Treatment of Textile by Adsorption Using Sawdust

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***Abstract*— In the present study adsorption capacity of Sawdust was used for the removal of methylene blue from aqueous solution at varying PH, Contact time, adsorbent dosage a concentration after the sawdust is treated with formaldehyde Initial pH ranges of 6-9 is favourable. This study indicates that and the sawdust is a good adsorbent for removing the harmful dye from the textile waste water. The Sawdust is an efficient and low cost bio adsorbent for the removal of textile dye from aqueous solution**

Keywords: ***Formaldehyde, Sawdust, Methylene blue.***

I. INTRODUCTION

Dyes may be defined as substances that, when applied to a substrate, provide color by a process that alters, any crystal structure of the coloured substances. Such substances with considerable coloring capacity are widely employed in the textile, cosmetics, plastics, photographic and paper industries. The presence of dyes in the environment can generate serious problems to the living organisms, humans and aquatic life, because their possible toxicity. They are no biodegradable and difficult to remove from the industrial effluents. Various methods like chemical precipitation, reverse osmosis, adsorption, ion exchange, oxidation, coagulation process...etc. are the used for the treatment of textile dye. Considering the fact that the textile dyeing process is recognized as one of the most environmentally unfriendly industrial processes, it is of extreme importance to understand the critical points of the dyeing process so as to find alternative, eco-friendly methods.

Adsorption is a wastewater purification technique for removing a wide range of compounds from industrial wastewater. Adsorption is most commonly implemented for the removal or low concentrations of non-degradable organic compounds from ground water, drinking water preparation. It has certain advantages in comparison with other methods, because the removal of contaminants is easy to design and operate (technologically simple and adaptable to many treatment formats, it works at a wide pH range), the process does not produce any toxic by product, requires low energy, it is efficient and cost-effective a wide range of products can be used as adsorbent (Waste materials or by products).

Hence, this study is aimed at the removal of colour, the most visible component of wastewater from textile industries using chemically treated sawdust of Mahogany.

II. LITERATURE REVIEW

Parihar et.al (2013) studied about the role of sawdust in the removal of waste substances from textile wastewater. The textile wastewater was treated with sawdust which is an adsorbent and then filtered. The various physicochemical characteristics of both sawdust treated and untreated textile effluent were analysed. The maximum percentage removal of 37% was observed for total suspended solids while minimum removal of 9% for chemical oxygen demand. The investigations showed that after treatment with sawdust, the treated effluent had lower values of all the parameters than the untreated effluent. T Pseudo first and second order kinetic models were used to calculate the amount adsorbed at equilibrium condition. It is established that treated sawdust has been used as a better adsorbent for the removal of Remazol Red as compared to commercial charcoal. This process may eventually be used to get industrial waste free purified water. The reduction in pollution load of treated effluent may be attributed to the adsorption of chemicals in effluent by sawdust through hydrogen bonding and ion exchange mechanism [1]

Sidiras et.al (2012) conducted a study to evaluate the feasibility of removing hexavalent chromium and methylene blue, taken as representative species for heavy metals and dyes, respectively from aqueous solutions, using industrial by-products, specifically pine sawdust, which comes from many sources. Maximum dye was adsorbed within 30 min after the beginning for every experiment. Similar experiments were carried out with commercially available activated carbon to compare the results. The material was tested in raw form and after acid treatment under mild conditions. Adsorption experiments were carried out to investigate the effects of adsorbent dose, pH, contact time and initial adsorbent concentration. The adsorption kinetics and adsorption equilibrium were further studied using the data obtained from these experiments. [2

Khattri et.al (2010) established that under various experimental conditions such as agitation time, dye concentration, adsorption dose, pH and temperature to assess the potentiality of neem sawdust for the removal of malachite green dye from wastewater. Neem sawdust was used as an adsorbent for the removal of malachite green dye from an aqueous solution. A greater percentage of dye removal was observed with decrease in the initial concentration of dye and increase in amount of the adsorbent. The adsorption of dye on neem 4 sawdust was found to follow a gradual process. The effects of different system variables, like adsorbent dosage, initial dye concentration, pH and contact time were studied. Higher adsorption percentages were observed at lower concentrations of dye. Optimum pH value for dye adsorption was determined as 7.0 for both adsorbents. Maximum dye was adsorbed within 30 min after the beginning for every experiment. The dimensionless factor, RL of the malachite green, neem sawdust isotherm revealed that the adsorption process is favourable in nature. [3]

Garg et.al (2013) studied about Formaldehyde treated and sulphuric acid treated sawdust were used to adsorb malachite green at varying dye concentration, adsorbent dose, pH and agitation time. Similar experiments were conducted with activated carbon to compare the results. The adsorption efficiency of sulphuric acid treated sawdust was higher than formaldehyde treated Sawdust. An initial pH in the range of 6–9 was favourable for the dye removal by both the adsorbents. Dilute solutions were effectively decolorized by the adsorbents. It is proposed that in batch or stirred tank reactors, both adsorbents can be an attractive option for dye adsorption. [4]

