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STABILITY AND AGITATION THERMODYNAMIC MODELING OF SORPTION OF ACID RED1 ON TO *BALSAMODENDRONCAUDATUM* WOOD WASTE ACTIVATED NANO CARBON

B. Sivakumar* Department of Chemistry, Angel College of Engineering and Technology, Tirupur, TamilNadu, India.*Corresponding Author

M.Vijayalakshmi Department of Chemistry, Nandha Engineering College, Erode,TamilNadu, India.

ABSTRACT The exclusion of Acid Red1 from aqueous solution by low-priced adsorbent such as Balsamodendroncaudatum wood waste activated Nano carbon (BANC) underneath dissimilar investigational environment was investigated in this work. The influences of initial Acid Red1 concentration (20-60 mg/L), and temperatures (30°, 45° and 60°C) and pH have been reported. Sorption of Acid Red1 is highly pH dependent and results indicate that the optimum pH 6.5 for the removal was found to be 99.4%. A comparison of kinetic models functional to adsorption of Acid Red1 on the adsorbent was evaluated for pseudo first–order, pseudo second-order and Elovich models, correspondingly. Results show that the pseudo second order kinetic model was found to compare the experimental data well.

KEYWORDS : BANC; Sorption; Acid Red1; kinetics; low-cost adsorbents; aqueous solution

INTRODUCTION

Fabric effluents are recognized toxicants, which impose acute disorders in aquatic organisms. Uptake of textile effluents through food chain in aquatic organisms may cause various physiological disorders like manic tension, periodic fever and renal damage etc, which are dangerous to human being as well as living thing physical condition. The lack of good quality water would lead to several harms affecting people and the other living entities, causing a threat to the fair environment.. Dyes are broadly employed in various industries like the cloth industry, paper and pulp industry, pharmaceutical, food industry, cosmetics, dyestuffs, etc, which are discharged in wastewater[1-3]. One of the major challenges associated with adsorption by activated carbon is its cost effectiveness. Hence research of recent past mainly focused on utilizing waste materials as alternatives to activated carbon. Bamboo[4] , sugar cane bagasse ash[5] ,fly ash [6] , peat moss[7], jujuba seeds[8], potatoes egg Husk[9] and chitosan and nano zerovalent iron composite [10] are some of the waste materials which have been fruitfully tried for this purpose.

1 EXPERIMENTAL

1.1Adsorbent

Balsamodendron caudatum wood waste was obtained from various regions of Erode & Tirupur Districts, Tamil Nadu, India. The study of *Balsamodendron caudatum* wood waste material is used as adsorbent is expected to be economical, environmentally safe and it has practical importance.

The above material was soaked well with H_2SO_4solution for a period of 24 hours. At the end of 24 hrs the excess of H_2SO_4 solution were decanted off and air-dried. Then the materials were placed in the muffle furnace carbonized at 120-130°C. The dried materials were powdered and activated in a muffle furnace kept at 800°C for a period of 60 minutes. After activation, the carbon of obtained were washed sufficiently with large volume of water to remove free acid, Then the obtained material was washed with plenty of water to remove excess of acid, dried then to desired particle size and named as BANC.

1.2 Preparation of aqueous dye solution

The stock solutions of the dye (1000 mg/L) were prepared by dissolving 1 g of respective dye in one litre of water without any further treatment, which were kept in dark coloured glass bottles. For batch study, an aqueous solution of this dye was prepared from stock solutions in deionized water. NaOH and HCl solutions were used as buffers for pH studies.

1.3Amount of dye adsorbed

The formula used to find the Amount of dye adsorbed, *Qe* , was as shown below:

$$Q_e = \frac{C_0 - C}{M} \times V \qquad (1)$$

Qe (mg/g) is the amount of dye adsorbed at equilibrium, *V* (L), isthe volume of the solution dye, *Co* (mg/L) is the initial dye concentration, *C* (mg/L) is the dye concentration at any time and *M* (g) is the adsorbent dosage.

1.4 The pseudo first – order equation

The pseudo first - order equation (Lagergren 1898) is generally expressed as follows.

$$\frac{dq_t}{dt} = k_1(q_e - q_t) \qquad (2)$$

where, q_e and q_t are the adsorption capacity at equilibrium and at time t., respectively (mg g^{-1}), k_1 is the rate constant of pseudo first –order adsorption (l min^{-1}).

