INTEGRATED EFFLUENT TREATMENT IN TANNERY INDUSTRIES - FEASIBILITY STUDY

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ABSTRACT

Waste water treatment with Reverse Osmosis technology is the best option for treating high conductivity of global waste water from tannery industry. Feasibility of reusing tannery waste water by combinations of existing conventional activated sludge process, with Ultra filtration, Nano filtration and Reverse Osmosis treatment technologies were studied. The characteristics of untreated effluent in two tannery industries were collected. From the result, it can be seen that conventional treatment system marginally removes the organic pollutant where as it failed to remove total dissolved solids. On the other hand membrane technology removed salts and organic pollutants. From the analytical result of the treated water it can be understand that the treated water can be reused for the process. The rejects obtained in the process is subjected to solar evaporation system or multiple evaporation system for further recovery of salt.

INTRODUCTION

Manufacturing of leather, leather goods, leather boards and fur produces numerous by products, solid wastes and high amount of waste water containing different loads of pollutants and emission in to the air. The transformation of the raw hide into leather requires various mechanical and chemical treatments and is generally carried out using different acids, alkali and salts of sodium and chromium (Dutta, 1999). The leather industry is one of the highly polluting industries. The uncontrolled release of tannery pollutants into natural water bodies increases the health risk for human beings and environmental pollution. Effluent from raw hide processing tanneries which produces wet blue, crust leather or finished leather. Organic and other ingredients are responsible for high BOD and COD values and result in an immense pollution load causing technical problems. In India the annual amount of hides and skins processed is about 80,000 tones resulting in 85,000m$^3$ of liquid effluent per day from 3500 tanneries (Naidu et al. 2000). Erode district of Tamilnadu in India has clusters of tanning units at Chithode, Bhavani and Perundurai. Sodium chloride, sodium sulfide lime, chromium proteins, fats are the major constituents used (More et al. 2001). The effluent discharged from these industries have high BOD and COD. Conventional Activated Sludge Process was adopted in the treatment of tannery industry effluent which was found to be
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The conventional treatment technology like chemical flocculation and biological process like up-flow anaerobic sludge blanket and activated sludge process are found to be effective in removal of organic pollutants. Tare et al. (2003) reported that the ASP is superior to UASB. However, these processes are not competent in reduction of total dissolved organics. Membrane technologies are advanced methods to solve problems of dissolved solids in the effluents. Pilot studies have been carried out for removal of chromium from tannery waste water using RO system and found high concentration of NaCl affected chromium separation as well as percent recovery of permeate (Hafez et al. 2002 & 2004). In the present work tanneries located in Erode district which have installed Reverse osmosis membrane process are studied to evaluate their performance.

MATERIALS AND METHODS

Two tanneries operating reverse osmosis membrane technology namely EKHM tannery andLeads leather, located in Erode district of Tamilnadu was considered for feasibility study. The information such as production capacity, raw materials, water balance and existing treatment technologies were collected. In general, hides and skins after stripping in the slaughterhouse are immediately preserved by applying NaCl (1:3 salt and skin weight ratios) and are brought to tanneries for making leather. Salts are removed initially by manual or mechanical desalting and hides are soaked in tank filled with water overnight and also one hour soaking is carried out at least in fresh water. Soaking removes the salt generation about 11-15L/kg of waste water with high TDS in the range of 20000 mg/L to 53000 mg/L. Finally, these effluents are subjected to multiple/solar evaporation (MSE).

The next part is to remove hair, fleshy and unwanted organics, the hide is soaked in the suspension of lime (7.5%) sodium sulphide (2.5%) and subject to de-hairing and de-fleshing. The quantity of effluent generated is 4 L/kg with high calcium, sodium sulphide and organic pollutants. The lime process is followed by ammonium salt picking overnight for the removal of imregnated lime in the process of hides. Sulphuric acid is used as acid picking to bring down the pH to 2-4 to avoid biological effect and good tanning. Chromic acid about 8% is used for tanning for about 9 hours. 20-30% of used chromium salts are let into the waste water.

Waste water sampling for analysis

Composite sampling has been carried in the interval period of 1 hr before and after treatments of both conventional and RO technologies. The sampling and analysis were carried out as per prescribed standard methods (APHA 1998) and (CPCB 2001).

RESULTS AND DISCUSSION

The characteristics of effluent in EKHM and Leads leather industries are shown in Table 1 & 2. The schematic diagram of effluent treatment followed in the above industries is shown in Figure 1. Characteristics of waste water of both tanneries are following bar chamber for particle separation, clarification/conventional sludge process as convention treatment process and it was embedded with UF, NF and RO system of advanced treatment. The initial values of pH for the tannery waste water are acidic due to the use of the mineral acids in the process. Lime and chemical coagulations have been added to raise the alkalinity of the water. This will remove 92-96% of BOD followed by biological oxidation which subsequently reduces 92-96% BOD. There is significant removal of suspended solids and chemical oxygen demand. Also it is noted that there is significant change in removal of inorganic substances in the range of 0-35%. Ammoniac treatment and polishing with lime and polyeletrolyte’s has further reduced BOD. The main purpose of the conventional method is to increase the life of the membranes of RO system which will result reduction in cost for effluent treatment. The conventional methods also pay way to efficient removal of toxic pollutants like chromium and sulphides by oxidation and precipitation. However, the removal of TDS is a hectic problem with respect to conventional technology. Therefore, in addition to conventional technology the RO treatment system is embedded for the removal of dissolved solids. To enhance the efficiency of recovery permeate and to increase the life cycle of the membrane a physical-chemical combination of UF and NF are used.

The permeate of these RO treatment system are more than 75-85% recovery and rejects 15-25%. The BOD level in the permeate was found to be below detection level. TDS is one of the important parameters to analyze the performance of RO system was found to be in the range of 3000-9000 mg/L in feed water and in the case of permeate it was in the range of 230-250mg/L which are well within the drinking water standard. On the other hand rejects are generally in the range of 12000 mg/L. The quality of RO permeate may be enhanced by installing further RO system before it is subjected to solar evaporation system or multiple evaporation system. The results are shown in Figures 2 and 3.

CONCLUSION

The effluents of tanneries are segregated as high TDS soaking waste water chromium toxic waste water and other waste water streams. From experimental study, it can be concluded that conventional sludge process followed in the above industries is shown in Figure 1. Characteristics of waste water of both tanneries are following bar chamber for particle separation, clarification/conventional sludge process as convention treatment process and it was embedded with UF, NF and RO system of advanced treatment. The initial values of pH for the tannery waste water are acidic due to the use of the mineral acids in the process. Lime and chemical coagulations have been added to raise the alkalinity of the water. This will remove 92-96% of BOD followed by biological oxidation which subsequently reduces 92-96% BOD. There is significant removal of suspended solids and chemical oxygen demand. Also it is noted that there is significant change in removal of inorganic substances in the range of 0-35%. Ammoniac treatment and polishing with lime and polyeletrolyte’s has further reduced BOD. The main purpose of the conventional method is to increase the life of the membranes of RO system which will result reduction in cost for effluent treatment. The conventional methods also pay way to efficient removal of toxic pollutants like chromium and sulphides by oxidation and precipitation. However, the removal of TDS is a hectic problem with respect to conventional technology. Therefore, in addition to conventional technology the RO treatment system is embedded for the removal of dissolved solids. To enhance the efficiency of recovery permeate and to increase the life cycle of the membrane a physical-chemical combination of UF and NF are used.

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REFERENCES


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Central Pollution Control Board, New Delhi.


