## 2. CONCLUSIONS

- Steel and polyethylene drums are reconditioned for reuse at 450 facilities located throughout the Nation. The U.S. EPA Region with the largest number of reconditioners is Region 4, with 24 percent of Nation's facilities. New Jersey, California and Illinois are the states with the largest numbers of reconditioners.

- The status of the industry's wastewater discharges is as follows:

| Discharge Status | Number of Facilities |
|---|---|
| Direct Discharge | 50 |
| Indirect Discharge | 200 |
| Zero Discharge | 200 |
| Total | 450 |

- Drum reconditioning facilities are registered under 28 different SIC Codes. Two-thirds of the 40 million drums reconditioned, annually, are tight-head drums that are washed with caustic solution to remove residues. The remaining are open head drums that are burned in furnaces to remove viscous residues. The following list summarizes the major drum types received by reconditioners:

| Drum Type | Percent |
|---|---|
| Petroleum | 36 |
| Chemicals | 25 |
| Resins and Adhesives | 16 |
| Paint and Ink | 15 |
| Other | 8 |
| Total | 100 |

- Drum reconditioning facilities may be subcategorized by drum type: either open head or closed head.

- The average drum reconditioner handles 427 drums daily and discharges 6.9 gallons of wastewater per reconditioned drum, or 2,950 gallons per day. Raw wastewater results from the washing and rinsing of tight head drums or the quenching of burning residue on open head drum surfaces.

- Industry raw wastewater is characterized by very high concentrations of conventional, nonconventional, metal, and organic pollutants. The data shown below for selected parameters is representative of a typical raw wastewater:

| Parameter | Concentration (mg/l) |
|---|---|
| $BOD^5$ | 3,714 |
| TSS | 4,709 |
| COD | 17,423 |
| Oil and Grease | 13,228 |
| TOC | 2,991 |
| Iron | 106 |
| Lead | 14 |
| Zinc | 25 |
| 2-Butanone | 288 |
| Acetone | 172 |
| Toluene | 18 |
| Ethylbenzene | 17 |

- Forty extractable and volatile organics are detected in industry raw wastewaters and one-third have concentrations greater than 10 mg/l.

- The following pesticide/herbicide compounds are found in industry raw wastewater at levels greater than 1 mg/l: azinphos ethyl, azinphos methyl, fensolfothion, diazinon, dimethoate, leptophos, nemacur, parathion and TEPP.

- Zero discharge is demonstrated to be a practical control technology for open head facilities. Furnace quench water is typically reused after simple sedimentation.

- Tight head facilities generally discharge wastewater and nearly half of the dischargers do not treat wastewater.

- Wastewater treatment pollutant removal efficiencies were poor at the 4 plants sampled by the Agency.

- Sedimentation, oil/water separation and air flotation are the dominant treatment technologies at tight head plants. Reuse of treated effluent is possible, however, zero discharge is only attainable if wastestreams are segregated and water conservation measures are implemented.

- A model wastewater treatment system would include emulsion breaking technology and treated wastewater reuse. A typical facility would incur a capital cost of $110,000 and an annual operating cost of $35,000 to install and operate such a system.

- Approximately 124 million pounds of residue are contained in drums received by reconditioners, annually.

- Drum reconditioning industry raw wastewater loads are significant when compared to loads for the metal finishing industry. These loads are compared below for selected parameters.

| Parameter | Loading (pounds/day) | |
|---|---|---|
| | Drum Reconditioning | Metal Finishing |
| Lead | 173 | 3,221 |
| Total Organics | 3,961 | 45,216 |

- Wastewater treatment sludges generated by the industry are composed mainly of oil and grease (15 percent) and suspended solids (7 percent). High concentrations of twenty-three organics are observed.
- Twelve dioxin/furan, compounds are found in industry sludges, however, these compounds are not prevalent in raw wastewaters.
- The industry is not expected to grow or decline significantly, hence, the waste quantities estimated here are reasonable projections of future waste quantities.

# 3. INTRODUCTION

This section discusses regulatory authority and pertinent regulations, and provides an overview of the industry. Sources of data and information used to support conclusions also are discussed.

## 3.1 PURPOSE AND AUTHORITY

### 3.1.1 Clean Water Act

The Federal Water Pollution Control Act Amendments of 1972 established a comprehensive program to "restore and maintain the chemical, physical, and biological integrity of the Nations waters," Section 101 (a). Under this statue, existing industrial dischargers were required to achieve compliance with "effluent limitations requiring the application of the best practicable control technology currently available" (BPT), Section 301(b)(1)(A); these dischargers were required to achieve "effluent limitations requiring 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 (BAT), Section 301(b)(2)(A). New industrial direct performance standards (NSPS), are based on best available demonstrated technology; and existing and new dischargers to publicly owned treatment works (POTWs) were subject to pretreatment standards under Sections 307(b) and (c) of the Act. While the requirements for direct dischargers were to be incorporated into National Pollutant Discharge Elimination System (NPDES) permits issued under Section 402 of the Act, pretreatment standards were made enforceable directly against dischargers to POTWs (indirect dischargers).

