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Project Summary

Barrel and Drum Reconditioning Industry Assessment

C. J. Touhill and Stephen C. James

An industry assessment was made of drum reconditioning process characteristics and the current status of pollutant generation and disposal. Typical industry practice for washing and burning processes for reconditioning are described along with operating and design criteria for individual unit operations. Processing procedures that influence product quality and environmental pollutant generation are discussed. Pollutant loadings are defined in terms of sources and pathways, major pollutant parameters, and generation and disposition modes. Current status of pollution control practice is defined in terms of processes and equipment, operating procedures, disposal practices, removal efficiencies, and costs.

This Project Summary was developed by EPA's Municipal Environmental Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

For many people, the spent 208-L (55-gal) steel drum has become the symbol of toxic and hazardous wastes. Even though drum reconditioning is intended to support environmentally desirable goals of recycle, reuse, and safe disposal of used drums, popular equating of drums and hazards focuses adverse attention upon the industry. The U.S. Environmental Protection Agency (EPA) recognizes the useful service performed by reconditioners, but also is alert to potential problems the industry may encounter in meeting high standards of environmental quality. Because of this awareness, EPA contracted for the following information:

- to define representative practice for barrel and drum reconditioning by washing and burning.
- to determine the environmental impact of reconditioning processes.
- to recommend procedures for designing, optimizing, and retrofitting reconditioning facilities to meet rigorous environmental standards.
- to determine the capabilities of the reconditioning industry to process pesticide and toxic chemical containers safely.

The project is being conducted in three parts. In the first, current status of the industry is evaluated in terms of state-of-the-art practices for both reconditioning and pollution control. In the second part, three reconditioning sites were selected for sampling and analysis to define more closely pollutant sources and pathways. The final phase is the development of recommendations for design modifications, process optimization, and retrofitting reconditioning processes.

Five sources of information were used to prepare the first-phase report: publicly available literature, transcripts of National Barrel and Drum Association

(NABADA) forums on reconditioning problems and techniques, proceedings of four International Conferences on Steel Drums, responses to a questionaire sent by NABADA to its membership, and visits to 11 drum reconditioning plants.

Industry Overview

During 1979, about 250 reconditioners processed more than 41 million steel drums. More than 95% were 208-L (55-gal) drums; most of the rest were 114-L (30 gal). About two-thirds of the drums are reconditioned at washing plants processing tight head drums. The remainder, open head drums, are burned in drum reclamation furnaces. Facilities that only wash drums account for 39% of reconditioning plants; 18% only burn; 43% do both.

NABADA members represent only 48% of the reconditioning plants in the country, but they process more than 90% of all washed drums and more than 97% of those burned. For non-NABADA reconditioning facilities, 70% recondition for service and resale, and 30% are users who process only their own drums. More than half (52%) of the drums washed are on a service of laundry basis; 45% are for resale. By comparison, only about one-third of the drums burned are on a service basis; 62% are resold.

For many years, the annual ratio of new drums produced to reconditioned has been nearly 1 to 1. Additionally, the ratio of new tight to open head drums (4 to 1) has not changed over the past 10 to 12 years. Trends, however, show an increase in drum thickness. For example, in 1969, 18-gage or heavier drums comprised 64.3% of those manufactured that year. In March 1980, that percentage had fallen to 41.4. This reduces the pool of potentially reconditionable drums because thinner drums are less able to withstand the rigors of transportation and reconditioning processes.

The prime users of new drums are the oil and petroleum and the industrial chemical industries. For reconditioned drums, these two industries and the paint industry are the main users. A high percentage of oil and petroleum drums are used and recycled. Because a low percentage of chemical drums are reused, it is not surprising that drums containing spent industrial chemicals or chemical residuals comprise a significant number of drums found at abandoned hazardous waste disposal sites.

Reconditioning Processes

Steel drums are processed by washing or burning. 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 called open head plants.

Washing Process

Most drum washing is done with strong hot caustic solution. Despite common use of this technique, no tight head reconditioning plants are the same. Certainly there are many similarities, but for maintenance or enhancement of environmental quality standards, each plant must be evaluated separately.

In a washing plant, the following operations generally are employed. After screening and draining upon receipt, drums are preflushed using a strong hot caustic solution. Subsequently, they proceed to a submerged caustic washing tank. When drum contents are difficult to remove using caustic alone, chains are put into the drum along with caustic, and the drum is tumbled to dislodge adhering materials. If drum contents cannot be removed by chaining or are cleaned only with great difficulty, the drum heads are cut off, thus converting them to open heads, and they are sent to a burning plant. About one-third of washing plants remove rust using hydrochloric acid washes. Tight head drums then are rinsed, dedented, shot blasted, leak tested, and painted.

Burning Process

At most burning 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 to reduce temperature excursions due to materials in the drum. Others believe that the best way to get rid of the residuals in the drum is to burn them directly.

