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REMOVAL OF RHODAMINE B DYE BY ADSORPTION TECHNIQUE USING NATURAL ADSORBENTS OF PLANT ORIGIN

***S. Priscilla Prabhavathi, Ranjith, Shameela Rajam, Maruthamuthu**

PG & Research Department of Chemistry, Bishop Heber College (Autonomous), Tiruchirapalli 620 017, Tamilnadu India.

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***Correspondence for Author**
Dr. S. Priscilla Prabhavathi
PG & Research Department of Chemistry, Bishop Heber College (Autonomous), Tiruchirapalli Tamilnadu India.

ABSTRACT

Due to industrial revolution, number of industries have increased enormously in recent years. These industries discharge industrial waste water into the aquatic systems affecting flora and fauna, which in turn affect animals and human beings as these effluents contain many dissolved synthetic dyes. Some of the Industries like textile industry, tanning industry, paper industry, food industry and chemical industry using (or) manufacturing compounds like Rhodamine B and methylene blue. These are very harmful for living organisms and aquatic life. Due to the leaching of dyes, ground water gets contaminated by using these dyes unknowingly and get accumulated in the liver and kidney of animals and human beings. In the present work, It is planned to conduct batch mode adsorption study by colorimetric method for the removal of Rhodamine B from waste water using Neem seed powder (NSP) and Jamun seed powder (JSP) as adsorbents.

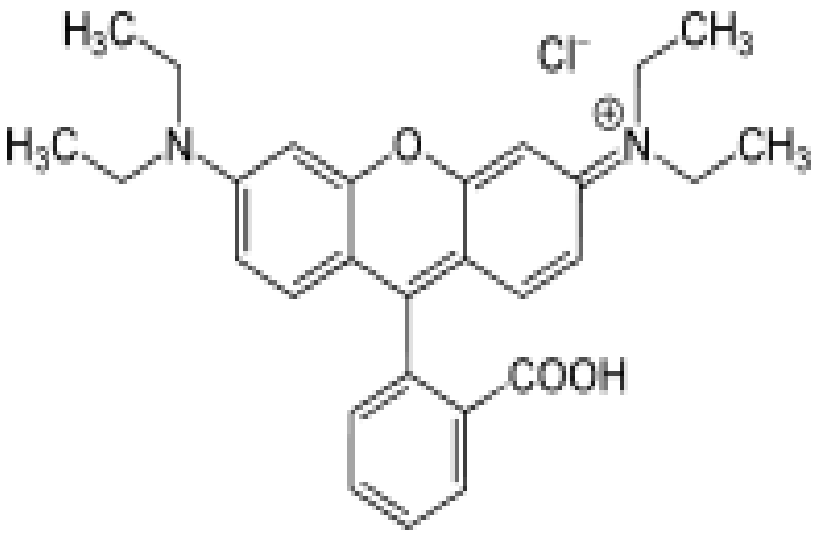
KEYWORDS: Dyes, Rhodamine B, Neem seed Powder (NSP), Jumble Seed Powder (JSP), Adsorption and Waste water.

INTRODUCTION

Nowadays, one of the most severe environmental problems is water pollution. The presence of coloured compounds in wastewater is not only aesthetically displeasing [1], but also hinders light penetration in water, increasing the biological oxygen demand and causing lack of dissolved oxygen to sustain aquatic life. Conventional methods for the removal of dyes in effluents include physical, chemical, and biological processes [2]. Adsorption is generally considered to be an effective method for dye removal, and the most widely used adsorbent is

activated carbon [3]. However, it suffers from high cost production and regeneration [4]. Due to this, a search for cheap and effective adsorbents is needed. Unlike activated carbons, clays are relatively cheap due to their accessibility and abundance [5]. Therefore, there is an increasing demand for porous materials as adsorbents and catalysts supports. The great potential for the retention of micro pollutants such as heavy metals cations and dyes [6]. Rhodamine B, which has a , [9-(2-carboxyphenyl)-6-diethylamino-3-xanthenylidene]-diethylammonium chloride unit-cell formula, is the Neem seed powder and Jumble Seed Powder with a microfibrous structure and has a theoretical high surface area and high chemical and mechanical stability. Diffusion of the adsorbate in the liquid phase is not as fast as in the gas phase, and so, the adsorbent particle size may influence adsorbate mass transfer [7]. Adsorbents with a small particle size are preferably used for adsorption from solution phase because they present in a large surface area and a small diffusion distance. However, considerable effort may be required to achieve small particle sizes. The present work is aimed to study the adsorption capacities of the adsorbents, Neem seed powder (NSP) and Jumble Seed Powder (JSP) for Rhodamine B removal from aqueous solutions [8]. Batch mode studies were conducted on a laboratory scale using synthetic dye solutions prepared from commercial dye. The scope included the study of surface modification and particle size neem seed powder and Jumble Seed Powder as well as, pH, and contact time [9].

