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## Development Document for Proposed Effluent Limitations Guidelines and New Source Performance Standards for the

# AUTO AND OTHER LAUNDRIES

## Point Source Category

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

APRIL 1974

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## Publication Notice

This is a development document for proposed effluent limitations guidelines and new source performance standards. As such, this report is subject to changes resulting from comments received during the period of public comments on the proposed regulations. This document in its final form will be published at the time the regulations for this industry are promulgated.

This report has been entered into a computer to facilitate processing, print outs, and revisions. The various "machine commands" necessary to accomplish these steps are, therefore, present in this draft version. For example, line numbers are shown in the right margin, percent and dollar symbols represent underlining instructions, and a dash under individual letters is a reference point for making corrections. The commands will not appear in the final report.

Readers who desire clarification or amplification of the material presented while making their reviews are invited to contact:

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DEVELOPMENT DOCUMENT

FOR

PROPOSED EFFLUENT LIMITATIONS GUIDELINES

AND

NEW SOURCE PERFORMANCE STANDARDS

FOR

AUTO AND OTHER LAUNDRIES

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April 1974

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## Abstract

This document presents the findings of an in-house study of auto and other laundries point sources by the National Field Investigations Center-Cincinnati, Environmental Protection Agency for the purpose of developing effluent limitations guidelines and Federal standards of performance for the industry, to implement Sections 304 and 306 of the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251, 1314 and 1316, 86 Stat. 816 et. seq.) (the "ACT").

Effluent limitations guidelines contained herein set forth the degree of effluent reduction attainable through the application of the best practicable control technology currently available and the degree of effluent reduction attainable through the application of the best available technology economically achievable which must be achieved by existing point sources by July 1, 1977, and July 1, 1983, respectively. The standards of performance for new sources contained herein set forth the degree of effluent reduction which is achievable through the application of the best available demonstrated control technology, processes, operating methods, or other alternatives.

Supportive data and rationale for development of the proposed effluent limitations guidelines and standards of performance are contained in this report.

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# SECTION I

## Conclusions

The auto and other laundries point source category has been subcategorized, for the purposes of establishing effluent limitations guidelines and standard of performance as follows:

Subcategory 1

Industrial Laundries (SIC No. 7218)

Subcategory 2

Linen Supply (SIC No. 7213)
Power Laundries, Family and Commercial (SIC No. 7211)
Diaper Service (SIC No. 7214)

Subcategory 3

Auto Wash Establishments (SIC No. 7542)

Subcategory 4

Carpet and Upholstery Cleaning (SIC no. 7217)

Subcategory 5

Coin-operated Laundries and Dry Cleaning (SIC No. 7215)
Laundry and Garment Service Not Elsewhere Classified (SIC No. 7219)

Subcategory 6

Dry Cleaning Plants, except Rug Cleaning (SIC No. 7216)

Factors such as age, size of laundry, process employed, wastewater constituents and wastewater control technologies do not justify further categorization.

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The laundries are listed in descending order of the strength of 57
the wastewater they discharge. Presently 90.1% of all laundries are 58
connected to municipal wastewater treatment facilities, and do not 59
treat their effluent before discharge.

Approximately 30% of existing car washes recycle their 62
wastewater. The rest discharge it untreated into a municipal sewer 64
system.

Dry cleaning plants, except those that clean rugs, discharge 66
little or no process wastewater. 67

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## SECTION II

### Recommendations

#### Best Practicable Control Technology Currently Available (BPCTCA)

Recommended limitations on pollutants in any process wastewater discharged into navigable waters are presented in Table 1 for: Subcategory 1 - industrial laundries; Subcategory 2 - power laundries (family and commercial), linen supply, and diaper service; and Subcategory 5 - coin-operated laundries, dry cleaning facilities, and laundry and garment services not elsewhere classified. The three remaining subcategories either do not discharge into navigable waters or can, but using BPCTCA, remove all of the pollutants before so discharging their effluent. These subcategories are: 3 - auto wash establishments; 4 - carpet and upholstery cleaning facilities; and 6 - dry cleaning plants (except rug cleaners).

#### Best Available Technology Economically Achievable (BATEA)

The recommended limitations on pollutants in any process wastewater discharged into navigable waters by plants in Subcategory 1 are the same as those presented in Table 1. By using BATEA, Subcategories 2 and 5 shall remove all the pollutants from any effluent so discharged, subcategories 3, 4, and 6 are no discharge of process wastewaters.

**NOTICE**
**These are tentative recommendations based upon information in this report and are subject to change based upon comments received and further internal review by EPA.**

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## New Source Performance Standards and Pretreatment Standards

### Performance Standards

New sources in the industry laundry subcategory should meet the limitations outlined as best practicable control technology currently available as presented in Table 1. New sources in the other five subcategories shall remove all pollutants listed in Table 1 from their process wastewater before discharging it into navigable waters.

### Pretreatment Standards

New sources that will discharge their process wastewater into a municipal sewer system shall treat it in the following manner before doing so:

Subcategories 1 and 2; reduce all incompatible pollutants to or below the levels shown in Table 1.

Subcategory 3; pass the wastewater through a detention sump or holding basin to settle out heavy solids.

Subcategories 4 and 5; filter the wastewater through a lint screen.

Subcategory 6; since little or no wastewater is generated, no pretreatment is required.

## Pretreatment by Existing Sources

The wastewater from plants in Subcategories 1 and 2 that contains incompatible pollutants referred to in 40 CFR, Part 128 shall be given BPCTCA treatment before being discharged into the treatment works. No materials prohibited in 40 CFR, Part 128.13 shall be



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introduced into such a system. Subcategories 3, 4, and 6 are no discharge of process wastewaters.

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TABLE 1

Best Practicable Control Technology

30-Day Averages*

| Parameter | Subcategory 1 Industrial** lb/lb or kg/kg | Subcategory 2 Linen*** lb/lb or kg/kg | Subcategory 3 Auto | Subcategory 4 Carpet | Subcategory 5 Coin-Op**** lb/load | Subcategory 5 Coin-Op**** kg/load | Subcategory 6 Dry Cleaning |
|---|---|---|---|---|---|---|---|
| BOD(5) | 0.0014 | 0.0014 | NDP | NDP | 0.0075 | 0.0034 | NDP |
| Suspended Solids | 0.0014 | 0.0014 | NDP | NDP | 0.0075 | 0.0034 | NDP |
| Oil and Grease | 0.0005 | 0.0005 | NDP | NDP | NR | NR | NDP |
| Hg | .5X10(-8) | .5X10(-8) | NDP | NDP | NR | NR | NDP |
| Ni | .2X10(-4) | .2X10(-4) | NDP | NDP | NR | NR | NDP |
| Cd | .1X10(-5) | .1X10(-5) | NDP | NDP | NR | NR | NDP |
| Zn | .2X10(-4) | .2X10(-4) | NDP | NDP | NR | NR | NDP |
| Cr | .2X10(-4) | .2X10(-4) | NDP | NDP | NR | NR | NDP |
| Cu | .9X10(-5) | .9X10(-5) | NDP | NDP | NR | NR | NDP |
| Pb | .2X10(-4) | .2X10(-4) | NDP | NDP | NR | NR | NDP |

* Daily maximum should not exceed two times the limits.
**Average load, 800 lb; average volume of water used, 4,470 gal (Reference 92).
***Average linen load, 550 lb; average volume of water used, 3,025 gal. (Reference 92)
****Average load, 10.5 lb; average volume of water used is 30 gal., page V-7, this report.
NR = Not regulated
Concentrations used in loadings calculations are contained in Section IX, Table 1.
NDP=No discharge of pollutants.

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# SECTION III

## Introduction

### Purpose and Authority

Section 301(b) of Federal Water Pollution Control Act, as amended (The Act) requires the achievement by not later than July 1, 1977, of effluent limitations for point sources, other than publicly owned treatment works, which require application of the best practicable control technology currently available as defined by the administrator pursuant to Section 304(b) of the Act. Section 301(b) also requires the achievement by not later than July 1, 1983, of effluent limitations for point sources, other than publicly owned treatment works, which are based on the application of the best available technology economically achievable which will result in reasonable further progress toward the national goal of eliminating the discharge of all pollutants, as determined in accordance with regulations issued by the Administrator pursuant to Section 304(b) to the Act. Section 306 of the Act requires the achievement by new sources of a Federal standard of performance providing for the control of the discharge of pollutants which reflects the greatest degree of effluent reduction which the Administrator determines to be achievable through the application of the best available demonstrated control technology processes. Operating methods, or other

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alternatives, including, where practicable, a standard permitting no discharge of pollutants.

Section 304(b) of the Act requires the Administrator to publish within one year of enactment of the Act, regulations providing guidelines for effluent limitations setting forth the degree of effluent reduction attainable through the application of the best practicable control technology currently available and the degree of effluent reduction attainable through the application of the best available control measures and practices achievable including treatment techniques, processes and procedure innovations, operation methods, and other alternatives. The regulations proposed herein set forth effluent limitations guidelines pursuant to Section 304(b) of the Act for auto and other laundries.

<u>Summary of Methods Used for Development of Effluent Limitations Guidelines and Standards of Performance</u>

The effluent limitations guidelines and standards of performance proposed herein were developed in the following manner.

1. The point source category was first studied for the purpose of determining whether separate limitations and standards are appropriate for different subcategories within the category. This included a determination of differences in materials used, product produced, process employed, age, size, wastewater constituents and other factors that would require development of separate limitations and standards for different segments of the point source category.

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2. The raw waste characteristics for each subcategory were then 63
identified. This included an analysis of: 65

(a) the source flow and volume of water used in the process 70
employed and the sources of waste and wastewaters in the plant; 71

(b) The constituents (including thermal) of all wastewaters, 75
including toxic constituents and other constituents which result 76
in taste, odor, and color in the water or aquatic organisms; 77

(c) The constituents of the waste waters which should be 78
subject to effluent limitations guidelines and standards of 81
performance were identified;

(d) the full range of control and treatment technology. 83
This included: 84

(1) identification of each distinct wastewater control 86
and treatment technology, including both in-plant and end of 88
process technologies, which are existent or capable of being 89
designed for each subcategory;

(2) the amount of constituents (including thermal) and 91
the chemical, physical and biological characteristics of 93
pollutants;

(3) the effluent level resulting from the application 94
of each of the treatment and control technologies; 97

(4) the problems, limitations and reliability of each 100
treatment and control technology and the required implementation 102
time;

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(5) the non-water quality environmental impact, such 107
as the effects of the application of such technologies upon other
pollution problems, including air, solid wastes, noise and 108
radiation;

(6) the energy requirements of each control and 111
treatment technology; 112

(7) the cost of the application of treatment 116
technologies.

The information, as outlined above, was then evaluated in order 118
to determine what levels of technology constituted the best 119
practicable control technology currently available, the best 120
available technology economically achievable, and the new source 121
performance standards and pretreatment guidelines. In identifying 122
such technologies various factors were considered. These included 123
the total cost of application of technology in relation to the 124
effluent reduction benefits to be achieved from such application, the 125
age of equipment and facilities involved, the process employed, the
engineering aspects of the application of various types of control 126
techniques process changes, non-water quality environmental impact 127
(including energy requirements) and other factors. 128

The data on which the above analysis was performed were derived 130
from EPA permit applications, EPA sampling and inspections, 131
consultant and industry reports. 132

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<u>General Description of the Industries</u> 134

The industries discussed by this document are the auto and other 136
laundries. It encompasses the following nine Standard Industrial 138
Code Classifications listed with their SIC numbers: 139

SIC 7211 - Power Laundries, Family and Commercial 142
SIC 7213 - Linen Supply 143
SIC 7214 - Diaper Service 144
SIC 7215 - Coin-operated Laundries and Dry Cleaning 145
SIC 7216 - Dry Cleaning Plants, Except Rug Cleaning 146
SIC 7217 - Carpet and Upholstery Cleaning 147
SIC 7218 - Industrial Laundries 148
SIC 7219 - Laundry and Garment Services, Not Elsewhere 149
Classified 150
SIC 7542 - Auto Wash Establishments 151

The definitions of the plants included are contained in the 155
Standard Industrial Classification Manual, 1972 (the definitions as 156
stated in the SIC Manual are included in Section XIV Glossary.) 157

<u>General Background</u> 159

The product of the auto wash establishments, is self-explanatory. 162
The product of the eight remaining categories is a clean fabric. The 163
methods, of obtaining this end, differ greatly depending on what is 164
being cleaned in any given operation or process.

With the exception of dry cleaning plants, the remaining five 167
categories use substantial quantities of process waters. The 168

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effluent from the process varies greatly from load to load depending 169
on laundering schedule used and the items being washed. 170

The various phases of the laundry industry can be separated into 173
each of the SIC classifications. But most laundries actually do work 174
in several of the SIC classifications; even though the company name 175
might tend to indicate only one phase.

In general, laundry wastewater in the major cities of America 177
makes up 5 to 10% of the average daily flow of sewage. It is one of 179
the most objectionable of all wastes, contributing anywhere from 10 180
to 20 times as much contamination as the average domestic waste. It 182
is usually strongly alkaline, highly colored, and contains large
quantities of soap or synthetic detergents, soda ash, grease, dirt 183
and dyes. Laundry wastewater has a biological oxygen demand of two 184
to five times that of domestic sewage. Laundry wastewater can be a 186
severe wastewater treatment problem for a community of any size.

The laundry industry is an essential service industry classified 189
according to Table 2, based on the 1967 Census of Business Report on 190
Laundries, Cleaning Plants and Related Services, issued by the U. S. 192
Department of Commerce Bureau of the Census, Released August 1970. 193

Considerable information has been collected, see References, 195
Section XIII. Additional information has been obtained by visiting 196
and sampling the wastewater from plants that were referred to as 197
being explanatory as to: strength and volume of wastewater; type of 198

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laundry and the pretreatment or the recycling of wastewater. The 199
following laundries were visited: Cintas, Cincinnati, Ohio; Mission
Linen Supply, Santa Barbara, California; the Roscoe Company, Chicago, 200
Illinois; Medical Arts Linen Supply Company, New York, New York; 201
Sterling Laundry, Silver Spring, Maryland. Security Amirkahanian, a 202
rug, drapery and furniture upholstery plant and the Parkway Auto 203
Wash, Inc., both of Cincinnati, Ohio, were also visited.

Samples were collected but they were not, in all cases, 205
representative of the pretreatment and recycle wastewater, because of 206
the failure and/or breakdown of the treatment systems.

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TABLE 2

Statistical Highlights
Laundry Industry
(1967)

| Segment of Industry | Receipts | Percent of Market | Number of Establishments | Number of Employees |
|---|---|---|---|---|
| Garment Pressing Alteration and and Repair | $ 242,453,000 | 4.9 | 7,738 | 18,796 |
| Self-service Laundries and Dry Cleaning | 407,412,000 | 8.2 | 29,551 | 32,207 |
| Industrial Launderers | 561,459,000 | 11.2 | 918 | 45,183 |
| Linen Supply | 733,874,000 | 14.7 | 1,435 | 67,507 |
| Power Laundries | 941,696,000 | 18.8 | 6,350 | 146,155 |
| Cleaning and Dyeing Plants | 1,938,024,000 | 38.7 | 30,625 | 246,348 |
| Laundries, except Power and Coin-operated | 46,524,000 | | 1,474 | 4,977 |
| Diaper Service | 64,331,000 | | 316 | 5,996 |
| Rug Cleaning and Repairing Plants | 66,342,000 | | 894 | 5,336 |

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# SECTION IV

## Industry Categorization

### Rationale For Subcategorization

There is a well-established order in the strength of laundry wastewater, with industrial laundry wastewater being the strongest and most varied. Linen supply laundries discharge the next most difficult wastewater to treat followed by that from power laundries, (family and commercial), diaper service activities, auto wash establishments, carpet and upholstery cleaning operations, and coin-operated laundries and dry cleaning facilities. Establishments primarily engaged in repairing, altering, or storing clothes for individuals, and those that function as other hand laundries have the least difficult wastewater to treat. Dry cleaning plants, except rug cleaning, have little or no discharge of process wastewaters.

Auto washes are classified by themselves because: (1) Technologically, it is easier for them to clean up their effluent than it is for the laundries; (2) they have an economic incentive to reclaim washwater; (3) the equipment they need to reclaim and reuse water is available, off the shelf, from many manufacturers.

Carpet and upholstery cleaning is classified separately because, its wastewater is different from other laundries and although the wastewater generated is similar to that from auto washes, it is much more dilute and the equipment needed to treat it for reuse is not available.

Dry cleaning plants (other than rug cleaning) were classed individually because their greatest use of water is for non-contact cooling purposes in solvent recovery stills.

Industrial Laundries

Industrial laundries are located in highly populated areas and discharge their wastewater into municipal treatment facilities. They are among the largest laundries covered in these guidelines. For example, a medium size industrial laundry will process between 80,000 - 100,000 pounds of dry wash per week. Typical industrial laundry waste characteristics and chemical formulas are covered in Section V.

Tables 3 and 4 present typical laundering schedules for shop towels and kitchen towels, respectively. Schedules for other items would vary slightly.

The first operation or flush on the schedule for Table 3 is merely an initial rinse to remove readily loosened soil. The suds operation of Table 3 emulsifies the oils and greases and loosens all the soil. The carryover is merely an extension of the suds operation as a high percentage of the supplies initially added are still present. This operation takes advantage of that fact by utilizing the remaining cleaning ability of the suds chemicals. The carryover

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is followed by as many as 10 rinses to remove the used detergent and loosened soil. The shop towels are then dyed and rinsed. On the next break salt is added to set the dye. A final cold rinse aids in setting the dye and also removing excess dye. The laundered items are then loaded into stainless steel tubs, which are rolled into an extractor where excess water is squeezed out. The water drains into the heat reclaimer pit and is used to warm the incoming water. The clean articles are then taken to gas-fired driers where the rest of the water is evaporated. After this operation, the laundered items are folded and packaged into standard bundles and redistributed to the customers.

The many different types of soil, laundry formulations, and operations (including the batch type operation of each washing machine) all contribute to altering contaminant concentrations and wastewater flows. Each operation presented in Tables 3 and 4 discharges such that with only one machine operating, a series of wastewater surges occurs, each unlike the one preceding it in quality. It is not practical to subcategorize industrial laundries because individual plants are so variable.

## Linen Supply, Power Laundries (Family and Commercial), and Diaper Services

This subcategory is recognized within the industry as having the second strongest average waste. Operations are similar to those

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TABLE 3*

Typical Laundering Schedule
For Shop Towels

| Washing Operations | Water Level (Gals) | Temperature °F | Operation Length (Min) | Supplies |
|---|---|---|---|---|
| Flush | 354 | Line | 2 | |
| Suds | 110 | 190 | 15 | NaOH, silicate and base oil |
| Carryover | 110 | 190 | 4 | |
| Rinse 1 | 354 | 190 | 2 | |
| Rinse 2 | 354 | 190 | 2 | |
| Rinse 3 | 354 | 190 | 2 | |
| Rinse 4 | 354 | 190 | 2 | |
| Rinse 5 | 354 | 190 | 2 | |
| Rinse 6 | 354 | 190 | 2 | |
| Rinse 7 | 354 | 185 | 2 | |
| Rinse 8 | 354 | 175 | 2 | |
| Rinse 9 | 354 | 165 | 2 | |
| Rinse 10 | 354 | 155 | 2 | |
| Dye | 354 | 145 | 2 | Dye |
| Salt | - | - | 4 | Sodium chloride |
| Cold Rinse | 354 | 100 | 2 | |

*From Reference 92, Table C-1.

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TABLE 4*

Typical Laundering Schedule
For Kitchen Towels

| Washing Operations | Water Level (Gals) | Temperature °F | Operation Length (min) | Supplies |
|---|---|---|---|---|
| Flush | 354 | 175 | 4 | |
| Flush | 354 | 190 | 2 | |
| Break | 111 | | 5 | Base oil alkali |
| Suds | 111 | 190 | 4 | Alkali, soap |
| Rinse 1 | 354 | 190 | 2 | |
| High Suds | 177 | 190 | 4 | Soap, alkali |
| Bleach | 150 | 150 | 7 | Bleach |
| Rinse 2 | 354 | 190 | 2 | |
| Rinse 3 | 354 | 175 | 2 | |
| Rinse 4 | 354 | 175 | 2 | |
| Rinse 5 | 354 | 175 | 2 | |
| Sour | 66 | Line | 4 | Sour, mildicide |

*From Reference 92, Table C-3

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outlined in Table 4, except that two sudsing stages and a bleach-and-sour step are utilized. A sour is an acid chemical added in the last washing operation to negate the swelling effect of the alkali. The initial break operation is similar to a suds operation except that no soap is added. Starch, as well as other compounds, is also frequently added to linen wash loads.

## Auto Wash Establishments

In general an auto wash has a tunnel or bay configuration, and there are variations of each type.

### Tunnel Type Carwash

In a tunnel-type plant the vehicle is washed as is is pulled from station to station by a continuous chain. Even if the washing operation itself is completely automated, wiping, drying and interior cleaning are usually done manually by employees or the customer. If the carwash is a drive-through type where the customer remains in his car, he usually has to do the detailing. The trend in the auto wash industry is to do away with as much labor as possible to reduce costs and to eliminate problems associated with an unskilled or semi-skilled labor force.

The tunnel type wash is the most expensive to build -- up to $200,000 -- but it can also produce the most income; the largest plants handle more than 1,000 cars a day.

Bay-type Carwash

There are many variations of the bay-type carwash.

At a "wand-type" coin-operated facility the customer parks his car in a bay and deposits coins in a meter, he then has five minutes to wash his car with water from a pressurized wand (300 - 500 psi). He can spend the entire period spraying on a soapy wash or elect to use some clear rinse water. Most operators find that their customers pay for two five-minute operations.

In some instances, the wand is activated by a pump in a roll-around cabinet. Wastewater characteristics are discussed in detail in Section V.

In a "roll-over" carwash the customer parks his car in a bay and the washing equipment, including brushes, move over the car. A variation of this is a system in which a coin-operated robot machine circles the car, and cleans it with pressurized soapy water and rinse water.

Carpet and Upholstery Cleaning

At present, about 30% of all rug cleaning operations are done in the home and this percentage will undoubtedly increase.

In a typical in-plant cleaning operation, the rug is first beaten to remove dust and dry solids and is then wetted with water and a mild, dilute detergent. It then passes through a system of either

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rollers or brushes which work the detergent into the fiber, to suspend the dirt, a clean water rinse follows, finally excess water is squeezed out and the rug is air dried. The industry is trying to reduce the amount of water used in the rinse cycle by using new detergent formulations, and about 25% is already doing so.

The amount of water from upholstery cleaning, which is basically a dry process, is in the order of 0.1% of the total effluent from carpet and upholstery cleaning operations and will, therefore not be described.

