Modern Applied Science
www.ccsenet.org/journal.html
Vol. 3, No. 1
January 2009

Treatment and Reuse of Tannery Waste Water by Embedded System

S.Krishanamoorthi (Corresponding author)
Dept. of Civil Engineering
Kongu Engineering College, Perundurai, India
Tel: 91-4294-226700 E-mail: sk_moor@yahoo.co.in

Dr.V.Sivakumar
Dept. of Chemical Engineering
Kongu Engineering College, Perundurai, India

Dr.K.Saravanan
Dept. of Chemical Engineering
Kongu Engineering College, Perundurai, India
E-mail: rumisivaesh@yahoo.com

T.V.Sriram Prabhu
Consultant /Akshay Water Tech.
Perundurai, India

Abstract

Due to scarcity of water problem in India especially southern part of India the large number small and medium scale industries are facing hectic loss in production. On the other hand the effluent discharged from these industries contaminates the water table and water sources. In this juncture, a novel technology should be developed to overcome these problems. Hence the present work focuses attention on the novel methods for treatment of tanner effluent and reuse for other purposes. For this purpose the experiments have been conducted by embedding UF and RO. Experiments have been performed for both UF and RO by varying the pressure and load to the membranes against the flux. Finally, based on the experimental results a suitable embedded system has been suggested for treating tannery effluent.

Keywords: Waste water, RO, UF,BOD, COD, Tannery Effluent

1. INTRODUCTION:

Leather is material that has a reasonable resistance, good chemical stability and acceptable thermal behavior. This material is obtained by means of specific reaction among carboxylic groups of the protein fiber network of animal skin (collagen) and tanning regents. In today scenario industrial waste water reuse is becoming nearly a duty to contribute to water consumption reduction due to water scarcity in around Erode district of India .Besides; the legal standards are becoming increasingly stringent. Thu those industries with a great water and chemical consumption are required to exhaustive waste water treatment and water reuse. Tanning industries use large quantities of water approximately 15 to 20 m^3 per tone of raw skin. During tanning process large amounts of waste water sludge and solid containing chromium, sodium chloride and sulfate are produced. The tannery effluents are characterized by high COD and BOD and conductivity values. The composition of the effluent varies according to the tanning process used and the type of leather to be obtained. The characteristics of the raw waste water from a tannery includes chrome tanning and finishing of cattle hides are shown in Table 1.Waste water is the effluent of the tannery that has a fast interaction with environment. The amount of waste water varies between 30 and 50 L per kilogram of the processed skin (Alexander K.T.W et al., (1992) from, the total amount of liquids, nearly 10 % corresponds to the tanning stage and the remainder to the other stages of processing (dehairing, pickling, neutralization, dyeing and washing). A s it can be observed that COD and SS values approximately five times higher than municipal water waters and high salt concentration similar to that of brackish water.

In order to minimize the pollution of these waters, some of the authors propose the adoption of integrated cleaner technologies (Rao J.R et al., 2003) and the treatment mainly by means of membrane technologies of the waste streams from particular process. It would drive to both water reuse and removal of pollutants that would not be included in the global waste water. Cassanoa and Molinari (1997,2001) studied experimentally the treatment of the unhairing waste stream., pickling solution by means of a RO system and chromium tanning effluent (to reuse water and chemicals by combining UF and RO) Galianna et al (2005) the use of nanofiltrtion for pickling and tanning effluents in order to minimize the sulphate ions concentration in the global waste water Galiana M.V et al (2005).However the high polluted partial waste streams make difficult the membrane operations Mantari *et al* (2005) In addition, recycling not sufficient for the water reuse after a conventional treatment of global waste water. Other authors suggest an integrated treatment of the global effluent for water reuse. The first step is a physical-chemical treatment of the waste water in order to reduce the suspended solids considerably. This entails COD and BOD5 reduction too. Only few process are able to separate salts from waste water. Reverse osmosis will be more feasible than evaporation , ion exchange or nano filtration because of the conductivity value and the high chloride ion concentration of the waste water. Suthanthararajan et al (2004) proposed an exhaustive tertiary treatment for the biological treated waste water from a tanning industry consisting of a sand filter, a photochemical oxidation step, a softener, chemical dosage cartridge filter NF and RO. This propose d treatment showed obviously excellent point of view these costs can be assumed by most of tanning industries.