Rhodamine-B



[9-(2-carboxyphenyl)-6-diethylamino-3-xanthenylidene]-diethylammonium chloride.

MATERIALS AND METHODS

Preparation of Doubly Distilled Water

Double distilled water is prepared by distilling distilled water over Sodium Hydroxide and Potassium permanganate solution in glass Pyrex apparatus.

Preparation of Stock Solution

125mg of Rhodamine B power was accurately weighed. It was dissolved in 250ml standard flask and it was made up to the mark using double distilled water. After that 200ml of this solution is pipetted out into an one litre standard flask and made up to the mark using double distilled water.

Standard Calibration Curve

100ppm of the dye solution was prepared. Solutions of various concentrations, 1 ppm to 10ppm were prepared in 50ml smf by diluting the stock solution. The colorimeter was calibrated using blank solution. The Optical density of each solutions were determined using a spectrophotometer at a wave length of 540nm. Now the concentration was plotted against optical density. A straight line curve is obtained.

Preparation of the Adsorbents

1. The ripe fruit pulp is removed from the seed as soon as possible. The seeds are then laid out in a thin layer in the sun to dry out for a few days. The dried seeds are stored in containers with plenty of air to stop mould growing, such as baskets or sacks. The shells have to be removed using stones or a big mortar. The loose shells can then be removed by winnowing in the same way as with cereals. The kernels are then ground in a miller in a mortar [10].

Effect of Ph

Adsorption experiments were carried out at pH 1- 10. The acidic and alkaline pH of the medium was maintained by adding the required amounts of dilute HCL and NaOH. All other factors were kept constant while carrying out of the experiments [11]. The pH meter was calibrated with 4.0 and 7 buffers.

Effect of Initial Concentration of Dye

In order to determine the rate of adsorption, experiments were conducted with different initial concentrations of dyes [12].

Effect of Adsorbent Dosage

Various doses of the adsorbents were mixed with dye solutions and the mixture was agitated in a mechanical shaker. The adsorption capacities for different doses were determined at a definite time interval [13].

Effect of Contact Time

The effect of period of contact on the removal of the dye on adsorbent in a single cycle was determined by keeping particle size, initial concentration, dosage, pH and concentration of other ions constant [14].

RESULTS AND DISCUSSION

Batch mode adsorption studies were conducted and the optimum conditions were determined by varying the pH, concentration, dose of the adsorbent, time and temperature using of adsorbents dried neem seed powder and jumble seed powder.

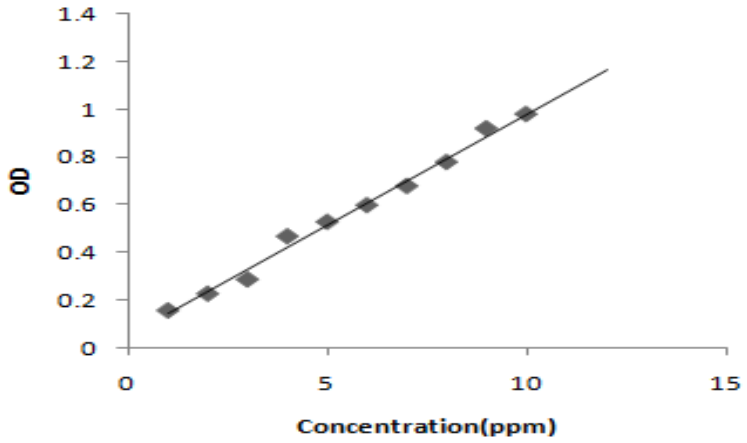


Fig – 1 Standard Graph for Rhodamine – B

Effect of Ph

Numerous studies have clearly demonstrated that the pH of the solution is the dominant parameter in controlling the adsorption process on to the adsorbent [15]. Hence, the influence of pH of the solution in the removal of dye was examined initially and the optimum pH for the adsorption study was determined by conducting experiments at various pH from 1 to 7.

