STM JOURNALS

Journal of Water Pollution & Purification Research

Volume 1, Issue 3
www.stmjournals.com

Use of Rice Straw as an Adsorbant to Eliminate Waste Color of Textile Industry Wastewater

Vijayakumar S.*, Arunprakash C., Gobinath R., Saravanan S.P., Nishanth M.
Department of Civil Engineering, Jay Shriram Group of Institutions, Avinashipalayam, Tirupur, Tamil Nadu, India

Abstract

Textile wastewater contains different colors which are harmful to the environment. The removal of dyes from effluent using adsorption process provides an attractive alternative treatment, especially if the adsorbant is inexpensive and readily available. In this present research paper natural adsorbant rice straw is used for removal of color from waste effluent of textile industry. The adsorbant prepared was employed for the removal of color at the different doses. The adsorbant was found to be capable of removing color from wastewater; the color removal capacity for rice straw was approximately 70% at normal pH and temperature. From the experimental investigations, the maximum color removal from the textile industry wastewater was obtained at an optimum adsorbant dosage of 2.5 g/l of wastewater, with an optimum contact time of 24 h, at room temperature. This result was higher than the results obtained by different process parameters for various adsorbants. It is found that the transmittance was found to be 72% with an absorbance of 0.15, BOD too was reduced from 400 mg/l to 200 mg/l. also owing to the adsorption process several other parameter such as chloride, sulfate, iron, COD was also reduced considerably.

Keywords*: rice straw, adsorbent, wastewater treatment, chemical oxygen demand, biological oxygen demand*

****Author for Correspondence*** E-mail: vijay.tip@rediffmail.com

INTRODUCTION

Industrial effluents are one of the major pollutants of water. Many dyes are carcinogenic and affect the life of Aquatic organisms [1, 2]. The worldwide annual growth rates of reactive dyes are four times as much as for conventional dyes [3]. Presence of such dyes in effluents causes a lot of pollution in water. Various challenges have been made to remove these harmful dyes from industrial wastes [4, 5]. Adsorption is one of the cheapest and most effective techniques [6]. Different adsorbants are used for the removal of dyes from aqueous solutions such as alumina, crushed bricks, peat, sand, charcoal bentonite, silica, apricot, etc. [7–9]. The demand for coloring matter has experienced phenomenal growth in the past some decades and the application of these dyes has incessantly increased in many industries. Industries like textile, rubber, drug, paper, plastic, cosmetic, food and beverages use dye to color their products.

These colored organic substances are common water pollutants and they are found in different quantities in industrial waste water. This highly colored water is discharged into nearby land, river or sea. Even at very low concentration, their presence in water is unquestionably visible and detrimental [10–14]. Indicated that due to complex aromatic structures, dyes are difficult to degrade and tend to persist in the environment and create severe water quality and public health problems. This contaminated water affects the flora and fauna of the related region. As a result, the environmental issues about the removal of these pollutants are gaining much more attention in recent years. However, adsorption was one of the promising methods to remove the dye pollutants from aqueous system completely [15]. It was, therefore, thought worthwhile to develop highly efficient

and effective adsorbents for the removal of dye from the textile effluents. In the present investigation, attempts have been made to explore for the removal of dyes with activated rice husk.

Table 1: *Initial Parameters of Textile Wastewater.*

pH	6.96
Conductivity	6.01mS
TDS	3.23ppt
Adsorption	0.36
Transmittance	43%
Turbidity	13NTU
BOD	440mg/l
COD	1680mg/l
Chloride	1052mg/l
Iron	18.7mg/l
Sulfate	318.45mg/l

MATERIALS AND METHODS

Rice Straw

The rice was collected from the local farm and cut in to 1 cm pieces. Then, it was washed with distilled water to remove the surface adhered particles and dried at a temperature of 60–80 ºC in an oven.

Collection of Samples

The wastewater samples were collected at the end of unit operation in dying unit at Tirupur which contains the wastewater of process as dyeing in acid washed cans.

Analysis of Samples

The effluent samples which contain several metals and organic compounds were analyzed to measure their pH, electrical conductivity, dissolved oxygen, Turbidity and chemical oxygen demand (COD), using standard methods.

Experimental Setup

The dye waste is taken in a clean, dry 250 ml Erlenmeyer flask and its initial pH value is fixed. Adsorbant which is pre-prepared is added into this with a dosage rate of 2.5 g, 5 g, 7.5 g, 10 g, and 12.5 g per liter. The flak are initially stirred with a glass rod for mixing, it's shaken in orbital shaker for 24 h. Samples were drawn at regular intervals and checked for pH, conductivity, TDS, turbidity, transmittance, absorbance, BOD, COD, chloride, sulfate as per APHA standards. All the tests are done in triplicate and the concordant values were taken for the results comparison, which are given in Figures 1−6. For the full study, analytical grade chemicals were used from, Merck, loba chemic and fisher scientific.

