FACT SHEET – 1

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

KANPUR LEATHER DEVELOPMENT PROJECT

Hair save unhairing-liming

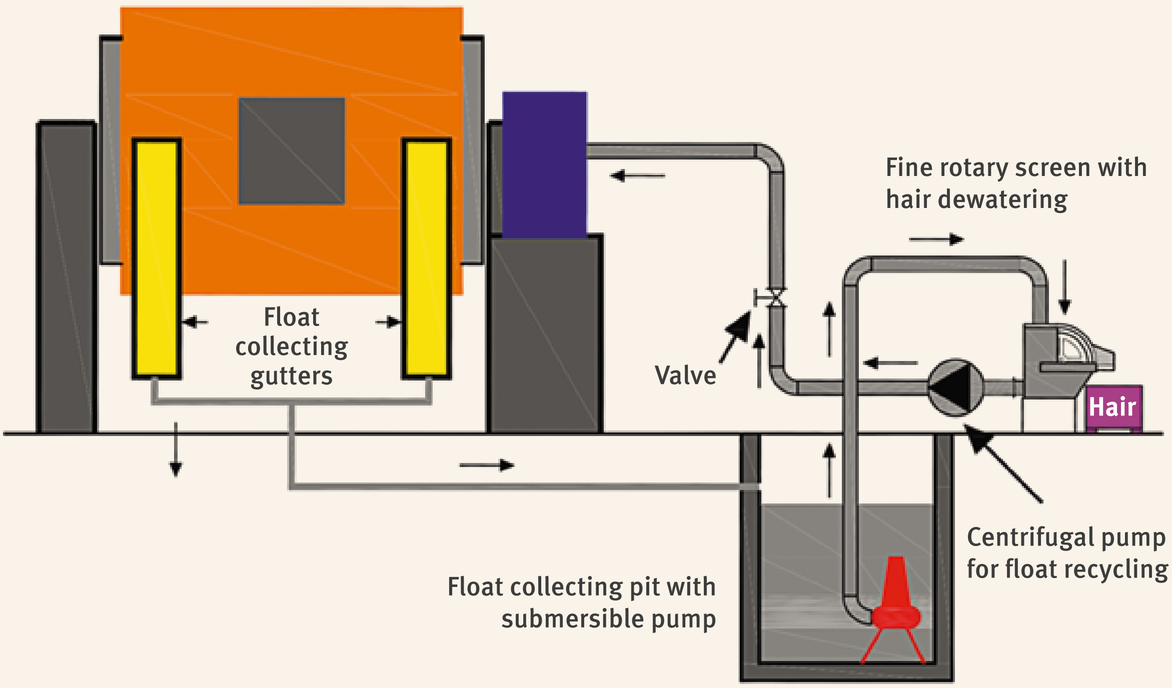
Introduction

Liming is a process employed in tanneries to remove the hair from raw hides and skins using drums or paddles. It is usually carried out using hydrated lime – Ca(OH)2 and sodium sulphide – Na2S. In addition to consuming large amounts of water, liming with hair-burning is one of the most polluting part of the entire leather manufacturing process in terms of nearly all the key parameters such as biochemical oxygen demand (BOD), chemical oxygen demand (COD), suspended solids, total dissolved solids (TDS) or salinity and nitrogen.

Although some forms of hair-save unhairing have been used since time immemorial, they have been compromised with the advent of rapid tanning methods. Fast, modern, commercial methods were only developed during the 1980s/1990s with the advent of the requisite equipment (mixers or drums are fitted to recirculate the liming liquor used during the process and to separate the loosened hair). This results in significantly less environmental pollution. The benefits of using the hair-save method nowadays are further outlined on page 2.

