PN-ABX-815 HBI-94-004-01, Pub. 10/31/94

EP3 Environmental Pollution Prevention Project

CASE STUDY

Pollution Prevention Assessment for a Textile Dyeing Facility Serving Fabric Manufacturers

What is EP3?

The amount of pollutants and waste generated by industrial facilities has become an increasingly costly problem for manufacturers and a significant stress on the environment. Companies, therefore, are looking for ways to reduce pollution at the source as a way of avoiding costly treatment and reducing environmental liability and compliance costs.

The United States Agency for International Development (USAID) is sponsoring the Environmental Pollution Prevention Project (EP3) to establish sustainable programs in developing countries, transfer urban and industrial pollution prevention expertise and information, and support efforts to improve environmental quality. These objectives are achieved through technical assistance to industry and urban institutions, development and delivery of training and outreach programs, and operation of an information clearinghouse.

EP3's Assessment Process

EP3 pollution prevention diagnostic assessments consist of three phases: *pre-assessment*, *assessment*, and *post-assessment*. During *pre-assessment*, EP3 in-country representatives determine a facility's suitability for a pollution prevention assessment, sign memoranda of agreement with each facility selected, and collect preliminary data. During *assessment*, a team comprised of U.S. and in-country experts in both pollution prevention and the facility's industrial processes gathers more detailed information on the sources of pollution, and identifies and analyzes opportunities for reducing this pollution. Finally, the team prepares a report for the facility's management detailing its findings and recommendations (including cost savings, implementation costs, and payback times). During *post-assessment*, the EP3 in-country representative works with the facility to implement the actions recommended in the report.

Summary

This assessment evaluated a dye house serving a variety of fabric manufacturers. The objective of the assessment was to identify actions that would: (1) reduce the quantity of toxics, raw materials, and energy used in the dying process, thereby reducing pollution and worker exposure, (2) demonstrate the environmental and economic value of pollution prevention methods to the dyeing industry, and (3) improve operating efficiency and product quality.

The assessment was performed by an EP3 team comprised of an expert in textile dyeing and a pollution prevention specialist.

Overall, the assessment identified 37 pollution prevention opportunities -- classified as first, second, and third priority opportunities -- that could reduce energy use at this facility and avoid the release of over 14 metric tons of air emissions each year, in addition to unquantified reductions in the release of global warming gases and heavy metals. Water use could be reduced by 125,000 cubic meters per year, and chemical releases to surface waters could also be reduced. Finally, it may be possible to avoid the disposal of 330 cubic meters of solid waste per year.

Facility Background

This facility is a dye house serving fabric manufacturers. The facility operates two eight-hour shifts, six days per week, employing seventy shift workers and twenty technical