RESULTS AND DISCUSSION

Effect of Adsorbant Dosage

A number of investigations were carried out by varying the amount of rice straw from 2.5 to 12.5 g at the fixed initial dye concentration of 1 l, pH of 7 and room temperature of 25±1 ℃. These studies showed an increase in adsorption with the increase in the dose of adsorbant. Optimum adsorbant dose was found to be 2.5 g/l. It was found that the maximum transmittance of 72% and turbidity 3.2 NTU.

Effect of Time

To study the effect of time on efficient removal of color from textile waste the study was carried out. The wastewater sample was taken in a 200 ml beaker and kept in an orbital shaker at temperature 25±1 ºC and 150 rpm. The sample was withdrawn from the beaker and results are compared with original color concentration of wastewater to know the color removal efficiency of adsorbants. It is clear from the results that time plays an important role in color removal of dye waste. The optimum time duration required for color removal is 24 h retention period.

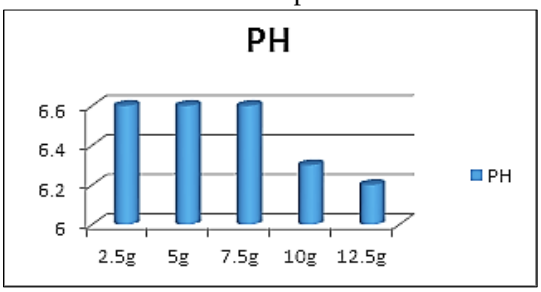

Fig. 1*: pH versus Adsorbant Dosage.*

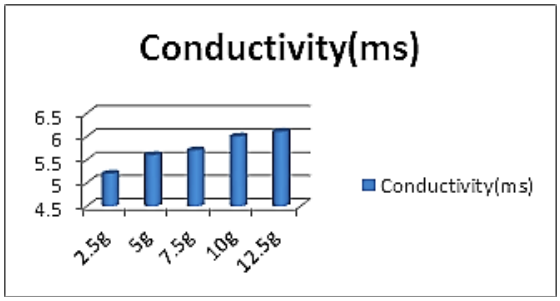

Fig. 2*: Conductivity versus Adsorbant Dosage.*

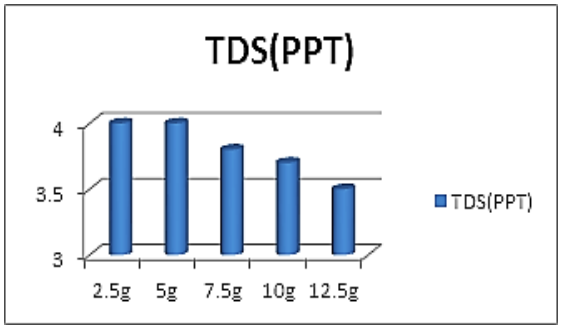

***Fig. 3**: TDS versus Adsorbant Dosage.*

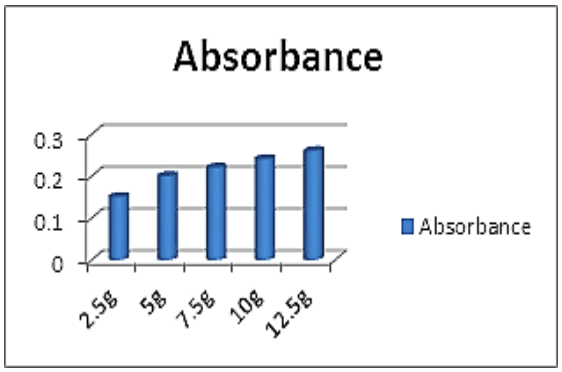

***Fig. 4**: Absorbance versus Adsorbant Dosage.*

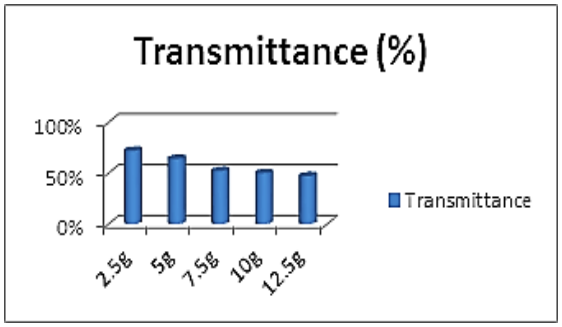

***Fig. 5:** Transmittance versus Adsorbant Dosage.*

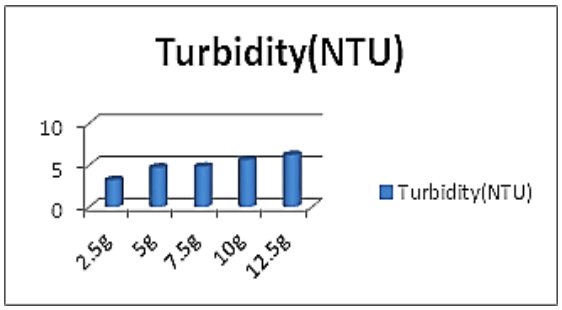

***Fig. 6**: Turbidity versus Adsorbant Dosage.*

CONCLUSIONS

In present work, attempt has been made for studying the color removal efficiency of low cost adsorbant prepared from rice straw. From the experimental finding, it has been observed that rice straw can be used as an effective adsorbant material which can be used successfully for removal of color. The maximum color removal efficiency was observed up to 70% for prepared rice straw. It was found that color removal efficiency was achieved maximum a very low dose of 2.5 g/l with retention time of 24 h. The result of pH study shows that the adsorbant was effective at neutral pH. It is also found that rice straw adsorbant reduced the sulfate content from 318.45 mg/l to 60.7 mg/l (81%), chloride content from 1052 mg/l to 630.2 mg/l (40%), iron from 18.7 mg/l to 4 mg/l (79%), BOD from 400 mg/l to 200 mg/l and COD from 1680 mg/l to 640 mg/l, which proved to be a more effective treatment solution; also, there is a 77% turbidity reduction and 59% absorbance reduction in this study. Thus, it is proved that rice straw can be effectively used as a low cost adsorbant. It is further advised that column studies may be performed to analyze the performance of rice straw as a low cost adsorbant.