Coin-operated Laundries and Dry Cleaning Facilities, and Laundry and Garment Services Not Elsewhere Classified

Most coin-operated laundries contain between 25 and 35 machines, each of which uses 25 - 30 gallons of water per washing cycle. An average weekly wastewater volume of 50,000 gallons can be expected. Approximately 100 pounds of commercial detergent are used per week. Fifteen cycles per day is about standard for a washer, but many laundromats use machines that do 25 cycles or more per day.

Many coin-operated laundries are located in areas without a municipal sewer system to discharge into, but package treatment facilities are available from several manufacturers which can reduce the contaminants from the process wastewaters to acceptable limits.

Coin-operated dry cleaning is a solvent cleaning process with no process wastewater discharge.

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Laundry and garment services not elsewhere classified include 190
Chinese and French hand laundries, facilities where clothes are 192
altered and repaired, and pillow-cleaning operations. Since their 194
effluent is small in both volume and contaminant level, this 195
operation will not be described.

As a group, the effluent of industries in this subcategory is 198
weaker than domestic sewage and can, therefore, be handled easily by 199
municipal treatment plants. Wastewater characteristics are discussed 200
in detail in Section V.

Dry Cleaning Plants, Except Rug Cleaning 202

The advent of wash and wear fabrics has reduced the business of 205
the conventional-type dry cleaning plants. Both the number of plants 206
operating and amounts processed have dropped sharply. The industrial 207
dry cleaner, however, is enjoying unprecedented growth because of two 209
factors. One is the increasing use of "65/35" dacron polyester 210
fabrics which lend themselves to easy dry cleaning. The other is 211
stricter local ordinances on industrial laundries which 212
conventionally wash with water.

There are basically three filter systems used in conventional- 215
type dry cleaning operations; (1) single charge filters; (2) 216
multicharge filters; and (3) regenerative filters. All are designed 218
to separate solids from the solvent and contain two essential parts, 219
a septum and a filter medium. The filter medium, usually diatomite 220

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powder, is contained in the septum, a porous but rigid structure. 221
Most septums are made of wire screen fabrics and paper. The filtered 223
solvent is then introduced into either an atmospheric or a vacuum 225
still. The first type is used to distill perchlorethylene, and the 227
second to distill petroleum solvent. After garments have been dry 229
cleaned, any solvent remaining in them is removed by centrifugation 230
and drying. Charcoal filters may be used to remove dyes from the 231
solvent.

Industrial type dry cleaners employ basically the same 233
technologies, but they have to contend with removing large amounts of 236
heavy oils and grease.

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## SECTION V

### Waste Characterization

The normal constituents of raw effluent from auto and other laundries are listed in Table 5.

### Industrial Laundries

The industrial laundry wastewater distribution system presented in Figure 1 has a recycle ratio of from 46 to 100%. It uses city-softened water, and any of it that is not recycled is discharged into the municipal treatment system (92).

#### Wastewater Constituents

The primary contaminates in industrial laundry wastewater are suspended solids, BOD, alkalies, oil and grease, and heavy metals. Typical concentrations are summarized in Table 6.

The wastewater has the general appearance of thin oily mud and contains material from towels used by printers, tool and die makers, filling station attendants, etc. The soil may be in the form of paints, varnishes, lacquer, latex rubber, ketone solvents, inks utilized in catalog and candy wrapper manufacturing, or carbon black and other material utilized at newspaper printing plants. Organic pollutants could be any or all of 30 hydrocarbon solvents, over 300 dyes, pigments, and inks from rags used to clean presses used in the printing of fliers, catalogs, and the like. Thus, the laundry ends up with what ever product its customers may be using plus any of the

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TABLE 5

General Characterization
of Wastewater from Laundries and Auto Washes

| Parameter | Minimum | Maximum<br>ppm | Average |
|---|---|---|---|
| BOD(5) | 15 | 2,482 | 1,073 |
| TSS | 15 | 4,350 | 869 |
| TDS | 104 | 6,454 | 2,267 |
| pH | 5.1 | 13.0 | 10.4 |
| Oil and Grease | 38 | 2,229 | 723 |
| Hg | 0.0005 | 0.007 | - |
| Ni | 0.3* | 2.5 | 0.4* |
| Fe | 3.2 | 8.3 | 4.0 |
| Cd | 0 | 0.6 | 0.02* |
| Zn | 0.40 | 8.9 | 0.40 |
| Cr | 0.4 | 3.6 | 0.5* |
| Cu | 0.1* | 9.3 | 0.1* |
| Pb | 0.6* | 35.8 | 0.6* |

* = Less Than

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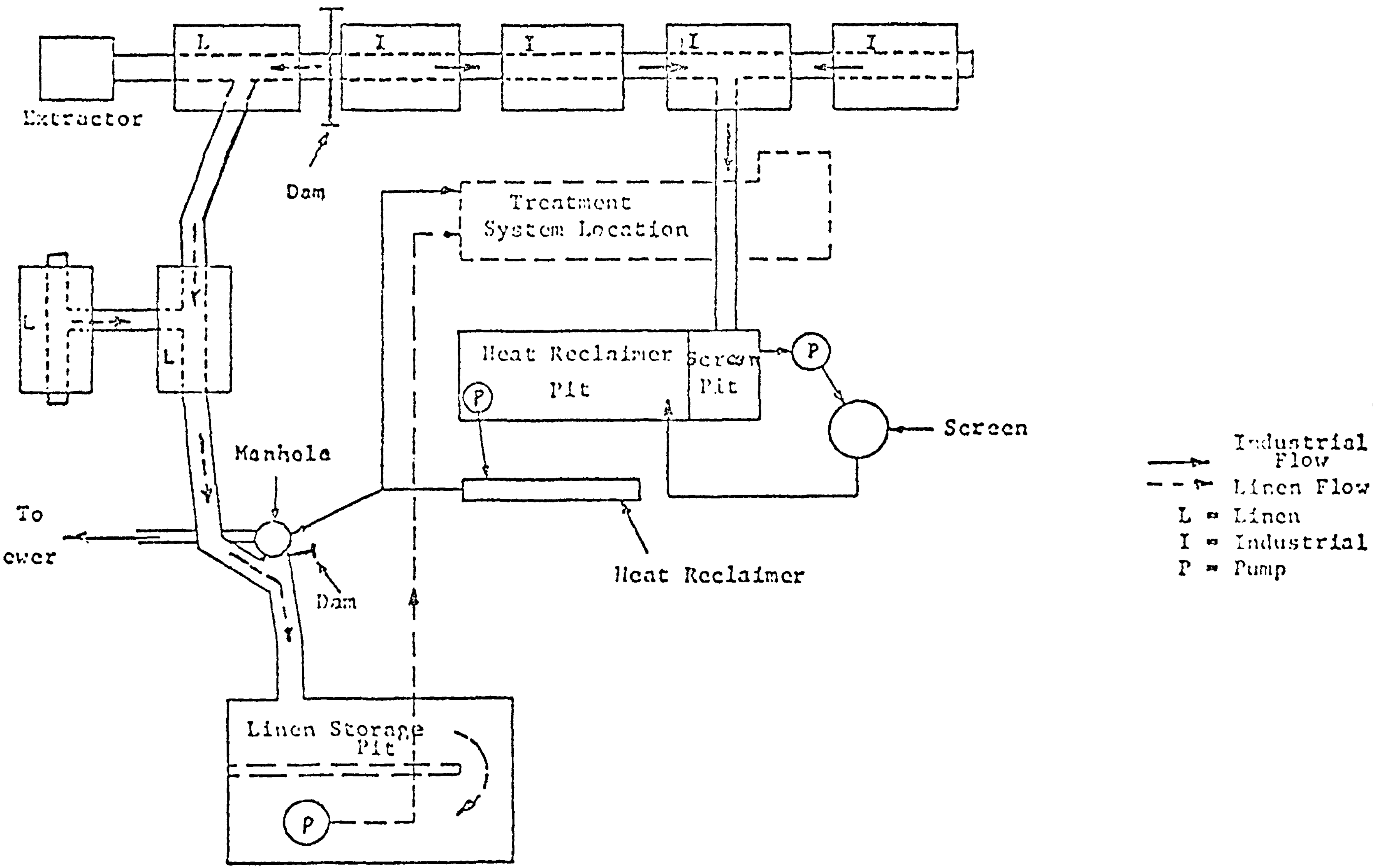


FIGURE 1
LAUNDRY WASTEWATER DISTRIBUTION SYSTEM (92)

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TABLE 6

Typical Industrial Laundry Waste(92)

| Parameter | Minimum | Maximum mg/1 | Average |
|---|---|---|---|
| Total Solids | 4,856 | 8,649 | 6,748 |
| TOC | 950 | 6,300 | 2,482 |
| Total Volatile Solids | 3,250 | 5,284 | 3,866 |
| Suspended Solids | 649 | 4,950 | 2,809 |
| Volatile Suspended Solids | 1,458 | 2,225 | 1,889 |
| Oil and Grease | 403 | 3,756 | 1,538 |
| pH - units | 11.0 | 13.0 | 12.0 |
| Total Alkalinity | 1,825 | 3,190 | 2,066 |
| BOD | 647 | 1,314 | 830 |
| Total Dissolved Solids | 1,550 | 6,545 | 4,697 |
| Chromium | 1.0 | 3.6 | 2.4 |
| Copper | 0.2 | 9.3 | 3.7 |
| Lead | 3.0 | 35.8 | 13.2 |
| Zinc | 0.55 | 8.9 | 4.1 |
| Cadmium | < .05 | 0.6 | .2 |
| Iron | 3.5 | 126 | 42 |
| Nickel | 1.0 | 2.5 | 1.4 |
| Mercury | 0.001 | 0.007 | 0.003 |

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pollutants it may add during the cleaning process which could include any or all of the following: (1) alkalies -- caustic soda, soda ash, soda metasilicate, sodium sesqui silicate, tri sodium phosphate, tetra sodium pyrophosphate, and sodium tri polyphosphate; (2) soaps -- of vegetable or animal oils; (3) detergents -- anionic synthetic and non-ionic synthetic; (4) bleaches -- sodium hypochlorite, calcium hypochlorite, lithium hypochlorite, dimethyl dichlorohydantoin (DDH) and chlorocyanuric acid; and trichloroisocyanuric acid; (5) sours -- acid fluorides, sodium silico fluoride, ammonium silico fluoride, zinc silico fluoride, sodium acid fluoride, ammonium acid fluoride and fluoro oxalate; (6) starches of both corn and wheat derivatives; (7) blueing compounds -- water solubles of aniline dye stuffs; (8) fabric softeners --( cationic synthetics); (9) bacterial static agents -- quaternary ammonium compounds, and two phenol compounds; (10) dust control compounds consisting of petroleum derivatives; (11) flame retardants -- boric acid - borax and phosphates; (12) dyes: (13) petroleum solvents -- including perchloroethylene; (14) fungicides -- quaternary ammonium salts used mostly in linen laundries and tributyl tin most used in industrial laundries; (15) spotting agents -- dichlorobenzene, carbitols and emulsifying agents; (16) stripers -- sodium hydrosulfite, titanium sulfate and titanium chloride; (17) neutralizers or antichlors such as sodium sulfite and sodium thiosulfate (18) enzymes of the protease type used primarily

in hospital work to reduce water consumption by removing the blood, 63
etc., from operating room gowns. 64

The loadings from a typical industrial laundry operation are 66
tabulated in Table 7. 67

Flow Rate Analysis 69

The flow rate depends upon the size and activity of the 71
particular plant, both of which vary widely. The plant shown in 73
Figure 1 has a flow rate that varies from 341 to 814 liters per
minute; however, its recycling system has a capacity of only 200 74
liters per minute.

Linen Supply - Power Laundries and Diaper Services 76

The wastes from linen supply laundries are typically lower in 78
concentration than those from industrial laundries (92). Values are 80
presented in Table 8.

The typical loading of suspended solids in the wastewater of 82
linen laundries is 0.03 lb/lb material washed, the TDS is 0.08 lb/lb 84
garment and 0.03 lbs/lb garment oil and grease.

Members of the industry claim that there are no bacteriological 87
or viral contaminates present in the wastewaters from diaper services 88
and hospitals. No definitive data are available to substantiate this 89
assertion.

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TABLE 7*

Wastewater Loadings
Industrial Laundry

| Parameter | Minimum (lb/1,000 gallons) | Maximum (lb/1,000 gallons) | Average (lb/1,000 gallons) | Unit Output lb/lb |
|---|---|---|---|---|
| BOD(5) | 13 | 20 | 17 | 0.098 |
| TSS | 8 | 36 | 18 | 0.025 |
| TDS | 13 | 55 | 39 | 0.220 |
| Oil and Grease | 2 | 19 | 10 | 0.056 |
| Hg | 0.000008 | 0.00006 | 0.00002 | 0.0000001 |
| Ni | 0.04 | 0.09 | 0.01 | 0.00006 |
| Fe | 0.03 | 1.05 | 0.35 | 0.0020 |
| Cd | 0.0004 | 0.01 | 0.002 | 0.00001 |
| Zn | 0.004 | 0.07 | 0.033 | 0.00018 |
| Cr | 0.01 | 0.03 | 0.020 | 0.0001 |
| Cu | 0.002 | 0.08 | 0.031 | 0.00017 |
| Pb | 0.02 | 0.29 | 0.110 | 0.00062 |

*Calculated from Table 6

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TABLE 8

Pollutant Concentration in Wastewater
From a Typical Linen Supply Laundry (92)

| | Minimum | Maximum | Average |
|---|---|---|---|
| pH | 10.3 | 11.2 | |
| Alk., mg/1 CaCO(3) | 500 | 925 | 679 |
| TS, mg/1 | 1,973 | 3,663 | 2,675 |
| TVS, mg/1 | 1,468 | 1,630 | 1,549 |
| SS, mg/1 | 500 | 1,474 | 736 |
| COD, mg/1 | 2,125 | 5,113 | 3,057 |
| BOD, mg/1 | 97 | 797 | 314 |
| Soluble Solids, mg/1 | 1,725 | 2,038 | 1,837 |
| Vol. Sol. Solids, mg/1 | 964 | 991 | 978 |
| Oil and Grease, mg/1 | 203 | 1,220 | 628 |
| Sol. COD, mg/1 | 1,173 | 2,590 | 1,649 |
| Cr | - | - | .06 |
| Cu | - | - | .27 |
| Pb | - | - | .70 |
| Zn | - | - | .47 |
| Cd | - | - | .04 |
| Ni | - | - | 2.10 |

No data available

## Auto Washes 91

A flow diagram showing a typical wastewater reclamation system 94
used at some car washes is presented in Figure 2. The designers of 95
this particular system claims that 85% of the water used can be
recycled. Although many other reclamation systems are available less 97
than 30% of car washes resort to recycle. The rest use municipal 99
water and are connected to a municipal treatment plant. 100

### Wastewater Constituents 102

The constituents found in wastewater from car washes vary widely 104
and are affected by such factors as number of cars cleaned, 105
geographic location, and weather conditions. The water contains 106
exceedingly high amounts of total solids, total volatile solids, 107
suspended solids, and grease, and its BOD content exceeds that
present in the effluent of secondary treatment plant (39). 108

Typical waste loadings in wastewater from a tunnel-type car wash 110
are presented in Table 9. The minimum, maximum, and average 112
concentrations of pollutants for a typical self-service car wash 113
during a ten-month period are shown in Table 10. Table 11 gives the 115
maximum, minimum, and average concentrations for eight grab samples 116
collected at a tunnel-type car wash during a seven and one-half hour 117
period in October 1973. These data are based on an average computed 118
from the eight samples.

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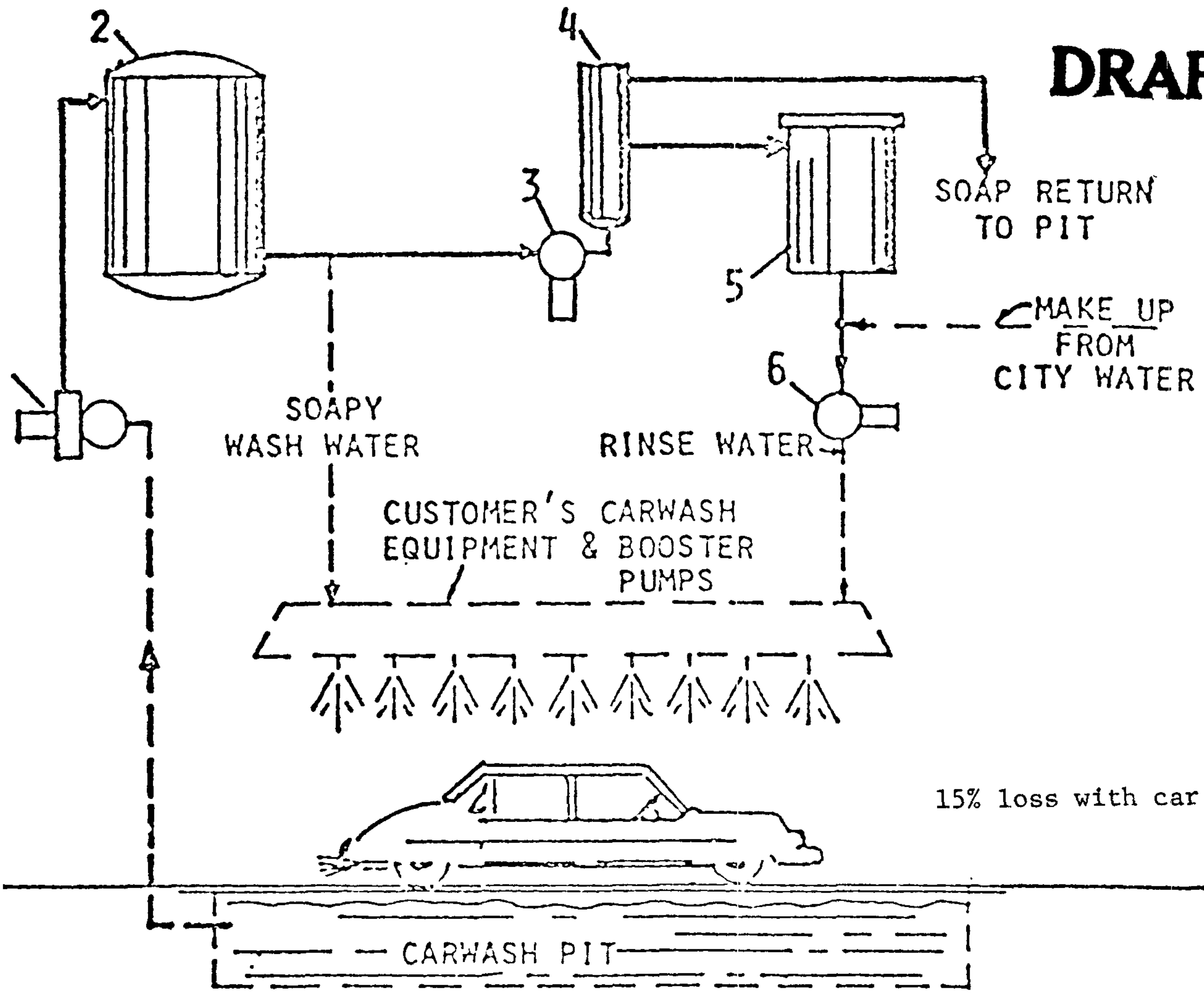


| | |
|---|---|
| 1 | FILTER PUMP WITH BASKET STRAINER |
| 2 | WASH WATER FILTER REMOVES DIRT FROM WATER |
| 3 | PUMP |
| 4 | DETERGENT FILTER REMOVES SOAP FROM WATER |
| 5 | RECYCLE TANK |
| 6 | BOOSTER PUMP |

Figure 2

Typical Wastewater Reclamation
System for Carwash(104)

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TABLE 9**

Typical Loadings in Wastewater
From Tunnel-Type Auto Washes

| Parameter | lb/1,000 gallons Maximum | Minimum | Average | Unit Output lb/car |
|---|---|---|---|---|
| BOD(5) | 0.95 | 0.17 | 0.48 | 0.020 |
| TSS | 4.5 | 0.95 | 2.3 | 0.011 |
| TDS | 17.6 | 5.0 | 10.2 | 0.46 |
| Detergents | 27.4 | 1.9 | 12.6 | 0.56 |
| Oil and Grease | 1.6 | 0.31 | 0.70 | 0.032 |
| Ni | 0.006* | 0.003* | 0.003* | 0.0001* |
| Fe | 0.03 | 0.03 | 0.03 | 0.001 |
| Cd | 0.0003* | 0.0002* | 0.0002* | 0.0001* |
| Zn | 0.003 | 0.003 | 0.003 | 0.0001 |
| Cr | 0.008* | 0.003* | 0.004* | 0.0002* |
| Cu | 0.003* | 0.001* | 0.001* | 0.00001* |
| Pb | 0.001* | 0.001* | 0.001* | 0.00001* |

* = Less Than
** Calculated From Tables 10 and 11

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TABLE 10

Typical Pollutant Concentrations in Wastewater
From Self-Service Auto Washes (40)

(10 month period)

| | Minimum mg/1 | Maximum mg/1 | Average mg/1 |
|---|---|---|---|
| Total Solids | 729 | 3,334 | 2,006 |
| Total Volatile Solids | 207 | 871 | 456 |
| Suspended Solids | 95 | 840 | 386 |
| Volatile Suspended Solids | 25 | 116 | 72 |
| BOD(5) | 15 | 166 | 57 |
| Oil and Grease | 38 | 200 | 86 |

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TABLE 11

<u>Pollutant Concentrations in Wastewater From A Tunnel-Type Auto Wash</u>

(Based on eight grab samples)

| | Minimum | Maximum | Average |
|---|---|---|---|
| Freon extractable oil-grease mg/1 | 0.1* | 0.3 | .2 |
| BOD(2), mg/1 | 4 | 32.8 | 18.6 |
| BOD(5), mg/1 | 28 | 78.7 | 52.2 |
| BOD(7), mg/1 | 39.3 | 99.0 | 64.8 |
| Suspended solids mg/1 | 160 | 234 | 189 |
| Volatile suspended solids mg/1 | 55 | 88 | 74 |
| Total solids mg/1 | 728 | 1,964 | 921 |
| Alkalinity -Phenolphthalein mg/1 | 6 | 25 | 11 |
| Alkalinity - Total mg/1 | 146 | 199 | 160 |
| Turbidity JTU | 68 | 179 | 124 |
| TOC mg/1 | 25 | 56 | 45 |
| COD mg/1 | 156 | 274 | 222 |
| Total P mg/1 | 27 | 37 | 34 |
| TKN mg/1 | 1.8 | 6.6 | 3.1 |
| Surfactants (LAS) mg/1 | 105 | 185 | 147 |
| Ni mg/1 | .3* | .7* | .4* |
| Ca mg/1 | 10 | 60 | 30 |
| Cr mg/1 | .4* | 1.* | .5* |
| Ba mg/1 | .2* | .4* | .2* |
| Sn mg/1 | 1.* | 1. | 1.* |
| Mg mg/1 | 10 | 20 | 15 |
| V mg/1 | 1.* | 3.* | 1.* |
| Mo mg/1 | .2* | .4* | .2* |
| Ti mg/1 | .2* | .6* | .3* |
| As mg/1 | 10.* | 30.* | 20.* |
| Pd mg/1 | .5* | 1.* | .6* |
| Tl mg/1 | .4* | 1.* | .5* |
| Ga mg/1 | .1* | .3* | .1* |
| Al mg/1 | .6 | 1. | .8 |
| Sr mg/1 | .1 | .3 | .2 |
| Sm mg/1 | .9* | 2.* | 1.* |
| Zn mg/1 | .3 | .4 | .4 |
| Cd mg/1 | .02* | .04* | .02* |
| Mn mg/1 | .1 | .1 | .1 |
| Fe mg/1 | 3. | 4. | 4. |
| Pb mg/1 | .5 | 1.* | .6* |

(Continued on next page)

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| | | | |
|---|---|---|---|
| Be mg/l | .01* | .03* | .01* |
| Sb mg/l | .5* | 1.* | .7* |
| Cu mg/l | .1* | .3* | .1* |
| pH units | 8.7 | 9.1 | 8.9 |
| Temp. C | 25.0 | 28.0 | 26.0 |
| 4 uhos/cm(3) Conductivity | 710 | 3,000 | 1,020 |

* = Less Than

Analyses by EPA, Office of Enforcement & General Counsel, NFIC-Cincinnati, October 1973.