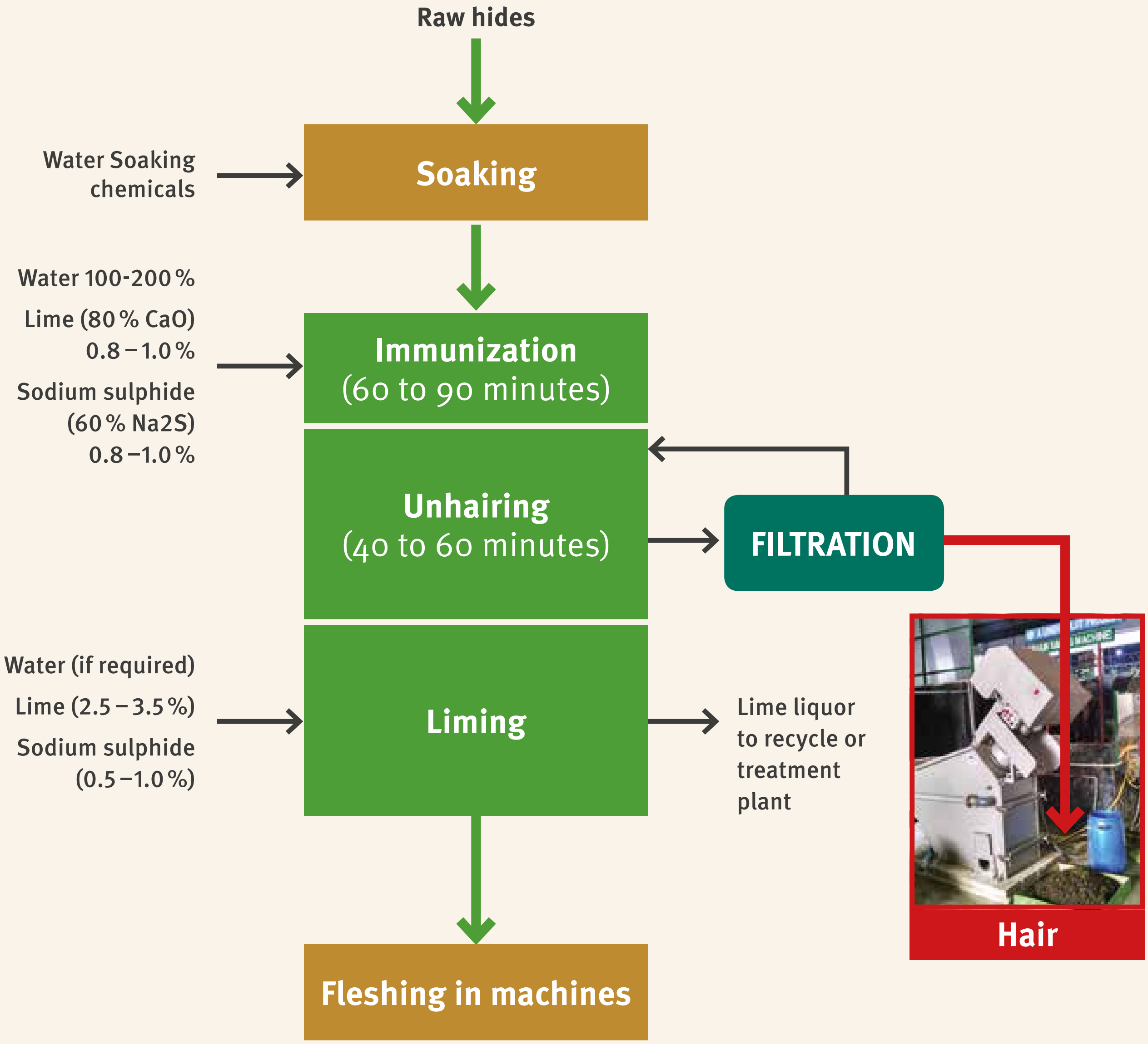
Process description

The principle of the hair-save unhairing method is as follows: firstly, the hair fibre is partially immunized by an alkali (lime); secondly, the hair fibre is removed using sulphide; and finally, the hair is recovered from the process liquor hrough filtration.



It is necessary to separate the liming liquor from the drum. The most efficient way to achieve this is by using drain valves fitted to the drums with a bath separation compartment inside the drum. The liquor is collected by bath collection channels and is either sent to the transfer pit or directly to the filtering machine. The liquor from the filtering machine is sent back to drum.

PROCESS FLOW DIAGRAM FOR HAIR SAVE UNHAIRING



The quantity of hair recovered from Indian origin buffalo hides is about 1 to 2 percent of the weight of raw hides, depending on the amount of hair present in the material. The recovered hair is used as compost.

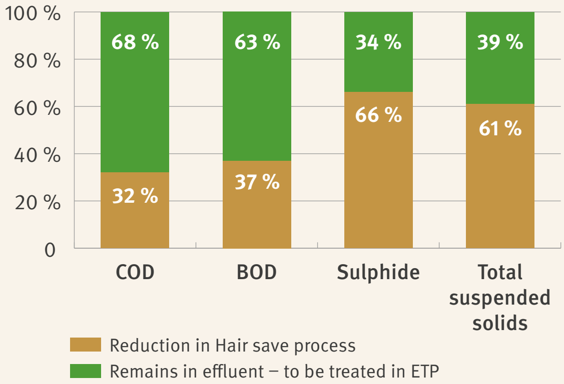
Benefits

The benefits of saving hair are as follows:

- significant decrease in the organic pollution load (SS, COD, BOD and sulphides);
- significantly lower volume of sludge for reuse or disposal; and
- lower costs of effluent treatment (fewer chemicals and less energy).

The chart below indicates the cost benefits of installing a hair save unhairing system for a tannery of processing capacity of about 5 tonnes per day.

Reduction of pollution load in liming wastewater while adopting hair save unhairing



Investment cost	**Rs. 1,320,000**
Annual savings *(after excluding operation and maintenance expenses)*	**Rs. 303,360**
Payback period	**4 years approximately**

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UNIDO KANPUR LEATHER DEVELOPMENT PROJECT,
A PROJECT OF DEPARTMENT OF INDUSTRIAL POLICY AND PROMOTION, GOVERNMENT OF INDIA.

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KANPUR LEATHER DEVELOPMENT PROJECT

Water mixing and measurement

If it isn't measured then it cannot be controlled

Introduction

In leather processing, water acts as a medium between the hides/skins and chemicals by (a) removing undesired materials from hides/skins and (b) facilitating the reaction between chemicals and hides/skins. Water consumption for tannery unit processes varies depending on the unit process, type of raw material, finished product, process vessels (drums/paddles), chemicals, availability of water, and legal restrictions.

In many tanneries (characterized by small- and medium-sized tanneries) the volume of water used during the process is not measured but judged visually, though the chemicals and hides/skins are weighed. If the water is not measured, consumption is almost always higher than the volume actually required. The following table shows the average values, ranging from soaking to post- tanning in tanneries.

The running wash generally ranges from 30 to 120 minutes. Estimates indicate that water used during this wash is 12 to 15 m^3/t of raw material, whereas the maximum water consumption in batch washing is only about 3 to 6 m^3/t.

PROCESS STAGE	PROCESS VESSEL	FLOAT REQUIREMENT (AS PER RECIPE)	ACTUAL USAGE	EXCESS USE OVER SPECIIED REQUIREMENT
Beamhouse	Paddles	150 to 200%	200 to 216%	+50 to +66%
Tanning	Drums	70 to 150%	120 to 200%	+50 to +130%
Post-tanning	Drums	100 to 150%	220 to 300%	+70 to +200%

Methods to measure water

WATER FLOW METERS: These meters are mechanical and based on the rotation of the turbine, which is rotated by the flow of water. Woltman type meters are preferred because of their longevity combined with the fact that the meters are dry and only the turbine runs in the wet chamber. A counter roller runs in the dry chamber and is magnetically coupled to the turbine. The counters are encapsulated, evacuated and protected against flooding. Water flow meters need a dirt box strainer to avoid frequent clogging.

ELECTROMAGNETIC FLOW METERS: These meters operate based on Faraday's law of electromagnetic induction. When a magnetic field is applied to the metering tube, a potential difference proportional to the flow velocity perpendicular to the flux lines is generated. The potential difference is displayed as a flow. A solenoid valve controls the flow if a specific set volume is reached.

WATER METERS.

