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Removal of Cationic Dye Using Corn Husk as an Adsorbent

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ABSTRACT *The ability of corn husk to remove methylene blue from solution was investigated. Factors such as initial dye concentration, contact time, adsorbent dosage ,pH of solution and morphology of corn husk were studied. Results show that Langmuir isotherm can be successfully applied to the methylene blue – corn husk system and that corn husk is a suitable adsorbent for such a dye. Maximum adsorption capacity is 99 mg/g mass as derived from Langmuir isotherm. Sem analysis was carried out and the results were obtain .*

KEYWORDS : adsorption, corn husk, methylene blue, Langmuir isotherm ,SEM

INTRODUCTION

The discharge of color materials from industrial wastewaters into streams and rivers constitutes one of the major sources of water pollution. Owing to its color, it is the most easily recognisable pollutant. Although it may be present in minute quantities, its presence is still clearly undesirable from the aesthetic point of view. The treatment of dyes in industrial wastewaters poses several problems as the dyes are generally stable to light and oxidation and hence they cannot be treated by conventional methods. The adsorption process provides an attractive alternative especially if the adsorbent is inexpensive and readily available. The use of activated carbon for treatment of color effluents has been investigated extensively (Molvar 1970; McKay, 1982). Fullers earth and bauxite have also been reported to bebic digestion successful in removing color on a laboratory scale (Pearson 1913; Thorton and Moore,1953).

Recently the use of low cost materials to remove colour has been reported by several Workers. Poots and co-workers found that peat and wood can be successfully used to remove acid and basic dyes (1976, 1978). The sorption of ionic dyes on wool carbonizing waste was reported to be feasible (Perineau, 1980). The removal of cationic dyes using natural mosses was also reported by Lee (1987).

Corn husk, a by product of corn , is being used for the production of charcoal, fuel and brooms.As the husk is readily available, we investigated the potential of such a material in removing dyes from solution.

The bulk of corn husk is made up of cellulose and lignin (60%) .The hydroxyl

groups in these two polymeric substance provide sites for adsorption of dyes. Preliminary investigation showed that cationic dyes like Astra zone Red GTLN, Astrazone Pink FG,Astrazone Blue BG and methylene blue could be readily adsorbed on the husk. However, neutral dyes like methyl orange and phenol red showed no such activity. In this paper, the adsorption characteristics of methylene blue-corn husk system on a laboratory scale has been investigated.Parameters studied included adsorptive equilibria as function of contact time , pH and Morphology character.

MATERIALS AND METHODS

Sample Preparation

Corn husks collected from a near by were washed with distilled water and dried at room temperature. It was then sieved in succession into various fractions after drying at 80°C. The largest fraction (55% by weight) of size 300-850 was used in all the experiments.Methylene blue of 82% purity (British DrugHouse) was used without further purification.

Contact Time Experiments

In all contact-time experiments, except where the effect of dosage of adsorbent was studied, 0.5 g of husk was shaken in 100 ml meythlene blue solutions of varied concentrations. Aliquots of 1 ml solution were withdrawn at regular intervals for the analysis of the dye using a Shimadzu UV-160 spectrophotometer.

All measurements were recorded at A 665 max nm at room temperature.In the study of the effect of adsorbent dosage on dye up take, the weight of sample was varied from 0.25 to 1.5 g while the dye concentration was maintained at 250 mg.The effect of initial concentrations was studied by varying the dye concentration of the dye solution from 50-500 mg 1-1.

The influence of pH was conducted under an equilibrium condition. The pH of the solution was adjusted by dilute HCl or NaOH before experimentation. A contact time of three hours with constant shaking was maintained. In order to eliminate the effect of pH on colour, all solutions were adjusted to the same pH that is 6.0 before measurements were recorded. The reproducibility of the experiments was established by shaking four replicates of 100 ml 500 mg J-l methylene blue solution with 0.5 g corn husk.

Adsorption Isotherms

Adsorption isotherms were obtained by shaking 0.25 g of corn husk with 100 ml of dye solution for four hours. The concentration of the dye solution was varied from 250-1000 mg 1-1.

