World Journal of Environmental Biosciences
All Rights Reserved Euresian Publication © 2014 **eISSN 2277- 8047**
Available Online at: **www.environmentaljournals.org**
Volume 3, Issue 1:56-60

Open Access **Short Communication**

Adsorption Studies on Tannery Wastewater Using Bamboo Dust as Adsorbent

Swathi M[1], Sathya Singh A[1], Aravind S[1], AshiSudhakar P.K[1], Gobinath R[2], Saranyadevi[3]

1,2Department of Civil Engineering, Jay Shriram Group of Institutions, Avinashipalayam, Tirupur, Tamilnadu, India.
3Department of Civil Engineering, Jay shriram group of institutions, Avinashipalayam, Tirupur, Tamilnadu, India.

Corresponding author: swathimahesh013@gmail.com

Abstract:

Due to the wastewater produced by the tannery industries causes ground water pollution by the presence of heavy metals like chromium which results in ill-effects to the environment. The removal of such heavy metals from industrial effluents and especially from tannery wastewater has become a subject of keen interest. This paper deals with the viability process of adsorption and its effect on COD, BOD, turbidity, iron, chromium and sulphate removal from the tannery waste water by using bamboo dust as an Adsorbent. The transmittance, COD, BOD, chromium, sulphate and iron were found to be 18%, 1400mg/l, 933.33mg/l, 2.667mg/l, 135.19mg/l and 72.92mg/l respectively in the collected tannery wastewater. Batch studies were conducted for evaluating the treatment efficiency of bamboo dust for tannery wastewater by adding different dosages varied from 2mg/l to 8mg/l. From the experimental results it has been proved that the COD, BOD, chromium and iron were reduced to the satisfactory level. It was also found that adsorption is one of the economical methodthat can be adopted for treating tannery wastewater than any other conventional methods.

Keywords: Tannery wastewater, adsorption, BOD, COD, chromium, sulphate and iron removal

1. Introduction:

In developing countries, many industries are operated in small and medium scales. This small unit can generate a considerable pollution load when discharged directly into environment without any pre-treatment (Quek S. Y, 1998). Tanneries are typically characterized as pollution intensive industrial complexes which generate widely varying and high strength wastewater. Tanneries generate wastewater in the range of 30-35l/kg skin or hide processed with variable pH and high concentrations of suspended solids, BOD and COD.(Rahman Muhammad Bozlur et al,2010) Major problems are due to wastewater containing heavy metals, toxic metals and other pollutants (Durai G, 2011).The tanning process is one of the largest polluters of chromium all over the world. Most of the tanneries in India adopt the chromium tanning process because of its processing speed, low costs, and light colour of leather and greater stability of the resulting leather.(Namasivayam et al,1994). In the chromium tanning process, the leather takes up only 60–80% of applied chromium, and the rest is usually discharged into the sewage system causing serious environmental impact. The maximum levels permitted in wastewater are 5 mg/L for trivalent chromium and 0.05 mg/L for hexavalent chromium (Acar F.N, 2004). With this limit, it is essential for industries to treat their effluents to reduce the Cr to acceptable levels. Due to the inherent characteristics of tannery effluents, various physico-chemical techniques have been studied for the applicability to the treatment of tannery wastewater (Aboulhassan M, 2008).

The physico-chemical technique includes adsorption, coagulation, chemical precipitation, ultra filtration, etc. Among these methods, adsorption is the most effective and economical method because of their relative low cost. Adsorption is one of the easiest, safest and most cost-effective methods for the removal of heavy metals from industrial effluent (RahmaniShah, 2013). The Adsorbents may be of minerals, organics, or biological origin, zeolites, industrial bi products, agriculture wastes, biomass and polymeric materials (Kurniawan, 1976). The major advantage of an adsorption system for water pollution control are less investment in terms of both initial cost and operational cost, simple design, easy operation and no effect of toxic substances compared to conventional biological treatment processes (Ranganathan, 2000).