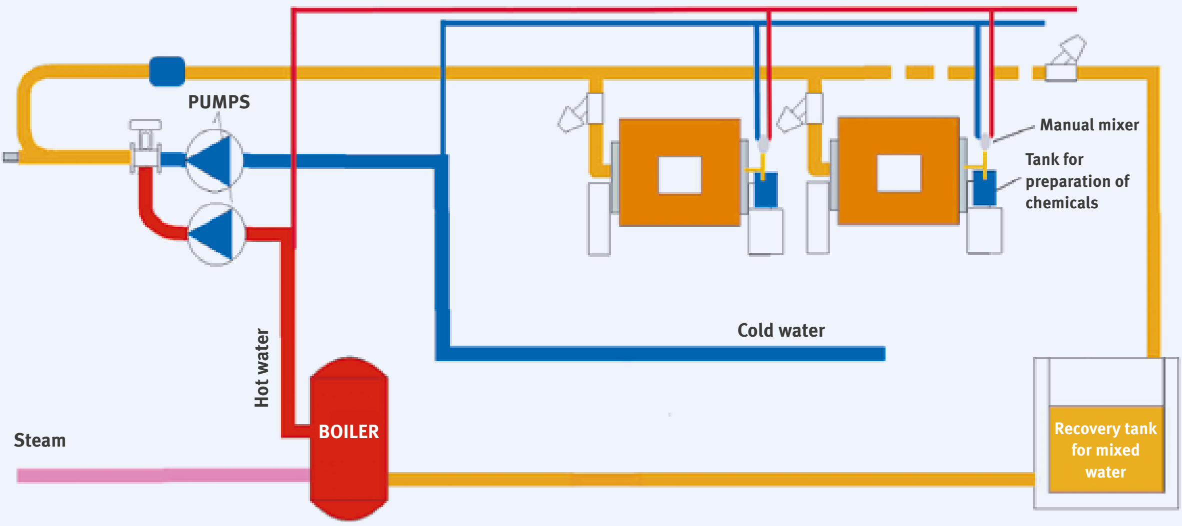
A comparison of various types of water flow measuring equipment is provided in the following table:

PARAMETER	WATER FLOW METER	ELECTROMAGNETIC FLOW METER	AUTOMATED WATER MIXING-CUM-ADDITION SYSTEM
Type	Mechanical	Electromagnetic	Electromagnetic, PLC controlled
Accuracy	Average	Very good	Very good
Possibility of manual error	Average	Average	Low
Ease of operation	Manual control is required	Easy	Very easy
Life	Less (strainers are required)	High	High
Investment (for a tannery with about 8 processing vessels)	Rs. 80,000	Rs. 300,000	Rs. 1,000,000 – 1,500,000

AUTOMATED WATER MIXING-CUM-ADDITION SYSTEMS: Automatic water addition systems also work on the electromagnetic flow metering principle and a programmable logic controller (PLC) control. In addition, they operate hot and cold water pumps, thus making the water addition completely automatic. The valves in each process vessel are operated by a pneumatic control valve actuated by the PLC. In addition, the automatic water mixing-cum-addition systems provide water at a desired temperature. The waiting time is low as these systems have high flow rates, i.e., from 400 to 800 litres per minute, thus productivity is increased. The use of these automated water mixing systems resulted in 20 percent less water consumption.

AUTOMATED WATER MIXING-CUM-ADDITION SYSTEMS.

SCHEMA WATER MIXING UNIT



Methods to reduce water consumption

Water consumption can be reduced using the following methods:

- Use of drums for soaking/liming
- Recycling waste streams within the leather processing
  - Counter current soaking;
  - Recycling of lime liquor;
  - Reuse of pelt wash liquors;
  - Reuse of chrome liquors directly or by reusing the supernatant liquor from chrome recovery plants in pickling; and
  - Combining rechroming and neutralization

When adopting a particular type of recycling, it is imperative to understand the process requirements and characteristics of waste streams. In addition, process control and monitoring are important until the process is standardized.

After adopting the most feasible methods for water measurement and recycling, it is possible to achieve between 20 to 22 m^3/tonne of raw material from raw hides to finished leather. In terms of area of finished leather, it is possible to achieve 8 to 10 litres per square foot. However, there have been several cases in which the tanning industry has succeeded in consuming even lower amounts of water up to 12 m^3/tonne of raw material.

Benefits of water measurement and conservation

While the measurement of water itself results in reduced water consumption, the following are the main advantages of adopting proper water management in tanneries:

- Reduced water consumption lowers the cost of effluent treatment, and improves the efficiency of treatment;
- Consistency in quality of leather made – batch to batch quality consistency;
- Reduction in quantity of chemicals, particularly post tanning chemicals; and
- Reduced exploitation of natural resource, i.e., ground water.

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UNIDO KANPUR LEATHER DEVELOPMENT PROJECT,
A PROJECT OF DEPARTMENT OF INDUSTRIAL POLICY AND PROMOTION, GOVERNMENT OF INDIA.

Solar water heating system

Introduction

The tanning industry uses a considerable amount of hot water during the leather production process, mainly during post-tanning operations. Until now, the industry has been heating water with fossil fuels, gas oil and natural gas, either using a conventional boiler or, in certain locations, with cogeneration.

New technologies are available for the industry to produce hot water. One option is to capture energy from the sun and convert it into thermal solar energy using a solar water heating system. In addition to generating hot water, tanneries derive other benefits including lower energy costs, reduced carbon emissions and greenhouse gases, and less reliance on fossil fuels. India is a tropical country, so its tanneries are favourably located for the application of the solar water heating systems.

Based on the experience gained from the pilot demonstration unit for solar water heating systems (PDU3) developed under UNIDO's Kanpur Leather Development Project, and similar experience gained in Bangladesh under a separate UNIDO project, this fact sheet discusses the key observations and basic considerations for implementing such systems.

Solar energy potential in Kanpur

The solar insolation data for Kanpur (Latitude 26.45 Longitude 80.332) obtained from NASA Surface meteorology and Solar Energy – Available Tables is provided below in Table 1.

