STUDY OF REMOVAL OF COD BY GUARGUM WITH COAGULANTS ALUM AND POLYALUMINIUM CHLORIDE IN WASTEWATER TREATMENT

B.Saritha[1], G.Sharmilaa[2]
[1,2]Assistant Professor
Department of Civil Engineering, Bharath University
173, Agaram Road, Selaiyur, Tambaram,Chennai,India

Abstract

This project work was conducted to study removal of COD from tannery effluent by coagulants which includes analysis of physico-chemical parameters of tannery effluent as well as the treatment efficiency of alum, PACl, their combination (alum + guargum) and (PACL + guargum). Sample collection and analysis were performed using standard methods for the examination of water and wastewater (1998). Tannery effluent has been treated with the coagulants. The influences of pH and coagulant dosages were studied. The effectiveness of chemical coagulants and guargum were measured by the reduction of COD. The results shows that the combination of coagulant PACl + guar gum is more effective than alum, PACl and alum +guargum. It can achieve upto 97% of COD reduction at low dosage of PACl (100 mg/l)and guargum (500 - 1000 mg/L). The results indicate that lower quantities of PACl are needed to obtain an acceptable reduction in COD in the treatment of tannery effluent.

Keywords: *Tannery effluent, alum,PACl, guargum,COD*

1. Introduction

All sectors of our society like industry, agriculture, mining, energy, transportation, construction and consumers generate wastes. Industrial wastes are usually generated from different industrial processes, as a result the amount and toxicity of waste released from industrial activities varies with the industrial processes. Again, among all the industrial wastes tannery effluents are ranked as the highest pollutants (Shen, 1999). In developing countries, many industrial units are operating in a small and medium scale. These industrial units can generate a considerable pollution load by discharging untreated effluents directly into the environment.

Over the last few decades large scale usage of chemicals in various human activities has

grown very fast, particularly in a country like India which has to go for rapid industrialization in order to sustain over growing large problem of population (Mustafa et al., 2010).

The current pattern of industrial activity alters the natural flow of materials and introduces novel chemicals into the environment. The released organic compounds and heavy metals are one of the key factors that exert negative influences on man and environment causing toxicity to plants and other forms of biotics and abiotics that are continually exposed to potentially toxic heavy metals (Chandra et al., 2010).

But in recent years, the concentrated growth of this industry in certain localities has shown how the waste from this industry can cause irreversible damage to the water environment in the vicinity. In view of its peculiar pollution potential, and the increasing demand for good quality of water, both for domestic and other industrial purposes, it has become essential to treat the waste to a certain degree prior to its disposal.

Treatment of tannery effluent is difficult and represents a serious environmental and technological problem due to presence of a series of chemicals with low biodegradability. So the treatment of tannery effluents is a matter of great concern in the country having leather tanning industry. As a result, a number of research work carried out around the world regarding the treatment of tannery effluents using different technology. Several studies have been carried out for the treatment of industrial effluents through coagulation and flocculation process (Shouli et al., 1992; Stephenson and Duff, 1996).

Tanning is a process by which animal hides and skins are converted into stable and durable leather. Discharging untreated tannery effluent into the environment leads to detrimental chemical, thermal and biological effects on aquatic, plant and animal life. The characteristics of tannery effluent vary widely depending on

a) the nature of the adopted tanning process
b) the amount of water used
c) the process of hide preservation

d) the hide processing capacity

e) the in-plant measures followed to reduce pollution in the leather sector

Even though the Indian environmental regulations for the tanning industry are equally stringent as the international regulations, the pollution load coming from the tanneries is still heavy, and it is a problem both for the people living nearby, and for the river and ground water.

2. Materials and Methods

2.1 Sampling of tannery effluent

For this study, the sample was collected at the discharge drain to sedimentation tank of Forward Leathers, Nagalkeni, Chromepet,Chennai.Tannery effluent was collected into plastic bottles which were thoroughly cleaned with nitric acid solution followed by repeated washing with distilled water and dried. After collection, physical appearance and pH were noted and preserved. All the pollutant parameters were analyzed following the procedure as per the Standards Methods for the Examination of Water and Wastewater (APHA-AWWA-WPCF,1998).

2.2 Analysis of physico-chemical parameters

All the pollutant parameters were analyzed following the procedure as per the Standards Methods for the Examination of Water and Wastewater (APHA-AWWA-WPCF,1998) which is shown in table 2.1.

