DYE REMOVAL FROM AQUEOUS SOLUTION BY USING CHEMICAL TREATED SUGARCANE BAGASSE AT VARIOUS pH

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Introduction

Nowadays, about 9000 types of dyes have been incorporated in the colour index. Due to low biodegradability of dyes, the discharge of coloured wastewater from these industries had caused many significant problems, such as increasing the toxicity and COD (chemical oxygen demand) of the effluent [1].
Most of the dyes are very stable, either to photo-degradation, bio-degradation or oxdizing agents. Currently, several physical and chemical processes are used for dyes wastewater treatment. However, these processes are highly cost and not efficient for the treatment of wide range of dye wastewater [2].
Sugarcane bagasse is an agro-waste from the sugar production industries, which used as a fuel for the boiler, to generate heat to the factory. In this study, sugarcane bagasse is pretreated with formaldehyde and sulphuric acid. The treated sugarcane bagasse adsorption on the methyl red is investigated for the various initial pH at room temperature.

Materials and Method

Preparation of adsorbents
Powdered activated carbon (PAC) was supplied by BHD Laboratory Supplies, Poles England. The adsorbents were used directly without any further grinding and sieving.

Sulphuric Acid Treated Bagasse
One part of the bagasse was mixed with one part of the concentrated sulphuric acid and then heated in a muffle furnace for 24 hour at 150 °C. The heated bagasse was washed with distilled water and soaked in 1% sodium bicarbonate solution overnight. The bagasse then was dried in an oven at 105 °C for 24 hour and sieve to a size of -80 to +230 mesh unit.

Dye Solution Preparation
A stock solution of 500 mg/L methyl red was prepared by dissolving 500 mg methyl red in 1 liter of double distilled water. Experimental solution of the desired concentration was obtained by successively dilution.
Adsorption Experiment
In each adsorption experiment, 250 mL of dyes solution of known concentration and initial pH was added to 400 mg of adsorbents in 250 mL round bottom flask at room temperature and the mixture was stirred on a rotary orbital shaker set at 160 rpm.
The sample was withdrawn from the shaker after 2 hour and separated from the solution by centrifugation at 4500 rpm for 5 minutes.
Dyes concentration was determined by using adsorbance value measured before and after the treatment at 617 nm with UV Visible Spectrometer.
The experiment were carried out at initial pH values ranging from 2 to 13, initial pH was controlled by the addition of sodium hydroxide, NaOH or hydrochloric acid, HCl.

Result and Discussion

For the powdered activated carbon, it was found that the percentage of dye removal was not affected by pH variation. The uptake of the dyes was nearly 100% for all pH values. Figure 1 shows the variation of dyes removal for different adsorbents at various pH values.

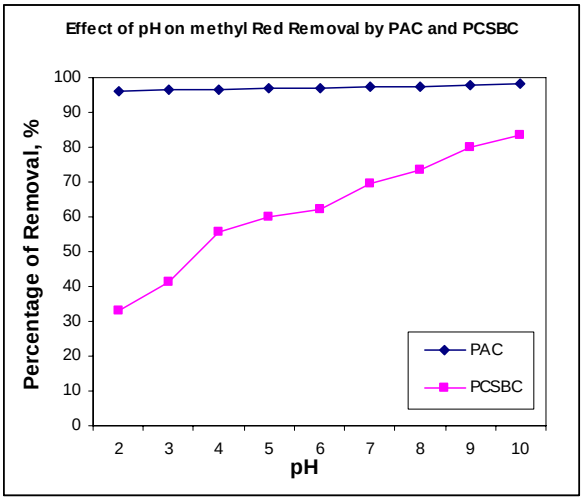

Fig 1

For the sulphuric acid treated bagasse (PCSBC), the dyes adsorption was significantly change over the pH value of 4 to 7. The lowest percentage of dye removal was recorded at pH 2 (52.2%). At the pH range 7 to 10, the percentage of removal was almost remains constant.

As the pH of the solution decrease (more acidic), the number of negatively charged adsorbents site increased. This will not favour the adsorption of the positively charge dyes cation. [4]. this, however didn't applied to PAC, as it was remained almost 100% for all pH values.
There might be another mode of adsorption, such as ion exchange. As the pH value increased from 9 to 13, the efficiency of the dyes removal is slightly become lessen [1].

Conclusion

The removal of methyl red from simulated wastewater by using PAC and PCSBC has been investigated for a various pH values. This study had shown that PCSBC had a lower adsorption efficiency compared to PAC at any given pH value. Initial dyes concentration over the range of 2 to 6, decreased the efficiency of the dyes removal. While, the pH range 7 to 10 is optimum for the dyes removal for PCSBC adsorbents. As sugarcane bagasse is easily available in the countryside, it has potential to be used for the small scale industries which produced dyes as their effluent, after it was being pretreated with formaldehyde and sulphuric acid. The data maybe useful for designing and fabrication of an economically cheap treatment process using batch or stirred tank flow reactors for the removal of methyl red from diluted industrial effluent.

References

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