Adsorption is a fundamental process in the physiochemical treatment of wastewaters, a treatment which can economically meet today's higher effluent standards and water reuse requirements.(Gordon et al,1998). Adsorption is a mass transfer process which involves the accumulation of substances at the interface of two phases, such as, liquid–liquid, gas– liquid, gas–solid, or liquid– solid interface. The substance being adsorbed is the adsorbate and the adsorbing material is termed the Adsorbent. The driving force for adsorption process is Surface affinity. Chemical reactivity, pH, surface area for adsorption per unit volume and reduction in surface tension is key parameter for adsorption (Babel et al, 2003). For high strength and low volumes of wastewater, heavy metal removal by adsorption technique is good proposition. Adsorption is one of the alternatives for such cases and is an effective purification and separation technique used in industry especially in water and wastewater treatments (Kailas L, 2010). Adsorption of Cr (III) and Cr (VI) on activated carbon from aqueous solutions has been studied. Granular activated carbon columns have been used to treat wastewaters containing lead and cadmium (Reed and Arunachalam, 1994). Granular activated carbon was used for the removal of Pb (II) from aqueous solutions (Cheng, 1993). The adsorption process was inhibited by the presence of humic acid, iron (III), aluminum (III) and calcium (II). In this work we have tried using dry bamboo dust as an economical, eco-friendly and effective Adsorbent.

2. Materials and methods

2.1. Bamboo dust preparation

Bamboo dust was collected from nearby saw mill and it was dried initially in sunlight and then it was dried in hot air oven at 100˚C. 250ml of tannery wastewater was transferred into clean conical flasks. The dosages of Adsorbents were varied from 2 mg/l to 8 mg/l at constant temperature and humidity. Twenty four hours of adsorption time was given to all samples. The sample was then filtered using Whatman filter paper No.1 and the filtrates were taken for further analysis.

In this study, the analytical grade chemicals from Merck, Rankem and Fisher brands were used for the test of various parameters of tannery wastewater. The absorbance and transmittance value of tannery wastewater were found using Elico SL-159 UV-VIS spectrophotometer. The pH value was found using Vanira pH meter and the conductivity was found using ELICO conductivity meter. The TDS and turbidity were found using Equiptronics TDS and turbidity meter. The chemical oxygen demand in the tannery waste water was found by open reflux method and other parameters like chromium, iron, sulphate and bio-chemical oxygen demand were tested as per APHA standards (Standard method for examination of water and wastewater, 20th edition, 1998).

2.1. Study area

Tannery waste water was collected from leather tanning industry. The wastewaters that are coming out from these industries are hazardous in nature and it contains heavy metals like lead, chromium etc. If they are not treated before discharging it into an open land or into streams of water, it causes environmental problems and health hazards. To avoid these kinds of problems an approach is made for pre-treating the tannery wastewater.

2.2 Sampling

Tannery wastewater was collected at collection sump of effluent treatment plant of a tannery industry situated in Erode district. The sampling was done with the help of 20 litre polyethylene cans which were washed several times with distilled water and then rinsed with 1N HNO_3 for the removal of micro-organisms and pathogens and also they are rinsed three times with distilled water and then the sample before collection.Then the sample was aided with 15ml/l of 2N HNO_3 for the preservation. The container was kept in a dark place and it was maintained at room temperature.

2.3 Experimental setup

The collected samples were taken out very carefully without any spillage with measuring jar and transferred into a clean conical flask for batch studies. The initial parameters of the wastewater were found. The studies were conducted in a clean, sterilised 250ml conical flask for performing adsorption and were placed in an orbital shaker with most care for performing better process and obtaining better results. The orbital shaker was operated at the speed of 120 rpm which was optimised before conducting the batch studies.Rubber gloves were used to avoid contact of wastewater to skin and cross checked twice before conducting batch studies.

Table 1: Initial parameters of tannery wastewater

S.No	Parameter	Initial value
01	pH	7.38
02	Transmittance	18%
03	Absorbance	0.72
04	Conductivity	13.24 ms
05	Turbidity	344NTU
06	Chromium	2.667 mg/l
07	BOD	933.33 mg/l
08	COD	1400 mg/l
09	Iron	72.92
10	Sulphate	135.19

