Journal of Engineering and Applied Sciences 13 (Special Issue 13): 10777-10779, 2018
ISSN: 1816-949X

Removal of Methylene Blue (MB) Dye from Aqueous Solution by Chicken Feather as Natural Adsorbent Material

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Abstract: The present research was targeted to remove the one of the most popular textile dyes which utilized as colorant dye in the textile industries from the effluent of these industries. The chicken feather was used as adsorbent after treated by thermal and acid method. Generally the operation conditions were: concentration of dye (20 ppm), (pH = 6), contact time (120 min) and adsorbent dosage (2 g/L). The results show that the activated chicken feather was scssusefly adsorbent, comparing with the non-activated samples. In addition to the thermal activation was more active than the acidic activation, at same time the removal percentage was increased with increase activation temperature the maximum removal dye percentage was 93%.

Key words: Methylene blue, adsorption, feathers, thermal activation, ecofriendly, dye

INTRODUCTION

The adulteration of surface water by industerial dyes has shaped a serious environmental problem in the world. A substantial amount of dyes which is discharged as wastewater into the water bodies through many industries such as solvent, petroleum, leather, paper, textile, carpet, paint, pigments, cosmetics, plastic, pesticide printing, food, rubber, etc. (Nharingo *et al*., 2013).

One of the most important basic dyes is methylene blue dye because of its applications in industry which is included coloring paper, hair colorant, dying cotton, wools and coating for paper stock, its chemical structure is shown in Fig. 1. The chemical structure shows the presence of aromatic amines that are carcinogenic, causes liver, bladder, intestine and skin cancer and sensitivity in humans (Chowdhury and Saha, 2012).

Many chemical or physical techniques have been used to treat wastewater-containing dyes such as adsorption, ozonation, electrochemical annihilation, filtration, ion exchange, precipitation and flocculation. Presently, biological treatment and adsorption technique are two effective scientifically fit methods for treating wastewater (Salih, 2014). Pollutant having wastewater due to the affluence, ability to treat dilute solutions, insensitivity to toxic substances and effectiveness (Marofi *et al*., 2017; Almamoori *et al*., 2017).

Recently, some researchers have been focused on the use of low-cost adsorbents. Using of cheap and efficient alternative materials for removing dyes from wastewater have been investigated (Santhi and Manonmani, 2012). A few studies have been shown that feathers are effective and economically feasible to remove some contaminants that involve dyes from aqueous solutions (Acemioglu, 2005). As far as we know, no study has been reported on the removal of MB using chicken feathers. Thus, our main goal was to explore and investigate the possibility of using these feathers as an adsorbent to remove MB from aqueous solutions.

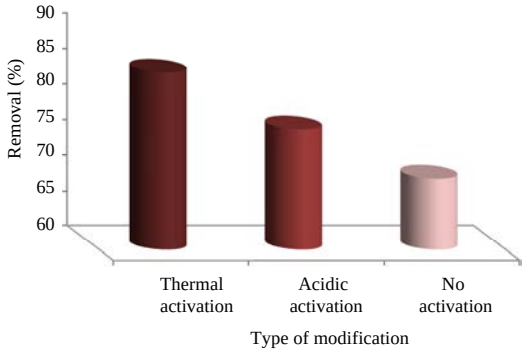

Fig. 1: The effect of the modufication condtions acidic condtions, thermal condtions on adsorption percentage of methylene blue dye on the feather as adsorbents

MATERIALS AND METHODS

The waste of feather births was by running tap water for removing the impurities like soils, blood and then it

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washed by distilled water. Finally, the feather washed by boiling distilled water for 3 h with starrier and the specimens were dried at room temperature for 1 day (Santhi and Manonmani, 2012).

The specimens feather divided to three samples, the first sample was treated with 100 mL 0.1 M hydrochloric acid, second sample was heated at 150°C for 2 h, the third sample was leave without any treatment. The all the sample washed by distilled water and dried at 80°C temperature for 6 h (Acemioglu, 2005).

