES include facilities processing one million or more pounds of incoming laundry per calendar year and 255,000 or more pounds of shop towels and/or printer towels/rags per calendar year. Industry scope is discussed in detail in Chapter 6.) The Agency also estimated the total compliance cost to the industry for each of the regulatory options. The following table lists the pollutant removals and costs (determined in Chapters 11 and 12, respectively) for industrial laundries covered by PSES for the five regulatory options considered.

Estimated Annualized Costs and Toxic and Nonconventional Pollutant Removals from Industrial Laundry Discharges for Covered Industrial Laundries After Implementing PSES[1]

Option	Estimated Mass of Pollutants Removed Annually Including TPH (thousands of pounds)	Estimated Mass of TPH Removed Annually (thousands of pounds)	Annualized Cost to Industry (millions of 1993 $s)	Option Selected?
DAF-IL	12,578	10,596	107.0	
CP-IL	12,768	10,828	85.0	✓
Combo-IL	12,324	10,596	90.0	
Combo-IL-2LIM	12,578 - 12,768	10,596 - 10,828	85.0 - 107.0	
OC-Only	70	0	41.6	

[1]Data for 1,606 in-scope industrial laundries for which PSES apply.

EPA selected the CP-IL Option for PSES for industrial laundries covered by PSES because it achieves the greatest reduction in pollutants discharged. This option, as discussed in the preamble to the proposed rule, is technically available and represents the best performance economically achievable. Furthermore, the CP-IL Option has acceptable non-water quality environmental impacts.

13.3.2 Pretreatment Standards for New Sources (PSNS)

In selecting the regulatory option for PSNS, the Agency determined the total pounds of pollutants that would be discharged by new industrial laundries for each regulatory option. (EPA is proposing no exclusions by size for new industrial laundries. Industry scope is discussed in detail in Chapter 6.) The Agency also considered the total compliance cost of the proposed PSNS technologies for new facilities for each of the regulatory options. EPA selected the CP-IL Option for PSNS for the reasons mentioned in Section 13.3.1 of this document and discussed in the preamble to the proposed rule.

13.3.3 Direct Dischargers

EPA is reserving effluent limitations guidelines for direct dischargers because EPA has identified no direct dischargers and has no means of evaluating performance to determine the appropriate level of control. Proposed limitations based on pretreatment control technologies would not likely represent best available technology or best available demonstrated technology for direct dischargers because the treatment technologies at existing industrial laundries that EPA evaluated were not designed for treatment prior to discharging directly to surface waters. The type or design (i.e., size) of treatment would not represent BAT because in all cases facilities rely on additional treatment at POTWs. For the pollutants evaluated in this proposed rule, the POTW's biological treatment removed from 4 percent to 99 percent depending on the pollutant. Because EPA has not identified any POTWs receiving a very large proportion of their load (70 to 100 percent) from an industrial laundry, a determination of direct discharge effluent limitations cannot be performed.

EPA is reserving the following direct discharge levels of control: Best Practicable Control Technology Currently Available (BPT), Best Conventional Pollutant Control Technology (BCT), Best Available Technology Economically Achievable (BAT), and New Source Performance Standards (NSPS). If any direct dischargers arise, they would be subject to limitations set on a best professional judgement basis.

CHAPTER 14

NON-WATER QUALITY ENVIRONMENTAL IMPACTS

14.1 Introduction

As required by Sections 304(b) and 306 of the Clean Water Act, EPA considered the non-water quality environmental impacts associated with the implementation of the regulatory options considered as the basis for the proposed PSES and 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 CP-IL and DAF-IL regulatory options on energy consumption, air emissions, and solid waste generation of oil and sludge. EPA also considered the impacts of the CP-IL and DAF-IL regulatory options on noise pollution, water usage, and chemical usage. EPA has determined that changes in noise pollution, water usage, and chemical usage from the CP-IL and DAF-IL regulatory options would be acceptable. Because the Combo-IL and Combo-IL-2LIM options involve combinations of the CP-IL and DAF-IL options, the non-water quality environmental impacts for Combo-IL and Combo-IL-2LIM would be within the range of the impacts for CP-IL and DAF-IL. EPA did not evaluate the non-water quality environmental impacts of the OC-Only option.

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, solid waste generation, and air emissions. Specifically, the following information is presented in this chapter:

- Section 14.2 presents the non-water quality environmental impacts associated with the implementation of the CP-IL and DAF-IL regulatory options considered as the basis for PSES for the Industrial Laundries Point Source Category;
- Section 14.3 presents the non-water quality environmental impacts associated with the implementation of the regulatory options considered as the basis for PSNS for the Industrial Laundries Point Source Category; and
- Section 14.4 presents the references used.

14.2 Non-Water Quality Environmental Impacts of the CP-IL and DAF-IL Regulatory Options Considered as the Basis for PSES

EPA evaluated the non-water quality environmental impacts associated with implementation of the CP-IL and DAF-IL regulatory options considered as the basis for PSES

for the Industrial Laundries Point Source Category. These options are described in Chapter 10 of this document. Specifically, the following information is presented in this section:

- Section 14.3.1 presents the energy consumption impacts;
- Section 14.3.2 presents the air emission impacts; and
- Section 14.3.3 presents the solid waste impacts.

14.2.1 Energy Consumption Impacts

EPA evaluated energy consumption impacts associated with implementation of the CP-IL and DAF-IL options. Based on this evaluation, EPA estimates that compliance with either of these options would result in a net increase in energy consumption for the industrial laundries industry. To calculate incremental energy increases for the industrial laundries industry, EPA examined the wastewater treatment in place at the industrial laundries that would be covered by the proposed regulation. For the CP-IL and DAF-IL options, EPA used the industrial laundries cost model to calculate the energy that would be required to operate wastewater treatment equipment to be installed at industrial laundries that are not currently operating treatment systems comparable with these options. The industrial laundries cost model is described in Chapter 12. EPA extrapolated the energy increases to represent the entire industrial laundries industry, and estimated the incremental energy increase for the industrial laundries industry as a result of the CP-IL and DAF-IL options. The incremental increases in electricity use from all existing in-scope industrial laundries identified by EPA for the CP-IL and DAF-IL regulatory options are presented in Table 14-1. Table 14-1 also presents the average incremental increase per facility (based on 1,606 in-scope industrial laundries identified by EPA) and the percentage of the national energy requirements represented by the incremental increase for each regulatory option. (Approximately 2,805 billion kilowatt hours of electric power were generated in the United States in 1990(1)).

EPA estimates that the incremental energy 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 has determined that energy impacts from the proposed rule would be 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 for hot water generation. The use of heat reclaimers at industrial laundries for energy conservation is discussed in Chapter 8.

14.2.2 Air Emissions Impacts

Industrial laundry facilities generate wastewater that contains significant concentrations of organic pollutants, some of which are on the list of Hazardous Air Pollutants (HAPs) in Title 3 of the Clean Air Act Amendments (CAAA) of 1990.

Table 14-1

Incremental Energy Increases Associated With Implementation of the CP-IL and DAF-IL Regulatory Options

PSES Regulatory Option Considered for Proposal[1]	Incremental Energy Increases[2]		Percentage of National Energy Requirements[3]
	Total Industry Increase (million kilowatt hours)	Average Increase Per Facility (kilowatt hours)	
DAF-IL	79.9	49,700	0.003%
CP-IL	75.6	47,100	0.003%

[1]Regulatory options are presented in Chapter 10 of this document.
[2]Incremental energy increases are based on 1,606 industrial laundries covered by the proposed rule.
[3]Approximately 2,805 billion kilowatt hours of electric power were generated in the United States in 1990(1).