Although Section 402(a)(1) of the 1972 Act authorized the setting of requirements for direct dischargers on a case-by-case basis, Congress intended that control requirements be based on regulations promulgated by the Administrator providing guidelines which consider the degree of effluent reduction attainable through the application of BPT and BAT. Sections 304(c) and 306 of the Act required promulgation of regulations for NSPS, and Sections 304(f), 307(b), and 307(c) required promulgation of regulations for pretreatment standards. In addition to the regulations for designated industry categories,

Section 307(a) of the Act required the Administrator to develop a list of toxic pollutants and promulgate effluent standards applicable to all dischargers of toxic pollutants. Categorical pretreatment standards originally were to be used for 34 specific industrial categories and 129 pollutants. EPA subsequently exempted several industries and pollutants from regulation. Currently, categorical standards apply to 22 specific industrial categories and over 126 priority pollutants. Finally, Section 501(a) of the Act authorized the Administrator to prescribe any additional regulations "necessary to carry out his functions" under the Act.

The principal mechanism for reducing the discharge of pollutants to the Nation's waters is the National Pollutant Discharge Elimination system (NPDES), which was established by Section 402 of the Act. NPDES permits have been issued to approximately 55,000 municipal and industrial point sources. Permits generally contain four elements: (1) final effluent limitations reflecting statutorily required treatment levels, (2) interim effluent limitations applying until attainment of final effluent limitations, (3) construction schedules for the achievement of final effluent limitations, and (4) reporting requirements relating to compliance with effluent limitations and construction schedules.

The General Pretreatment Regulations (40 CFR 403) establish two types of Federal standards to control toxic wastewater discharges from industrial users into POTWs: (1) prohibited discharge standards, and (2) categorical pretreatment standards. Prohibited discharge standards apply nationally to all industrial and commercial establishments connected to POTWs. These standards prohibit discharges that are flammable, explosive, or corrosive; obstruct flow; upset treatment processes; or increase temperature. These standards are particularly relevant to control the discharge of domestic sewage exclusion wastes.

## 3.2 REGULATORY OVERVIEW

### 3.2.1 Resource Conservation and Recovery Act

Congress enacted the Resource Conservation and Recovery Act (RCRA) in 1976 to define a Federal role in solid waste and resource management and

recovery. The primary goals of RCRA are to: (1) protect human health and the environment from hazardous and other solid wastes; and (2) protect and preserve natural resources through the implementation of programs emphasizing resource conservation and recovery. The principal regulatory focus of RCRA is to control hazardous waste. To this end, RCRA mandates a comprehensive system to identify hazardous wastes and to track and control their movement from generation through transport, treatment, storage, and ultimate disposal. RCRA subsequently was amended in 1978, 1980, and 1984.

Hazardous waste management under RCRA has often been characterized as "cradle to grave" management. A firm generating solid wastes is required to determine if such waste is hazardous. Any generator of a hazardous waste must notify the U.S. Environmental Protection Agency (EPA). If the generator chooses to move the waste offsite for treatment or disposal, a manifest must be maintained by the generator, transporter, and the receiving treatment, storage, or disposal facility. Any wastes shipped offsite to be treated, stored, or disposed must be sent to an authorized hazardous waste disposal facility. Wastes managed onsite, like those shipped offsite, must be handled according to specific management and technical requirements in RCRA.

### 3.2.2 Domestic Sewage Exclusion

EPA conducted a study in response to Section 3018(a) of RCRA. This provision required that EPA prepare:

> "...a report to the Congress concerning those substances identified or listed under section 3001 which are not regulated under this subtitle by reason of the exclusion for mixtures of domestic sewage and other wastes that pass through a sewer system to a publicly owned treatment works. Such report shall include the types, size and number of generators which dispose of such substances in this manner, and the identification of significant generators, wastes, and waste constituents not regulated in a manner sufficient to protect human health and the environment."

The report is known as the Domestic Sewage Study (USEPA 1986a) is an evaluation of the impacts of wastes discharged to local waste water treatment

plants as a result of the Domestic Sewage Exclusion (DSE) [specified in Section 1004 [27] of RCRA and codified in 40 CFR 261.4 (a)(1)]. Under Section 1004(27) of RCRA, solid or dissolved material in domestic sewage is not, by definition, a "solid waste" and, as a corollary, cannot be considered a "hazardous waste." Thus, the DSE covers:

- "Untreated sanitary wastes that pass through a sewer system"
- "Any mixture of domestic sewage and other wastes that passes through a sewer system to a POTW for treatment."

