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Efficiency Improvement of Tannery Effluent Treatment Plant

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Abstract : The amount of waste water generation is predominantly high in commercial usage when compared to domestic purposes. The process of treating the tannery waste water in an efficient manner can be studied in this project. Through the application of industrially proven low-waste advanced methods such as using salt-free preserved raw hides and skins, hair-save liming, low-ammonia or ammonia-free deliming and bating, advanced chrome management system, etcetera - it is possible to decrease the pollution load expressed as COD and BOD_5 by more than 30%, sulphides by about 60 to 70 %, ammonia nitrogen by 80%, total (Kjeldahl) nitrogen by 50%, chlorides by 70%, sulphates by 65 % and chromium by 90%. Yet, despite all preventive measures, there is still a considerable amount of pollution load to be dealt with by the end-of-pipe methods.
Keywords : tannery, deliming, hides, chrome, ammonia.

1.0 Introduction

Water is the main component which is used in all type of the Industries. Water is used for different processes in the industries. Generally, almost all the industries generate waste water that needs urgent attention. Most of the water is that is used in industries is actually meant for non-consumptive process uses and is ultimately discharged as effluent[3]. Effluent wastewater treatment covers the mechanisms and processes used to treat waters that have been contaminated in some way by anthropogenic industrial or commercial activities prior to its release into the environment or its re-use.

Tanning is a process of treating skins of animals to produce leather, which is more durable and less susceptible to decomposition. Traditionally, tanning used tannin, an acidic chemical compound from which the tanning process draws its name .A **t**anner**y** is the term for a place where the skins are processed. Making raw hide does not require the use of tannin. Raw hide is made by removing the flesh and fat and then the hair by use of an aqueous solution then scraping over a beam with a somewhat dull knife, then drying. The aforementioned aqueous solution for removing the hair also act to clean the fiber network of the skin and allow penetration and action of the tanning agent, so that all the steps in preparation of rawhide except drying are often preludes to the more complex process of tanning and production of leather.

2.0 Significance of the Project

To eliminate the coarse material normally present in the raw wastewater that could clog/block pumps, pipes and possibly sewer lines.

To mix and balance well different tannery streams and thus produce homogenized ¯raw material‖ that can be treated in a consistent manner.

To adjust pH and eliminate toxic substances (sulphides) and avoid shock loads that can negatively affect the rather sensitive biological treatment.

To significantly decrease the BOD/COD load and thus simplify the biological treatment phase and reduce its cost.

3.0 Methodologies

3.1 Pre settling tank

These are usually large tanks in which solids settle out of water by gravity where the settle-able solids are pumped away (as sludge), while oils float to the top and are skimmed off. It operates by means of the velocity of flow which when reduced results in the suspended material (organic settleable solids) to settle out. The usual detention time is 11/2–21/2 hours. Longer periods usually result in depletion of dissolved oxygen and subsequent anaerobic conditions. Removal of suspended solids ranges from 50–65 per cent, and a 30–40 per cent reduction of the five-day biochemical oxygen demand (BOD) can be expected.

3.2 Lime bath collection

The tank is used to remove the lime impurities present in the effluent. Lime impurities usually do not dissolve in water. The hardness due to lime impurities can be removed by boiling or by adding sodium zeolite or by allowing the effluent to pass through a series of filters[6.] A lime bath collection tank is a tank consisting of a series of fine screens. The screen sizes vary depending on the size of the impurities present and the amount of efficiency needed. The tank can be classified into 3 types depending on the inlet pattern. They are i) inlet from top, ii) inlet from bottom, iii) radial inlet. The inlet from bottom type is usually used. In case the volume of floating impurities in the effluent is high, then a lime bath collection tank is used in an effluent treatment plant such as an tannery effluent treatment plant.

3.3 Equalisation tank

Generally the collection tank shall have maximum 10 hrs retention time. Here specific volume and retention time is provided to ensure homogenous mixing and also reduces the temperature of the effluent. If the suspended solids are very high, the equalization tank is provided with coarse diffuser system to provide mixing; so that all the suspended solids shall be kept in solution and will not settle in the collection tank. The correction of P^H is done in this tank. Further, mixing in equalization tank helps to provide homogenous solution, for maintaining constant dosage of chemical in the subsequent treatment[3]. The equalized water is then pumped to Flash Mixer and flocculator for further treatment after adjusting the pH.