Some furnaces have water sprays or steam injection at the inlet opening to prevent flashbacks and possible operator injury. Others have built-in distance barriers to reduce operator exposure to flashbacks.

Conveyor belts move drums through the furnace at an average rate of from 6 to 8 per minute. Average residence time is 6.6 min. Mean furnace temperature is 675°C (1250°F). All drum reclamation furnaces use afterburners to control air emissions. Afterburners are on all the time at more than 80% of burning plants. Afterburners operate 95% of the time considering an average of all plants. Average temperature and residence time for afterburners is 810°C (1490°F) and 0.5 sec. The state of California requires reconditioners who burn pesticide drums to operate afterburners at 900°C (1650°F) using a 0.5 sec. residence time.

When drums exit the furnace, they are either air-cooled or are water quenched. About 40% of burning plants have the capability to quench, but not all use it all the time. Some only operate the water quencher when smoky drums are being burned or when there is a visible emission from the drum outlet opening. After cooling, open head drums are shot blasted, dedented, leak tested, lined, and painted.

Natural gas is the preferred furnace fuel. Where it is unavailable or uneconomical, No. 2 oil is recommended.

Operating Procedures

Most reconditioners have established procedures for drum receiving and storage, and nearly two-thirds have oil recovery systems. At a typical plant, about 22,700 L (6,000 gal) of oil are recovered monthly.

About 5.4% of drums bound for reconditioning eventually are discarded. The bulk of these are sold for scrap.

Almost all reconditioners refuse to accept drums containing certain materials. Pesticides are refused by 83% of reconditioners. Other drums frequently refused are those formerly containing ink and those containing adhesives. The industry processes over 200,000 used pesticide drums per year, although there is some uncertainty in this figure. Most are burned, but a few plants do wash significant numbers of pesticide drums. Even though the industry claims that few facilities accept pesticide drums, most plants have such drums scattered within their inventories.

Plants that process pesticide drums on a regular basis use special handling and processing procedures. Reported results indicate that burning (using afterburners at 900°C or 1650°F) effectively detoxifies most pesticide drums. Additionally, in washing plants, phosphorus and nitrogen-containing pesticides lend themselves to detoxification by alkaline hydrolysis.

Pollutant Loadings

The project emphasized liquid and solid wastes in terms of pollutant sources and pathways. Previous investigations indicated that air emissions presented little problem in drum reconditioning.

Most washing facilities either recycle and reuse caustic and rinse waters or discharge effluents into public sewerage systems. Nearly 20% of washing plants claim to have completely closed cycle or "zero discharge" systems. About half of all plants (including those that burn), claim to discharge some water into public sewers. Only 10% are direct dischargers after treatment. Mean flow for a typical facility is 56,800 L/day (15,000 gal/day). Because such a high percentage of plants discharge to sewers, water quality limitations for such discharges become very important. Reconditioning wastewater is characterized by high pH, COD, BOD, and solids values. There is wide variability in wastewaters depending upon the types of drums processed. There is some evidence of hazardous organics in small concentrations in some reconditioning wastewater.

The biggest problem facing reconditioners is the need to provide safe, economical, and environmentally acceptable means for residuals management. Evolving solid and hazardous waste management regulations are expected to have major effect on the industry. Landfilling has been and continues to be the predominant method for residue disposal. Use of incineration is increasing and will continue to at an accelerated rate as the impact of RCRA regulations are felt.

On the average, drums received by reconditioners contain 2.5 L (0.65 gal) or 2.5 kg (5.4 lb) of residues. Caustic sludges have high pH, COD, BOD, and oil and grease washing solutions, but in far greater amounts.

Presently, surface runoff at reconditioning facilities is not being handled to any extent.

Pollution Control Practice and Costs

Major potential alternatives for air pollution control at drum reclamation furnaces are: (1) direct combustion in the 650°C (1200°F) to 900°C (1650°F) temperature range with an afterburner residence time of 0.3 to 0.7 sec.; (2) catalytic oxidation in the 315°C (600°F) to 510°C (950°F) range; (3) sorption using activated carbon, silica gel, or other materials; and (4) scrubber systems. Worldwide, the direct combustion and afterburner method is the one most frequently used. Other methods usually are adjuncts to this primary method.

All U.S. reconditioning drum furnaces have afterburners to consume particulates and organics not burned in the furnace main chamber. About 37% of drum burning facilities use air pollution control equipment and techniques in addition to afterburners. Typically, equipment includes scrubbers, packed towers, baghouses, and dust collectors. Some methods used to optimize existing equipment are automatic ducts to regulate air flow, and entry and exit air curtains for better and more efficient combustion.

For washing plants, about 55% have or have under construction their own wastewater treatment plants. Water pollution control equipment being used includes caustic filters, vacuum drying systems, oil/water separators, screens for gross particle removal, dissolved air flotation units, flocculation/sedimentation units, coalescing plate separators for oil removal, oil skimmers (often the endless belt or rope type), and packaged wastewater treatment systems.

