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EPA ENVIRONMENTAL RESEARCH BRIEF

Waste Minimization Assessment for a Manufacturer of Water Analysis Instrumentation

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Abstract

The U.S. Environmental Protection Agency (EPA) has funded a pilot project to assist small- and medium-sized manufacturers who want to minimize their generation of hazardous waste but who lack the expertise to do so. Waste Minimization Assessment Centers (WMACS) were established at selected universities and procedures were adapted from the EPA *Waste Minimization Opportunity Assessment Manual* (EPA/625/7-88/003, July 1988). The WMAC team at Colorado State University performed an assessment at a plant manufacturing instruments for water analysis—approximately 50,000 units/yr. Primary operations include production of cabinets and assembly of instruments. Sheet metal and small metal parts are usually chemically treated for desired finishes. Cabinet fabrication involves forming sheet metal, drilling, surface preparation, and painting. Most manufacturing involves assembly, and many of the electronic and optical components are purchased from external suppliers. The team's report, detailing findings and recommendations, indicated that most waste is generated as spent reagents and rinse water from metal surface finishing, but greatest savings could be obtained by filtering and pasteurizing metal cutting fluid for recycle and separating its organic and aqueous phases when disposal becomes necessary.

This Research Brief was developed by the principal investigators and EPA's Risk Reduction Engineering Laboratory, Cincinnati, OH, to announce key findings of an ongoing research project that is fully documented in a separate report of the same title available from the authors.

Introduction

The amount of hazardous waste generated by industrial plants has become an increasingly costly problem for manufacturers and an additional stress on the environment. One solution to the problem of hazardous waste is to reduce or eliminate the waste at its source.

University City Science Center (Philadelphia, PA) has begun a pilot project to assist small- and medium-size manufacturers who want to minimize their formation of hazardous waste but who lack the in-house expertise to do so. Under agreement with EPA's Risk Reduction Engineering Laboratory, the Science Center has established three WMACs. This assessment was done by engineering faculty and students at Colorado State University's (Fort Collins) WMAC.

The waste minimization assessments are done for small- and medium-size manufacturers at no out-of-pocket cost to the client. To qualify for the assessment, each client must fall within Standard Industrial Classification Code 20-39, have gross annual sales not exceeding $50 million, employ no more than 500 persons, and lack in-house expertise in waste minimization. The potential benefits of the pilot project include minimization of the amount of waste generated by manufacturers, reduced waste treatment and disposal costs for participating plants, valuable experience for graduate and undergraduate students who participate in the program, and a cleaner environment without more regulations and higher costs for manufacturers.

Methodology of Assessments

The waste minimization assessments require several site visits to each client served. In general, the WMACs follow the procedures outlined in the EPA *Waste Minimization Opportunity Assessment Manual* (EPA/625/7-88/003, July 1988). The WMAC staff locate the sources of hazardous waste in each plant and identify the current disposal or treatment methods and their

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associated costs. They then identify and analyze a variety of ways to reduce or eliminate the waste. Specific measures to achieve that goal are recommended, and the essential supporting technological and economic information is developed. Finally, a confidential report which details the WMAC's findings and recommendations including cost savings, implementation costs, and payback times is prepared for each client.

Plant Background

The plant produces instruments used for water analysis. The plant operates 4,394 hr/yr to produce approximately 50,000 units.

Manufacturing Process

The plant produces colorimeters, spectrophotometers, pH meters, ion-selective electrodes, titrators, BOD and COD instruments and reagents, turbidimeters, controllers and test kits. Most manufacturing involves assembly with many components purchased from external suppliers. Other manufacturing operations are sheet-metal forming, machining, metal surface preparation, soldering, and painting. Electronic components are wave-soldered onto prefabricated circuit boards. (Circuit boards are obtained from outside suppliers).

Metal forming and machining operations result in spent hydraulic oil and spent cutting fluid, both shipped for disposal by incineration. Spent reagents from steel surface preparation (alkaline detergent, phosphoric acid descaler, and iron phosphate conversion coatings) and aluminum surface preparation (caustic, sulfuric acid, and ferric sulfate) are combined with rinse water, treated for Ph adjustment by caustic addition, and sewered as industrial wastewater.

