



LEATHER PROCESSING

RESOURCE EFFICIENT AND CLEANER PRODUCTION BRIEFING AND RESOURCE GUIDE FOR MICRO & SMALL ENTERPRISES



PURPOSE

Issue. Certain process, technique, and management deficits are commonly found in micro- and small-scale leather processing operations. These deficits can have serious adverse effects on short- or long-term business performance---AND, on the local environment and on community health and safety. Among the most significant areas where economic savings can be realized through cleaner production are management actions that address **inefficient use of chemicals, excess chemical exposure by workers, excess water use, poorly managed waste streams, and poor process control.**

Response. Addressing these deficits by adopting resource-efficient and cleaner production (RECP) processes, techniques, and management practices can reduce costs and improve business performance and, at the same time, avoid or minimize adverse impacts on the local environment and on community health and safety. RECP approaches generally focus on improving resource and production efficiency which saves physical and energy resources, time, and money needed in production—and results in less waste and pollution. This briefing supports the application of RECP solutions in these five key areas.

Contents. This briefing addresses each deficit area in turn. General business, environmental and health and safety issues are identified first. Then, a question and answer format is used to identify specific deficits and potential RECP solutions. The References and Resources section at the end of this briefing provides more detailed and quantitative information on these solutions.

Audience. This briefing is intended for business development services providers working directly with leather processing MSEs, for those designing MSE strengthening projects, and for USAID staff (and the staff of other funding organizations) charged with overseeing projects in the leather processing sector.

Scope. This briefing focuses on MSEs that are processing animal hides into leather. However, some of the solutions outlined in this briefing could also be applied to MSEs that using animal hides to make glue, or agricultural operations that perform some of the initial tanning steps before selling hides.

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THE PROVEN BENEFITS OF RESOURCE EFFICIENT AND CLEANER PRODUCTION (RECP)

In 1990, UNEP defined Cleaner Production (CP) as “*The continuous application of an integrated environmental strategy to processes, products and services to increase efficiency and reduce risks to humans and the environment*”. The CP concept is widely accepted and promoted internationally, including by USAID. The strategies used to implement CP can be as simple as following the guidance in this briefing, or more complex and formal Environmental Management Systems (e.g., ISO 14001 standard) utilized by medium and large enterprises. UNEP is now advancing the concept of Resource Efficient and Cleaner Production, updating CP with additional emphasis on efficient utilization of resources in product and service enterprises.

This briefing is specifically concerned with RECP/CP technical and management interventions in production operations. Such interventions focus on (1) increasing the efficiency with which resources are utilized and/or (2) assuring that resources are utilized “cleanly”—without incurring costs and impacts that adversely affect the bottom line of the enterprise, the environment, and worker and community health and safety. Typical RECP interventions include:

- substituting different materials
- modifying processes
- improving process management
- upgrading equipment
- redesigning products

Inefficient use of resources like fuel, water and raw materials incurs both business and environmental costs. Experience shows that by reducing inefficiencies, RECP interventions in many cases substantially improve business performance AND deliver environmental, health and safety benefits—sometimes with little or no investment.

Is this always true? No. Some RECP interventions may not improve business performance. But RECP approaches offer the most cost-effective way to improve environmental or social performance when required by project implementation conditions, local regulations, or simply to preserve community goodwill.

For more information see <http://www.usaidgems.org/sme.htm>.

AREA 1: USE CHEMICALS EFFICIENTLY

Business Issues: Leather processing requires extensive use of chemicals to treat and soften hides. When chemicals are improperly or inefficiently used in production, costs rise. More efficient chemical use can lower production costs.

Environmental Issues: Toxicity is an issue for both human health and ecosystems. Inefficient use of chemicals increases concentration of chemicals and pollutants in the wastestream and soils. For example, hexavalent chromium in particular is highly toxic to aquatic animals at very small doses. It is also highly toxic to humans, causing kidney damage and increasing the risk of lung cancer in humans.

Community and Occupational Health and Safety Issues: Chemicals present in the facility's wastewater can contaminate soils and community water sources. Exposure to excess chemicals can have detrimental effects on workers and members of the surrounding community.

Use the following questions and answers to identify specific causes of inefficient chemical use and the corresponding RECP methods that address them.



A Bangladeshi woman embosses leather that will be used to manufacture handbags and shoes for export.

