



# ENVIRONMENTAL RESEARCH BRIEF

## Waste Reduction Activities and Options for a Manufacturer of Finished Leather

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### Abstract

The U.S. Environmental Protection Agency (EPA) funded a project with the New Jersey Department of Environmental Protection and Energy (NJDEPE) to assist in conducting waste minimization assessments at 30 small- to medium-sized businesses in the state of New Jersey. One of the sites selected was a manufacturer of finished leather. A site visit was made in 1990 during which several opportunities for waste minimization were identified. Recommendations included 1) changeover to water-based coatings; 2) installation of a solvent recovery/reuse capability; 3) use of a hand pump to reduce spillage during transfer and physical layout considerations to reduce the distances materials must be moved; 4) reducing the volume of the container for test mixes; 5) improvements to the computer-controlled spray-coating operation to reduce overspray; and 6) the use of covers over formulated coating mixtures to reduce air emissions. Implementation of the identified waste minimization opportunities was not part of the program. Percent waste reduction, net annual savings, implementation costs and pay-back periods were estimated.

This Research Brief was developed by the Principal Investigators and EPA's Risk Reduction Engineering Laboratory in Cincinnati, OH, to announce key findings of this completed assessment.

### Introduction

The environmental issues facing industry today have expanded considerably beyond traditional concerns. Wastewater, air emissions, potential soil and groundwater contamination, solid waste disposal, and employee health and safety have become increasingly important concerns. The management and dis-

posal of hazardous substances, including both process-related wastes and residues from waste treatment, receive significant attention because of regulation and economics.

As environmental issues have become more complex, the strategies for waste management and control have become more systematic and integrated. The positive role of waste minimization and pollution prevention within industrial operations at each stage of product life is recognized throughout the world. An ideal goal is to manufacture products while generating the least amount of waste possible.

The Hazardous Waste Advisement Program (HWAP) of the Division of Hazardous Waste Management, NJDEPE, is pursuing the goals of waste minimization awareness and program implementation in the state. HWAP, with the help of an EPA grant from the Risk Reduction Engineering Laboratory, conducted an Assessment of Reduction and Recycling Opportunities for Hazardous Waste (ARROW) project. ARROW was designed to assess waste minimization potential across a broad range of New Jersey industries. The project targeted 30 sites to perform waste minimization assessments following the approach outlined in EPA's *Waste Minimization Opportunity Assessment Manual* (EPA/625/7-88/003). Under contract to NJDEPE, the Hazardous Substance Management Research Center at NJIT assisted in conducting the assessments. This research brief presents an assessment of a manufacturer of finished leather (1 of the 30 assessments performed) and provides recommendations for waste minimization options resulting from the assessment.

### Methodology of Assessments

The assessment process was coordinated by a team of technical staff from NJIT with experience in process operations,

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basic chemistry, and environmental concerns and needs. Because the EPA waste minimization manual is designed to be primarily applied by the inhouse staff of the facility, the degree of involvement of the NJIT team varied according to the ease with which the facility staff could apply the manual. In some cases, NJIT's role was to provide advice. In others, NJIT conducted essentially the entire evaluation.

The goal of the project was to encourage participation in the assessment process by management and staff at the facility. To do this, the participants were encouraged to proceed through the organizational steps outlined in the manual. These steps can be summarized as follows:

- Obtaining corporate commitment to a waste minimization initiative
- Organizing a task force or similar group to carry out the assessment
- Developing a policy statement regarding waste minimization for issuance by corporate management
- Establishing tentative waste reduction goals to be achieved by the program
- Identifying waste-generating sites and processes
- Conducting a detailed site inspection
- Developing a list of options which may lead to the waste reduction goal
- Formally analyzing the feasibility of the various options
- Measuring the effectiveness of the options and continuing the assessment.

Not every facility was able to follow these steps as presented. In each case, however, the identification of waste-generating sites and processes, detailed site inspections, and development of options was carried out. Frequently, it was necessary for a high degree of involvement by NJIT to accomplish these steps. Two common reasons for needing outside participation were a shortage of technical staff within the company and a need to develop an agenda for technical action before corporate commitment and policy statements could be obtained.

It was not a goal of the ARROW project to participate in the feasibility analysis or implementation steps. However, NJIT offered to provide advice for feasibility analysis if requested.

In each case, the NJIT team made several site visits to the facility. Initially, visits were made to explain the EPA manual and to encourage the facility through the organizational stages. If delays and complications developed, the team offered assistance in the technical review, inspections, and option development.

## Facility Background

The plant produces finished leathers which are sold to manufacturers of leather goods such as handbags, belts, shoes, and other items. The operation of the plant varies according to customer demand. Many different colors, textures, and designs must be incorporated into the product to meet varying customer requirements, forcing the operation of several special production steps on an irregular basis. The facility formerly tanned raw hides, but that process has been phased out as a result of changing supply and market conditions.

## Manufacturing Process

This facility receives tanned leather from various sources and transforms it into a product of higher commercial value by

applying various coatings and other surface modifications to make it more usable and appropriate for finished consumer products. The raw materials include, in addition to the leather itself, various water- and solvent-based coatings as well as some specialized colorants and other surface modification products. The solvents in the coatings typically are aromatic and aliphatic hydrocarbons, esters, and alcohols.

The following processes are carried out in the facility but not every hide necessarily receives each finishing process.

