Comparative Adsorption Studies on Removal of Congored Dye From Aqueous Solution using Rice Husk and Ipomea Palmate Leaves

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Abstract

A comparative study on removal of congored dye has been carried out by adsorption method using Rice husk and Ipomeapalmate leaves. This paper presents the results of studies carried out on sorption of congoreds from aqueous solutions by rice husk and ipomea palmate leaves as a sorbent. It was found that ipl possess relatively high sorption capacity, when compared with other sorbents.. The adsorption experiments were performed under various conditions such as different initial concentrations, pH, adsorbent concentration and solution Temperature. It was found that the equilibrium of the process was reached after 165 min. The optimum pH value was found to be 6. The experimental equilibrium data were adjusted by the adsorption isotherm Freundlich model, and its equilibrium parameters were determined.

Keywords: Adsorption; ipl; Rice husk and isotherms.

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1. Introduction

Dyes and pigments have been used in many industries for coloration purpose. Textile industry is one of the prominent polluters releasing high concentrated effluent into the surrounding environment. Dyes contain carcinogenic materials which can pose serious hazards to aquatic life and end users of the water. The effluents from textile, leather, food processing, dyeing, cosmetics, paper and dye manufacturing industries are important sources of dye pollution [1]. Many dyes and their breakdown products may be toxic for living organisms [2]. Therefore, decolorization of dyes is important aspect of wastewater treatment before discharge. It is difficult to remove the dyes from the effluent, because dyes are not easily degradable and are generally not removed from wastewater by conventional wastewater systems [3]. Adsorption process have potential for removing dyes from water due to their high efficiency and ability to separate a wide range of chemical compounds [5,6]. The object of this paper has been to evaluate the efficiency of removal of Congo red using Rice Husk and Ipomea Palmate Leaves. The performance analysis was carried out as function of various operating parameters, such as initial concentration of dye, adsorbent dose, pH, Temperature, and contact time. The data analysis showed that the adsorption of congo red followed Freundlich isotherm and well fitted with the adsorbent ipomeanalmate leaves than the Rice husk.

2. Materials and Methods

2.1 Preparation of Adsorbent Rice Husk and Ipomea Palmate Leaves

Adsorbents Rice Husk and ipomea palmate leaves collected from rice mills, near by canal, Tenali respectively. Initially the both adsorbents were washed thoroughly with distilled water. Later adsorbents treated with sodium hydroxide and washed with distilled water for 2 to 3 times to remove the impurities over them. After through washing with distilled water, adsorbents were sun dried for ten days until they became crispy, cut into small pieces, powdered and sieved. The finally obtained particles of Rice Husk and Ipomea Palmate were stored in air tight bottles until required.

2.2 Preparation of Congo Red Solution

Mother solution of Congo Red concentration 1000 mg/l was prepared by dissolving 1 gram of Congo Red powder in 1000 ml of distilled water .The mother solution was then diluted to get the test solution of desired Congo Red concentration varied between 10 to 30 mg/L.

3 Batch Adsorption Studies

3.1 Effect of Contact Time

3.2 Effect of Initial Concentration

To study the effect of Congo Red concentration 0.1 grams of IPL is added to 50 ml of stock solution of Congo Red concentration 0.01g/l and is kept for shaking for optimum time then the procedure is repeated at pH 7 with 50 ml of stock solution with different

initial concentrations 0.01, 0.015, 0.02, 0.025, 0.03 g/L keeping the agitation speed and room temperature constant then the samples were filtered from adsorbent and they are analyzed for Congo Red concentration. The above said procedure was adopted for the adsorbent RH also and analyzed the congo red concentration.

3.3 Effect of Adsorbent Dose

The effect of adsorbent dosage on the amount of Congo Red adsorbed was obtained by agitating 50ml of Congo Red solution of 0.01 g/L separately with 0.1,0.15, 0.2, 0.25 and 0.3 grams of adsorbent at room temperature for optimum shaking time at constant agitation speed, maintaining the pH 7. The filtered solution of Congo red concentration was analyzed for the both adsorbents.

3.4 Effect of pH

To determine the effect of pH the stock solutions of concentration 0.01g/L with pH=7,sulfuric acid was added in order to reduce the pH value to 2, 4, 6 and Sodium hydroxide base was added to increase the pH up to 10. After setting the pH of the ranges 2, 4, 6, 8, 10, 50ml stock solution was taken into each flask witht 0.1g IPL was added and allowed to undergo shaking for 165min. After filtration solution of Congo red concentration was analyzed for the both adsorbents separately.

3.5 Effect of Temperature

To know the effect of Temperature 50ml of 0.01g/L stock solution was added to 0.1 gram of adsorbent and it was kept for shaking for the optimum time. The procedure was repeated with different temperatures from 283K to 323K for both the adsorbents. Further the sample was filtered and analyzed for concentration of Congo Red.

