Multilateral Investment Guarantee Agency

Environmental Guidelines for

Tanning and Leather Finishing

Industry Description and Practices

Preservation of hides and skins is sometimes performed to enable raw hides and skins to reach leather tanneries in an acceptable condition. Commonly used preservation techniques include drying, salting, and chilling. The use of environmentally persistent toxics for preservation of raw hides and skins is to be avoided. In the tanning process, animal hides and skins are treated to remove hair, and nonstructured proteins and fats, leaving an essentially pure collagen matrix. The hides are then preserved by impregnation with tanning agents. Leather production usually involves three distinct phases: (a) preparation (in the beamhouse); (b) tanning (in the tanyard); and (c) finishing, including dyeing and surface treatment. A wide range of processes and chemicals (including chrome salts) are used in the tanning and finishing processes.

The tanning and finishing process generally consists of:

- soaking and washing to remove salt, restore the moisture contents of the hides, and remove any foreign material such as dirt and manure;
- liming to open up the collagen structure by removing interstitial material;
- fleshing to remove excess tissue from the interior of the hide;
- dehairing/dewooling to remove hair/wool either by mechanical or chemical means;
- bating and pickling to delime the skins, and condition the hides to receive the tanning agents;
- tanning to stabilize the hide material and impart basic properties to the hides;
- retanning, dyeing, and fat-liquoring to impart special properties to the leather, increase penetration of tanning solution, replenish oils in the hides and impart color to the leather; and
- finishing to final product specification.

Waste Characteristics

The potential environmental impacts of tanning are significant. A composite untreated wastewater, 20 to 80 cubic meters per metric ton (m^3/t) of hide or skin, is turbid, colored, and foul smelling. It consists of acidic and alkaline liquors, with chromium levels from 100 to 400 milligrams per liter (mg/L), sulfide levels from 200 to 800 mg/L, nitrogen levels from 200 to 1,000 mg/L, biochemical oxygen demand (BOD_5) levels from 900 to 6,000 mg/L, (usually ranging from 160 to 24,000), chemical oxygen demand (COD) (ranging from 800 to 43,000 mg/L in separate streams with combined wastewater levels of 2,400 to 14,000 (mg/L), and chloride (200 to 70,000 mg/L in individual streams and 5,600 to 27,000 mg/L in the combined stream) and high levels of fat. Suspended solids are usually half of chloride levels. It may also contain residues of pesticides used to preserve hides during transport and pathogens at significant levels. Significant volumes of solid wastes are produced, including trimmings, degraded hide, and hair from the beamhouse processes. The solid wastes can represent up to 70% of the (wet) weight of the original hides. In addition, large quantities of sludges are generated. Decaying organic material produces strong odors. Hydrogen sulfide is released during dehairing. Ammonia is released during deliming. Air quality may be further degraded by release of

solvent vapors from spray application, degreasing, and finishing (for example, dye application).

Pollution Prevention and Control

The design of new plants should address the following process modifications:

- Process fresh hides or skins to reduce the quantity of salt in wastewater, where feasible.
- Reduce the quantities of salt used for preservation. When salted skins are used as raw material, pretreat the skins with salt elimination methods.
- Use salt or chilling methods to preserve hides instead of persistent insecticides and fungicides.
- When antiseptics/biocides are necessary, avoid toxic and less degradable ones especially those containing arsenic, mercury, lindane, pentachlorophenol or other chlorinated substances.
- Fleshing of green hides instead of limed hides.
- Use sulfide and lime as a 20-50% solution to reduce sulfide levels in wastewater.
- Split limed hides to reduce the amount of chrome needed for tanning.
- Consider the use of carbon dioxide in deliming to reduce ammonia in wastewater.
- Use only trivalent chrome when required for tanning.
- Inject tanning solution in the skin using high pressure nozzles and implement chrome recovery from chrome containing wastewaters which should be kept segregated from other wastewaters. Recycle chrome after precipitation and acidification. Improve fixation of chrome by addition of dicarboxylic acids.
- Recycle spent chrome liquor to the tanning process or to the pickling vat.
- Examine alternatives to chrome in tanning, such as titanium, aluminum, iron zirconium, and vegetable tanning agents.
- Use non organic solvents for dyeing and finishing.
- Recover hair by using hair saving methods (for example, avoid dissolving hair in chemical both by proper choice of chemicals and use screens to remove them from wastewater) to reduce pollution loads.
- Use photocell assisted paint spraying techniques to avoid over spraying.
- Precondition hides before vegetable tanning.

Through good management, water use can be reduced by 30-50% to 25 liters per kilograms (L/kg) of raw material. Actions to reduce water consumption should include the following:

- Monitoring and control of process waters–reductions of up to 50% can be achieved.
- Batch washing instead of continuous washing -- reductions of up to 50%.
- Use low float methods such as having 40-80% floats. Recycle liming, pickling, and tanning floats. Recycle sulfide in spent liming liquor after screening to reduce sulfide losses (say by 20-50%) and lime loss (say by 40-60%).
- Use of drums instead of pit for immersion of hides.
- Reuse of wastewaters for washing—for example, by recycling lime wash water to the soaking stage. Reuse treated wastewaters in the process to the extent feasible (such as in soaking and pickling).

Waste reduction measures should include the following:

- Recover hide trimmings for use in the manufacture of glue, gelatin, and similar products.
- Recover grease for rendering. Use aqueous degreasing methods.
- Recycle wastes to the extent feasible in the manufacture of fertilizer, animal feed, and tallow provided the quality of these is not compromised.
- Use tanned shavings in leather board manufacture.
- Control odor problems by good housekeeping, such as minimal storage of flesh trimmings and organic material.
- Recover energy from the drying process to heat process water.

