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Research Article

Decolorization of textile waste water using low cost adsorbent

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ABSTRACTS

Water pollution due to release of industrial wastewater has already become a serious problem in almost every industry using dyes to color their products. Normally wastewater is treated in plants to remove undesirable components which include both organic and inorganic matters and soluble and insoluble materials. Experimental investigations have been made for color removal of textile waste water containing dyes using waste material from sugar cane industry. Adsorption of a basic dye, Methylene Blue (MB), from aqueous solution onto baggase (waste material from sugar cane) has been investigated. The parameters of the experiments include initial concentration of dye, adsorbent amount temperature and adsorption time.

Keywords: Adsorbent, Baggase, Color removal, Dyes

INTRODUCTION

The effluent of textile wastewater contains a variety of large quantities of dyes which are inert and may be toxic at the concentration discharged into receiving water. The discharge of highly colored effluents into natural water bodies is not only aesthetically displeasing but it also impedes light penetration thus upsetting biological processes within a stream[1-3.] In addition, many dyes are toxic to some organisms causing direct destruction of aquatic communities. Some dyes can cause allergic dermatitis, skin irritation, cancer and mutation in human beings.Although some existing technology may have certain advantages in the removal of dyes their initial and operational costs are so high that they constitute an inhibition to dyeing and finishing industries [4-9]. On the other hand low cost technology does not allow a wishful color removal or may have certain disadvantages. Hence, this paper suggests a low cost method using the cellulose waste material as adsorbent giving good results.

Treatment of wastewater containing dyes by adsorption is an emerging field of research. The process of adsorption has an edge over other methods due to its sludge free clean operation and complete removal of dyes even from the dilute solutions. The commonly used adsorbent is activated carbon. However, commercially available activated carbons are very expensive. Therefore, there is a need to produce low cost and effective activated carbon that can be used to control water pollution problem. The investigation reported here deals with the adsorption studies by activated carbon derived from H3PO4- impregnated baggasse for the removal of basic dyes from their aqueous solutions. The choice of basic dye for the detailed investigation was based on extensive use of this dye in textile industries. Methylene blue is the common basic dye used for dyeing. Experiments were conducted using the parameters such as initial concentration of dye, adsorbent amount and adsorption time. Color removal was measured using UV – VIS Spectrophotometer at wave length of 565nm.

MATERIALS

Baggase: Also called MEGASS, it is the fiber remaining after extraction of sugar bearing juice from sugar cane . It is a waste material obtained after all the juice has been extracted from sugarcane The bagasse can be easily obtained from any sugar cane juice corner or sugar manufacturing industry at nominal cost in abundant quantities.
Methylene Blue **:**Methylene blue is a heterocyclic aromatic chemical compound with molecular formula: $C_{16}H_{18}N_3SCl$ and molecular weight 319.85 gm/mole. It has many uses in a range of different fields such as biology and chemistry. At room temperature it appears as a solid, odorous, dark green powder, which yields a blue solution when dissolved in water.

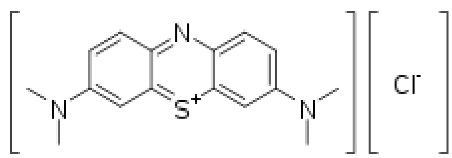

Figure 1- Structure of methylene blue.

IUPAC name:- 3, 7-bis (Dimethylamino) -phenothiazin-5-ium chloride

Methylene Blue is a synthetic dye used in textile industry. Methylene blue is a commonly used stain that helps us see microscopic life in brilliant colors and also for testing of DNA. Biologists often add a drop or two of Methylene blue to bacteria on a glass slide before placing the slide under the microscope. The blue color that stains the bacteria helps biologists see their shapes.
Batch adsorption experiments were carried out using the stock solution having dye concentration 100mg/l of stock solution.
Preparation of Activated charcoal: Baggase was collected from nearby sugar mill. It was washed with hot distilled water to remove dust and dried in sunlight .The baggase was treated with 50 % phosphoric acid and burnt at 250^{o}C in muffle furnace for 5 and half hrs. After burning, yield charcoal was washed with distilled water and dried in sunlight and packed for utilization.

EXPERIMENTAL METHODS

1. Three subdivided samples of 50 ml each having concentrations of 5%,10% and 15% dye were prepared by using the stock solution in different conical flask.
2. These test samples were examined in UV – VIS Spectrophotometer to check the initial %Transmittance in order to measure the color of the solution.
3. 0.2gm of activated carbon from baggase was added in each conical flask .It was kept for 30 min. with periodic shaking.
4. After 30 min. the solution was filtered and final reading of %Transmittance was measured.