Garg et.al (2014) studied about the potential use of Indian Rosewood sawdust, pre-treated with formaldehyde and sulphuric acid, for the removal of methylene blue dye from simulated wastewater. The effects of different system variables, like adsorbent dosage, initial dye concentration, pH and contact time were studied. Higher adsorption percentages were observed at lower concentrations of dye. Optimum pH value for dye adsorption was determined as 7.0 for both adsorbents. Maximum dye was adsorbed within 30 min after the beginning for every experiment. Similar experiments were carried out with commercially available activated carbon to compare the results. [5]

Giwa et.al (2018) conducted a study of the decolourisation of wastewater from a local textile facility by concentrated Sulphuric acid modified sawdust was conducted. The adsorbent was characterized using Fourier Transform Infrared Spectroscopy (FTIR), Scanning Electron Microscopy (SEM) and Elemental Diffraction X - ray Spectroscopy (EDS) techniques. The effects of adsorbent dose, contact time and temperature were investigated. The characterization analysis indicates that the adsorbent has potential adsorption sites with several pores, and carbon content as high as 66.77%. The percentage colour removal from the wastewater increased with adsorbent dose, contact time and temperature. [6]

III. EXPERIMENTAL WORKS

A. Adsorbent

In this studies sawdust of Mahogany were used as adsorbent for the removal of methylene blue dye from the aqueous solution. It is collected from the mill at Kottayam district, Kerala, India which were available in abundant.
The collected sawdust from the mill were dried in the sunlight to evaporate the moisture present in it. The dried material sieved with a particle size of 53 microns. *The* sieved adsorbent sample prepared was kept in an airtight container for further tests.

B. Formaldehyde Treated Sawdust

Sawdust of Mahogany tree is collected from the local saw mill was dried in the sunlight until all the moisture evaporated. The sawdust is treated with 1% of formaldehyde in the ratio 1:5 at 50°C for 4 hours. Then washed with distilled water to remove formaldehyde and oven dried at 80°C for 24 hours. Then the dried material kept in an airtight container.

Fig.1 Formaldehyde Treated Sawdust

C. Dye Solution Preparation

Methylene blue was used in this study for the adsorption. 5 ml of methylene blue is added to 500ml of distilled water used for each tests. The concentration of the methylene blue is measured by using UV/visible spectrometer at a maximum value is 665mm.

Fig 2- Prepared Dye Solution

IV. RESULT AND DISCUSSION

Effect of Contact Time

Here use 5 containers for the test having 100 ml of prepared dye solution in each. Add same amount of adsorbent in each container and stir it for different time intervals (10, 20, 30, 40 and 50 minutes). Then the maximum efficiency is 91.07 at 40 minute."

TABLE I.

Sl No.	Contact Time(Min)	Initial Colour	Final Colour	Effitiency(%)
1	10	0.56	0.11	80.35
2	20	0.56	0.08	85.71
3	30	0.56	0.06	89.28
4	40	0.56	0.05	91.07
5	50	0.56	0.05	91.07

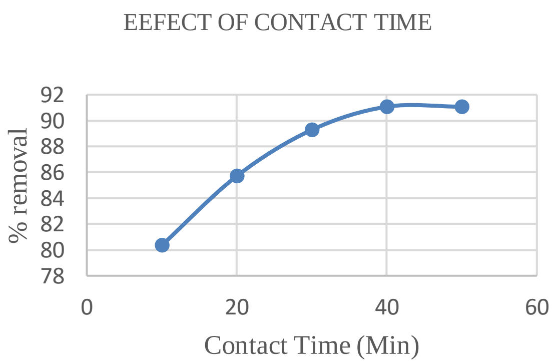

Fig. 3 Effect of Contact Time

Fig 4 Stirring of Solution

Effects of Initial Concentration:

In this study the same amount of adsorbent is used in 5 containers but variations in the quantity of stock solution taken in the 5 containers for the test (100,150,200,250&300 ml) and stir at a constant time. Then measure the efficiency of the solution. In this study the maximum efficiency is 82.14 at 100 ml of stock solution taken.

TABLE II.

SL No.	Initial Concentration(mL)	Initial Colour	Final Colour	Effitiency(%)
1	100	0.56	0.1	82.14
2	150	0.56	0.14	75
3	200	0.56	0.2	64.28
4	250	0.56	0.22	60.71
5	300	0.56	0.27	51.78

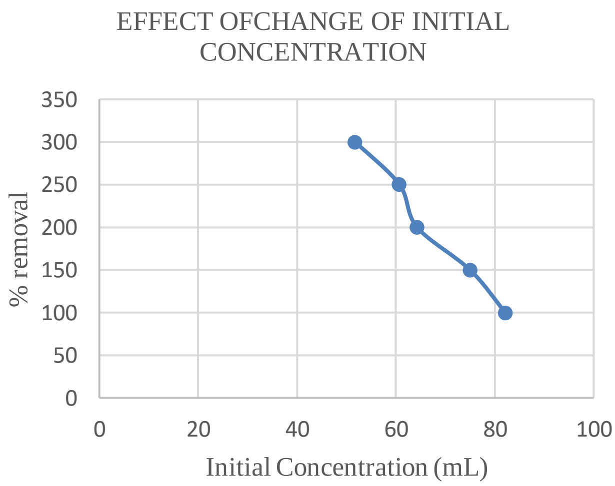

Fig 5 Effect of change of initial concentration

Effects of Adsorbent Dosage :