Atmospheric exposure of the organic-containing wastewater may result in volatilization of HAPs and volatile organic compounds (VOCs) from the wastewater. Emissions from wastewater treatment systems occur at process drains, manholes, trenches, sumps, screens, equalization basins, dissolved air flotation units, chemical precipitation units and at any other locations where the wastewater is in contact with the air.

EPA believes, however, that air emissions from existing industrial laundry wastewater would be similar before and after implementation of the PSES regulatory options considered for proposal. 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. Air emissions from the wastewater occur as the wastewater flows from the facility to the POTW and at the POTW. At a facility with treatment, the wastewater has more contact with air while still at the facility as it is treated in open tanks and other open treatment 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 and at the POTW. EPA believes that the overall amount of air emissions from industrial laundries wastewater would not change as a result of the PSES regulatory options considered for proposal, but that the location of air emissions would shift from the POTW's treatment system to the facility's treatment system.

EPA evaluated total fugitive air emissions for a representative industrial laundry based on a worst-case scenario. EPA considered whether this total amount of fugitive air emissions would be acceptable assuming it represented incremental air emissions due to each of the PSES regulatory options considered for proposal. However, EPA does not believe that the total amount of fugitive emissions calculated represents incremental air emissions because the amount of air emissions would be similar before and after implementation of the rule. EPA's methodology for estimating fugitive air emissions is described below.

As discussed in Chapter 9, EPA collected and analyzed wastewater samples at six industrial laundries operating treatment systems that effectively treated industrial laundry wastewater. These treatment systems are also the basis of the five PSES regulatory options considered for proposal. At all six 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 all of the PSES regulatory options considered for proposal 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:

$$Y\frac{Mg}{year} = \left[X\frac{mg}{liter}\right]\left[F\frac{gallons}{day}\right]\left[N\frac{days}{year}\right]\left[3.785\frac{liters}{gallon}\right]\left[\frac{1\ Mg}{1\ x\ 10^9\ mg}\right]$$

where

Y = megagrams of organic pollutant volatilized per year;
X = average concentration of the organic pollutant in the wastewater;
F = average daily wastewater flow rate; and
N = average days of operation per year.

Fugitive emissions were calculated for all volatile and semivolatile organic pollutants. 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 emissions levels presented in Table 14-2. Based on summing the fugitive emissions for each individual HAP, the total annual HAP emissions from this industrial laundry would be 14 Mg/year.

Under the Clean Air Act, major sources of pollution by HAPs are defined as having either:

(1) A total emission of 25 Mg/year or higher for the total of all HAPs from all emission points at a facility; or

(2) An emission of 10 Mg/year or higher for a single HAP from all emission points at a facility.

Based on these criteria, fugitive air emissions from this worst-case industrial laundry would not be classified as a major source of pollution. Based on the assumptions made to evaluate a worst-case scenario, the increases in fugitive air emissions from the PSES regulatory options considered for proposal would be much less than the fugitive air emissions calculated from the worst-case scenario. Because EPA does not believe there would be an overall increase in air emissions and because even a shift of location of air emissions would not render a facility a major source of air pollution, EPA has determined that the incremental fugitive air emissions impacts from the PSES regulatory options considered for proposal are acceptable.

Table 14-2

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
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

Table 14-2 (Continued)

Organic Air Pollutant	Hazardous Air Pollutant?	Raw Wastewater Concentration (mg/L)	Amount Volatilized (Mg/year)
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
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

Table 14-2 (Continued)

Organic Air Pollutant	Hazardous Air Pollutant?	Raw Wastewater Concentration (mg/L)	Amount Volatilized (Mg/year)
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
Total for HAPs:			**13.86**

14.2.3 Solid Waste Impacts

To determine the impact of the proposed regulation on solid waste generation, EPA used information provided in the industrial laundries detailed questionnaire responses to estimate the incremental sludge generation from the CP-IL and DAF-IL options. Both of these options involve treatment of industrial laundry wastewater followed by dewatering of the sludge generated during treatment. The dewatered sludge is then disposed. Most industrial laundries responding to the detailed questionnaire reported disposing of their sludge at nonhazardous industrial landfills. To estimate the incremental sludge generation from CP-IL and DAF-IL, EPA subtracted the volume of sludge currently generated by industrial laundries from the estimated volume of sludge that would be generated after implementation of either option.

The volume of sludge currently generated by industrial laundries (in dry solids, pounds per year) was calculated using the industrial laundries cost model for all industrial laundries included in the proposed regulation that currently operate a wastewater treatment system. EPA did not include sludge generation reported from facilities with minimal treatment (i.e., settling pits and screens) in the baseline sludge generation amount. Therefore, the baseline sludge generation is the minimum volume of sludge currently generated and any calculated incremental increases in sludge generation from the CP-IL or DAF-IL options are larger than would actually be observed from implementation of these options.

EPA used the industrial laundries cost model to calculate the volume of sludge that would be generated by the 172 in-scope industrial laundries included in the proposed regulation after implementation of the CP-IL and DAF-IL options. By subtracting the baseline sludge generation volume from the volume of sludge generated after implementation of CP-IL and DAF-IL, EPA determined an incremental sludge generation increase for each of the 172 in-scope industrial laundries included in the proposed regulation. EPA then extrapolated the sludge volumes to account for the 1,606 industrial laundries that would be covered by the proposed rule. Table 14-3 presents the incremental increase in sludge generation (in wet sludge and dry solids) from all existing in-scope industrial laundries identified by EPA for CP-IL and for DAF-IL. Table 14-3 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(2)). Based on this analysis, EPA has determined that the solid waste impacts of the regulatory options consider for proposal are acceptable.

Table 14-3

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 Non-Hazardous 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]	
DAF-IL	62,200	34,200	38.7	21.3	0.008%
CP-IL	73,500	25,700	45.8	16.0	0.006%

[1]Regulatory options are presented in Chapter 10 of this document.
[2]Incremental sludge generation increases are based on 1,606 industrial laundries covered by the proposed rule.
[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(2).

14.3 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 regulatory options considered for PSNS for the Industrial Laundries Point Source Category. Over a three-year period (1991, 1992, and 1993), according to the 1994 Industrial Laundries Industry Detailed Questionnaire, laundry operations began at only about 80 facilities (and it is not absolutely clear from the data whether these facilities were actually 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. EPA also believes that new sources will incorporate more pollution prevention practices and will recycle more of the wastewater generated at their facilities. Therefore, EPA has determined that the non-water quality environmental impacts associated with the implementation of the regulatory options considered for PSNS will be negligible.

14.4 References

1. Steam, Its Generation and Uses, 4th Edition, Babcock & Wilcox, Ed Stutz & Kitto, Barberton, Ohio. 1992.

2. U.S. Environmental Protection Agency. Subtitle D Study Phase I. Washington, DC, 1986, EPA 530-SW-86-054.

CHAPTER 15

PRETREATMENT STANDARDS FOR EXISTING SOURCES (PSES) AND PRETREATMENT STANDARDS FOR NEW SOURCES (PSNS)

15.1 Introduction

Pretreatment standards for existing sources establish quantitative limits on the indirect discharge of priority and nonconventional pollutants to waters of the United States. 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 Clean Water Act (CWA) requires pretreatment for pollutants that pass through POTWs in amounts that would exceed direct discharge effluent limitations or limit POTW sludge management alternatives, including the beneficial use of sludges on agricultural lands. EPA also determines that there is pass-through of a pollutant if the pollutant exhibits significant volatilization prior to treatment by POTWs. Pretreatment standards are to be technology-based. The technology selected by the Agency to define the PSES performance for the removal of priority and nonconventional pollutants may include end-of-pipe treatment, process changes, and internal controls.

Pretreatment standards for new sources also establish quantitative limits on the indirect discharge of priority and nonconventional pollutants to waters of the United States. New indirect discharging facilities have the opportunity to incorporate the best available demonstrated technologies, including process changes, in-plant control measures, and end-of-pipe wastewater treatment technologies that reduce pollution to the maximum extent feasible.