Name of the adsorbent - Neem Seed Powder (NSP) and Jumble Seed Powder (JSP)
Initial Concentration - 10ppm
Shaking Time - 60mins
Weight of the adsorbent - 5g
Temperature - Room temperature

The maximum adsorption of dye on the adsorbent was found to be at pH 2 (fig-2) for dry Jambul seed powder (NSP) and at pH 4 (fig -3) for dry Neem seed powder.

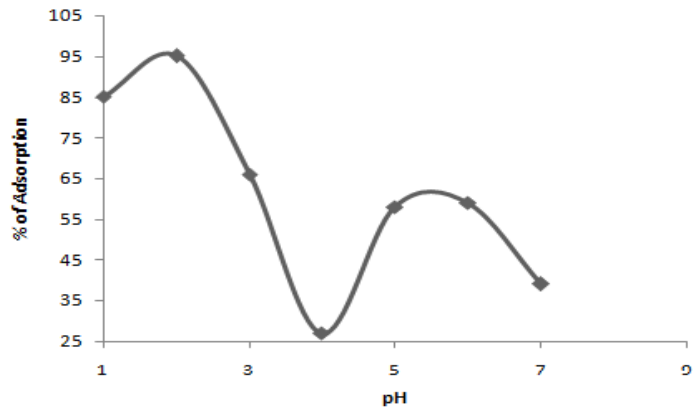


Fig-2

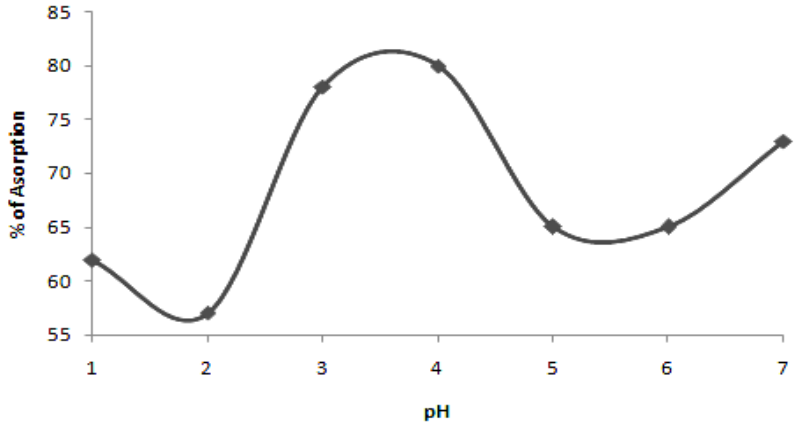


Fig-3

Hence, the experiments were carried out at pH 2while using jambul seed powder and pH 4 while using Neem seed powder (NSB). The maximum adsorption percentage with dry jambul seed powder is found to be 95% and that with Neem seed powder is found to be 80% at the optimum pH.

EFFECT OF CONCENTRATION

The uptake of Rhodamine B by the adsorbent Jambul seed powder(JSP) shows a constancy of about 90%, when the concentration of the dye solution is increased from 10ppm to 60ppm at the optimum pH 2 [16]. In the case of Neem seed powder (NSP) adsorbent at pH 4, the percentage of adsorption ranges between 78 and 82% when the concentration is increased from 10 – 60 ppm (Fig -4 and Fig -5).