5. Same procedure was followed for 60 min., 90 min., 120 min. 150 min. and 180 min. to study the effect of adsorption time.
6. The procedure was repeated for varying the amount of absorbent i.e. 0.4gm, 0.6 gm and 0.8 gm.

RESULTS AND DISCUSION

Effect of adsorption time: To study the effect of adsorption time, the observations were plotted in **Figure 2.** This figure shows that the %Transmittance increases with adsorption time for constant adsorbent amount of 0.2 gm. It is observed that initial uptake of dye is quite fast showing 87 % Transmittance during the first 90 min. and obtains an equilibrium stage at 150 min. for the sample having 5 % Methylene Blue dye.

Effect of amount of adsorbent: Experiment was performed for four different amounts of adsorbent and it was observed that % Transmittance increases with increasing the amount of adsorbent for the same adsorption time for a constant dye composition **Figure 3**. For instance the solution of 5% composition gave 89% transmittance for 0.2 gm of adsorbent and 95% transmittance for 0.8 gm adsorbent, when observed for 150 min. adsorption time.

Effect of Temperature [3,5]: The effect of temperature was investigated in the temperature range of 30^0C to 65^0C. It is observed that adsorption decreases with increase in temperature, **Figure 4**. The solubility of the adsorbate increases with inceases in adsorption. These result indicate that adsorption of MB on Baggase is exothermic.