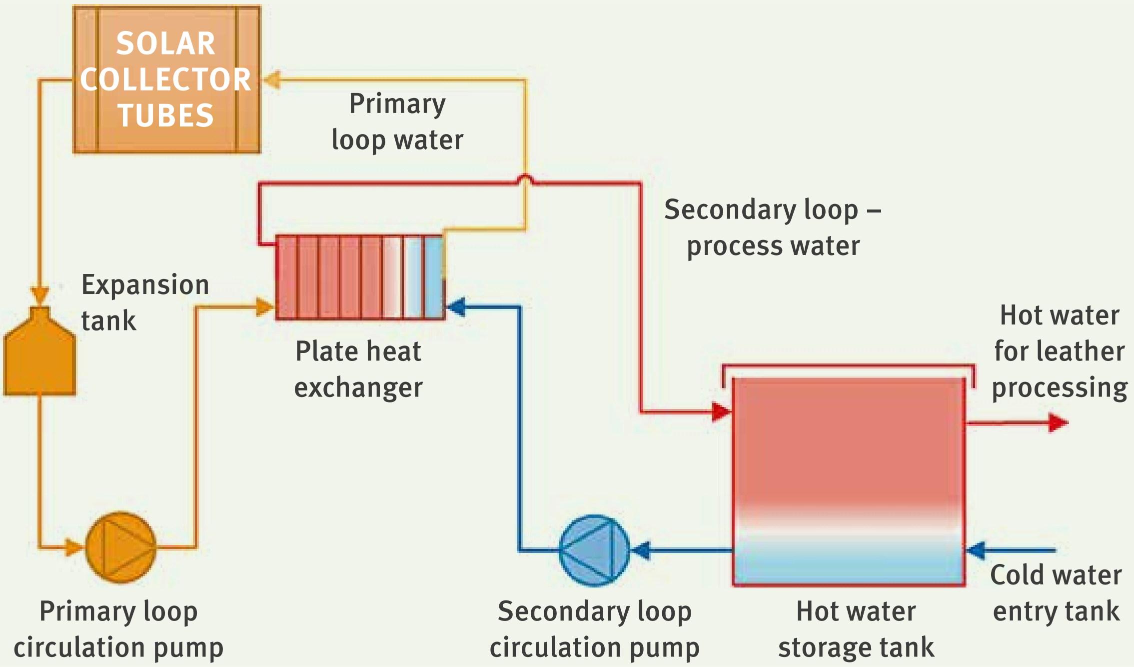
TABLE 1 **MONTHLY AVERAGED INSOLATION INCIDENT ON A HORIZONTAL SURFACE (KWH/M²/DAY) FOR KANPUR**

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL AVERAGE
22 year average	3.72	4.67	5.75	6.32	6.57	5.91	4.8	4.48	4.51	4.87	4.26	3.6	4.95

Source: https://eosweb.larc.nasa.gov

Brief description of the system

In the primary loop, pure water is sent to the solar collectors for heating. After heating by solar irradiation, it flows to the expansion tank. This primary loop water is pumped to the plate heat exchanger where heat is transferred to the process water. The primary loop water is then sent to the solar collector tubes for further heating; thus the primary loop is a closed loop. The process water, which is kept in the hot water storage tank, is pumped to the plate heat exchanger to gain heat from closed loop water. The hot water is then circulated between plate heat exchanger and storage tank until the desired temperature is reached. This forms the secondary loop.



Main components of the system

The solar water heating system consists of the following:

1. Evacuated tube collector tubes – 40 numbers manifold, each manifold containing 30 tubes. Total occupied area: 192 m^2.
2. Expansion tank with a capacity of 650 litres to regulate the flow and level of water in the primary closed loop.
3. Pump for the circulation of pure water in the primary loop.
4. Tank for the make-up water (to compensate for water loss by evaporation) with a capacity of 200 litres to replenish the primary loop water.
5. Plate heat exchanger: plates are made of 316 L type stainless steel, 0.5 mm thickness.
6. Hot water storage tank with a capacity of 10,000 litres.
7. Pump to circulate water in the secondary loop.
8. Necessary valves and instrumentation such as pressure gauges and temperature probes.
9. Control panel for automatic operation of the system with an energy recorder device.

Operational data

DESCRIPTION / PARAMETER	DECEMBER 2016	MARCH 2017	APRIL 2017
Volume of hot water from the system	**2,000–3,000 litres**	**6,000–7,000 litres**	**8,000–9,000 litres**
Average temperature of the hot water from the system	**48° C**	**52° C**	**61° C**
Average time taken to heat 2,000 litres from ambient to desired temperature	**300 minutes**	**230 minutes**	**115 minutes**
Savings in coal (annualized)	**45 tonnes**		
Reduction in CO2 emission	**115 tonnes**		

Water Hardness

SCALING IN
PLATE HEAT EXCHANGER

If the hardness of the water is high, scaling inside the plate heat exchanger or hot water pipelines occur frequently, which needs frequent cleaning. It is necessary to operate the system at following conditions: (a) temperature of primary loop water should not go beyond 80° C and
(b) the temperature difference (Δt) in secondary loop before and after heating should not be >30° C.

Energy and environmental savings

The use of hot water in leather processing increases the uptake of chemicals, thereby reducing the chemical consumption. The environmental savings include a 17–30 percent reduction in chemical oxygen demand (COD) and a 6–13 percent reduction in total dissolved solids (TDS) in post-tanning operations as a result of increased uptake of chemicals.

Specific energy consumption in leather production	**54 MJ/m² of finished leather**
Hot water requirements	**7.2 litres/m² of finished leather**
Energy savings from solar hot water	**6.6 MJ/ m² of finished leather**
Savings in energy by using solar water heating system	**12 %**
Reduction in CO_2 emissions	**0.88 kg of CO_2/m² of finished leather**

Cost benefit analysis

In addition to the savings etc. in the above-mentioned cost benefit analysis, the use of hot water in post-tanning operations provides other benefits which are not quantified due to the influence of multiple factors:

(i) Use of hot water in retanning, dyeing and fat liquoring contributes to increased fixing of chemicals in leather. This provides an opportunity to reduce the quantity of these post-tanning chemicals; and

(ii) Improved quality of finished leather, particularly uniformity of shade within a piece of finished leather, as well as from piece to piece and from batch to batch.

Investment cost	**Rs. 1,700,000**
Operating cost (electricity for pumps) @ Rs.7 per kWh	**Rs. 35,000 per annum**
Cost of coal saved	**Rs. 400,000 per annum**
Cost savings in effluent treatment due to COD reduction	**Rs. 16,000 per annum**
Annual savings	**Rs. 381,000 per annum**
Payback period	**4.5 years**

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KANPUR LEATHER DEVELOPMENT PROJECT

Solar air heating system

Introduction

The leather industry uses a considerable amount of thermal energy, particularly during the leather drying process — a mechanical operation which eliminates most of the water soaked up by the tanned leather. Thermal energy accounts for between roughly 50 and 55 percent of total energy consumption during leather making.

During autospray and roller coating, the leather is dried in tunnel driers through hot air of 80 to 90° C produced from steam or hot thermic oils. Until now, the industry has been using fossil fuels, coal, oil and natural gas, either with a conventional boiler or, in certain locations, with cogeneration.

Alternative technologies are available for the industry to produce hot air. One option is the use of thermal solar energy, which also reduces energy costs, decreases carbon emissions and greenhouse gases, and minimizes the reliance on fossil fuels. India is a tropical country, so its tanneries are favourably located for application of the solar air heating systems.