On the other hand the operation of a biological reactor for tannery waste waters is sometimes difficult due to high conductivity and the presence of chromium and organic substances coming from finishing operations which can damage the reactor biomass.

The present work focus treatment method for tannery waste which consisting of physical-chemical process (carried in the factory), filtration, ultrafiltration and reverse osmosis is evaluated for water reuse.

1.1 Materials and Methods

The present work was divided into three stages: waste water characterization, UF and RO experiments.

1.2 Waste water characterization

Integrate waste water samples were taken from the tannery plant (**EKM Tannery, Erode**) after being treated with physical-chemical process. The samples were collected in the frequency of one hour at various location and mixed samples was analyzed for further study. The main analyze parameters were COD, turbidity, pH, conductivity, total solids (TS) suspended solids (SS), sulphate, chlorides, and colour.

1.3 UF experiments

Tannery effluent was treated physical-chemically in the industry and filtered at the laboratory with a 25 micron cartridge filter previously to UF experiments. The scheme of UF is shown in Figure 1,Uf module was plane with an effective membrane area of 0.009 m^2. Four polyetersulphone (PES) membranes of different cut off (3,10,30100 kDa) were tested at different transmembrane pressures(1,2 and 3 bar) For all test the cross –flow velocity was 1.3 m/s and the temperature was held at 25 C. The permeate and reject were recycled to the feeding tank. Periodically permeate flux (Jp), conductivity and pH were determined. In addition at end of each experiments COD , colour, suspended solids and turbidity were analyzed.

1.4 RO experiments

Ro experiments were performed in lab scale plant equipped with pressure vessel that contains one spiral wounded membranes element. The membrane tested was from Hydranauatics with an effective area of 2.8 m^2. The operating conditions were three different transmembranes pressures (20,25 and 30 bar) a feed flow rate of 500 l/h and a temperature of 25 C. Permeate and reject streams were recycled to feed tank.

1.5 Results and Discussion

The characterization of the physical-chemically treated wastewater from tannery was shown in Table 2. It can be seen that the COD and alts concentrations are considerably higher than those measured for municipal waste water.

1.6 UF experiments

UF experiments were carried for both distilled water and tannery waste water. The results are shown in Figure 3. From this figure it can be seen that the measured fluxes at different transmembrane pressure. As expected the higher transmembrane pressure the higher permeate fluxes were achieved. However, from figure 3 it can be seen that the flux sharply increased from 10 to 30 kDa deviating from a lineal flux evaluation with the membrane cut off. In case of tannery waste water experiments the best result in terms of flux and rejection were obtained P= 2 bar and a cross flow velocity 1.5 m/s. Table 3 shows the characteristic of feed and permeate streams at these operating conditions. For all membranes it can be observed an appreciable turbidity and colour drop after UF process . Nevertheless, COD values hardly decreased . This can be explained as since COD was mainly soluble consisting in hydrolyzed proteins of low molecular weights . The presence of inorganic reduction agents could contribute to the high COD values. The influence of the membranes cutoff on the COD separation was almost negligible. This facts determines the selection of low fouling membranes for the RO step The variation of the fluxes with operating time is shown in Figure 4a. Fluxes were very low in comparison with those obtained with distilled water figure 4. While the permeate fluxes of the membranes and 10kDa were very low from the beginning of experiments.

The highest flux was achieved by the 30kDa membrane. This flux was even slightly higher than that obtained with the 100 kDa . This behavior can be explained by the effect of the solutes molecular size on the membrane fouling. Table 3 shows the characterization of the feed and permeates steams for the RO experiments. As expected salt and COD rejections were higher than 98%. Permeates can be reused in tannery seen in those process that require the lowest salt concentration like the dyeing one. The evolution of the permeates fluxes with the time at three different transmembranes pressure in the RO tests can be observed in Figure 5.

