

INDUSTRIAL CHEMICALS AND ENVIRONMENT

Industrial effluents from Tannery industry and their treatment :-

* General introduction to Tannery industry -

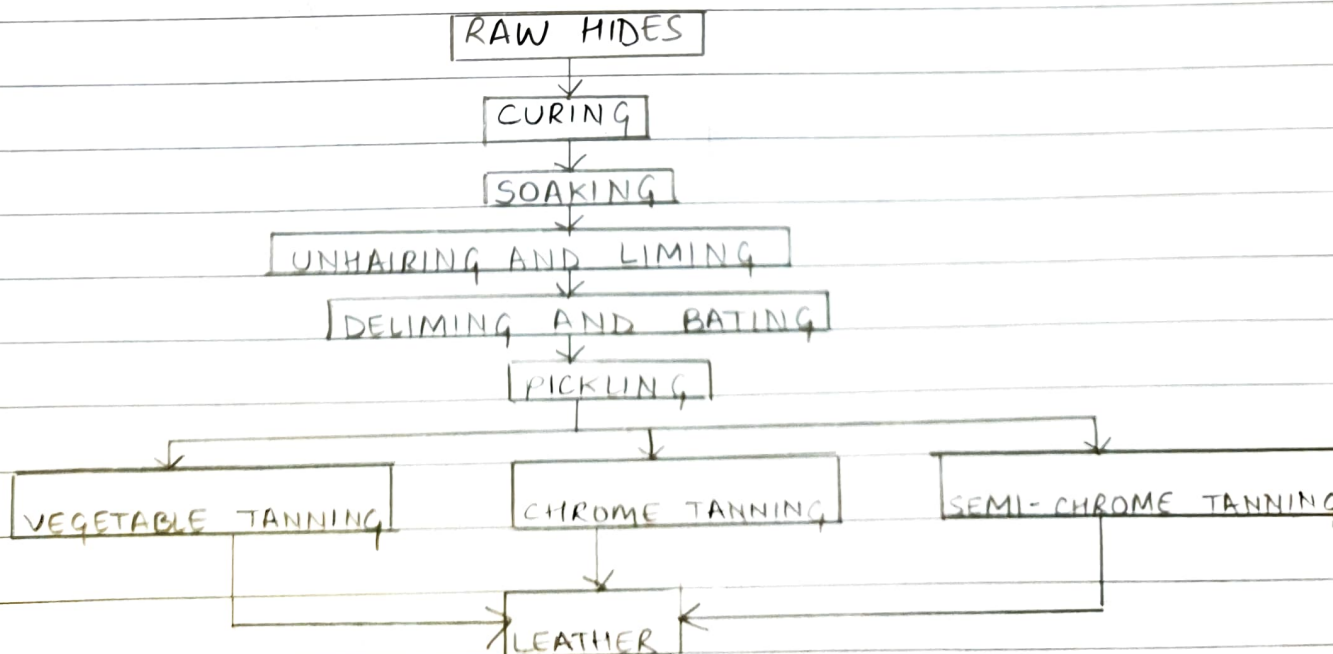
Tanning is the process of treating skins and hides of animals to produce leather.

A TANNERY is the place where the skins are processed.

Tanning hide into leather involves a process which permanently alters the protein structure of skin, making it more durable and less susceptible to decomposition.

It is a reaction between the collagen of the skin which is the middle layer of the skin and different chemicals.

During tanning, cross links are formed between the collagen fibre structure & the fibres do not shrink due to bacterial action, hydrolysis & high temperatures.