3.4 Flash mixer

Effluent from equalization tank shall be pumped to the primary clarifier through flash mixer wherein optimum amount of coagulants (Lime, alum and poly electrolyte) shall be added & flash mixture wherein coagulant is mixed with effluent with the help of high speed stirring system in a mechanically controlled manner for solids to be settled as sludge in the clarifier[1]. Ferrous sulfate solution and lime solution will be dosed in the raw waste water for the purpose of removal of color, BOD and content of the raw waste water to some extent.Lime, alum and poly electrolyte solution will be dosed by means of centrifugal type feed pump. The partition plate dividing the tank allows the water to pass over to the Flash Mixture.

3.5 Flocculation

Modern tannery effluent treatment plants apply mainly dissolved air flotation (DAF), which is the most efficient method of removing suspended solids. The main advantages are less space requirements and better performance compared with settlement techniques. Dissolved air floatation works on the reverse principle to sedimentation, employing fine air bubbles to lift suspended solids to the surface. This leads to the formation of a floating sludge layer, which is removed with a scraper. The main advantage is that fine solids such as hair and fibres or fats and proteins can also be very efficiently removed by flotation. Air is dissolved under pressure in a saturator with part of the recycled treated/effluent. When the pressure is subsequently relieved in the floatation vessel, small air bubbles rise to the surface, carrying the suspended solids. A scraping device periodically removes the surface sludge ‘blanket’. The flotation process relies on coagulant and flocculent chemical

conditioning of the feed stream, in order to enhance the solids separation process. A suitable coagulant is in-line dosed to the effluent, followed by pH adjustment and polymer addition.

3.6 Primary clarifier

Primary clarifier is the next necessary unit to settle down larger particles that comes from flash mixture. Waste water along with chemical solution will gravitate to the Primary clarifier. Approximately 75% of the suspended solids will be settled at the bottom sludge hopper.In the primary sedimentation stage, effluent flows through large tanks, commonly called "pre-settling basins", "primary sedimentation tanks" or "primary clarifiers"[3]. The tanks are used to settle sludge while grease and oils rise to the surface and are skimmed off. Primary settling tanks are usually equipped with mechanically driven scrapers that continually drive the collected sludge towards a hopper in the base of the tank where it is pumped to sludge treatment facilities. Grease and oil from the floating material can sometimes be recovered for saponification. The sedimentation tanks are thus designed to remove a part of the organic matter from the sewage effluent coming out from grit chambers. Inorganic solids of size more than 0.2 mm and specific gravity of2.65 are generally removed by sedimentation tanks.

3.7 Anaerobic lagoon

Lagooning provides settlement and further biological improvement through storage in large man-made ponds or lagoons. These lagoons are highly aerobic and colonization by native macrophytes, especially reeds, is often encouraged

3.8 Aeration tank

The activated sludge process provides an excellent method of treating either rawsewage or more generally the more settlable sewage. The sewage effluent from the primary sedimentation tank[2], which is, thud normally utilized in this process, mixed with 20-30% of own volume of activated sludge which contains a large activated concentration of highly active aerobic micro organisms.

The mixture enters an aeration tank, where the micro organism and the sewage, are mixed together with a a large quantity of air for the organic matterand the susupended and the colloidal mattertend to coagulate and form a precipitate, which settles down readily in the secondary settling tank recycled to the head of the aeration tank to be mixed again with the sewage being treated.

3.9 Secondary clarifier

Effluent from Activated sludge reactor will passes to the will draw off by a sludge pump to the sludge sumpand the clarified water over flows through a launder/channel to the Clarified water tank.

In the primary sedimentation stage, sewage flows through large tanks, commonly called "secondary sedimentation tanks" or "Secondary clarifiers". The tanks are used to settle sludge while grease and oils rise to the surface and are skimmed off. Secondary settling tanks / Clarifiers are usually equipped with mechanically driven scrapers that continually drive the collected sludge towards a hopper in the base of the tank where it is pumped to sludge treatment facilities[5]. Secondary tube settlers use tube deck media for settling out the solids and Clear water passes to Clear water collection tank as surface overflow.

3.10 Polishing tank:

Polishing tank is used for the purpose of desalination process. The desalination process is carried by adding chemicals or by passing the treated effluent over resins(mostly epoxy). This process is carried out to reduce the total dissolved solid content present in the effluent. It is a compulsory process in a tannery effluent treatment plant as the effluent consists of a major of alkaline impurities than biological impurities. If this process is not carried out, then the final treated water will have a ph greater than that which should be present as per standards.

In a tannery effluent treatment plant the process of polishing tank will usually take place after the secondary clarifier process. The process is carried out predominantly using chemicals in a tannery effluent

plant. The size of a polishing tank is usually the size of a secondary clarifier as the effluent can be easily collected.

