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Pollution Prevention Assessment for a Cattle Hide Tannery CASE STUDY

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 cattle hide tannery. The objective of the assessment was to identify actions that would: (1) reduce the quantity of toxics, raw materials, and energy used in the manufacturing process, thereby reducing pollution and worker exposure, (2) demonstrate the environmental and economic value of pollution prevention methods to the tanning industry, and (3) improve operating efficiency and product quality.

The assessment was performed by an EP3 team comprised of a US expert in hide tanning, a pollution prevention specialist, in-country EP3 staff, and local consultants.

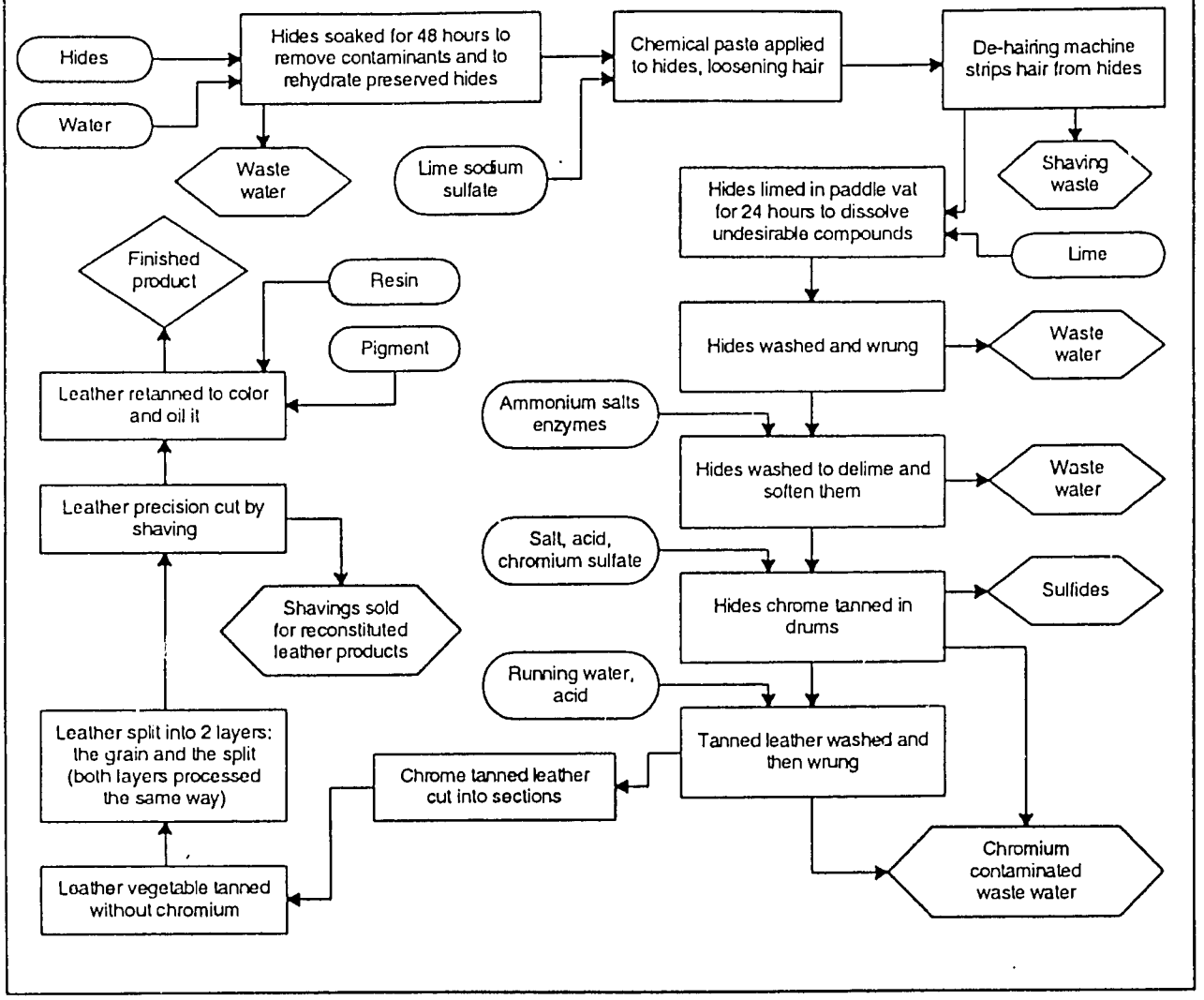
Overall, the assessment identified nine pollution prevention opportunities at this facility. Recommendations for pollution prevention include using fleshings for rendering, recycling the spent chrome tanning wastes, recycling some wash water to compatible processes, oxidizing the sulfide containing wastes, reducing suspended solids by physico-chemical precipitation, using solid wastes from the waste stream as fertilizer, instituting secondary treatment of the waste stream, and reducing VOC emissions by changing to water-based lacquer finishes.