Flow Rate Analysis

A self-service facility uses approximately 20 gallons per car, and at a typical 6-bay facility about 38,000 gallons are used per month(39). The tunnel type car wash for which data are presented in Table 10 used 4,200 gallons of water for 94 cars in a seven and one-half hour period. For an average of approximately 45 gallons.

The removal of protective coatings from newly imported autos using organic solvents is considered an industrial process and is, therefore, treated under transportation guidelines.

Carpet and Upholstery Cleaning

The constituents in wastewater generated by this operation are similar to those found in the effluent from car washes excepting that less oil and grease are present. No definitive data are available to substantiate this assertion.

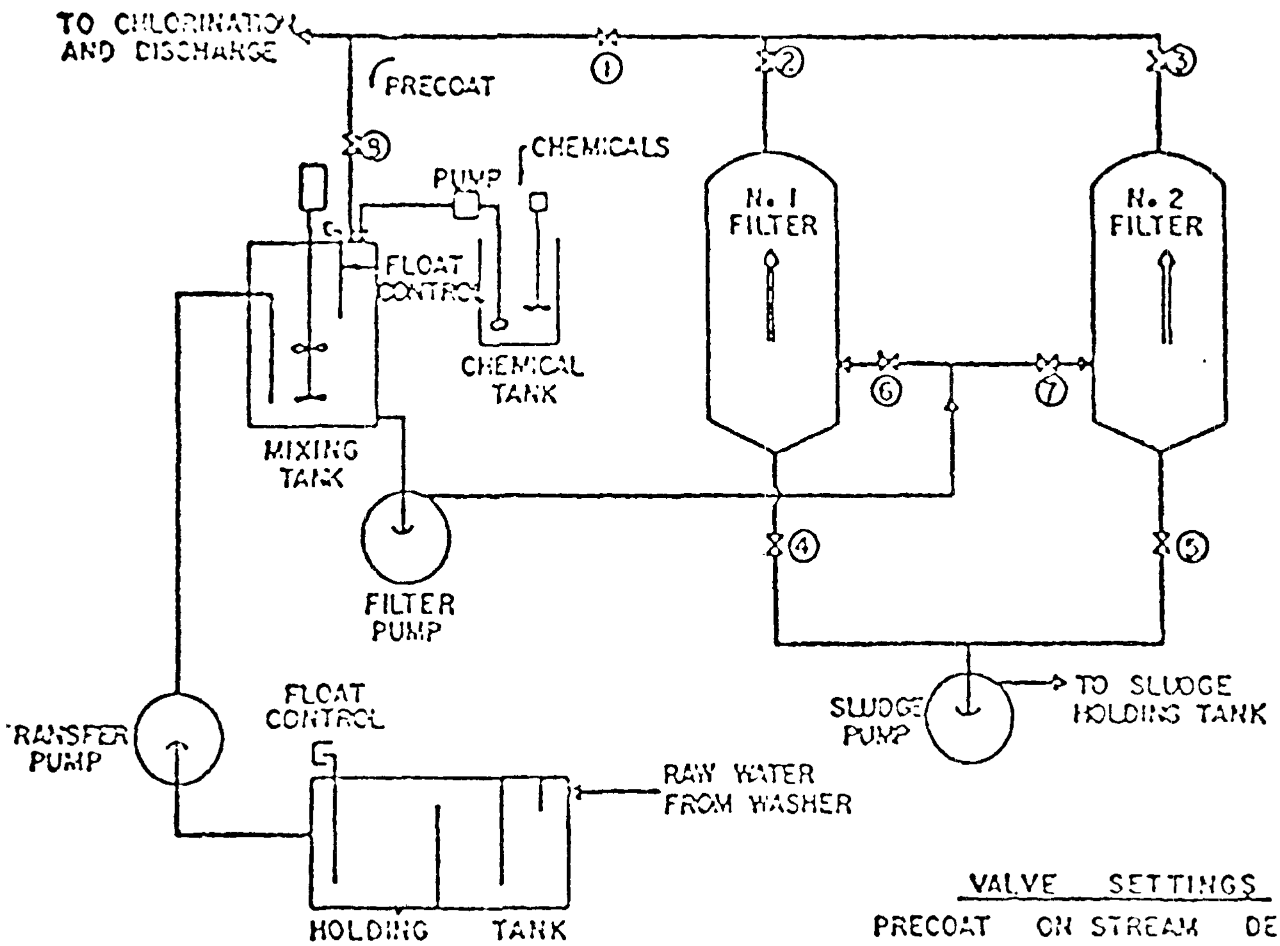
Coin-operated Laundries and Dry Cleaning Facilities and Laundries and Garment Services Not Elsewhere Classified

The normal daily flow through the waste filtration system of the typical laundromat shown in Figure 3 is 6,300 to 8,500 gallons.

Wastewater Constituents

Typical wastes are presented in Table 12.

Typical waste loadings re 0.04 lb of suspended solids/load, 0.20 lb of of TDS and .01 lb detergents.




VALVE SETTINGS

| | PRECOAT | ON STREAM | DESLUDGE |
|---|---|---|---|
| OPEN | 1,2,3,6,7,8 | 1,2,3,6,7 | 4,5,6,7 |
| CLOSED | 4,5 | 4,5,8 | 1,2,3,8 |

Precoat is diatomaceous earth.

Figure 3

Laundromat Wastewater Treatment Sysemt (110)

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TABLE 12

Pollutant Concentrations in Wastewaters From Typical Laundromats(110)

| | Minimum mg/l | Maximum mg/l | Average |
|---|---|---|---|
| ABS | 3.0 | 126.0 | 44.0 |
| Suspended Solids | 15.0 | 784.0 | 173.0 |
| Dissolved Solids | 104.0 | 2,064.0 | 812.0 |
| COD | 65.0 | 1,405.0 | 447.0 |
| Alkalinity | 61.0 | 398.0 | 182.0 |
| Chlorides | 52.0 | 185.0 | 57.0 |
| Phosphates | 1.0 | 430.0 | 148.0 |
| pH | 5.1 | 10.0 | - |
| Nitrates | - | - | 1.0* |
| Free Ammonia | - | - | 3.0 |
| Sulfates | - | - | 200.0 |
| BOD(5) | 119 | 243 | 170 |

* = Less Than

All units in mg/l except pH which is expressed in units.

Flow Rates Analysis

Most installations contain between 25 and 35 machines, each of which uses 25-30 gallons of water per washing cycle for a total weekly average of 50,000 gallons. Approximately 100 pounds of commercial detergent are used per week (69).

Dry Cleaning Other Than Rugs

The only pollutants in the dry cleaning process are those which are extracted from the cleaned materials. These are collected at the time of solvent recovery and should be disposed of by a scavanger.

Section VI describes the pollutant parameters and sets forth the rationale for selection or rejection of waste constitutents and their relation to the control parameters.

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# SECTION VI

## Pollutant Parameters

Based on this study, the selected control parameters for each subcategory are listed in Table 13. The rationale for selection or rejection of waste constituents is as follows.

Upon review of the EPA regional permit applications for the discharge of wastewaters from auto and other laundries, industrial data, and observations made during EPA plant inspections, it was determined that the following chemical, physical, and biological properties or constituents are found within the process wastewater effluent. The values will differ by type of laundry, plant size, and production: suspended solids, dissolved solids, BOD(5) COD, TOC, pH, alkalinity, oil and grease, turbidity and heavy metals. The degree of control exercised over these various parameters depends on whether the wastewater is discharged into a stream or a municipal sewer system.

### Suspended Solids

Soil and grit from the products laundered will show up in the effluent as suspended solids.

Suspended solids can kill fish and shellfish by causing abrasive injuries and can clog the gills and respirating passages of various aquatic fauna. They can also blanket stream bottoms, thereby killing

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TABLE 13

Control Parameter

| Subcategory | pH | SS | BOD(5) | Oil and Grease | Heavy Metals |
|---|---|---|---|---|---|
| 1. Industrial Laundries | X | X | X | X | X |
| 2. Linen, Power and Diaper Laundries | X | X | X | X | X |
| 3. Auto Wash | | X | X | X | |
| 4. Carpet Upholstery Cleaning | | X | X | | |
| 5. Coin-operated and Laundries Not Classified Elsewhere | X | X | X | X | |
| 6. Dry Cleaning Except Rug Cleaning | | | | | |

eggs and food organisms and destroying spawning beds. Indirectly, suspended solids are inimical to aquatic life because they screen out light and carry down and trap bacteria and decomposing organic wastes on the bottom. This promotes and maintains the development of noxious conditions and depletes oxygen, kills fish, shellfish, and fish food organisms, and reduces the recreational value of the water.

The suspended solids and BOD(5) in a laundry effluent can cause an oxygen sag to occur if it is discharged directly to a small stream, but they can be handled without difficulty in a sanitary waste treatment facility. The municipality may, however, levy a surcharge for having to process them.

Dissolved Solids

Soil removed from laundered items can raise the concentration of dissolved solids in the wash water by 500 to 6,000 mg/l. Dissolved solids concentrations as low as 50 mg/l are harmful to some industrial operations. The United States Public Health Service (USPHS) has set a limit of 500 mg/l for drinking water. Lethal concentrations for fresh water fish range from 5,000 to 10,000 mg/l, and concentrations exceeding 2,100 mg/l in irrigation waters have harmed crops.

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Turbidity 65

Turbidity is a measure of the light absorbing properties of 68
constituents in water. For a commercial laundry these result from 69
colloidal susions. For an auto wash these result from colloidal 70
suspensions. Values range from 100 to 700 turbidity units. 71

Excessive turbidity in water interferes with the penetration of 74
light and inhibits photosynthesis; this, in turn, decreases the 75
production of organisms on which fish depends for food. 76

Settleable solids and turbidity were not selected as controlling 78
parameters because they are functions of suspended solids. Suspended 80
solids are a more precise measurement of the concentration which is 81
controllable through treatment.

Biochemical Oxygen Demand (BOD) 83

Because of the nature of the organic compounds present in the 85
detergents used and in various types of soil, oxygen-consuming 86
materials are found in laundry-generated wastewater. BOD refers to 88
the amount of oxygen required to destroy biodegradable organic matter 89
under aerobic conditions. Biological treatment facilities have 90
little trouble treating this constituent, but industrial wastes 93
having high BOD(5) concentrations have caused serious oxygen
depletion problems in streams whose assimilative capacity is 95
relatively low.

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Chemical Oxygen Demand (COD) 97

A sizeable chemical oxygen demand will exist in the raw waste 101
stream for the same reasons as given under BOD. Values range from 102
2,125 mg/l to 5,311 mg/l, and higher values are found in recycled 103
waters. One activated sludge plant effected 94% reduction but 105
concentration was still high (300 mg/l). Under certain conditions, 107
wastewaters with a high COD can deplete oxygen in receiving waters. 109

Total Organic Carbon (TOC) 111

In general TOC is equal to or greater than BOD(5). TOC is a 114
measure of total carbon, while BOD(5) measures about two-thirds of 115
the total in a five-day period. When an empirical relationship can 117
be established between the total organic carbon and biochemical 119
oxygen demand, the total organic carbon provides a speedy and 120
convenient way to estimate the other parameters that express the 121
degree of organic contamination.

The mg/l ranges for this parameter are: linen laundries 530-2,150 123
and industrial laundries 2,200-4,400 mg/l. Since most loading and 126
removal data are given in terms of BOD, and an interrelation between 127
BOD, TOC, and COD exists, the parameters of TOC and COD have been 128
excluded in favor of BOD control.

pH 130

Unless neutralization is practiced, wastewater from industrial, 133
linen and coin-operated laundries will have a high pH value because 134
of the alkalinity of the detergents used. The range will be 9.5 - 135
13.3.

Not only is the hydrogen ion a potential pollutant in itself, it 138
can also increase the toxicity of other substances, such as ammonia. 139
The permissible range of pH for fish is 6.0 to 9.0 under normal 140
conditions as is influenced by such factors as temperature, dissolved 142
oxygen, prior acclimatization, and the content of various anions and 143
cations.

Alkalinity 145

The alkalinity of water, a measure of its capacity to accept 148
protons, is usually imparted by the bicarbonate, carbonate, and 150
hydroxide components of a natural or treated water supply. These 152
constituents can have a direct or indirect effect on soil, plant 153
growth, water fowl, and public water supply processing control. 154

The use of caustic solutions to swell the fiber in a commercial 156
laundry produces an alkaline wastewater. The concentrations of 159
alkalinity, expressed in terms of mg/l total alkalinity (CaCO(3)), 160
vary from 250-3,200 depending on the type of fabric to be laundered 161

and its soil content. Since regulation of pH indirectly controls alkalinity, there is no need to control alkalinity directly.

Oil and Grease

Oil and grease are found in laundry effluents in varying degrees, depending on the use to which the laundry was put. The range can be as broad as 245 - 2,300 mg/l. The concentration in the effluent from a carwash ranges from 38 to 200 mg/l. Oil and grease can have deleterious effects on domestic water supplies and can be toxic to fish. Oil and grease can form unsightly scum in streams, clog sewers, and cause operating problems in treatment plants.

Detergents (Methylene Blue Active Substances)

The use of synthetic detergents that contain surface active agents ("surfactants") for general cleaning purposes sometimes caused natural waters to foam when alkyl benzene sulfonate (ABS) was popular. The number of such incidents has dropped, however, since mid-1965 when the detergent industry switched to the production of the more biodegradable linear alkylate sulfonate (LAS).

Heavy Metals

The presence of metals in industrial laundry effluents is a matter of serious concern because they may be toxic to the biological system of a receiving stream. They can also affect operation of public biological treatment facilities. If they are discharged to a sewer system, they either pass through a treatment system untreated or, if present in high concentrations, create a toxic condition in the facility. For these reasons it is imperative that heavy metals be controlled if they are discharged to either surface water or a municipal waste facility.

Some of the more common metals and their ranges of concentration in mg/l for industrial laundries are: chromium 1.0 - 3.6; copper 0.2 - 9.3; lead 3.0 - 35.8; zinc 0.55 - 8.9; cadmium 0.01 - 0.6; iron 3.5 - 12.6; nickel 1.0 - 2.5; and mercury 0.05 - 0.70 (92).

The metals of concern are Hg, Ni, Cd, Zn, Cr, Cu, and Pb.

# SECTION VII

## Control and Treatment Technology

### Historical Treatment

At present, very few laundries discharge directly into a stream or have any type of waste treatment system. Historically, about nine out of 10 plant owners have preferred to discharge their wastewater directly to publicly owned treatment facilities rather than to treat it. Some constituents of the discharges, such as heavy metals and oil and grease, are incompatible with sanitary treatment, but the owners generally ignored this on the grounds that the concentrations are extremely small.

Wastewater recycling is practiced at approximately 30% of existing car washes. Almost all the rest discharge their effluent directly into municipal sewer systems after removing some grease and oil and solids; a few direct it into leaching fields.

Coin-operated laundries almost invariably discharge into municipal systems.

The dry cleaning industry uses expensive solvents and reuses them as many times as possible. The only water discharged is cooling water from the condenser.

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## State-of-the-Art Treatment Technology

The discussion of a particular technology under one subcategory does not limit its possible application in others. A wastewater treatment system will probably have to be designed that is applicable to the individual plant, using various existing subsystems of technologies.

The following assumptions are made for all recycle systems mentioned in this report; (1) That all systems have appreciable losses of water primarily through carryoff on product, evaporation and consequently will require the addition of make-up water to compensate for the negative water balance. Examples of this would be (a) 15% losses for car washes by carryout, (b) 20 - 30% losses in fabric laundry operations by drying. (2) The removal of solid wastes generated by these recycle systems are beyond the scope of these guidelines. Proper disposal of these wastes is the responsibility of the individual operation concerned and is regulated by appropriate governmental agencies.

## Industrial Laundries

No technology currently exists that can treat the exceedingly high concentrations of pollutants in industrial laundry wastewater in a completely satisfactory manner. One unproven system has been constructed specifically to pretreat industrial laundry wastewater, and it might be possible to modify several linen laundry systems for

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such use. There is also an alternative operating procedure that could be applied to industrial laundries.

Flotation Diatomaceous Earth (DE) Filter System

In this system, the wastewater is first treated with calcium chloride during a high pH. This aids in breaking any emulsions. Air flotation and skimming then removes the bulk of the oil and grease. The flotation effluent is passed through a diatomaceous earth filter and the scum collected is compacted by vacuum filtration. The final effluent is neutralized with sulfuric acid prior to discharge, and the sludge cake is stored until periodically removed for disposal.

The average percent and range of removal achieved by both flotation and the overall system is presented in Table 14, and Table 15 gives the average concentrations in the influent and the effluent from the flotation system and the diatomaceous earth filter. Table 16 presents the ranges of the water quality.

One of the problems with this type of system is that it does not reduce the concentration of many of the pollutants to the point that they can be discharging into a public system or navigable waters. Sludge removal and space requirements are also problems.

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TABLE 14

Waste Treatment Efficiences For Various Parameters In Industrial Laundry Waste Treatment(92)

| Parameter | Average % Removed by Flotation | Maximum % Removed by Flotation | Average % Removed by System | Maximum % Removed by System |
|---|---|---|---|---|
| BOD | 24.4 | 67 | 57.1 | 73 |
| TOC | 50.1 | 93 | 74.0 | 95 |
| Suspended Solids | 70.0 | - | 88.7 | - |
| Total Solids | 25.2 | 54 | 33.7 | 57 |
| Oil and Grease | 48.2 | 95 | 83.4 | 99 |
| Copper | 64.8 | 93 | 68.2 | 73 |
| Lead | 59.5 | 99 | 69.5 | 99 |
| Mercury | 56.5 | 91 | 70.8 | 91 |
| Cadmium | 26.7 | 95 | 35.4 | 95 |
| Zinc | 83.3 | 99 | 96.5 | 99 |
| Chromium | 21.1 | 73 | 20.6 | 88 |
| Iron | 83.3 | 99 | 92.8 | 99 |
| Nickel | 29.4 | 70 | 29.3 | 80 |

- No data available

TABLE 15

Average Contaminant Concentration Reductions
Achieved by Industrial Laundry Treatment For Flotation-DE System(92)

| | Raw Waste | Pounds/ 1,000 Gallons | Flotation Effluent | Pounds/ 1,000 Gallons | Diatomaceous Earth Effluent | Pounds/ 1,000 Gallons |
|---|---|---|---|---|---|---|
| BOD, mg/l | 830 | (6.9) | 611 | (5.1) | 335 | (2.79) |
| Suspended Solids, mg/l | 2,809 | (23.4) | 674 | ( 5.6) | 87 | (0.74) |
| VSS, % of Sus. Solids | 62.7 | - | 82.2 | - | 75.8 | - |
| TOC, mg/l | 2,482 | (20.7) | 1,067 | (8.9) | 362 | (0.29) |
| Total Solids, mg/l | 6,748 | (56.3) | 4,693 | (39.1) | 4,073 | (3.42) |
| VTS, % of Total Solids | 31.5 | - | 25.7 | - | 16.6 | - |
| Oil and Grease, mg/l | 1,538 | (12.8) | 568 | (4.7) | 95 | (0.14) |
| Chromium, mg/l | 2.3 | (0.02) | 1.8 | (0.01) | 2.0 | (0.02) |
| Copper, mg/l | 4.0 | (0.03) | 0.7 | (0.006) | 0.5 | (0.004) |
| Lead, mg/l | 12.7 | (0.11) | 2.3 | (0.02) | 1.4 | (0.01) |
| Zinc mg/l | 3.9 | (0.03) | 0.4 | (0.003) | 0.1 | (0.001) |
| Cadmium, mg/l | 0.24 | (0.002) | 0.23 | (0.002) | 0.19 | (0.002) |
| Iron, mg/l | 39.5 | (0.33) | 1.4 | (0.12) | 0.4 | (0.003) |
| Nickel, mg/l | 1.6 | (0.01) | 1.2 | (0.01) | 1.2 | (0.01) |
| Mercury, ug/l | 3.3 | (0.03) | 1.0 | (0.01) | 0.7 | (0.006) |
| TOC/BOD | 2.5 | - | 1.5 | - | 1.25 | - |
| Alkalinity to pH 8.3 mg/l as CaCO(3) | 326 | (2.7) | 152 | (1.27) | 142 | (1.18) |
| Alkalinity to pH 4.5 mg/l as CaCO(3) | 1,725 | (14.4) | 295 | (2.46) | 249 | (2.07) |

- No data available.

