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CLEANER PRODUCTION CONCEPTS AND METHODOLOGIES FOR TANNERIES

BACKGROUND

Leather Industry is one among the 17 categories of industries, which is considered as highly polluting industry. More than 3,000 tanneries are located in different parts of India with a total processing capacity of 7,00,000 tons of raw hides and skins per year. More than 80% of tanneries are in small and medium scale sector having processing capacities less than 2 tons of hides / skins per day. The total waste water discharge from these tanneries is about 9,00,000 M^3/day. The total value of production is estimated to have crossed Rs.302 billion in the year 2000. Andhra Pradesh with a livestock population more than 46 million is a major producer of hides and skins in India, contributing about 19 million pieces per annum, which constitutes about 10% of the country's raw material and most of this raw material goes to the state of Tamil Nadu and West Bengal for processing. There are 37 tanneries in the state of Andhra Pradesh out of which 12 were sick producing about 40 million sq.ft. of processed hides and skins per annum.

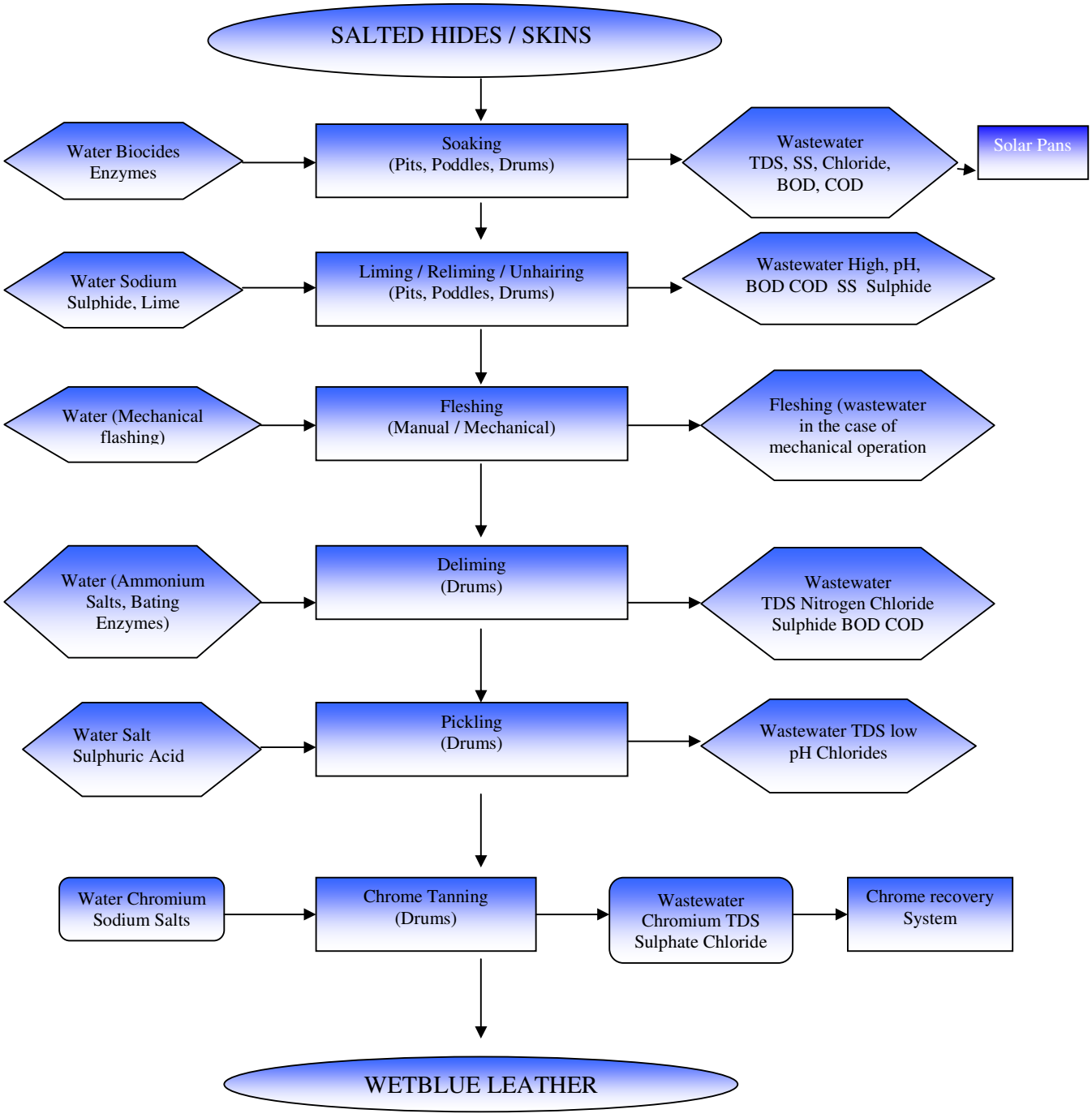
Since, 1990 there has been growing awareness about environmental damages resulting from the discharge of untreated effluents by tanneries into streams and rivers. Public interest litigation cases against tanneries culminated in court orders directing relocation or closure of tanneries, which have not either erected ETPs or connected to CETPs. Setting up of an effluent treatment plant of reasonable size with back up of modern technology appears to be a difficult task to small-scale units. The constraints include unpredictable seasonal and daily variations in quality, volume of tannery wastewater to be discharged, selection of appropriate technology, finance for high capital investment, operation and maintenance cost, power problems, sludge disposal and difficulties in meeting some of the pollution control parameters etc. In this context, cleaner production technologies play a key role for minimizing the pollution load from Tanneries.