The owners or operators of facilities subject to PSES or PSNS are not required to use the specific wastewater treatment technologies selected by the Agency to establish the limitations and standards. Rather, a facility can use any combination of process changes, water use changes, and wastewater treatment to comply with permit limitations and standards, provided that the limitations and standards are not achieved through prohibited dilution.

EPA has selected the CP-IL Option, a regulatory option based on chemical precipitation, as the technology basis for the proposed PSES. The CP-IL Option is based on chemical precipitation treatment of all industrial laundry wastewater for control of wastewater discharges to POTWs from industrial laundry facilities. The proposed standards would be applicable to all wastewater discharged from facilities covered under PSES. EPA finds this option to be the best available treatment performance technology economically achievable based on data collected during the development of the proposed rule. EPA has also selected the CP-IL Option as the proposed technology basis for the proposed PSNS. The rationale behind these selections is discussed in the preamble to the proposed rule and in Chapter 13 of this document.

The following information is presented in this section:

- Section 15.2 reviews the industrial laundries regulated by PSES and PSNS, provides a brief description of EPA's POTW pass-through analysis, discusses pollutants proposed to be regulated by PSES and PSNS, and presents the proposed PSES and PSNS; and

- Section 15.3 discusses PSES and PSNS implementation with regard to point of application, permit limitations, and monitoring and compliance issues.

15.2 Summary of the Proposed PSES and PSNS

15.2.1 Regulated Facilities

PSES and PSNS are proposed for the industrial laundries covered by this rule. As discussed in Section 6.3 of this document, the regulated facilities include facilities that meet the definition of an industrial laundry.

Under PSES, EPA is proposing to exclude existing facilities laundering less than one million pounds of incoming laundry per calendar year and less than 255,000 pounds of shop towels and/or printer towels/rags per calendar year. EPA made this exclusion in order to eliminate unacceptable disproportionate adverse economic impacts on these smaller facilities. If any excluded facility launders one million pounds or more of laundry or more than 255,000 pounds of shop towels and/or printer towels/rags during any calendar year, the facility would no longer be excluded from PSES. See Chapter 6 for a detailed discussion of the scope of the proposed rule.

Under PSNS, EPA proposes that no facilities would be excluded, since the economic projections indicate that there would be no barrier to entry as a result of the new source standards.

15.2.2 POTW Pass-Through Analysis

Based on currently available data and information, EPA evaluated POTW pass-through for those pollutants proposed for regulation (listed in Section 7.4 of this document). In determining whether a pollutant is expected to pass through a POTW, EPA assessed the following:

- Whether the pollutant would be volatilized from conveyance systems, equalization or other treatment units, or POTW head works that are open to the atmosphere;

- Whether the nation-wide average percentage of a pollutant removed by well-operated POTWs achieving secondary treatment is less than the percentage removed by the proposed PSES treatment options; or

- Whether there are any specific instances of POTW interference, upset, or pass-through known to EPA as being caused by the pollutants proposed for regulation.

The uncontrolled transfer of a pollutant from water to air through volatilization does not constitute treatment. Therefore, EPA has determined that for the pollutants proposed for regulation that undergo significant volatilization from conveyance systems, equalization or other treatment units, or POTW head works that are open to the atmosphere, will pass through POTWs and should be regulated by pretreatment standards.

EPA usually determines whether a particular pollutant is passing through a POTW by comparing the average POTW removal with average removal obtained by direct dischargers. Direct dischargers have not been identified to date for the industrial laundries industry. Therefore, EPA determined pass-through for the industrial laundries industry by comparing the average treatment provided by POTWs nationwide (expressed as a percentage removal) to the average treatment provided by the proposed PSES options. Chapter 7 provides a detailed description of the pass-through analysis.

15.2.3 Regulated Pollutants

The pollutants proposed to be regulated by EPA include seven organics, three metals, and one nonconventional bulk parameter, total petroleum hydrocarbons (TPH, measured as silica gel treated-hexane extractable material (SGT-HEM)). Table 15-1 presents the proposed list of regulated pollutants. EPA believes that regulating these 11 pollutants will control the discharge of all pollutants of concern in industrial laundry wastewater. A detailed description of the pollutants proposed for regulation is in Chapter 7.

15.2.4 PSES and PSNS

Table 15-2 presents the proposed PSES and PSNS for the industrial laundries industry. The proposed PSES and PSNS for the industry are based on a combination of long-term average treatment performance concentrations and variability factors that account for day-to-day variation in measured treated effluent concentrations. Long-term average treatment performance concentrations, discussed in Chapter 9, are target values that a facility should achieve on a long-term average basis. The variability factors, also discussed in Chapter 9, represent the ratio of an elevated value that would be expected to occur only rarely to the long-term average. The purpose of the variability factor is to allow for variations in effluent concentrations that comprise the long-term average. A facility that designs and operates its treatment system to achieve a long-term average on a consistent basis should be able to comply with the daily and monthly limitations in the course of normal operations.

Table 15-1

Pollutants Proposed to be Regulated Under PSES and PSNS

Metals
Copper
Lead
Zinc
Organics
Bis(2-ethylhexyl) Phthalate
Ethylbenzene
Naphthalene
Tetrachloroethene
Toluene
m-Xylene
o-&*p*-Xylene
Nonconventional Pollutants
Total Petroleum Hydrocarbons (measured as SGT-HEM)

SGT-HEM - Silica gel treated-hexane extractable material

Table 15-2

Proposed PSES and PSNS for the Industrial Laundries Industry

Pollutant or Pollutant Property	Proposed PSES and PSNS for End-of-Pipe Monitoring Points	
	Maximum for any 1 day (mg/L)	Monthly Average (mg/L)
Copper	0.24	---[1]
Lead	0.27	---[1]
Zinc	0.61	---[1]
Bis(2-ethylhexyl) Phthalate	0.13	---[1]
Ethylbenzene	1.64	---[1]
Naphthalene	0.23	---[1]
Tetrachloroethene	1.71	---[1]
Toluene	2.76	---[1]
m-Xylene[2]	1.33	---[1]
o-&*p*-Xylene[2]	0.95	---[1]
TPH (as SGT-HEM)[3]	27.5	15.4

[1]EPA is not proposing monthly average limitations for these pollutants.
[2]EPA is proposing the use of EPA Methods 1624 and 624 for the analysis of xylenes, even though xylenes are not specifically listed as an analyte in either of these methods (promulgated at 40 CFR Part 136). EPA used data obtained from the analysis of xylenes by these two methods in the development of the proposed industrial laundry standards.
[3]TPH (as SGT-HEM) is total petroleum hydrocarbons measured by the silica gel treated-hexane extractable material analytical method proposed January 23, 1996 (Method 1664).

15.3 Implementation of the PSES and PSNS

15.3.1 Point of Application

PSES and PSNS for wastewaters from industrial laundry operations are applicable at end-of-pipe discharge points, as denoted in Table 15-2, for all pollutants proposed for regulation. The end-of-pipe monitoring point should be located prior to the POTW sewer system. If the facility is treating only part of its stream, the end-of-pipe monitoring point should be located after all process wastewater is commingled.

15.3.2 Permit Limitations

If final PSES and PSNS are promulgated as proposed, EPA expects that permit limitations for pollutants at end-of-pipe discharge points would be concentration-based. Proposed concentration-based limitations are listed in Table 15-2, and are the same for PSES and PSNS. Concentration-based permit limitations offer a direct measure for both the permitting authority and the permitted facility that PSES or PSNS performance levels are being achieved.

