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Timber Waste as a Low Cost and Effective Biosorbent for the Removal of Congo red Dye

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ABSTRACT
Congo red is an organic compound. It is an azo dye. Congo red is a water-soluble compound yielding a red colloidal solution. It is a major water pollutant of the textile industry and has its adverse affects on the aquatic life due to its carcinogenic properties. This dye is very difficult to degrade and has a harmful affect on the human beings. Being an azo dye it can remain in the water bodies for a longer period of time. Hence the removal of this dye is necessary. For the removal of this dye the waste of timber (mixture of bark leaves wood of various plants and trees) is taken up. It helps in the management of the solid waste material as the timber waste is used up for the removal of this dye from water. The timber waste which is easily available and has also been found to be effective in the removal of the Congo red dye due to its good adsorption tendency. The Congo red dye aqueous solutions are used in different concentrations. The Freundlich and Langmuir adsorption isotherms have been verified by the experimental data. The Adsorption studies were done at room temperature.
Keywords: Congo red, Adsorption, Adsorption isotherms, Bioadsorbents, Timber waste.

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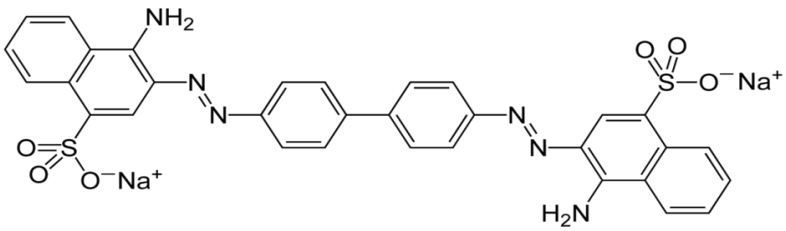
I. INTRODUCTION

Congo red is an azo dye which is an organic pollutant. This dye is water soluble yielding a colloidal solution and its solubility is greater in organic solvents. This dye due to its carcinogenic properties must be removed from water. Due to its solubility in water it can be removed by the adsorption techniques such as synthetic adsorption through readymade activated carbon, biosorbents etc[1 2 3]. The timber waste in nature acts as a good adsorbent because in this waste we can come across various plant parts like roots, barks, leaves which have a high amount of carbon which is the main component of adsorption. Today these Bioadsorbents are found to be very attractive and are in high demand because of their availability and their effectiveness in the removal of the dyes present in the water; they are also in demand because they are of less cost compared to the synthetic adsorbents. In this study the identification of timber waste as a biosorbent is made by the adsorption studies of Congo red by using this timber waste as an adsorbent. The experimental data is verified by the Freundlich and Langmuir isotherms. The structure of the Congo red [4] is given below.



II. MATERIALS AND METHODS:

The adsorbate which is the Congo red dye is taken in 5×10^{-5} M aqueous solution; this is prepared as the stock solution. This stock solution is made into various dilutions and is taken up for the adsorption studies. The timber waste is collected from a local saw mill and is washed , dried , powdered finely, sieved for its uniformity and is stored in separate containers which are air tight.

III. EXPERIMENT:

In this study the different dilutions of the stock solution of the Congo red dye was made. This

is used up for the testing of the adsorption characteristics of the adsorbent. The amount of adsorbent used was 0.5gms/0.5ml of adsorbate. After a duration of 24hrs the adsorbate is filtered and the filtrate is collected and its optical density (O.D) values were determined at 25^0C and at $\lambda_{maximum}$=510nm to check the discoloration. Beer's law is also verified and the calibration curve using Congo red dye is shown in Fig 1.