1.5 The pseudo second – order equation.

The pseudo second – order adsorption kinetic rate equation is expressed as (Ho et al. 2000)

$$\frac{dq_t}{dt} = k_2(q_e - q_t)^2 \qquad (3)$$

2 RESULTS AND DISCUSSIONS

2.1 Characterization of adsorbent

Physico-chemical characterizations of the adsorbents were presented in Table 1.

Table 1 Characteristics of the Activated Carbon BANC

Parameter	BANC
pH	6.5
Surface area (m^2/g)	502
pH_{zpc}	4.5

The surface area of the BANC was measured through N_2 adsorption at 77K using a NOVA1000, Quanta chrome Corporation. The pH of BANC was measured by a PHS-3C pH meter. pH of zero charge (pHpzc) of the samples was determined using pH drift method . The surface area of the BANC obtained from the N_2 equilibrium adsorption isotherms was found to be 502 m^2/g. The results of "pH drift" experiment, from which the pHpzc of BANC studied in this test was found to be 4.5.

2.2 Effect of pH

From the set of experiments conducted to find the effect of pH on adsorption phenomenon, it was observed that pH influences BANC surface dye binding sites and the dye chemistry in water. Figure 1 shows the amount of dye adsorbed, q_e using acid activated absorbent at initial pH value. In this experiment, the initial dye concentration was fixed at 20 mg/L. From the shake flask experiments, better colour removal of the dye, Acid Red1, was observed at pH of 6.5 .The uptake of Acid Red1 was found to be optimal at pH 6.5 with the maximum dye uptake of 99.4 mg/g .

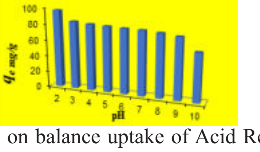

Fig. 1 contact of pH on balance uptake of Acid Red1 sorption onto BANC. M, 100 mg; V, 50 ml; C_0 20 mg/L; temperature, 30°C).

2.3 Effect of initial dye concentration and contact time

For conducting the kinetic studies, the dye is agitating at equal time intervals were used. Contact time experiments were carried out by agitating with 50 ml of dye solutions whose concentrations viz. 20 mg/L, 40 mg/L and 60 mg/L at an optimum pH of 6.5 with100 mg of BANC at room temperature. The speed of agitation was maintained constant at 250 rpm. The colour reduction profiles were obtained using the absorbance measurements.

2.4 Effect of Temperature on kinetic rate constant and rate parameters

Adsorption experiment was carried out with fixed initial dye concentration (20mg/L) at pH 6.5 and at different temperature viz. 30 °C. 45 °C and 60 °C. The analysis of the data in (Table 2) reveals that the influence of temperature of the dye has very little influence on the pseudo second order rate constants. The table 2 also reveals that the influence of the temperature of dye on Elovich and pseudo first order rate constant is neither appreciable nor little.It is obvious that the adsorption of dye on the BANC waste activated carbon is best described by first order rate equation with regression coefficient value is greater than 0.99.

Table 2 The adsorption kinetic model rate constants for BANC at different Temperature

Adsorbent	Initial Temperature	Pseudo first order		Pseudo Second order			Elorich Model		
		k_1 l min^{-1}	r^2	k_2 g mg^{-1} min^{-1}	h mg g^{-1} min^{-1}	r^2	β g min^{-1}	α mg g^{-1} min^{-1}	r^2
BANC	30^0C	0.0285	0.9977	0.0085	0.4654	0.9345	0.1134	0.8453	0.9134
	45^0C	0.0066	0.8880	0.0485	0.3678	0.3645	0.7645	0.5467	0.9557
	60^0C	0.0256	0.7054	0.0745	0.1332	0.6689	0.0967	0.4238	0.9243

3 CONCLUSIONS

Adsorption of reactive dye on the BANC was found to be dependent on the pH, (The optimal pH of Acid Red1 was 6.5), temperature and concentration for adsorbent. Thermodynamic parameters obtained for the adsorbent accounts for feasibility of the process at each concentration. Adsorption equilibriums were reached within 105 min contact time for reactive dye used in this test. The kinetics of Acid Red1 adsorption on adsorbent was found to follow a pseudo first -order rate equation.

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