3.6 Adsorption Isotherms

Adsorption isotherm is basically to describe how solutes interact with adsorbents. Adsorption isotherm study is carried out well-known isotherm Freundlich. The application of the isotherm equation is compared by judging the correlation coefficients R^2 . Isotherm is useful for estimating the total amount of adsorbent needed to adsorb a required amount of adsorbate from solution.

Freundlich Equation:
$$Logq_e = LogK_F + nLogC_e$$
 ⁽¹⁾

Where q_e is the amount adsorbed and C_e is the equilibrium concentration of the adsorbate (g/L). n is the Freundlich constant. While K_f is the Freundlich constant related to adsorption capacity.

4. Results and Discussion 4.1 Effect of contact time



Fig.1. Effect of contact time on adsorption of C.R onto RH and IPL.

From the Fig.1 The data obtained from the adsorption of Congo Red on to rice husk and ipomea palmate leaves showed that a constant time of 180,165 minutes respectively was sufficient to achieve equilibrium and adsorption did not change significantly with further increase of time.

4.2 Effect of Concentration



Fig.2. Effect of concentration on adsorption of C.R onto RH and IPL.

The study has shown that the percentage of dye removal (58% for RH and 62% for IPL) was high at initial concentration 0.01g/L at an agitation time 180min. There fore It was found that from Fig.2. There is a decrease in % dye removal with an increase in concentration due to the adsorbent cannot accommodate much more adsorbate available in the solution concentration.

4.3 Effect of Adsorbent Dose



Fig.3. Effect of dosage on adsorption of C.R onto RH and IPL.

From the Fig.3 It was observed that there is an increase in % dye removal with an increase in adosorbent weight for the both adsorbents due to increase in the surface area and availability of adsorption site with increase in the adsorbent dosage.

4.4 Effect of pH



Fig.4. Effect of dosage on adsorption of C.R onto RH and IPL

It can be seen from the Fig.4 that the percentage of dye removal was increased with an increase in the pH from 2 to 7, but there observed a decrease in dye removal for the pH 7 to 10 in the both adsorbents. As expected, the adsorbent surface acidity and basicity are strong functions of pH solutions.

4.5 Effect of Temperature



Fig.5. Effect of Temperature on adsorption of C.R onto RH and IPL

The effect of changes in the temperature on the adsorption of congored dye is shown in Fig. 5. It was noted that the % dye removal increase with increase in temperature from 283K to 313K thereafter there is mild increase in removal of congored dye.

Rice Husk		Ipomea Palmate Leaves	
LogC _e	Logq _e	LogCe	Logq _e
0.623	0.46	0.58	0.49
0.908	0.54	0.85	0.60
1.064	0.62	1.00	0.70
1.176	0.70	1.11	0.78
1.262	0.77	1.21	0.84

4.6 Adsorption Isotherms

Table 1 Freundlich Adsorption Data for Congo red



Fig.6. Freundlich Isotherm on adsorption of C.R onto RH



Fig.7. Freundlich Isotherm on adsorption of C.R onto RH

From the figures 6&7 It was found that the regression value $R^2 = 0.948$ for Rice Husk and 0.984 for Ipomea palmate Leaves and intercept $K_i=1.4$ and the regression value $R^2=0.950$.

5. Comparative Study and Conclusions

Table 2 Comparison of different adsorbents			
Type of Adsorbent	% Adsorption		
Ipomea Palmate Leaves	62		
Rice Husk	58		
Saw Dust	55		
Activated Carbon	54		
Coconut Shell	50		
Archas Sapota	44		
Sugarcane Baggase	40		
Tamarind Nut Shell	35		

From the above Table 2 [7-9] it is clear that percentage adsorption of Congo red from aqueous solution having concentration 0.01g/L on IPL,Rice Husk is more than that compared to different adsorbents (Saw dust, Activated carbon, Coconut shell, Archas sapota, Sugarcane baggase, Tamarind nut shell) adsorption capacity after undergoing a constant shaking of 180 minutes.

The experimental results were analytically discussed and the following conclusions were listed below from the solution of CongoRed using adsorption technique.

- The data obtained from the adsorption of Congo Red showed that a contact time of 180minute (RH),165minutes(IPL) was sufficient to achieve equilibrium.
- It was observed that the % adsorption of the Congo Red decreases with increase in the initial concentration of the aqueous solution for both adsorbents.
- It was observed that percentage adsorption increases with increasing temperature of the solution.
- The amount of adsorbate adsorbed increases with the increase of adsorbent dose.
- The experimental data satisfied with Frendlich isotherm and the adsorption coefficient agreed well with conditions of favorable adsorption.

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