The effects of adsorbent dosage on adsorption was investigated by adding various quantities of adsorbent to the stock solution (2, 4 ,6 ,8 ,10 ,12 ,14 and 16g). Then the chemical flasks were well corked and the mixture was constantly shaken in a shaker for 15 minutes. The final dye concentration reading were measured after agitation.

TABLE III.

Sl No.	Adsobent Dose(g)	Initial Colour	Final Colour	Efficiency(%)
1	2	0.56	0.20	64.28
2	4	0.56	0.17	69.64
3	6	0.56	0.14	75
4	8	0.56	0.09	83.92
5	10	0.56	0.06	89.28
6	12	0.56	0.04	92.85
7	14	0.56	0.03	94.64
8	16	0.56	0.03	94.64

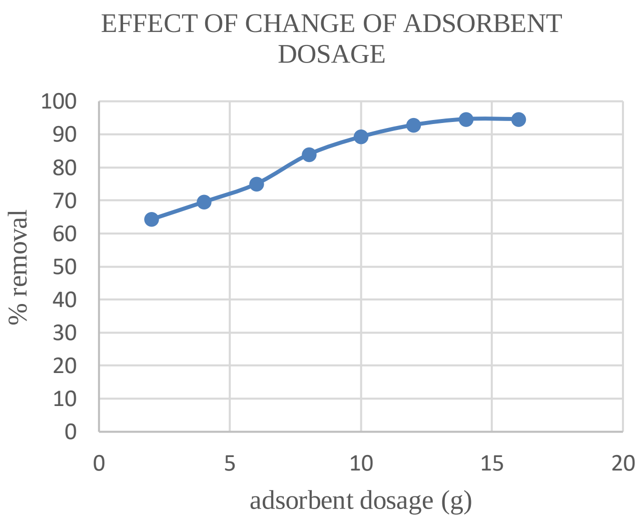

Fig 6 Effect of change of adsorbant dosage

Effects of pH

The effect of pH was investigated by varying the pH values of the stock solution (2, 4, 6, 8 and 10).The pH value of the stock solution is 7 so add 0.5N H_2SO_4 for reducing the pH value. (6, 4 and 2) and then add 0.5N NaOH for increasing the pH value (8 and 10).After this process add 5 mL of sawdust in each container and shaken for 15 minutes. Then the final reading measured after agitation.

Fig 7 Testing of pH

TABLE IV.

Sl No.	pH	Initial Colour	Final Colour	Effitiency(%)
1	2	0.4	0.1	77
2	4	0.6	0.12	80
3	6	0. 55	0.08	85.45
4	8	0.52	0.09	82.69
5	10	0.43	0.06	79

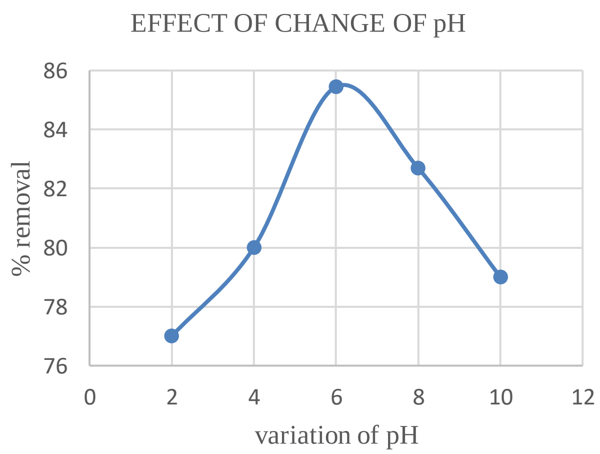

Fig 8 Effect of change of pH

V. CONCLUSION

Sawdust is used in the study that is Mahogany shows significant adsorption capacity for methylene blue under suitable experimental conditions and it will serve as an useful adsorbent. Sawdust is abundantly available and inexpensive too. Its binding capacity of basic dye is appreciably high. This method may be helpful for designing and fabricating a basic dye rich effluent treatment plant in the future. In this journal generally studied the batch study such as effect initial dye concentration, effect of pH, effect of adsorbent dosage, effect of contact time and graphically represented it's variation and effectiveness.ph over the range of 6 to 8 shows maximum efficiency where increasing the amount of adsorbent dosage the efficiency reaching maximum after a particular limit it will become constant. The study related to contact time will shows the maximum efficiency at 40 minute then it become constant also the initial dye concentration maximum at 100ml then the efficiency decreasing with the increasing amount of initial dye concentration.

VI. REFERENCES

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