RESULTS AND DISCUSSION

Reproducibility

The reproducibility of the experiments was

established by shaking four replicates of 100

ml 500 mg J-l methylene blue solution with 0.5 g corn husk. The relative standard deviation was found to be less than 4%.

Effect of pH

The corn husk (CH) was used for the adsorption of methylene blue dye from aqueous solution. Absorbance data were recorded after 1 h with the help of spectrophotometer. The sorption capacity of the corn husk at different pH was shown in Figure1. It was observed that sorption capacity of MB increased with the increase in pH and was maximum at pH 3 for corn husk. This may be due to the fact that at higher pH values, the surface of adsorbent becomes negative which enhances the adsorption of positively charged MB cationic dye through electrostatic force of attraction. At pH 9 there is slight decrease in adsorption, which was due to repulsion between the adsorbent surface and presence of partial negative charge on MB due to chloride ions.Results showed that that the sorption capacity at pH 3 which was due to increase in surface active sites after activation.

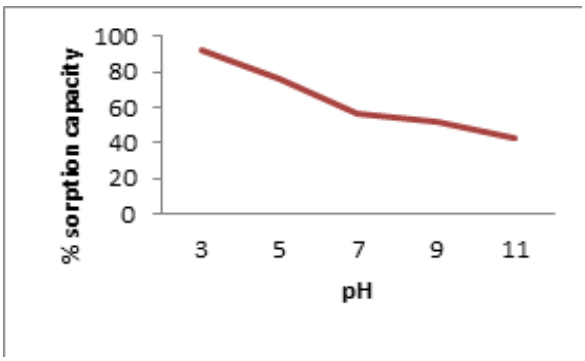


Fig 1 Effect of pH on sorption capacity

Effect of Contact Time on Adsorbent

The effect of the amount of adsorbent on the

adsorption of a fixed quantity of methylene

blue is shown in *Fig.2*. The rate of adsorption and the percentage adsorption of the dye

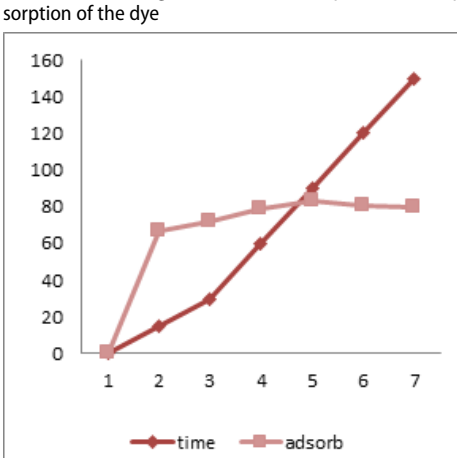


Fig 2. Effect of contact time on % adsorption of MB

Adsorption Isotherm

The results from adsorption studies at equilibrium can be used to determine the maximum of dye adsorbed by the husk by using a modified Langmuir isotherm shown below (Zimdahl and Skogerboe 1972).

$C_e/N_e = 1/N^* b + C_e/N^*$

where N is the amount of dye adsorbed per gram of husk at concentration C_e. A plot of C_e/N against C is shown in *Fig.* 3. The coefficient of correlation of such a plot is 0.996 indicating the general validity of the equation when applied to the adsorption of dye on corn husk. The maximum adsorption of the system (N*) is 99 mg g-l. This compares increased with increasing the amount of husk.This is due to the increase in binding sites inthe adsorbent favourably with the experimental value of 102 mg g-l.

In a similar study using natural moss as an adsorbent, a value of 252 mg glwas reported by Lee and Low (1987). Despite its lower adsorptive power, coconut husk, a cheap agricultural by product, could still be used to remove methylene blue from wastewaters

Experiments were performed for equilibrium contact time at different concentrations of methylene blue dye and data were recorded with the help of spectrophotometer. With the help of recorded data various parameters of Langmuir [23] was calculated. Linear plot of Langmuir isotherm of dye on CH is shown in Figure3. The correlation coefficient of the linear plot of Langmuir isotherm was R^2 =.996