The premise behind the exclusion is that it is unnecessary to subject hazardous wastes mixed with domestic sewage to RCRA management requirements, since these DSE wastes would receive the benefits of treatment offered by POTWs are and already regulated under Clean Water Act programs, such as the National Pretreatment Program.

The exclusion allows industries to be connected to domestic sewers without having to comply with certain RCRA generator requirements, such as manifesting and reporting requirements. Moreover, POTWs receiving excluded wastes are not subject to RCRA treatment, storage, and disposal facility requirements. Congress specially requested a report containing information on: (1) types, size, and number of generators using the DSE; (2) types and quantities of wastes disposed under the DSE; and (3) significant generators, wastes, and constituents not sufficiently regulated to protect human health and the environment.

In performing its source evaluation, EPA collected information on waste discharges from 47 industrial categories and the residential sector. The evaluation concluded that the quantities of hazardous wastes generated and discharged to POTWs by the Drum Reconditioning Industry are unknown. EPA's regulatory efforts, in the past, have focused on larger, industrial categories. The drum reconditioning industry traditionally has been considered a less significant waste source due to its small size and service-related orientation. Therefore, this industry never has been extensively reviewed, for regulatory purposes, at the national level.

### 3.2.3 Residues of Hazardous Waste in Empty Containers

Any hazardous waste remaining in either an empty container or an inner liner removed from an empty container is not subject to regulation under RCRA. Empty is defined in 40CFR261.7 paragraph (b) as follows:

"(i) all wastes have been removed that can be removed using the practices commonly employed to remove materials from that type of container, e.g., pouring, pumping, aspirating and;

(ii) no more than 2.5 centimeters (one inch) of residue remain on the bottom of the container of inner liner, or

(iii) (A) no more than 3 percent by weight of the total capacity of the container remains in the container or inner liner if the container is less than or equal to 100 gallons in size, or; (B) no more than 0.3 percent by weight of the total capacity of the container remains in the container or inner liner if the container is greater than 100 gallons in size."

This definition does not apply to containers that have held a hazardous waste that is a compressed gas when the pressure of the container approaches atmospheric. Nor does the definition apply to a container or inner liner that has held an acute hazardous waste listed in 261.31, 261.32, or 261.33(e) unless,

"(i) the container or inner liner has been triple rinsed using a solvent capable of removing the commercial chemical product or manufacturing intermediate;

(ii) the container or inner liner has been cleaned by another method that has been shown in scientific literature, or by tests conducted by the generator, to achieve equivalent removal; or

(iii) in the use of a container, the inner liner that prevented contact of the commercial chemical product or manufacturing chemical intermediate with the container has been removed."

Table 3-1 presents the acute hazardous wastes addressed listed under 261.31, 261.32, and 261.33(e).

Table 3-1 goes here

### 3.2.4 Hazardous Materials Transportation Act

The Hazardous Materials Transportation Act of 1975 and its amendments established a program to protect the Nation adequately against the risks to life and property that are inherent in the transportation of hazardous materials in commerce. The key provisions of the Act address the definition of designated hazardous materials handling and the registration of transporters.

Through authority granted by the Act, the Department of Transportation (DOT) requires reconditioners of drums to comply with 49 CFR 173.28. Containers used more than once (refilled and reshipped after having been previously emptied) must be in such condition, including closure devices and cushioning meterials, that they comply in all respects with the prescribed requirements for those containers. Specifications 17C, 17E, and 17H for steel drums from which contents have been removed, may be reused as prescribed in this part as packaging for shipment of flammable liquids, flammable solids, oxidizing materials, radioactive materials, and corrosive liquids covered by Sections 173.249 and 173.249(a), only if the following requirements, in addition to the other requirements of this section, are complied with prior to each reuse:

- Visual inspection - Drums must be thoroughly cleaned to remove all residue and foreign matter. Deterioration or defects, and parts that are weak, broken, or otherwise deteriorated, must be replaced.
- Air pressure test for leakage - The entire surface of each closed-head drum and each open-head drum, except for its removable head and adjacent chime area, must be tested for leakage by constant internal air pressure.
- Markings - All previous markings, commodity identification markings, and labels must be removed. All drums that qualify for reuse must be marked on the body within 10 inches of the top of the work, "Tested," the month and year it was tested, and the DOT registration number of the reconditioner.

Retest of polyethylene carboy packages must have been made by or for shippers, or their authorized agents, as required by applicable provisions of the specifications of 49 CFR 178.19 before carboys that are to be offered for transportation are filled. Requirements for reconditioners of carboys are

similar to those for steel drum reconditioners. However, registration with DOT is not required for carboy reconditioners.

