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A CASE STUDY: EVALUATION OF TANNERY EFFLUENT

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ABSTRACT

The Tannery industry is important to our country's economy were it is transformed from the raw material into useful by products. Processing of leather is in two stages (i.e.) 1) Raw to semi-finished 2) Semi-finished to finished leather. Different types of effluent are generated from processing of leather which includes organic and inorganic constituents. In India the existing effluent treatment system is a combined treatment process in many industries, The E.K.M leather process co., Erode is unique from the above. The effluent is a combination of low saline effluent, high saline effluent and chrome effluent. They have an effective Effluent Treatment Plant and are working with the 3R concepts Reduce, Recycle, and Reuse by achieving ZLD system as per the TNPCB & CPCB Norms. The treatment system consist of Primary treatment system and Secondary treatment system (i.e.) Developed wastewater treatment plants adopt Activated Sludge Process technology as biological process, and tertiary treatment system follows mechanical filtration as an advanced treatment for effective Effluent Treatment

KEYWORDS: Tannery Industry, Reuse, Treated Wastewater, Activated Sludge, Chrome.

Leather sector has contributed significant economic growth by providing job opportunities. Today the industry ranks 8th in the export trade in terms of foreign exchange earnings of the country. Leather industry occupies a place of prominence in the Indian economy, by contributing 2 billion US dollars in terms of export, and its share in world trade is 2%. Leather industry is providing employment to nearly 2.5 million people and the majority of tanneries fall under small and medium scale enterprises (Taylor 2005). Leather is manufactured in a number of steps involving about 170 types of chemicals, which include sodium chloride, lime, sodium sulphate, fat, ammonium sulphuric acid, chromium sulphate and a number of dyes (Kankaria et. al., 2011).

Raw tannery effluent is unacceptable into any municipal sewage system as it is too strong in many aspects. Prior to disposal, the effluent must meet stringent regulatory standards. Erode city is the top and famous for tannery industries. The industry is highly water intensive also. The city is also known for their pollution in tamilnadu. The main reason for pollution is due to Tannery and Textile industries. Only about 20% of the chemicals used in the tanning process are absorbed by leather manufacturing process. The Raw leather – Semi finished leather each tone of hide/skin tanned requires over 15,000 litres of water per day. After each step, waste is generated and it contributes to the final effluent. These wastes contain high BOD, COD, High Total Dissolved Solids, chrome salts and residual dyes. The wastes from the tannery consist of tanned and un-tanned solids, waste effluents, and waste gases. Environmental pollution is one of the major problems of the world which increases day by day due to urbanization and industrialization. Release of the effluents in the receiving water is the major reason for water pollution. These pollutants find their way to aquatic ecosystem such as rivers and ponds and lakes, which pose a risk to the health of human and ecosystem.

TANNERY OPERATION OVERVIEW

Operation process stages are trimming, soaking, liming, de-liming, bating, degreasing, pickling, chrome tanning, and tannage, fat-liquoring, dyeing, drying and finishing.

Table 1: Types pollution generated

S.No	OPERATION	TYPES OF POLLUTIION GENERATED
1	Soaking	Mainly blood, manure, dung, soluble proteins salt, emulsifying agents
2	Un-hairing/Liming	Mainly sulphides, high alkalinity, suspended solids (hairs and lime) proteins nitrogenous matter, Total Dissolved Solids, high COD and BOD.
3	De-liming	Ammonium salts , enzymes
4	Pickling	Mainly common salts and Inorganic acids
5	Degreasing	Mainly fats, degreasing agents and common salt
6	Chrome tanning	Mainly chromium III salts, sulphates and carbonates
7	Vegetable Tanning	Natural and synthetic tannins, organic acids and phenols
8	Fat liquoring	Natural and synthetic fats and oils
9	Dyeing	Synthetic dye stuffs, inorganic and organic acids, ammonia
10	Finishing	Organic Solvents, pigments, emulsifying agents and heavy metals

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METHODOLOGY

Case Study Project: Wastewater Treatment Process Methodology Description

In India, an existing tannery effluent treatment system was achieved by ZLD concept in many industries. This ZLD concept involves the combination of Chrome effluent, Low saline effluent and high saline effluent. But it may be difficult to achieve the ZLD concept through these combinations. So the easy way to achieve this concept was by separating the effluents. The monitoring and analysis was done for performance assessment of the ETPs. For this, the sampling was collected from E.K.M leather process co., and then the effluents was separated as low saline effluent, high saline effluent and chrome effluent for effective Effluent Treatment . The E.K.M tannery has installed Biogas plant for the digestion of fleshing waste. .

Chrome Recovery Plant

Chromium sulphate effluent was treated by the screening, collection tank and by adding magnesium oxides in the optimized level of 5000 ppm into the flash mixer with sterling wheel which provides and maintain the HRT for 8hours for sludge settling in the hopper bottom clarifier. The supernatant (magnesium sulphate) was used for the pickling stage.

High Saline Effluent Treatment

Soak effluent is highly saline in the tannery effluent. Soaking rehydrates the fibre which helps to restore the natural swollen condition of the skin and to remove dirt, blood, dung, soluble proteins and curing agents such as salt. Soak effluent containing hair, Total Suspended Solids, Total Dissolved Solids, highly organic and inorganic constituents. So, it should be treated by screening, grit removal, sand filter and finally adding coagulant of 500 ppm with clarifier system to remove the suspended and colloidal impurities. Finally the supernatant water was sent to the solar evaporation pans for salt crystallizer.