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TABLE 16

Ranges of Wastewater Quality
For The Industrial Laundry Wastewater Treatment System
For Flotation-DE System

| Parameters | Raw Waste Concentration | Raw Waste (lb/1,000 gal) | Flotation Effluent Concentration | Flotation Effluent (lb/1,000 gal) | Diatomaceous Earth Effluent Concentration | Diatomaceous Earth Effluent (lb/1,000 gal) |
|---|---|---|---|---|---|---|
| BOD, mg/l | 647 -1,314 | ( 5.40 )-(10.95 ) | 313 -1,167 | ( 2.61 )-( 9.73 ) | 319 - 353 | ( 2.66 )-( 2.94 ) |
| SS, mg/l | 649 -4,950 | ( 5.40 )-(41.28 ) | 108 -2,914 | ( 0.901 )-(24.30 ) | 9 - 174 | ( 0.075 )-( 1.45 ) |
| VSS, % ss | 54.5 - 64 | | 68.2 - 95.1 | | 60.6 - 89.9 | |
| TOC, mg/l | 950 -6,300 | ( 7.92 )-(52.54 ) | 370 -2,080 | ( 3.09 )-(17.35 ) | 123 - 470 | ( 1.03 )-( 3.92 ) |
| TS, mg/l | 4,856 -8,649 | (40.50 )-(72.13 ) | 3,452 -6,670 | (28.79 )-(55.63 ) | 2,876 -5,609 | (23.99 )-(46.78 ) |
| VTS, % TS | 21.3 - 43.9 | | 14.7 - 47.6 | | 12.5 - 20.5 | |
| Oil and Grease | 403 -3,756 | ( 3.36 )-(31.33 ) | 146 -1,663 | ( 1.22 )-(13.87 ) | 16 - 266 | ( 0.133 )-( 2.22 ) |
| Chromium, mg/l | 1.0 - 3.6 | ( 0.01 )-( 0.01 ) | 0.9 - 3.2 | ( 0.008 )-( 0.027 ) | 0.3 3.9 | ( 0.003 )-( 0.033 ) |
| Copper, mg/l | 0.2 - 9.3 | ( 0.002 )-( 0.078 ) | 0.3 - 1.5 | ( 0.003 )-( 0.013 ) | 0.2 - 0.7 | ( 0.002 )-( 0.006 ) |
| Lead, mg/l | 3.0 - 35.8 | ( 0.025 )-( 0.299 ) | 0.35- 3.3 | ( 0.003 )-( 0.028 ) | 0.1 - 2.2 | ( 0.0008)-( 0.018 ) |
| Zinc, mg/l | 0.55- 8.9 | ( 0.005 )-( 0.074 ) | 0.02- 0.6 | ( 0.0002)-( 0.005 ) | 0.02- 0.18 | ( 0.0002)-( 0.002 ) |
| Cadmium, mg/l | 0.02- 0.6 | ( 0.0002)-( 0.005 ) | 0.02- 0.40 | ( 0.0002)-( 0.0033) | 0.01- 0.35 | ( 0.0001)-( 0.0029) |
| Iron, mg/l | 3.5 - 126 | ( 0.029 )-( 1.05 ) | 0.8 - 2.5 | ( 0.007 )-( 0.021 ) | 0.2 - 2.4 | ( 0.0017)-( 0.020 ) |
| Nickel, mg/l | 1.0 - 2.5 | ( 0.008 )-( 0.021 ) | 0.3 - 2.0 | ( 0.003 )-( 0.017 ) | 0.2 - 1.8 | ( 0.002 )-( 0.015 ) |
| Mercury, ug/l | 1.2 - 7.0 | ( 0.010 )-( 0.058 ) | 0.5 - 1.2 | ( 0.004 )-( 0.010 ) | 0.5 - 1.2 | ( 0.0042)-( 0.010 ) |
| pH, units | 10.2 - 11.9 | | 10.1 - 11.5 | | 9.8 - 11.45 | |

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### Dual System 90

In essence, this is an alternative operating procedure that calls 92
for pretreatment by dry cleaning before washing, reducing the amount 94
of oil and grease present by 80 to 85%. Costs and space requirements 97
can be problems.

### Modified Linen Systems 99

It might be possible to modify the flotation-sand filter system 102
and the oxidation-charcoal filter system for use at industrial 103
laundries.

## Linen Laundries, Power Laundries (Family and Commercial), and 105
## Diaper Services 107

Wastewater from this subcategory contains a much smaller 110
concentration of pollutants than industrial laundry wastewater. Four 113
pilot treatment systems are presently in operation.

### Flotation DE Filter System 116

This system has been described under industrial laundries. 119

The concentrations and percent reductions of pollutants for both 122
the flotation and DE filter effluents are presented in Table 17.
Sludge removal and space requirements are two problems posed by this 123
system.

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TABLE 17

Linen Wastewater Treatment
Effluent Quality Data

| Parameter | Number of Observations | Mean Value Concentration | Mean Value (lb/1,000 gal) | 95% Confidence Limits Concentration | 95% Confidence Limits (lb/1,000 gal) |
|---|---|---|---|---|---|
| Raw Wastewater | | | | | |
| BOD, mg/l | 20 | 501 | ( 4.18) | 331 - 672 | ( 2.76 )-( 5.60 ) |
| TOC, mg/l | 20 | 410 | ( 3.42) | 311 - 510 | ( 2.59 )-( 4.25 ) |
| Total Solids, mg/l | 20 | 4,061 | (33.87) | 2,418 - 5,705 | (20.17 )-(47.58 ) |
| Suspended Solids, mg/l | 20 | 852 | ( 7.11) | 384 - 1,320 | ( 3.21 )-(10.96 ) |
| Oil & Grease, mg/l | 20 | 207 | ( 1.73) | 163 - 251 | ( 1.35 )-( 2.08 ) |
| Flotation Effluent | | | | | |
| BOD, mg/l | 20 | 222 | ( 1.85) | 173 - 271 | ( 1.44 )-( 2.25 ) |
| TOC, mg/l | 20 | 176 | ( 1.47) | 145 - 208 | ( 1.20 )-( 1.73 ) |
| Total Solids, mg/l | 20 | 3,752 | (31.29) | 3,130 - 4,374 | (25.98 )-(36.30 ) |
| Suspended Solids, mg/l | 20 | 101 | ( 0.84) | 69 - 133 | ( 0.57 )-( 1.10 ) |
| Oil & Grease, mg/l | 20 | 69 | ( 0.58) | 48 - 90 | ( 0.40 )-( 0.75 ) |
| DE Effluent | | | | | |
| BOD, mg/l | 9 | 155 | ( 1.29) | 108 - 202 | ( 0.90 )-( 1.68 ) |
| TOC, mg/l | 9 | 120 | ( 1.00) | 89 - 150 | ( 0.74 )-( 1.25 ) |
| Total Solids, mg/l | 9 | 3,521 | (29.37) | 2,636 - 4,405 | (21.98 )-(36.74 ) |
| Suspended Solids, mg/l | 9 | 59 | ( 0.49) | 29 - 90 | ( 0.242)-( 0.751) |
| Oil & Grease, mg/l | 9 | 47 | ( 0.39) | 32 - 62 | ( 0.267)-( 0.52 ) |
| Flotation Percent Removal | | | | | |
| BOD, mg/l | 20 | 42.5 | ( 0.35) | 29.7- 55.2 | ( 0.25 )-( 0.460) |
| TOC, mg/l | 20 | 50.7 | ( 0.42) | 40.9- 60.5 | ( 0.341)-( 0.505) |
| Suspended Solids, mg/l | 20 | 74.1 | ( 0.62) | 62.1- 86.1 | ( 0.518)-( 0.718) |
| Oil & Grease, mg/l | 20 | 62.1 | ( 0.52) | 50.7- 73.4 | ( 0.423)-( 0.612) |
| System Percent Removal | | | | | |
| BOD, mg/l | 9 | 55.6 | ( 0.46) | 40.3- 70.8 | ( 0.336)-( 0.590) |
| TOC, mg/l | 9 | 64.5 | ( 0.54) | 52.3- 76.7 | ( 0.436)-( 0.640) |
| Suspended Solids, mg/l | 9 | 81.8 | ( 0.68) | 86.7- 97.1 | ( 0.723)-( 0.810) |
| Oil & Grease, mg/l | 9 | 71.7 | ( 0.60) | 55.1- 88.2 | ( 0.460)-( 0.736) |

### Flotation-Sand Filter System

In this system, the wash wheels dump the process water into an equalization and storage tank. From there it passes through an air flotation unit to a holding tank. Then it is pumped rapidly through a sand filter and into a final storage tank. After that, it goes through a heat exchanger and is returned to the plant for reuse. This system reduces suspended solids from 800 mg/l to 320.

### Oxidation Charcoal Filter System

This system was designed to treat the wastewater partially by altering the laundry chemicals and partially by a recycling technology. The hardware of this system consists of a modular arrangement of several components.

The first of these is a spillway from the wash wheel with a sloped flume that causes heavy particles to fall into a sludge pit. There are three screens of graduated sizes in the spillway. The water is pumped into a tank which contains an oxidation chamber and a settling chamber.

The chemical and the oil and grease are destroyed in the oxidation chamber. In the settling chamber the remaining heavy particles and the insoluble salts settle out. The water is then pumped through a filter tank which screens out the lint and into an 8 inch diameter 30 inch high charcoal column where final filtration

takes place. The reduction of pollutants achieved by this system are 157
presented in Table 18. 158

Centrifugal Filter Aerobic Digestion System 160

In this system a polymer coagulent is added to the wastewater, 164
the pH is adjusted, and the effluent is passed through a centrifugal 165
separator. It then goes through a mixed-media polishing filter into 167
an atmospheric aerobic digester and soap separation chamber. 168
Finally, the effluent passes through a pressure adsorption filter. 169
The pollutant reduction efficiency of this system is presented in 171
Table 19.

Auto Washes 173

Because of the relatively low concentrations of pollutants in 176
their wastewater, many owners of these establishments have found it 177
both economical and practical to recycle wash and/or their rinse 178
water.

The simplest of these technologies calls for recirculating 180
untreated washwater. The washwater flows to a sump where the solids 182
settle out. Depending on the size of the sump and settling time 183
allowed, normally only suspended solids larger than 100 microns will 185
settle out. Although simple in operation, this system had two major 186
economic drawbacks: (1) effective results call for the use of large, 187
expensive sumps; (2) the sumps must be cleaned frequently. 188

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TABLE 18

Reduction of Pollutants by the
Oxidation-Charcoal Filter System*

| Item | Raw Waste mg/l | Raw Waste (lbs/1,000 gal) | Treated Effluents mg/l | Treated Effluents (lbs/1,000 gal) | Percent Reduction |
|---|---|---|---|---|---|
| pH (units) | 12.1 | | 7.5 | | |
| Chloride | 136 | ( 1.134) | 118 | (0.984) | 13 |
| TDS | 9,000 | (75.06 ) | 780 | (6.51 ) | 91 |
| SS | 165.7 | ( 1.382) | 16.8 | (0.140) | 90 |
| Fatty Acids | 25 | ( 0.209) | 0 | | 100 |
| Sulfates | 360 | ( 3.00 ) | 35 | (0.292) | 90 |
| Phosphates | 25 | ( 0.209) | 5 | (0.042) | 80 |
| Hardness | 32 | ( 0.267) | 0 | | 100 |
| Alkalinity | 1,392 | (11.61 ) | 464 | (3.870) | 67 |
| Pheno-alkalinity ** | 5,682 | (47.39 ) | 8 | (0.067) | 100 |
| Silicates | 46 | ( 0.384) | 8 | (0.067) | 83 |
| BOD (5) | 206.3 | ( 1.72 ) | 17.1 | (0.143) | 92 |

* Field Reports and Laboratory Studies
** Titration to pH 8.3 with standardized $H_2SO_4$

TABLE 19

Reduction of Pollutants by the
Centrifugal-Filter-Aerobic Digestion System*

| | Wastewater Before Treatment | Lbs. Per 1,000 Gal | Wastewater After Treatment | Lbs. Per 1,000 Gal | Percent Reduction |
|---|---|---|---|---|---|
| pH | 10.10 | | 6.7 | | |
| Total Solids, mg/l | 2,080 | (17.35) | 400 | (3.34 ) | 81 |
| Suspended Solids, mg/l | 274 | ( 2.29) | 2 | (0.017) | 99 |
| TOC, mg/l | 440 | ( 3.67) | 7 | (0.058) | 98 |
| **Oil and Grease, mg/l** | 88 | ( 0.73) | 14 | (0.117) | 84 |

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*Correspondence Hart Enterprises

Often there is an economic advantage to treating and recycling the washwater. This is done by having an automatic system inject a prepared solution of germicide and clarifier into the used washwater to preserve detergents, prevent the formation of slime and odors, and improve water quality. The water then passes through centrifugal separators which can remove solids smaller than five microns. There are savings on the "tap in" charge to a sewer, sewage charges, and the cost of water and soap.

Systems used to recycle rinse water are much more elaborate than washwater recycling methods because greater purity must be obtained. The used rinse water is collected in gravity drains that run to an inground collection sump or storage tank where it is chemically treated with a prepared solution of germicide, de-emulsifier, and clarifier. Then it passes through a basket strainer, a washwater filter to remove dirt from the water and a detergent removal filter to remove soap. A washwater recycling system combined with a rinse water recycling system forms a total recycling system.

## Carpet and Upholstering Cleaning

Much the same as auto wash, see Section V.

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Coin-Operated Laundries and Dry Cleaning Facilities, and Laundry and 218
Garment Services Not Elsewhere Classified 219

There are a large number of wastewater treatment technologies 223
available for use at coin-operated laundries and some are adaptable 224
for the complete recycling of wastewater.

Coagulation with Alum and Adsorption Through Activated Carbon 226

This system coagulates the effluent with alum and lime, then 228
passes it through a carbon filter element. The values of pollutants 230
in the raw waste, in the effluent after coagulation, and in the 231
effluent from the carbon filter are presented in Table 20.

Coagulation With Alum, Sand Filtration and Adsorption 234
Through Activated Carbon 236

In this system, the wastewaters are screened and temporarily 239
stored in a holding tank, then pumped through an alum coagulation 241
system. Alum is added to lower the pH to 4.2 - 4.5 and then the 242
wastewater enters an upflow tank to be flocculated (three minute 243
contact time). The wastewater from this tank is treated with lye so 244
that the pH after settling is about 7.0. The wastewater flows 246
through copper tubing to the mid-depth of a large settling tank. The 248
sludge that forms is disposed of periodically and the clear super-
natant is pumped through one of five pressure sand filters in 250
parallel. The effluent passes up through a bed containing Duolite 251
anion exhange resin A 102D for detergent removal. It then flows up 253

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TABLE 20

Performance of CAAAC* System in Treating Laundromat Wastewater (63)

| | Number of Samples | Raw Waste | | Coagulated and Clarified | | Carbon Filter Effluent | | Overall Percent Reduction |
|---|---|---|---|---|---|---|---|---|
| | | Concentration | (lb/1,000 gal) | Concentration | (lb/1,000 gal) | Concentration | (lb/1,000 gal) | |
| COD, mg/l | 14 | 491 | (4.005) | 152 | (1.27) | 70 | (0.58) | 86 |
| BOD, mg/l | 14 | 184 | (1.535) | 43 | (0.36) | 24 | (0.20) | 87 |
| Suspended Solids, mg/l | 11 | 206 | (1.718) | 43 | (0.36) | 16 | (0.13) | 92 |
| Total Solids, mg/l | 2 | 880 | (7.339) | 1,030 | (8.59) | 880 | (7.34) | 0 |
| pH (Median) | 14 | 7.8 | | 11.2 | | 11.0 | | |
| Total Alkalinity, mg/l | 14 | 167 | (1.393) | 225 | (1.877) | 178 | (1.48) | 5 |
| Coliform (Range) Organisms/100 ml | 9 | $36\text{-}46 \times 10^6$ | | $3.6\text{-}24 \times 10^4$ | | $3.6\text{-}24 \times 10^3$ | | |
| Res. Alum (Range), mg/l | 9 | - | | 6-14 | (0.05-0.12) | 5-14 | (0.04-0.12) | |
| Phosphate, mg/l | 1 | 18 | (0.15 ) | 0.90 | (0.008) | 0.30 | (0.003) | 98 |

*Coagulation with alum and absorption through activated carbon through a bed of granular activated carbon to remove objectionable odors and colors. From there, one-third of the flow passes through a cation and an anion exchange resin for complete deionization, and is combined with the other two-thirds of the wastewater. The wastewater is then chlorinated and the pH adjusted before it enters the clean water tank for reuse. The pollutant reduction values achieved by various subsystems are presented in Table 21, 22, and 23.

Precoating and Filtration Through Diatomaceous Earth (DE)

In this system, a 45-pound charge of DE is added to water in the mixing tank and the liquid is then passed through the filter elements which become coated with the suspended DE. This operation usually takes 3-6 minutes, and the waste purification cycle is then initiated. Wastewater is pumped from the holding tank to the mixing tank, through the filters, and finally to the treated water tank. This cycle normally lasts 15 minutes during which time 375 gallons of wastewater are processed. A timer switch then shuts off the filter pumps and activates a mechanical shaker which "bumps" the coating off of the filter elements. Another coating is then applied as described above.

The pollutant reduction data for this system are presented in Table 24.

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TABLE 21

Efficiency of CASFAAC* System in Reducing BOD and COD Content of Laundromat Wastewater (60)

| Parameter | Number of Samples | Influent mg/1 | | | Influent lb/1,000 gal | | | Effluent mg/1 | | | Effluent lb/1,000 gal | | | Average Percent Reduction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. | |
| BOD | 101 | 185 | 50 | 119 | 1.5 | .42 | .99 | 118 | 20 | 52 | .98 | .17 | .43 | 56.4 |
| COD | 70 | 438 | 136 | 293 | 3.7 | 1.1 | 24 | 244 | 38 | 114 | 2.03 | 0.32 | 0.95 | 62.1 |

*Coagulation with alum, sand filtration, and adsorption through activated carbon.

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TABLE 22

Summary of pH Values Achieved by CASFAAC* System in Treating Laundromat Wastewater (60)

| Units | Number of Samples | Minimum | Maximum | Average |
|---|---|---|---|---|
| Raw Waste | 134 | 5.0 | 7.6 | 7.13 |
| Flocculation Tank | 136 | 3.9 | 6.0 | 4.45 |
| Settling Tank | 117 | 4.2 | 6.7 | 5.58 |
| Sand Filter | 117 | 4.5 | 6.7 | 5.76 |
| Detergent Removal | 117 | 5.0 | 7.0 | 5.95 |
| Activated CArbon | 117 | 5.2 | 6.9 | 5.99 |
| Demineralizer | 134 | 5.1 | 6.8 | 6.07 |

*Coagulation with alum, sand filtration, and adsorption through activated carbon.

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TABLE 23

Summary of Values for Total Dissolved Solids Achieved by CASFAAC* System in Treating Laundromat Wastewater(60)

| Units | Number of Samples | Total Dissolved Solids, mg/l | | | | | |
|---|---|---|---|---|---|---|---|
| | | Max. | Lbs. Per 1,000 Gal | Min. | Lbs. Per 1,000 Gal | Avg. | Lbs. Per 1,000 Gal |
| Raw Waste | 81 | 1,450 | (12.01) | 625 | (5.21) | 931 | (7.76) |
| Settle Tank Effluent | 79 | 1,425 | (11.88) | 750 | (6.26) | 952 | (7.94) |
| Sand Filter Effluent | 79 | 1,400 | (11.68) | 700 | (5.84) | 953 | (7.95) |
| Detergent Removal Effluent | 79 | 1,375 | (11.47) | 690 | (5.75) | 956 | (7.97) |
| Activated Carbon Effluent | 79 | 1,410 | (11.76) | 700 | (5.84) | 968 | (8.07) |
| Demineralizer Effluent | 81 | 1,325 | (11.05) | 750 | (6.26) | 974 | (8.12) |

*Coagulation with alum, sand filtration, and adsorption through activated carbon.

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TABLE 24

Pollutant Reduction Efficiency of
Diatomaceous Earth Filter System
in Treating Laundromat Wastewater(110)

| Parameter | Influent | Effluent | Percent Reduction |
|---|---|---|---|
| BOD mg/1 | 133 | 34 | 73 |
| COD mg/1 | 285 | 45 | 85 |
| TDS mg/1 | 488 | 715 | -44 |
| Turbidity Percent Trans. | | 97 | |
| PO(4) mg/1 | 169 | 6 | 94 |
| pH (Units) | 7.2 | 8.5 | |
| Acidity mg/1 | 91 | 89 | 2 |
| Alkalinity mg/1 | 368 | 372 | - 1 |
| Hardness mg/1 | 208 | 266 | - 8 |
| Coliform/100 ml | >2,000 | < 10 | |

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## Precoating with Diatomaceous Earth and Cationic Surfactant Flocculation

This treatment system is designed to treat up to 10,000 gals/day of wastewater which is pumped to the mixing tank at a constant rate from a 6,000 gallon holding tank. The holding tank operates on level control and time cycle so that one day's flow can be treated prior to low-level cutoff. Chemicals, such as cationic surfactant and calcium salt, are metered to the mixing tank. At alkaline pH operation, caustic is also added at this point. The retention period in the mixing tank is 10 minutes.

At the start of a day's operation, diatomaceous earth is added to the mixing tank and pumped through the filter to coat it. Flocculated waste is then filtered through the diatomite at a constant flow rate for a period of 15-30 minutes. The filter elements are then mechanically bumped to remove the decoating. The precoat floc mixture is reprecoated on the filter elements and cycled until the filtrate runs clear. The waste is again filtered for the 15-30 minute period. Filtration and bumping are repeated until all waste is treated.

During each filtration cycle, the flow rate tends to fall off as flocculated solids build upon the outside of the filter cake. When the cake is bumped and reprecoated, the flocculated solids are redistributed through the diatomite. Since this increases the resistance to filtration, the flow rate and total volume filtered per cycle gradually decreases. A practical maximum of 25 bumps can be attained before reprecoating with fresh diatomite. At the end of a treatment run, the spent diatomite mixture is pumped to a disposal point. The total volume of sludge per treatment run is 70 gallons. This can be periodically hauled to a disposal site or dried on a small sand bed. The pollutant parameter reductions for this system are given in Table 25.

### Vacuum Diatomite Filter

The basic unit consists of a vacuum diatomite filter preceded by a reaction and recycling tank. The unit for a 30-machine laundromat is contained in a prefabricated metal tank 8 ft long, 3 ft wide, and 6 ft high (3.4 m by 0.9 m by 3.6 m). The reaction chamber is approximately 2.5 ft (0.8 m) long and the filter chamber is 5.5 ft (1.7 m) long. The basic treatment equipment consists of 8 filter elements, each of which has a surface area of 15 sq ft (1.4 sq m), a 120 gpm (0.44 cu m/min) recirculating pump, a dry feeder, slurry feeder and controls, and a pump to transfer the wastewater from the storage tank to the treatment unit. Typical operating results are detailed in Table 26.