To establish daily maximum limitations and monthly average limitations, a permit writer must examine the discharge wastewater streams present at a facility. The permit writer must define the components of the discharged wastewater stream, as discussed in Chapter 3 of the Guidance Manual for the Use of Production-Based Pretreatment Standards and the Combined Wastestream Formula (1).

The proposed concentration-based limitations specified in the categorical standards apply to the discharge of wastewater from regulated processes (i.e., water washing of all items) prior to mixing with unregulated and dilute wastewater streams. Because some facilities may combine regulated and nonregulated streams prior to the discharge location, the combined wastestream formula (CWF) was developed to allow permit writers to calculate alternative pollutant limits at industrial facilities where a regulated wastestream is mixed with other wastestreams, while protecting against inappropriate dilution (see 40 CFR 406(e)). The formula establishes alternative concentration-based or mass-based limits based on the proportionate contribution of each wastestream. The formula divides the universe of wastestreams into three types:

1) Regulated - A wastestream for which a categorical treatment standard has been promulgated;

2) Unregulated - A wastestream that may contain regulated pollutants but for which categorical treatment standards have not been promulgated; and

3) Dilute - A wastestream that contains few or no regulated pollutants.

The unregulated and the dilute wastestreams are referred to as nonregulated streams.

When a regulated wastestream is combined prior to treatment with other wastestreams, the CWF must be used to calculate alternate discharge limits that apply to the combined stream. When a regulated wastestream is combined with other wastestreams after treatment, the CWF may be applied to calculate alternate discharge limits but it is not mandatory.

Equation 15-1, the CWF, presents the methodology used to calculate alternative concentration limits (also see 40 CFR 403.b(e)(1)):

$$C_T = \frac{\sum C_i F_i}{\sum F_i} * \frac{F_T - F_D}{F_T} \qquad 15\text{-}1$$

where:

C_T	=	Alternative concentration limit for the pollutant in the combined wastestream
C_i	=	Concentration-based categorical pretreatment standard for the pollutant in regulated stream i
F_i	=	Average daily flow (at least 30-day average) of regulated stream i
F_D	=	Average daily flow (at least 30-day average) of dilute wastestream(s)
F_T	=	Average daily flow (at least 30-day average) of all wastestreams (including regulated, unregulated, and dilute wastestreams).

If a nonregulated wastestream is combined with a regulated wastestream, after treatment and monitoring occurs after the streams are combined, the flow-weighted average formula may be used instead of the CWF. For concentration-based standards, a flow-proportioning calculation must be performed in order to properly account for the levels of the regulated pollutant in the nonregulated wastestream(s).

Equation 15-2 presents the flow-weighted average formula:

$$C_A = \frac{\sum C_i \times F_i + \sum M_i}{F_T} \qquad 15\text{-}2$$

where:

C_A	=	Adjusted concentration limit for the pollutant in the combined wastestream
C_i	=	Concentration-based categorical pretreatment standard for the pollutant in regulated stream i
F_i	=	Average daily flow (at least 30-day average) of regulated stream i
F_T	=	Average daily flow (at least 30-day average) of all wastestreams (including regulated, unregulated, and dilute wastestreams)
M_i	=	Actual Mass of pollutant in nonregulated wastestreams combined with regulated wastestream after treatment.

Using the formula in this manner will adjust the limitations based on the types (regulated, unregulated, or dilute) of wastestreams and the point where they are combined. If the nonregulated wastestream(s) have high pollutant loadings the adjusted concentration limit will be higher than the categorical standard after implementation of this formula. However, if the pollutant loading is lower in the nonregulated stream than in the regulated stream, the adjusted concentration limit will be lower than the categorical standard. When dilute wastestreams are added, the formula reduces the flow-weighted average in proportion to the flow of the dilute wastestreams. This adjustment is made to prohibit dilution.

If the effluent guidelines for the Industrial Laundries Point Source Category is promulgated as proposed, the combined wastestream formula would be applied in the following manner. The regulated wastestream would consist of process wastewater generated from the water washing of all items. An example of an unregulated wastestream for the Industrial Laundries Point Source Category would be the wastewater stream generated from the dry-cleaning process. A dilute wastestream is defined in 40 CFR Part 403 to include sanitary wastewater, noncontact cooling water, and boiler blowdown.

Table 15-3 provides discharge streams and discharge flows for three example facilities. All examples shown here represent use of the CWF, not the flow-weighted average formula. Example calculations of alternative concentration limits for three proposed regulated pollutants for the three facilities are presented below.

15.3.2.1 Facility One

Facility One has one regulated wastewater stream. The CWF does not need to be applied in this instance. The limits for this facility are those presented in Table 15-2.

Table 15-3

Alternative Concentration-Based Limits for Example Facilities

Facility One				
Wastestream[1]	Average Daily Flow (gal/day)	Example Pollutants	Concentration-based Categorical Pretreatment Standard (mg/L)	Alternative Concentration Limit (Derived from CWF, mg/L)
Process Flow	20,000	TPH Copper Naphthalene	27.5 0.24 0.23	--- --- ---
Total Flow = Process Flow	20,000	TPH Copper Naphthalene	27.5 0.24 0.23	Not Applicable Not Applicable Not Applicable
Facility Two				
Wastestream[1]	Average Daily Flow (gal/day)	Example Pollutants	Concentration-based Categorical Pretreatment Standard (mg/L)	Alternative Concentration Limit (Derived from CWF, mg/L)
Process Flow	20,000	TPH Copper Naphthalene	27.5 0.24 0.23	--- --- ---
Noncontact Cooling Water	2,000	None	---	---
Total Flow = Process Flow + Noncontact Cooling Water	22,000	TPH Copper Naphthalene	27.5 0.24 0.23	25.00 0.22 0.21
Facility Three				
Wastestream[1]	Average Daily Flow (gal/day)	Example Pollutants	Concentration-based Categorical Pretreatment Standard (mg/L)	Alternative Concentration Limit (Derived from CWF, mg/L)
Process Flow from Water Washing Shop Towels	20,000	TPH Copper Naphthalene	27.5 0.24 0.23	--- --- ---
Dry-cleaning Flow	10,000	TPH Copper Naphthalene	--- --- ---	--- --- ---
Total Flow = Process Flow from Shop Towels + Dry-cleaning Flow	30,000	TPH Copper Naphthalene	27.5 0.24 0.23	27.5 0.24 0.23

[1]At this facility, streams are combined prior to treatment.

The permit writer must compare the concentration of the pollutants in the discharge stream to the limits presented in Table 15-2; if the concentration measured in the discharge is less than the limit, then the facility is in compliance.

15.3.2.2 Facility Two

Facility Two has two wastewater streams, a regulated stream (process flow) and a dilution stream (noncontact cooling water). These streams are combined prior to treatment; therefore, the CWF must be applied. As shown in Table 15-3, the following flow data were used for the calculation.

F_i (process flow)	= 20,000 gal/day
F_D (noncontact cooling water flow)	= 2,000 gal/day
F_T (total flow)	= 22,000 gal/day

Equation 15-1 is then applied using the flow data as well as the concentration-based limits from Table 15-2. An example calculation of the alternative daily maximum concentration for copper is shown as follows:

$$C_T = \frac{0.24 \text{ mg/L} * 20{,}000 \text{ gal/day}}{20{,}000 \text{ gal/day}} * \frac{22{,}000 \text{ gal/day} - 2{,}000 \text{ gal/day}}{22{,}000 \text{ gal/day}}$$

$$C_T = 0.218 \text{ mg/L}$$

The alternative maximum daily limits for all other regulated pollutants would be calculated in a similar manner. After calculating the alternative limits, the permit writer would compare the measured concentrations in the discharge stream to the alternative limits. The facility would be in compliance if the measured concentrations in the discharge stream are lower than the alternative limits.