Many reconditioners fabricate their own pollution control systems as opposed to using commercially available products. Operating procedures such as preflushing, stream segregation, and cascading water use are important adjuncts to pollution control equipment.

The 1980 price for reconditioned tight and open head drums is about $12.00; the cost for pollution controls associated with their cleaning is about $0.38 for washing and $0.35 for burning.

Environmental Assessment

The three facilities selected for testing were: (1) a large drum washing plant that recycles most of its caustic washing and rinsing solutions; (2) a large burning and washing plant that is representative of typical practice; and (3) a large washing plant that handles substantial volumes of pesticide containers.

Generally, results of the sampling and analysis program confirmed typical ranges of pollutants found in previous evaluations of the industry. Two exceptions were:

(1) Higher concentrations of organic compounds, particularly priority pollutants, were evident in aqueous waste streams.
(2) Lower metals concentrations, for most elements, were found in aqueous waste streams.

Based upon regulatory standards, results of the sampling and analysis test program indicated the following probable methods of pollutant control for the principal waste streams of concern:

(1) incinerator particulate emissions - operational controls
(2) incinerator organic emissions - operational controls
(3) incinerator metals emissions - operational controls and/or baghouse filters
(4) caustic washing solutions - treatment and reuse
(5) rinse water - treatment and reuse
(6) quench water - treatment and reuse or mixing with other liquid streams
(7) stormwater runoff - housekeeping, drainage control, treatment and direct discharge
(8) leak tester water - discharge to public sewers
(9) incinerator ash - landfill (conventional or secured)
(10) caustic sludge - treatment and either incineration or landfill (conventional or secured)
(11) drum drainage - treatment and either incineration or landfill (conventional or secured)

Pollution Control Needs and Optimization Methods

It was determined that implementation of regulations promulgated in conjunction with the Resource Conservation and Recovery Act (RCRA) could have a positive impact upon drum reconditioners under the following circumstances: (1) if the industry refuses to accept drums that formerly contained materials listed by name in 40 CFR 261.33 (e) that have not been triple rinsed by an appropriate solvent (2) if the industry refuses to accept drums containing residues of hazardous wastes (other than 261.33 (e) materials) in quantities greater than 1 inch; and (3) if reconditioners avoid storing accumulated sludge or containers of hazardous wastes for more than 90 days, and if this sludge or containers are not burned, buried, or treated at the reconditioning site.

The following identifies specific areas for upgrading and optimizing pollution control at drum reconditioning plants:

- Operational and management procedures
  - receiving
  - storage
  - draining
  - waste stream segregation
  - water conservation
  - housekeeping
  - waste heat utililzation
- Pesticide container processing
  - drums triple-rinsed before acceptance
  - storage in separate area
  - compliance with specified safety procedures
- Air emissions
  - operation in accordance with NABADA guidelines
  - minimum operational temperature of 1200°F
  - minimum residence time of 4 sec
  - afterburner temperature of 1400°F with 0.5 sec residence time
  - special operating conditions for pesticide drums
  - use of baghouse to control trace metal emissions
- Liquid waste streams
  - segregate all liquid waste streams
  - treated rinse water should be used to make up losses in caustic solutions
  - source of quench water should be treated rinse water
  - management of stormwater runoff
  - proper drum storage to include berms and dikes for stormwater runoff collection
  - proper sludge handling
- Solid residues
  - testing to determine if solids are hazardous
  - operation control to reduce sludge volume
  - proper sludge disposal
  - proper handling of incinerator ash
  - processing of recovered oil
  - treatment of hazardous waste drum drainage

Research and Development

Research and development needs identified as a result of this program are:

(1) Evaluate whether incinerator particulates, trace metal, and organic emissions can be controlled effectively using operational procedures, e.g., rigorous temperature control, elevated temperatures, variable conveyor speeds, drum spacing, and drum mixing.

(2) Develop better filtration systems for preparing caustic washing solutions for reuse.

(3) Determine the feasibility of ultrafiltration for use in processing rinse water for reuse.

(4) Develop a strategy for cascading water uses (from higher to lower quality needs).

(5) Evaluate the potential of good housekeeping and drum storage yard management procedures for minimizing contamination of stormwater runoff.

(6) Develop better processes for caustic and rinse water sludge dewatering.

(7) Evaluate procedures for disposing of non-hazardous sludges and residues, including oily waste recovery, and sludge burning and drying methods.

*C. J. Touhill is with Touhill, Shuckrow and Associates, Inc., Pittsburgh, PA 15237; and the EPA author **Stephen C. James** (also the EPA Project Officer, see below) is with the Municipal Environmental Research Laboratory, Cincinnati, OH 45268.*

This Project Summary covers two reports, entitled:

"Barrel and Drum Reconditioning Industry Status Profile," (Order No. PB 82-113 382; Cost: $15.00)

"Drum Reconditioning Process Optimization," (Order No. PB 82-113 374; Cost: $9.00)

The above reports are available only from: (prices subject to change)

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