For these three transmembrane pressures, the steady state was reached after a brief period of time remaining the flux practical constant during the rest of experiments. the solutes concentration was too high enough to produce scaling and fouling problems in the experiments. At 30bar the permeate flux was nearly 40l at steady state.

CONCLUSION

- Reverse Osmosis is necessary for water reuse in a plant when o high chloride concentration
- The combination of a physical-chemically treatment with ultrafilteration was not efficient to remove soluble COD of the waste water.
- The selection of UF membrane was based on the permeate flux rate
- The quality of RO permeate was high enough even after for its reuse in tannery process.
- In spite of organic matter contents of the UF permeate no fouling problems were observed.

References

APHA Standard methods for the examination of water and waste water, 20th edi 1998.

Cassanao E. Driolli and Molinari R., “ Recovery and reuse of chemicals in unhairing,degreasing and chromium tanning process by membranes, Desalination, 113,1997,251-256.

Cassano .,A Molinnari R. Romano and Drioli. E” Treatment of aqueous effluents of the leather industry by membrane process”, J.Memb.Science 181,2001 111-126.

Rao., J.R., Chandrababu., C.Muraidharn,N.B Unni P.G. and Ramasami.T” Recouping the waste water: a way forward for cleaner leather processing , J.Cleaner production, 11(2003) 591-599.

Sunthanthararajan R. Ravindranath E., Cits, Umamageshwari B. Ramesh T. and RajamaniS.” Membrane application for recovery and reuse of water from treated tannery waste water” Desalinaion 164, 2004, 151-156.

Table 1. Characteristics of tannery effluent

Parameter	Tannery effluent
COD,mg/l	5000-5500
BOD, mg/l	3000-3500
Suspended solids (SS), mg/l	2500-3000
Cr+2, mg/l	80-100
SO4 2-	1800-2000
Cl-, mg/l	5000-6000
pH	8-9
Conductivity, ms/cm	10-12

Table 2. Characterization of the physical-chemically treated waste water from tannery

Parameter	Feed stream
pH	7-9
Conductivity, ms/cm	10-13
COD, mg/l	2700-3600
Sulphates, mg/l	1300-2400
Chlorides, mg/l	2500-3000
TS, mg/l	11000-25000
SS, mg/l	500-800
Colour	0.9-2
Turbidity, NTU	65-95

Table 3. Characterization of Feed and Permeate from RO

Sample	**Conductivity, ms/cm**	**Colour**	**COD, mg/l**	**Turbidity, NTU**
Feed	12	0.72	2531	53.2
Permeate 100kDa	11.92	0.1	2259	5.7
Permeate 30kDa	11.97	0.1	2133	6.82
Permeate 10kDa	12.03	0.18	2222	8.02
Permeate 3 kDa	11.8	0.12	2197	6.3

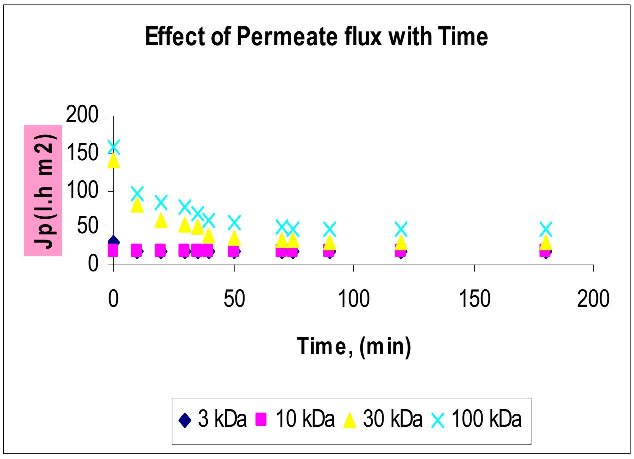

Figure 1.