MANUFACTURING PROCESS

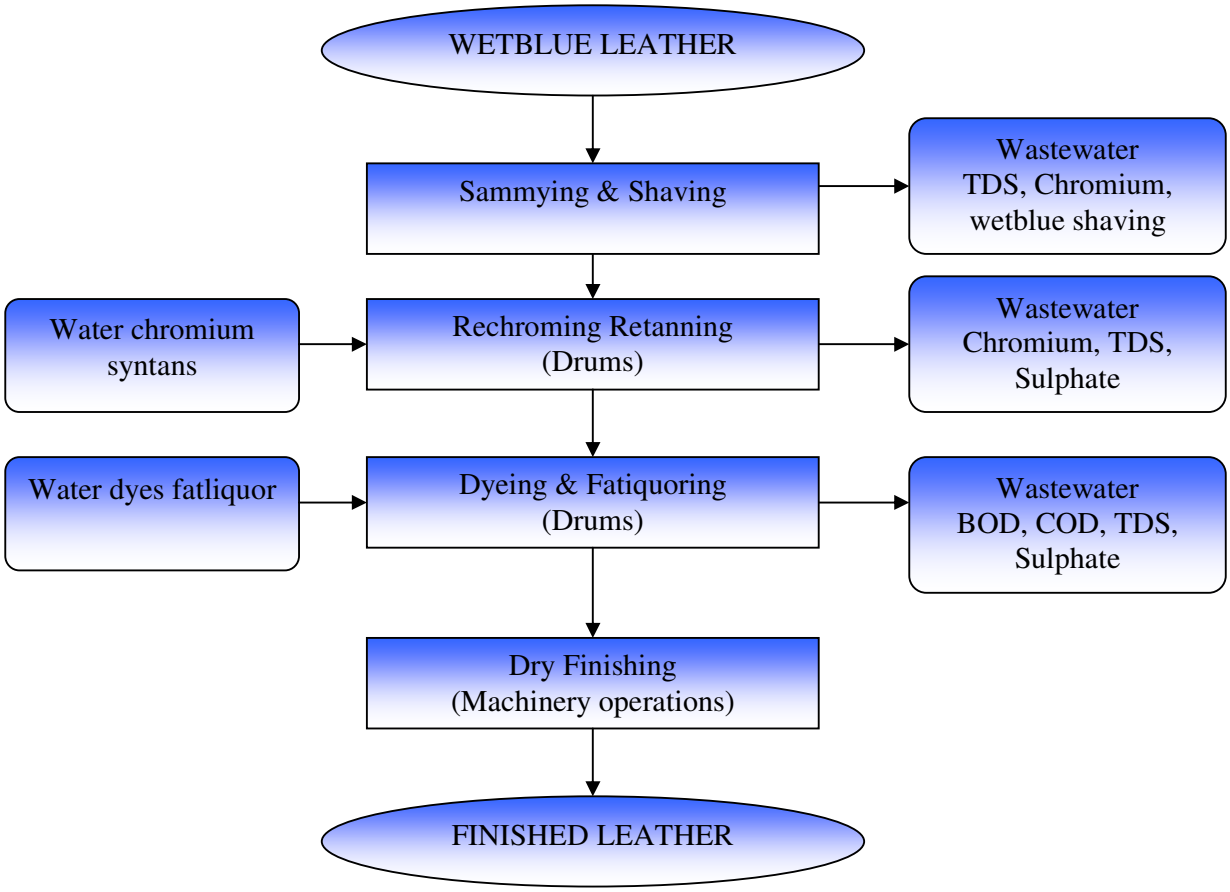
Tanning is the act of converting animal skins into leather. The dry matter of the skin is almost entirely protein, of which 85 percent is collagen. The skin also contains minor amounts of lipids, albumins, globulin, and carbohydrates. The preliminary processes prepare the hide protein (mainly collagen) so that all undesirable impurities are removed leaving the collagen in a receptive condition to absorb the tannin or chromium used in tanning. The tanning process involves soaking of salted skin for cleaning and re-hydration, liming for removal of hair, flesh and fat opening of network, de-liming for removal of lime, bating for removal of globular proteins, pickling for reduction of pH, tanning for permanent stabilization using organic or inorganic materials, re-tanning for supplementation of properties, fat liquoring for rendering softness, dyeing for rendering colour and finishing for surface coating.