Figure 1: Cotton and Polyester Processing

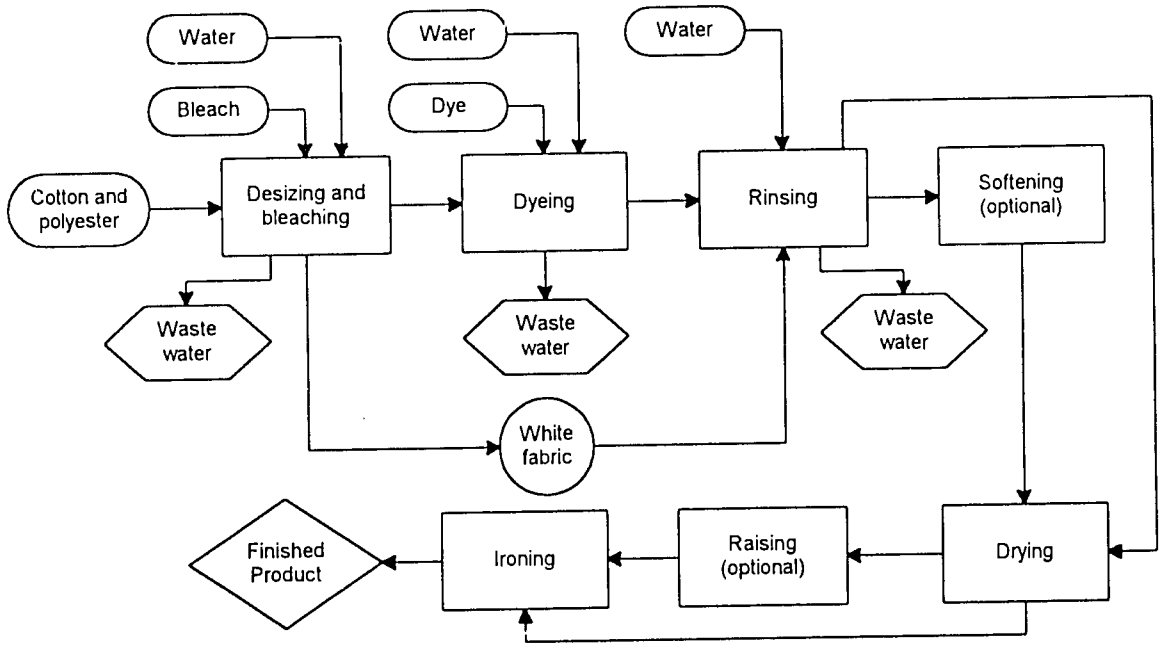
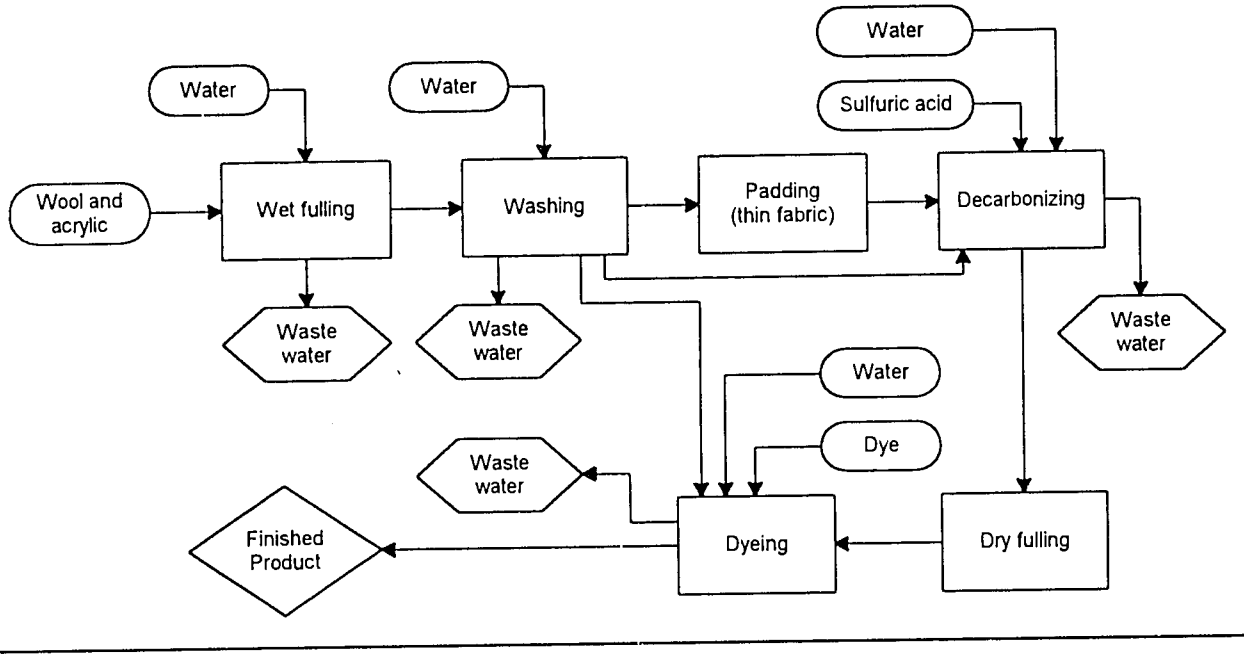


Figure 2: Wool and Acrylic Processing



and administrative employees. In 1992, the facility processed 350,000 kg of cotton and 360,000 kg of wool fabric.