Spent solvent from degreasing operations is sent to a recycler, and recovered solvent is purchased for use in the plant. Waste solvents from a chemical laboratory and waste solvent-based paints and thinners are disposed of as hazardous waste.

Existing Waste Management Practices

- The plant returns waste solder to the supplier and sells metal chips and cuttings as scrap.
- A dry booth is used for painting to avoid generation of contaminated rinse water and reduce generation of spent solvents.
- An internal drainage system eliminates miscellaneous discharges to the sewer, and screens placed over internal drains prevent entry of melted chips and turnings.
- In the anodizing line, parts are rinsed over a black dye tank to reduce drag-out to the rinse tank, extending the life of the rinse water.

Waste Minimization Opportunities

The type of waste currently generated by the plant, the source of the waste, the quantity of the waste, and the annual management costs are given in Table 1.

Table 2 shows the opportunities for waste minimization that the WMAC team recommended for the plant. The type of waste, the minimization opportunity, the possible waste reduction and associated savings, and the implementation cost along with the payback time are given in the table. The quantities of hazardous waste currently generated by the plant and possible waste reduction depend on the production level of the plant. All values should be considered in that context.

It should be noted that, in most cases, the economic savings of the minimization opportunities result from the need for less raw material and from reduced present and future costs associated with hazardous waste treatment and disposal. Other savings not quantifiable by this study include a wide variety of possible future costs related to changing emissions standards, liability, and employee health. It should also be noted that the savings given for each opportunity reflect the savings achievable when implementing each waste minimization opportunity independently and do not reflect duplication of savings that would result when the opportunities are implemented in a package.

Additional Recommendations

In addition to the opportunities recommended and analyzed by the WMAC team, two additional measures were considered. These measures were not completely analyzed because of insufficient data or minimal savings as indicated below. They were brought to the plant's attention for future reference, however, since these approaches to waste reduction may increase in attractiveness with changing plant conditions.

- Replace solvent-based paint with electrostatic coating, which might be used on 70% of painted production. However, investment cost for such a system would be high with a long payback, since present cost for disposal of waste paint and thinner is small.

- Re-establish a cooperative approach to cutting fluid management. A balance should be struck between the desire to minimize waste cutting fluid, which promotes recycling, and the need for product quality, which does not emphasize recycling.

This research brief summarizes a part of the work done under Cooperative Agreement No. CR-814903 by the University City Science Center under the sponsorship of the U.S. Environmental Protection Agency. The EPA Project Officer was Emma Lou George.

Table 1. *Summary of Current Waste Generation*

Waste Generated	Source of Waste	Annual Quantity Generated	Annual Waste Management Cost
Spent cutting fluid	Cutting fluid is discarded when bacteria buildup has become excessive or viscosity difficult to control. Spent fluid is disposed of by incineration.	600 gal	$2,850
Spent hydraulic oil	Hydraulic oil is filtered and reused. When it can no longer be used, it is disposed of by incineration.	450 gal	1,100
Waste paint and thinner	Paint spray nozzle cleaning operations result in waste paint and thinner.	150 gal	440
Spent reagent solutions and rinse waters	Steel surface preparation and aluminum anodizing result in spent reagent solutions. Spent detergents, descaler, conversion coatings, caustic, ferric sulfate, and sulfuric acid solutions and rinse waters are pH-adjusted and discharged as industrial wastewater.	487,500 gal	460
Spent solder flux	The flux bath is drained when solderability approaches an unacceptable level. The spent flux is disposed of as hazardous waste.	300 gal	700
Spent degreaser solvent	Spent solvent from degreasing operations is shipped to a recycler. Recovered solvent is purchased for use in the process.	20 gal	20

Table 2. *Summary of Recommended Waste Minimization Opportunities*

Waste Generated	Minimization Opportunity	Annual Waste Reduction		Net Annual Savings	Implementation Cost	Payback Years
		Quantity	Percent			
Spent cutting fluid	Use existing equipment to filter and pasteurize spent cutting fluid for recycling. When disposal is needed, treat the spent fluid with sulfuric acid. Neutralize and sewer the resulting aqueous phase and dispose of the organic phase as hazardous waste.	300	50	$2,910	$550	0.2
Spent hydraulic oil	Ship the spent hydraulic oil to a recycler rather than a disposal facility for cost savings.	0	0	1,050	0	0

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