Adsorption Dyes in Aqueous Solutions by Activated Carbon-Based White Wood

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Abstract: Among the dyes, the blue disperse and reactive orange have well recognized toxicities and dissemination facilities in the different compartments of the environment. Various regulations set maximum permissible levels of these dyes in both drinking water and industrial discharges. In order to comply with these various standards, many depollution techniques have been developed in recent years. Our choice is to carry out the adsorption of activated carbon based wood because this adsorption has main advantages of being more effective and easy to implement. Furthermore, the use of less expensive non-conventional adsorbents guarantees its economic feasibility. However, this elimination is affected by several parameters related to the carbon atom, to the solution and the active suspension. The adsorption results for Disperse Blue and orange reactive with activated charcoal showed adsorption capacity up to 4.8 mg / g and 12.4 mg / g. The study showed that the adsorption of activated carbon prepared from wood is more effective for the removal of these two wastewater dyes.

Keywords: Activated carbon, dispersed Blue, Orange reagent, adsorption, waste water.

1. INTRODUCTION

In the textile industry various dyes are used. An important part is located downstream of the process circuits, in a discharge. These have varying degrees of harmfulness or high toxicity. This pollution is particularly dangerous because it is poorly understood. To fight against this dissolved pollution, research has been directed toward acceptable economic procédées by their low cost, using several techniques: adsorption on different materials [1-5], membrane filtration [5].

The removal of dye adsorption is considered one of the most adopted methods [3,4]. Industrially, the activated carbon is commonly used as adsorbent in the extraction of colored species in the liquid phase due to its excellent adsorption capacity, this capacity is related to its high surface area and porosity [1].

The valuation of useful substances (clay, sand, wood ...) is a major theme of research [2]. In this work, we study the use of charcoal made from wood mills in order to launder liquid discharges.

2. RÉSULTATS ET DISCUSSIONS

2.1. Characterization of Two Dyes Studied

A proper dye is a substance that has two specific independent properties to each other, the color and the ability to be fixed to a support such as a textile.

Table 1: Class of Dyes and Chemical Types (Zawlotzki, 2004)

Class	substratum	Application Method	chemical type
Scattered	Polyester, polyamide, acetate, acrylic and plastic	often fine aqueous dispersions applied by methods at higher pressure and temperature or at a lower temperature; the dye is fixed on the tissues thermally.	Azo, Anthraquinones, styryl group, nitro, benzo difuraones
Reagent	Cotton, wool, silk and nylon	Sitréactifs the dye reacts with the functional group on the fiber to form a covalent bond under the influance temperature and alkaline conditions.	Azo, anthraquinones, phthalocyanine, formazone and oxacin

2.1.1. Classes of Dyes and Chemical Types Studied

Synthetic dyes are of various nature and structure. The most frequently used chemical classes on an industrial scale are the azo compounds, anthraquinones, sulfur, indigo, triphénylmethyls, and phthalocyanines. However, it was stressed that the overwhelming majority of synthetic dyes currently used in industry are azo. The table below summarizes chemical structures and methods of application classes dyes studied in dye baths on substrates.

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2.1.2. Determination Lengths Maximum Adsorption Wave

To determine the maximum wavelength of absorption of both blue dye and reactive dispersion orange studied, we studied curves showing the optical densities OD at different wavelengths λ. The reference used is a solution of distilled water.

The curves shown schematically in Figures **1** and **2** are used to indicate that the values of the peak wavelength for the blue dispersion (BD) and the reactive orange (OR) are 568 nm and 493 nm respectively.