Can chrome tanning be replaced with less hazardous chemicals?

Consider using alternative chemicals that are less hazardous. Many leather tanning processes use hexavalent chromium, as well as chromium (III) sulfate, which can cause irritation to the eyes and respiratory tract of workers in contact with the chemical. It also can cause irritation to the gastrointestinal tract and renal failure in those who ingest chromium-contaminated water. Titanium, aluminum, iron, zirconium, or vegetable tanning agents (i.e. tannins) can be substituted for chromium (III) sulfate. However, take into consideration that leather tanned using chromium-based processes may be easier to work with, is softer, more water-proof, and require decreased production times.

Are chemicals recycled, and are bath temperatures controlled/ monitored?

Recycle chrome and tanning bath solutions.

Chrome and lime effluent can be reused in future

production stages without loss of effectiveness; use filters to screen out solid wastes and then set aside the solution to use it again. Assess the cost-effectiveness of such strategies before proceeding, however. For example, some chrome-recycling strategies may not be cost-effective for smaller operations.

Improve production methods to increase efficiency. Using higher temperatures and pH control in chrome baths helps chrome adhere to hides and reduces the amount of chemicals left in the wastewater. Instruct workers

about the correct chemical ratios to use in tanning and finishing baths. Use measuring equipment to minimize overuse.

How are chemicals stored?

Improve chemical storage to reduce waste and spills. Store chemicals in sturdy, waterproof containers. Instruct employees to seal containers after use to avoid spills and unnecessary evaporation.

AREA 2: MINIMIZE WORKERS' CHEMICAL EXPOSURE

Business Issues: Unhealthy workers may be less productive, miss work too often and make potentially costly mistakes. Therefore minimizing chemical exposure can contribute to reduced operating costs.

Environmental Issues: Measures to reduce workers' exposure to chemicals can also reduce dispersion of chemicals into the environment.

Community and Occupational Health and Safety Issues: Certain working conditions in leather processing—such as exposure to chemicals in the air or in solution baths—can be hazardous to workers. Symptoms can include skin irritations, dizziness and breathing problems.

Use the following questions and answers to identify specific causes of workers' chemical exposure and the corresponding RECP methods that address them.

Is the tannery structure well-ventilated?

Ventilate the production sites well. Organic solvents, in particular, are harmful when inhaled. Over time, even minor exposure can cause long-term damage to workers' health.

What safety measures are currently in place?

Provide safety equipment such as face masks, rubber gloves and boots for workers. Small improvements can increase worker safety dramatically and improve long-run productivity.

Are workers provided with safety training?

Minimize chemical spills and accidental exposure by educating workers about preventive safety measures. Train workers in the proper handling of chemicals and procedures to follow in the event of a chemical spill.

AREA 3: REDUCE WATER USAGE

Business Issues: Leather processing requires water in almost every stage of production, but certain production methods or machinery can lead to overuse. Energy costs for pumping, as well as for environmental impacts from energy consumption, will also be higher than necessary. Excessive



Two leather workers wearing gloves and aprons.
Photo by: Patrick Hall

groundwater use may lower the water table and require frequent redrilling of wells.

Using water more efficiently guarantees less costly production and ensures against water shortages that could interrupt production. If the enterprise pays by volume for the water it uses, reducing water usage can be expected to provide substantial savings.

Environmental Issues: If excessive well or pump water is used for leather processing, water sources for future production or community use could be depleted.

Community and Occupational Health and Safety Issues: Untreated wastewater (effluent) from processing operations may contain toxic wastes, which can both pollute local water sources and degrade water quality for downstream communities.



Stacked pelts in a leather processing facility.
Photo by: Patrick Hall

Use the following questions and answers to identify specific causes of excess water use and the corresponding RECP methods that address them.

Is water usage optimized in the production line?

Conserve water by improving production methods. Turn off water between batches or while transferring hides between baths. Install nozzles on hoses to increase the effectiveness of spraying while decreasing water use. Prevent baths from overflowing by monitoring water levels closely or installing an automatic shut-off mechanism.

Reuse water from “cleaner” stages of production in “dirtier” stages of the next production cycle. For example, use rinse water from the final stage of production for the initial soaking or washing of the next batch of hides.

How is the production facility cleaned?