Solar energy potential in Kanpur

The solar insolation data for Kanpur (Latitude 26.45 Longitude 80.332) obtained from *NASA Surface meteorology and Solar Energy - Available Tables* is provided below in Table 1.

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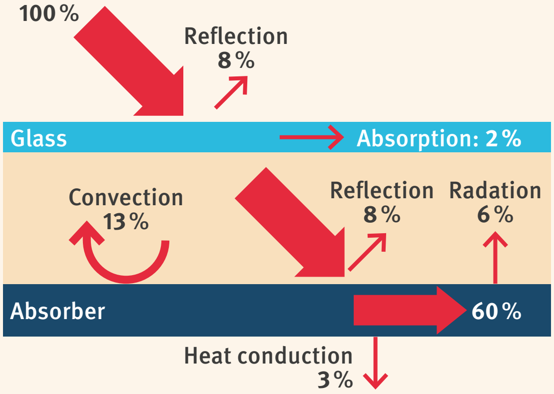
22 year average	3.72	4.67	5.75	6.32	6.57	5.91	4.8	4.48	4.51	4.87	4.26	3.6	4.95

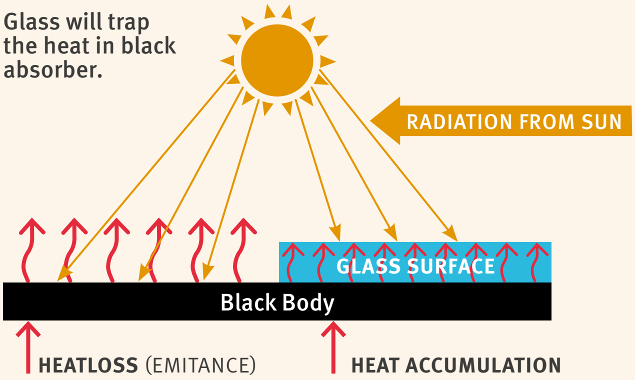
Source: https://eosweb.larc.nasa.gov

Brief description of the system

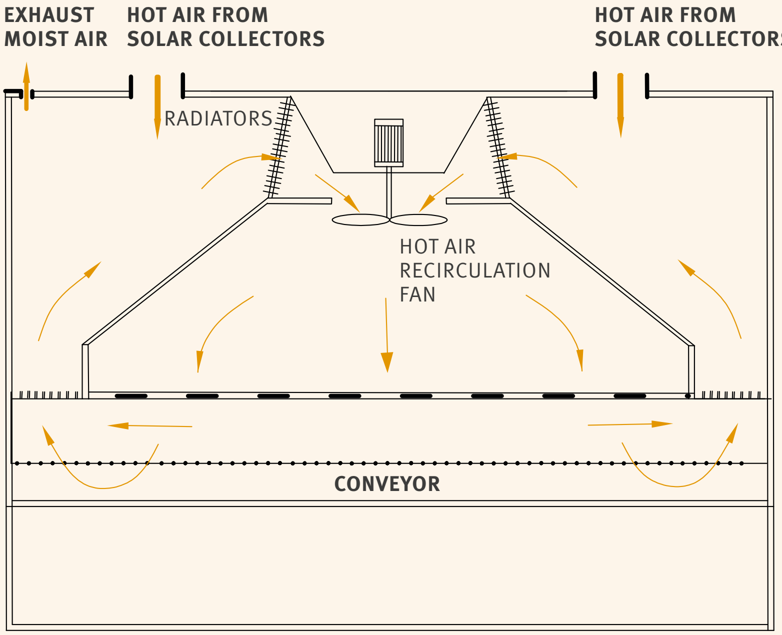
A black surface absorbs solar heat. Air is passed through the space between the glass and the corrugated black surface, thus allowing the air to be heated by the direct solar rays as well as the reflection from black surface. The heat convection from the black surface adds to the increased temperature of air. The heat loss below the black surface is prevented by insulation.

LET US SEE ABOUT HOW TO USE THE ACCUMULATED HEAT?





CONCEPTUAL DIAGRAM OF SOLAR HOT AIR GENERATION



CROSS SECTION VIEW OF AN AUTOSPRAY DRIER WITH THE INTRODUCTION OF SOLAR HOT AIR.

DISTRIBUTION HOT AIR INTO DRYING TUNNELS

SOLAR AIR HEATING SOLAR PANELS.

Main components of the system

1. Roof sheet made of metal comprising GI material of 0.45 to 0.56 mm thickness.

2. Solar collectors (flat plate collectors) made of corrugated black painted aluminium base material, with space for air flow and glass cover on top over an area of 270 m^2. Solar collector collectors are made of 144 aluminium boxes, each measuring about 1.875 m^2. Air heating is performed in 6 compartments, with each compartment comprising 24 solar collectors. The thickness of the aluminium collector boxes ranges from 0.45 to 0.56 mm.

