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ENVIRONMENTAL RESEARCH BRIEF

Waste Minimization Assessment for a Manufacturer of Caulk

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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. In an effort to assist these manufacturers 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). That document has been superseded by the *Facility Pollution Prevention Guide* (EPA/600/R-92/088, May 1992). The WMAC team at Colorado State University performed an assessment at a plant that manufactures latex and acrylic caulk. Raw materials, such as water, latex, and dry ingredients for latex caulk, and solvents and thermoplastic rubber for acrylic caulk, are blended and mixed. The resulting product is packaged and shipped. The assessment team's report, detailing findings and recommendations, indicated that the greatest quantity of waste was generated by cleaning of equipment. The greatest cost saving opportunity recommended to the plant involved using a solvent recovery unit to recover water from waste cleaning water/caulk. The recovered water can be reused.

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 generation 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 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 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 in-house expertise in waste minimization.

The potential benefits of the pilot project include minimization of the amount of waste generated by manufacturers, and reduction of waste treatment and disposal costs for participating plants. In addition, the project provides valuable experience for graduate and undergraduate students who participate

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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

This plant manufactures water-based latex caulk and solvent-based acrylic caulk. It operates approximately 2,800 hr/yr to produce more than two million pounds of caulk annually.

Manufacturing Process

Latex caulk is produced from a mixture of water, latex, and dry ingredients. The raw materials are blended together and mixed for several hours. After mixing, the caulk is pumped into tubes or larger buckets and packaged in boxes for shipping.

An abbreviated process flow diagram for latex caulk production is shown in Figure 1.

Acrylic caulk is made from dry ingredients, including a thermoplastic rubber, and liquid solvents, including toluene. The raw materials are blended together and mixed for several hours under vacuum and heat in an isolated explosion-proof room. The product is stored in heated silos prior to packaging. During the packaging process, the caulk is pumped through heated pipes to the filling machinery. Then the caulk is packaged and boxed for shipping.

The process for acrylic caulk manufacturing is shown in Figure 2.

Existing Waste Management Practices

This plant already has implemented the following techniques to manage and minimize its wastes.

- Aqueous wastes from the latex caulk manufacturing process are shipped offsite instead of being sewered. The plant has set zero discharge of aqueous wastes as an eventual goal.
- Plant personnel are investigating methods to evaporate water from the aqueous wastes generated by the latex caulk manufacturing process.
- Plant personnel are investigating alternate production techniques to reduce cleanup between latex caulk color changes, improve production efficiency, and reduce product inventory.
- Citrus-based cleaning agent is used instead of mineral spirits to clean product display tubes.