Manufacturing Process

In general, cotton dyeing involves two procedures, desizing and bleaching, and dyeing. Each procedure involves a number of steps that must be carried out in proper sequence and under optimal conditions. For detailed depictions of these processes, see **Figure 1**. Wool dyeing also involves several procedures: (1) washing, (2) padding (heating thin wool fabrics in boiling water to improve appearance and brightness), and (3) dyeing. For detailed depictions of these processes, see **Figure 2**.

White fabric is desized and bleached in becks, with nominal capacities of 500 liters, 1,000 liters, and 1,500 liters of water. Fabrics to be dyed are desized and then dyed in jets.

Table I: Summary of Recommended Pollution Prevention Opportuntities

Unit Operation	Pollution Prevention Action and Environmental/ Product Quality Benefit	Cost (US$)	Financial Benefit	Payback Period
	First Priority Opportunities			
Steam Traps	Repair leaking traps - reduces air emissions and fuel costs.	$700 to replace traps.	$47,000 per year	1 week
Steam System	Evaluate steam system components and layout and add at least two steam traps - reduces energy use prolongs life of components and reduces bath and boiler water contamination.	$120 for insulation;$500 for traps.	To be determined	To be determined
Steam Traps	Improve knowledge of steam trap selection - reduces energy use and avoids purchase and repair of traps.	None	To be determined	Immediate
Steam Traps	Purchase and use steam leak detector - reduces fuel consumption.	$1100 for instrument	To be determined	To be determined
Dyeing Becks	Modify rinsing procedures and becks - reduces water costs.	$400 for 16 valves flow restrictors and siphon piping.	$45,000 per year	Less than 1 week
Dye Baths	Replace sodium sulfate with sodium chloride - reduces sulfate emissions below effluent standards and reduces chemical costs.	None	$7,500 per year	Immediate
Wool Laundries	Repair leaks - reduces water and energy use.	$50 for screens and valve.	$3,700 per year	Less than 1 week
Zonco Washer	Repair leaks and maintain drain valves - reduces water and energy use.	None	$2.200 per year	Immediate
Sulfuric Acid Decarbonizing	Filter acid continuously - reduces release of sulfuric acid to sewer system.	$700 for in-tank filter.	$300 per year	2.5 years
Floor Drains	Install and maintain screens to prevent lint from entering drains - reduces suspended solids sedimentable solids and sulfide in effluent.	$10 for screens.	To be determined	To be determined
Beck Number 10	Relocate steam coil to prevent boil-over - reduces loss of chemicals and energy to drains.	None	To be determined	Immediate
All Becks	Repair and maintain steam coils - reduces fuel consumption and prevents contamination of dye baths and boiler water.	None	To be determined	Immediate
Boiler	Purchase and install combustion controls - reduces emissions and fuel use.	Unquantified	To be determined	Immediate
Jet Dyers	Monitor dye bath temperature to detect out-of-control condition - avoids chemical loss to sewer and reduces energy use.	$25 for thermometers.	To be determined	To be determined
Dyeing Process	Use Datacolor instrument to control process - reduces chemical use.	None	To be determined	Immediate
EMOS Water Supply	Test plant water distribution system for leaks - reduces water use.	None	To be determined	Immediate
Green Dryer	Re-balance internal air flow - reduces emissions of H2SO4 mist and energy use.	None	To be determined	Immediate
Green Dryer	Install exhaust fan after re-balancing dryer - avoids worker exposure to sulfuric acid mist and future medical costs.	$700 (est.)	To be determined	To be determined
Sewer Effluent	Determine nitrogen and hydrocarbon concentrations - assures compliance with effluent standards and helps set reduction priorities.	$200 for testing.	To be determined	To be determined
TOTALS		$4,500	At least $105,700 per year	