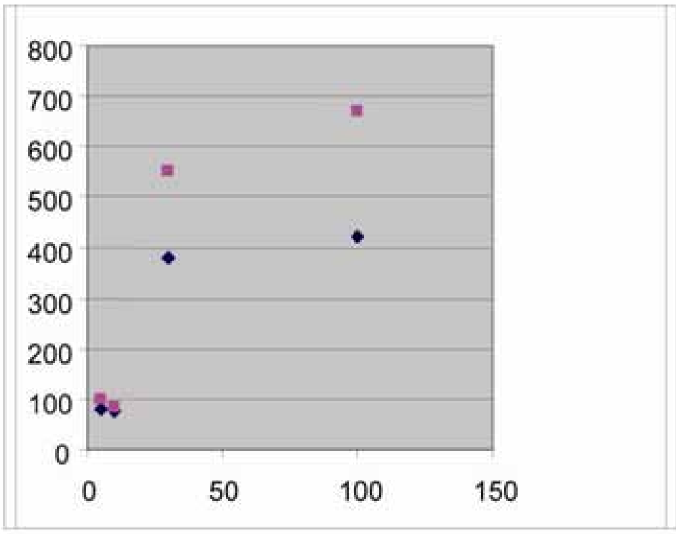

Figure 2.

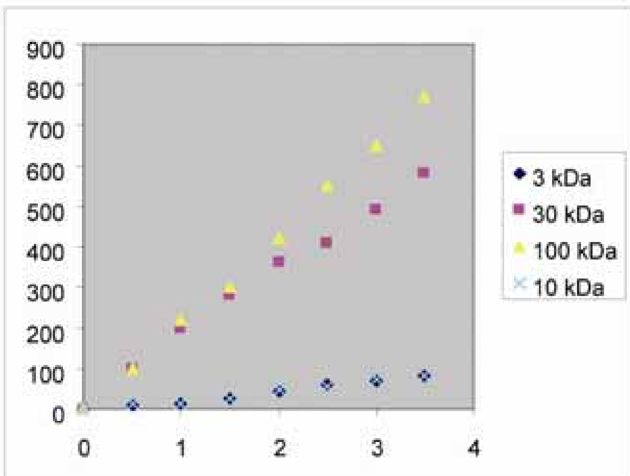

Figure 3.

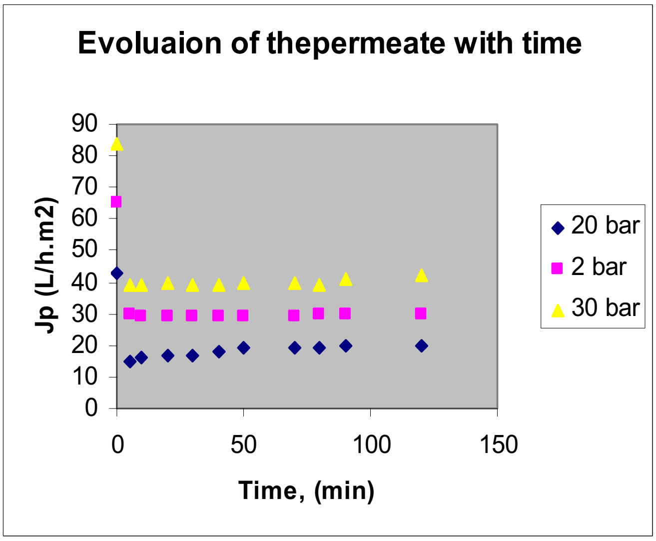

Figure 4.

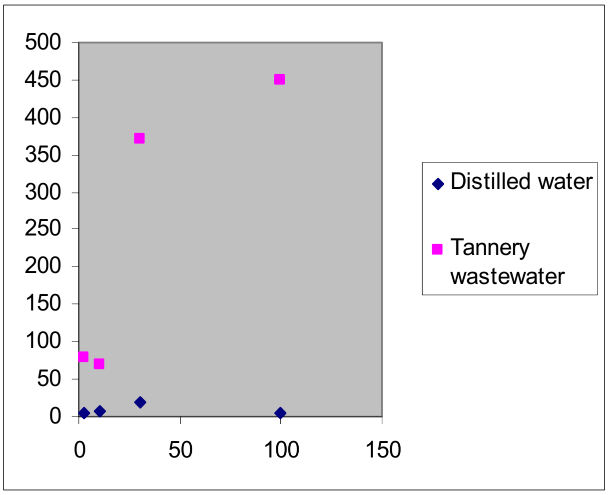

Figure 5.