Use dry cleanup methods. Wipe down spills with dry material; use brooms or cloth to remove as much solid or semi-solid waste as possible from floors or machinery before rinsing them down with water.

AREA 4: MANAGE WASTE STREAMS

Business Issues: Controlling waste streams through improved waste treatment techniques, or even recycling may reduce costs.

Environmental Issues: Improper treatment and disposal of tannery wastes can contaminate local soil and water bodies.

Community and Occupational Health and Safety Issues: Tannery effluent often contains highly odorous waste. Strong smells can damage the quality of life around the tannery site and may reduce or destroy community support for further production or expansion.

Use the following questions and answers to identify problems with wastestream management and the corresponding RECP methods that address them.

Are odors from sludges controlled?

Control sludge to decrease odors. Do not let sludge stagnate in or around the tannery site. Place it in a landfill or treatment area. Standing pools of liquid smell bad and are potential breeding grounds for insects, particularly mosquitoes. Eliminate these problems by draining the pools.

Can wastes or trimmings be separated before chemical processing of leather?

Some organic wastes can be sold to farmers and be reused as fertilizers (assuming it is uncontaminated by the tanning chemicals). Additionally, depending on the fat content the organic waste, it can potentially be used as a fuel source (either burned directly or processed into a liquid fuel). Hide trimmings can be recovered to manufacture glue, gelatin, and similar products.

Where are wastes disposed of?

Implement a waste disposal or treatment system that diverts organic effluent away from water bodies. Avoid simply dumping solid wastes; instead, use a proper landfill or dig an appropriately sized pit. (See the chapter on solid waste in the Guidelines.) Bury waste to minimize odors. Wherever solid waste is disposed of, make sure it is away from water sources and cannot be washed away. If possible, chemical wastes should be kept separate and trucked to a wastewater treatment facility that can handle chemical wastes.



A designer at the Leather and Shoe Research Institute in Hanoi.

AREA 5: IMPROVE PROCESS CONTROL

Business Issues: Inefficient or poor production methods contribute to excessive waste and costly product loss. Tanneries with low-quality production processes may have to discard or rework an unnecessarily high proportion of their products. Improving production through maintenance and training can save costly reworking, reduce product loss, and thereby save money while reducing environmental impacts.

Environmental Issues: Improving process control reduces the quantity of chemical inputs to be mined/synthesized, used, and discharged. Additionally, more efficient and reliable tanning processes allows the same amount of product (leather) to be produced with fewer hides, and thus a smaller agricultural footprint.

Community and Occupational Health and Safety Issues:

Use the following questions and answers to identify specific inefficiencies in process control and the corresponding RECP methods that address them.

Are unprocessed hides salted as soon as they are received by the tannery?

Unprocessed hides need to be salted as soon as possible to prevent spoilage (putrification).

Are the appropriate concentrations of chemicals used?

Determine appropriate concentrations of chemicals needed for chemical baths to produce consistently high-quality products with the minimum necessary quantities of chemicals. This may require some trial and error to determine the optimal mix. Once that is determined, provide workers with measuring equipment that allows them to consistently mix chemicals to the specified concentration.

Are a consistent number of hides treated per batch?

Treating a consistent number of hides per batch complements the process described above by ensuring a consistent ratio of chemicals to hides. Overfilling tanning baths with hides reduces efficiency, while under filling wastes valuable inputs.

Are machines regularly maintained? Which production processes are easiest to modify in order to reduce waste?

Ensure that regular maintenance schedules for machinery are followed. For example, to reduce spoilage or losses, workers should regularly clean filters and screens of machinery used in dehairing and hide-shaving.

REFERENCES AND RESOURCES

- Marks and Spencer, CP Module 3a: Minimum Standards and Best Practices for tannery. Version 1.0 (2013). http://corporate.marksandspencer.com/documents/how_we_do_business/ecp3a.pdf.

This module explains the Marks & Spencer minimum standards and best practices for tanneries.

- Policy Options to Address Informal Sector Contamination in Urban Latin America: The Case of Leather Tanneries in Bogotá, Colombia. LATEN Dissemination Note # 14 (1995). Biller, Dan and Quintero, Juan David.: World Bank.

This report is a case study of informal leather tanneries in the San Benito neighborhood of Bogotá, Colombia. It includes proposals and policy options for addressing the industry's pollution problems.