15.3.2.3 Facility Three

Facility Three has two wastestreams, a regulated stream (process flow from shop towels) and an unregulated wastestream (flow from dry-cleaning processes). These streams are combined prior to treatment; therefore, the CWF must be applied. It should be noted that, when the CWF is applied to a facility combining an unregulated steam with a regulated stream, the alternative concentration limit of a pollutant will be equal to that of the concentration-based categorical pretreatment standard for that pollutant. This is due to the fact that unregulated streams are presumed, for the purposes of the CWF, to contain pollutants of concern at concentrations equivalent to the regulated stream. Rather than treating the unregulated flow as dilution, which would result in lowering the allowable concentration of a pollutant, the CWF allows the pollutant to be discharged in the unregulated wastestream at the same concentration as the standard for the regulated wastestream that is being discharged.

Pollutants that are present in the unregulated wastestream are presumed to be treated to the same level as the regulated wastestream.

As shown in Table 15-3, the following flow data were used for the calculation:

F_i (process flow) = 20,000 gal/day
F_D (dilution flow) = 0 gal/day
F_T (total flow) = 30,000 gal/day

Equation 15-1 is then applied using the flow data as well as the concentration-based limits from Table 15-2. An example calculation of the daily maximum concentration for copper is shown as follows:

$$C_T = \frac{0.24 \text{ mg/L} * 20{,}000 \text{ gal/day}}{20{,}000 \text{ gal/day}} * \frac{30{,}000 \text{ gal/day} - 0 \text{ gal/day}}{30{,}000 \text{ gal/day}}$$

$$C_T = 0.24$$

The maximum daily limits for all other regulated pollutants would be calculated in a similar manner. After calculating the maximum daily limits, the permit writer would compare the measured concentration in the discharge stream to the calculated maximum daily limits. If the measured concentration in the discharge stream is lower than the calculated maximum daily limits, then the facility is in compliance.

15.3.3 Monitoring and Compliance

The limitations are provided as daily maximums and monthly averages for TPH (measured as SGT-HEM) and as daily maximums for all other regulated pollutants. Monitoring was assumed to occur four times per month for TPH and one time per month for all other regulated pollutants. Compliance with the daily maximum discharge limit is required, regardless of the number of samples analyzed. EPA-approved analytical methods for analyzing the regulated pollutants are shown in Table 15-4.

15.4 References

1. U.S. Environmental Protection Agency. Guidance Manual for the Use of Production-Based Pretreatment Standards and the Combined Wastestream Formula. September 1985.

Table 15-4

EPA-Approved Analytical Methods for Analyzing the Regulated Pollutants[1]

Pollutant	EPA Analytical Method
Copper	200.7, 220.2, 1620[2]
Lead	200.7, 239.1, 239.2, 1620[2]
Zinc	200.7, 289.1, 289.2, 1620[2]
Bis(2-ethylhexyl) Phthalate	606, 625, 1625
Ethylbenzene	602, 624, 1624
Naphthalene	610, 625, 1625
Tetrachloroethene	601, 624, 1624
Toluene	602, 624, 1624
m-Xylene	624, 1624[3]
o-&*p*-Xylene	624, 1624[3]
Total Petroleum Hydrocarbons (measured as SGT-HEM)	1664[4]

[1]This table shows EPA methods only. Except for total petroleum hydrocarbons measured as silica gel treated-hexane extractable material (SGT-HEM) and xylenes, methods for monitoring these pollutants are specified at 40 CFR Part 136. The CFR also specifies methods published by voluntary consensus standards bodies, when available.
[2]Although not specifically listed at 40 CFR Part 136, EPA Method 1620 is a consolidation of methods 200.7, 204.2, 206.2, 239.2, 270.2, 279.2, 245.5, 245.1, and 245.2. EPA used data obtained from the analysis of metals and elements by Method 1620.
[3]EPA is proposing the use of EPA Methods 1624 and 624 for the analysis of xylenes. Xylenes are not specifically listed as an analyte in either of these methods (promulgated at 40 CFR Part 136). EPA used data obtained from the analysis of xylenes by these two methods in the development of the proposed industrial laundries standards.
[4]Total Petroleum Hydrocarbon (measured as SGT-HEM) is total petroleum hydrocarbons measured by the silica gel treated-hexane extractable material analytical method proposed January 23, 1996 (Method 1664).

CHAPTER 16

GLOSSARY OF TERMS

Absorbents: Substance used to absorb leaks, spills, and sprays around machinery and workstations. Oil, coolants, solvents, and water are common materials absorbed.

Administrator: The Administrator of the U.S. Environmental Protection Agency.

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: 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.

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 (COD) - 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.

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.

CWA: Clean Water Act. The Federal Water Pollution Control Act Amendments of 1972 (33 U.S.C. 1251 et seq.).

DAF: Dissolved air flotation.

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: A facility is 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: 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.

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). HEM has been proposed to replace the conventional pollutant oil and grease for EPA survey and monitoring programs under the Clean Water Act.

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 (IL): 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.

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, filters, and clean room garments.

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 an 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.

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: Organics control.

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). The hexane extractable material (HEM) method has been proposed to replace O&G for EPA survey and monitoring programs under the Clean Water Act.

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).

Pretreatment standard: A regulation specifying industrial wastewater effluent quality required for discharge to a POTW.

Printer towel/rag: 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). SGT-HEM is proposed to replace the nonconventional pollutant total petroleum hydrocarbons for EPA survey and monitoring programs under the Clean Water Act.

Shop towel: 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.

TPH: Total petroleum hydrocarbons. 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). Silica gel treated-hexane extractable material (SGT-HEM) has been proposed to replace TPH for EPA survey and monitoring programs under the Clean Water Act.

TRSA: Textile Rental Services Association of America.

TSCA: Toxic Substances Control Act (15 U.S.C. 2601 et seq.)

TSS: Total suspended solids.

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]
Surfactants	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

Tables Referenced in Chapter 5

Table B-1

Wastewater Characterization for Item Specific Wastewater at Industrial Laundries

Industrial Garments						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	218	600	386	4	4	100
Oil and Grease (measured as HEM)	19	116	91	4	4	100
Total Suspended Solids (TSS)	154	524	348	4	4	100
Priority Organics						
1,1,1-Trichloroethane	0.0100	0.100	0.0550	4	0	0
1,2-Diphenylhydrazine	0.0200	0.200	0.110	4	0	0
4-Chloro-3-methylphenol	0.0100	0.504	0.178	4	1	25
Bis(2-ethylhexyl) Phthalate	0.100	0.352	0.224	4	3	75
Butyl Benzyl Phthalate	0.0100	0.100	0.0550	4	0	0
Chlorobenzene	0.0100	0.100	0.0550	4	0	0
Chloroform	0.0100	0.100	0.0550	4	0	0
Di-*n*-butyl Phthalate	0.0100	0.100	0.0550	4	0	0
Di-*n*-octyl Phthalate	0.0114	0.100	0.0600	4	2	50
Ethylbenzene	0.0100	0.482	0.151	4	1	25
Isophorone	0.0100	0.100	0.0550	4	0	0
Methylene Chloride	0.0100	0.100	0.0558	4	1	25
Naphthalene	0.0100	0.100	0.0550	4	0	0
Phenol	0.0257	0.127	0.0702	4	3	75
Tetrachloroethene	0.0100	0.100	0.0550	4	0	0
Toluene	0.0100	0.128	0.0666	4	2	50
trans-1,2-Dichloroethene	0.0100	0.100	0.0550	4	0	0
Trichloroethene	0.0100	0.100	0.0550	4	0	0
Nonconventional Organics						
2-Butanone	0.0500	0.500	0.275	4	0	0

Table B-1 (Continued)

