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Research Paper

Removal of Methyl Blue Dye From Aqueous Solution By Using CUS-CDS Material

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ABSTRACT:
The CuS-CdS material was synthesized in the laboratory by following literature known method. The synthesized CuS-CdS materials was used for the removal of methyl blue dye. The removal of methyl blue dye from aqueous solution at different concentration of methyl blue dye, amount of CuS-CdS material, pH and nature of CuS-CdS material has been studied. Langmuir isotherm models were found fit for the removal of methyl blue dye from the aqueous solution. The adsorption of methyl blue followed pseudo second order kinetics. The CuS-CdS material could be successfully used as a low-cost adsorbent for the removal of methyl blue dye from aqueous solution.
KEYWORDS: *CuS-CdS material, methyl blue dye, adsorption, Langmuir isotherm etc.*

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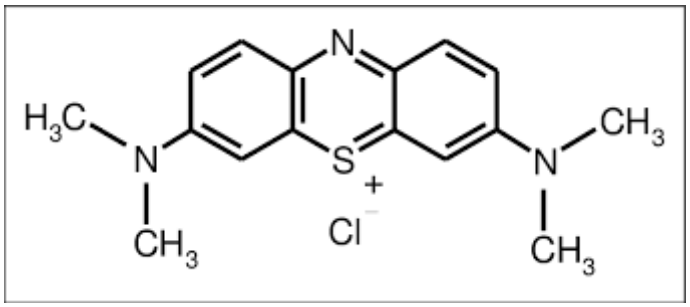
I. INTRODUCTION

Nowdays, water has been contaminated due to industrialization as well as man-made processes. The waste water effluents from industries like printing, food processing, leather, rubber, pulp, textile, plastic and cosmetics contain the different dyes [1]. It's very difficult to treat the effluents because of its chemical structure [2]. The effluents also contain inorganic and organic material, salts, surfactants, additives etc. The human beings and living organism are affected due to such materials and other contaminants [3]. The effluents pollutes the ground water and degrades the quality of water and soil, hence it affects the environment [4]. In India most of the industries work on dyestuffs and produces the hazardous effluents in the water so the industry are also facing the problem regarding environmental pollution.



Structure of methyl blue dye

Blue dyes are more toxic than red dye. Methyl blue dye is thiazine cationic type dye and used in coloring paper, biological staining, wools, hair and cottons [5]. The excess amount of methyl blue in water causes serious problems in breathing, diarrhea, eye burns, nausea and vomiting [6], while the methyl blue injection is useful in the treatment of urinary tract infections and methemoglobinemia infections. The azo dyes are more toxic because the dyes are relatively non-biodegradable and it contains azoic linkages, aromatic rings and amino acids [7].

The number of biological and physicochemical processes has been used for the removal of dye from the waste water like photocatalytic degradations [8], adsorption [9], membrane filtration [10], irradiation [11], ultrasonic assisted adsorption [12] and biological treatment [13]. Among all these techniques the adsorption is

commonly used because of its facile operation, selectivity and availability of adsorbents. The number of adsorbents is used for the removal of methyl blue dye [14-20].

In the present work, the removal of methyl blue dye has been studied by using the synthesized CuS-CdS material. The important parameters such as concentration of methyl blue dye, amount of CuS-CdS material, pH and nature of CuS-CdS material are investigated.

II. MATERIALS AND METHODS

The CuS-CdS adsorbent was synthesized by the literature known method [21]. The methyl blue dye was purchased from Merck Ltd. (India). The stock solution was prepared by dissolving 0.5 gm of dye in 1000 ml of distilled water which results in 500 ppm of dye solution. The solution of different concentrations of dye was prepared by using above stock solution. The absorbance of the methyl blue dye solution was measured using UV spectrophotometer. The absorption spectrum shows that maximum absorption at 660 nm [22]. The initial pH of dye solution was adjusted by using dilute hydrochloric acid or sodium hydroxide solution.

III. RESULTS AND DISCUSSION

3.1. Effect of pH:

The surface properties of adsorbent material and dissociation of dye molecules are extremely affected by the pH of the solution. The adsorption capacity was studied over a pH range of 2-10. The removal of methyl blue dye increases with increase in pH value up to 4. Beyond the pH value 4 the adsorption of dye was remains constant.