## 3.3 OVERVIEW OF THE INDUSTRY

The drum reconditioning industry is not included in a specific U.S. Department of Commerce, Bureau of Census Standard Industrial Classification (SIC). DOT regulates facilities that clean or recondition steel or polyethylene drums, after having been previously emptied, for the purpose of resale or reuse. As of May 1986, 770 facilities were registered with DOT and EPA identified 337 additional facilities that were not registered with DOT. From a combined list of 1,107 facilities EPA estimates that only 450 are actively engaged in drum reconditioning. Thirty-five DOT registrants are listed in the EPA Industrial Facilities Database (IFD) as NPDES permit holders. Two of these registrants identify their business as SIC No. 3412 - Metal Shipping Barrels, Drums, Kegs and Pails. The remaining registrants that are listed in IFD files under the numerous SIC numbers are shown in Table 3-2. Little information is available on the age of drum reconditioning facilities or on the number of employees per facility.

Data on effluent discharges from the 450 active drum reconditioners are limited, since most of the reconditioners are regulated by local pretreatment authorities that do not require extensive monitoring. EPA estimates that wastewater is directly discharged from approximately 50 facilities. POTWs receive indirect discharges from an estimated 200 facilities. The remaining 200 active facilities are believed not to discharge process wastewater (SAIC 1987a).

## 3.4 DATA AND INFORMATION GATHERING

EPA sought to obtain a broad and accurate understanding of the drum reconditioning industry and to evaluate wastewater characteristics and treatment practices. This involved a review of the literature; meetings with trade associations, and Federal and local agencies; site visits; and information

TABLE 3-2. SIC INDUSTRY CODES FOR DOT REGISTRANTS THAT ARE LISTED IN IFD FILES

| Industry Number | Description |
|---|---|
| 1044 | Uranium - Radium - Vanadium Ores |
| 2041 | Flour and Other Grain Mill Products |
| 2711 | Newspapers |
| 2812 | Alkalies and Chlorine |
| 2813 | Industrial Gases |
| 2822 | Synthetic Rubber |
| 2823 | Cellulosic Man-Made Fibers |
| 2831 | Biological Products |
| 2834 | Pharmaceutical Preparations |
| 2851 | Paints, Varnishes, Lacquers, Enamels and Allied Products |
| 2869 | Industrial Organic Chemicals, Not Elsewhere Classified |
| 2911 | Petroleum Refining |
| 2999 | Products of Petroleum and Coal, Not Elsewhere Classified |
| 3111 | Leather Tanning and Finishing |
| 3412 | Metal Shipping Barrels, Drums, Kegs and Pails |
| 3471 | Electroplating, Plating, Polishing, Anodizing and Coloring |
| 3499 | Fabricated Metal Products, Not Elsewhere Classified |
| 3662 | Radio and Television Transmitting, Signaling and Detection Equipment |
| 3671 | Radio and Television Receiving Type Electronic Tubes |
| 3676 | Resistors, for Electronic Applications |
| 3679 | Electronic Components, Not Elsewhere Classified |
| 3731 | Ship Building and Repairing |
| 3822 | Automatic Controls for Regulating Residential and Commercial Environments and Appliances |
| 4952 | Sewerage Systems |
| 4961 | Steam Supply |
| 7041 | Organization Hotels and Lodging Houses |
| 7397 | Commercial Testing Laboratories |
| 8999 | Services, Not Elsewhere Classified |

of all facilities potentially in the drum reconditioning universe. In summary, the major sources of data and information are as follows:

- o The Touhill Report
- o State and Local Agencies
- o Department of Transporation
- o Trade Associations
- o Facility Site Visits
- o Other Sources of Information.

### 3.4.1 The Touhill Report

In 1981, the EPA Office of Research and Development (ORD) completed a program to assess barrel and drum reconditioning processes (Touhill 1981a and b). The intent of the program was to provide recommendations for upgrading and optimizing drum reconditioning processes.

An industry profile was developed, which was based on the results of a questionnaire distributed by the National Barrel and Drum Association (NABADA). The status profile was intended to be indicative of average practice without reference to any specifically identified facility. Additionally, the questionnaire dealt primarily with environmental and process considerations. Items dealing with business, personnel, and proprietary matters were avoided. NABADA received 49 responses to the 119 questionnaires that were distributed.

### 3.4.2 State and Local Agencies

EPA contacted state hazardous waste offices by telephone and mail to identify names of drum reconditioners. In some cases, no information was available since some states do not regulate drum reconditioners as hazardous waste facilities. In other cases, the state's hazardous waste facility data base does not indicate the nature of an activity of a facility.

Hazardous waste agencies, for 18 states, do not track drum reconditioners. Eighty-three facility names were collected through contacts at the remaining states. Attempts were made to contact United States territories; however, information was not readily available.

