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EPA ENVIRONMENTAL RESEARCH BRIEF

Waste Minimization Assessment for a Manufacturer of Industrial Coatings

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Abstract

The U.S. Environmental Protection Agency (EPA) has funded a pilot project to assist small- and medium-size manufacturers who want to minimize their generation of 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 the University of Louisville performed an assessment at a plant manufacturing industrial coatings — approximately 2,700,000 gal/yr. The products are diversified, being made in batches of varying size to meet customer specifications. Pigments are milled as needed, and batches are prepared by controlled mixing of solvents, resins, pigments or dyes, and additives. The products are packaged in small containers, drums or tanker trucks, or held in bulk storage tanks. The team's report, detailing findings and recommendations, indicated that most waste occurred as solvent loss by evaporation and as residual solvent in emptied containers, and that the greatest savings could be obtained by fitting batch tanks with covers and submerged-filling tubes to reduce vapor losses and storing solvent drums on an incline to reduce residual solvent remaining in drums.

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 University City Science Center.

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Introduction

The amount of 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 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 waste but who lack the inhouse 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 the University of Louisville's WMAC. The assessment teams have considerable direct experience with process operations in manufacturing plants and also have the knowledge and skills needed to minimize waste generation.

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 $75 million, employ no more than 500 persons, and lack inhouse 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 waste in the plant and identify the current disposal or treatment methods and their 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 that 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 industrial coatings including stains, varnishes, and pigmented products. It operates 2,000 hr/yr to produce approximately 2,700,000 gallons.

Manufacturing Process

This plant produces lacquer and varnishes; solvent-based and water-based pigmented metal, wood, and plastic finishes; and stains. The raw materials include resins, fillers, milling pastes, pigments, dyes, sealers, nitrocellulose, and solvents. Solvents used are methyl ethyl ketone, methyl isobutyl ketone, toluene, xylene, mineral spirits, and alcohol.

The coatings are made in batches. The following steps are involved:

- Tint pastes are prepared by grinding pigments with solvent in ball mills and sand mills. The mills are cleaned with a solvent-resin mixture to be used in the batch.
- Other raw materials for the batch are charged to a mixing tank.
- The batch is mixed, and the tints are added to adjust the color to specifications.
- The batch is filtered to remove large particles and dirt and packaged in designated containers.
- The mixing tank is cleaned to prepare for the next batch.

An abbreviated process flow diagram is shown in Figure 1.

Existing Waste Management Practices

This plant already has taken the following steps to manage and minimize its wastes:

- The plant uses offsite solvent reclamation, purchasing the recovered solvent for use in cleaning equipment. Off-spec and obsolete products are reworked into saleable products.
- A still is used to recover spent wash solvent onsite.
- A trial lid is under test on batch tanks to reduce evaporation losses and avoid dust loss when charging pigments.
- A sweep-blade mixer with attached squeegees is used to minimize the amount of solvent needed for cleaning the batch tank after mixing high-viscosity materials.
- The final solvent charge used to expel the last remaining tint paste from a milling machine is incorporated into the product formulation and not disposed of as spent solvent.

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 times 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, several additional measures were considered. These measures were not analyzed completely because of insufficient data, implementation difficulty, or a projected lengthy payback as indicated below. Since one or more of these approaches to waste reduction may, however, increase in attractiveness with changing conditions in the plant, they were brought to the plant's attention for future consideration.

- Use a commercial alkaline cleaner instead of aqueous caustic to clean process materials buildup from the floor. Because the alkaline cleaner solutions are more effective, a 50% reduction in the volume of cleaning waste is expected.
- Use the same alkaline cleaner instead of solvent to clean up small spills that occur in daily operation.
- Dispose of collected pigment dust through a waste exchange. Pigment dust is now disposed of in a landfill and is regulated as a hazardous waste.
- Use dedicated drip pans for particular raw materials in the drum storage area, so collected material can be used in product batches. At present the collected materials are combined and disposed of as spent solvent.
- Make repeated use of wash solvent to reduce the amount of solvent that must be purchased or reclaimed. Such multiple use would require separation of solids present (by decanting, filtering or centrifuging). At present, wash solvent is used only twice.
- Implement procedures for complete discharge of material from drums. This would result in additional charges for labor or equipment.
- Recover solvent vapors now lost as fugitive and stack emissions. This would require installation of equipment, possibly at the point of emission of individual solvents.

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.