Industrial Garments						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
2-Methylnaphthalene	0.0100	0.100	0.0550	4	0	0
2-Propanone	0.0500	0.5000	0.313	4	1	25
4-Methyl-2-pentanone	0.0500	0.500	0.275	4	0	0
∝-Terpineol	0.0100	0.100	0.0550	4	0	0
Benzoic Acid	0.374	0.500	0.450	4	2	50
Benzyl Alcohol	0.0396	0.100	0.0699	4	2	50
Hexanoic Acid	0.0728	0.100	0.0885	4	2	50
m-Xylene	0.0100	0.0100	0.0100	2	0	0
n-Decane	0.0100	0.100	0.0550	4	0	0
n-Docosane	0.0118	0.111	0.0632	4	3	75
n-Dodecane	0.0100	0.100	0.0630	4	1	25
n-Eicosane	0.0140	0.100	0.0694	4	2	50
n-Hexacosane	0.0190	0.226	0.130	4	4	100
n-Hexadecane	0.0100	0.100	0.0759	4	1	25
n-Octacosane	0.0167	0.220	0.0956	4	4	100
n-Octadecane	0.0100	0.147	0.0471	4	3	75
n-Tetracosane	0.0188	0.100	0.0679	4	2	50
n-Tetradecane	0.0100	0.100	0.0634	4	1	25
n-Triacontane	0.0177	0.100	0.0620	4	2	50
o-&*p*-Xylene	0.0100	0.0100	0.0100	2	0	0
p-Cresol	0.0100	0.100	0.0550	4	0	0
p-Cymene	0.0100	0.186	0.0764	4	1	25
Pentamethylbenzene	0.0100	0.100	0.0550	4	0	0
Priority Metals and Elements						
Antimony	0.0182	1.57	0.454	4	4	100
Arsenic	0.00110	0.0232	0.0116	4	1	25
Beryllium	0.000420	0.00100	0.000758	4	2	50
Cadmium	0.00500	0.0387	0.0246	4	3	75
Chromium	0.0159	0.161	0.0936	4	4	100

Table B-1 (Continued)

Industrial Garments						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Copper	0.148	1.31	0.672	4	4	100
Lead	0.0460	0.316	0.214	4	3	75
Mercury	0.000200	0.000760	0.000408	4	2	50
Nickel	0.0180	0.164	0.103	4	3	75
Selenium	0.000500	0.0200	0.0102	4	0	0
Silver	0.00230	0.0188	0.00710	4	1	25
Thallium	0.00100	0.0100	0.00360	4	0	0
Zinc	0.264	3.07	1.47	4	4	100
Nonconventional Metals and Elements						
Aluminum	3.20	8.73	5.19	4	4	100
Barium	0.0404	0.560	0.254	4	4	100
Boron	0.0306	0.369	0.195	4	4	100
Cobalt	0.00230	0.0461	0.0171	4	1	25
Iron	1.42	15.4	9.70	4	4	100
Manganese	0.0732	0.205	0.139	4	4	100
Molybdenum	0.00450	0.0539	0.0213	4	2	50
Tin	0.0266	0.267	0.0922	4	3	75
Titanium	0.0842	0.223	0.148	4	4	100
Vanadium	0.00200	0.0120	0.00700	4	0	0
Yttrium	0.000300	0.00400	0.00215	4	0	0
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	1,070	2,760	1,740	4	4	100
Total Organic Carbon (TOC)	163	540	359	4	4	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	5	74	47	4	4	100

Table B-1 (Continued)

Shop Towels						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	1,130	3,310	2,060	5	5	100
Oil and Grease (measured as HEM)	2,090	3,020	2,550	3	3	100
Total Suspended Solids (TSS)	2,540	6,730	4,590	3	3	100
Priority Organics						
1,1,1-Trichloroethane	0.0180	38.3	5.16	5	3	60
1,2-Diphenylhydrazine	0.0700	2.00	1.36	3	0	0
4-Chloro-3-methylphenol	0.0200	2.06	1.03	3	1	33
Bis(2-ethylhexyl) Phthalate	0.633	9.44	3.30	4	3	75
Butyl Benzyl Phthalate	0.0350	1.00	0.678	3	0	0
Chlorobenzene	0.0100	1.00	0.313	4	1	25
Chloroform	0.0100	1.00	0.370	3	0	0
Di-*n*-butyl Phthalate	0.0350	1.00	0.678	3	0	0
Di-*n*-octyl Phthalate	0.0350	1.00	0.678	3	0	0
Ethylbenzene	0.556	36.0	6.25	5	5	100
Isophorone	0.0350	1.00	0.678	3	0	0
Methylene Chloride	0.0307	39.9	5.28	5	3	60
Naphthalene	0.329	5.16	2.88	4	3	75
Phenol	0.0350	1.00	0.381	3	1	33
Tetrachloroethene	0.170	55.5	8.03	5	4	80
Toluene	1.11	11.6	4.81	4	4	100
trans-1,2-Dichloroethene	0.0100	1.00	0.456	4	1	25
Trichloroethene	0.0100	1.00	0.294	4	1	25
Nonconventional Organics						
2-Butanone	0.0898	5.00	1.92	3	2	67
2-Methylnaphthalene	0.627	1.21	0.946	3	2	67
2-Propanone	1.00	5.95	3.98	3	2	67
4-Methyl-2-pentanone	0.132	5.00	1.88	3	1	33
∝-Terpineol	0.0350	1.59	0.874	3	1	33

Table B-1 (Continued)

Shop Towels						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Benzoic Acid	0.301	5.00	3.23	3	2	67
Benzyl Alcohol	0.0350	1.00	0.678	3	0	0
Hexanoic Acid	0.0200	1.00	0.373	3	0	0
m-Xylene	0.884	2.49	1.69	2	2	100
n-Decane	4.70	154	49.5	4	4	100
n-Docosane	0.313	1.54	0.949	3	2	67
n-Dodecane	13.3	23.7	18.2	3	3	100
n-Eicosane	1.44	84.6	29.8	3	3	100
n-Hexacosane	0.470	4.01	1.83	3	2	67
n-Hexadecane	2.85	17.4	9.85	4	4	100
n-Octacosane	0.118	2.21	1.11	3	2	67
n-Octadecane	1.06	22.1	11.4	4	4	100
n-Tetracosane	0.328	1.16	0.831	3	2	67
n-Tetradecane	6.51	36.8	16.9	3	3	100
n-Triacontane	0.0689	1.71	0.926	3	2	67
o-&*p*-Xylene	0.482	0.645	0.563	2	2	100
p-Cresol	0.0200	1.00	0.373	3	0	0
p-Cymene	0.0350	8.11	2.54	4	1	25
Pentamethylbenzene	0.0350	1.00	0.678	3	0	0
Priority Metals and Elements						
Antimony	0.0973	0.369	0.211	5	5	100
Arsenic	0.00800	0.0511	0.0238	4	3	75
Beryllium	0.00100	0.00100	0.00100	3	0	0
Cadmium	0.105	0.856	0.391	5	5	100
Chromium	0.119	1.17	0.478	5	5	100
Copper	2.44	9.79	6.65	5	5	100
Lead	2.04	20.5	7.34	5	5	100
Mercury	0.000200	0.00350	0.00122	4	2	50
Nickel	0.175	1.61	0.600	5	5	100

Table B-1 (Continued)