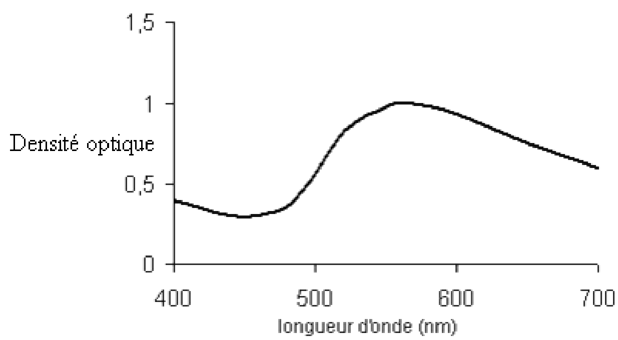

Figure 1: the peak wavelength of BD.

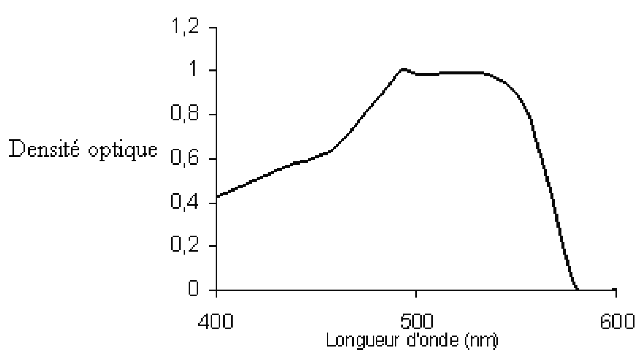

Figure 2: the peak wavelength of OR.

2.1.3. Determination of Calibration Curves

We plotted the calibration curves that give optical densities OD at different concentrations of both and dispersed orange reactive blue dye in water to lengths of respective maximum waves. Figures **3** and **4** show the calibration curves of the two dyes studied. The equations of these two curves are as follows:

*For blue disperses: OD = 0.012 + 3.877 C 10-4;

*For the reactive orange: OD = 0.015 C;

The treatment of activated carbon adsorption colored waters is influenced by the pH of the medium, the stirring time and the amount of activated carbon used.

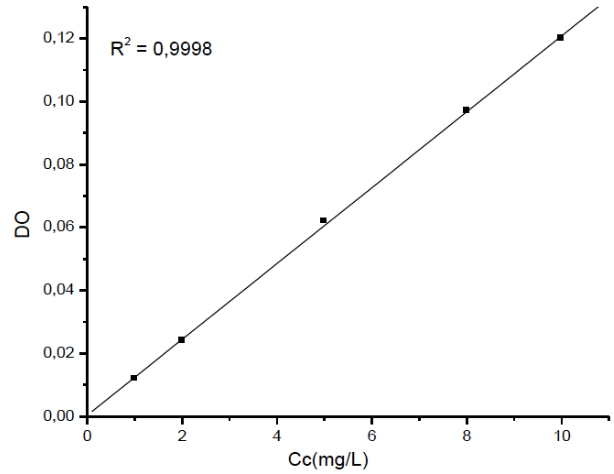

Figure 3: Calibration curve OD = f (C) BD.

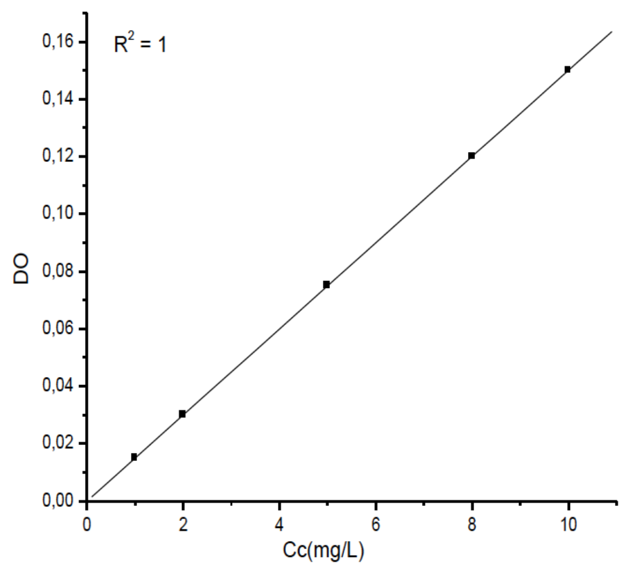

Figure 4: Calibration curve OD = f (C) BD.