### Activated Charcoal Polyelectrolite System

This process calls for adding of activated charcoal to a polyelectrolite to form a floc. The effluent is then clarified and passed through a diatomite filter. The BOD of the effluent is

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TABLE 25

Laundry Waste Treatment

Coin-Operated Laundry

Pollutant Reduction Efficiency of DEFCSF* System in Treating Laundromat Wastewater(85)

| | Influent | | Effluent | | Percent |
|---|---|---|---|---|---|
| | mg/l | lb/1,000 gal | mg/l | lb/1,000 gal | Reduction |
| BOD | 243 | 2.03 | 90 | 0.75 | 67 |
| COD | 572 | 4.77 | 171 | 1.43 | 70 |
| Total Solids | 1,270 | 10.59 | 1,050 | 8.76 | 17 |
| Volatile Solids | 379 | 3.16 | 110 | 0.92 | 71 |
| Phosphate | 267 | 2.23 | 150 | 1.25 | 44 |

*Diatomaceous earth filtration and cationic surfactant flocculation.

| | | |
|---|---|---|
| Salt added | 480 | 4.00 |
| Cationic added | 88 | 0.73 |

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TABLE 26

Operating Results from Vacuum Diatomite Filter* (57)

| Sample Number | Suspended Solids (mg/l) Inf. | Suspended Solids (mg/l) Eff. | Suspended Solids (lb/1000 gal) Inf. | Suspended Solids (lb/1000 gal) Eff. | Dissolved Solids (mg/l) Inf. | Dissolved Solids (mg/l) Eff. | Dissolved Solids (lb/1000 gal) Inf. | Dissolved Solids (lb/1000 gal) Eff. | COD (mg/l) Inf. | COD (mg/l) Eff. | COD (lb/1000 gal) Inf. | COD (lb/1000 gal) Eff. | Phosphates (mg/l) Inf. | Phosphates (mg/l) Eff. | Phosphates (lb/1000 gal) Inf. | Phosphates (lb/1000 gal) Eff. | Acidity (mg/l) Eff. | Acidity (lb/1000 gal) Eff. | pH Inf. | pH Eff. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 126 | 8 | (1.05) | (0.067) | 858 | 1,008 | (7.16) | (8.41) | 587.6 | 80.5 | (4.90) | (0.67) | 120 | 10.8 | (1.0) | (0.09) | 163 | (1.36) | 6.69 | 2.45 |
| 2 | 70 | 18 | (0.584) | (0.15) | 768 | 1,232 | ([illegible].41) | (10.27) | 511.4 | 115.9 | (4.27) | (0.97) | 112 | 65.0 | (0.93) | (0.54) | 125 | (1.04) | 6.59 | 2.55 |
| 3 | 76 | 23 | (0.63) | (0.19) | 666 | 795 | (5.55) | (6.63) | 388.0 | 136.7 | (3.24) | (1.14) | 82 | 47.0 | (0.68) | (0.39) | - | | 7.92 | 5.14 |
| 4 | 106 | 4 | (0.002) | (0.03) | 800 | 997 | ([illegible]) | (8.31) | 596.0 | 49.8 | (4.97) | (0.42) | 98 | 10.8 | (0.82) | (0.09) | 148 | (1.23) | 8.49 | 2.35 |
| 5 | 62 | 9 | (0.52) | (0.08) | 1,037 | 910 | (8.[illegible]) | (7.59) | 506.4 | 123.8 | (4.22) | (1.03) | 140 | [illegible]5.0 | (1.17) | (0.54) | - | | 7.83 | 5.50 |
| 6 | 131 | 12 | (1.09) | (0.10) | 699 | 1,045 | (5.83) | (8.72) | [illegible]03.3 | 99.2 | (5.03) | (0.83) | [illegible]2 | 94.0 | (0.52) | (0.78) | - | | 6.81 | 5.70 |
| 7 | 132 | 24 | (1.10) | (0.20) | 722 | 819 | (6.02) | (6.83) | 653.8 | 124.2 | (5.45) | (1.04) | 67 | 62.0 | (0.56) | (0.52) | 18 | (0.15) | 6.70 | 4.12 |
| 8 | 15 | 13 | (0.13) | (0.11) | 669 | 1,033 | (5.58) | (8.62) | 182.9 | 165.2 | (1.53) | (1.38) | 72 | 92.0 | (0.60) | (0.77) | 36 | (0.30) | 5.14 | 3.17 |
| 9 | | [illegible] | | (0.17) | | 1,200 | | (10.01) | | 64.7 | | (0.54) | | - | | | 85 | (0.71) | | 2.30 |
| 10 | | 1 | | (0.01) | | 743 | | (6.20) | | 14.0 | | (0.12) | | 2.4 | | (0.02) | 137 | (1.14) | | 2.4[illegible] |
| 11 | | 17 | | (0.14) | | 1,278 | | (10.66) | | 128.5 | | (1.07) | | 79.0 | | (0.66) | 51 | (0.43) | | 2.89 |
| 12 | | 4 | | (0.03) | | 992 | | (8.27) | | 115.3 | | (0.96) | | 65.0 | | (0.54) | - | | | 5.74 |
| 13 | | 1 | | (0.01) | | 1,222 | | (10.19) | | 79.5 | | (0.66) | | 18.0 | | (0.15) | 94 | (0.78) | | 2.78 |
| 14 | | 13 | | (0.11) | | 1,311 | | (10.93) | | 71.7 | | (0.60) | | 18.0 | | (0.15) | 102 | (0.85) | | 2.52 |
| 15 | | 14 | | (0.12) | | 1,134 | | (9.46) | | 82.2 | | (0.69) | | 26.0 | | (0.22) | 50 | (0.42) | | 3.07 |
| 16 | | 5 | | (0.04) | | 2,212 | | (18.46) | | 106.9 | | (0.89) | | 67.0 | | (0.56) | 520 | (4.34) | | 1.91 |
| 17 | | 18 | | (0.15) | | 1,808 | | (15.08) | | 84.0 | | (0.70) | | 27.0 | | (0.23) | 220 | (1.83) | | 2.54 |
| 18 | | 12 | | (0.15) | | 1,304 | | (11.[illegible]) | | 87.4 | | (0.73) | | [illegible] | | (0.27) | 280 | (2.3[illegible]) | | 2.[illegible] |
| 19 | | 14 | | (0.12) | | 2,071 | | (17.27) | | 112.7 | | (0.94) | | 22.5 | | (0.19) | 261 | (2.18) | | 2.48 |
| 20 | | 2 | | (0.02) | | 9.8 | | (0.082) | | 56.1 | | (0.47) | | 36.0 | | (0.30) | 91 | (0.76) | | 3.04 |
| 21 | | 65 | | (0.54) | | 2,623 | | (21.88) | | 2.2 | | (0.02) | | 16.0 | | (0.13) | 420 | (3.50) | | 2.16 |
| 22 | | 0 | | - | | 1,317 | | (10.98) | | 138.2 | | (1.15) | | 54.0 | | (0.45) | 47 | (0.39) | | 2.15 |
| 23 | | 5 | | (0.04) | | 1,707 | | (14.24) | | 61.9 | | (0.52) | | 35.0 | | (0.29) | 171 | (1.43) | | 3.11 |
| Avg. | 89.7 | 12 | (0.75) | (0.10) | 777 | 1,295 | (6.48) | (10.80) | 331.7 | 73.5 | (2.77) | (0.61) | 94 | 40.6 | (0.78) | (0.34) | 159 | (1.33) | 6.81 | 3.50 |

* Alkalinity averaged 147 mg/l in the influent and 13 mg/l in the effluent.

reduced by 95% and the pH is about 10 or 11; the system does not remove oil and grease.

Flotation Clarification

In this process, laundry wastewater is pumped into a 1,000-gallon tank to produce a mixture of acid and alkaline wastes. Bentonite is injected into the waste line to the ballast tank. Treatment is begun when the tank is nearly full.

The blended wastewater has a temperature of about 120 degrees F as it leaves the ballast tank, where a 1.44% solution of sulfuric acid is injected into the waste line. An automatic recorder-controller is used to maintain the pH at 5.0. As the wastewater flows from the ballast tank to the clarifier, it passes through a lint trap, a hydraulic flow regulator, and a heat exchanger where it is warmed to 140 degrees F. Downstream from the heat exchanger, a 10.8% solution of alum is injected by a metering pump at the rate of 25.0 gpg. A 1.94% solution of caustic soda (sodium hydroxide) is injected, and the pH level is maintained at 7.0 by another automatic pH recorder-controller. A chemical floc is formed by the addition of alum and caustic. This floc is then lifted by bubbling air through the liquid.

The floc formed in the main flow line contains or is attached to air bubbles which cause it to rise through the flocculation chamber when it reaches the clarifier. The floc and its entrapped air and waste collect on the surface as a foamy sludge, which is removed by skimmer blades. The liquid, separating from the floc as it emerges from the flocculation chamber, flows first downward, then upward through an annular space, and over a weir into the laundry. There it is tapped off and pumped into a 1,000 gallon storage tank. Laundromat wastewater reductions by flotation clarification are presented in Table 27.

## General

The following technologies can be applied by all the subcategories discussed thus far in this Section.

### Micro-Straining

This process involves the use of high-speed, continuously backwashed, rotating drum filters, that work in open, gravity-flow conditions. It could be employed directly after rapid-and-slow-sand filtration for the recovery of wash water. Micro-straining has not been studied in relation to industrial laundry wastewater.

### Lint Screen

This is a simple screen that filters the lint out of wastewater. It must be removed and cleaned periodically.

TABLE 27

Laundromat Waste Water Reductions
by Flotation Clarification (90)

| | Influent mg/l | Influent lb/1,000 gal | Effluent mg/l | Effluent lb/1,000 gal | Sludge mg/l | Sludge lb/1,000 gal | Percent Removal |
|---|---|---|---|---|---|---|---|
| pH | 7.9 | | 7.0 | | 7.0 | | |
| Alkalinity (total) (mg/l as $CACO_3$) | 226.4 | 1.88 | 123.0 | 1.03 | 101 | 0.84 | 46 |
| Specific Gravity | 1.00 | | 1.00 | | 1.01 | | |
| Moisture Content (%) | - | - | - | - | 98.8 | | |
| Grease (mg/l as fat) | 283 | 2.36 | 40 | 0.033 | 2600 | 21.68 | 86 |
| Volatile Acids | 0.0 | 0.0 | 0.0 | | 0.0 | | |
| Sulfate (mg/l as $SO_4$) | 123 | 1.03 | 125 | 1.04 | 81 | 0.68 | - 2 |
| Total Solids | 2080 | 17.34 | 2000 | 16.08 | 11,900 | 99.25 | - 4 |
| Alum (mg/l as $Al_2O_3$) | - | | 8. | 0.07 | 2,629 | 21.93 | |
| Bacteria Count (number/c.c.) | 20,000 | | 0 | | 300 | | 100 |
| Coliform Test | negative | | negative | | negative | | |

- No data available

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## Reverse Osmosis 409

In this process, wastewater is cleaned by passing it through a 412
semipermeable membrane. Only one facility is known to be using it -- 413
a linen laundry in Denmark. Equipment is expensive and energy 415
requirements are high. Typical percent rejections for various 417
constituents found in domestic sewage are summarized in Table 28; 418
feed water recovery level of approximately 92%.

## Ozonization 420

This process consists of adding ozone to wastewater to oxidize 423
the pollutants. Its principal applications are the sterilization of 424
conventionally-purified water, taste and odor control, the 425
elimination of iron and manganese, and the removal of color. This 427
process has not been used in a laundry wastewater system.

The reduction of foaming by ozonizing raw sewage and the effluent 429
from sewage treatment plants is closely related to the reduction of 431
anionic surfactants (as measured by the methylene blue test). The 433
ozonized effluent is crystal clear and nearly odorless. 434

## Ultrasonic Cleaning 436

Verbal information has been obtained from researchers that the 439
laundering of fabrics by the use of ultrasonics has been successfully 440
demonstrated on a joint laboratory-industrial laundry study. No 442
definitive data is available at this time.

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TABLE 28

Typical Rejection Levels
by
Reverse Osmosis Treatment of Domestic Sewage*(27)

| Constituent | Percent |
| --- | --- |
| Total Dissolved Solids | 93 |
| Total Volatile Solids | 92 |
| Total Hardness | 93 |
| Soluble TOC | 40 - 50 |
| Soluble TIC | 68 |
| Organic Nitrogen | 100 |
| Ammonia Nitrogen | 88 |
| Phosphates | 98 |
| Chlorides | 89 |
| Sulfates | 97 |
| Alkalinity | 81 |
| Total Coliforms | 100 |

*Type 510 membrane utilized.

## Dry Cleaners

The only process wastewater generated comes from using a water injection method to remove water-soluble soil. This wastewater is removed from the recycled solvent by means of a separation and filtering system. The volume is small and disposal should be no problem. The only control required of the dry cleaning industry is a program of good housekeeping such as proper maintenance and operation of equipment.

## Summary

The effluent reductions obtainable by the application of the various technologies are summarized in Table 29.

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TABLE 29

SUMMARY OF VARIOUS WASTEWATER TREATMENT SYSTEMS

| Wastewater Treatment Systems | pH | Suspended Solids | Total Solids | Total Solids Dissolved | Alkalinity (Total) | Chloride | Phosphate | $BOD_5$ | TOC | COD | Hexane Solubles (Oil & Grease) | Coliform | Cr | Cu | Fe | Pb | Ni | Zn | Cd | $Hg^{(ug)}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Industrial Laundries | | | | | | | | | | | | | | | | | | | | |
| 1 Flotation DE Filter (Total System) | Influent | 2809 | 6748 | | | | | 830 | 2482 | | 1538 | | 2.3 | 4.0 | 39.5 | 12.7 | 1.6 | 3.9 | 0.24 | 3.3 |
| | Effluent | 87 | 4073 | | | | | 335 | 362 | | 95 | | 2.0 | 0.6 | 0.4 | 1.4 | 1.2 | 0.1 | 0.19 | 0.7 |
| 1A Flotation DE Filter System Flotation Unit | | 2809 | 6748 | | | | | 830 | 2482 | | 1538 | | 2.3 | 4.0 | 39.5 | 12.7 | 1.6 | 3.9 | 0.24 | 3.3 |
| | | 674 | 4693 | | | | | 611 | 1067 | | 568 | | 1.8 | 0.7 | 1.4 | 2.3 | 1.6 | 0.4 | 0.23 | 1.0 |
| 1B Flotation DE Filter System DE Filter | | 674 | 4693 | | | | | 611 | 1067 | | 568 | | 1.8 | 0.7 | 1.4 | 2.3 | 1.6 | 0.4 | 0.23 | 1.0 |
| | | 87 | 4073 | | | | | 335 | 362 | | 95 | | 2.0 | 0.5 | 0.4 | 11.4 | 1.2 | 0.1 | 0.19 | 0.7 |
| Dual System | 6-8<br>6-8 | | 80 - 85% Reduction of All Particulates | | | | | | | | | | | | | | | | | |
| Linen Supply Laundries | | | | | | | | | | | | | | | | | | | | |
| 1 Flotation DE Filter Total System (Linen) | | 852 | 4061 | | | | | 501 | 410 | | 207 | | | | | | | | | |
| | | 59 | 3521 | | | | | 155 | 120 | | 47 | | | | | | | | | |
| 1A Flotation DE Filter (Linen) Flotation Unit | | 852 | 4061 | | | | | 501 | 410 | | 207 | | | | | | | | | |
| | | 101 | 3752 | | | | | 222 | 176 | | 69 | | | | | | | | | |
| 1B Flotation DE Filter (Linen) DE Filter (Unit) | | 101 | 3752 | | | | | 222 | 176 | | 69 | | | | | | | | | |
| | | 59 | 3521 | | | | | 155 | 120 | | 47 | | | | | | | | | |
| 2 Flotation Sand Filter System | | 800<br>320 | | | | | | | | | | | | | | | | | | |
| 3 Oxidation Charcoal Filter System | 12.1 | 1800 | 9000 | | 582 | 136 | 25.0 | 208 | | | 25 | | | | | | | | | |
| | 7.5 | 120 | 780 | | 8.0 | 118 | 5.0 | 17 | | | 0 | | | | | | | | | |
| 4 Centrifuged Filter Aerobic Digestion System | 10.1 | 274 | 2080 | | | | | | 440 | | 88 | | | | | | | | | |
| | 6.7 | 2 | 400 | | | | | | 7 | | 14 | | | | | | | | | |
| Coin Operated Laundries | | | | | | | | | | | | | | | | | | | | |
| 1 Coagulation with Alum and Adsorption through Activated Carbon Total System | 7.8 | 206 | 880 | | 167 | | 18.0 | 184 | | 991 | 68. | 36-46 x $10^6$ | | | | | | | | |
| | 11.0 | 16 | 880 | | 178 | | 0.3 | 24 | | 70 | | 3.6-24 x $10^3$ | | | | | | | | |
| 1A Coagulation with Alum and Adsorption through Activated Carbon Coagulation and Clarified Unit | 7.8 | 206 | 880 | | 167 | | 18.0 | 184 | | 491 | | 36-46 x $10^6$ | | | | | | | | |
| | 11.2 | 43 | 1030 | | 2.5 | | 0.9 | 143 | | 152 | | 3.6-24 x $10^4$ | | | | | | | | |
| 1B Coagulation with Alum and Adsorption through Activated Carbon Carbon Filter Unit | [illegible] | 43 | 1030 | | 225 | | 0.9 | 143 | | 152 | | 36-24 x $10^4$ | | | | | | | | |
| | 11.0 | 16 | 860 | | 178 | | 0.3 | 24 | | 70 | | 36-24 x $10^3$ | | | | | | | | |
| 2 Coagulation with Alum Sand Filtration and Adsorption through Activated Carbon Total System | 3 | | | 931 | | | | 119 | | 293.4 | | | | | | | | | | |
| | 6.07 | | | 974 | | | | 52 | | 113.8 | | | | | | | | | | |
| 2A Flocculation Tank | 7.13<br>4.45 | | | | | | | | | | | | | | | | | | | |
| 2B Settling Tank | 4.45<br>5.58 | | | 931<br>952 | | | | | | | | | | | | | | | | |
| 2C Sand Filter | 5.58<br>5.76 | | | 952<br>953 | | | | | | | | | | | | | | | | |
| 2D Detergent Removal | 5.76<br>5.95 | | | 953<br>956 | | | | | | | | | | | | | | | | |
| 2E Activated Carbon | 5.95<br>6.09 | | | 956<br>968 | | | | | | | | | | | | | | | | |
| 2F [illegible] | 6.09<br>6.07 | | | 968<br>974 | | | | | | | | | | | | | | | | |
| 3 Precipitation and Filtration through DE | 7.2 | | | 488 | 368 | | 169 | 133 | | 285 | | | | | | | | | | |
| | 6.5 | | | 715 | 370 | | 6 | 34 | | 45 | | | | | | | | | | |
| 4 Precoating with DE and Cationic Surfactant Flocculation | | | 1270 | | | | 267 | 243 | | 572 | | >2,000 | | | | | | | | |
| | | | 1050 | | | 275 | 150 | 90 | | 171 | | < 10 | | | | | | | | |
| 5 Vacuum Diatomite Filter | 6.81 | 89.7 | | 777 | | | 94.0 | | | 331.7 | | | | | | | | | | |
| | 3.50 | 12 | | 1295 | | | 40.6 | | | 13.5 | | | | | | | | | | |
| 6 Activated Charcoal Polyelectrolyte System | 10-11 | | | | | | | | | | | | | | | | | | | |
| 7 Flotation Clarification | 7.9<br>7.0 | | 2080<br>2000 | | 226.4<br>123.2 | | | | | | 283<br>39.6 | | | | | | | | | |

NOTE (1) The analytical results are expressed in mg/l except for pH which is expressed in units and Hg, and As which are expressed in μg/l or ppb (parts per billion)

(2) The upper number in the block is the influent value
The lower number in the block is the effluent value

(3) 1-1A - The letter (A) identifies the next treatment phase of the system (1)

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# SECTION VIII

## $%Cost, Energy and Non-Water Quality Aspect$%

### $%Auto Wash Establishments$%

$%Best Practicable Control Technology (BPCT)$%
$%Best Available Treatment (BAT), and$%
$%New Source Performance Standards (NSPS)$%

Base level of practice in the auto wash industry is passage through a sump and direct discharge to a sewer, a leaching field, or surface waters. For those plants discharging to surface waters, BPCT is total recycle. Total recycle systems are commercially available and are already in operation in auto washes that previously discharged to municipal systems. The systems have typically been installed as cost-saving devices to avoid paying effluent charges.

Recycle systems are characterized by scale economies that result in a differential impact depending on the size of an auto wash. In view of this impact costs have been developed for two sizes of facilities: (1) an average self-service car wash; and (2) an average automatic car wash.

### $%Self-Service Auto Washes$%

The average self-service car wash is assumed to have 6 bays and to service 1500 cars per month or 18,000 cars per year. Manufacturers of recycle systems indicate that the lowest cost to equip and install a recycle system for a self-service auto wash would

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be about $7820 (1973 costs). Maintenance costs are assumed to be 4% 43
of capital costs or $312/year. Operating costs are based upon 4 man 44
days per year of service, and are equal to $320/year. Sludge would 45
accumulate at a rate of about 200 lbs. per year (0.011 lbs. per car
washed) and disposal costs would be negligible. The system would 47
consume about 1600 kilowatt hours of energy per year.

Manufacturers of recycle equipment claim that without recycling 49
about $0.06 of detergents are used to wash each car; with recycling 50
these costs for detergents are cut to $0.03 per car. These claims 51
may be subject to question so the costs for BPCT in Table 30 are
presented for two conditions. First the costs assume no savings on 52
detergents. The second set of costs assumes a $0.03 per car savings 53
on detergent costs. In addition, a savings of ___ per gallon is 54
assumed for water saved by recycling in the second set of costs. 55

The costs of BAT and NSPS would be essentially the same as BPCT 57
because the technology is the same. The cost of NSPS would be 58
somewhat lower because installation costs would be reduced. The 59
difference, however, is not great enough to be economically
significant.

Pretreatment costs for small self-service auto washes are zero. 61
Base level of practice in the industry is passage through a sump 62
prior to discharge to the sewer. Since the pretreatment guideline 63
specifies this technology, no costs are involved.

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$%Automatic Auto Washes$% 65

The typical automatic auto wash is assumed to service 7,000 autos 67
per month. The capital cost for purchase and installation of a 68
recycle system for this facility would be about $14,400 (Sept. 1973
dollars). At 4% of capital costs, maintenance costs would be $575 69
per year. Operations would demand about 8 man days per year or $640 70
per year. The system would use about 5000 kilowatt-hours of energy 71
per year. Sludge would accumulate at a rate of 77 pounds per month 72
and disposal costs would be negligible.

Again, as was the case for the self-service auto wash, two sets 74
of costs for BPCT are presented in Table 31. The first set assumes 75
no savings for detergents or water and the second set does.

