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EP3
Environmental Pollution Prevention Project

CASE STUDY
Chile

Pollution Prevention Implementation at a Goatskin Tannery

Executive Summary

The Environmental Pollution Prevention Project (EP3) identified and assisted with the implementation of pollution prevention measures at a goatskin tannery in Chile.

In 1993, an EP3 assessment team, comprised of a hide tanning expert and a pollution prevention specialist, conducted a pollution prevention diagnostic assessment at the facility. The team identified a total of eight pollution prevention opportunities.

The original pollution prevention recommendations, if implemented, were expected to significantly reduce the facility's overall pollution output. Recommendations included: recycling spent chrome tanning wastes; oxidizing sulfide containing wastes; decreasing water use by instituting a batch wash system; and using solid wastes from the waste stream as fertilizer.

EP3 provided the facility with technical assistance and guidance over the course of the following year. The project then conducted a follow up diagnostic assessment in 1995 to investigate how the facility had implemented the original recommendations and to evaluate its success in preventing waste.

The implementation assessment identified that the facility had implemented five of the recommended measures. These measures have yielded the facility annual savings of $59,950.

Facility Background

The facility is a goatskin tannery producing chrome tanned suede and grain shoe, garment, and fancy leathers. Dry and salted skins, as well as wet blue goatskins are used. The tannery produces leather from approximately 1,000 kilograms (kg) of dried goatskins per day.

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

Manufacturing Process

Figure 1 outlines the process of leather production at the plant. In the production of leather from dry goatskins, the dry skins must be thoroughly re-wet and the dirt, salt, and undesirable hide substances removed.

Soaking and washing of the skins is done in three steps. The first step removes dirt, salt, and some organic matter, while the remaining steps are rinses. The wastewater from this process contains salt and some suspended solids. Next, the skins are dehaired by treatment with lime and sulfides. This wastewater is very alkaline, contains toxic sulfides, and is the main cause of the high biological oxygen demand (BOD) and suspended solids in the total waste stream.

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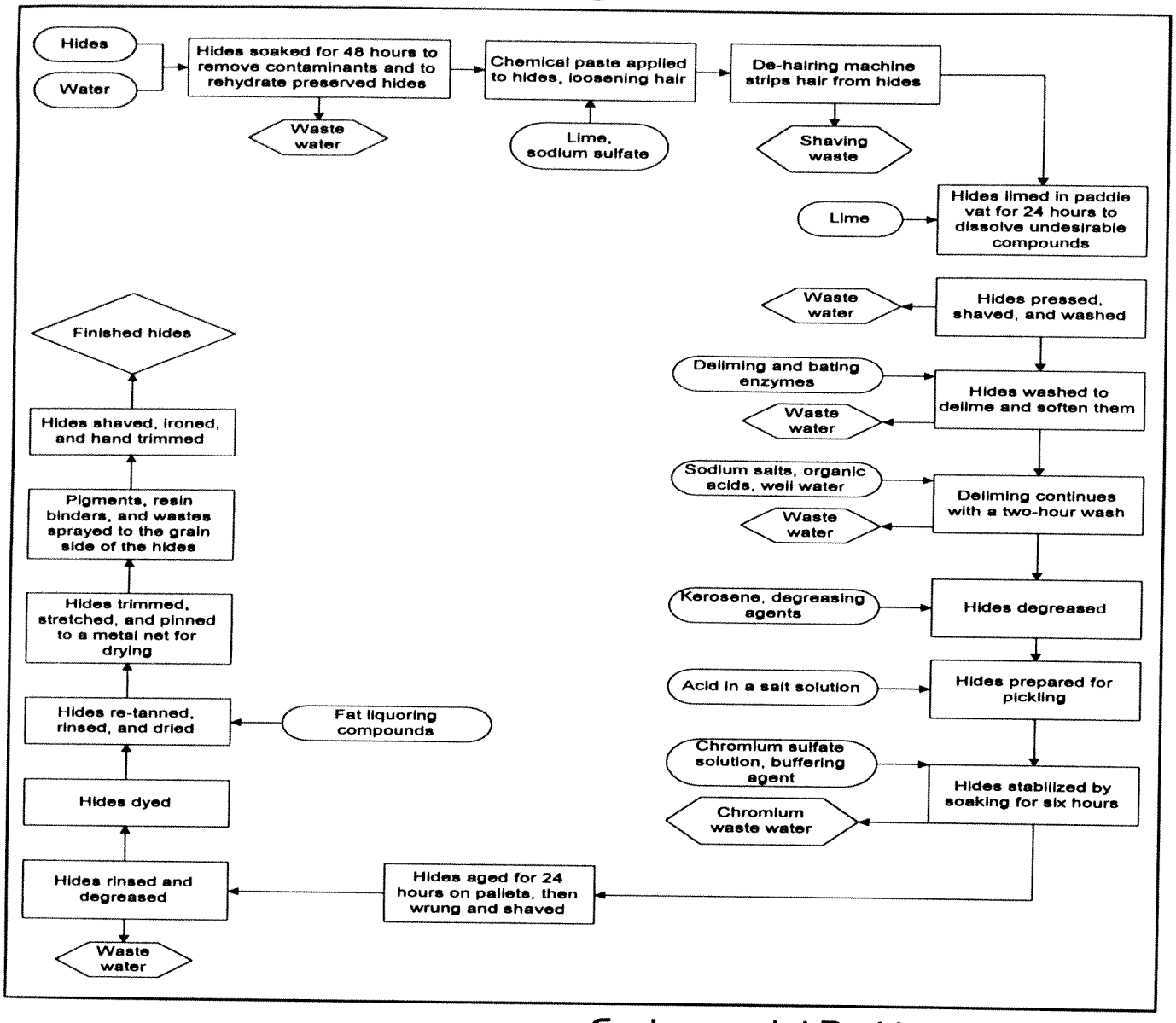
Figure I: Overview of Goatskin Tanning Process