2.2. Effect of pH on the Adsorption of Dyes

The adsorption of BD and OR by CAB was studied in a field caught between pH 0.6 and 12 at room temperature, the initial concentration of the dye is 20 mg / L, the adsorbent mass is set to 0 2 g per 50 ml of the dye solution and the stirring time is 60 minutes.

The two curves of Figure **5** reflect the variation in BD-adsorbing capacity and OR adsorbed by CAB depending on pH. These results show that the acid pH favors adsorption, since its capacity is maximum, 4,28mg / g for BD and 4,065mg / g OR, pH = 1.2 for the two dyes. While at basic pH adsorption is unfavorable [8].

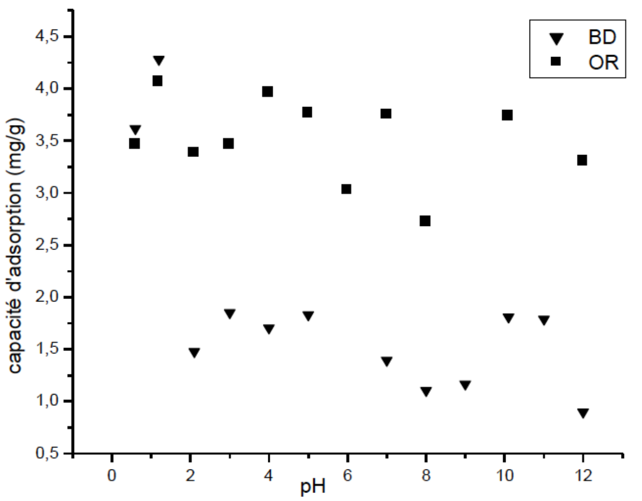

Figure 5: Effect of pH on the adsorption of BD and OR by CAB m = 0, 2g. C0 = 20mg / L, t = 1 hour, V = v = 50mL and 150 r / min.

The pH of the solution influences the adsorbent surface, thus that the degree of ionization of pollutants. The hydronium ion H_3O^+ and OH^- hydroxide ions are strongly adsorbed and influences the adsorption of other ions. The change in pH has a great effect on the adsorption process, during the attachment of the functional group of the dye on the active sites of the adsorbent surface. This influences thereafter the reaction kinetics and adsorption equilibrium characteristics.

In the aqueous solution, the two studied dyes are dissolved and converted to the anionic ions. For the acid pH, high rate of adsorption is due to strong electrostatic attractions between the positive charge of the adsorbent surface and the negative charge of the anionic dyes. To the basic pH, there is competition between the OH^- ions and the anions of OR and BD dyes for adsorption sites [8].

2.3. Study the Adsorption Kinetics

In Figure **6**, we reported the adsorption curves obtained at room temperature for initial concentration solutions of 20mg / l, Q is the amount of the dye adsorbed in mg per gram of CAB.

The results showed that the BD dye is not completely removed during the time for the mass of 0.2 g of CAB used. The retention increases BD 4.018 mg / g to stabilize at 4,40mg / g. Against by the OR dye is strongly adsorbed. At first, the retention increases OR of 3,94 mg / g and subsequently Revenue Is it a step to stabilize at 4,97 mg / g.

The increase observed at baseline may be due to the fact that the adsorption is initially controlled by mass transfer, this transfer ensures diffusion of molecules of the dye to the grain surfaces of the cabinet through a liquid film surrounding the particles adsorbent. And stability of retention may be due to the saturation of the active sites CAB [8].

The optimal time of adsorption of two dyes is about 120 minutes. It is found that the activated carbon has an affinity for both dyes and preferably in the order of OR and BD.