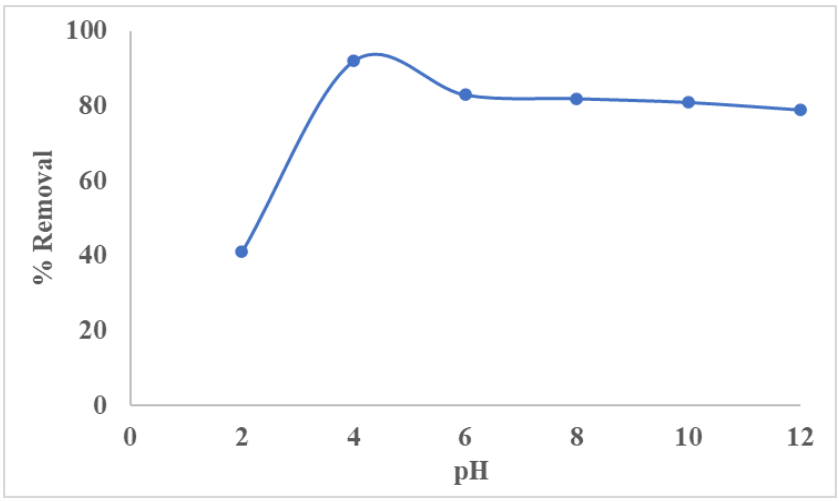


Figure 1

3.2. Effect of Concentration of Dye:

To study the effect of concentration of the methyl dye on the removal of the dye the amount of dye varied from 50 ppm to 500 ppm at the same experiment condition. The removal of dye was carried out at pH 4.0 with different amount of the methyl blue dye solution. As the concentration of dye increases the removal of dye from aqueous solution decreases. The maximum removal of dye was observed at 50 ppm concentration of the dye.

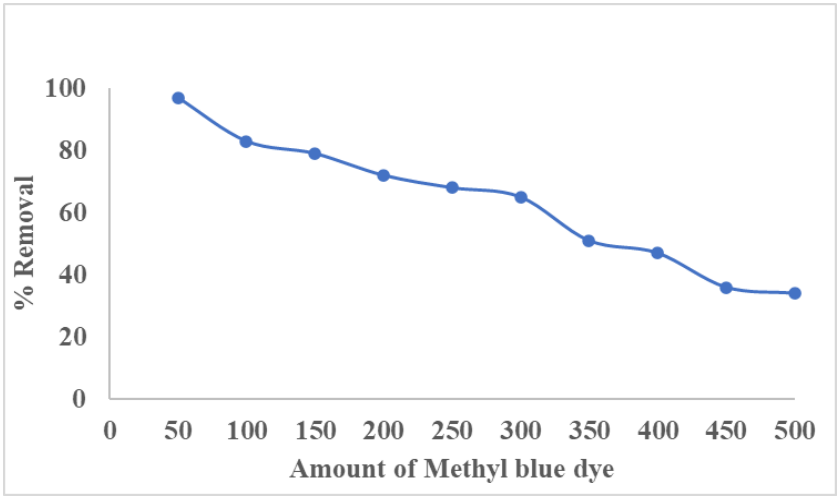


Figure 2

3.3. Effect of Amount of CuS-CdS:

In order to study the effect of amount of CuS-CdS on the removal of methyl blue dye, the experiment was carried at pH 4.0 and with 50 ppm solution of methyl blue dye. The maximum removal of the methyl blue dye was observed at 40 mg of the CuS-CdS adsorbent material. Though the amount of the CuS-CdS adsorbent increases, the removal of the dye remains steady.