Stages of Tanning

⇒ Chemicals used :-

Soaking :

Chloral

Sodium tri chloro phenate

Liming :

Slaked lime

Sodium sulfide

Sodium Hydroxide

Calcium hydrosulfide

Dimethyl Amine

Deliming :

Hydrochloric acid

Sulfuric acid

Formic acid

Acetic acid

Chrome tanning

Chromium sulfate

Chromium chloride

Sodium carbonate

⇒ Wastes from Tannery industries (Generated stagewise)

- In the soaking stage - the most polluting stage of the tanning process, contributed around 50-55% of the total pollution load of the tanning industry.
- In the liming stage - protein, hair, skin & emulsified fats are removed from the hides, they are released in the effluent and increase its total solids contents.
- De-liming and bating - The effluents from these tan-yard processes contain sulfides, ammonium salts and calcium salts and the effluent is slightly alkaline.
- Pickling and chrome tanning - effluents contain sulphuric acid, chrome, sulphides, chlorides, sodium bicarbonate & sulphates.

- The major pollutants of the post-tanning process are chrome salts, dyestuff residues, syntans & other organic matter.



Nature of wastes

The tanning process is almost completely a wet process that consumes significant amounts of water and generates about 90% of the water used as effluent. Effluents from tannery industries carry heavy pollution loads due to a massive presence of -

- highly coloured compounds
- sodium chloride & sulphate
- various organic & inorganic substances
- toxic metallic compounds
- different types of tanning material which are biologically oxidizable
- large quantities of putrefying suspended matter.
- The pH values of the effluents at various leather manufacturing stages ^{range} from 3.8 to 12.5 depending on the strength and amount of the reagents used.
- The total suspended solids (TSS) of the effluents range from 830 to 11000 mg/L and the mean Total Dissolved Solids (TDS) ranges from 4100 to 156700 mg/L, both of which are higher than the permissible standard limits.
- The mean BOD and COD of the effluents also record a higher value than allowed, at 700 to 2400 mg/L and 7200 to 71040 mg/L respectively.

⇒ Common Pollutants, their sources & associated health effects on human

* Pollutant - Salt, Dust, Hair, Soot

Sources - Flething, Dehairing, Soaking

Health effects - aggravates respiratory & heart diseases, toxic and at high level causes coughing, irritates throat & causes chest discomfort.

* Pollutant - Chromium

Sources - Chrome tanning

Health effects - mainly affect the skin & respiratory system, also causes mucous membrane irritation, dermatitis, chrome irritation and ulceration & in extreme cases cancer.

* Hydrogen Sulphide

Sources - Decomposition wastes, Liming, Pickling

Health effects - has unpleasant odour, nausea, irritates throat

* Pollutant - Sulfuric acid

Sources - Pickling process, Chrome tanning

Health effect - impairs breathing and irritates eyes

* Pollutant - Arsenic (Arsenic)

Sources - Tanning process

Health effects - Breakdowns red blood cells in body, damages kidney & causes jaundice.

⇒ Effluents & their treatment.

* WASTEWATER TREATMENT

Tanning industry is one of the oldest industries of the world and the problem of treatment & disposal of these wastes is probably as old as the industry itself.

Tanneries wastewater or effluent is treated in many different ways —

Mechanical treatment

Effluent treatment

Post purification, sedimentation & sludge handling

A. MECHANICAL TREATMENT

- The first treatment of the raw effluent is the mechanical treatment that includes screening to remove coarse material.
- Upto 30-40% of gross suspended solids in the raw waste stream can be removed by properly designed screens.
- Mechanical treatment may also include skimming of fats, grease oils and gravity settling.
- Coagulation & flocculation are also part of this treatment to remove a substantial percentage of COD & SS.
- After this treatment, effluent is generally easily biodegradable in standard aerobic biological treatment plants.

B. EFFLUENT TREATMENT

- In order to carry out effluent treatment in most effective manner flow segregation is useful to allow preliminary treatment of

concentrated wastewater streams, in particular for sulphide & chrome tanning liquors.

- Sulfide-containing effluent is kept in a separate beamhouse at a high pH until sulfide is treated because at a pH lower than 9, the formation of toxic Hydrogen Sulfide can occur.
- The sulfides can be easily oxidized in the drum by adding hydrogen peroxide, sodium metabisulphite or sodium bisulphite.
- Where segregation of sulfide-bearing liquors is not possible, the sulphides are generally removed by means of precipitation with iron (II) salts & aeration.