The next step is de-liming and bating to remove the lime in the skins and soften them by enzymatic action. The first stage of this process involves a bath with ammonium sulfate, enzymes, and some protein. The subsequent baths 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 sulfate salt and some free acid. Approximately 75% of the chromium present combines with the hide.

Finally, the re-tan, color, and fat liquor 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% of the load is fixed to the leather. The spent solutions are mildly acidic, with a pH of between 4 and 6.

Environmental Problems

The original assessment identified a number of water, air, and solid waste pollution problems at the facility. Water was used excessively and the wastewater stream contained high concentrations of chromium, sulfides, leather pieces, suspended solids, oil and grease, and BOD. Volatile organic compounds (VOCs) were released to the air as a result of lacquering operations. Solid wastes, such as leather scraps and hair, were regularly disposed of into the wastestream.

Pollution Prevention Opportunities and Implementation

This section details the tanning processes and pollution prevention opportunities that were identified during the original assessment and the actions that the

Table I: Summary of Pollution Prevention Opportunities

Unit Operation	Pollution Prevention Action	Implementation Status	Environmental Benefit	Implementation Cost (US$) Projected/Actual	Financial Benefits (US$) Projected/Actual	Simple Payback Period Projected/Actual
Chromium Tanning	Recycle chrome tanning solution	*IMPLEMENTED*	Chromium level in wastewater reduced by 500 kg/month	Projected: $5,000 Actual: $0	Projected: Unknown Actual: $10,000/year	Projected: Unknown Actual: Immediate
Solvent Discharge	Use water-based lacquer finishes	*IMPLEMENTED*	VOC emissions reduced by 80%	Projected: $0 Actual: $35,000	Projected: Unknown Actual: $35,000/year	Projected: 6-12 months Actual: 12 months
Water Use	Use batch washes	*IMPLEMENTED*	Water use reduced by 900,000 l/month	Projected: $0 Actual: $30,000	Projected: Unknown Actual: $4,500/year	Projected: Unknown Actual: 80 months
Solid Waste	Modify leather disposal procedures	*IMPLEMENTED*	Solid waste reduced by 0.7- 1.45 tons/month	Projected: $5,000 Actual: $0	Projected: Unknown Actual: $450/year	Projected: Unknown Actual: Immediate
Sulfide Waste	Oxidize sulfides	*IMPLEMENTED*	Sulfide and sulfate use reduced by 42% and 55% respectively	Projected: $20,000 Actual: $0	Projected: Unknown Actual: $10,000	Unknown
Primary Treatment	Install primary treatment system	Implementation under consideration	Suspended solids reduced	Projected: $50,000 Actual: Unknown	Unknown	Unknown
Sludge from Effluent	Dry sludge for land application	Not implemented	Sludge in effluent reduced	Projected: $10,000 Actual: N/A	Projected: Unknown Actual: N/A	Projected: Unknown Actual: N/A
Secondary Treatment	Install secondary treatment system	Implementation under consideration	BOD reduced	Projected: $50,000 Actual: Unknown	Unknown	Unknown

facility has undertaken since that time.

Table 1 lists the pollution prevention opportunities, indicates the implementation status of the recommended measures, identifies the environmental benefits associated with those measures, and presents data on projected and actual implementation costs and savings.

Recycle Chrome Tanning Solution.