Shop Towels						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Selenium	0.0100	0.0200	0.0138	3	1	33
Silver	0.00300	0.877	0.174	5	3	60
Thallium	0.00100	0.0120	0.00467	3	0	0
Zinc	6.82	29.4	13.9	5	5	100
Nonconventional Metals and Elements						
Aluminum	5.57	19.3	11.3	5	5	100
Barium	0.730	10.3	3.98	5	5	100
Boron	0.0500	3.81	1.81	5	4	80
Cobalt	0.0720	0.795	0.336	5	5	100
Iron	24.6	114	55.2	5	5	100
Manganese	0.510	1.95	1.18	5	5	100
Molybdenum	0.153	1.27	0.351	5	5	100
Tin	0.0290	0.808	0.270	5	4	80
Titanium	0.0177	0.574	0.199	5	5	100
Vanadium	0.0106	0.113	0.0433	5	5	100
Yttrium	0.00320	0.0171	0.00810	3	3	100
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	7,700	26,300	14,000	5	5	100
Total Organic Carbon (TOC)	750	2950	1,950	5	5	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	520	3410	1,630	3	3	100

Table B-1 (Continued)

Printer Towels						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	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	2.000	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

Table B-1 (Continued)

Printer Towels						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Benzoic Acid	1.50	5.00	3.30	3	2	67
Benzyl Alcohol	0.100	1.00	0.500	3	0	0
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	0.1000	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

Table B-1 (Continued)

Printer Towels						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
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
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 B-1 (Continued)

Mats						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	248	248	248	1	1	100
Oil and Grease (measured as HEM)	84	84	84	1	1	100
Total Suspended Solids (TSS)	365	365	365	1	1	100
Priority Organics						
1,1,1-Trichloroethane	1.60	1.60	1.60	1	1	100
1,2-Diphenylhydrazine	0.0200	0.0200	0.0200	1	0	0
4-Chloro-3-methylphenol	0.0100	0.0100	0.0100	1	0	0
Bis(2-ethylhexyl) Phthalate	2.02	2.02	2.02	1	1	100
Butyl Benzyl Phthalate	0.0197	0.0197	0.0197	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	0.0100	0.0100	0.0100	1	0	0
Di-*n*-octyl Phthalate	0.0494	0.0494	0.0494	1	1	100
Ethylbenzene	0.283	0.283	0.283	1	1	100
Isophorone	0.361	0.361	0.361	1	1	100
Methylene Chloride	0.442	0.442	0.442	1	1	100
Naphthalene	0.0244	0.0244	0.0244	1	1	100
Phenol	0.0100	0.0100	0.0100	1	0	0
Tetrachloroethene	0.125	0.125	0.125	1	1	100
Toluene	1.29	1.29	1.29	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	0.579	0.579	0.579	1	1	100
2-Methylnaphthalene	0.0100	0.0100	0.0100	1	0	0
2-Propanone	2.11	2.11	2.11	1	1	100
4-Methyl-2-pentanone	0.458	0.458	0.458	1	1	100
∝-Terpineol	0.0825	0.0825	0.0825	1	1	100

Table B-1 (Continued)

Mats						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Benzoic Acid	0.231	0.231	0.231	1	1	100
Benzyl Alcohol	0.0724	0.0724	0.0724	1	1	100
Hexanoic Acid	0.0737	0.0737	0.0737	1	1	100
m-Xylene	0.520	0.520	0.520	1	1	100
n-Decane	1.98	1.98	1.98	1	1	100
n-Docosane	0.0130	0.0130	0.0130	1	1	100
n-Dodecane	0.121	0.121	0.121	1	1	100
n-Eicosane	0.0166	0.0166	0.0166	1	1	100
n-Hexacosane	0.0197	0.0197	0.0197	1	1	100
n-Hexadecane	0.0305	0.0305	0.0305	1	1	100
n-Octacosane	0.0100	0.0100	0.0100	1	0	0
n-Octadecane	0.0152	0.0152	0.0152	1	1	100
n-Tetracosane	0.0100	0.0100	0.0100	1	0	0
n-Tetradecane	0.0190	0.0190	0.0190	1	1	100
n-Triacontane	0.0306	0.0306	0.0306	1	1	100
o-&*p*-Xylene	0.291	0.291	0.291	1	1	100
p-Cresol	0.0100	0.0100	0.0100	1	0	0
p-Cymene	0.0100	0.0100	0.0100	1	0	0
Pentamethylbenzene	0.0100	0.0100	0.0100	1	0	0
Priority Metals and Elements						
Antimony	0.0203	0.0203	0.0203	1	1	100
Arsenic	0.00380	0.00380	0.00380	1	0	0
Beryllium	0.00100	0.00100	0.00100	1	0	0
Cadmium	0.00950	0.00950	0.00950	1	1	100
Chromium	0.0806	0.0806	0.0806	1	1	100
Copper	0.220	0.220	0.220	1	1	100
Lead	0.307	0.307	0.307	1	1	100
Mercury	0.000430	0.000430	0.000430	1	1	100
Nickel	0.0543	0.0543	0.0543	1	1	100

Table B-1 (Continued)

Mats						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Selenium	0.00460	0.00460	0.00460	1	0	0
Silver	0.0171	0.0171	0.0171	1	1	100
Thallium	0.0120	0.0120	0.0120	1	0	0
Zinc	1.06	1.06	1.06	1	1	100
Nonconventional Metals and Elements						
Aluminum	3.42	3.42	3.42	1	1	100
Barium	0.214	0.214	0.214	1	1	100
Boron	0.0500	0.0500	0.0500	1	0	0
Cobalt	0.0135	0.0135	0.0135	1	1	100
Iron	6.87	6.87	6.87	1	1	100
Manganese	0.115	0.115	0.115	1	1	100
Molybdenum	0.0240	0.0240	0.0240	1	1	100
Tin	0.0439	0.0439	0.0439	1	1	100
Titanium	0.0100	0.0100	0.0100	1	0	0
Vanadium	0.00920	0.00920	0.00920	1	1	100
Yttrium	0.00500	0.00500	0.00500	1	0	0
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	80	80	80	1	1	100
Total Organic Carbon (TOC)	186	186	186	1	1	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	33	33	33	1	1	100

Table B-1 (Continued)

Mops						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	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

Table B-1 (Continued)

Mops						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Benzoic Acid	1.91	2.78	2.35	2	2	100
Benzyl Alcohol	0.100	1.12	0.610	2	1	50
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	0.0556	0.0556	0.0556	1	1	100
Arsenic	0.0178	0.0178	0.0178	1	1	100
Beryllium	0.00100	0.00100	0.00100	1	0	0
Cadmium	0.0373	0.0373	0.0373	1	1	100
Chromium	0.184	0.184	0.184	1	1	100
Copper	3.52	3.52	3.52	1	1	100
Lead	1.76	1.76	1.76	1	1	100
Mercury	0.00840	0.00840	0.00840	1	1	100
Nickel	0.195	0.195	0.195	1	1	100

Table B-1 (Continued)

Mops						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Selenium	0.00460	0.00460	0.00460	1	0	0
Silver	0.0160	0.0160	0.0160	1	1	100
Thallium	0.00240	0.00240	0.00240	1	0	0
Zinc	5.32	5.32	5.32	1	1	100
Nonconventional Metals and Elements						
Aluminum	17.3	17.3	17.3	1	1	100
Barium	0.953	0.953	0.953	1	1	100
Boron	0.327	0.327	0.327	1	1	100
Cobalt	0.0620	0.0620	0.0620	1	1	100
Iron	31.9	31.9	31.9	1	1	100
Manganese	0.638	0.638	0.638	1	1	100
Molybdenum	0.0940	0.0940	0.0940	1	1	100
Tin	0.128	0.128	0.128	1	1	100
Titanium	0.307	0.307	0.307	1	1	100
Vanadium	0.0320	0.0320	0.0320	1	1	100
Yttrium	0.00500	0.00500	0.00500	1	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 B-1 (Continued)

Steam-Tumbled Printer Towels						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	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

Table B-1 (Continued)

Steam-Tumbled Printer Towels						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Benzoic Acid	0.977	0.977	0.977	1	1	100
Benzyl Alcohol	0.819	0.819	0.819	1	1	100
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

Table B-1 (Continued)

Steam-Tumbled Printer Towels						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
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
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 B-1 (Continued)

Items Dry Cleaned Prior to Water Washing						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	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 B-1 (Continued)

Linen Supply Items						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	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

Table B-1 (Continued)

Linen Supply Items						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Benzoic Acid	0.116	0.216	0.150	3	3	100
Benzyl Alcohol	0.0100	0.575	0.202	3	2	67
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

Table B-1 (Continued)

Linen Supply Items						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
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
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 non-detects.