C. POST-PURIFICATION, SEDIMENTATION & SLUDGE-HANDLING

This is the last step in wastewater treatment. With sedimentation the sludge in the wastewater treatment plant is separated from the water phase by gravity settlement.

* CHROME TANNING & RECOVERY

→ Environmental Impact of Chrome

Cr(VI) compounds are responsible for majority of the health problems associated with all chromium compounds. Normally, during tanning only Cr(III) salts are used but under conditions this can be transformed to Cr(VI) which adversely affects human life, agriculture & livestock, and other ailments such as eye diseases, kidney failure and gastrointestinal problems.

Chromium is carcinogenic & can be linked to chromium pollution in the groundwater.

Cr(VI) penetrates undamaged skin and subsequently reduces to Cr(III) which combined with proteins and other skin components to form a whole skin allergen.

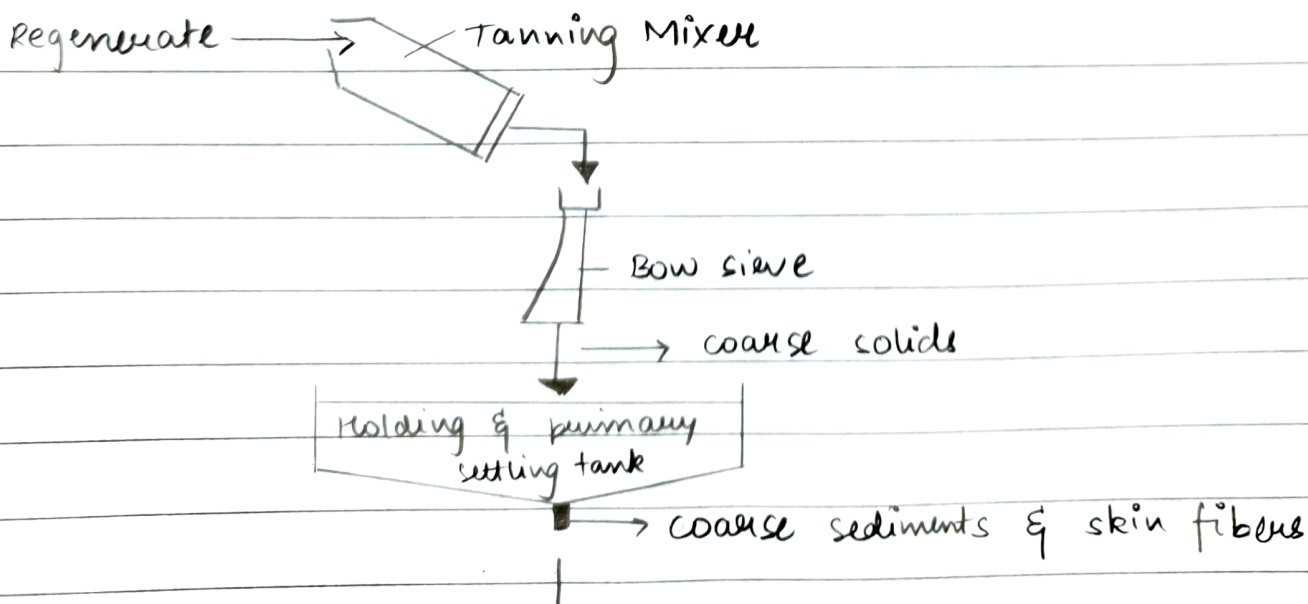
Treatment & recycling techniques

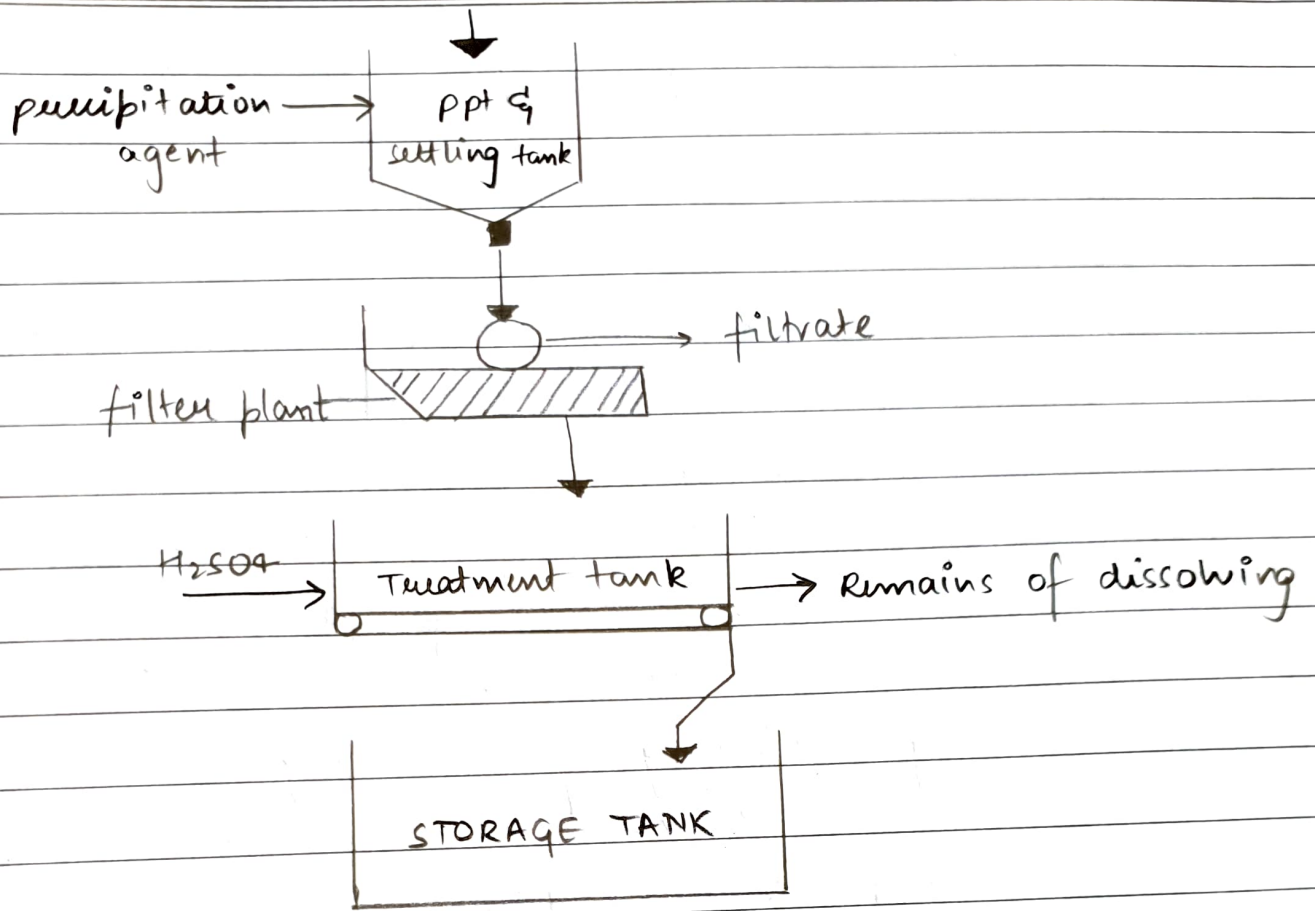
This technique is based on precipitation of chrome containing effluents with alkalis. Common precipitation agents include MgO , Ca(OH)_2 , Soda, NaOH and others.

After settling, thickening & dewatering of the chrome oxide suspension, the filter cake is dissolved in sulfuric acid.

After modifying the basicity, the basic chromium sulfate soln. can be ~~used~~ reused for tanning.

Chromium recycling is not recommended for effluents containing residue of surfactants, fat liquors, dyes & tanning agent other than chromium. The separated liquid phase can be discharged into effluent but chromium sludge is to be disposed safely.





Process flow of Chrome Recovery