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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 facility that tans cattle hides. 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 leather tanning and a pollution prevention specialist.

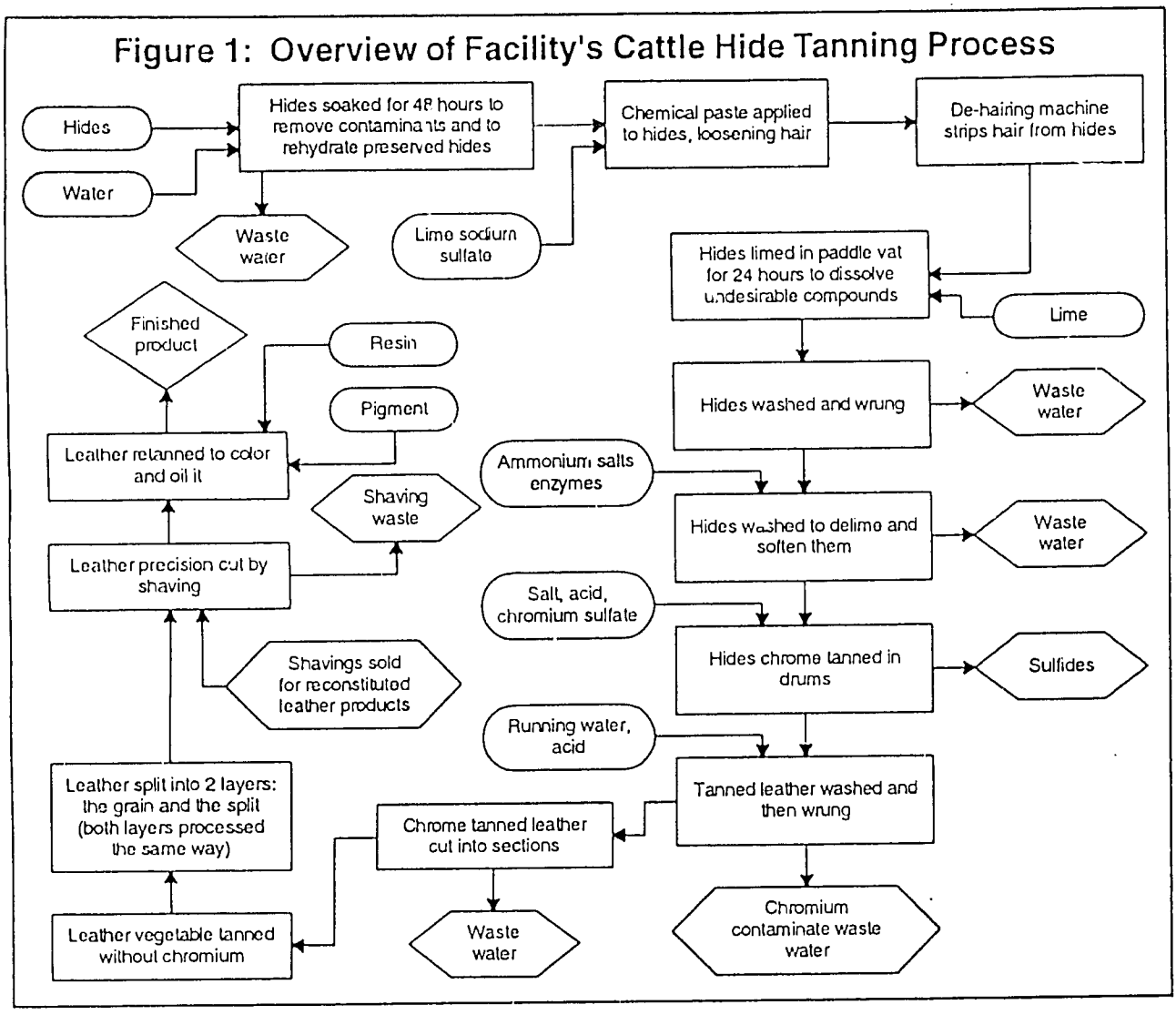
Overall, the assessment identified eight pollution prevention opportunities at this facility. Recommendations include recycling the spent chrome tanning wastes, oxidizing the sulfide containing wastes, decreasing the volatile organic discharge by changing finishing materials, decreasing water use by batch washing, and using solid wastes from the waste stream as fertilizer.

Facility Background

This facility is a cattle hide tannery producing chrome tanned shoe upper leather from salted cattle hides. The tannery has a nominal capacity of five hundred hides per day. Monthly production is 25 days at 400 hides per day, with an average hide weight of 23 kg. The total weight of hides processed per day is 9,200 kg.

The wastes generated by the tannery come from the hides and the chemicals used in the tanning process. Tannery wastes are discharged in a number of batches during the production day.

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



Manufacturing Process

Figure 1 outlines the process of leather production at the plant. In the production of leather from salted cattle hides, the hides must be thoroughly re-wet, and the dirt, salt and undesirable hide substances must be removed. Soaking and washing the skins is done in a series of steps to remove dirt, salt, and organic matter, and rinse the hides. The waste water is nearly neutral, and contains salt and some suspended solids.