Low Saline Effluent

All the floating material should be arrested by the screening process where the effluent passes to the pre-settling tank and was pumped into the collection tank. The supernatant water was pumped into the equalization (Homogeneous) tank. This homogeneous effluent was added with alum in flash mixer for proper agitation, flocculent was added in the flocculating channel and was allowed to settle down in the primary clarifier.

In ETPs of tanneries the wastewater coming from different processes was collected through the collection sump and from the collection sump it was passed into the neutralization cum equalization tank where pH was brought down to neutral. The flow was equalized for further treatment, after that the effluent was passed into the chemical reaction tank where chemical dosing was applied for coagulation and flocculation process.

Sampling of effluent location named as S1 (Raw Effluent), S2 (Primary Clarifier Outlet), S3 (Secondary clarifier Outlet) and S4 (Tertiary Clarifier) and S5 (Reverse Osmosis). Locations of the ETP and analyzing for the different major physiochemical biological parameters is done. The results obtained from monitoring and evaluation studies were compared with the effluent standards prescribed in order to assess compliance. Even pH of the collected samples was measured on site; the samples from different sampling location were collected in plastic bottles. Until the analysis was over, the samples were stored in deep freeze.

The treatment system consists of Screening, Pre-setting, Collection tank, Equalization tank, Flash mixer, Flocculation channel, Primary clarifier 1 & 2, Anaerobic tank, Double stage aerobic system and Tertiary Clarifier.

In pre-settling tank heavy particles settle down towards gravity and the supernatant effluent was pumped into the collection tank. This supernatant effluent was made homogeneous with floating aerator.

In coagulation channel alum was added in an optimized level for coagulant in 3000-3500 ppm and was provided in two stages, primary clarifier with sterling wheel for retention time capacity of 8 hours. The colloidal and suspended particular matter settles down and the total BOD & COD is reduced and also the TSS from the raw effluent parameters.

After coagulation and flocculation the effluent was passed into primary clarifier for sludge settlement. The supernatant was passed into the anaerobic tank followed by double stage aeration tank for biological treatment and air was supplied into the aeration tank. The D.O level was maintained as 1.8 to 2.2 in aeration tank by means of blower with disc diffuser. After providing sufficient HRT in aeration tank, it was drained into the secondary clarifier for further sludge settling. This settled biomass should recirculate into the aeration tank for maintaining the MLSS and MLVSS.

The supernatant wastewater from secondary clarifier is stored in polishing tank and treated as tertiary treatment processing for hardness removal process by adding soda ash and alum ratio of 1:5 and flocculent was added, this effluent was passed into the tertiary clarifier. The E.T.P outlet water was pumped into the Reverse Osmosis process. The settled sludge from the primary and tertiary clarifier sludge was sent into the conventional Sludge Drying Beds, Filter press and E.K.M leather process co, tannery unit was doing the cost effective filter bags to dewater purpose.

Figure 1a: Flocculation channel

Figure 1b: Equalization tank

Figure 1c: Aeration tank

Figure 1d: Collection Tank

RESULTS AND DISCUSSION

Table 2: High Saline Effluent Treatment

S.No	Parameters	Raw effluent in Ranges	Treated Effluent Parameters
1	pH	6.5 - 8.5	6.5
2	BOD (mg/l)	1000 – 1200	800 – 1000
3	COD (mg/l)	3750 – 4250	3000 – 3500
4	TSS (mg/l)	1000 – 1200	2000 – 4000
5	TDS (mg/l)	40,000 - 60,000	40,000 - 60,000

Table 3: Low Saline Effluent Treatment

S.No	Parameters	Raw (E.T.P Inlet) Effluent	Primary Clarifier Outlet	Secondary Clarifier Outlet
1	pH	12 – 14	7 - 8	7 – 8
2	BOD (mg/l)	3000 - 3500	2250 - 2600	30 – 50
3	COD (mg/l)	7000 - 8000	5250 - 6000	200 – 300
4	TSS (mg/l)	1000 - 1200	200 - 250	100 - 150
5	TDS (mg/l)	18,000 - 22,000	18,000- 22,000	18,000 - 22,000
6	Hardness (mg/l)	2000 - 2500	2000 - 2500	2000 - 2500
7	Turbidity(mg/l)	-	-	-

Table 4: Chrome Effluent Treated Effluent

S.No	Parameters	Raw effluent	Treated effluent
1.	pH	3 - 4	8 - 8.5
2.	TDS	60,000	60,000

CONCLUSION

By separating the low saline effluent, high saline effluent and chrome effluent the 3R concept of Effective Effluent Treatment plant can be achieved the

ZLD system as per TNPCB & CPCB norms. While adding coagulants, high saline effluent was reduced to 25 - 35% BOD & COD and 80% TSS and it can be directly sent into the solar evaporation pans for salt crystallizer. The low saline effluent lime bath achieved the BOD, COD reduction as 95% and TSS as 95% and Hardness was reduced to 60 % from the raw effluent in E.T.P outlet water which was done by the primary, secondary and tertiary systems. This E.T.P outlet was passed into the Reverse Osmosis and practically 85% recovery of water was stored in the OHT tank and was utilized for the production process. Chrome effluent was treated by adding magnesium oxide and sludge settles down in the clarifier and 95% supernatant was reused by the pickling process, the 3% salt percentage can be minimized in the pickling process, Remaining 5% settled sludge will be a chromium hydroxide it should be diluted with sulphuric acid and was converted into chromium sulphate. This chromium sulphate was reused in chrome tanning.

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