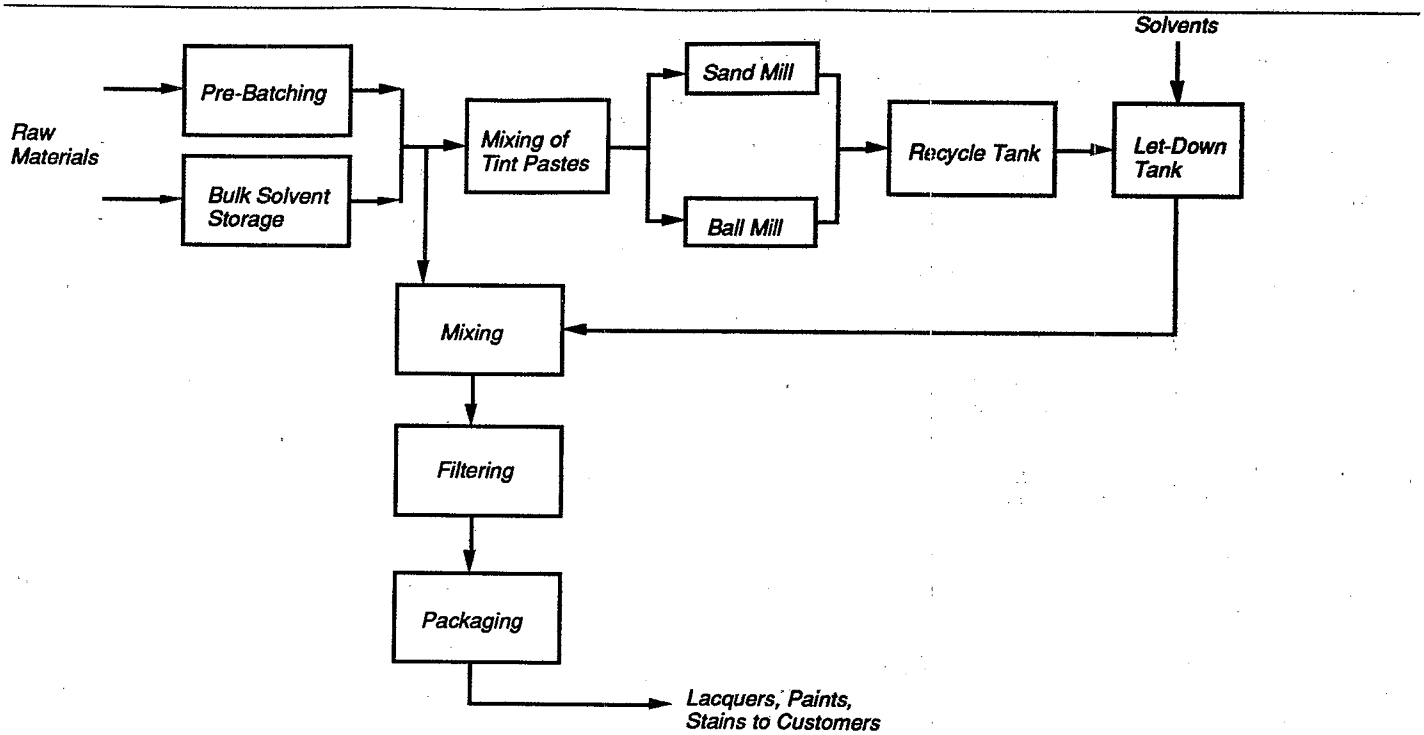

Figure 1. Abbreviated process flow diagram.

Table 1. Summary of Current Waste Generation

Waste Generated	Source of Waste	Annual Quantity Generated	Annual Waste Management Cost
Pigment dust	Pigment dust from process dust collectors, bag breakage, and sweepings is disposed of as hazardous waste.	6,600 lb	$39,600
Residual pigment in bags	Empty bags with residual pigment are disposed of as landfill.	44,200 lb	44,200
Sludge and still bottoms	Sludge and bottoms from distillation of spent cleaning solvent are disposed of in a fuels or incineration program.	13,250 gal	33,532
Solvent vapors	Volatile solvents are lost by evaporation from mixing tanks and from pigment mills operated at 140 °C or higher.	27,518 gal	68,797
Residual solvents in containers	Solvents are lost in discarded or recycled containers.	19,018 gal	63,710
Drum leakage	Drum leakage is collected and combined with spent wash solvent for distillation recovery by a recycler.	9,116 gal	30,540
Spent filter cartridges	Filter cartridges are used once and disposed of as landfill.	8,840 pcs	54,785
Discarded bags and spent filter media	Spent filter units are dried and disposed of with empty pigment bags as landfill.	Unknown	680
Used staging pails from prebatching	Used pails are disposed of with nonhazardous trash as landfill.	48,620 pcs	104,039

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Table 2. Summary of Recommended Waste Minimization Options Identified

Waste Generated	Minimization Opportunity	Annual Waste Reduction Quantity	Annual Waste Reduction Percent	Net Annual Savings	Implementation Costs	Payback Years
Used staging pails from prebatching	Use a solvent spray washer to clean the pails for reuse instead of discarding them.	39,000 pcs	80	$71,330	$53,320	0.5
Used staging pails from prebatching	The used pails can be taken by a metal scrap recycler at no charge.	48,620 pcs	100	13,584	0	0
Solvent vapors	Install lids on coating batch tanks to reduce solvent vapor losses.	26,053 gal	95	65,000	300	0.0
Spent cartridge filters	Replace disposable cartridge filters with reusable stainless steel filters.	8,840 pcs	100	51,887	6,640	0.1
Residual pigment in bags	Shake or scrap the bags for more complete discharge of the pigment.	33,165 lb	75	28,100	0	0
Solvent vapors	Modify process tanks for submerged-filling (through a dip tube) to reduce vapor loss.	4,655 gal	50	11,638	3,202	0.3
Residual solvent in drums	Incline solvent drums to reduce the residual heel of solvent.	4,559 gal	25	15,270	794	0.1

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