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Removal of blue G dye by adsorption on walnut shell

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ABSTRACT

Walnut shell has been used as adsorbent for removal of Blue G dye from aqueous solution. Adsorption experiments were performed as a function of pH, dye concentration, adsorbent dose and temperature. Results show that the sorption capacity decreases with an increase in solution temperature from 25 to 55°C that indicate the adsorption Blue G dye onto walnut shell was exothermic. The optimum pH required for the maximum adsorption was found to be 10 and the regular decrease in percentage of color removal when the concentrations of the dye were increased.

KEYWORDS

Removal of dye;
Walnut shell;
Blue G dye.

INTRODUCTION

Dyes are one of the major constituents of the wastewater produced from dyestuff manufacturers and some similar industries, which poses a severe threat to the surrounding ecosystem because many of dyes are extremely toxic. At the present, there is a growing interest in using low cost, commercially available materials for the adsorption of dyes[1-7]. Walnut shell, a low-cost and easily available adsorbent, could be an alternative for more costly wastewater treatment processes. In this study the potential for the use of walnut shell as an adsorbent for removal of Blue G dye from environmental samples was investigated.

EXPERIMENTAL

Materials

The dye used in this study is Blue G, which is an anionic dye (color, Blue; λmax, 668 nm) was obtained from Merck. The rest of the chemicals were used as received.

General procedure

An aliquot of the Blue G solution, at pH=10 and 25±1°C was passed through a mini column containing 0.2g powder walnut shell (100 mesh). The absorbance of Blue G was measured spectrophotometrically at λmax=668 nm before and after passing of Blue G through the column. Finally, the percent of removal of Blue G was calculated by using a calibration curve of Blue G.

Preparation of adsorbent and dye solution

Walnut was collected from a local market. Walnut shells were washed to remove impurities, and were sieved for particles of 40, 60 and 100 mesh sizes. Then, walnut shells were boiled with dilute hydrochloric acid for 20 min. The dye solution was prepared by dissolving accurately weighted dye in known volume of dis-

tilled water. The subsequent dilutions were made by diluting the dye solution in accurate proportions to the desired initial concentrations.

Effect of adsorbent dose

As the adsorbent dose increase, better adsorption take place in the present study. The adsorbent dosages were varied from 0.04 to 0.20 g for removal of 80 ppm dye solution. The maximum adsorption was 94% using 0.2g adsorbent. However, it was observed that the efficiency did not increase linearly with increasing adsorbent dosage.

Effect of pH

The effect of pH was studied by varying the initial pH of dye solution and keeping the other process parameters as constant. The experiments were carried out for different dye concentration (40, 60 and 80 ppm) at different pH (pH 3-10) and constant walnut shell dosage of 2.0 g. The adsorption of the dye is highly pH-dependent. As shown in Figure 1, by increasing pH from3 to 10, the efficiency of dye removal was increased. Therefore, pH=10 was chosen for the following experiments.

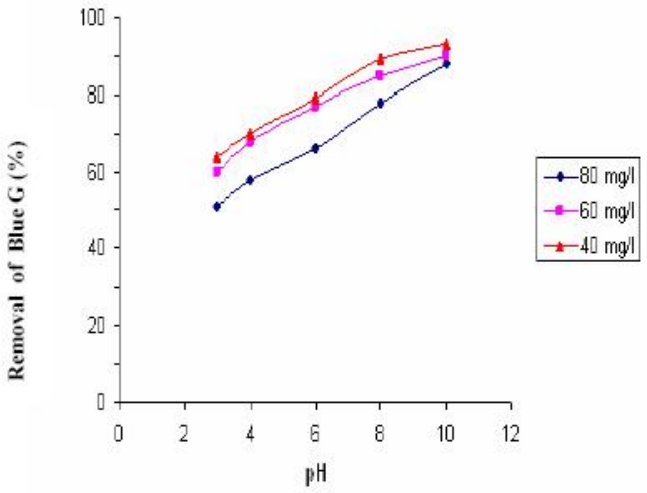

Figure 1 : Effect of pH on the removal of blue G

TABLE 1 : Effect of pH on the removal of blue G

pH	Removal of dye (40mg/L)	Removal of dye (60mg/L)	Removal of dye (80mg/L)
3	54	60	64
4	59	68	70
6	66	77	79
8	78	85	89
10	81	90	93

Effect of initial concentration of dye

The Effect of dye concentration was studied by keeping the adsorbent dose constant at 0.2 g. The concentration of dye was in the range of 40-100 ppm. As was shown in Figure 2, the efficiency of dye removal was decreased with increasing in initial concentration of the dye. This may be due to lack of available active sites required for the high initial concentration of the dye.

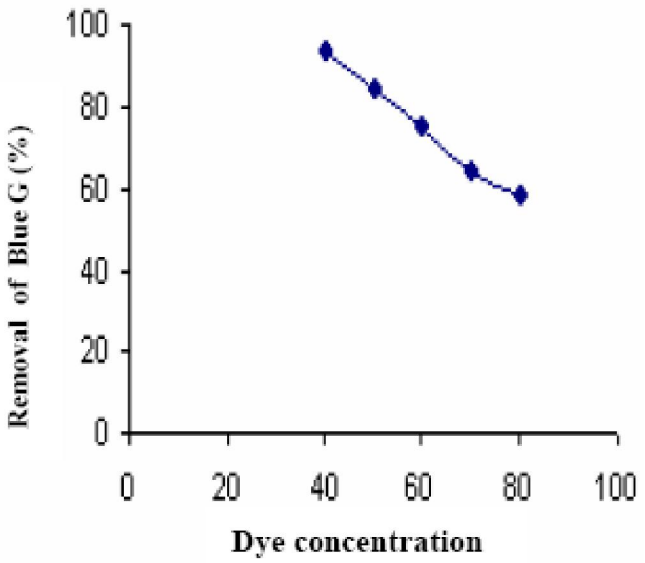

Figure 2 : Effect of dye concentration on the blue G dye concentration

TABLE 2 : Effect of initial concentration of blue G dye on the removal of glue G

	Initial dye concentration (mg/L)	Removal of dye *(%)*
1	40	93
2	50	84
3	60	75
4	70	64
5	80	58

Effect of temperature

Temperature is a highly significant parameter in adsorption process. The effect of temperature was studied with a constant initial concentration of 80 mg/lit at pH=10. The adsorption studies were carried out at four different temperatures 25, 35, 45 and 55ºC. The removal of Blue G was decreased from 94% to 58% by walnut shell with an increase in temperature from 25 to 55ºC. The retention capacity of the walnut shell is enhanced with decreasing temperature. It indicates that

the adsorption process is exothermic in nature.

CONCLUSION

Adsorption process is a powerfull technique that can be used for efficient removal or uptake of toxic material from liquid phases and it was found walnut shell is a suitable, low cost adsorbent. The optimum pH for adsorption was found to be 10.

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