Next, the skins are unhaired by treatment with lime and sulfides. The waste water is very alkaline, contains toxic sulfides, and is the main cause of the high BOD and suspended solids in the total waste stream.

The next step is de-liming to remove the lime in the skins and soften them by enzymatic action. The first dump of this process contains ammonium sulfate, enzymes, and some protein. The subsequent washes are very dilute, nearly neutral pH solutions.

The skins are then tanned. The chrome tanning process is standard for the industry: the solutions contain chromium as chromium sulfate salt and some free acid. About 75 percent of the chromium present combines with the hide.

Finally, the color and fatliquor steps are employed to color and oil the leather to make it as soft or firm as desired. A number of chemicals are used in these steps, and about 90 percent of the load is fixed to the leather. The spent solutions are mildly acidic, with a pH of between 4 and 6, BOD and suspended solids are relatively low.

Table 1: Summary of Recommended Pollution Prevention Opportunities

Unit Operation	Pollution Prevention Action and Environmental/ Product Quality Benefit	Cost	Payback Period
Chromium Tanning	Recycle chrome tanning - decreases Chromium to less than 3 mg/l	$20,000 (saves $60,000 per year)	4 months
Solvent Discharge	Change to water-based lacquer finish - decreases VOC discharge by 60-90 percent	None	To be determined
Water Use	Change to batch washes - decreases water usage by 20-40 percent	None	To be determined
Solid Waste	Save leather trimmings for reconstituted leather - decrease leather waste by 60-80 percent	10,000	To be determined
Sulfide Waste	Destroy sulfides by air oxidation - decreases sulfide waste by 95-98 percent	30,000	To be determined
Suspended Solids	Primary treatment - decreases suspended solids by 70-85 percent	100,000	To be determined
Sludge from Effluent	Dry sludge for land application - allows disposal of sludge as fertilizer	20,000	To be determined
Secondary Treatment	Treat primary waste - decreases BOD by 60-80 percent	$50,000 (trickling filters)	To be determined
TOTALS		$230,000 capital costs	

Existing Pollution Problems

At the time of the assessment, there were a number of pollution problems at the facility, including excessive (1) chromium discharge, (2) VOC discharge, (3) water usage, (4) leather waste, (5) sulfide waste, (6) suspended solids in effluent, (7) oil and grease in the effluent, and (8) BOD of effluent.

Pollution Prevention Opportunities

The assessment identified eight pollution prevention opportunities that could address the problems identified, with significant environmental and economic benefits to the facility (see Table 1). Two of the recommendations can be implemented with no capital investment.

The recommended actions are based on cost effective methods that have been proven in commercial applications:

Chromium recycling. This step allows the collection of the spent chrome tanning solutions, without dilution or contamination, for use in the pickle and tanning process. Since the tannery also tans splits, the spent chrome tanning solution can be used here as well. The tanning of splits results in very good fixation of chromium, so the concentration of chromium in the final effluent should meet effluent regulations. This system results in a saving of about 25 percent in the chromium chemicals used.

Solvents. The suppliers of finishing products have developed water-based lacquers with significantly lower volatile solvent contents. These materials are now widely accepted as quality products, and their use is strongly advised.

Process Water. In some hide wetting processes there is an opportunity to recycle the final rinses. The final rinse waste water in this process is compatible with fluids used for the first wetting of the hides.

Solid Waste. Elimination of solid leather waste discharges through the use of trimmings in reconstituted leather will ease the burden on landfills.

Capital Intensive Modifications. Eliminating sulfides from the effluent is very important, as they will corrode pipes, cause objectionable odors, and may cause fatal accidents. The sulfide-lime solution, and washes from this process, can be collected without contamination from other solutions. These collected wastes can be placed in a tank and the sulfides oxidized by air with a catalyst. This method is effective and can destroy the sulfide in 4-8 hours.

At this point the lime waste, with high BOD and suspended solids, can be used to neutralize the acid wastes that are being continuously discharged. The

acid and alkaline wastes from the tanning process will react to produce a co-precipitation of much of the suspended solids and BOD. This is done with a mixing tank and automatic pH control. Coagulants can also be added at this point.

The neutral streams can then flow to a primary clarifier for the removal of suspended solids as sludge. The sludge can be dewatered in a sand bed to more than 50 percent solids for disposal. Although this effluent is somewhat high in BOD, over 80 percent of the pollution load has been removed. The sludge is a good soil conditioner, and if used as such, will eliminate possible high disposal costs.

Secondary Treatment. In the future, a secondary treatment system can be added for BOD removal. The secondary system need only be as large as needed for the clarified wastes, and it may consist of a trickle filter, a secondary clarifier, and/or a filter press.

Effect on the Environment

Implementation of the suggestions will lead to a number of positive environmental benefits. Chromium recycling will decrease the chromium in the discharge by 80-90 percent. The reduction of volatile solvents will decrease VOC releases to the atmosphere by 60-75 percent. Changes to water usage patterns will decrease effluent volume by 30 percent. Elimination of solid leather waste discharges through the use of trimmings in reconstituted leather eases the burden on landfills. With primary and secondary treatment, the BOD can be reduced by 75 percent. In addition, the suspended solid reduction creates a useable by-product in the form of an organic fertilizer.

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 apenderg@habaco.com.