The tanning operations of raw hides / skins into semi-finished leather and semi-finished leather to finished leather are given below:

PROCESS OF RAW HIDES / SKINS INTO WETBLUE



PROCESS OF WETBLUE TO FINISHED LEATHER



The volume of water required for processing one ton of raw hide / skin to semi-finished leather ranges from 16-22 m^3 and for finished leather is 28-35 m^3 on raw weight basis.

ROLE OF CLEANER TECHNOLOGIES FOR POLLUTION REDUCTION IN TANNERIES

The principles of Clean Technology are: Recycle, Reuse, Replace or develop alternative technologies that either result in a reduction of waste, or produce a useful byproduct.

The Cleaner Technological methods for reducing the negative environmental impact of hide processing fall into two broad groups. The first group involves the introduction of processing technologies usually termed low-waste or cleaner technologies that can be regarded as advanced technologies in comparison to conventional methods. They mainly aim at decreasing the pollution load avoid the use of harmful chemicals and use of solid waste as byproduct. The second group encompasses the treatment of wastewater and the environment-friendly handling and processing of solid waste. The methods applied in both groups can be used to prevent pollution loads due to leather production on the environment.

MAJOR WASTE MINIMISATION OPTIONS FOR TANNERIES

Sl. No	Process Stage	Problems	CP options
1.	Soaking	Salt in skins are released- Chloride, TDS Protein from skins are released- N, BOD and COD	Better desalting – Machine Segregation and Solar evaporation of wastewater
2.	Liming	Lime and Sodium sulfide contribute - Ca, Sulfide, TDS, COD Protein matter from skins- BOD, COD, N	Recycling spent floats, Less sulfide, Enzyme aided system, Lime splitting Hair saving process
3.	Deliming	Ammonium and Calcium salts- Ca, N, TDS, COD Protein matter from skins- BOD, COD, N	Ammonia free deliming, CO_2 Deliming Reuse of Deliming wastewater for deliming or soaking
4.	Pickling	Common Salt - Na, TDS Protein matter from skin- BOD, COD, N	Pickle free process Reuse of Pickling wastewater for a minimum of 10 recycles
5.	Tanning	Chrome Tanning – Problems of Chromium, sulfate, Sod. Bicarb - Cr, Sulfate, Na, TDS	High-exhaustion tanning process, Chrome recovery and reuse
6.	Wetfinishing	Phenolics, Acrylics, Oil, Dyes - Sulfate, Na, TDS, COD, BOD, VOC	Chrome fixing in neutralization, Chrome precipitation, Buffing dust and leather fibre separation, Replacing Nitrogenous compounds, Screening of chemical products for degradability and treatability

On introducing the above waste minimization options, the following overall reduction in waste water discharge and pollution parameters can be assessed:

A) Reduction in waste water discharge:

C - conventional technology
A - advanced technology

(After implementation of waste minimization options)

Operation	Discharge m^3/t raw hide	
	C	A
Soaking	7 - 9	2.0
Liming	9 - 15	4.5
Deliming, bating	7 - 11	2.0
Tanning	3 - 5	0.5
Post-tanning	7 - 13	3.0
Finishing	1 - 3	0
Total	34 -56	12

B). Reduction of pollution parameters:

- Suspended solids by 58%
- COD by 38%
- BOD by 37%
- Chrome by 94%
- Sulphides by 90%
- NH_3-N by 87%
- TKN by 57%
- Chlorides by 75%
- Sulphates by 70%

Summary of pollution loads discharged in effluents from individual processing operations (C-conventional technology, A-advanced technology (after implementation of waste minimisation options)).