- Covington, Anthony D. (1999). Innovations in Processing. International Union of Leather Technologists and Chemists Societies (IULTCS) Congress held in Chennai, India, January 1999. <http://leather.webindia.com/innovation.html>.

This paper includes a useful overview of hide processing and presents new or alternative production methods that increase efficiency and/or reduce chemical use.

- Hair-Save Unhairing Methods in Leather Processing (2000). Regional Programme for Pollution Control in the Tanning Industry in South-East Asia,

United Nations Industrial Development Organization (UNIDO).
http://www.unido.org/fileadmin/import/userfiles/puffk/l_hairsave_unhairing.pdf.

This report discusses methods of unhairing that result in lower levels of contaminated wastewater, compared to traditional chemical unhairing procedures.

- Re-Use of Chromium in Leather Tanning. United Nations Environment Program (UNEP) Cleaner Production Case Studies.
<http://www.p2pays.org/ref/10/09545.htm>.
- EP3-Pollution Prevention Audit for a Sheep Hide Tannery. United Nations Environment Program (UNEP) Cleaner Production Case Studies.
<http://www.p2pays.org/ref/10/09234.htm>.
- EP3-Cleaner Production Audit for a Cattle Hide Tannery. United Nations Environment Program (UNEP) Cleaner Production Case Studies.
<http://www.p2pays.org/ref/10/09238.htm>.
- Three short case studies of cleaner production in a medium-scale sheep and cattle hide tanneries. These provide a useful overview of cleaner production opportunities. Included are cost estimates of cleaner production methods. The studies also focus on re-use of chemical effluents.
- Food and Agricultural Industry (1997). United States Environmental Protection Agency (EPA). <http://www.epa.gov/ttnchie1/ap42/ch09/final/c9s15.pdf>.

The linked chapter on tanning has a good overview of the tanning process and an intuitive process flow diagram.

- Leather Tanning and Finishing Waste Management Research and Development Program (1976). United States Environmental Protection Agency (EPA).
<http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=9101BG3W.txt>.

A quantitative resource on initial steps to take to control pollution (most especially biological oxygen demand and chromium in wastewater).

- Sahasranaman, A. (1999). Occupational Safety and Health in the Tanning Industry: Emerging Challenges. International Union of Leather Technologists and Chemists Societies (IULTCS) Congress held in Chennai, India, January 1999.
<http://leather.webindia.com/safety.html>.

This short report lists worker safety issues associated with tanneries and provides policy strategies for addressing these issues.

- Sources, Detection and Avoidance of Hexavalent Chromium in Leather and Leather Products (2000). Regional Programme for Pollution Control in the Tanning Industry in South-East Asia, United Nations Industrial Development Organization (UNIDO).
<http://www.unido.org/fileadmin/import/userfiles/puffk/hexavalent.pdf>.

This document evaluates a variety of tanning production methods to see which produce dangerous levels of chromium IV, a by-product of chromium III usage. Technical in some sections, but the general discussion on which methods produce the most danger is quite accessible.

- "Tanning and Leather Finishing" (1998). In Pollution Prevention and Abatement Handbook. Washington, D.C.: World Bank.
http://www1.ifc.org/wps/wcm/connect/7d72fb00488553bab04cf26a6515bb18/tanning_PPAH.pdf?MOD=AJPERES&CACHEID=7d72fb00488553bab04cf26a6515bb18.

This chapter from the World Bank's pollution prevention handbook provides minimum pollution standards for tanneries and leather finishers.

Other Resources:

- Money, Catherine A. Curing of Hides and Skins: Alternative Methods. Australia: CSIRO Leather Research Centre. <http://www.csiro.au/files/files/pez8.pdf>.

These two papers present alternative methods of hide preparation and unhairing. There is a short discussion of current methods and alternative methods that can improve quality.

- Pojer, Peter M. and Chi P. Huynh (2009). A Salt-Free Pickling Regime for Hides and Skins. Australia: CSIRO Leather Research Centre.
<http://www.scribd.com/doc/95760042/A-Salt-free-Pickling-Regime>.

Provides information on eliminating the salt pickle method of preparing hides for tanning.

- Tanneries and the Environment: A Technical Guide to Reducing the Environmental Impact of Tannery Operations (1991). Technical Report Series No. 4. United Nations Environment Program (UNEP)..

Extensive discussion of environmental issues associated with tanneries, with possible solutions.