Name of the adsorbent = Jambul Seed Powder (JSP) and Neem Seed Powder (NSP)

Shaking Time = 60mins

Weight of the adsorbent = 5g

pH of the dye solution = 2 (JSP) and 4(NSP)

Temperature = Room temperature

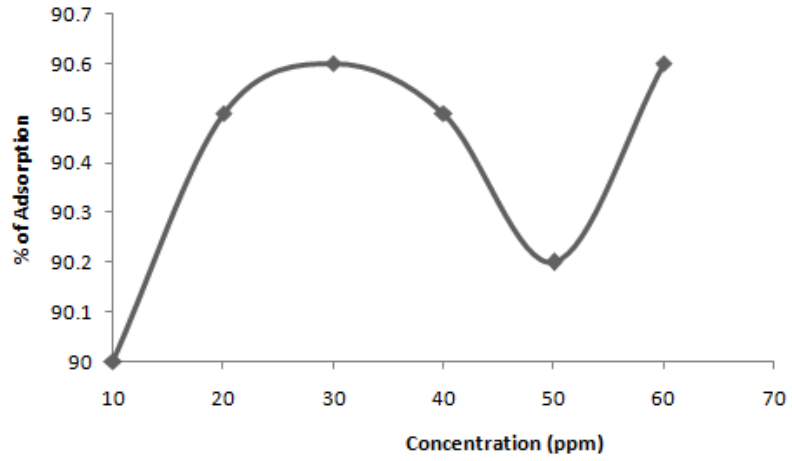


Fig-4

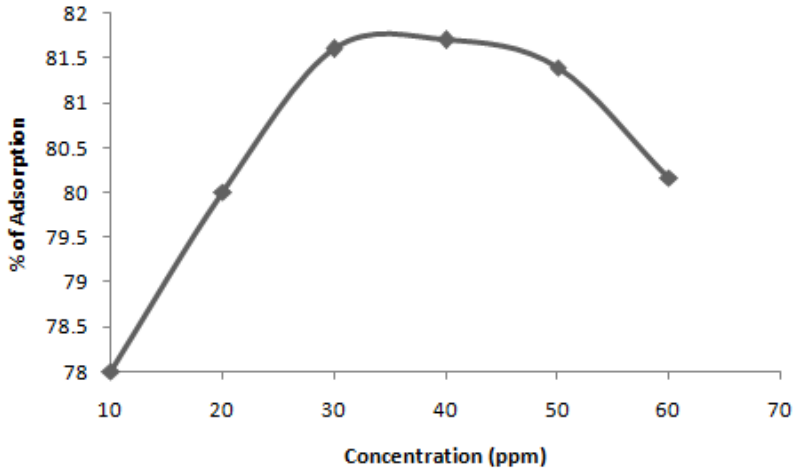


Fig-5

INFLUENCING THE ADSORBENT DOSE

The effect of dose of the adsorbent was examined by conducting batch mode experiments at pH 2 for Jambul seed powder(JSP) and at pH 4 for Neem seed powder(NSP) at room temperature and at an initial concentration of 10ppm dye solution with various doses of the adsorbents (i.e.) 0.25, 0.5, 0.75, 1.00, 1.25, 1.50 g. The agitation speed and the size of the particles were kept constant [17].

Name of the adsorbent - Jambul Seed Powder (JSP) and Neem Seed Powder (NSP)

Shaking Time - 60mins

pH of the dye solution - 2(JSP) and 4 (NSP)

Initial Concentration - 10ppm

Temperature - Room temperature

The study showed that there is a significant increase in the percentage removal of the dye on increasing the adsorbent dose from 0.25g to2.0g. The maximum dye removed was found to be 92% with jambul seed powder (JSP) and 62 % with Neem seed power (NSP) (fig-6) and (fig-7). It was suggested that this increase is due to the increase in the availability of the binding sites [18].