Facility Background

This facility is a cattle hide tannery producing chrome tanned and vegetable tanned leather from salted cattle hides. The wastes generated by the tannery come from the hides and the chemicals used in the production process. The tannery has a nominal production capacity of five hundred hides per day. The hides average 23-24 kg, with the total weight of hides at 12,000 kg/day. Chrome/vegetable retan leather accounts for 10,640 kg of hides per day, while vegetable tan leather accounts for the remaining 1,560 kg. The hides are domestic and imported from small slaughter house production.

EP3 is sponsored by the U.S. Agency for International Development.

Figure 1: Overview of Facility's Cattle Hide Tanning Process



Manufacturing Process

See Figure 1. The salted hides are inspected, resalted if needed, then weighed into production lots. The hides are placed in a conventional drum and soaked in cold water. Some minor chemicals may be added to assist in the soaking. The water use is approximately two liters of water per kg of hide. After the desired soaking time, the hides are washed in additional water.

The hair pulp process is carried out in the same drums as the soak. First, the hides are treated with lime and sulfides. Then, more lime is added and the hides are washed in cold water in the rotating drum.

The washed, limed hides are removed from the drum, wrung, then placed in a drum for deliming and bating. This process involves the use of ammonium salts and enzymes, which remove most of the lime from the hide.

The next step is chrome tanning, which is conducted in drums. The hides are placed in a solution of salt and acid, followed by the chrome tanning agent (chromium sulfate). The pH of the solution is adjusted by adding magnesium oxide. When the chrome tannage is complete, the leather is washed with running water and the surface is then cleaned by adding a small quantity of acid. The tanned leather is then removed from the drum and wrung.

The hides to be vegetable tanned are separated from the other hides after liming. These hides are cut into sections for bellies, shoulders, and bends in order to assure the most efficient use of the expensive veg-

Table 1: Summary of Recommended Pollution Prevention Opportunities

Unit Operation	Pollution Prevention Action and Environmental/ Product Quality Benefit	Cost	Financial Benefit	Payback Period
Fleshings from Soaked Hides	Use fleshings for rendering - decreases solid waste by 1000-1500 kg per day.None.To be determined	$3,000	To be determined	To be determined
Chromium Tanning	Recycle chrome tanning - decreases Chromium to less than 3 mg/l.	$20,000 (saves $60,000 per year).	To be determined	To be determined
Solvent Discharge	Change to water-based lacquer finish - decreases VOC discharge by 60-90 percent.	None.	To be determined	To be determined
Water Use	Recycle some wash and cooling water to compatible processes - decreases water usage by 130-150 cubic meters per day.	$20,000 (pumps, pipes, tanks)	To be determined	To be determined
Sulfide Waste	Destroy sulfides by air oxidation - decreases sulfide in effluent to less than 3 mg/l.	$30,000 (pumps, pipes, tanks)	To be determined	To be determined
Primary Treatment	Physico-chemical precipitation with spent unhairing waste -decreases suspended solids by 60-80 percent; decreases BOD by 40-60 percent.	$100,000 (pumps, pipes, tanks)	To be determined	To be determined
Sludge from Primary Treatment	Dry sludge for land application - disposes of sludge as fertilizer.	$20,000 (sand filters)	To be determined	To be determined
Secondary Treatment	Treat primary waste - decreases BOD by 60-80 percent.	$50,000 (trickling filters)	To be determined	To be determined
TOTALS		$240,000 capital costs, with $60,000 savings/yr.		

etable tanning materials. The vegetable tanning is done without the use of chromium. Because the retan system for the chrome tanned leather is also a vegetable tannage, in most cases the effluent from the vegetable tannages is combined with the other effluents from the retan step.