The stock solution of Methylene Blue (MB) dye with concentration of 1000 mg/L was prepared by issolving accurate weight of powder dye in the distilled water. Chemical formula of Methylene Blue (MB) = $C_{16}H_{18}ClN_3S.3H_2O$ was obtained by Sigma-Alderich chemicals. The experimental solutions were prepared from stok solution by dilutions (Acemioglu, 2005). About 0.5 g was taken from each sample of feather as adsorbent and put each along into 250 mL conical flasks. Added for each conical 50 mL solution methylene blue dye. The conical flasks shaken continuously for different times to reach equilibrium concentration. The suspended particles of adsorbent were separated by filtration and the final absorption corresponding each solutions by using spectrophotometer (UV/Vis-Jenway, 1600, German). The removal percentage calculated from the equation:

$$\text{Removal\%} = (A^\circ - A)/A^\circ \times 100$$

A° and A is the absorption of concentration of dye before and after adsorption, respectively. The initial and equilibrium concentrations of the dye in solution were measured and the amount of methylene blue adsorbed on the activated feather was calculated from the mass balance equation given as:

$$Q_e = [V(C_i - C_e)]/m \quad (1)$$

Where:

C_i and C_e = The initial and equilibrium concentrations of MB (mg/L), respectively

Q_e = The amount of MB adsorbed at equilibrium (mg/g)

V = The volume of the MB solution (L)

m = The mass of the adsorbent (g) (Gecgel *et al*., 2012)

RESULTS AND DISCUSSION

The effect of the modufication condtions acidic condtion, thermal condtion on adsorption percentage of methylene blue dye on the feather as adsorbents, comparing with adsorption percentage this dye on raw sample feather were investigated at different contact time (10-80 min) and the experiments were completed with initial dye concentration ppm at pH-6.0, room temperature and adsorbent dose-5 g/L. The obtained data are exposed in Fig. 2 and 3.

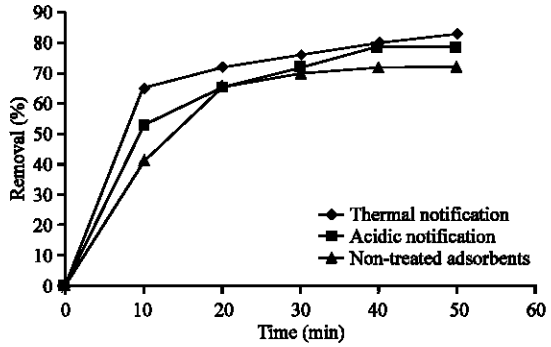

Fig. 2: The removal methylene blue dye percentage on the different activated feather as adsorbents contact time (10-80 min) and the experiments were completed with initial dye concentration ppm at pH-6.0, room temperature and adsorbent dose-5g/L

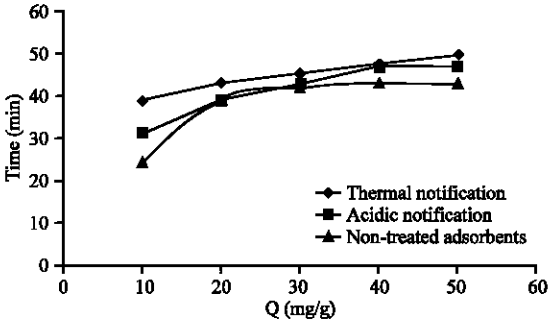

Fig. 3: Amount of methylene blue adsorbed on the different activated feather as adsorbents contact time (10-80 min) and the experiments were completed with initial dye concentration ppm at pH-6.0, room temperature and adsorbent dose-5g/L

The results showed increasing in the removal percentage of dye, for both used activation methods (acidic and thermal) comparing with the raw adsorbents with continue contact time (Husseien *et al*., 2007; Hayashi *et al*., 2000; Bhattacharyya and Sharma, 2005; Gupta *et al*., 2008; Slimani *et al*., 2011).

At the same time the dry activation was more active than the wet activation for both dyes as show in the results the removal Congo red dye efficiency was 81.3% for non-actiation, 87.7% for acidic activation, 96% for thermal activation. The thermal actviation involve dehydreatin process, realase the miostuer and

impurite adsorbed on the common reed powder, this lead to increasing surface eara and increasing active site of the catalyst (Omran *et al*., 2016).

Physical properties inhencement with the acidic activation, like increasing in the poure size, surface area. Also, the chemical changes occure due to acidic activation such as cation exchanges (Salman *et al*., 2015, 2016; El-Latif and Ibrahim, 2009; Mohammed *et al*., 2018; Halbus *et al*., 2017).

The wet activation favorable due to low cost, decomposition of adsorbents is controlled via. acid concentration, temperature, time imergenation.

CONCLUSION

The study includes an evaluation of the effect of various effective activation methods such as acidic activation and thermal activation on adsorption process.

ACKNOWLEDGEMENT

Researchers are gratefully acknowledge the support that was provided by Babylon University, Environmental Research and Study Center, Iraq for funding this research.

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