Application of Activated Awiss Mango biosorbent for Dye Industrial Wastewater Treatment

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Abstract: In this paper, the new activated biosorbent with excellent properties for the removal of basic dye e.g. methylene blue from wastewater was prepared. Alo, this paper focused on the synthesis of a novel biosorbent from mango seed then activated using HCl. NaOH and $ZnCl_2$. The activated mango biosorbent was characterized using infrared spectra. The activated mango biosorbent was tested for removing of the methylene blue dye (MBD) from wastewater; the various parameters like MBD concentration, temperature and shaking time were studied to optimize the best condition for removing of MBD from aqueous solution. It was found that MBD was removed 100% in pH 7 with shaking 5 min at room temperature. It is indicate that activated mango biosorbent would find important application for removal of basic dyes from wastewater, owing to the advantages of high efficiency, low cost and environmental friendliness.

Key Words: Activated mango biosorbent; removal, wastewater, Basic dyes; Methylene blue

1. Introduction

Many industries use dyes to color their fifinal products [1]. Most of the dyes are lost during the manufacturing process, producing large quantities of colored wastewater [2]. The wastewater discharged from dye industries can adversely affect the aquatic environment by impeding light penetration and, as a consequence, precluding photosynthesis of aquatic flflora [3, 4]. Moreover, most of the dyes can cause allergy, dermatitis, skin irritation and can also provoke cancer and cell mutation in humans [5-7].

Adsorption process is an efficient method for the removal of basic dyes from wastewater [8-11]. It is due to its simplicity and high effificiency for removing of dyes [12, 13]. This process transfers the dyes from the wastewater to a solid phase [14, 15]. Biosorbent is one of the most employed adsorbents for dye removal from wastewater because of its excellent adsorption properties [16, 17].

Mango seed is an abundant residue discarded by the mango juice industry, and is increasing due to the expansion of fruit production [18]. The seeds correspond to 30–45% of each mango's weight, depending on the variety, and remain as a residue which is usually burned or discarded [19]. The chemical modifier of wastes of mango seeds can be used as a biosorbent for the removal of dyes from industrial wastewater [20].

In this work, the activated biosorbents were prepared from awaiss mango seeds using HCl, NaOH andl $ZnCl_2$ solutions. Also, the activated mango biosorbent was tested for removing of the methylene blue dye (MBD) from wastewater. The various parameters like MBD concentration, temperature and shaking time were studied to optimize the best condition for removing of MBD from aqueous solution.

2. Experminal

2.1. Materials and methodes

After drying the mango seeds at 250 °C then grinding them to powder. There are soaked for an 24 hour to activate its surface with 0.1` mol/L HCl, NaOH and $ZnCl_2$..

2.2. Recommended procedures

The removal of MBD onto activated mango biosorbents was tested using batch experiments. A 0.1 g of activated mango biosorbents was shaken with 25 mL of the MBD solution then the remaining MBD concentration in the solution was analyzed at λmax= 460 nm. The percentages of MBD removal (%E) and the mango biosorbents capacity (qe) were calculated from the following equations:

$$\%E = ((C_0 - C_e)/C_0) \times 100 \quad (1)$$

$$q_e = (C_o - C_e)\ V/m \quad (2)$$

Where C_o is the initial MBD concentration, C_e is the concentration of MB in solution at equilibrium, V is the volume of MBD solutions and m is the mass of mango biosorbents.

3. Result and Discussion

3.1. Characterization

FTIR spectra were obtained on a JASCO FTIR-4100 spectrometer in the 4000–400 cm^{-1} spectral range using KBr discs to prepare the samples. The functional groups of mango—B1, mango-B2 and, mango-B3 were recorded using FTIR spectroscopy in the 4000–400 cm^{-1} range (Fig. 1). The broadband of Activated mango biosorbents at 3739-2973 cm^{-1} was attributed to υOH, while bands at 2917, 2906, 1655, 1628 and 1343 cm^{-1} were assigned to υCH, υC=C and υC-O-C, C-H and COOR.