Existing Pollution Problems

At the time of the assessment, there were a number of pollution problems at the facility, including (1) excessive loss of water, chemicals, and heat energy from the becks, (2) excessive use of water in the rinsing process due to residual solution left at bottom of the beck, (3) excessive suspended solids, primarily lint washed off fabric, (4) leakage of detergent-laden water from the wool washing machines, (5) excessive pH of effluent from the decarbonizing acid bath, (6) excessively hot effluent, (7) excessive oil and grease and sulfate concentrations in effluent, (8) leakage from steam coils, (9) hydrogen sulfide generation at the wool laundry sump, (10) disposal of dry wool, cotton combings and shavings, and sodium sulfate bags (materials that could be recycled), (11) excessive air emissions of particulates, and (12) lint and sulfuric acid mist in the wool laundry room.

This facility uses about twice as much water as the average commission batch dyer its size; thus, many of the recommendations focus on reducing water consumption and the energy required to heat it for various dyeing processes.

Pollution Prevention Opportunities

The assessment identified almost 40 pollution prevention opportunities that could address the problems identified, with significant environmental and economic benefits to the facility. The assessment team prioritized these opportunities based on pollution prevented and implementation cost. **Table 1** lists the high priority opportunities recommended for the facility and presents the environmental benefits, savings and implementation costs, and estimated payback period for each (a complete list of recommendations is available from the EP3 Clearinghouse). Many of the recommendations can be implemented with no capital investment. Further, many can be implemented almost immediately, and most are not dependent upon other projects for their initiation.

Of the 19 high priority opportunities recommended, the savings possible from implementing six have been quantified. These six recommendations will reduce operating costs by almost US$106,000 per year for an initial investment of US$1,900. The simple payback period for these changes is one week. Another US$2,600 in investments is required to implement other changes whose savings potential cannot be quantified without further research.

Effect on the Environment

Implementation of the recommended actions will produce positive environmental impacts in three areas: reduced air emissions, lower water and chemical use, and reduced generation of solid waste.

Air Emissions. Many of the proposed changes will reduce steam consumption and lower fuel use, thereby reducing air emissions. Repairing all traps should reduce fuel consumption by 36 percent, or 454 metric tons of number 6 residual oil per year. The expected reductions in air emissions from this change total over 14 metric tons per year. In addition, this change will result in reduced carbon dioxide and heavy metal emissions.

Water and Chemical Use. When all rinsing changes have been implemented, the facility should consume half the water it currently does. The yearly reduction in water use will be about 125,000 cubic meters. Chemical use will decline due to a number of changes. Sulfate in the effluent will be reduced by more than 70,000 kg/year by changing to sodium chloride and filtering the decarbonizing acid bath.

Releases to the sewer of other chemicals such as dye, dye stabilizers, de-foamers, detergents, sodium hydrosulfite, bleach, optical brighteners, acetic acid, equalizers, and boiler treatment chemicals will be reduced as a result of the recommended changes. Among the changes that will affect chemical releases are: (1) better process controls, (2) screening drains and cleaning sumps regularly to prevent sulfide generation, (3) preventing beck boil-over, (4) repairing coil steam leaks that contaminate boiler feed water and process baths, (5) using a lower-foaming jet-dye detergent, (6) calibrating and shimming becks, (7) repairing and modifying becks and wool laundries, and (8) determining sizing formulae. Until these changes are made, it is not possible to calculate the degree to which releases will be reduced.

Solid Waste. Solid waste discarded by the facility consists mainly of sulfate chemical bags and shavings and combings from fabric finishing. Assuming that the eight sulfate bags generator per day fill one large (0.1 cubic meter) garbage bag and that the combings fill ten bags per day, the yearly uncompressed volume of these solid wastes is 330 cubic meters. If both wastes are recycled, this volume of waste can be reused at least once before being discarded.

For Further Information

For futher information on this assessment or other activities sponsored by EP3, call the EP3 Clearinghouse at (703) 351-4004, send a fax to (703) 351-6166, or on Internet: ep3clear@habaco.com