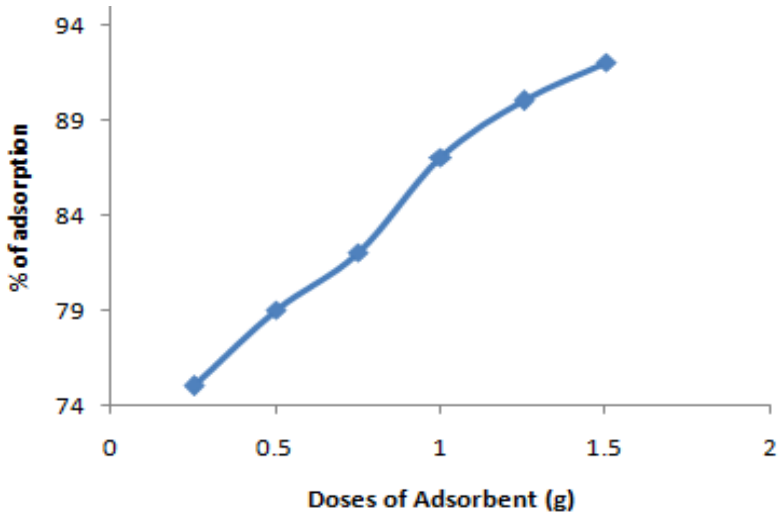


Fig-6

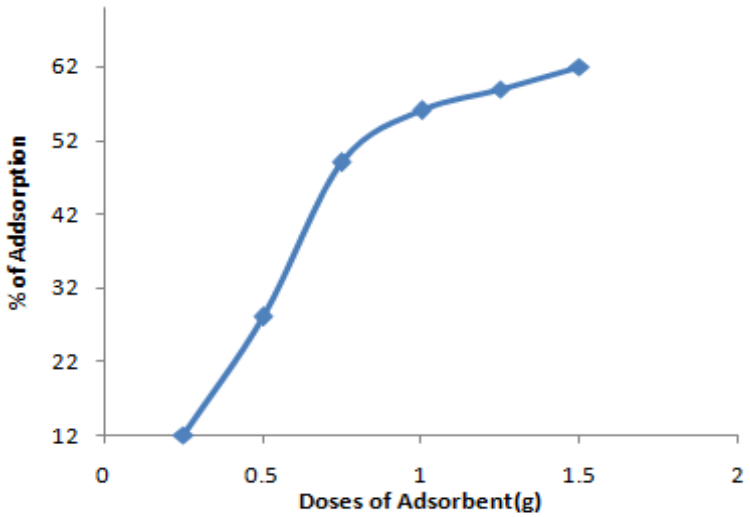


Fig-7

INFLUENCE OF TIME

The contact time is a function of both the nature of adsorption and its pore structure. The study shows that the removal of Rhodamine B from its solution by the Jambul seed powder increases with time till equilibrium is reached [19]. The fig. 8 shows that a maximum of 92% adsorption has take place in 45 minutes at the optimum pH and at room temperature. No considerable adsorption is observed after this time.

Name of the adsorbent = Jambul Seed Powder (JSP) and Neem seed powder (NSP)

pH of the dye solution = 2(JSP) and 4(NSP)

Initial Concentration = 10ppm

Weight of the adsorbent = 0.25g

Temperature = Room temperature

In the case of Neem seed powder, the uptake of dye by the adsorbent is found optimum at 60minutes, a gradual and small increase [20] in the adsorption percentage is observed. Hence 60 minutes is considered to be equilibrium time in the case of Neem seed powder (NSP) [21]