Table 2.1. Analysis of physico-chemical parameters

SI.No	Parameter	Method of analysis used
1	pH	pH meter
2	COD	Digital Nephlometer
3	Total solids	Gravimetric Method
4	Total dissolved solids	Gravimetric Method
5	Total suspended solids	Gravimetric Method
6	Chlorides	Colorimetric Method
7	Biological oxygen demand	Microbiological Titration Method

8	Chemical oxygen demand	Closed Reflux Colorimetric
9	Chromium	Colorimetric Method
10	Weight	High precision electronic balance

2.3 Physical and Chemical parameters of tannery effluent

Physical and chemical parameters of collected tannery effluent were analyzed by the method of analysis shown in table 3.1. and the observed values were tabulated in table 2.2.

Table 2.2 Physical and chemical parameters of tannery effluent

Parameter	**Values**
Appearance	Brownish
Odor	Objectionable
pH	6.7
COD	207.5 NTU
Total solids	7500 mg/l
Total suspended solids	2550 mg/l
Total dissolved solids	4950 mg/l
Chlorides	1136 mg/l
BOD_5	3480 mg/l
COD	5479 mg/l
Chromium	67 mg/l

2.4 Coagulants used

Alum

The coagulant alum weighed individually (15 g) and dissolved in 1 litre of distilled water. After rigorous mixing, different doses (100,500,1000,1500 and 2000 mg/L) of coagulant solution were taken to treat 1 L of tannery effluent.

Guargum

An amount of 0.5 g of the guar gum powder was weighed and dissolved in 500 ml of distilled water to make a solution of 1 g/l. The guar gum powder was slowly added to distilled water while the beaker containing the water was slowly shaken. Each guar gum solution prepared was used within a day.

Polyaluminium Chloride (PACl)

The coagulant PACl weighed individually (15 g) and dissolved in 1 litre of distilled water. After rigorous mixing, different doses (100,500,1000,1500 and 2000 mg/L) of coagulant solution were taken to treat 1 L of tannery effluent.

2.5 Experimental Procedure

The jar test is the most widely used method for evaluating and optimizing the flocculation process.This study consists of rapid mixing,slow mixing and sedimentation.The apparatus consists of four beakers to be agitated simultaneously. Tannery effluent with coagulants are agitated in a flocculator at 100 rpm for 1 minute and then 30 rpm was quickly established for 10 mins.After slow mixing beakers were removed carefully from the flocculator and allowed to settle for 60 mins.The clear effluent from few mm below level of water was taken out for analysis.

2.6 Analytical Method

COD was measured by a Digital Nephelometer manufactured by EI Instruments (Model 341). COD was measured by putting 10 ml of sample into COD vial and place it in Digital Nephelometer to measure COD.

3. Results and Discussion

3.1 Treatment by alum

Tannery effluent with coagulant alum was agitated in a flocculator.The optimum working conditions for coagulation process was determined by varying coagulant dosage and pH. In this study by using inorganic coagulants, an optimum pH value at which metal hydroxide forms precipitates was determined. The effects of pH and coagulant dosage by alum were optimized according to the pollutant removal efficiencies measured in terms of reduction in concentration of COD . COD reduction efficiencies increase with the increase in coagulant dosage till it reaches its highest value after which the reduction and removal efficiencies start to decrease. It can be seen that the optimum dosage is approximately 1500 mg/L and the optimum pH is approximately 6.0. At these optimum dosage and pH, COD reduction is 91.73% .

3.2. Treatment by PACl

The effects of the PACl dosage and pH on the COD reduction were studied by conducting jar tests by varying PACl dosages and pH. The results obtained are shown in Fig.2. The effects of coagulant dosage and pH with PACl are parallel to the effects observed with alum. The COD reduction efficiencies increase with the increase in coagulant dosage and pH till it reaches its highest value after which the reduction and removal efficiencies start to decrease. The COD reduction efficiency at pH 6 is higher than that at pH4, pH8 and pH10 at each dosage. The highest COD reduction is 94.53%. This result reveals that the optimum coagulant dosage for PACl (1000 mg/l) which is less than that of alum .