3. Centrifugal hot air blower of maximum flow rate of capacity 7000 m^3/h.

4. Aluminium ducts, insulated using glass wool of 100 mm thickness.

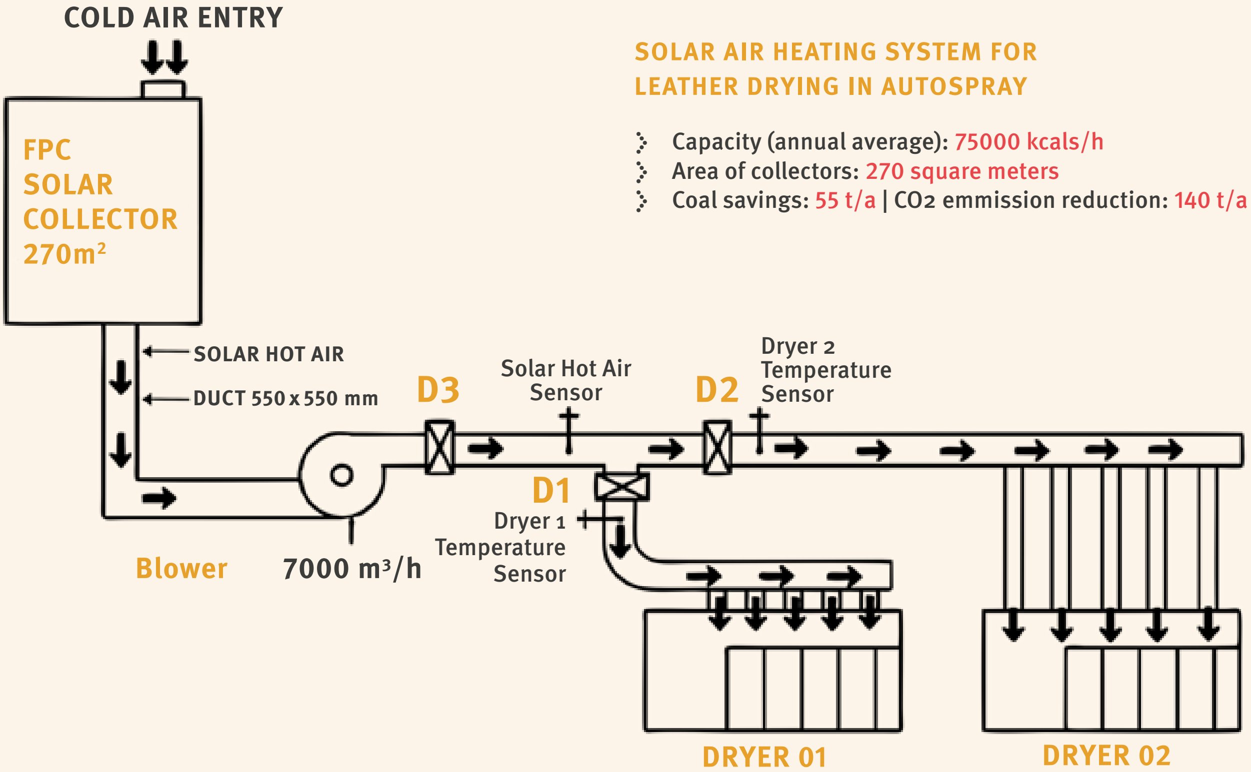
5. Steam flow meter to measure the steam flow.

6. Pneumatically operated steam control valve which is inbuilt in the autospray driers.

7. Control panel for the on/off switches, including the energy recorder device.

Technical description and process flow

The solar collector is made using aluminium extrusions, highly sensitive special absorbers, 4 mm thick toughened glass (partial double), mineral wool insulation, polyurethane sealant and an EPDM rubber. Almost all (92 percent) of the short wavelength radiation emitted by the sun is transmitted through the glass. When it falls on the black absorber, radiant energy is converted into thermal energy. Since glass blocks re-radiation [long wavelengths] from the



absorber, the temperature rises in the absorber. Fresh air meanders below the absorber sheet so that the collector delivers hot air in the range of 70–100° C, depending upon the solar radiation. After passing through three segments of solar collectors, the air finally exits through the insulated outlets, which are connected to an insulated metal box. A blower with specifications of 2.2 kW, 7000 m^3/h, and 1420 rpm draws the hot air from the panel and pushes it into the auto sprayer through the insulated duct.

In this pilot demonstration unit, the solar hot air is provided to one autospray drier and one roller coater drier. It is also possible to use only one of these driers at a time.

The steam flow meter measures the cumulative flow of steam to the autospray drier, which is used to calculate the energy savings. In addition, the control panel includes an energy recorder device which provides the energy supplied by the solar air heating in kWh units.

Operational data

The steam consumption without solar air heating in autospray drier is 210 kg/h @ 5 bar pressure.

DESCRIPTION / PARAMETER	FEBRUARY 2017	MARCH 2017	APRIL 2017
Savings in steam saved using solar hot air (9 AM to 5 PM)	**1127 kg/d**	**1586 kg/d**	**1656 kg/d**
Steam consumption along with solar	**553 kg/d**	**94 kg/d**	**24 kg/d**
Average maximum temperature obtained from solar collectors	**83° C**	**92° C**	**95° C**
Savings in coal (annualized)	**71 tonnes**		
Reduction in CO_2 emission	**181 tonnes**		

Energy and Environmental savings

The use of hot air in leather drying during the autospray process reduces dependency on fossil fuel and increases the renewable energy footprint.

Specific energy consumption in leather production	**54 MJ/m^2 of finished leather**
Energy savings from solar hot water	**7.47 MJ/m^2 of finished leather**
Savings in energy by using solar water heating system	**14%**
Reduction in CO_2 emissions	**1 kg of CO_2/m^2 of finished leather**

Cost benefit analysis

Investment cost	**Rs. 2,200,000**
Operating cost (electricity for blower) @ Rs.7 per kWh	**Rs. 26,000 per annum**
Cost of coal saved	**Rs. 642,000 per annum**
Annual net savings	**Rs. 616,000 per annum**
Payback period	**3.6 years**

FACT SHEET – 5

Processing fresh chilled hides

Introduction

Tanning centres are clustered in relatively few locations in India and receive raw hides and skins from slaughterhouses across the country. It is therefore imperative to ensure that they are preserved during transportation and while kept at the storage yards. The most common way to preserve raw hides and skins in India between the time they are flayed and subsequently processed in tanneries is by applying common salt. This process, which is called wet-salting, dehydrates the hide or skin as well as preserving it. The raw hides and skins are generally re-salted in small warehouses (mandis). An estimated 300 to 400 kg of common salt are used to preserve one tonne of raw material.

Most of the salt (about 80 percent) applied to raw hides and skins finds its way into effluent streams, primarily from the soak liquor. Around 20 percent of this salt can be removed by desalting prior to soaking. The wet-salting process thus represents a major contribution to salinity in tannery effluents. This is especially the case when the tanneries are clustered and discharge large quantities of effluents, often making salinity in the tannery effluent difficult to manage. In some locations, this issue is addressed through the use of reverse osmosis and the evaporation of rejects, but this process is expensive and energy intensive.

Another option is to preserve the raw hides and skins by chilling them, without salting, until the hides are processed in tanneries, which significantly reduces salinity in the tannery effluent. However, chilling requires energy.

Chilling conditions

WITHIN THE SLAUGHTERHOUSE: After flaying, the hides are hung in the cold store at a temperature of about 4 degrees Celsius, preferably in a conveyor for easy handling.

DURING TRANSPORTATION: Refrigerated containers inside which the hides can be folded and stacked in chilled conditions are required during transportation to the tannery. Since there is risk of temperature buildup within the piles of raw hides, it is generally not advised to store the hides in stacks for more than five days.