Table B-2

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	11.6	18	16	89
Butyl Benzyl Phthalate	0.0100	74.4	8.96	18	6	33
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	1.45	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	5.07	18	18	100
Phenol	0.0100	1.00	0.303	18	3	17

Table B-2 (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			
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
∝-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	4.41	18	17	94
n-Hexacosane	0.100	1.28	0.354	18	5	28
n-Hexadecane	0.269	38.4	9.49	18	18	100
n-Octacosane	0.100	1.44	0.370	18	4	22

Table B-2 (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			
n-Octadecane	0.100	13.6	4.00	18	17	94
n-Tetracosane	0.0100	1.05	0.316	18	4	22
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	3.55	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
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

Table B-2 (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			
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 B-2 (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	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

Table B-2 (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			
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
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

Table B-2 (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			
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
Zinc	0.624	2.79	1.47	14	14	100

Table B-2 (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 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 B-2 (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	3,470	879	51	51	100
Oil and Grease (measured as HEM)	558	2,130	1,450	8	8	100
Total Suspended Solids (TSS)	60	4,070	849	51	51	100
Priority Organics						
1,1,1-Trichloroethane	0.00100	5.56	0.334	18	12	67
1,2-Diphenylhydrazine	0.000025	0.200	0.0984	16	0	0
4-Chloro-3-methylphenol	0.000005	0.315	0.070	17	2	12
Bis(2-ethylhexyl) Phthalate	0.000420	38.9	5.42	17	17	100
Butyl Benzyl Phthalate	0.000005	1.23	0.139	17	5	29
Chlorobenzene	0.000100	1.41	0.155	18	7	39
Chloroform	0.00200	0.100	0.0344	18	12	67
Di-*n*-butyl Phthalate	0.000005	3.49	0.273	17	4	24
Di-*n*-octyl Phthalate	0.000005	0.493	0.103	17	5	29
Ethylbenzene	0.00200	3.95	0.681	38	32	84
Isophorone	0.000005	0.529	0.0790	17	3	18
Methylene Chloride	0.005000	4.13	0.390	27	16	59
Naphthalene	0.000014	13.6	1.72	17	14	82
Phenol	0.000005	0.464	0.0861	20	9	45
Tetrachloroethene	0.00100	46.2	3.69	18	15	83
Toluene	0.000500	20.9	2.49	47	41	87

Table B-2 (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			
trans-1,2-Dichloroethene	0.00500	0.100	0.0230	14	0	0
Trichloroethene	0.000020	0.100	0.0211	18	4	22
Nonconventional Organics						
2-Butanone	0.00500	47.5	2.98	20	14	70
2-Methylnaphthalene	0.0150	0.405	0.157	13	9	69
2-Propanone	0.00500	61.8	12.8	20	18	90
4-Methyl-2-pentanone	0.00500	16.7	1.89	14	9	64
∝-Terpineol	0.0100	2.27	0.326	12	4	33
Benzoic Acid	0.0200	3.13	0.779	13	8	62
Benzyl Alcohol	0.0100	0.269	0.0753	13	3	23
Hexanoic Acid	0.0100	0.175	0.0854	12	2	17
m-Xylene	0.0393	25.3	5.56	13	13	100
n-Decane	1.31	712	97.0	12	12	100
n-Docosane	0.0200	3.04	0.680	12	9	75
n-Dodecane	1.13	17.5	6.75	12	12	100
n-Eicosane	0.0200	6.41	2.12	12	11	92
n-Hexacosane	0.0200	3.28	0.529	12	10	83
n-Hexadecane	0.0200	22.5	5.57	12	11	92
n-Octacosane	0.0108	0.251	0.103	12	6	50
n-Octadecane	0.0382	8.97	1.82	12	12	100
n-Tetracosane	0.0200	8.34	1.63	12	10	83

Table B-2 (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			
n-Tetradecane	0.236	19.9	5.08	12	12	100
n-Triacontane	0.0296	0.531	0.160	12	9	75
o-&*p*-Xylene	0.125	9.45	3.02	13	13	100
p-Cresol	0.0100	0.100	0.0713	12	0	0
p-Cymene	0.0100	0.360	0.143	12	6	50
Pentamethylbenzene	0.0100	2.33	0.313	12	1	8
Priority Metals and Elements						
Antimony	0.0589	0.144	0.0945	12	8	67
Arsenic	0.00100	0.180	0.0185	31	17	55
Beryllium	0.00100	0.0200	0.00752	12	4	33
Cadmium	0.00300	0.290	0.0574	42	39	93
Chromium	0.00360	3.59	0.263	45	35	78
Copper	0.0357	6.19	1.36	44	44	100
Lead	0.00500	3.26	0.809	45	44	98
Mercury	0.000100	0.00800	0.00110	31	20	65
Nickel	0.0100	2.87	0.165	41	35	85
Selenium	0.00100	0.258	0.0648	25	13	52
Silver	0.000500	0.500	0.0278	48	31	65
Thallium	0.00100	0.130	0.0248	12	2	17
Zinc	0.139	6.89	2.16	45	45	100

Table B-2 (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 Metals and Elements						
Aluminum	0.441	14.0	5.86	19	19	100
Barium	0.240	2.93	1.18	18	18	100
Boron	0.0500	1.89	0.701	12	10	83
Cobalt	0.141	0.289	0.184	12	8	67
Iron	13.6	58.3	30.9	12	12	100
Manganese	0.190	1.40	0.504	15	15	100
Molybdenum	0.110	0.793	0.386	12	12	100
Tin	0.0290	0.580	0.176	12	7	58
Titanium	0.0190	0.370	0.166	12	12	100
Vanadium	0.00820	0.190	0.0710	12	9	75
Yttrium	0.00200	0.0300	0.0127	12	3	25
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	528	10,600	5,290	22	22	100
Total Organic Carbon (TOC)	619	2,700	1,440	12	12	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	139	1,170	530	8	8	100

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

Appendix C

Tables Referenced In Chapter 6

Table C-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

Table C-1 (Continued)

CWA Part	Industry
433	Metal Finishing
434	Coal Mining
435	Oil and Gas Extraction
436	Mineral and Mining Processing
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 D

Tables Referenced in Chapter 7

Table D-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	

Source: 40 CFR Part 423, Appendix A

[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).

Table D-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
1-METHYLPHENANTHRENE	1625
1-NAPHTHYLAMINE	1625
1-PHENYLNAPHTHALENE	1625

Table D-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
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
2-PROPENENITRILE, 2-METHYL-	1624
3,3'-DICHLOROBENZIDINE	1625
3,3'-DIMETHOXYBENZIDINE	1625
3,6-DIMETHYLPHENANTHRENE	1625
3-CHLOROPROPENE	1624

Table D-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
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
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

Table D-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
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
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

Table D-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
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
GALLIUM	1620
GERMANIUM	1620
GOLD	1620
HAFNIUM	1620
HEXACHLOROBENZENE	1625
HEXACHLOROBUTADIENE	1625
HEXACHLOROCYCLOPENTADIENE	1625
HEXACHLOROETHANE	1625
HEXACHLOROPROPENE	1625
HEXANOIC ACID	1625
HOLMIUM	1620

Table D-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
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
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

Table D-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
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
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

Table D-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
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
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

Table D-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
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
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