Target Pollution Loads

Implementation of cleaner production processes and pollution prevention measures can provide both economic and environmental benefits. The following production-related waste load figures can be achieved by implementing measures such as those detailed in the previous section.

The figures are for the waste loads arising from the production processes before the addition of pollution control measures.

These levels are derived from typical loads recorded in industry studies and should be used as maximum levels of unit pollution in the design of new plants.

Target Loads per Unit of Production

Parameter	*Maximum value (kg per t raw material)*
BOD_5	40
COD	140
Nitrogen	7
Chromium	6 (aim for 1.5)
Sulfide	1
Solid waste	500
Effluent flow rate	30,000 (aim for 15,000)

Sources: UNEP, 1991, and Indian Standards Institution, 1977.

Volatile organic compounds (VOC) emissions from finishing of less than 4 (aim for 2) kg/t (by using techniques such as water based paints and roller coating).

Treatment Technologies

Treatment of tannery wastewaters is always required. Some streams, such as soaking liquor (which has high salinity), sulfide-rich lime liquor, and chrome wastewaters should be segregated. Preliminary screening of wastewaters is required because of the large quantities of solids present. Hair recovery from the dehairing and liming process reduces the BOD of the process effluent. Physical-chemical treatment precipitates metals and removes a large portion of solids and BOD_5/COD. Biological treatment is usually required to reduce the remaining organic loads to acceptable levels (0.3 kg BOD, 2 kg COD, and 0.004 kg chromium per metric ton of raw hide.

Minimization of solvent release and good ventilation can avoid the need for collection and treatment of vapors in carbon adsorption beds. VOC emissions from finishing are approximately 30 kg/t if pollution prevention measures are not adopted.

Maximum upstream pollutant reduction is essential for tanneries, but treatment is also required.

Emission Guidelines

Emission levels for the design and operation of each project must be established through the Environmental Assessment (EA) process, based on country legislation and the *Pollution Prevention and Abatement Handbook* as applied to local conditions. The emission levels selected must be justified in the EA and acceptable to MIGA.

The following guidelines present emission levels normally acceptable to the World Bank Group in making decisions regarding provision of World Bank Group assistance, including MIGA guarantees; any deviations from these levels must be described in the project documentation.

The guidelines are expressed as concentrations to facilitate monitoring. Dilution of air emissions or effluents to achieve these guidelines is unacceptable.

All of the maximum levels should be achieved for at least 95% of the time that the plant or unit is operating, to be calculated as a proportion of annual operating hours.

Air Emissions

Odor controls should be implemented to reduce impacts on nearby residents.

Liquid Effluents

For tanning and leather finishing, the following effluent levels should be achieved:

Effluents from Tanning and Leather Finishing Processes

Parameter	*Maximum value milligrams per liter (mg/L)*
pH	6 - 9
BOD_5	50
COD	250
Total suspended solids	50
Oil and grease	10
Sulfide	1.0
Chromium (hexavalent)	0.1
Chromium (total)	0.5
Nitrogen (NH_4-N)	10
Phosphorus (total)	2
Coliform	400 Most Probable Number/100 ml

Note: Effluent requirements are for direct discharge to surface waters.

Solid Wastes

Solid wastes and sludges must be disposed of in a secure landfill.

Ambient Noise

Noise abatement measures should achieve either the following levels or a maximum increase in background levels of 3 dB(A). Measurements are to be taken at noise receptors located outside the project property boundary.

Ambient Noise

	Maximum Allowable L_{eq} (hourly), in dB(A)	
Receptor	*Daytime 07:00 - 22:00*	*Nighttime 22:00 - 07:00*
Residential; institutional; educational	55	45
Industrial; commercial	70	70

The emission requirements given here can be consistently achieved by well-designed, well-operated and well-maintained pollution control systems.

Monitoring and Reporting

Frequent sampling may be required during start-up and upset conditions. Once a record of consistent performance has been established, sampling for the parameters listed above should be on a monthly basis.

Annual monitoring for pesticides should be carried out and, if pesticides are present at levels of 0.05 mg/L and above, corrective actions should be taken.

Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Records of monitoring results should be kept in an acceptable format. These should be reported to the responsible authorities and relevant parties, as required, and provided to MIGA if requested.

Key Issues

The following box summarizes the key production and control practices that will lead to compliance with emissions guidelines:

- Minimize chrome use; avoid the use of hexavalent chrome and use trivalent chrome instead; recover and recycle chrome.
- Give preference to the following:

- Avoid the use of hides treated with persistent insecticides and fungicides.

- Use non-organic solvents for dyeing and finishing.

- Minimize storage of flesh trimmings and organic material.

- Adopt the following pollution prevention measures to reduce water use:

- Monitor and control process waters.

- Use batch instead of continuous washing.

- Use drums for immersion of hides.

- Reuse wash water and recycle floats.
- Segregate wastewater streams to simplify treatment.
- Minimize solid waste by recovery and reuse of hide trimmings.

Further Information

The following are suggested as sources of additional information (these sources are provided for guidance and are not intended to be comprehensive):

Danish Technological Institute. 1992. *Possibilities for a Reduction of the Pollution Load from Tanneries.* Final Report, Nordic Council of Ministers.

Indian Standards Institution. 1977. Guide for Treatment and Disposal of Effluents of Tanning Industry. New Delhi, India.

United Nations Environment Programme (UNEP). 1991. *Tanneries and the Environment: A Technical Guide to Reducing the Environmental Impact of Tannery Operations.*

World Bank, Environment Department. 1996. "Pollution Prevention and Abatement: Tanning and Leather Finishing." Technical Background Document.