3.0 Results and discussions

In this study it was found that an adsorption is the most efficient and cost effective method among physic-chemical treatments for treating the tannery wastewater. The results obtained are represented in the graph given below. In figure 1, the pH level of wastewater for different Adsorbent dosage is given. It has been clearly shown that the pH was maintained at same level throughout this study and the pH value doesn't change more by the addition of Adsorbent dosages.Figure 2 shows the reduction of turbidity level from 344 NTU to 109.6 NTU. Increase in Adsorbent dosage decreases the turbidity level in wastewater. In figure 3, the increase in transmittance of the wastewater was shown, initially the wastewater was very turbid and transmittance was found to be at the level of 18%, by the reduction of turbidity from wastewater the transmittance was increased to a level of 70%. Figure 4 represents the conductivity of the wastewater and the figure 5 shows the reduction of absorbance in the wastewater. Figure 6 clearly represents the reduction of chromium content in the wastewater. Since chromium is the major pollutant of tannery wastewater, it has been greatly reduced to the level of acceptance by increasing the Adsorbent dosage. Initially the chromium content in the wastewater was 2.667mg/l and it has been reduced to the level of 0.692mg/l by varying the Adsorbent dosage. The reduction in iron and sulphate in the wastewater were shown in the figure 7 and figure 8 respectively. Figure 9 represents the reduction of COD from the wastewater. Initially COD was found to be 1400mg/l and by varying the Adsorbent dosage it has reduced to 495.28mg/l. BOD present in the wastewater was reduced from 933.33mg/l to 330.19mg/l was shown in figure 10.