In conjunction with presampling site visits, EPA contacted and met with local regulatory agencies. Permit applications, industrial user permits, and monitoring data were obtained for drum reconditioners that indirectly discharge wastewater. The following agencies provided information:

- The Metropolitan Sanitary District of Greater Chicago
- City of Detroit Water and Sewage Department
- County Sanitation District of Los Angeles County
- City of San Antonio Department of Wastewater Management
- State of Washington, Department of Ecology.

### 3.4.3 Department of Transportation

The Research and Special Programs Administration of DOT manages the registration of drum reconditioning facilities. A single list is updated monthly and is readily available for the production of mailing labels. Only half of the 770 registrants are believed by DOT officials to be active facilities and the remainder are thought to be brokers or drum dealers. DOT also maintains lists of new steel and polyethylene drum manufacturers.

### 3.4.4 Trade Associations

Membership directories and address lists were requested, by mail, from 12 associations that are active in the waste management field. Lists were received from the following five associations:

- Association of Petroleum Re-refiners
- Chemical Waste Transportation Council
- Institute of Chemical Waste Management
- National Association of Solvent Recyclers
- Spill Control Association of America.

Five other trade associations also were contacted by telephone. Based on conversations with association directors, these five associations are not believed to be pertinent to this study.

NABADA did not submit a current membership list, but did meet with EPA. During this meeting, NABADA representatives stated that the industry profile presented by Touhill (1981) is still representative. Later, NABADA assisted the Agency in its selection of sampling candidates.

### 3.4.5 Facility Site Visits

EPA contacted numerous drum reconditioners to identify candidates for wastewater sampling. Site visits were conducted to locate sampling points in the facilities and to collect file information. Facilities that did not treat wastewater or did not have accessible sampling points were not selected for sampling. Presampling site visits were conducted at the following facilities:

- ABC Drum and Barrel Co. - Detroit, Michigan
- Acme Barrel and Drum Co. - Chicago, Illinois
- Allied - Hastings Drum Co. - Chicago, Illinois
- Columbus Steel Drum Co. - Livonia, Michigan
- Cooper Drum Co. - South Gate, California
- Dixie Drum Co. - San Antonio, Texas
- Duke Refining Corp. - High Point, North Carolina
- Hansen-Sterling Drum Co. - Chicago, Illinois
- Midwestern Drum Service Inc. - Venice, Illinois
- Myers Container Corp. - Emeryville, California
- Myers Container Corp. - Oakland, California
- Northwest Cooperage Co. Inc. - Seattle, Washington
- Pacific Coast Drum Co. - South El Monte, California
- United Drum/Reliance - High Point, North Carolina
- United Steel Drum Co. - East St. Louis, Illinois
- West Cooperage Co. - Detroit, Michigan.

### 3.4.6 Other Sources of Information

EPA conducted a search of commonly used data bases to locate pertinent literature on the drum reconditioning industry. Titles published before 1980 were not sought. Since the publication of the Touhill reports, in 1981, no significant publications have appeared in these data bases.

Telephone books available at the Library of Congress were inspected to compile a list of drum vendors and reconditioners. Three hundred and thirty-seven facilities were identified in telephone books from 112 metropolitan areas that were not on the DOT list.

EPA did not conduct an extensive effort to verify the discharge status of drum reconditioners, since most reconditioners are believed to be indirect dischargers. Telephone contacts were made only to identify presampling trip candidates in geographically key areas.

The Chemical Engineering Branch of EPA's Office of Toxic Substances is conducting a study of the drum reconditioning industry to assess worker exposure to new chemicals and the potential for the chemical to be released to the environment.

In summary, EPA coordinated its information-gathering efforts with DOT, five local governments, and the states. Pertinent trade associations were contacted and a meeting was held with NABADA, the primary industry representative. Site visits were made to 16 facilities and a literature search was conducted. EPA believes that the conclusions presented in this report reflect the best information available.

# 4. DESCRIPTION OF THE INDUSTRY

This section discusses industry products and processes, as well as facility characteristics. This information is necessary to establish groupings within the industry. These groupings should reflect differences in wastewater generation, control, treatment, and discharge.

## 4.1 INDUSTRY PROFILE

Drum reconditioning is a general term for the cleaning or reconditioning of steel or polyethylene drums for resale or reuse. In 1985, approximately 50 million drums were reconditioned (Rich 1986). Table 4-1 presents a distribution of the types of products used in drums received by reconditioners (Touhill 1981a). Drums formerly containing oil and petroleum are the most prevalent type reconditioned. Drums that previously contained paint, ink, and industrial chemicals are also significant. About 95 percent of the drums reconditioned are 55-gallon steel drums, while the remaining 5 percent are 30-gallon steel drums (Touhill 1981a). Despite increased use of plastic (polyethylene) containers, reconditioners have concluded that these containers present no serious competitive threat to the use of steel drums due to the difficulty of reconditioning and problems with disposing spent plastic containers (Touhill 1981a). Drums are reconditioned either as a service or for resale. In 1979, about 45 percent of washed drums were offered for resale, 52 percent were laundered, and 3 percent were discarded. About 62 percent of burned drums were resold, 33 percent were laundered, and 5 percent were discarded (Touhill 1981a).