Operation	Techno-logy	Pollution load (kg/t raw hide)								
		SS	COD	BOD_5	Cr	S^{2-}	NH_3-N	TKN	Cl^-	SO_4^{2-}
Soaking	C	11-17	22-33	7-11	-	-	0.1-0.2	1-2	85-113	1-2
	A	11-17	20-25	7-9	-	-	0.1-0.2	1-2	5-10	1-2
Liming	C	53-97	79-122	28-45	-	3.9-8.7	0.4-0.5	6-8	5-15	1-2
	A	14-26	46-65	16-24	-	0.4-0.7	0.1-0.2	3-4	1-2	1-2
Deliming, Bating	C	8-12	13-20	5-9	-	0.1-0.3	2.6-3.9	3-5	2-4	10-26
	A	8-12	13-20	5-9	-	0-0.1	0.2-0.4	0.6-1.5	1-2	1-2
Tanning	C	5-10	7-11	2-4	2-5	-	0.6-0.9	0.6-0.9	40-60	30-55
	A	1-2	7-11	2-4	0.05-0.1	-	0.1-0.2	0.1-0.2	20-35	10-22
Post-Tanning	C	6-11	24-40	8-15	1-2	-	0.3-0.5	1-2	5-10	10-25
	A	1-2	10-12	3-5	0.1-0.4	-	0.1-0.2	0.2-0.5	3-6	4-9
Finishing	C	0-2	0-5	0-2	-	-	-	-	-	-
	A	0-2	0	0	-	-	-	-	-	-
Total	C	83-149	145-231	50-86	3-7	4-9	4-6	12-18	137-202	52-110
	A	35-61	96-133	33-51	0.15-0.5	0.4-0.8	0.6-1.2	5-8	30-55	17-37

COD Chemical Oxygen Demand, BOD_5 Biological Oxygen Demand (in five days), SS Suspended Solids, TKN Total Kjeldahl Nitrogen

CONCLUSIONS

- Beam house operations i.e. soaking, liming and unhairing, deliming and bating produce 86 - 93% of the total SS load, 77 - 82% of the total COD, 77 - 83% of the total BOD and 85 - 92% of the total TKN load in effluents.
- 70 % of the total chrome load in effluents comes from tanning operations, 30% from post-tanning operations when processing leathers by means of conventional technology. After reducing the chrome load by means of advanced technology, the main amount of residual chrome comes from post-tanning (75%).
- Practically the sole source of the sulphides load is liming (95 - 97%). Sulphide residues of the order of 3 - 5% are discharged in deliming and bating effluents.
- The highest portion of NH_3-N pollution (65%) comes from conventional deliming and bating. Ammonia-free deliming and bating reduces the share of the NH_3-N discharge to 32%.

- Soaking and tanning operations are the main source of chlorides (59%, and 29%, respectively) discharged in effluents under standard conditions. When processing unsalted hides, chloride pollution originates primarily from tanning and post-tanning (77%).

- Sulphates emanate primarily from tanning and post-tanning operations (73 - 82%). When performing ammonia-free deliming and bating (instead of ammonium sulphate deliming) reduces the sulphate load from deliming and bating from23% to 6%.

- 62-70% of the total water discharge is clearly from beam house operations. Water consumption of 56 m^3/t raw hide or more is uneconomical, and hence environmentally unfriendly. With less than 30 m^3/t raw hide, the tannery operation can be considered relatively well managed, with good housekeeping.

WORKSHOP ON CLEANER PRODUCTION ON TANNERIES

A workshop on "Cleaner Production Concepts and Methodologies for Tanneries" was conducted by APPCB on 2nd February, 2005 at A.P.Pollution Control Board Head Office, Hyderabad. During the workshop, the present scenario of Environmental pollution in Tanneries, the concept and need for cleaner production and various case studies of the Tanneries who have implemented Cleaner Production options were discussed and many tanneries have agreed to implement the same.

For further information and assistance contact :

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