3.11 Tertiary clarifier

Tertiary clarification is a unit process that can be used after conventional biological treatment to provide effluent water quality that is better than secondary standards. Common applications for tertiary clar tertiary clarification are enhanced removal of phosphorus, suspended solids, metals, and pathogens. Information is presented in this chapter on the scientific basis for tertiary clarification processes, including characterization of suspended solids, settling velocities and overflow rates, chemical coagulation, precipitation of metals and chemical phosphorous removal.

3.12 Ultra filtration feed tank

In a tannery effluent plant an ultra-filtration unit is used to reduce the BOD, COD & TSS present in the treated effluent. The criteria of the effluent standards cannot be maintained in this plant so the life of membrane will not be achieved as mentioned. The efficiency can be increased by reject recycling and management system in which 3 membranes will be present and the effluent is recycled in the process so that better treatment process is carried out. The life time of membrane also decease due to the alkaline impurities. The treatment process is carried out 3 times for the same effluent for better purification process. Since this is the final stage of treatment the final effluent is achieved as per the standards mentioned. Hence the effluent is treated and is recycled for the tanning process thereby reducing the water consumed for the tanning process.

3.13 Sludge storage tank

Once the effluent is treated at the primary clarifier, it's then separated into the water waste and the solid waste which is otherwise known as the sludge. This sludge is then sent to the sludge storage tank which is used to store the sludge gor a period of time until it's ready for the next process.

3.14 Solar evaporation shed

Solar evaporation shed is a type of dewatering method. A tent like arrangement is created though which the sludge water is sent. The tent is constructed using a transparent geo-membrane. This heats the sludge and the water is evaporated and allowed to fall on the membrane. The specific heat of water is reduced before the initiation of this process[4-6.] The water then is allowed to flow through the membrane surface and is collected through the pipes placed at the end of membrane. The water is collected through a separate outlet and the remaining sludge is carried out for the sludge drying beds.

3.15 Sludge drying beds

Digested sludge is placed on drying beds of sand where the liquid may evaporate or drain into the soil. The dried sludge is a porous humus-like cake which can be used as a fertilizer base. The above process can be carried out only in the case of water treatment plant or municipal waste water treatment plant as the sludge would contain a majority of organic impurities. The retained sludge acts as manure or gets degraded thereby any vegetation can be carried out over the land or the top layer can be skimmed of, then recycled and can be used. So this process cannot be carried out in a tannery effluent plant.

In a tannery effluent plant the sludge drying bed process is carried out over a rigid concrete surface or over a geo membrane. The disadvantage of this method is the large area it occupies, hence the area can be reduced by drying the sludge over a porous gravel layer. This reduces the area of bed required. After the process is completed the gravel is sent to a vibrator to remove the salt attached on it's surface. This salt is used as a raw material source for the process of tanning.

4.0 Results and Discussions

The results of the field data from the samples collected after treatment and the salient discussions are presented.

A. Salinity

Salinity reduces from 1000ppt (station A) to 30ppt(station D)

B. Temperature

The temperature ranges from 28.00ºc to 30.50ºc. The difference in the temperature is due to normal changes in the climate, intermediate rains occurring at times.

C. Oxygen Demand

The BOD level varies from 3500mg/l (Station A) to 20mg/l (station D). The COD varies from 6000mg/l to 60mg/l.

D. ph

The observed value of pH varied from 7.5 to 12. The maximum of the value was observed from station A and the minimum of 7.5 is noticed from the water samples collected from station B.

E. Total Solids

The total solids content varied from 20000ppm at station A to 250ppm at station D.

The results obtained from various stations at different stages of the treatment process are tabulated.

- Station A – Raw effluent
- Station B – Sample after flocculation
- Station C – Sample before ultra-filtration
- Station D – Treated effluent

The parameters are mentioned in their SI units

Parameters Tested	**Station A**	**Station B**	**Station C**	**Station D**
Temperature (ºC)	28.00	28.40	28.60	28.20
pH	12	11.2	9.5	7.8
BOD (mg/L)	3500	2800	240	20
Salinity (ppt)	1000	1200	145	30
COD (mg/L)	6000	4900	300	60
TS (ppm)	20000	22500	700	250

5.0 Conclusions

The performance has been improved by `testing various primary treatment chemicals and selection of the most suitable polymer. In the following, the addition of the selected coagulants and polymers has been adjusted and a reduction of the overall treatment chemicals has been achieved. The solar evaporation shed increased the efficiency of the plant by 3%. The area for salt reclamation decreased The implementation of the new primary treatment has significantly improved the effluent quality and has also reduced the sludge disposal volumes and costs. The plant is fully automatic and requires minimum supervision.

7.0 Reference

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