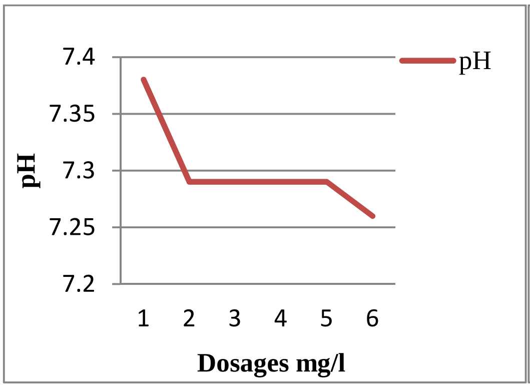

Figure 1 – Adsorbent dosage Vs pH

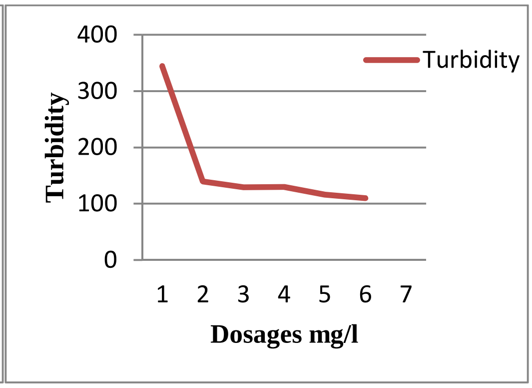

Figure 2 – Adsorbent dosage Vs turbidity

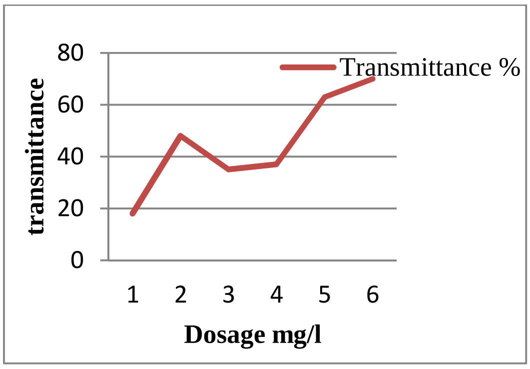

Figure 3
Adsorbent dosage Vs transmittance

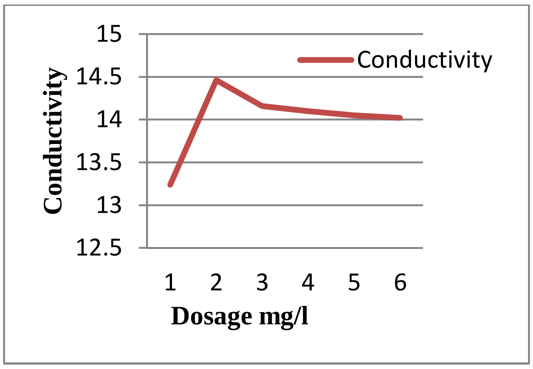

Figure 4
Adsorbent dosage Vs conductivity

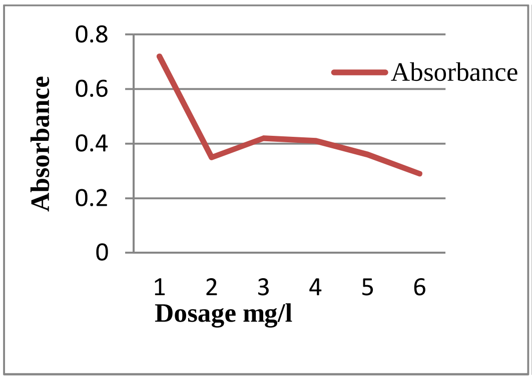

Figure 5
Adsorbent dosage Vs absorbance

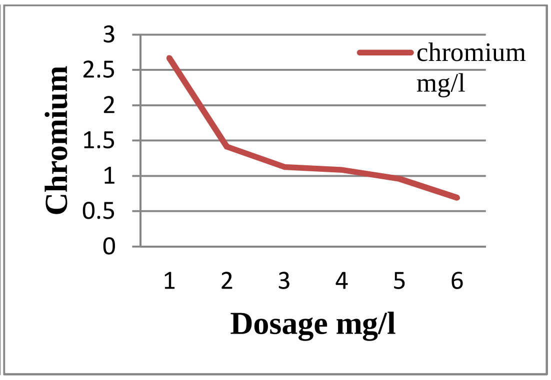

Figure 6
Adsorbent dosage Vs chromium

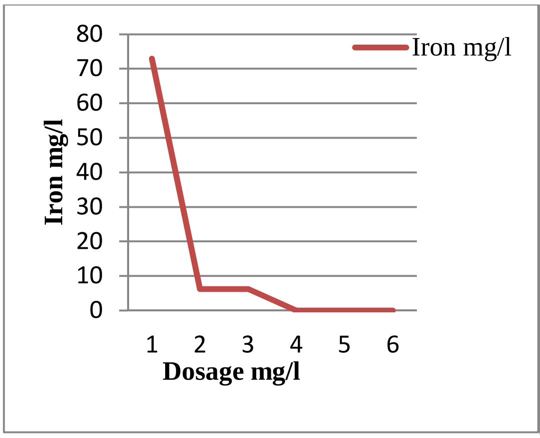

Figure 7 – Adsorbent dosage Vs iron

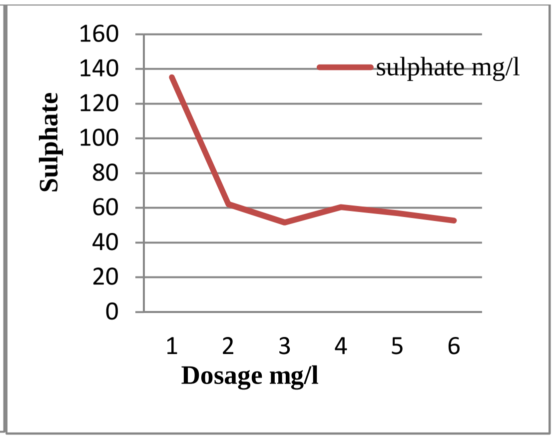

Figure 8 – Adsorbent dosage Vs sulphate

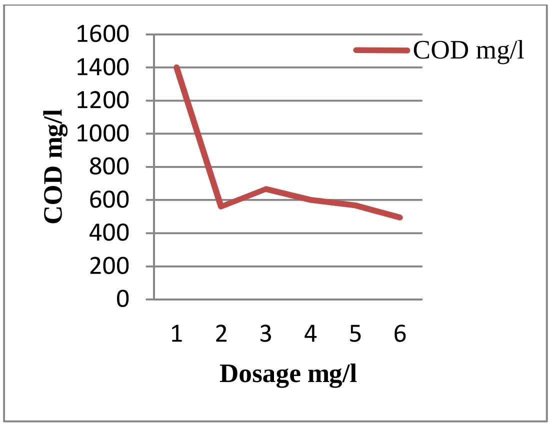

Figure 9 – Adsorbent dosage Vs COD

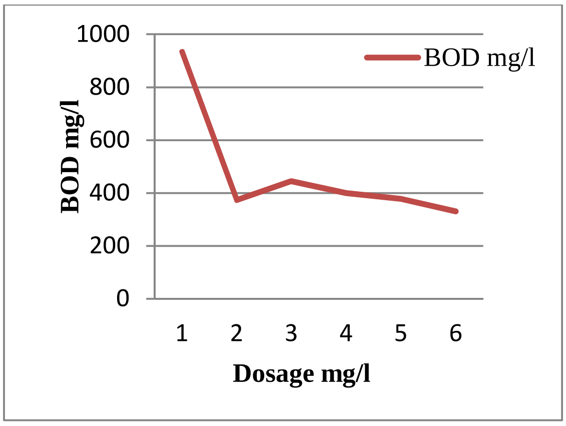

Figure 10 – Adsorbent dosage Vs BOD

4.0 Conclusion

The present study showed that the bamboo dust can be effectively used as an excellent alternative for removing heavy metals from tannery wastewater. From this study, it was found that COD, BOD, chromium, sulphate and iron were reduced to the level of acceptance. Chromium was reduced to the percentage of 72%, sulphate reduction was upto 65%, Iron was reduced to the level of 80% since the adsorption has greater affinity to adsorb iron compounds from the wastewater. BOD and COD reduction was upto

