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Waste Minimization Assessment for a Manufacturer of Printed Plastic Bags

F. William Kirsch and Gwen P. Looby*

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 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 the University of Tennessee performed an assessment at a plant manufacturing printed plastic bags for snack foods—approximately 1.8 million lb/yr. Plastic stock is ink printed and oven cured. To make single-layer bags, a heat seal process is used, and the bags are then packaged and shipped. For certain products, a plastic or metalized film is laminated to the printed plastic film, the rolls are slit to obtain individual bags, and the bags are packaged and shipped. The team's report, detailing findings and recommendations, indicated the most waste was generated in the lamination process and that the greatest savings could be obtained by installing an automatic adhesive/solvent mixing system to reduce (75%) the waste from the unused metalized film adhesive/solvent mixture.

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. For additional information please contact the authors.

*University City Science Center, Philadelphia, PA 19104

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 generation of hazardous 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 Tennessee's (Knoxville) WMAC. The assessment teams have considerable direct experience with process operations in manufacturing plants and also have the knowledge and skills needed to minimize hazardous 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 a gross annual sales not exceeding $50 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 locates the sources of hazardous waste in the plant and identifies 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 printed plastic bags for snack foods. The plant operates 6,240 hr/yr to produce approximately 1.8 million lb of bags.

Manufacturing Process

This plant prints designs onto plastic roll stock and then forms the plastic into bags for snack foods and other consumer products. The raw materials include polypropylene and metallic films, inks, adhesives, and solvents. The adhesives include clear film adhesive, metalized film adhesive, and thermostripping adhesive; the solvents are ethyl acetate, ink solvent, and thermostripping solvent.

The following steps are involved in making the bags:

- Ink printing of plastic stock followed by oven curing. Unused and contaminated ink/solvent mixture is collected and transferred to the onsite distillation unit. Waste ink resulting from run color changes is disposed of offsite as hazardous waste. Solvent vapor is emitted directly to the outdoor atmosphere by three of the four curing ovens. In the remaining curing oven, 50% of the vapor is recycled to the oven and the remaining is ducted to an incinerator outside of the plant building.
- Single-layer bag-making. A heat seal process is used, and then these bags are packaged and shipped.
- For certain products, lamination to form multi-layered plastic rolls followed by oven curing. A clear plastic or metalized film is laminated to the printed plastic film, or a special kind of lamination called thermostripping is done. Unused adhesive/solvent mixture from the metalized film application are disposed of offsite as hazardous waste. Half of the stack gases from the curing oven, which contain evaporated solvents, are directed back into the oven. The remaining gases are ducted to the outside incinerator.
- Slitting of laminated plastic rolls to obtain individual bags. These bags are then packaged and shipped.

Existing Waste Management Practices

- Recovery of ink-contaminated solvent using an onsite distillation unit. The recovered solvent is reused in the inking operation or is used for cleanup. Ink still bottoms are disposed of offsite as hazardous waste.
- Incineration of oven stack vapor in the outdoor gas-fired incinerator.

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 treatment and disposal 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 the economic savings of the minimization opportunity, in most cases, results 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.

- Mix the ink and solvent in a smaller container directly at the presses to reduce the generation of ink/solvent waste. Minimal savings are projected for this measure.
- Possibly recover solvent on the used cleanup rags through some type of evaporation process. This opportunity was not analyzed further because of a lack of detailed data and limited field experience with such systems.

Table 1. Summary of Current Waste Generation

Waste Generated	Source of Waste	Annual Quantity Generated	Annual Waste Management Cost
Unused ink	Ink presses. Ink that cannot be used because of changes in run color is collected and disposed of as hazardous waste.	60 gal	$970
Evaporated ink solvent	Ink presses. Solvent evaporates in the curing ovens associated with the ink presses. A portion of the solvent is lost to the atmosphere. The remainder is fed to the onsite incinerator.	8,550 gal	720
Unused metalized film adhesive/solvent mixture	Laminator. Unused adhesive/solvent required for metalized film application is discarded daily, collected, and disposed of as hazardous waste.	2,490 gal	43,690
Evaporated adhesive solvents	Laminator. Solvents in the adhesives evaporate in the curing oven associated with the laminator. The vapor is fed to the onsite incinerator.	39,100 gal	3,280
Spent Ink	Solvent recovery distillation unit. Ink still bottoms from the distillation unit are disposed of as hazardous waste.	195 gal	4,880
Spent solvent on rags	Equipment and plant cleanup. Soiled rags wetted with solvent are disposed in municipal trash.	7,000 lb[1] 1,850 gal[3]	0[2]

[1] Rags
[2] Plant personnel report no incremental cost associated with present disposal in municipal waste,
[3] Solvent

Table 2. Summary of Recommended Waste Minimization Opportunities

Waste Generated	Minimization Opportunity	Annual Waste Reduction		Net Annual Savings	Implementation Cost	Payback Years
		Quantity	Percent			
Evaporated solvents	Install a condensing system on each of the oven stacks to recover evaporated solvents. Remove any water collected along with the solvents in a distillation unit. Reuse the solvents	23,900 gal	50	$69,800[1]	$ 63,800	0.9
Unused metalized film adhesive/ solvent mixture	Install an automatic adhesive/solvent mixing system. The amount of unused adhesive/solvent will be reduced as will evaporation of the solvent.	1,860 gal	75	75,900[2]	27,900	0.4
Spent solvent on rags	Use solvent as a cleaning agent only for equipment. For all other cleanup use a nonhazardous detergent.	1,750 lb[3] 463 gal[5]	25	20[4]	0	0

[1] Total savings reduced by annual operating cost of the condensing systems and distillation unit.
[2] Includes savings on raw materials.
[3] Rags
[4] Total savings reduced by the purchase price of the new detergent.
[5] Solvent

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