Approximately 450 drum reconditioners are active in the United States. This number is based on a revision to the number of active facilities estimated by the U.S. Environmental Protection Agency (EPA) in 1979, 250 drum reconditioners (Touhill 1981a). At that time, 429 active and inactive facilities were registered by the Department of Transportation (DOT); however in May 1986, 770 facilities were registered. Therefore, 250 was multiplied by a ratio, 770:429, to derive approximately 450 active facilities. EPA identified 337 facilities that are not included in the May 1986 DOT registration list. Therefore, the estimate of 450 active facilities is

TABLE 4-1. TYPES OF PRODUCTS USED IN DRUMS RECEIVED BY RECONDITIONERS

| Product | Percent |
|---|---|
| Oil and Petroleum | 36.2 |
| Industrial Chemicals | 15.6 |
| Paint and Ink | 14.8 |
| Cleaning Solvents | 8.8 |
| Resins | 8.8 |
| Adhesives | 6.8 |
| Food | 6.8 |
| Other | 1.8 |
| Pesticide | 0.5 |

believed to be conservative. Table 4-2 is lists the 450 drum reconditioners by state. The three states with the largest numbers of drum reconditioners are New Jersey, California, and Illinois. Table 4-3 lists the 450 drum reconditioners by EPA Region. Of the facilities identified, about 24 percent located are in EPA Region V. The DOT list of 770 facilities is provided in Appendix A. The list of 337 additional facilities identified by the Agency is provided in Appendix B.

There are three types of drum reconditioning facilities: (1) those that wash drums only (39 percent), (2) those that burn drums only (18 percent), and (3) those that both wash and burn drums (43 percent). Of all drums reconditioned, approximately two-thirds are the tight-head, or bung-top type, which must be washed. The remainder are open-head drums that are burned. The average commercial tight-head plant reconditioned 700 drums in 1979, while the average commercial open head plant reconditioned 550 drums. Combined plants washed and burned a daily total of 1,400 drums. Facilities that recondition their own drums for in-house use wash about 50 drums daily and burn very few (Touhill 1981a).

Wastewater treatment and control practices employed by drum reconditioners depend on their mode of processing. Most washing facilities reuse caustic wash solutions and discharges to publicly owned treatment works (POTW)s usually consist of rinse waters (Touhill 1981a). Many washing plants have moved to complete recycle systems. Some burning facilities discharge quench water from post-furnace drum cooling. However, the majority of burning plants are believed to recycle this cooling stream after solids are settled. There is wide variability in wastewaters, depending on the types of drums processed. The most commonly used water pollution control equipment includes screens, oil/water separators, flocculation and sedimentation tanks, filters, and dissolved air flotation units. Operating procedures such as preflushing, stream segregation, and cascading water use are important adjuncts to pollution control equipment.

TABLE 4-2. POTENTIAL DRUM RECONDITIONERS BY STATE

| State | Number of Plants |
|---|---|
| Alabama | 9 |
| Alaska | 12 |
| Arkansas | 2 |
| Arizona | 8 |
| California | 33 |
| Colorado | 5 |
| Connecticut | 6 |
| Florida | 11 |
| Georgia | 13 |
| Hawaii | 2 |
| Illinois | 30 |
| Indiana | 11 |
| Iowa | 4 |
| Kansas | 7 |
| Kentucky | 10 |
| Lousiana | 9 |
| Maine | 1 |
| Maryland | 5 |
| Massachusetts | 13 |
| Michigan | 20 |
| Minnesota | 12 |
| Mississippi | 1 |
| Missouri | 19 |
| Nebraska | 2 |
| New Hampshire | 2 |
| New Jersey | 35 |
| New Mexico | 2 |
| New York | 24 |
| Nevada | 1 |
| North Carolina | 14 |
| Ohio | 24 |
| Oklahoma | 9 |
| Oregon | 5 |
| Pennsylvania | 17 |
| Rhode Island | 2 |
| South Carolina | 3 |
| South Dakota | 1 |
| Tennessee | 15 |
| Texas | 22 |
| Utah | 4 |
| Virginia | 4 |
| Washington | 7 |
| West Virginia | 2 |
| Wisconsin | 9 |
| Wyoming | 1 |
| (District of Columbia) | 1 |
| (Puerto Rico) | 1 |
| Total | 450 |