68% and 70% from its initial concentrations respectively. Turbidity was reduced to the level of 75%. This study clearly shows that the Adsorbents made from natural material can efficiently perform the primary treatment of tannery wastewater and also removes some of the major heavy metals present in it upto a considerable levels. This can be considered as an cost-effective treatment technology for treating the tannery wastewater with minimal time and energy consumption. Thus it has been proved that an adsorption through bamboo dust is more efficient and relatively economical in treating the tannery wastewater before discharging it to the open land or into the streams of water.

5.0 Acknowledgement

Authors sincerely acknowledge the Shri. Thangaraj, Chairman of Jay Shriram Group of Insititutions, Shri. Govindasamy, Treasure of Jay Shriram Group of Institutions, Shri T.Karupannasamy, Vice Chairman of Jay Shriram Group of Institutions for providing the necessary facilities and also for supporting morally for performing this project. We also acknowledge the support rendered by Prof.magudeeshwaran, Principal of Jay Shriram Group of Institutions for all the technical support rendered during this work without which this work may not be materialized.

References

1) Aboulhassan M. Souabi S, Yaacoubi A., (2008), Pollution reduction and biodegradability index improvement of tannery effluents, international journal of Science and technology, 5 (1), pp 11-16, 2008.
2) Acar F.N, Malkoc E., (2004), The removal of chromium(VI) from aqueous solutions by Fagusorientalis L. Bioresource Technology, 94, pp13–15.
3) Babel S, Kurniawan T A, (2003), Low-cost adsorbents for heavy metals uptakefrom contaminated water: a review, Journal of Hazardous Material, 97, pp219-224.
4) Cheng, Huang, C.P., Wu, M.H., (1977), The removal chromium (VI) fromdilute aqueous solution by activated carbon, Journal of Water Resuorces, 1(1), pp673–679.
5) Durai G, Rajasimman M and Rajamohan N,(2011), —Kinetic studies on biodegradation of tannery wastewater in a sequential batch bioreactor, Journal of Biotech Research [ISSN: 944-3285], 3, pp 19-26.
6) Gordon McKay,(1998), Application of Surface Diffusion Model to the Adsorption of Dyes on Bagasse Pith. Journal of Adsorption, 4, pp361-372.
7) Kailas L. Wasewar, (2010), Adsorption of metals onto tea factory waste: A review, International journal of research and reviews in applied sciences, 3(3), pp75-86.
8) Kurniawan, Randall, J.M, Hautala, E, Waiss, A.C, (1976), Treatment of tannery effluents using alignate as polymeric Adsorbent, Food production journal, 1(2), pp. 89-97.
9) Namasivayam C and Kadirvelu K, (1994), Coir pith, an agricultural wasteby-product, for the treatment of dyeing wastewater, BioresourceTechnology, 48, pp 79–81.
10) Quek S.Y, Wase D. A. J, Forster C.F. Water SA C.F, 1998, 24 (3), pp 251-56.
11) Rahman Muhammad Bozlur, Shinichi Shibata,CSiddiqua Farah Diba and MagaliUono, (2010), Low Cost Biodegradable Adsorbent Material for the Removal of Dissolved Dyes from AqueousSolutions: An Economical Process, International Journal of Engineering and Technology, 2(5), pp 468-473.
12) RahmaniShah , Mohammed Merzouki , Mohamed Benlemlih, (2013), Journal of material and environmental science, 4(4), pp 532-541.
13) Ranganathan K, (2000), Chromium removal by activated carbons prepared fromCasurinaequisetifolia leaves, Bioresource Technology, 73, pp 99-108.
14) Reed and Arunachalam, (1994), Removal of chromium (iii) from waste water using gossypiumherbaciumas a biosorbent, Journal of environment research and development, 1, pp 53-69.