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TABLE 30

BPCT Treatment Costs (Sept. 73)
Self-Service Auto Wash (1500 autos/month)

| | No Savings | Savings Included |
|---|---|---|
| Investment: | $7,820 | $7,820 |
| Annual Costs: | | |
| Capital Costs | 782 | 782 |
| Depreciation | 782 | 782 |
| O & M (excluding energy and power costs) | 632 | 632 |
| Energy and Power Costs | 50 | 50 |
| Detergent Savings | | -450 |
| Water Savings | | -108 |
| Total | $2,240 | $1,682 |
| Costs per Auto Washed | $0.124 | $0.093 |

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TABLE 31

BPCT Treatment Costs (Sept. 1973)
Automatic Car Wash (7,000 autos/month)

| | No Savings | Savings Included |
|---|---|---|
| Investment: | $14,400 | $14,400 |
| Annual Costs: | | |
| Capital Costs | 1,440 | 1,440 |
| Depreciation | 1,440 | 1,440 |
| O&M (excluding energy and power costs) | 1,215 | 1,215 |
| Energy & Power Costs | 125 | 125 |
| Detergent Savings | | -2,520 |
| Water savings | | -504 |
| Total | $4,220 | $1,196 |
| Costs per Auto Washed | $0.050 | $0.014 |

The costs of BAT and NSPS for the automatic auto wash would again be essentially the same as BPCT. At most, the installation cost for a new auto wash would be reduced by $1,000. This would amount to a total reduction of only $0.001 per auto washed.

As for the self-service auto wash, the costs of pretreatment are zero.

$%Assumptions$%

Power Costs - $0.025 per kwhr

Depreciation - 10% per year

Capital Costs - 10% per year

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### Credit for Water - $0.30 per 1000 gallons

### Use Reduction

## Industrial Laundries

### Best Practicable Control Technology Available (BPCTCA)

The task of estimating the costs of achieving BPCTCA by industrial laundries is complicated because laundries come in a variety of sizes, and their inputs and processes differ markedly. These variations are reflected in differences in wastewater flows and characteristics. The task of cost estimation is further complicated by the absence of operating treatment systems.

The cost estimates developed here rely heavily on the costs of installing and operating the oxidation charcoal filter system which has been used as the model on which the proposed treatment is based.

Base level of practice in the industry is assumed to be a heat reclaimer unit and a lint screen. Costs have been developed for two laundry sizes -- a 90,000 lb/week laundry and a 25,000 lb/week laundry. The unit processes and overall treatment system for the two sizes are exactly the same. Only the scales of the treatment systems are different.

The first step in the treatment process is flow equalization. For the 90,000 lb/week laundry, this requires a tank with a capacity

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of 1,500 gallons while a 900-gallon tank is needed for the 25,000 lb/week laundry.

The second step in the treatment process is a dissolved air flotation and skimming unit. The third step in the process is a chemical-physical separator system employing aeration. This stage of the process has also been referred to as aerated storage. For the 90,000 lb/week laundry the system requires two of these units having 1,200-gallon capacity. The two units operate in coordination with each other. One stores and aerates while the other empties and fills. Two 900-gallon units are required for the 25,000 lb/week laundry. These units are essentially aeration mixing devices that have been installed to operate as part of the overall treatment system. Units are available from a number of manufacturers.

The fourth step in the treatment system is passage of the wastewater through the monofilament filter/oxidation chamber. This unit is essentially an aerated tank lined with a fabric filter. Influent waters are aerated and filtered through the filter. Again, the size of these units could be 1,200 and 900-gallons of capacity for the 90,000 and 25,000 lb/week laundries, respectively.

The fifth and final step in the system is carbon filtration. In both cases -- for the large and small laundry -- this is assumed to be a 300-gallon, upflow filter containing 75-100 lb of granular carbon.

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The estimated costs of installing and operating this treatment system appear in Tables 32 and 33.

TABLE 32

COST OF BPCTCA
INDUSTRIAL LAUNDRIES
90,000 LB/WEEK PLANT

| | |
|---|---|
| Investment Costs: | |
| (Including installation and contingencies) | |
| 1,500-gallon equalization tank | $3,000 |
| Dissolved air flotation unit | 15,000 |
| Two aerated storage units | 12,600 |
| Filter/oxidation chamber | 3,300 |
| Carbon filter | 1,100 |
| 200 square foot area @ $50/SF | 10,000 |
| Total | $45,000 |
| Annual Costs: | |
| Capital | $ 4,500 |
| Depreciation | 4,500 |
| Sludge disposal ($12/day X 250) | 3,000 |
| Operation/Maintenance* | 4,500 |
| Carbon (replaced twice per year) | 100 |
| Filters (replaced twice per year) | 60 |
| Subtotal | $16,660 |
| Electricity | 800 |
| Total | $17,460 |
| Cost per pound of laundry -- $0.004 | |

*Other package systems have required as high as one-fourth pound of carbon replacement for every 1,000 gallon treated. This would translate to about $3,000 per year.

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TABLE 33

COST OF BPCTCA
INDUSTRIAL LAUNDRIES
25,000 LB/WEEK PLANT

| | | |
|---|---|---|
| Investment Costs:<br>(Including installation and contingencies) | | |
| 900-gallon equalizing tank | | $ 2,000 |
| Dissolved air flotation unit | | 15,000 |
| 900-gallong aerated storage unit | | 5,700 |
| 900-gallon filter/oxidation chamber | | 3,000 |
| Carbon filter | | 1,100 |
| | Subtotal | $26,800 |
| 200 square feet @ $50/SF | | 10,000 |
| | Total | 36,800 |
| Annual Costs: | | |
| Capital | | $ 3,680 |
| Depreciation | | 3,680 |
| Sludge Disposal ($3/day x 250) | | 750 |
| Operation and Maintenance | | 3,500 |
| Carbon | | 50 |
| Filters | | 50 |
| | Subtotal | $11,710 |
| Electricity | | 400 |
| | Total | $12,110 |

Cost per pound of laundry $0.009

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Best Available Technology Economically Achievable (BATEA) and New Source Performance Standards (NSPS)

The effluent requirements of BATEA and NSPS are the same as for BPCTCA in the industrial laundry subcategory. The costs of BATEA and NSPS might be somewhat less than BPCTCA because of the possibility of innovative process changes and overall lower installation costs. Nevertheless, costs may be as high as those of achieving BPCTCA by existing sources. Therefore, the costs of BATEA and NSPS are taken to be the same as those in Tables 32 and 33.

Pretreatment Standards for Existing and New Sources

Pretreatment requirements for existing and new sources are equivalent to BPCTCA. The costs of pretreatment for new sources are estimated to be the same as the estimates for BPCTCA that appear in Tables 32 and 33. Pretreatment for existing sources would never be more than the costs in Tables 32 and 33. In many cases the costs of pretreatment for existing sources may be zero provided the municipality receiving the discharge is committed in its National Pollutant Discharge Elimination System (NPDES) permit to remove the portion of incompatible pollutants equal to that which would be provided by BPCTCA. In these cases, the savings achieved by not having to install BPCTCA equipment will be offset by user charges.

Linen Supply, Power Laundries (Family and Commerical) and Diaper Service

As was true for industrial laundries, this subcategory is

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characterized by variety --primarily with respect to size, rates of wastewater flow, and concentations of constituents in the waste flows. It would be fruitless to try to provide the great number of separate cost estimates that would be necessary to capture all of the diversity in this subcategory. The differences, though identifiable, are not that great when reflected in their effects on treatment systems costs or economic impacts owing to scale and equipment limitations in pollution control engineering and technology.

Cost estimates have been developed for two sizes of linen supply laundries. Costs for commercial and diaper service laundries are assumed to be essentially the same for similar size operations. The two sizes of laundries are the 90,000 lb/week operation and the 25,000 lb/week facility. These sizes cover the range for industrial laundries and similarly appear to cover the range for linen, commercial, and diaper services laundries.

Available (BPCTCA)

A lint screen and a heat reclaimer are again assumed to comprise base level of practice. Thereafter, BPCTCA consists of equalization, screening, aerated storage, monofilament filtration/oxidation, and carbon filtration. These unit processes are described in more detail in the cost discussion for industrial laundries with the exception of the screening process. This screening process consists of a motorized screen filter that is self cleaning. Solids collect on the screen and are automatically scraped off into a sludge container that is emptied periodically.

The costs of BPCTCA for linen supply, power laundries, and diaper services are presented in Tables 34 and 35.

## Best Available Technology Economically Achievable (BATEA) and New Source Performance Standards (NSPS)

BATEA and NSPS require total recycle of wash and rinse waters. Since a minimum of 10% and usually 15 or more percent of process waters are lost through evaporation and being carried out with the wash load, the recycle system requires considerable make-up water. Recycle systems that have been operated have typically run at between 10 and 20% make-up water.

The BPCTCA system described in the previous section and costed out in Tables 34 and 35 provides a level of effluent quality that can be reused as wash and rinse water. The only modifications necessary to the BPCTCA system are the addition of a storage tank, the provision of recirculation pipes and pump, and the automatic valving for make-up waters from the water supply. The costs of these modifications have been estimated for the 90,000 and 25,000 lb/week plants and have been added to the BPCTCA costs to provide the incremental BATEA cost estimates that appear in Tables 36 and 37.

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TABLE 34

COST OF BPCTCA
LINEN SUPPLY, POWER LAUNDRIES, AND DIAPER SERVICE
90,000 LB/WEEK PLANT

| | |
|---|---|
| Investment Costs: | |
| 1,500-gallon equalization tank | $3,000 |
| Traveling Screen | 3,600 |
| Two 1,200-gallon aerated storage tanks | 12,600 |
| 1,200-gallon filter/oxidation chamber | 3,300 |
| Carbon filter | 1,100 |
| 200 square foot area @ $50/SF | 10,000 |
| | $33,600 |
| Annual Costs: | |
| Capital | $ 3,360 |
| Depreciation | 3,360 |
| Sludge Disposal ($12/week) | 650 |
| Operation and Maintenance | 3,500 |
| Carbon (replace twice per year) | 100 |
| Filters (replace twice per year) | 60 |
| | $11,030 |
| Electricity | 800 |
| | $11,830 |

Cost per pound of laundry $0.0026

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TABLE 35

COST OF BPCTCA
LINEN SUPPLY, POWER LAUNDRIES, AND DIAPER SERVICES
25,000 LB/WEEK PLANT

| | |
|---|---|
| Investment Costs: (Including installation and contingencies) | |
| 900-gallon equalization tank | $2,000 |
| Traveling screen | 3,600 |
| 900-gallon aeration storage unit | 5,700 |
| 900-gallon filter oxidation chamber | 3,000 |
| Carbon filter | 1,100 |
| 200 square feet of space @ $50/SF | 10,000 |
| | $25,400 |
| Annual Costs: | |
| Capital | $ 2,540 |
| Depreciation | 2,540 |
| Sludge disposal | 200 |
| Operation and maintenance | 2,500 |
| Carbon | 50 |
| Filters | 50 |
| | $7,880 |
| Electricity | 400 |
| | $8,280 |

Cost per pound of laundry $0.0067

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TABLE 36

INCREMENTAL COSTS OF BATEA
LINEN SUPPLY, POWER LAUNDRIES, AND DIAPER SERVICES
90,000 LB/WEEK PLANT

| | | |
|---|---|---|
| Investment Costs: | | |
| Storage Tank (12,500 gallons) | | $18,000 |
| Piping and valves | | 500 |
| | Subtotal | $18,500 |
| 144 square feet at $50/SF | | 7,500 |
| | Total | $26,000 |
| Annual Costs: | | |
| Capital | | $ 2,600 |
| Depreciation | | 2,600 |
| Operation and maintenance | | 500 |
| | Total | $ 5,700 |

Increased cost per pound of laundry $0.0013

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TABLE 37

INCREMENTAL COSTS OF BATEA
LINEN SUPPLY, POWER LAUNDRIES, AND DIAPER SERVICES
25,000 LB/WEEK PLANT

| | |
|---|---|
| Investment Costs: | |
| Storage Tank (3,500 gallons) | $ 5,200 |
| Piping and valves | 350 |
| | 5,550 |
| 70 square feet $50/SF | 3,500 |
| | $ 9,050 |
| Annual Costs: | |
| Capital | $ 905 |
| Depreciation | 905 |
| Operation and Maintenance | 300 |
| Total | $ 2,110 |

Incremental cost per pound of laundry $0.0017

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The 90,000 lb/week laundry is assumed to use approximately 5.5 gallons of water per pound of laundry. One consultant has estimated that by recycling a laundry one can save as much as $0.95 per 1,000 gallons of water used or $0.0052 per pound of laundry. Table 38 shows the consultant's estimates. If the figures in the table are correct, the decision to go to BATEA directly rather than to BPCTCA would result in a lower annual per pound cost of laundry washed. The total cost of BATEA from existing base level of practice would amount to $0.0026 and 0.0013 less $0.0052 or a net saving of $0.0013 per pound of laundry for the 90,000 lb/week laundry and $0.0067 and $0.0017 less $0.0052 or a net cost of $0.0032 per pound for the 25,000 lb/week laundry.

TABLE 38

CONSULTANT'S ESTIMATE OF RESIDUAL VALUE IN LAUNDRY WASTEWATER

| | Value/1,000 gallons |
|---|---|
| Water purchase | $ 0.33 |
| Sewerage Surcharge | 0.28 |
| Water softening | 0.05 |
| Heating water | 0.26 |
| Laundry room supplies | 0.02 |
| | $ 0.95 |

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New Source Performance Standards (NSPS)

NSPS for linen supply, power laundries, and diaper services are the same as the requirements for BATEA. The costs of achieving NSPS for a new source are equal to the sum of the costs of BPCTCA and the incremental costs of achieving BATEA. The costs of NSPS for the two sizes of typical laundries appear in Tables 39 and 40.

TABLE 39

COST OF NSPS
LINEN SUPPLY, POWER LAUNDRIES, AND DIAPER SERVICES
90,000 LB/WEEK PLANT

| | |
|---|---|
| Investment Costs: | |
| 1,500 gallon equalizing tank | $ 3,000 |
| Traveling screen | 3,600 |
| 2 - 1,200 gallon aerated storage tanks | 12,600 |
| 1,200 gallon filter/oxidation chamber | 3,300 |
| Carbon filter | 1,100 |
| Storage tank | 18,000 |
| Piping and valves | 500 |
| 344 square feet @ $50/SF | 17,500 |
| Total | $59,600 |
| Annual Costs: | |
| Capital | $ 5,960 |
| Depreciation | 5,960 |
| Sludge disposal | 650 |
| Operation and maintenance | 4,000 |
| Carbon replacement | 100 |
| Filter replacement | 60 |
| | $16,730 |
| Electricity | 800 |
| | $17,530 |
| Cost per pound of laundry $0.0039 | |

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TABLE 40

COST OF NSPS
LINEN SUPPLY, POWER LAUNDRIES, AND DIAPER SERVICES
25,000 LB/WEEK PLANT

| | |
|---|---|
| Investment Costs: | |
| 900 gallon equalizing tank | $ 2,000 |
| Traveling screen | 3,600 |
| 900 gallon aerated storage unit | 5,700 |
| 900 gallon filter/oxidation chamber | 3,000 |
| Carbon filter | 1,100 |
| Storage tank | 5,200 |
| Piping and valves | 350 |
| 270 square feet @ $50/SF | 13,500 |
| | $34,450 |
| Annual Costs: | |
| Capital | $ 3,450 |
| Depreciation | 3,450 |
| Sludge disposal | 200 |
| Carbon replacement | 50 |
| Filter replacement | 50 |
| Operation and maintenance | 2,800 |
| | $10,000 |
| Electricity | 400 |
| | $10,400 |

Cost per pound of laundry $0.0083

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## Pretreatment Standards for Existing and New Sources 634

Pretreatment requirements for existing and new sources are 638
equivalent to BPCTCA. The costs of pretreatment for new sources are 640
the same as those estimated for BPCTCA in Tables 34 and 35. In many 642
cases, the cost of pretreatment for existing sources may be zero 643
provided the municipality receiving the discharge is committed in its
NPDES permit to remove the portion of incompatible pollutants equal 644
to that which would be provided by BPCTCA. In these cases, the 646
savings achieved by not having to install BPCTCA equipment will be 647
offset by user charges.

## Coin-Operated Laundries and Dry Cleaning Facilities, and Laundry 651
## and Garment Services Not Elsewhere Classified 652

Coin-operated laundries and the catch-all subcategory of dry 657
cleaning and laundry and garment services not elsewhere classified
include a wide range of types and sizes of facilities. The dry 659
cleaning establishments not elsewhere classified should already be
practicing no discharge of any process wastewaters. The laundries 661
other than coin-operated laundries more than likely have wastes that
are similar to those of coin-operated laundries. If the wastes of 663
these other laundries are not comparable, then they can be treated as 664
linen or industrial laundries whichever has the strength of wastes
that more closely approximates that of the laundry in question. 665

For the purposes of cost estimates, one size of coin-operated laundry has been treated. Since coin-operated laundries cater to local demand and depend heavily on proximity to the user, these facilities seldom exceed 50 machines. On the other hand the minimum size coin-operated laundry would seldom contain fewer than 10 machines. In view of this relatively limited range, a representative facility of 25 machines will serve as a good basis for cost estimates. The economies of scale are not so great that the estimated unit costs for the 25 machine facility cannot be readily assumed about equal for the 10 or 50 machine facility. Similarly, the accuracy of the cost estimating techniques and the economic impact techniques is not so fine as might be offered by a multiple set of estimates based on size of the laundry facility.

The typical facility is assumed to contain 25 washing machines. The maximum daily design flow for the facility is assumed to be 1,000 gallons per hour or 40 washes per hour given a typical flow of 25 gallons per load. Base level of practice for the facility is assumed to be passage of the wastewaters through a lint screen prior to discharge.

Best Practicable Control Technology Currently Available (BPCTCA)

BPCTA is passage through a lint screen and filtration. The capital cost required is that for the installation of the filter and a sludge gravity thickening tank for removal of sludge from the

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backwash water. The costs of BPCTCA appear in Table 41. (The costs are based on the cost of a mixed media filter and not a diatomaceous earth filter.)

TABLE 41

COST OF BPCTCA
COIN-OPERATED LAUNDRY
25 MACHINE INSTALLATION

| | |
|---|---|
| Investment Costs: | |
| 3-phase filter, including media, valving and skid mounting | $ 2,500 |
| Piping and valving | 500 |
| Gravity sludge thicking tank with pump drain (100 gallon) | 750 |
| Space (20 square feet @ $50/SF) | 1,000 |
| Total | $ 4,750 |
| Annual Costs: | |
| Capital | $ 500 |
| Depreciation | 500 |
| Sludge removal | 50 |
| Operation and maintenance | 100 |
| | $ 1,150 |
| Electricity | 100 |
| Total | $ 1,250 |
| Cost per wash (50,000 gal/wk @ 25 gal/wash) $0.012 | |

## Best Available Treatment Technology Economically 729
## Achievable (BATEA) 730

BATEA for coin-operated laundries and the other facilities in 734
this subcategory is recycle of process wastewaters. Several 736
manufacturers produce physical-chemical units that provide this level
of treatment. The systems consist of chemical coagulation, 738
clarification, filtration, and carbon absorption. Although these 740
systems are package units there is no reason why, with planning and
minor modifications, the filter installed for BPCTCA could not be 741
incorporated into the package plant for BATEA. 742

The estimate for the incremental costs of going from BPCTCA to 744
BATEA appears in Table 42. 745

Again it is useful to examine the possible offsetting savings 782
that might be made possible by recycling. According to the figures 784
in Table 38, and the flow assumptions with respect to the 25 machine 785
laundry, the recycling system could reduce production costs by $0.018 786
per wash. If these savings were realized, the incremental costs of 787
achieving BATEA would be equal to $0.066 less $0.018 or $0.048 per 788
wash.

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TABLE 42

INCREMENTAL COST OF BATEA
COIN-OPERATED LAUNDRY
25 MACHINE INSTALLATION

| | |
|---|---|
| **Investment:** | |
| Package plant installed | $ 27,000 |
| Less savings for filter from BPCTCA | - 1,000 |
| Additional space (100 - 20 = 80 SF) | 4,000 |
| | $30,000 |
| **Annual Costs:** | |
| Capital | $ 3,000 |
| Depreciation | 3,000 |
| Sludge removal | 0 |
| Carbon replacement | 300 |
| Operation and maintenance | 400 |
| Subtotal | $ 6,700 |
| Electricity | 50 |
| Total | $ 6,750 |

Incremental cost per wash
(50,000 gal/wk @ 25 gal/wash) $0.066

## New Source Performanc Standards (NSPS)

NSPS requirements are the same as BATEA. The total costs of achieving NSPS will be somewhat less than the sum of the BPCTCA costs and the incremental costs of BATEA because no transition costs are incurred in going from BPCTCA to BATEA. The costs of achieving NSPS appear in Table 43.

TABLE 43

TOTAL COST OF NSPS
COIN-OPERATED LAUNDRY
25 MACHINE INSTALLATION

| | | |
|---|---|---|
| Investment Costs: | | |
| Installed package plant | | $27,000 |
| Space (100 square feet) | | 5,000 |
| | Total | $32,000 |
| Annual Costs: | | |
| Capital | | $ 3,200 |
| Depreciation | | 3,200 |
| Sludge removal | | 50 |
| Operation and maintenance | | 500 |
| | | $ 6,950 |
| Electricity | | 150 |
| | | $ 7,100 |
| Cost per wash | | |
| (50,000 gal/wk @ 25 gal/wash) | $0.068 | |

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Again, should the savings of Table 38 be realized this cost could be reduced to $0.068 less $0.018 or $0.05 per wash.

Pretreatment for Existing and New Sources

No pretreatment will be required of coin-operated laundries except under very unusual circumstances. Therefore, the costs of pretreatment are expected to be zero.

Dry Cleaning Plants Except Rug Cleaning

The dry cleaning subcategory discharges non-contact cooling water only. BPCTCA, BATEA, NSPS, and pretreatment requirements for existing and new sources all specify no discharge of processing water. Base level of practice in the subcategory is no discharge of process water. The cost of water pollution control is zero for the subcategory.

Carpet and Upholstery Cleaning Facilities

The typical carpet and upholstery cleaning facility passes its wastewater through a lint trap and discharges to a municipal sewer. Generally, those wastewaters contain no incompatibles and there will be no pretreatment requirements for existing or new sources other than a lint trap which is already accepted practice so the costs of pretreatment for existing and new sources are zero.

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The volume and characteristics of the wastewaters from carpet and 858
upholstery cleaning facilities are similar to those of the auto wash
industry. BPCTCA requires recycling of treated wastewaters and no 859
discharge for carpet and upholstery cleaning facilities that 860
presently discharge to surface waters. Makeup water will be required 861
for such systems to replace the waters retained by the laundered 862
materials and lost through drying.