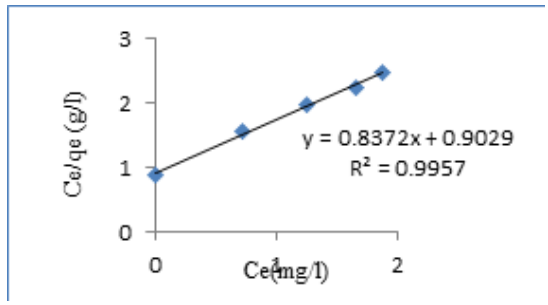


Fig.3 Langmuir istherm for the adsorption of MB on CH

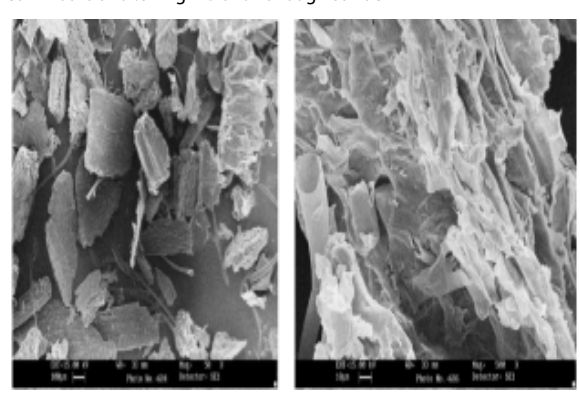
SEM Analysis

Scanning electron microscopy (SEM) is a method for high-resolution imaging of surfaces. The SEM uses electrons for imaging, much as a light microscope uses visible light. The advantages of SEM over light microscopy include much higher magnification (>100,000X) and greater depth of field up to 100 times that of light microscopy. Qualitative and quantitative chemical analysis information is also obtained using an energy dispersive x-ray spectrometer (EDS) with the SEM

SEM analysis is aimed to see the morphology of a sample. The sample analyzed was size 60 *mesh* corn husk.

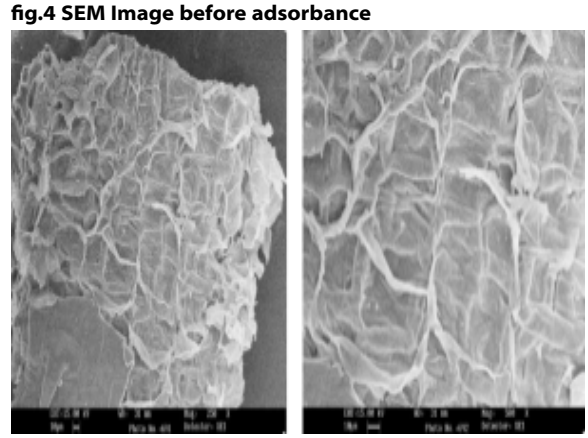
SEM results in Figure 4 shows corn husks fiber in which the fibers appear dominant in corn husks,where corn husks have high fiber Fig.5 that picture shows smooth rough surface and this indicates the morphology

after corn husks and MB are adsorbed with the composition of .001mg corn husks , it shows that corn husk and MB has been mixed mechanically. Fig, 6 shows biocomposite with the composition of corn husks and .01mg MB shows rough surfac



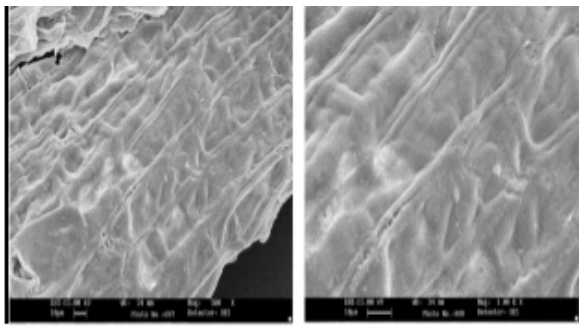
(a) (b)

fig.4 SEM Image before adsorbance



(a) (b)

Fig.5 SEM Image after .001 mg MB adsorbance



(a) **(b)**

Fig. 6 SEM Image after .01mg MB adsorbance

and also fibres of corn husks.Rough surface on corn husks indicates that corn husks have adsorbed Methylene Blue 99%.

CONCLUSION

The study shows that Corn husk, a cheap and easily available agricultural by product, can be effectively used to remove methylene blue from solution. Results of the studies show that the rate at which the husk has to be replaced once it is saturated with the dye, can be predicted quite satisfactorily .

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