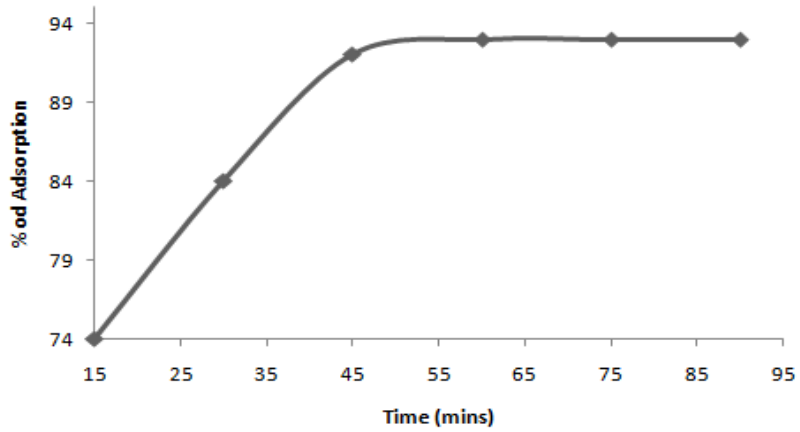


Fig – 8

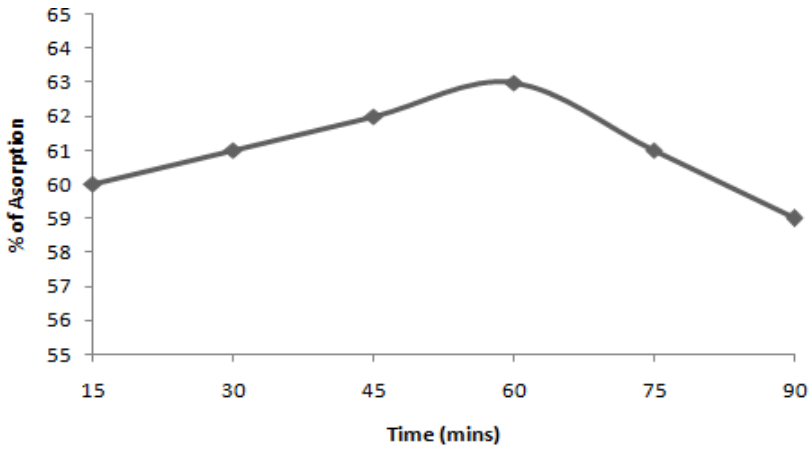


Fig-9

INFLUENCE OF TEMPERATURE

Temperature has an important effect on the adsorption process. As the temperature increases, the rates of diffusion across the external boundary layer and interval pores of the adsorbent particles increase. Change in temperature will change the equilibrium capacity of the adsorbent for a particular adsorbate [22].

Name of the adsorbent = Jambul Seed Powder (JSP) and Neem Seed Powder (NSP)

pH of the dye solution = 2 (JSP) and 4 (NSP)

Initial Concentration = 10ppm

Weight of the adsorbent = 0.25g

Shaking time = 60mins

Figures (10 and 11) shows the effect of temperature of Rhodamine B on Jambul seed powder and neem seed powder. The removal of the dye on the adsorbents increases upto 93% and 83%, when the temperature increases from 30 to 50C indicating the process to be endothermic.

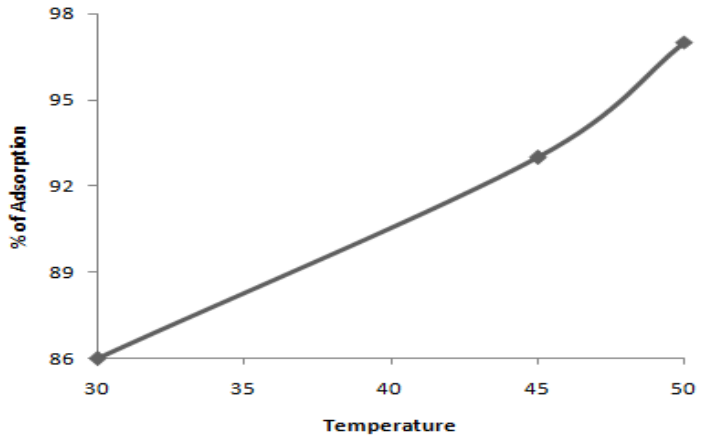


Fig – 10

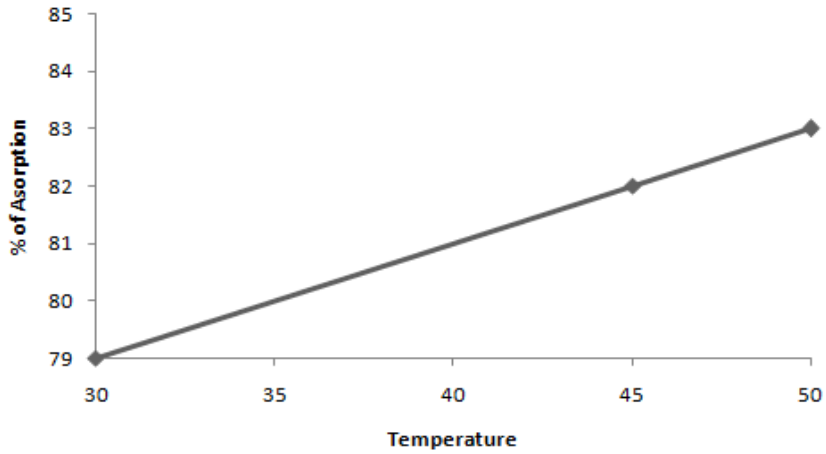


Fig-11

CONCLUSION

In the present work the investigator has chosen adsorption technique for the removal of Rhodamine B dye from waste water using neem and jambul as adsorbents. It is found that neem (NSP) and jambul (JSP) are good adsorbents having high adsorptive capacity.

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