The cost of BPCTCA has been estimated for a typical carpet and 865
upholstery cleaning facility. The typical facility is assumed to be 866
primarily a carpet cleaning operation. It cleans up to 1,200 square 868
yards of carpet per day using an average of twelve gallons of wash 869
and rinse water per square yard of carpet. The daily design flow for 870
the waste treatment and recycle system is assumed to be 15,000 871
gallons per day.

The installed cost of a package recycle system for a car wash 874
would be approximately $12,000. The modification of the system to 875
incorporate the addition of activated carbon filtration could cost 876
another $3,000. The overall capital cost for the system installed 877
would be about $16,000.

The estimated investment and annual costs for BPCTCA for the 879
typical carpet and upholstery cleaning facility appear in Table 44. 880

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TABLE 44

ESTIMATED COSTS OF BPCTCA
CARPET AND UPHOLSTERY CLEANING FACILITY
(DESIGN FLOW -- 15,000 GALLONS PER DAY,
CAPACITY -- 1,200 SQUARE YARDS OF CARPET)

| | |
|---|---|
| Investment Cost: | |
| Modified package treatment system | $16,000 |
| Annual Costs: | |
| Capital | 1,600 |
| Depreciation | 1,600 |
| Operation and Maintenance (excluding energy and power) | 1,000 |
| Carbon replacement | 1,500 |
| Sludge disposal | 50 |
| Subtotal | $ 5,750 |
| Power | 100 |
| Total Annual Cost | $ 5,850 |
| Cost per square yard of carpet | $0.019 |
| Cost per (9 x 12) carpet | $0.23 |

BATEA and NSPS for sources discharging to the surface waters are the same as BPCTCA. The incremental costs of BATEA above those of BPCTCA are zero. The costs of NSPS are the same as those for BPCTCA presented in Table 44.

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## SECTION IX

## Best Practicable Control Technology Currently Available Effluent Guidelines and Limitations

### Introduction

The effluent limitations which must be achieved by July 1, 1977, are to specify the degree of effluent reduction attainable through the application of the best practicable control technology currently available. There is, within the industry, a lack of technical sophistication that derives from the fact that it is a service industry. Because its custcomers are also potential competitors, each cost increase results in a diminished market. The industry has, therefore, done little research and development in the field of water pollution control.

Best practicable control technology currently available emphasizes treatment facilities at the end of the servicing process but includes the control technology employed within the process itself when this is considered to be normal practice within an industry.

Consideration was given to:

- The total cost of application of technology in relation to the effluent reduction benefits to be achieved from such application;
- the size and age of equipment and facilities involved;
- the process employed and the type of product being processed;
- the engineering aspects of the application of various types of control techniques;
- process changes; and

NOTICE

**These** are **tentative** recommendations based upon **information in this report** and are subject to change based upon comments received and further internal review by EPA.

- non-water quality environmental impact (including energy requirements).

A further consideration is the degree of economic and engineering reliability which must be established for the technology to be currently available. As a result of demonstration projects and pilot plants, there must exist a high degree of confidence in the engineering and economic practicability of the technology at the time construction starts or control facilities are installed.

<u>Pretreatment Standards for Existing Sources</u>

Some companies, particularly industrial and linen supply laundries, may have to pretreat their wastewater if it contains pollutants that are incompatible with a municipal sewer system. Incompatible pollutants, such as heavy metals, are discussed in 40 CFR, Part 128. Pretreatment should be to the degree attainable by the application of the best practicable control technology currently available, except that credit may be taken if the municipality is committed in its NPDES permit to remove a portion of the incompatible pollutant. Industries other than industrial and linen supply laundries would not generally have incompatible pollutants and would not need to pretreat prior to discharge to a municipal system. Other materials, such as rags, grease, acids, and explosive wastes, must not be allowed to enter the sewerage system.

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Identification of Best Practicable Control Technology 87
Currently Available (BPCTCA) 89

Industrial Laundries 92

BPCTCA will include the following: 94

1. A lint screen; 96

2. an equalization tank large enough to handle varrying 99
operational flows; 100

3. a flotation clarification system; 102

4. a chemical physical separator system employing aeration; 104

5. a settling chamber where the remaining heavy particles and 107
insoluble salts will settle out;

6. a monofilament filter/oxidation chamber; 109

7. a charcoal filter. 111

The levels of effluent reductions obtainable by such a system are 114
listed in Table 45. Since present control and treatment practices 115
followed at industrial laundries are almost completely inadequate, it 117
is not possible to delineate a specific existing sequence or
combination of in-process controls which could qualify as BPCTCA. 119
The system described above is not in use at any industrial laundry. 120
but represents a level of technology that can be applied by July 1, 121
1977.

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TABLE 45

BPCTCA

| | Industrial Laundries | Linen Laundries | Auto Washes | Carpet and Upholstery Cleaners | Coin-ops | Dry Cleaning Plants |
|---|---|---|---|---|---|---|
| mg/1 | | | | | | |
| BOD(5) | 30 | 30 | NDP | NDP | 30 | NDP |
| SS | 30 | 30 | NDP | NDP | 30 | NDP |
| Oil and Grease | 10 | 10 | NDP | NDP | | NDP |
| Hg | .0001 | .0001 | NDP | NDP | | NDP |
| Ni | 0.5 | 0.5 | NDP | NDP | | NDP |
| Cd | 0.02 | 0.02 | NDP | NDP | | NDP |
| Zn | 0.5 | 0.5 | NDP | NDP | | NDP |
| Cr | 0.5 | 0.5 | NDP | NDP | | NDP |
| Cu | 0.2 | 0.2 | NDP | NDP | | NDP |
| Pb | 0.5 | 0.5 | NDP | NDP | | NDP |
| Units | | | | | | |
| pH | 6-9 | 6-9 | NDP | NDP | 6-9 | NDP |

Still cooling water not included.

NDP = No discharge of pollutants.

NOTICE

These are tentative recommendations based upon information in this report and are subject to change based upon comments received and further internal review by EPA.

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Linen Supply, Power Laundries (Family and Commercial), and Diaper Services

A typical system currently being used in linen laundries consists of a screening operation, an oxidation tank, and an activated charcoal filter. The effluent reductions obtainable by this system are listed in Table 45.

Auto Wash Establishments

Approximately 30% of the auto wash industry has found it economical to recycle process wastewaters. It is estimated that approximately 15% of the wash water is lost through vehicle carryoff. Recycling represents the best practicable control technology currently available for this industry. A typical recycling facility consists of a filter pump with basket strainer, a wash water filter to remove dirt, a detergent filter to remove soap, and a recycling tank. The system can be completely self-contained.

Carpet and Upholstery Cleaning

At present the carpet and upholstery cleaning industry does not treat its process wastewater, but it can do so by making simple modifications to systems used by the auto wash industry. This can include, for example, adding a charcoal filter to remove color. By taking such steps, carpet and upholstery cleaning industry can achieve recycling. Makeup water is required to replace the water lost through drying.

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Coin-Operated Laundries and Dry Cleaning Facilities, and Laundry and Garment Services Not Elsewhere Classified

Various types of treatment exist within the coin-operated laundries ranging from a simple lint screen to recycle. A system that is consistent with the best practicable control technology currently available for the coin-operated laundries is filtration through a lint screen and a diatomaceous earth filter. The effluent reductions obtainable by this type of treatment are presented in Table 45.

The coin-operated dry cleaning segment discharges only noncontact cooling water and therefore the best practicable control technology currently available will be no discharge of process wastewaters. The soil that is removed from the garments is in the form of a muck or sludge.

Dry Cleaning Plants Except Rug Cleaning

The dry cleaning subcategory discharges only noncontact cooling water and, therefore BPCTCA will be no discharge of process wastewater. The soil that is removed from the garments is in the form of a muck or sludge.

## Loadings Summary

The wastewater loadings for all subcategories in terms of lb/unit of production based on typical water volume and amount of fabric

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processed are presented in Table 46. The concentrations are from Table 45.

TABLE 46

<u>BPCTCA</u>

| Parameter | Waste Loading Industrial* Laundry lb/lb | lbs/Unit Output Linen** Laundry lb/lb | Coin-Operated*** Laundry lb/load |
|---|---|---|---|
| BOD(5) | 0.0014 | 0.0014 | 0.0075 |
| Suspended Solids | 0.0014 | 0.0014 | 0.0075 |
| Oil and Grease | 0.0005 | 0.0005 | |
| Hg | .5 X 10(-8) | .5 X 10(-8) | |
| Ni | .2 X 10(-4) | .2 X 10(-4) | |
| Cd | .1 X 10(-5) | .1 X 10(-5) | |
| Zn | .2 X 10(-4) | .2 X 10(-4) | |
| Cr | .2 X 10(-4) | .2 X 10(-4) | |
| Cu | .9 X 10(-5) | .9 X 10(-5) | |
| Pb | .2 X 10(-4) | .2 X 10(-4) | |

*Average industrial load 800 pounds, average volume of water used is 4,470 gallons as per pp 24-25 Rexnord Report.
**Average linen load of 550 pounds, average volume of 3,025 gallons as per page 148, Rexnord Report.
***Flow/unit = 30 gal/load, page VII of this report.

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SECTION X

## Best Available Technology Economically Achievable

### Introduction

The best available technology economically achievable guidelines and limitations for the auto and other laundries are to be achieved not later than July 1, 1983. The technologies described in Section VII were determined by identifying the best control and treatment technology employed within the industrial category or subcategory during on-site inspections, by EPA laboratory analyses, and following consultation with recognized experts in the industry. Unlike BPCTCA technology, which is based on an average of the best performance, BATEA technology is based on the best demonstrated technology taking into account such factors as: (1) type of process employed; (2) operating methods; (3) batch as opposed to continuous operations; (4) use of alternative raw materials and mixes of raw materials; (5) use of dry rather than wet processes (including substitution of recoverable solvents for water); (6) recovery of pollutants as by-products.

### Industrial Laundries

Industrial laundries must treat their effluent using a method that reflects the best demonstrated technology discussed in Section VII. Since there are wide variations within the industrial laundry



**NOTICE**

**These are tentative recommendations based upon information in this report and are subject to change based upon comments received and further internal review by EPA.**

industry, no single system can be used by all plants. An example of BATEA would be the use of recoverable solvents (oil) in the cleaning of floor mopheads because this completely eliminates wastewater discharges. The dual-phase washing process can also represent BATEA. Expanded modifications of individual modular treatment equipment, as described in Section VII, used individually or in combination can also qualify as BATEA. The effluent reductions obtainable by the application of the best available technology economically achievable are the same as those listed in Table 30 of Section IX.

Linen Supply, Power Laundries (Family and Commercial) and Diaper Services

The best available technology economically achievable by this subcategory is recycling of process wastewaters. The technology for achieving this is described in Section VII.

Auto Wash Establishments

By employing BPCTCA, this subcategory can achieve zero discharge of process wastewater pollutants into navigable waters; BPCTCA was discussed in Section IX.

Carpet and Upholstering Cleaning

By employing BPCTCA, this subcategory can achieve zero discharge of process wastewater pollutants into navigable waters; BPCTCA was discussed in Section IX.

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Coin-operated Laundries and Dry Cleaning Facilities 69
and Laundry and Garment Services Not Elsewhere Classified 71

The best available technology economically achievable by this 75
subcategory is recycle of process wastewaters; the technology for 76
achieving this is described in Section VII.

Dry Cleaning Plants Except Rug Cleaning 78

By employing BPCTCA, this subcategory can achieve zero discharge 80
of process wastewater pollutants into navigable waters; BPCTCA was 82
discussed in Section IX.

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## SECTION XI

### New Source Performance Standards and Pretreatment Standards

#### Introduction

The term "new source" is defined in the Act to mean "any source, the construction of which is commenced after the publication of proposed regulations prescribing a standard of performance." New source performance technology is based on an analysis of how the level of effluent may be reduced by changing the production process itself either by extension or modification of existing systems or by complete conversion to new, more efficient methods.

Except for industrial laundries, new sources have two choices: (1) discharge to a municipally owned treatment plant with pre-treatment where required by Federal regulations or as prescribed by the local sewer ordinance, (2) wastewater treatment to reclaim and recycle process water in what is basically a closed loop system. Fresh water would be added only to make up what is lost through evaporation or carryout in the product. Periodic removal of dissolved solids by sophisticated treatment methods may be required. Due to the possible build up of salts in industrial laundry wastewater, new sources in Subcategory 1 will not have to employ a closed loop system.

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Industrial Laundries

Performance Standard

New sources within this subcategory shall meet the limitations outlined as best practicable control technology currently available in Section IX.

Pretreatment Standard

Before discharging into municipal systems all incompatible pollutants, as defined in the Federal Register Vol. 38, No. 215, November 8, 1973, shall be pretreated to or below the levels presented in Table 30 of Section IX. The technology consistent with achieving these reductions is discussed in Section IX.

Linen Supply, Power Laundries (Family and Commercial) and Diaper Service

Performance Standard

New sources within this subcategory shall not discharge any process wastewater pollutants into navigable waters. It shall be recycled through reclamation plants, as outlined in Sections VII, IX, and X for reuse.

Pretreatment Standard

If a once-through method of operation is used, incompatible pollutants must be pretreated prior to being discharged into a

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publicly owned treatment works and the pollutant levels achieved shall not exceed those given in Table 30 of Section IX.

## Auto Wash Establishments

### Performance Standard

New sources within this subcategory shall not discharge any process wastewater pollutants into navigable waters. The technology that can be used to achieve this objective is discussed in Section IX.

### Pretreatment Standards

For new systems designed to discharge into publicly owned treatment facilities, pretreatment can be satisfactorily accomplished by passing the wastewater through a detention sump to remove heavy particulate matter.

## Carpet and Upholstery Cleaning

### Performance Standard

New sources in this subcategory shall not discharge any process wastewater into navigable waters but recycle it as discussed in Section IX.

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Pretreatment Standards

No pretreatment other than a lint screen is required because the wastewater generated does not contain incompatible pollutants.

## Coin-operated Laundries and Dry Cleaning Facilities and Laundry and Garment Services, Not Elsewhere Classified

Performance Standard

New sources in this subcategory shall not discharge any process wastewater into navigable waters.

Pretreatment Standard

Because of the nature of the wastewater generated (Section V) and the economics involved (Section VIII) no treatment is required before the wastewater is discharged into publicly owned treatment works.

In the event that the effluent pollutant strength or flows exceeds the limits required by a municipality's sewer code, the payment of a sewer surcharge would be economically preferrable for the laundry.

## Dry Cleaning Plants Except Rug Cleaning

Performance Standard

New sources in this subcategory shall not discharge any process wastewater into navigable waters.

Pretreatment Standards

Because the largest amount of water used by this industry is non-contact in nature, it does not have to be treated before it is allowed to enter a publicly owned treatment works.

Any solid waste generated as a result of solvent recovery operations should not be dumped into storm sewers but should be disposed of in a well-operated landfill or hauled to such a facility by a firm approved by the governing authority.

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**DRAFT**

## SECTION XIII

### References


1. Keffer, C. E., "The Syndet Problem After Five Years of Progress," Public Works, 95, 1, 82 (1964).

2. Semling, Harold V., "Detergents and Water Quality," Household and Personal Products Industry, July 1972, pp 30.

3. Lashen, Edward S., and Keith A. Booman, "Biodegradability and Treatability of Alkylphenol Eehoxylates - A Class of Non-ionic Surfactants, Jour. WPCF.

4. Eisenhauer, Hugh R., "Chemical Removal of ABS from Wastewater Effluents," Jour. WPCF Vol. 37, No. 11, pp 1567-1578. November 1965.

5. Eckenfelder, W. Wesley,Jr., "Removal of ABS and Phosphate from Laundry Wastewaters," Purdue Univ. Eng. Ext. Bull. Series 117, Pt. 1, pp 467 (1965).

6. Coughlin, F. J., "Detergents and Water Pollution Abatement," Am. J. Public Health, 55, 5, 760 (1965).

7. Sengupta, Ashis K., and W. O. Pipes, "Foam Fractionation - The Effect of Salts and Low Molecular Weight Organics on ABS Removal," XIX Purdue Conference, pp. 811.

8. Buescher, C. A., and D. W. Ryckman, "Reduction of Foaming of ABS by Ozonation," XIX Purdue Conference, p. 251.

9. U. S. Department of Commerce, "1967 Census of Business" Selected Services, Laundries Cleaning Plants, and Related Services.

10. National Automatic Laundry and Cleaning Council, "Coin Laundry Waste Discharge Survey."

11. Wayman, C., et al., "Behavior of Surfactants and Other Detergents in Water and Soil-Water Environments," Public Works 96, 9, 160 (1965).

12. Hoover, Thomas B., "Polorographic Determination of NTA," Environmental Protection Technology Series, June 1973.

DRAFT


13. O'Farrell, Thomas P., Dolloff F. Bishop, and Stephen M. Bennett, "Advanced Waste Treatment at Washington, DC," FWPCA, Taft Research Center, May 1969.

14. Feige, Walter A., and Edward L. Berg, "Full Scale Mineral Addition at Lebanon, Ohio," Water and Sewage Works, 1973, pp R-79-94.

15. Stomberg, John B., Dolloff F. Bishop, Paul H. Warner, and Samuel H. Griggs, "Lime Precipitation in Municipal Wastewaters," Chemical Engineering Symposium Series, Water 1970, Vol. 67, No. 107.

16. Ghassemi, Masood, and Harold L. Recht, "Phosphate Precipitation with Ferrous Ion," Water Pollution Control Series, 17010 EKI, September 1971.

17. Rand Development Corp., "Phosphorus Removal by Ferrous Iron and Lime," Water Pollution Control Series, 11010 ECO, January 1971.

18. Menar, A. B., and D. Jenkins, "Calcium Precipitation in Wastewater Treatment," Research Reporting Sereis, No. 17080, DAR, December 1972.

19. Boucher, P. L., "Micro-Straining and Ozonization of Water and Wastewater, XIX PUrdue Conference, p. 771.

20. Villers, R. V., E. L. Berg, C. A. Brunner, and A. N. Masal, "Municipal Wastewater Treatment by Physical and Chemical Methods," W & SW Reference #1971 (Jour. WPCF, Part 1, March 1972).

21. Hais, Alan B., John B. Stomberg, Dolloff F. Bishop, "Alum Addition to Activated Sludge With Tertiary Solids Removal," presented at 68th National Meeting of the A.I.Ch.E., March 1971.

22. Smith, John M., Arthur M. Masse, and Walter A. Feige, "Upgrading Existing Wastewater Treatment Plants," Pergamon Press, Inc., September 1972.

23. Rex Chainbelt, Inc., "Amenability of Reverse Osmosis Concentrate to Activated Sludge Treatment," Water Pollution Control Series, 17040, EUE, July 1971.

24. Feige, Walter A., and John M. Smith, "Wastewater Applications with a Tubular Reverse Osmosis Unit," A.I.Ch.E. Publication, Water - 1973, January 1974.

# DRAFT


25. Bashaw, J. D., J. K. Lawson, and T. A. Orafino, "Hollow Fiber Technology for Advanced Waste Treatment," Environmental Protection Technology Series, 17040 FEE, December 1972.

26. Douglas, A. S., M. Tagami, and C. E. Milstead, "Membrane Materials for Wastewater Reclamation by Reverse Osmosis," Water Pollution Control Research Series 17040 EFO, June 1970.

27. "R.O.:A Profile," Industrial Water Engineering Vol. 70, No. 3, May-June 1973.

28. "Removal of Synthetic Detergents from Laundry - Laundromat Wastes," Research Report #5, New York State Water Pollution Control Board, Albany, March 7, 1960.

29. Grieves, Robert B., Jerry L. Bewley, "Treating Laundry Wastes by Foam Separation," Jour. Water Poll. Contr. Federation, Vol. 45, No. 3, 1973.

30. Galonian, G. E., and Autenbach, "Phosphate Removal from Laundry Wastewater," Jour. Water Poll. Contr. Fed., August 1973. pp. 36-53.

31. "Commercial Laundering Industry," Public Health Service Publication No. 50N.

32. Knutson, V. A., "Plant Operations," Hospitals, 46, pp. 171-6, April 1, 1972.

33. Engley, Frank B., Jr., "Hospitals and the Environment Biological Interrelationships," Hospitals, 46, p. 83, October 16, 1972.

34. Economics of Clean Water, Vol. 1, EPA, U. S. Government Printing Office, Washington, DC (1972).

35. Smith, Robert, and Walter F. McMichael, "Cost and Performance Estimates for Tertiary Wastewater Treating Processes," FWPCA Report No. TWRC 9, June 1969.

36. "Air and Water News," Vol. 7, No. 34, pp. 4-5, August 20, 1973.

37. Industrial Wastewater Discharges, New York State Department of Health, Albany, New York, June 1969.

38. Bailey, James R., Richard J. Benoit, John L. Dodson, James M. Bobb, Harold Wallman, "A Study of Flow Reduction and Treatment of Wastewater from Households," Water Pollution Control Research Series, Prog. No. 11050FKE, December 1969.

**DRAFT**


39. Hedges, Ralph C., "The Coin Carwash Industry," New York State Coin Carwash Seminar, April 25, 1968.

40. Yu, Ben C. H., "A Report on Water Pollution Control Research," May 1965 (Final Report, June 1965).

41. "Detergents in the Carwash Age," Detergent Age, Vol.3, No. 12, May 1967.

42. Reilich, Helmut G., "Technical Evaluation of Phosphate Free Home Laundry Detergents," EPA Project No. 16080 DVF, February 1972.

43. Menar, Arnold B., and David Jenkins, "The Fate of Phosphorous in Waste Treatment Processes: The Enhanced Removal of Phosphate by Activated Sludge." 25th Industrial Waste Conference, Purdue University, 1970,p. 655.

44. Mulbarger, M. C., "The Three Sludge System for Nitrogen and Phosphorus Removal," EPA, Office of Research and Monitoring, April 1972.

45. Bunch, Robert L., and M. B. Ettinger, "Biodegradability of Potential Organic Substitutes for Phosphates," 25th Industrial Waste Conference, Purdue University, 1970.

46. City of Baltimore, Maryland, "Phosphate Study at the Baltimore Back River Wastewater Treatment Plant," Water Pollution Control Research Series, No. 17010 DFV, September 1970.

47. Sadek, Shafik E., "An Electrochemical Method for Removal of Phosphates from Waste Waters," Water Pollution Control Research Series, No. 17010, February 1970.

48. Azad, Hardom S., and Jack A. Borchardt, "Phosphorus Uptake by P-Starved Algae," 25th Industrial Waste Conference, Purdue University, p. 325, 1970.