TABLE 4-3. POTENTIAL DRUM RECONDITIONERS BY EPA REGION

| EPA Region | Number of Plants |
|---|---|
| I | 24 |
| II | 60 |
| III | 29 |
| IV | 76 |
| V | 106 |
| VI | 44 |
| VII | 32 |
| VIII | 11 |
| IX | 44 |
| X | 24 |
| Total | 450 |

## 4.2 RECONDITIONING PROCESSES

The reconditioning process type is strictly a function of the previous usage of a given drum. Open-head drums are used primarily for viscous materials that do not readily pour through a tight-head bung. Tight-head drums are used for liquids that flow freely, although some tight head drums are cut into open heads if drum residue is difficult to remove during reconditioning. For example, solvents and some petroleum products are less viscous liquids; therefore, they are stored in tight-head drums that eventually are reconditioned by washing. Open-head drums are used for high-viscosity liquids, such as paints and adhesives, and these are reconditioned by burning. Food products often are stored in lined, open-head drums. Liners are discarded before drums are burned.

Steel drums are processed by either washing or burning. Each method has several variations. Because tight-head drums almost always are washed, reconditioners frequently refer to washing facilities as "tight-head plants." Conversely, open-head drums are processed almost exclusively by burning; hence, burning operations often are referred to as "open-head plants." Figure 4-1 shows a typical tight-head drum. An open-head drum looks almost the same, except the top is replaced by a lid. The flanged lid and top chime are joined by a compression-type steel ring fitting. Neoprene or similar material gaskets are used to create a good seal. The open-head drum lid sometimes does not have bung holes. Appendix C is a copy of a DOT Information Bulletin on specifications for reconditioned steel drums.

Touhill (1981a, 1981b) covers, in detail, the large majority of drum reconditioning processes. Through visits to 16 drum reconditioners, EPA has uncovered only one operation not addressed by Touhill. This includes preflushing with steam or solvents instead of caustic solutions.

### 4.2.1 Tight-Head Drums

Despite common usage of caustic washing, no tight-head reconditioning plants are identical (Touhill 1981a). There are many similarities, but for maintenance or enhancement of environmental quality standards, each plant must be evaluated separately. Nevertheless, a process diagram, which represents

Figure 4-1 goes here

the general caustic washing process and its many variations, is shown in Figure 4-2.

Almost all reconditioners at washing plants perform some kind of screening upon drum pickup or delivery at the reconditioning facility. Most (more than 90 percent) will return to the shipper damaged drums, those not empty, or those containing unacceptable materials. Many reconditioners have lists of types of drums that they will not accept for processing. Moreover, The National Barrel and Drum Association (NABADA) and EPA have issued guidelines defining drum "emptiness." Both topics will be discussed as part of operating criteria and processing procedures later in this section.

Drums often are drained and preflushed before entering the process lines, especially oil drums. Some plants have oil siphons especially for oil recovery. After draining, drums receive a caustic preflush to remove the bulk of readily loosened material. Sometimes steam or, rarely, a solvent is used as a preflush agent. Prior to caustic preflushing, plant employees judge whether drums should proceed directly to a submerged caustic washer, should be chained to remove difficult adhering material, or should be converted by deheading to open-head drums, which in turn subsequently are burned. In some cases, trained employees can spot drums requiring conversion to open-head before the preflushing step. In some smaller plants, drums are transferred directly from trucks to a submerged caustic washer without draining, preflushing, and sometimes chaining steps. This adds a significant solids burden to the caustic solution and requires more frequent caustic makeup.

Most washing plants dedent drums after all caustic washes and rinsing, usually just before chime sealing and leak testing. However, some plants prefer to dedent immediately after draining or caustic preflushing. Presumably, dedenting is conducted at this stage so that drums can be classified earlier. Also, some reconditioners state that it is easier to find dents as drums are rolled off of the trucks.

When the contents of a drum are difficult to remove using caustic alone, chains are inserted into the drum, along with caustic and the drum is tumbled to dislodge adhering materials. Chaining typically occurs as a separate step

Figure 4-2 goes here

before the submerged stripping caustic wash, or in conjunction with the submerged wash. Most often, drums that fail to be cleaned during chaining are sent for conversion to open-heads, but some washers will try a second chaining cycle. A few reconditioners will send chained drums to a subsequent caustic flush. Chains are about 0.76 meters (30 inches) long, and typically 6 to 20 pieces are used. Two kinds of chaining machines are employed. One of the more effective is one which rotates the drum around its vertical axis when laid on its side, and also causes some horizontal rotation that permits the chain to contact both top and bottom heads as the machine moves from side to side. A second type of machine does the same thing, but does not move from side to side; therefore, the drums must be moved to another machine, which stands the drum upright and again rotates about the vertical axis. In order to clean the other head, the drum would have to be turned over. In some cases, the heads are not chained. Upon completion, the chains are removed from the drums using wire hooks. Paint drums constitute the largest volume of drums chained. Drums containing automobile sealing compounds are thought to be among the most difficult to wash, so chaining always is used with these drums.