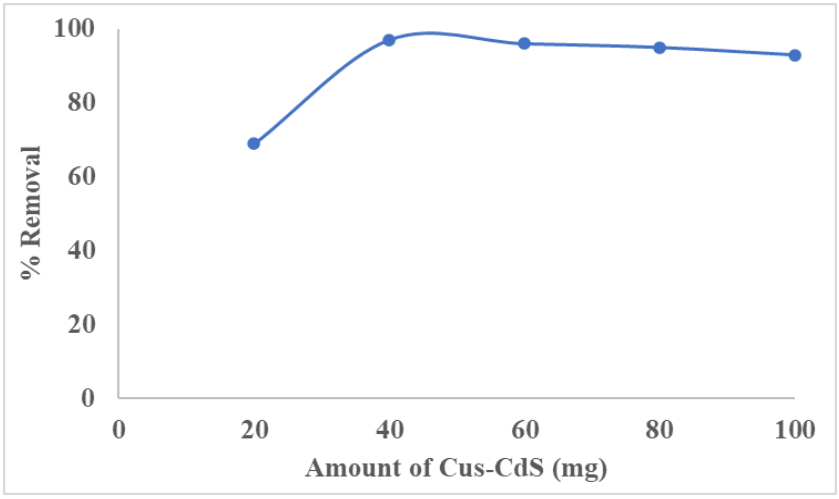


Figure 3

3.4. Effect of Contact Time:

The contact time of methyl blue dye and the CuS-CdS adsorbent material was studied by carried out at the pH 4.0, 40 mg of the CuS-CdS adsorbent and 50 ppm of methyl blue dye solution. The data obtained shows that the 100 minutes contact time was sufficient for the removal of the methyl blue dye from the aqueous solution. Beyond the 100 minutes contact time no more increase in the removal of dye was observed.

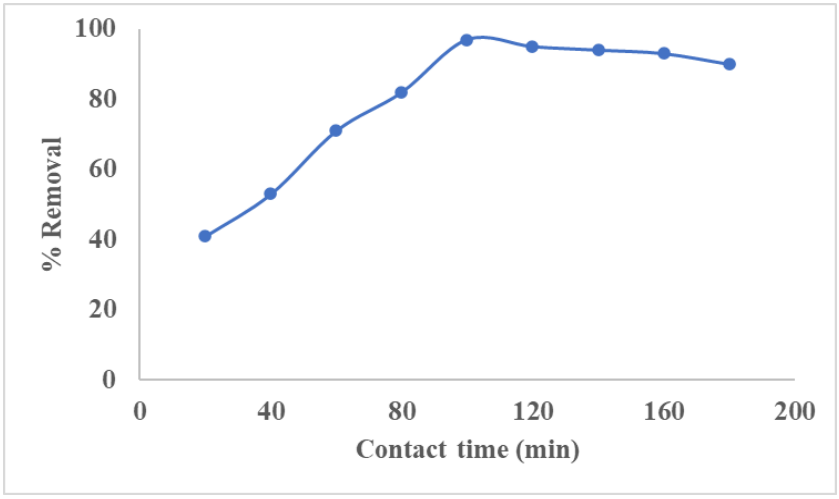


Figure 4

3.5. Adsorption Isotherm:

The plot of C_e/q_e against Ce shows the linear nature with theoretical adsorption capacity (q_m) is 5.320 mg/g while Langmuir adsorption constant is 0.1322. The separation factor was found to range from 0.1322 to 0.5124 and increases with increase in the concentration of the dye. The result shows that CuS-CdS adsorbent surface is favourable since R_L is less than unity but greater than zero [23].

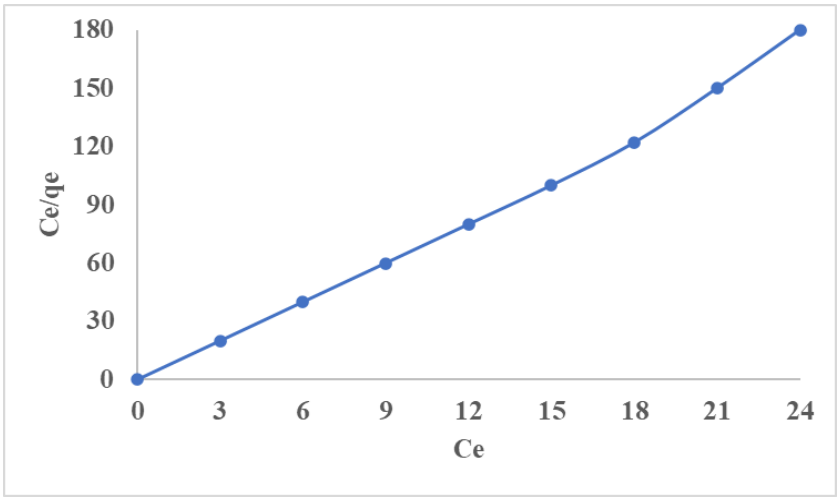


Figure 5

IV. CONCLUSION

The CuS-CdS adsorbent was successfully used for the removal of methyl blue dye under different conditions. The result shows that initial concentration of the methyl blue dye, amount of adsorbent, pH and contact time were the influencing factors. The maximum removal of the methyl dye was observed at pH 4.0, with 40 mg of adsorbent and for 100 minutes contact time.

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