49. Grieves, Robert B., "Foam Separation Processes From Industrial Waste Treatment: Phenol, Phosphate, and Hexavalent Chromium," 25th Industrial Waste Conference, Purdue University, p. 192, 1970.

50. Zenz, David R., and Jos. R. Pinnicka, "Effective Phosphorus Removal by the Addition of Alum to the Activated Sludge Process," 25th Industrial Waste Conference, Purdue University, 1970, p. 273.

**DRAFT**


51. Campbell, Lorne A., "The Rcle of Phosphate in the Activated Sludge Process," 25th Industrial Waste Conference, Purdue University, 1970, p.214.

52. Witherow, Jack L., "Phosphate Removal by Activated Sludge," 25th Industrial Waste Conference, Purdue University, 1970, p. 1169.

53. Heinke, Gary W., and Jack D. Norman, "Hydrolysis of Condensed Phosphates in Wastewater," 25th Indus. Waste Conference, Purdue University, 1970, p.644.

54. Mulbarger, Michael C., and Shifflett, "Combined Biological and Chemical Treatment for Phosphorus Removal," Chemical Engineering Progress Symposium Series, Vol. 67, No. 107, 1970.

55. Black & Veatch Consulting Engireers, "Process Design Manual for Phosphorus Removal," Program 17010 GNP, October 1971.

56. Aulenbach, Donald B., Patrick C. Town, Martha Chilson, Treatment of Laundromat Wastes," Research Reporting Series, Project 12120 DOD, February 1973.

57. Flynn, John M., and Barry Andres, "Laundrette Waste Treatment Processes," Journal Water Pollution Control Board, p. 783, June 1973.

58. "Coin Operated and Other Commercial Laundries," West Virginia 1970 Regulations, Sec. 14.

59. Rosenthal, Barnet L., Joseph E. O"Brien, Gilbert T. Joly, and Alan Cooperman, "Treatment of Laundromat Wastes by Coagulation With Alum and Adsorption Through Activated Carbon," Massachusetts Department of Public Health, March 1963.

60. Aulenbach, Donald B., Patrick C. Town, Martha Wilson, "Treatment of Laundromat Wastes - I. Winfair Water Reclamation System," 25th Industrial Waste Conference Purdue University, 1970, pp. 36-53.

61. Elenfelder, W. Wesley, Jr., Edwin Barnhart, "Removal of Synthetic Detergents From Laundry and Laundromat Wastes," Research Report #5, New York State Department of Health April 2, 1957.

# DRAFT


62. International Fabric Institute, "An Introduction to Industrial Drycleaning Methods, Part 2," IFI Special Reporter, Vol. 1, No. 4, February 1973. 249 250 251

63. Rosenthal, Barnet L., et al, "Industrial Laundry Waste Water Treatment Study," Massachusetts Department of Public Health, Project 148, April 1964. 253 254 255

64. Guidelines Washing Formula, White Family Work, F - 1 - 1, H. Kohnstamm and Company, Inc. 257 258

65. Guideline Washing Formula, White Industrial Garments (Coveralls, Shirts and Pants), F-4-1, H. Kohnstamm and Company, Inc. 260 261 262

66. Guideline Washing Formula - Diapers, F-6-1, H. Kohnstamn & Co., Inc.. 264

266

67. Guideline Washing Formula - Linen Supply Classification #1 - Litht Soil - Motel and Hotel Sheets and Pillowslips, F-3-1, H. Kohnstamn & Co., Inc.. 267 268 269

68. Guideline Washing Formula - Hospital, Motel, Hotel, Nursing Home, Institutional Lightly Soiled White and Fast Colors, F-2-1-1,H. Kohnstamn & Co., Inc.. 271 272 273

69. Guideline Washing Formula - H. K. Detergent Oil, Polyester/ Cotton Garments Including "Perment Press" White Fabrics, "Light to Medium Soiled," F-7-1, H. Kohnstamn and Co., Inc. 275 276 277

70. International Fabric Institute, "Drycleaning Solvent Vapors and O.S.H.A.," IFI Bulletin Service No. 5-491, Aug. - Sept. 1973. 279 280

71. I.F.I., "Rule 66 Petroleum Solvents," IFI Bulletin Service, No. T-490, July 1973. 282 283

72. I.F.I., "Textile Damage Analysis Statistics for 1972," IFI Bull. Service, No. T-489, June 1973. 285 286

73. I.F.I., "Monitoring Solvent Leaks," IFI Bull. Service, No. T-488, May 1973. 288 289

74. I.F.I., "Performance of Vinyls in Drycleaning," IFI Bull. Service, No. T-487, April 1973. 291 292

75. I.F.I., "Approved Solvents - 1973," IFI Bull. Service, No. T-486, March 1973. 294 295

76. I.F.I., "Washing Formulas," IFI Monthly Special Reporter, 297

# DRAFT


1-3, September 1972.

77. I.F.I., "An Introduction to Industrial Drycleaning Methods, Part I," IFI Special Reporter, 1-3, Winter 1973.

78. I.F.I., "Sewer Ordinances, Part I," IFI Special Reporter, 1-11, June 1973.

79. I.F.I., "Sewer Ordinances, Part 2," IFI Special Reporter, 1-12, July 1973.

80. I.F.I., International Fair Claims Guide for Consumer Textile Products, IFI Special Reporter, 1-13, August 1973.

81. Livesy, Ruth P., "The Contribution of Diaper Service Accreditation to Infant Health Care," Clinical Pediatrics, Vol. II, No. 9, September 1972.

82. Standards for Accrediting Diaper Services, Diaper Service Accreditation Council, July 1973.

83. National Automatic Laundry and Cleaning Council Wastewater Treatment Committee, Coin Laundry Waste Discharge Survey, NALCC, Chicago, Illinois

84. American Association of Textile Chemists and Colorists, "An Industrial Waste Guide to the Commercial Laundering Industry," Industrial Laundrer, p.23.

85. Eckenfelder, W. Wesley, "Removal of ABS and Phosphate From Laundry Waste Waters," 25th Industrial Waste Conference, Purdue Univ., p. 467, 1964.

86. Chicago Sewer Ordinance, Metropolitan Sanitary District of Greater Chicago.

87. McCabe, Joseph C., "Reclaiming Laundry Waste Water for Reuse, Part I," Starchroom Laundry Journal, p. 70, November 1954.

88. McCabe, Joseph C., "Reclaiming Laundry Waste Water for Reuse, Part II," Starchroom Laundry Journal, p. 70, December 1954.

89. Stark, Karl, "Treatment of Water Wastes," Industrial Launderer, p. 29, March 1962.

90. Halton, J. E., L. L. Silver, and J. V. Graham, "Navy Points Way to Water Savings," Starchroom Laundry Journal, p. 10, July 15, 1957.

**DRAFT**

91. Barnum, Marshall, "Water Reuse Project Shows Possibilities," 347
Line Supply News, p. 70, March 1969. 348

92. Douglas, Gary. Demonstration of a Modular Wastewater Treatment 350
System for the Textile Maintenance Industry, EPA Grant #FYY 12120 351

93. Oehnel, Erich, "Clean Laundry Without Pollution .. A Discussion 353
of Washfloor Supplies," Can Hosp., 48: 46-8, July 1971. 354

94. Eisenhauer, Hugh R., "Chemical Removal of ABS From Wastewater 356
Effluents," Jour. WPCF, Nov. 1965, p. 1567. 357

95. Pollution Control Department, City of Kansas City, Mo. 359

96. Degler, Stanley E., "News From Washington," Water and Wastes 361
Engineering, 10 September 1973. 362

97. U. S. Army Mobility Equipment Research and Development 364
Center, Fort Belvoir Virginia "Treatment of Wastewaters 365
From Military Laundries." 366

98. Allen News, Vol. 1, Number 3, 1973. 368

99. National Carwash Council, "Survey Report for Water and Sewer 370
Costs and Tap-on Fees in 295 U. S. Cities." 371

100. Wiltrout, Dale, "Water Reclamation and Vehicle Washington," 373
Auto Laundry News, Vol. 22, No. 8, Aug. 1973, p. 18. 374

101. Smith, Louis H. V., "Reclaimed Water Plays Role of Growing 376
Importance," Auto Laundry News, May 1970. 377

102. Moore, Jack W., "How the 1965 Water Quality Act Affects Coin 379
Laundry Operations," Management Guidelines from NALCO, No. 48, 380
September 1967. 381

103. Water Quality Standards of the United States, Territories, 383
and the District of Columbia, American Public Health 384
Association Subcommittee on Water Quality Control, June 1969. 385

104. Aqua Systems Equipment Brochure, Aqua Systems, Inc. 387

105. I.F.I. Bulletin 1-14 "Perchlorethylene Vapors in Dry 389
Cleaning," Sept. 1973. 390

106. Greater Cincinnati Metroplitan Sewer District, Sewer 392
Ordinances 1973" 393

107. Office of Research and Monitoring, U. S. Environmental 395

DRAFT


Protection Agency, "Treatment of Laundromat Wastes," Environmental Protection Technology Series, EPA-122-73-108, February 1973.

108. "Pretreatment of Discharges to Publicly Owned Treatment Works," EPA Bulletin.

109. Engineering Study "Denormandle Towel and Linen Supply Company," Chicago Illinois - Laicon Corporation.

110. Engineering Study "Ideal Uniform Rental Service," Niles, Illinois - Laicon Corportation.

111. Manfred Wentz, "Effluent Guidlines Survey," International Fabricare Institute.

112. EPA 16080 DVF, Dec. 1970 "Development of Phosphate Free Home Laundry Detergent."

113. Laicon Incorporated, "Engineering Report on Waste Discharge from North Shore Uniform Inc."

114. Engineering Study "Morgan Laundry - Laicon Corp.

115. Eilers, Richard G., "Condensed One-page Cost Estimates for Wastewater Treatment," Nov. 1970.

116. North Carolina Dept. of Water Resources - "Investigation of Treatment of Waste From Coin Operated Laundries," 1960.

117. Philadelphia Quartz Company, "Laundry Washroom Handbook."

118. Office of Permit Program "Interim Effluent Guidance for NPDES Permits," 1973.

119. U. S. Environmental Protection Agency, "Proposed Water Quality Information, Volume I and II, October 1973.

120. J. M. Flynn, B. Andres, "Launderette Waste Treatment Processes," Water Pollution Control Federation Journal pp. 783-798, June 1963.

122. Ruffner, G., et al, "Encyclopedia of Association," Volume I, National Organizations of the U. S.

122. Johns-Manville Corp, "Drycleaners Handbook," 10th Edition.

123. Laicon Incorporated, "Engineering Report on Pilot Precoat Rotary Drum Vacuum Filter @ Morgan Linen Facility," 1973.

# DRAFT


124. "1967 Census of Business" Selected Service, Laundries, Cleaning Plants, August 1970.

125. Robert C. Thomas, Innovative Consultants, Inc., "New Developments for Treating and Reclaiming Waste Water," paper presented at the 61st Annual Convention and Exhibit; Linen Supply Association of America, May 3, 1973, p. 10.

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# SECTION XIV

## Glossary

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|---|---|
| ABS | Alkyl benzene sulfonate. |
| Activated Sludge | The gross mass of viable cells and their associated solid products. |
| Aeration | The ratio of a volume of air drawn into a volume of gas or liquid. |
| Afterfloc | Solids formed by the precipitation or crystallization of dissolved material in water upon standing. This material is measured as suspended solids in subsequent analysis. |
| Analine dye | Coal tar dyes. |
| Anionic synthetic | Surface active agents which attract grease and dirt from the surface to the water. |
| Bacterial static agents | Quaternary ammonium compounds and two phenol compounds. |
| Bench scale testing | Lab testing that closely simulates full scale waste treatment unit processes and are utilized to size full-scale equipment. These tests are quick, portable, and easily performed. |
| Bentonite clay | Diatomaceous earth (D.E.). |
| Blueing compounds | Water solubles of analine dye stuff. |
| BOD | Biochemical Oxygen Demand, a term which signifies the amount of dissolved oxygen which will be taken out of the water during the decomposition of the wastes. |
| Break | The first step in a wash cycle in which supplies are used. It is designed to wet down the loadand remove as much of the readily soluble soil as possible. |
| Calcium hardness | Hardness based on a calcium carbonate titration to a pH of 4.5. |

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<u>City softened water</u> — Water with the calcium hardness removed. 60
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<u>Cycle time</u> — The time required for a vacuum filter to make one 65
complete drum revolution. 66

<u>D.E. body feed</u> — The addition of filter aid (D.E.) while filtering 69
wastewater on a precoated DE filter to the 70
wastewater feed; thus, providing a continuous 71
clean surface for subsequent solids separation. 72

<u>D.E. filter backwash</u> — The act of reversing the water flow to the DE 74
filter at a flowrate sufficient to knock off the 76
filter ake. This occurs when the filter cake 78
resistance is too great to accommodate the 79
required flow rate.

<u>D.E. precoat</u> — The initial layer of DE added to the DE filtering 81
elements prior to starting the dirty wastewater 83
feed. Generally, 0.5 to 0.76 kg/sq m (0.1 to 0.15 85
lb/sq ft) of filter aid is applied to treat the 86
initial wastewater flow.

<u>Dissolved Solids</u> — Those solids passing through a standard glass 88
fiber filter and dried at constant weight at 180 90
degrees C.

<u>Dry Time</u> — That portion of a vacuum filtration cycle occur- 94
ring between the point of drum rotation out of the 95
sludge to the point of vacuum release. 96

<u>Effluent</u> — Waste containing water discharged from a plant. 100

<u>Effluent Criteria</u> — Maximum or minimum limits for waste loads 103
established by regulatory agencies. 104

<u>Enzymes</u> — A protein produced by a living cell that acts as a 108
catalyst.

<u>Filter leaf</u> — A small filter system of known area that is free 112
draining and utilized for holding filter cloths 113
during vacuum filter sizing bench tests.

<u>Filter septums</u> — The filter aid support element, generally long 116
tubular stainless steel supports or cloth bags 117
supports, that retain the filter aid. 118

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| Flush | A wash operation occurring at the beginning of the wash cycle in which no supplies are added to merely wash out loose soil and dirt to increase the effectiveness of the supplies when they are added. |
| Grease | See Hexane Solubles. |
| Heavy metals | Lead, cadmium, zinc, mercury, iron, chromium, nickel and copper in this report. |
| Hydrocarbons | A general term for organic compounds which contain only carbon and hydrogen in the molecule. |
| Industrial Laundry | A laundry washing especially shop towels, printers towels, and dust mops, wherein the wastewater contamination is abnormally high compared to other laundry types. |
| LAS | Linear alkyl sulfonate. |
| Linen laundry | A laundry washing primarily linen flatwork such as sheets, table linen, continuous towels, kitchen towels, etc., wherein the wastewater contamination is low compared to the other laundry types. |
| Mass loading | The mass of suspended solids applied to a unit area of the flotation tank in a unit of time, measured as kgs/day/sq m or lbs/day/sq ft. |
| Neutralizers or Anti-chlors | Sodium sulfate and sodium sulfite. |
| Oxygen-sag curve | A curve that represents the profile of dissolved oxygen content along the course of a stream, resulting from deoxygenation associated with biochemical oxidation of organic matter and reoxygenation through the absorption of atmospheric oxygen and through biological photosynthesis. Also called dissolved oxygen sag curve. |
| Pickup time | That portion of the vacuum filtration cycle occurring during the time the drum is submerged in the sludge. |
| Pilot Plant | Small scale continuous testing of model waste |

| | |
|---|---|
| Testing | treatment processes to develop design data for direct scale up to full scale equipment. |
| Point Source | Any discernible, confined and discrete conveyance, including any pipe, ditch, channel, tunnel, conduit, well, discrete operations, or vessel, or other floating craft, from which pollutants are or may be discharged. |
| Quaternary | Consisting of four components. |
| Recycle ratio | Pressurized flow rate divided by the raw flow rate times 100, expressed as percentage. |
| Rise rate | The rate at which solids separation occurs in a flotation unit, i.e., the velocity with which a suspended particle is lifted in the liquid medium. |
| Scum | The liquid fraction containing the solids that is skimmed from the flotation unit and used as vacuum filter feed. |
| Sewer charge | A sewer use tax, or cost charged by a municipality to a sewer user to pay for this service. |
| Sewer surcharge | A sewer tax above the sewer charge determined by the strength of the wastewater discharge, generally in terms of wastewater BOD and suspended solids. |
| SIC code | Standard Industrial Classification code. |
| Soil | The dirt, grease, and other material present in laundry prior to washing. This is the material that must be cleaned from the articles. |
| Sour | An acid compound added to the last wash operation to adjust the pH of the final rinse near neutrality. |
| Specific resistance | A measure of the ability of a vacuum filter sludge cake to impede the flow of water through its pore structure; utilized to measure the effect of sludge chemical conditioning. |
| Spotting agents | Dichloro benzene, carbotols, ard emulsifying agents. |

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Stripers — Sodium hydro sulfite, titanium sulfate and 229
titanium chloride.

Submergence — A measure of sludge depth in the vacuum filter, 231
usually expressed as the percentage of the drum 233
diameter beneath the filter vat sludge level. 234

Suds — The wash operation wherein the detergent is added 238
to emulsify oil and greases and to suspend the 239
majority of the soil for discharge.

Supplies — The chemicals used for removing the soil in the 242
wash cycle; this includes all chemicals added to 243
the wash cycle.

Surface overflow rate — The hydraulic loading of the flotation unit per 245
unit area of tank per unit time, usually expressed 247
as 1 pm/sq m (gpm/sq ft) of tank. 249

Suspended solids — Solid matter retained by a standard glass fiber 252
filter and dried to constant weight at 103-105
degrees C. 253

Syndets — Synthetic detergent. 255

Thermal pollution — A rise in water temperature induced by higher 258
temperature effluents. 259

Total solids — The sum of the homogeneous suspended and for one 262
hour at 180 degrees centigrade. 263

Treatment load (Waste load) — Numerical value of any waste parameter (such as 265
BOD content, etc.) that serves to define the 267
characteristics of a plant effluent. 269

Treatment Work — Includes sewage treatment facilities, sewage 271
collection systems and their appurtenances. 272

Vacuum Filter blinding — The deposition of solids in the weave of a filter 274
cloth such that the cloth cannot pick up any new 277
solids. On a belt filter, cloth blinding leads to 279
no cake discharge from the discharge roll;
therefore, no sludge is being dewatered by those 280
areas manifesting blinding.

Vacuum filter solids loading — The mass of dry sludge solids picked up per unit 282
area of filter; a measure of cake thickness. 285

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Vacuum filter yield — The mass of dry sludge solids dewatered on a unit 287
area of filter in a unit of time, normally 290
measured as kgs/sq m filter/hr 9lbs/sq ft/hr). 291

Vacuum filtrate — The water passing through the filter cloth and not 295
retained in the sludge.

Wash cycle — The entire operation required to launder a machine 298
load of an article. 299

Wash formula — The complete schedule of application of detergents 302
and other supplies in laundering. 303

Wash operation — One discrete machine discharge during a wash 306
cycle, e.g. a flush, suds, or rinse. 307

Washroom — The area where the wash wheels are located. 309

Wash wheel — The washing machine itself. 311

Water level — The depth of water in the cylinder of the wash 314
wheel while it is laundering an item. This depth 315
is often used to calculate the volume of water 316
used in the laundering process, and in the 317
calculation of water volume used in one wash
operation.

Wipers — Shop towels and printers' towels. 319

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## Abbreviations 322

| | | |
|---|---|---|
| BOD | Biochemical Oxygen Demand | 326 |
| BTU | British Thermal Units | 327 |
| cm | centimeter | 328 |
| cfm | cubic feet per minute | 329 |
| cmm | cubic meter per minute | 330 |
| cu ft | cubic feet | 331 |
| cu m | cubic meter | 332 |
| cu yd | cubic yard | 333 |
| DE | diatomaceous earth | 334 |
| ft | foot | 335 |
| gal | gallons | 336 |
| gpm | gallons per minute | 337 |
| hp | horsepower | 338 |
| hr | hour | 339 |
| in. | inches | 340 |
| kg | kilograms | 341 |
| kg-cal | kilogram-calories | 342 |
| l | liter | 343 |
| lb | pound | 344 |
| lpm | liters per minute | 345 |
| u | microns | 346 |
| ug | micrograms | 347 |

# DRAFT

| | | |
|---|---|---|
| umohs | micro-mohs | 348 |
| mg | milligram | 349 |
| min | minute | 350 |
| mm | millimeter | 351 |
| mpm | meters per minute | 352 |
| psi | pounds per square inch | 353 |
| sq cm | square centimeter | 354 |
| sq ft | square feet | 355 |
| sq m | square meters | 356 |
| TOC | total organic carbon | 357 |

# DRAFT

## CONVERSION TABLE
## ENGLISH TO METRIC UNITS

| Multiply (English Units) | | by | | to Obtain (metric Units) |
|---|---|---|---|---|
| English Unit | Abbreviation | Conversion | Abbreviation | Metric Unit |
| acre | ac | 0.405 | ha | hectares |
| acre - feet | ac ft | 1,233.5 | cu m | cubic meters |
| British Thermal Unit | BTU | 0.252 | kg cal | kilogram-calories |
| British Thermal Unit/pound | BTU/lb | 0.555 | kg cal/kg | kilogram calories/ kilogram |
| cubic feet/minute | cfm | 0.028 | cu m/min | cubic meters/minute |
| cubic feet/second | cfs | 1.7 | cu m/min | cubic meters/minute |
| cubic feet | cu ft | 0.028 | cu m | cubic meters |
| cubic feet | cu ft | 28.32 | l | liters |
| cubic inches | cu in | 16.39 | cu cm | cubic centimeters |
| degree Fahrenheit | F° | 0.555(°F-32)1 | °C | degree Centigrade |
| feet | ft | 0.3048 | m | meters |
| gallon | gal | 3.785 | l | liters |
| gallon/minute | gpm | 0.0631 | l/sec | liters/second |
| horsepower | hp | 0.7457 | kw | killowatts |
| inches | in | 2.54 | cm | centimeters |
| inches of mercury | in Hg | 0.03342 | atm | atmospheres |
| pounds | lb | 0.454 | kg | kilograms |
| million gallons/day | mgd | 3,785 | cu m/day | cubic meters/day |
| mile | mi | 1.609 | km | kilometer |
| pound/square inch (gauge) | psig | (0.06805 psig +1)1 | atm | atmospheres(absolute) |
| square feet | sq ft | 0.0929 | sq m | square meters |
| square inches | sq in | 6.452 | sq cm | square centimeters |
| tons (short) | ton | 0.907 | kkg | metric tons (1,000 kilograms |
| yard | yd | 0.9144 | m | meters |

1 Actual conversion, not a multiplier





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