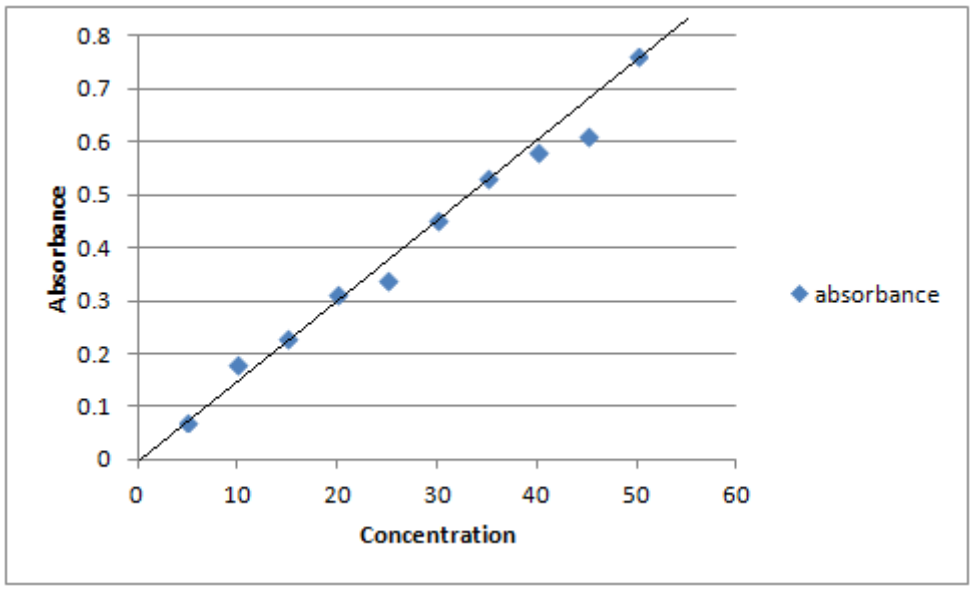


Fig.1: Calibration curve

IV. RESULT AND DISCUSSION

The adsorption properties of the timber waste have been studied by using the Freundlich and Langmuir adsorption isotherms. The Freundlich adsorption isotherm equation is

$$\log \frac{x}{m} = \log k + \frac{1}{n} \times \log Ce.$$

The Langmuir adsorption isotherm is valid for monolayered adsorption onto a surface with a finite number of identical sites. Langmuir adsorption equation is

$$\frac{Ce}{x/m} = \frac{1}{k_1 k_2} + \frac{Ce}{k_2}$$

Where 'k_1' and 'k_2' are Langmuir constants. The Freundlich adsorption isotherm using timber waste as an adsorbent for the removal of Congo red dye yielded a straight line with an intercept and the graph is presented in Fig 2. log k value is found to be 1.5 and the value of 'n' is 2.6 The graph between Ce/x/m on y-axis and Ce on x-axis yielded a straight line with an intercept which is in accordance to the Langmuir adsorption isotherm. The Langmuir constants are calculated from the graph and the values of k_1 and k_2 are found to be 0.125 and 1 respectively. The Langmuir plot is shown in Fig 3.

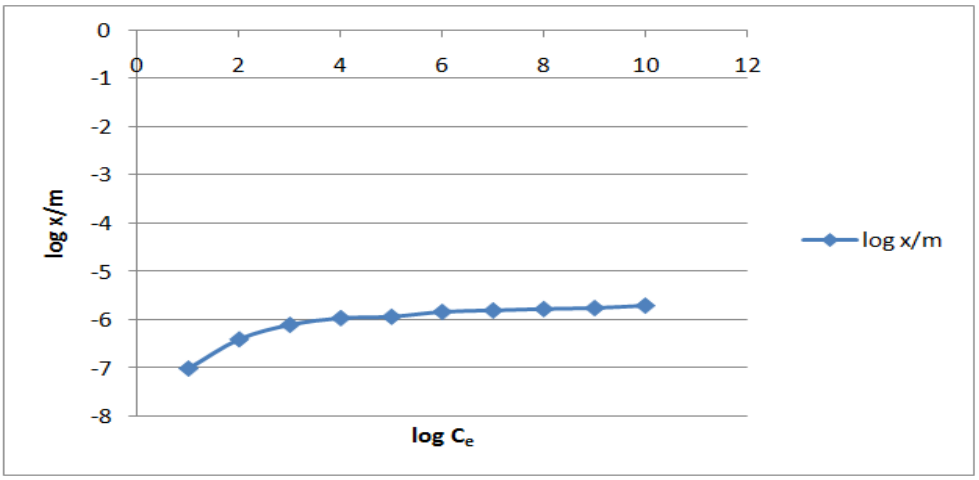


Fig 2: Freundlich adsorption isotherm

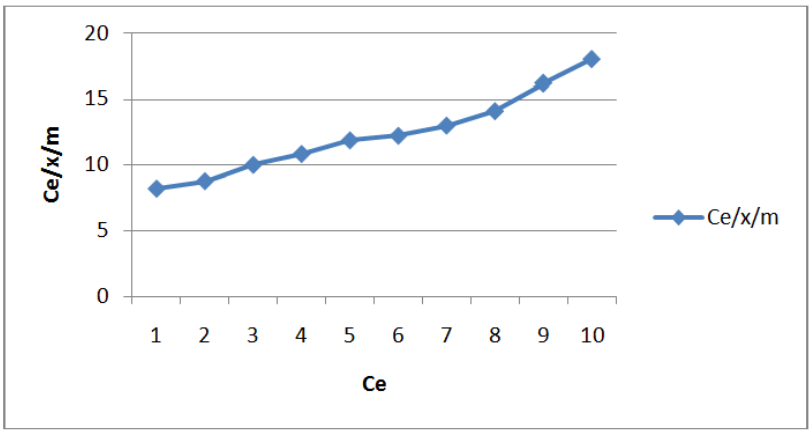


Fig 3: Langmuir adsorption

V. CONCLUSION

The results obtained for the studies of adsorption properties of the timber waste are in agreement with the Langmuir and Freundlich adsorption isotherms. The value of 'k_1' and 'k_2' obtained from the Langmuir adsorption isotherm suggest the Timber waste has a maximum adsorption potential for Congo red.

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