3.3 Treatment by alum with guargum

In this study guargum is used as a flocculant aid in the coagulation process. Alum and guargum are used to improve the performance of flocculation process. The effect of guargum flocculant dosages on the reduction of COD was investigated.Flocculant dosage was varied from 100-2000 mg/L with a fixed amount of alum . The initial pH of wastewater was adjusted to pH

6.0. The percentage of reduction of COD were calculated from the initial concentration of COD in the raw tannery effluent and final concentration in the supernatant. The reduction and removal efficiencies of COD is more at dosage 1500 mg/l for alum and guargum combination.

PACl and guargum to improve flocculation process. Flocculant dosage was increased from 100-2000 mg/L with a fixed amount of PACl .The initial pH of wastewater was adjusted to pH 6.0. It is very clear that the performance of PACl and guargum is the best combination in comparison with alum and guargum combination in terms of COD reduction.The effect of flocculant addition on COD removal is depicted in Fig.4 which shows the performance of PACl and guargum combination.This combination achieves more than 97% removal of COD when guargum dosage is greater than 100 mg/l.This means that lower quantities of PACl and guargum are needed to obtain high reduction in COD.

4. Conclusion

Reduction of COD was studied using alum, PACl, alum+guargum and PACl + guargum for tannery effluent. The results were compared with conventional coagulants like alum and PACl.The results show that the combination of PACl + guargum is more effective than alum, PACl and alum + guargum in the removal of COD of tannery effluent.

.It can achieve greater than 97% of COD reduction at low dosage of PACl and guargum . Guargum was found to be an effective flocculant aid in the pilot scale coagulation-flocculation experiments described in this project work.

Reference

1. APHA-AWWA-WPCF (1998) 'Standard methods for the examination of water and wastewater', 19th Ed., Washington DC.
2. Aboulhassan, M. A. Yaacoubi, A. and Souabi, S. (2007) 'Pollution reduction and biodegradability index improvement of tannery effluents', Int. J. Environ. Sci. Tech., Vol.5, No.1, pp. 11-16.
3. Eckenfelder, (1989) 'Industrial water pollution control', pp. 92.
4. Haydar,S. Aziz,J.A, and Ahmad, M.S. (2007) 'Biological Treatment of Tannery Wastewater Using Activated Sludge Process', Pak. J. Eng. Appl. Sci., Vol.1, pp. 61-66.
5. Lofrano, G. Belgiorno, V. Gallo, M. Raimo, A. and Meriç,S.(2006) 'Toxicity reduction in leather tanning wastewater by improved coagulation flocculation process', Global Nest Journal, Vol. 8, No.2, pp. 151-158.
6. Metcalf and Eddy, 'Wastewater Engineering' (4th Ed.)
7. Nazmul Islam, K.M. Khaled Misbahuzzaman, Ahemd Kamruzzaman Majumder and Milan Chakrabarty, (2011) 'Efficiency of different coagulants combination for the treatment of tannery effluents - A case study of Bangladesh', African Journal of Environmental Science and Technology, Vol.5, No.6, pp. 409-419.
8. Shen, T.T. (1999) 'Industrial pollution prevention' Springer, (2nd Ed.), pp. 40.
9. Shouli, A.S. Bewtra, J.K. Biswas, N. (1992) 'Effectiveness of coagulation and flocculation processes in removal of selected volatile organic contaminants from wastewaters', Int. J. Environ. Stud., Vol.40, pp. 2-7.

10. Sajjad Haydar, Javed Anwar Aziz (2009) 'Characterization and treatability studies of tannery wastewater using chemically enhanced primary treatment (CEPT)—A case study of Saddiq Leather Works', Journal of Hazardous Materials, Vol. 163, No. 2–3, pp. 1076–1083.

11. Sajjad Haydar and Javed Anwar Aziz (2009) 'Coagulation– flocculation studies of tannery wastewater using combination of alum with cationic and anionic polymers', Journal of Hazardous Materials,Vol.68, pp. 1035-1040.

12. Song, Z. Williams, C.J. and Edyvean,R.G.J. (2004) 'Treatment of tannery wastewater by chemical coagulation', Desalination, Vol.164, No.3, pp. 249–259.

13. Zouboulis, A.I. Samaras, P. and Ntolia, A. (2006) Study of tannery wastewater treatment in a leather industry of the area of Kastoria, 2nd international conference, AQUA – 2006.