AT THE TANNERY: Upon arrival at the tannery, it is necessary to ensure that the hides continue to be stored in chilled conditions. It is generally advisable to process the hides directly on arrival. In any case, the hides should not be stored in a folded position for more than five days.

Processing details for chilled hides

The processing of chilled hides is similar to processing wet-salted hides. However, the following aspects should be considered when soaking fresh chilled hides:

1. The weight of raw hides can be assumed to be the same as that of wet-salted hides – the weight loss due to dehydration is compensated for by the mass of salt;
2. The hides will need to be soaked for about 4 to 5 hours in drums or paddles. The duration of this process may vary for wet-salted hides depending on the moisture content or dryness fraction. The primary purpose of soaking is to remove blood and other foreign unwanted materials on hides as well as to remove soluble proteins;
3. In drum soaking, a float of about 70 percent is sufficient compared with 150 percent for wet-salted hides;
4. Bactericide of about 0.1 percent is necessary to preserve the hides during soaking, which is a similar requirement when soaking wet-salted hides;
5. A wetting agent of 0.5 percent is required to facilitate cleaning and washing;
6. The addition of about 0.5 percent of sodium carbonate is recommended as a pre-treatment to increase the pH level of the hides, which are subjected to a much higher pH of up to 11 in the subsequent liming operation; and
7. Liming can be continued according to the usual practice.

SALT FROM WET SALTED HIDES.

Energy requirement for chilling

The energy requirement for keeping the hides chilled inside the refrigerated 40 feet container is approximately 100 kWh per day. The electricity required to store 1,000 hides in a container is about 0.1 unit per day per hide, which is about Re. 1 per day per hide.

Benefits

The main benefit of the chilling technique is the environmental savings: the total dissolved solids (TDS) discharge in effluents is reduced by between 30 and 40 percent.

WET SALTED HIDES.

Cost comparison

The following cost is estimated for the storage of 1 tonne of raw buffalo hides for 15 days:

PARAMETER	CHILLING	WET-SALTING
Power requirement	50 units for chilling + 50 units for 15 days' storage in refrigerated container = 100 units	Nil
Salt requirement	Nil	300 kg
Cost for preservation	Rs. 800/tonne	Rs. 900/tonne
Labour cost	Rs. 30/tonne	Rs. 60/tonne
Capital expenditure	Chilling rooms, cold store and refrigerated containers	Floor space for applying salt
Number of days in storage	Limited to 15 days	About 60 days

The environmental cost is associated with the management of TDS through dilution with treated sewage or by desalination and evaporation of reject streams. The corresponding savings in environment costs are about Rs.1260 / tonne of raw material in the case of dilution and Rs.4600 / tonne of raw material in the case of zero liquid discharge systems.

CHILLED HIDES IN COOLING BOX.

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Desalting of raw hides

Introduction

Common salt is traditionally used in India to preserve hides. This method is often called 'curing' or 'short-term preservation' as the raw hides/skins are only preserved until they reach the tannery. Common salt is generally applied within a few hours of flaying. This salt serves a dual purpose: it dehydrates raw hides and skins to a moisture level of 50 to 60 percent of the original moisture of 80 to 85 percent; and it prevents microorganisms from decaying on the skin/hide material. In this way, the raw material is preserved from putrefaction.

The process of applying common salt to freshly flayed hides/skins is called wet salting. The common salt used in the preservation process is dissolved in water in the first unit process, called soaking, and discharged as wastewater. This contributes to about 50 percent of the TDS content in the effluent. Alternative curing methods have not been prevalent in India for reasons which include the dispersed nature of slaughtering throughout the country, combined with the easy availability of common salt and its low preservation costs.

The common salt applied on hides for curing enters the soak liquor, which is the first unit process in tanneries. The presence of salt in tannery wastewater contributes to a substantial portion of the TDS. Conventional treatment systems such as the chemical and biological treatment stages are unable to remove the TDS. The removal of salinity or TDS in the effluent requires expensive and very sensitive processes such as reverse osmosis (RO) and the evaporation of RO reject in multiple effect evaporators.

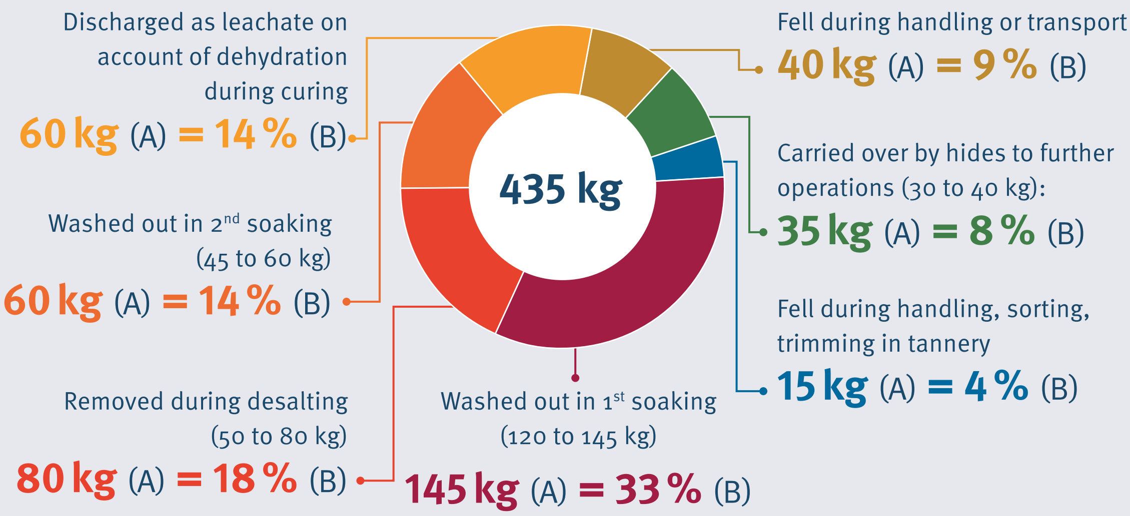
Although alternative curing methods such as chilled hides processing, low salt curing, etc. are being pursued, it is anticipated that the majority of the hide/skin supply will be wet salted for some more time to come.

Under these circumstances, the removal of salt from raw and skins to the maximum extent possible will lead to a reduction in TDS in the effluent, which is expected to result in the better treatment of effluent at lower costs.

Salt removal potential in raw hides and skins

About 400 kg of salt is applied per tonne of raw hides/skins. While most of the salt penetrates the skin, a substantial quantity remains on the surface. By desalting, it is possible to remove a major portion of this salt. The following graph provides a description, followed by the average quantity of salt in kg (A) and the corresponding percentage of total salt applied in curing (B).