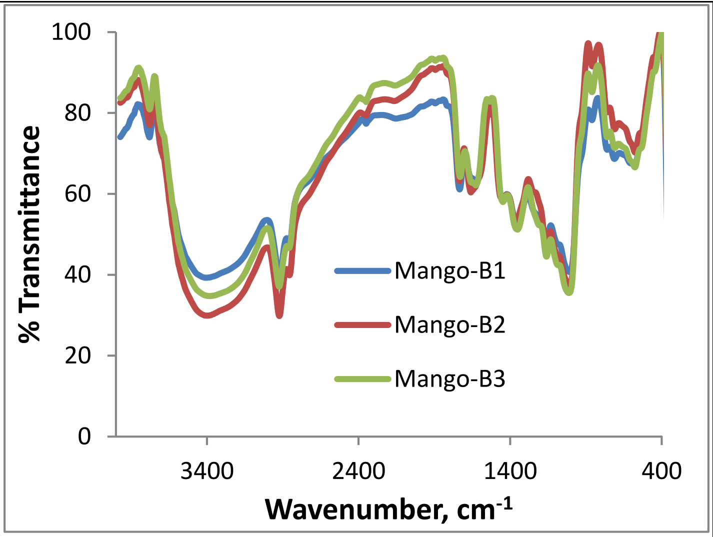

Fig.1: Infrared spectra for actiated mango biosorbents

3.1. Removal condition of methylene blue dye

The optimum condition for MBD removal using activated mango biosorbents was carried out at 0.1-1 mg/L MBD in pH 7 and shaking for 1-60 minutes at temperature ranges 25-65 ºC.

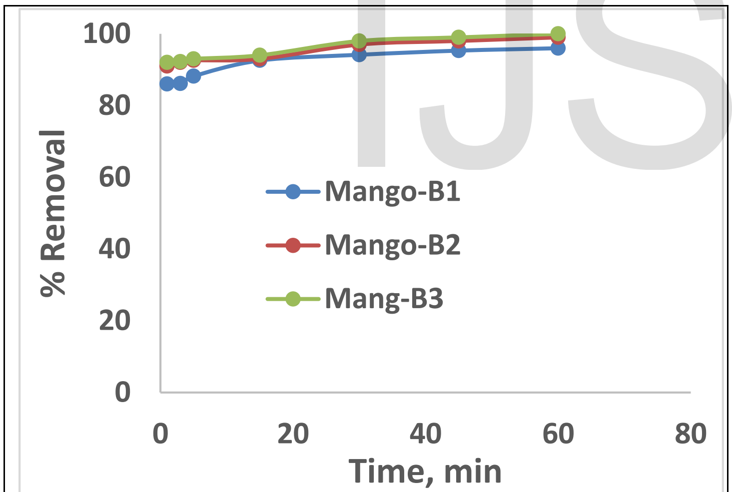

Fig.2: Effect of Shaking time on the removal of MBD

The results obtained, the percentages rates for sorption MBD (80-90%) were very rapid at the initial stage of the contact period time at (1-10 min) at room temperature (Fig. 2). Then the sorption rate became slower until reached to the equilibrium time (96-100%). This phenomenon was happened because of a large number of vacant surface sites were available for adsorption during the initial stage of the adsorption process. Near to equilibrium, due to the slow pore diffusion of the MBD on activated mango biosorbents, the repulsive forces between the solid molecules and the bulk phases, the remaining vacant surface sites were difficult to occupy (Fig. 3). Also, the removal percentages of MBD using activated mango biosorbents with NaOH and $ZnCl_2$ are mor than activated mango biosorbents with HCl.