REFERENCES

1 Baughman GL. Perenich TA. Fate of dyes in aquatic systems: I. Solubility and partitioning of some hydrophobic dyes and related compounds. *Environ. J. of Toxicol and Chem.* 1998; 7: 183–99p.

2 Hassan SMS, Awwad NS, Aboterika AHA. Removal of synthetic reactive dyes from textile wastewater by Sorel's cement. *J. of Hazardous Mater.* 2009; 162: 994–99p.

3 Zollinger H. Color Chemistry: Syntheses, Properties, and Applications of Organic Dyes and Pigments. 3rd Ed., Switzerland: WILEY-VCH Publication; 2003: 432–37p.

4 Ho YS, Chiu WT, Wang CC. Regression analysis for the sorption isotherms of basic dyes on sugarcane dust. *Bio Resource Technology.* 2005; 96: 1285–91p.

5 Mohanty K, Naidu JT, Meikap BC, Biswas MN. Removal of crystal violet from waste water by activated carbons prepared from rice husk. *Industrial and Engineering Chemical Research.* 2006; 45: 5165–71p.

6 Cotoruelo ML, Marques MD, Rodriguez JJ. Adsorption of aromatic compounds on

activated carbons from lignin: Equilibrium and thermodynamic study. *Industrial and Engineering Chemical Research.* 2007; 46: 4982–90p.

7 Hu QH, Qiao SZ, Haghseresht F, Wilson MA, Lu GQ. Adsorption study for removal of basic red dye using bentonite. *Industrial and Engineering Chemical Research*. 2006; 45: 733–38p.

8 Jain R, Sharma N, RadhapyarK. Electrochemical treatment of pharmaceutical azo dye amaranth from waste water. *J. of Appl. Electrochem.* 2009; 39: 577–82p.

9 Senthilkumaar S, Kalaamani P, Porkodi K, Varadarajan PR, Subburaam CV. Adsorption of dissolved reactive red dye from aqueous phase onto activated carbon prepared from agriculture waste. *J. of Bioresearch and Technol.* 2006; 97(14): 1618–25p.

10 Al-Ahmary KM. Kinetics and Thermodynamics Study of Malachite Green Adsorption on Seeds of Dates. *Int. J. of Basic and App. Sci.* 2013; 2(1): 27–37p.

11 Malik A, Taneja U. Utilizing Flyash for Colour Removal of Dye Effluents. *American Dyestuff Reporter*. 1994: 20–26p.

12 Marmangne O, Coste C. Colour Removal from Textile Effluents. *American Dyestuff Reporter*. 1996:15–21p.

13 Perkowski J, Kos L. Decolourization of Model Dye House Wastewater with Advanced Oxidation Processes. *Fibers andTextiles in Eastern Europe*. 2003; 11: 67–71p.

14 Rosario LC, Abel GE, Marta IL. Photo degradation of an Azo Dye of the Textile Industry. *Chemosphere*. 2002; 48: 393–99p.

15 Alzaydie AS. Adsorption of methylene blue from aqueous solution onto a low-cost natural Jordanian Tripoli. *Amer. J. of Environ. Sci.* 2009; 5(3): 197–208p.