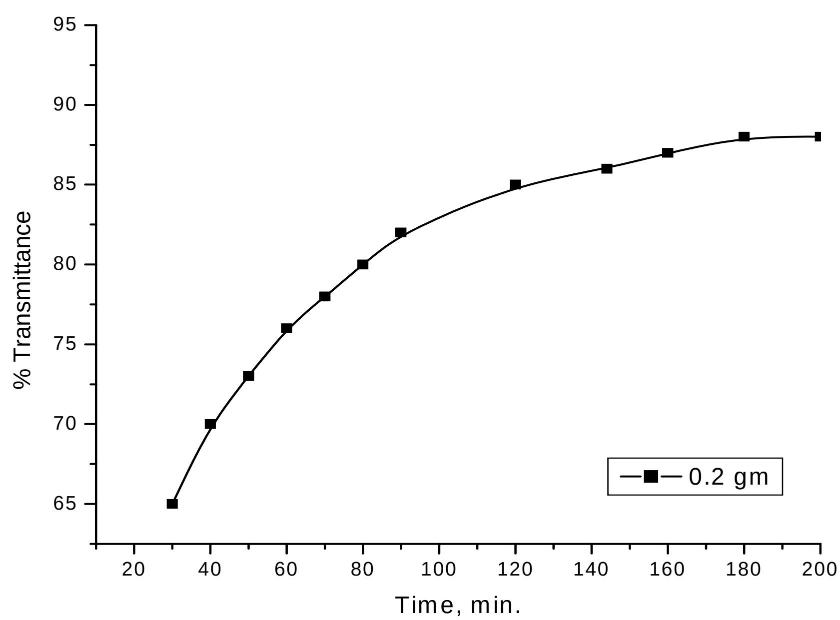

Figure 2 -Effecr of adsorption time

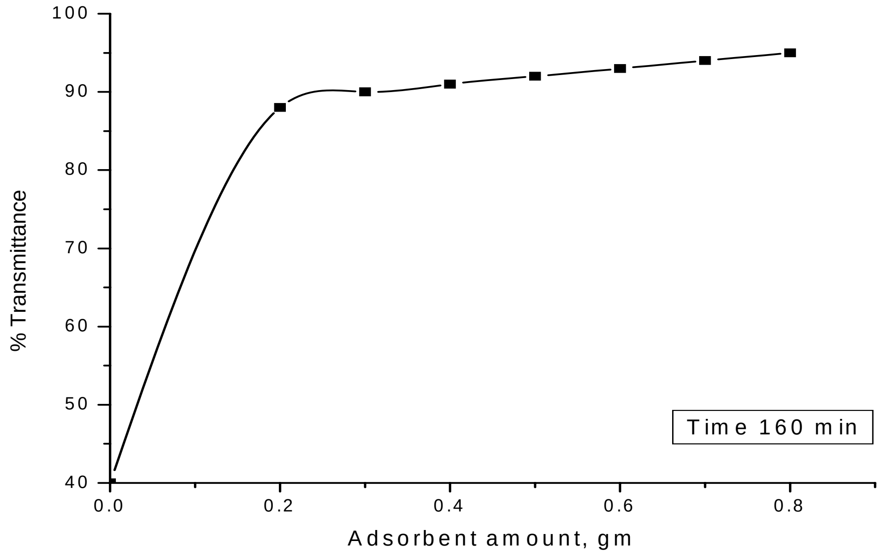

Figure 3- Effect of adsorbent amount

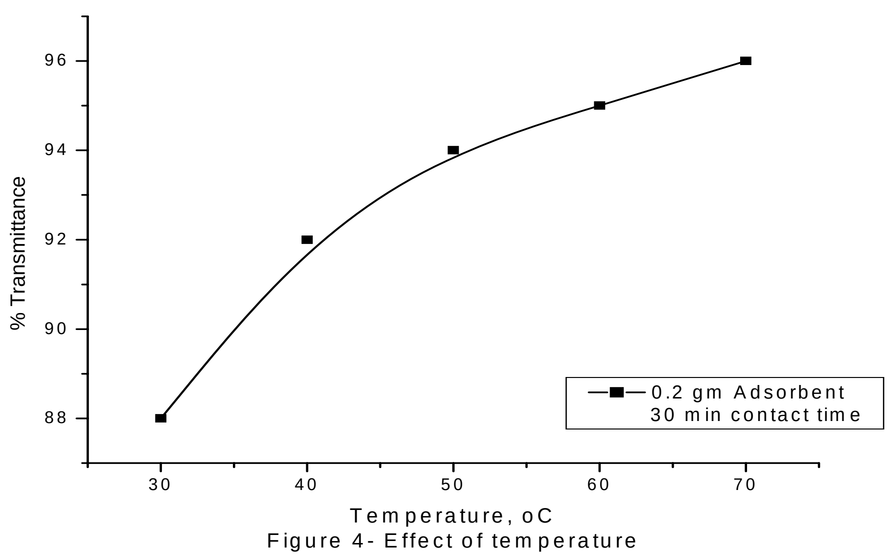

Figure 4- Effect of temperature

CONCLUSIONS

The following conclusions can be drawn from the present investigation: For a given composition, the adsorption of dyes in activated charcoal of baggase increases with amount of adsorbent when operated for equal adsorption time. This may be explained because of the fact that adsorption is a surface phenomena where adsorbate molecules occupy specific sites on the adsorbent. These sites are commonly known as active centers.

The concentration of these active center on the surface is further related to the pore size and pore volume available after impregnation. This explains why increasing the quantity of adsorbent results is increased adsorption.

With increase in adsorption time the adsorption of dye in activated charcoal of baggase increases while the

other two parameters i.e. amount of adsorbent and composition are same. The optimum condition is 0.8 gm adsorbent, 150 min. adsorption time for 95 % Transmittance. As seen from figure 5 initially the %transmittance increase (including higher adsorption) rapidly, however, after sometime the rate of this increase becomes almost constant. This is because all the available active centers on the adsorbent have been occupied and there being no further sites no further adsorption is possible. The time when this phenomenon occurs therefore, may be termed optimum time.

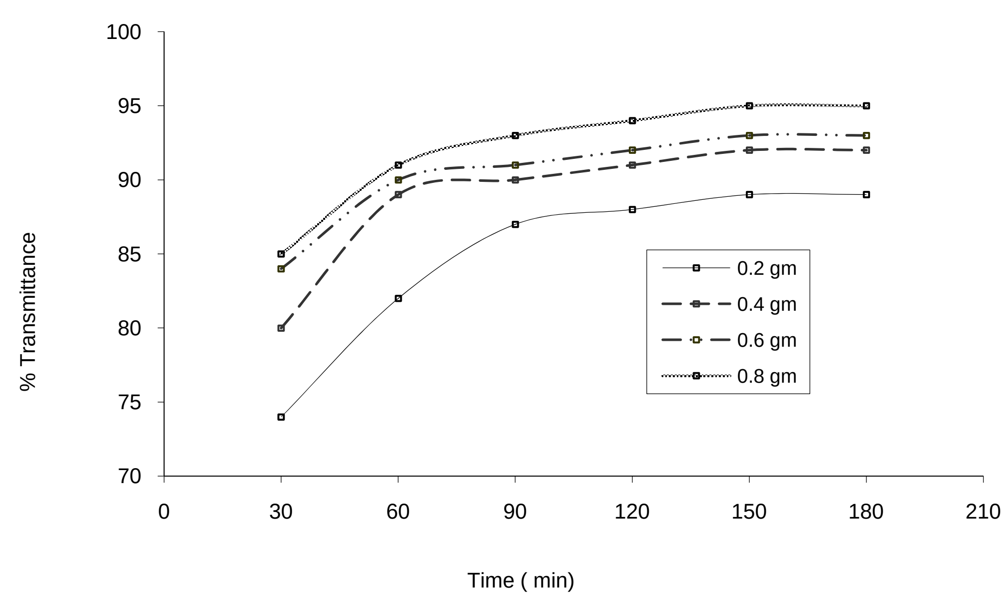

Figure 5- Comparison of data

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