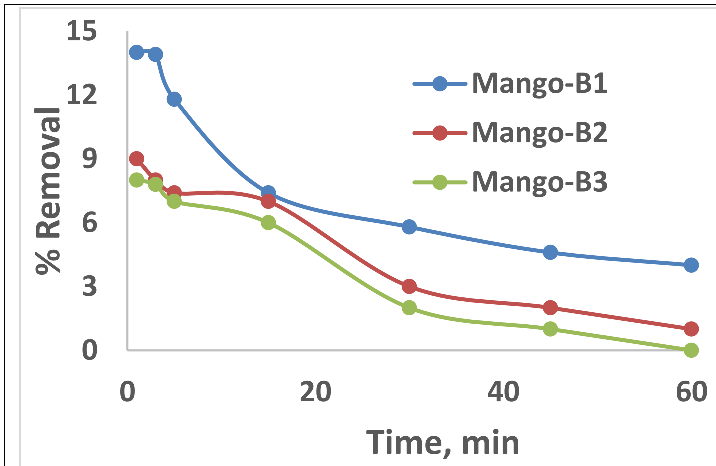

Fig.3: Effect of Shaking time on the removal of MBD

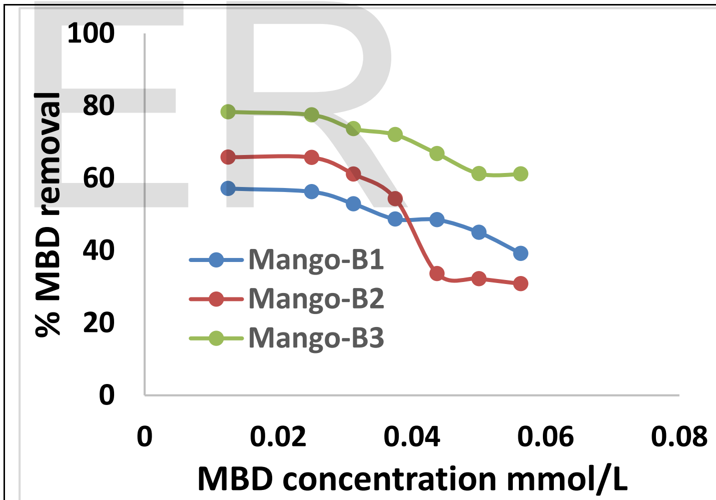

Fig.4: Effect of MBD concentration on the removal of MBD

The effect of methylene blue concentration on the percentages of MBD during 30 minutes at room temperature. The sorption percentages was decreased with increasing MBD concentration until reached to the equilibrium (Fig. 4).

The activated mango biosorbents capacities for methylene blue dye was increased with increasing initial concentrations until be reached to maximum capacity (Qmax) at room temperature, pH 7 and contact shaking time for 30 minutes. mango biosorbents capacities value of MBD were 0.011, 0.015 and 0.016 mmol/g with the correlation coefficients (R^2) were 0.982, 0984 and 0.988 (Fig. 5).

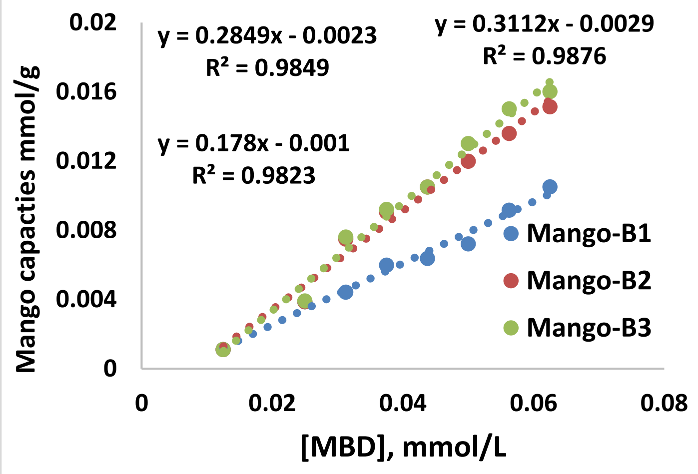

Fig.5: Removal isotherms for MBD onto mango biosorbents

The efficiency of the activated mango biosorbents for removal at different solution temperature (25-65 ˚C) was evaluated. By increasing temperature, the sorption percentages of MBD were decreased from 100% to 50% (Fig.6).

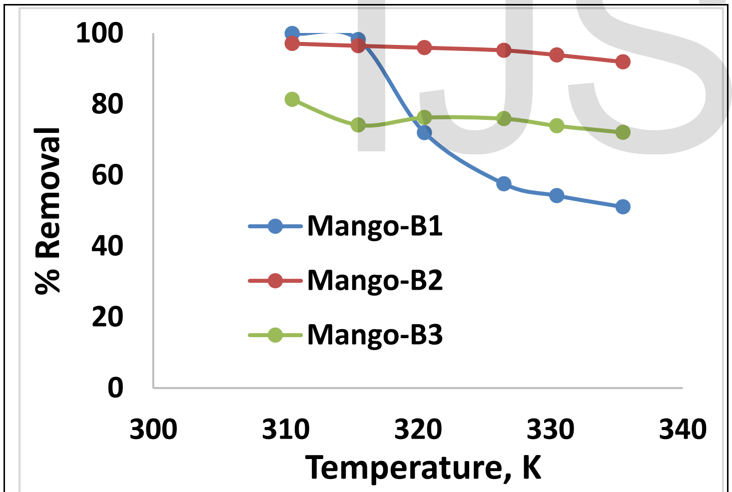

Fig. 6: Effect of temperature for removal of MBD

4. Conclusion

In our study presents a low-cost and eco-friendly activated mango biosorbents which prepared by simple activation with soaking in HCl, NaOH and $ZnCl_2$ solutions. The physicochemical characteristics of activated mango biosorbents were investigated FTIR. The effect of different factors including shaking time, initial MBD concentration, solution temperature have been investigated. Mango biosorbents has been developed in this study was tested successfully for complete removal of methylene blue dye from wastewater.

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