- Back Coating
- Base Coating
- Plating Top
- Tipping (hand made)
- Color Top
- Clear top

A typical hide in the manufacturing process might receive the following finishing steps.

Newly received hides are prepared for finishing by washing, retanning if necessary, and drying. The aqueous wastes from these steps are sent to the POTW with regular monitoring to assure compliance.

Some hides undergo surface modification by mechanical buffing. The resulting dust is classified as a hazardous waste and is disposed of offsite.

The back coating step applies essentially the final finish to the back of the leather while the base coating of the smooth side serves as the primer for additional finishes to be applied. The coatings are applied using an automated spray system. The facility has shifted largely to water-based coating for these steps resulting in a significant decrease in solvent use. Any over-spray is captured by a water-screen or by filters and disposed of offsite.

The next coating steps are accomplished using solvent-based materials. No satisfactory non-solvent based coatings have yet been identified for these finishing steps. The applied finishes are thermally dried with venting of solvent vapors to the atmosphere.

The final steps in the manufacturing process are ironing, grading, measuring, and shipping—operations which are not significant waste-generating activities.

## Existing Waste Management Activities

The facility has shifted to the use of water-based coatings where possible. Moreover, the technical staff continues to evaluate new commercial reduced-solvent products in order to make further reductions. An optical/computer interfaced system has been used to determine the shape and position of each hide presented for coating which is used to control the automated spray coating system, resulting in significant reduction of overspray.

## 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 (where known and available) are given in Table 1.

Table 2 presents the opportunities for pollution prevention which were identified during the assessment. The type of waste, the minimization opportunity, and the possible waste

reductions, are presented in the table. When available or estimable, the associated saving, and implementation costs along with payback times are also given. However, because the feasibility analysis was to be carried out by the staff of the facility, that information is not always readily available.

### Additional Options Identified

In addition to the options previously discussed two other options were suggested. It was observed that the wooden pallets and cardboard used for shipping hides to the facility might have increased value if recycled. Second, the future use of a spray coating system based upon supercritical carbon dioxide as a solvent/carrier was identified. However, such a system depends not only on the availability of the hardware, but also on the manufacture of coatings compatible with the spray system and capable of providing the required quality for the finished leather. Such coatings are not presently available.

### Regulatory Implications

The significant regulatory issue at a facility such as this is the impending requirement for more efficient air emission control

practices. This concern is driving the interest in pollution prevention. Unfortunately, the apparent best solution—changing to water based coatings—is not technically feasible. It is unknown if the perhaps next best solution—solvent capture and recovery from the process air emissions—would be acceptable to the regulatory authorities in light of better known thermal oxidation systems which have less source reduction potential. If a facility has capital resources to install only one system, it is uncertain what position and role a regulatory authority will take.

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**Table 1.** Summary of Current Waste Generation

<i>Waste Generated</i>	<i>Source of Waste</i>	<i>Annual Quantity Generated</i>	<i>Annual Costs</i>
<i>Washing Waters</i>	<i>Cleaning of incoming hides</i>	<i>130,000 gal</i>	<i>\$30</i>
<i>Buffing Dust</i>	<i>Mechanical abrasion of hide surface</i>	<i>&lt;100 lb</i>	<i>\$325</i>
<i>Evaporated Coating Solvent</i>	<i>Application of back coating, base coating, plating top, color top, and clear top to hides. Most solvent evaporation occurs during oven assisted drying. Some loss also occurs as a result of spills and leaks during material mixing and transfer.</i>	<i>130 tons</i>	<i>These are either fugitive emissions or regulated emissions to the atmosphere, and therefore have no management costs except the loss of potential recovery value.</i>
<i>Solvents and Coatings</i>	<i>Excess coatings and solvent from equipment cleaning</i>	<i>12,300 gal</i>	<i>\$ 61,000</i>

**Table 2. Summary of Waste Minimization Opportunities**

Waste Generated	Minimization Opportunity	Annual Waste Reduction		Net Annual Savings	Implementation Cost	Payback Years*
		Quantity	Percent			
Buffing Dust	Sale for beneficial reuse in resin-based composite product.	100 lb	100%	\$325	0	immed
Evaporated Solvent	Continue changeover to water based coatings subject to development of satisfactory materials by coating manufacturers.	1.3 tons	10%	The savings will come from avoided treatment from an air emissions control system not yet installed. The facility is clearly dependent upon the coating production industry and cannot make progress in this area alone.		
Solvents and Coatings	Prepare test formulations in smaller quantities.	300 lb	2%	\$ 900	0	immed
Evaporated Solvent	Reprogram automated spray coating equipment to compensate for required angle spraying.	up to 65% when angle spraying is required. 12.7 tons	9.7%	\$25,000	\$5,000	0.2
	Install covers on coating reservoir containers during spray coating operations.	variable depending upon solvent volatility 500 lb	0.2 %	\$500	\$1,000	2.0
	Install solvent capture system allowing capture and reuse. Possibilities include a carbon system with steam distillation regeneration capability permitting recovery of the captured solvent. Distillation and reuse of the solvent is possible if the solvent mixture is not too complex. Difficult mixtures may have to be distilled offsite where more efficient columns are available.	up to 90% depending upon type of solvent. 117 tons	90%	\$200,000	\$300,000	1.5
(A system of this type could serve as the emission control device assuming that the regulatory authority would approve it instead of more usual equipment.)						

\* Savings result from reduced raw material, and treatment and disposal costs when implementing each minimization opportunity independently.

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