MASS BALANCE OF SALT APPLIED FOR CURING



Brief description of the desalting systems

Desalting can be done by simple shaking of the hides or by using salt shaker machines. Four types of desalting operations that can be adopted are described below.

SALT SHAKER MACHINE: The desalting drum (cage) is primarily made of 316 stainless steel and is rotated by a 15 Kw motor. The drum is run at 6 rpm. The raw hides are folded and placed on the conveyor belt. They are subsequently unfolded in the desalting cage and any salt that is stuck to the hides falls off. The desalting process can be timed by modifying the inclination of the drum. The salted hides leave the drum at the rear end. The diameter of the drum is 2.7 metres (m) and the overall length is 7.7 m, of which the length of the drum (cage) is about 5 m. While the transfer time for one hide through the drum varies depending on the inclination, it generally takes about three to six minutes. Ten tonnes are usually desalted in about two hours.

BRUSH TYPE DESALTING MACHINE:
The machine has a cylindrical roller with nylon bristles embedded on it. When the wet salted raw hide/skin is fed into the machine, the salt on the flesh side is removed by the nylon bristles. The hides are pulled out on the rotating brush roller at a speed of 0.075 m/s. The time required to desalt one tonne of raw hides is about one hour. The quantity of salt collected ranges from 7 to 8 percent on a raw hide weight basis. The dusted salt can be collected from the rear of the machine. The removed salt falls over a wooden plank sloping downwards at the rear side of the machine. All metallic components, namely the frame to hold the cylinder, the motor and the plummer blocks, are covered by wooden planks. These planks are bolted using stainless steel bolts and nuts. The following are the specifications:

Working width	2,100 mm
Width of each strip of bristles	125 mm
No. of strips of bristles	5
Speed of brush roller	400 rpm
Motor	3.7 kW

DESALTING MACHINE.

SALT SHAKER MACHINE.

DESALTING DRUM: Old drums which are no longer used for tanning operations can be converted into desalting drums. This is done by drilling holes of 85 mm diameter at a distance of 130 mm from each other into the surface of the drum and fitting it with a 3.75 kW electrical motor. Wet salted raw hides/skins are weighed and loaded into the desalting drum in loads of 400–600 kg. After closing the door, the drum is run slowly at 3 rpm (velocity 0.35 m/s) for 15 to 20 minutes. The salt loosened from the hide surface drops out of the drum through the holes and collects on the stone floor beneath the drum. After 20 minutes, the drum is stopped, hides unloaded, weighed and taken for soaking. About 7 to 8 tonnes of raw hides can thus be desalted in a day.

DODECA WOODEN FRAME: This comprises a dome type wooden frame with dimensions 0.75 m x 0.75 m x 0.75 m height. Desalting is performed by holding the hides at the edges and beating them on the frame three times. The salt that falls off is collected manually from the floor. For large hides, four workmen are required; for smaller sides and skins, two workmen are sufficient. On average, it takes two hours to desalt one tonne of raw material. This is suitable only for small skins, i.e. goat and sheep skins.

Operational data

The following table provides a comparison of operational parameters in different types of desalting methods:

PARAMETER	SALT SHAKER	BRUSH TYPE DESALTING MACHINE	DESALTING DRUM	DODECA WOODEN FRAME
Salt removal	80 – 100 kg/t	70 – 80 kg/t	50 -70 kg/t	50 – 80 kg/t
Time taken for desalting one tonne of raw hides	30 minutes	60 minutes	60 minutes	120 minutes
Manpower requirement	2 man-hours	2 man-hours	2 man-hours	4 man-hours
Investment cost for one unit	Rs. 3,000,000	Rs. 240,000	Rs. 200,000	Rs. 25,000
Suitability	Hides	Hides and skins	Hides	Skins

Environmental benefits

The environmental savings are mainly the TDS reduction in tannery effluents. The overall reduction in TDS in the combined effluent stream due to desalting of raw hides/skins is about 15 percent, while the reduction in the soak liquor is about 40 percent.

TDS IN SOAK LIQUOR AFTER DESALTING

TDS EMISSION IN SOAK	FIRST SOAK	SECOND SOAK
Average TDS of soak liquor without desalting (300% water for soaking)	**53,780 mg/l**	**27,580 mg/l**
Average TDS of soak liquor after desalting (300% water for soaking)	**33,250 mg/l**	**15,000 mg/l**

In addition to the environmental savings, desalting offers a range of other benefits including the following:

- The decrease in TDS in the effluent will help the biological treatment work more efficiently, due to less salinity;
- The number of soakings can be reduced from two to one. Thus the volume of effluent will be 150 percent less in the case of drums and 300 percent in the case of paddles;
- For tanneries that choose to dilute the treated tannery effluent with treated sewage, there will be less dependency on the volume of treated sewage as the TDS in the effluent can be minimized in desalting;
- For tanneries opting for zero liquid discharge systems, the desalting of raw hides will increase the recovery rate in RO plants by about 5 percent of effluent feed as well as increasing the life of the membranes in RO plants and decreasing the salt load sent to the evaporators. This will result in less salt at the end of the pipe treatment, hence easing the disposal or storage of salt-laden solid residues from the evaporators.

Cost benefit analysis

The following cost benefit analysis has been made for desalting using the brush type desalting machine:

Investment cost (capacity 2 tonnes per day)	**Rs. 240,000**
Operating cost › Electricity: **Rs. 26/t,** › Labour: **Rs.105/t** › Depreciation: **Rs.80/t**	**Rs. 126,540 per annum**
Cost saving (for tanneries opting for zero liquid discharge) › Savings in effluent treatment cost @ 1500 l/t: **Rs.90/t** › Cost saving in evaporation for increased recovery rate in › RO plants by 2%: **Rs. 540/t**	**Rs. 378,000 per annum**
Cost saving (for tanneries opting for dilution) › Savings in effluent treatment cost @ 1500 l/t: **Rs.90/t** › Cost saving in reduced sewage for dilution by 50 m^3/t: **Rs. 700/t**	**Rs. 474,000 per annum**
Annual net savings	**Rs. 251,460 to Rs.347,460 per annum**
Payback period	**0.7 to 0.9 years**

THIS PILOT DEMONSTRATION UNIT HAS BEEN IMPLEMENTED BY
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