The chrome tanned leather, after wringing, is split to the desired thickness. This results in two layers of leather: the grain and the split. The grain layer is the larger and more valuable layer. The split is trimmed and further processed in the same manner as the grain leather. Following splitting, the leather is precision cut to the desired thickness by shaving, which involves a high speed rotating blade that removes leather in small shavings (1 x 3 mm). These shavings are sold to be used in reconstituted leather products.

The chrome tanned leather is retanned in small batches to color and oil the leather as desired. The retan formulations vary widely depending on the leather desired. In most of the leather made in this tannery, vegetable tanning materials are used. In addition, dyes, specialty chemicals, and leather lubricating oils are applied. The retanning process produces large quantities of effluent with relatively low pollutant concentrations.

Existing Pollution Problems

At the time of the assessment, there were a number of pollution problems at the facility, including excessive: (1) solid waste, (2) chromium discharge, (3) VOC discharge, (4) water usage, (5) sulfide waste, (6) suspended solids in effluent, and (7) BOD of effluent.

Pollution Prevention Opportunities

The assessment identified nine pollution prevention opportunities that could address the problems identified, with significant environmental and economic benefits to the facility. Table 1 lists the opportunities recommended for the facility, and presents the environmental benefits and implementation costs for each. Two of the recommendations can be implemented with no capital investment.

The largest sources of pollutants at the plant are the soaking and hair pulp systems, which have very high concentrations of suspended solids and high BOD. The hair pulp system also contains sulfides and strong alkali as calcium hydroxide. Sulfides are deadly toxic

materials and must be destroyed chemically. The normal treatment system in the industry is to collect all the sulfide containing wastes, then oxidize the sulfides with air with a manganese sulfate catalyst. The lime solution, free of sulfide, can be used to neutralize the acid wastes to adjust the pH to the acceptable range.

The mixing of the acid and alkaline wastes at a controlled pH will result in a coagulation of the suspended solids. The removal of the coagulated materials by primary treatment will result in a decrease of suspended solids by about 80 percent. The primary treatment of tannery wastes by coagulation and settling will also decrease the BOD by 50-70 percent. This approach has been successfully used in at many tanneries.

The chrome tanning wastes contain valuable chrome tanning materials. These spent solutions should be recycled to remove the chromium from the effluent and also reduce processing costs.

It is recommended that several steps be taken by the tannery:

- The hides, after washing, should be fleshed before the hair pulp step, improving the quality of the production and allowing the sale of 1000-1500 kg of fleshings per day to a rendering facility.
- Recycling spent chrome tanning solutions will produce economic benefits for the tannery, decrease water use and prevent pollution of the effluent by chromium.
- Recycling some water washes that are only slightly contaminated with process chemicals, where compatible with production processes, will result in water use reduction.
- Removing toxic sulfides from the waste stream by oxidation will effectively decrease the sulfide in the waste stream to less than 3 mg/l.
- Mixing the separated waste streams with pH control, after sulfide oxidation and chromium removal, will co-precipitate the suspended solids and decrease the BOD.
- Implementing secondary treatment, which will lower BOD, should be delayed until the primary system has been optimized. At that time, the most cost effective method for BOD reduction can be determined.

Implementation of the Recommendations

The implementation of the recommendations will be required to meet regulatory pollution abatement requirements.

Wash Water. The change in hide washing practices to produce better hair pulping and cleaner flesh is a relatively simple matter. There is no quality risk in this change and it should be taken as soon as possible.

Chrome Recovery. In addition to pollution prevention benefits, recycling chrome tanning solutions has technical benefits for the tanner. This step is not simple, however, and will require some process adjustments. Required personnel should be hired and the project started as soon as possible.

Sulfide Oxidation. The pollution control regulations require sulfide oxidation; this step can not be avoided. The engineering of the sulfide oxidation system should be started and the project implemented as soon as possible.

Primary Treatment. The primary treatment system is the most extensive project recommended in this report. The suspended solids requirements make the primary treatment system essential. The design of the system should begin immediately and construction should start when planning is complete.

For Further Information

For further 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 at apenderg@habaco.com.