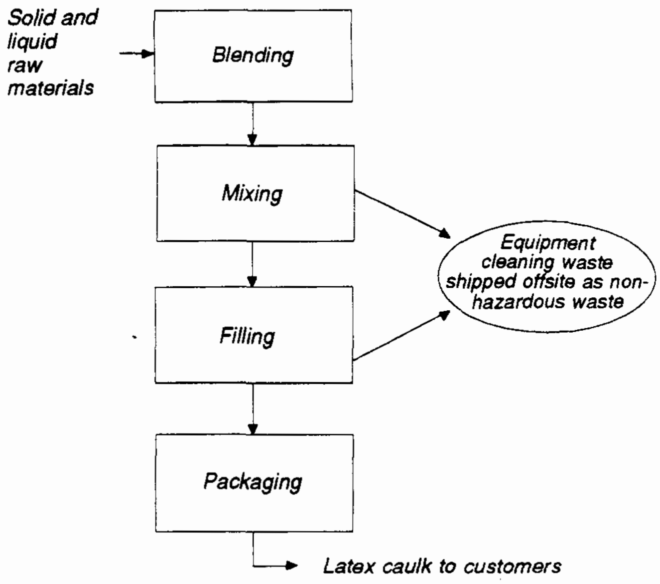

Figure 1. *Abbreviated process flow diagram for latex caulk.*

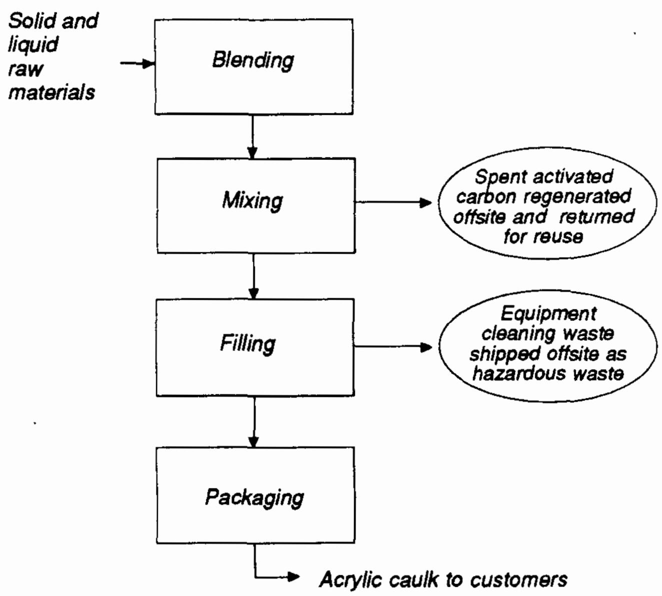

Figure 2. *Abbreviated process flow diagram for acrylic caulk.*

- Mineral spirits are used instead of perchloroethylene to clean floors in the acrylic caulk mixing room.
- An aggressive data collection and management system has been implemented to track production and productivity.

Waste Minimization Opportunities

The type of waste currently generated by the plant, the source of the waste, the waste management method, the quantity of the waste, and the annual waste management cost for each waste stream identified are given in Table 1.

Table 2 shows the opportunities for waste minimization that the WMAC team recommended for the plant. The minimization opportunity, the type of waste, the possible waste reduction and associated savings, and the implementation cost along with the simple payback time are given in the table. The quantities of 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 also should 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. 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.

- Develop colorizing equipment that can add and mix the coloring agents with the caulk during packaging, in a just-in-time fashion. This measure would reduce the amount of cleaning wastes generated and improve product quality thereby reducing off-specification products.
- Replace toluene and perchloroethylene used in cleaning operations with safer, less volatile solvents.
- Distill the waste cleanup solvent onsite and use the recovered solvent for further cleaning.
- Install liquid level detectors and a control system to prevent spills in the mixing room for the acrylic caulk production line.
- Replace Stoddard solvent used for equipment and tool cleaning with a less volatile solvent.
- Develop a stronger quality assurance/quality control program to inspect raw materials prior to mixing in caulk batches.
- Reduce the amount of powdered raw material that is spilled from the mixing tanks.
- Reuse cleaning water in subsequent caulk batches. (Because of the low water content of caulk, this recommendation was found to be impractical.)

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*	*Waste Management Method*	*Annual Quantity Generated (lb)*	*Annual Waste Management Cost*[1]
Cleaning water	*Cleaning of mixing and filling equipment in latex caulk production line*	*Shipped offsite for disposal as nonhazardous waste*	*59,500*	*$4,23*
Mixed solvent wastes	*Cleaning of acrylic caulk production line*	*Shipped offsite for recycling incineration*	*10,700*	*6,800*
Evaporated solvents	*Cleaning of acrylic caulk production line*	*Evaporates to plant air*	*130*	*0*
Waste Stoddard solvent	*Cleaning of tools and filling equipment in acrylic caulk production line*	*Shipped offsite for recovery by distillation; reused*	*1,160*	*460*
Spent activated charcoal	*Collection of solvent emissions from mixing of raw materials in acrylic caulk production line*	*Shipped offsite for regeneration; reused onsite*	*1,050*	*1,575*
Waste Stoddard solvent	*Cleaning in maintenance area*	*Shipped offsite for recovery by distillation; reused*	*1,160*	*460*
Waste soybean oil	*Production of an obsolete product*	*Stored onsite pending disposal*	*6,190*[2]	*970*[3]

[1] *Includes waste treatment and disposal costs.*
[2] *Not a recurring stream.*
[3] *Estimated cost to dispose of waste.*