In most washing plants, drums are treated inside and out by submerging in a hot caustic bath. Drums are set on their sides with bungs removed and are rotated as they proceed through the caustic bath. The caustic strength usually ranges from 10 to 15 percent and is heated to between 82°C (180°F) and 93°C (200°F). In larger plants, drums proceed in assembly-plant style. Typically, two receiving arms automatically lower the drums into the submerger. The drums are held in place by wheels that permit flow of the solution into the drum. One plant pumps solution over the top of the drum as it rotates to achieve better stripping. In this same plant, both preflush and submerger caustic tanks are insulated in order to conserve heat. In smaller plants, drums are handled batchwise, but the cleaning principle remains the same. Some plants only use hot caustic to wash the inside of the drum. Rotating steel brushes remove paint from the outside of the drum. This procedure is not common. After caustic washing, regardless of the manner in which it was conducted, drums are rinsed. Finished drum quality improves with better rinsing; therefore, a concerted effort is made to keep rinsewater clean.

About 40 percent of washers follow the caustic rinse step with an acid wash. The primary reason for an acid wash is to remove rust spots. Re-rinsing follows the acid wash. A corrosion inhibition step is used by some washing plants. Its location in the flow train varies. Some washers prefer to siphon dry after rinsing, then dedent, chime seal, and leak test before shot blasting. Other washers chime seal and leak test after shot blasting. After the caustic and acid rinses, drums are dried using vacuum siphons.

Dedenting with tight-head drums is conducted using compressed air: 560 kPa (80 psi) pressure is used for 18 gauge drums, and 280 kPa (40 psi) for 20 gauge drums. Worker safety necessitates that the drum be shielded during dedenting. Weak drums occasionally rupture explosively upon application of compressed air.

Because the most frequent kinds of leaks are those around the bottom chime, and because handling and shipping often cause the drums to become out-of-round, the bottom chime is sealed on all reconditioned drums.

Leak testing is an operation critical to maintaining product quality control. Several methods are used, as follows:

- Leak testing is conducted by inserting an expandable plug connected to a compressed air line into the 5-cm (2-inch) bung hole. The 2-cm (3/4-inch) bung hole already has a fitting in place. After the plug is inserted, a star wheel rotates to hold the drum completely submerged for about 5 seconds while about 7 pounds of internal pressure are maintained within the drum.
- The drum is pressurized with an air hose in the 2-cm (3/4-inch) bung hole with the 5-cm (2-inch) bung in place. The drum then rotates under a soap spray.
- The drum is pressurized to 49 to 56 kPa (7 to 8 psi), and an air valve is closed behind an air gauge. The operator checks the gauge for a pressure drop.
- In some cases, carbon monoxide is used to pressurize the drum. If leaks are found, it is repaired or discarded.

During shot blasting, a small steel shot is used to abrade the drum exterior. Shot blasting serves two purposes: (1) it cleans the outside of

the drum, removing residual paint, labels, or caustic; and (2) it prepares the surface for painting. Paint adheres better to rough drum surfaces. Some reconditioners use steel buffing to prepare surfaces for painting.

Some reconditioners preheat drums before painting in order to improve finish quality, and some facilities bake the paint. Upon inspection and placement of final fittings, the drums are ready to be shipped.

### 4.2.2 Open-Head Drums

The burning process for open-head drums differs significantly from the washing process, since relatively little water is used. The description for burning pertains to a continuous tunnel furnace operation, although close similarities exist between the process train at batch and continuous furnace plants (Touhill 1981a). Figure 4-3 shows a process diagram for a burning facility. Such plants have fewer unit operations than washing plants. Less variation tends to exist among burning plants than among washing facilities.

At most plants, drums are inspected upon receipt, and those containing residues beyond plant criterion for emptiness, and those containing unacceptable materials, are returned to the shipper along with damaged drums. Some reconditioners drain the drums before burning in order to reduce temperature excursions due to materials within the drum. Others reconditioners believe that the best method of getting rid of the residuals in the drum is to burn them directly; thus, draining before burning is avoided. Except for a few small batch incinerators, most open-head drums are burned in tunnel-type continuous furnaces. Conveyor belts move the drums through a furnace at an average rate of 6 to 8 drums per minute. During a 4-minute residence time, drum residual contents, linings, and outside paint are burned.

Some furnaces have water sprays or steam injection at the inlet opening to prevent flashbacks, and hence possible operator injury. Other furnaces contain built-in distance barriers to reduce operator exposure to flashbacks. Most burning plants have afterburners. Some burning plants are continuously in operation, but most are designed to operate only when an opacity detector signals that particulates are in the furnace emission. When drums exit the

Figure 4-3 goes here