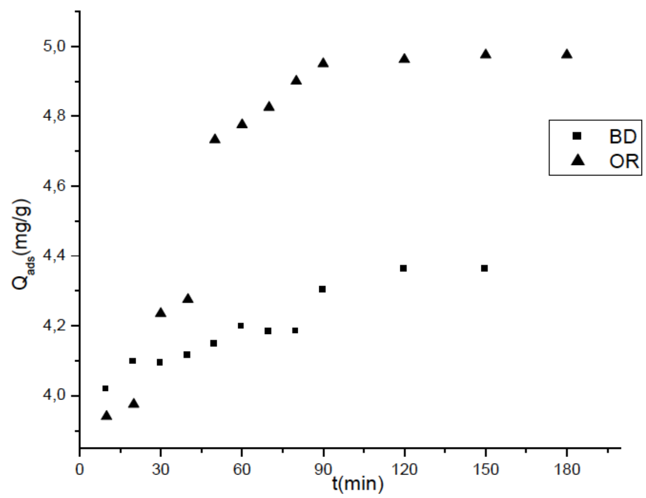

Figure 6: Variation of the adsorption capacity of the BD and OR function of time pH = 1, m = 0.2g, C0 = 20mg / L, V = 50mL and v = 700 rev / min.

2.4. Effect of Adsorbent Mass

7 shows the variation of the concentration of the dye adsorbed by the cabinet according to the mass of the latter. From these results, we hold that the OR is heavily eliminated by the CAB. The concentration of

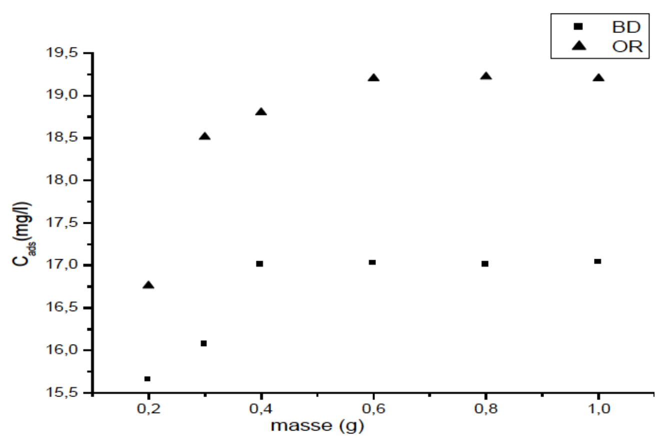

Figure 7: Effect of the mass of adsorbate on the adsorption of BD and OR pH = 1, t = 1 hour, C0 = 20mg / L, V = v = 50mL and 200 rev / min.

adsorbed increases OR of 16.75 mg / L with the increase of the mass of the cabinet until the maximum value of 19.25 mg / L. In result it remains constant with increasing the adsorbent mass.

Likewise for the blue dye dispersed BD is less eliminated by the CAB. The concentration of adsorbed BD increases of 15.6 mg / L up to the maximum value of 17 mg / L, and then remains constant.

Optimum amounts of CAB that we found are 0.6 g and 0.4 g of CAB for 50 ml of the OR and BD solution respectively. The adsorption increases with the amount of adsorbent can be attributed to its increased surface area, and the availability of more the number of active sites with an increase in the weight of CAB [9].

3. CONCLUSION

The study of adsorption of dyes has permit to show that the adsorption capacity is important for reactive orange dye and reached 4.97 mg/g, i.e. 99% of reactive orange is adsorbed. She reached only 4, 37 mg/g, meaning 87% of blue scatters is adsorbed. Kinetics is fast initially and subsequently slows to reach a level of equilibrium of adsorption. Time to saturation for two dyes is 120 minutes. The elimination of dyes by activated carbon shows that the adsorption process is important based on the mass of adsorbate. Optimized activated charcoal has an affinity for the two studied dyes and preferentially in order: orange, and blue reactive disperse.

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