- *Opportunity*: Recycling will decrease the chromium in the wastewater discharge by 80-90%. The spent chromium solutions contain about 25% of the total chromium used in the tannage. The loss of this valuable material can be decreased and the chromium concentration lowered by recycling. Some of the spent chromium solution can be directly used to make the pickle solution without affecting the quality of the leather. The remainder can be saved, and the chromium precipitated with the addition of an alkali. The recovered chromium can be dissolved in acid for use in the tannage. The recycling of the chrome tanning solutions is the most cost effective recommendation in that the company will have a large saving in material costs in addition to significant pollution prevention. The value of chrome recycling to the tannery and its low capital costs should make it an attractive option.
- *Implementation status*: This measure has been implemented. The facility now uses 500 kg/month (or 20% less chromium with its new recycling procedures. Additives added to the chromium have led to an 80% reduction in the amount of chromium that is lost.

Use Water-Based Lacquer Finishes.

- *Opportunity*: The suppliers of finishing products have developed water-based lacquers with sig-

nificantly lower volatile solvent contents. The reduction of volatile solvents will decrease VOC releases to the atmosphere by 60-75%.

- *Implementation status*: This measure has been implemented. With the change to water-based finishes, VOC emissions have decreased by 80%. Emission particles have been reduced by 90%.

Use Batch Washes.

- *Opportunity*: In some hide wetting processes there is an opportunity to recycle the final rinses. In the goatskin process, extensive washing of the bated skin is common. The water from this wash could be used for rinse water in the original soaking, as the final rinse wastewater is compatible with fluids used for the first wetting of hides. The judicious recycling of rinse waters and the use of automated systems in the tannery could result in savings of up to 50% of water consumed. The decrease in the volume of process water used can be accomplished without a capital investment. The batch washing of coloring and fatliqouring batches could result in savings of about 50% in these operations. With the recommended pretreatment system, a decrease in flow would decrease the capital and operating costs of the treatment system.
- *Implementation status*: This measure has been implemented. Water use has been reduced by 900,000 liters (l)/month. Wastewater discharge has experienced a similar reduction, from 98,000 l/day to 64,000 l/day. This decreased volume of discharged wastewater means that the facility will spend less in wastewater treatment costs. A system has been installed to automatically control process water quantites. Rinse water is also recycled, leading to a 30-50% reduction in water use for that purpose.

Modify Leather Disposal Procedures.

- *Opportunity*: Solid leather waste discharges should be eliminated by using trimmings to make reconstituted leather. This step will ease the burden on local landfills.
- *Implementation status*: Although this measure was implemented, the facility found that using the goat skin trimmings to manufacture reconstituted leather yielded poor product quality.

Oxidize Sulfides.

- *Opportunity*: Eliminating sulfide discharges is very important as sulfides can corrode pipes, cause objectionable odors, and cause fatal accidents. The sulfide-lime solution, and washes from this process can be easily collected, placed in a tank, and the sulfides oxidized by air with a manganese sulfate catalyst. This method is effective and can destroy the sulfide in 4-8 hours. The oxidized wastes can be kept for use in controlling the pH of the effluent stream.
- *Implementation status*: This measure has been implemented. In addition, the facility fleshes the hides before the pulping process which leads to lower sulfide and sulfate generation. The use of an amine additive has translated into a 42% reduction in the amount of sulfate and 55% in the amount of lime used.

Install Primary and Secondary Treatment Systems.

- *Opportunity*: Suspended solids can be reduced by 80% through a primary waste treatment system. A secondary waste treatment system will help to reduce the BOD of the wastewater. With primary and secondary treatment, BOD levels can be reduced by 75%.
- *Implementation status*: The facility is considering joining with other facilities in the area to construct waste treatment systems.

Dry Sludge for Land Application.

- *Opportunity*: The reduction of suspended solids creates a useable by-product in the form of an organic fertilizer, thus eliminating possible high disposal costs. At present, the tannery has disposed of most of its solid wastes in the form of fleshings, trimmings, and leather shavings. With the introduction of a pre-treatment system, a new source of solid waste -- about 1,000 kg of solid sludge containing 120-150 kg of nitrogen -- will be generated. This organic nitrogen and the other materials in the sludge have been proven to be very valuable as fertilizers and soil conditioners.
- *Implementation status*: This measure has not been implemented. The facility has managed to reduce its solid waste disposal load (e.g., clippings, grease, and paint) by 5-10%. Screens installed in the floor have reduced effluent load and toxicity.

Benefits of Implementation

The facility reports yearly savings of at least $59,950 from the measures that it has implemented. The payback period for the facility's total investment of $65,000 averages 13 months.

Implemented process changes have also translated into higher product quality. Ventilation and gas extraction systems have been added to work areas and have led to noticeably improved environmental working conditions.

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: ep3clear@habaco.com