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ROLE OF PLANT WASTES AS AN ECOFRIENDLY FOR POLLUTANTS (CRYSTAL VIOLET DYE) REMOVAL FROM AQUEOUS SOLUTIONS

Aseel M. Aljeboree and Ayad F. Alkaim*
College of science for women-Chemistry Department/ university of Babylon -Iraq
E-mail: alkaimayad@gmail.com, alkaim@iftc.uni-hannover.de

Abstract

The preparation of Activated carbon(Coconut Shell) with HNO_3 activation and its ability to remove textile dye (Cristal Violet (CV)), from aqueous solutions were reported in this study. The adsorbent was characterized with scanning electron microscope (SEM). Various physiochemical parameters such as, contact time, initial dye concentration, adsorbent dosage and temperature were investigated in a batch-adsorption technique. The equilibrium time at normal pH was found 24h. Result showed that the adsorption of CV dye found to increase with increase in initial dye concentration, and contact time but decreases with the amount of adsorbent, temperature of the system. It was found that (CV) dye adsorption was spontaneous and endothermic and That percentage removal E% (35-99%), (45-99.6%) and (85-99.5%) when the temperature increase (15-50 ^{o}C). The concentration of dye was measured before and after adsorption by using UV-Visible spectrophotometer at 663 nm.

***Keyword*:** Activated carbon, Cristal Violet (CV), textile dyes; plant.

Introduction

Dye wastewater is mainly from textile, leather, paper, rubber, plastics, cosmetics, pharmaceutical, and food industries. Because dye wastewater always comes as large quantities, complex composition, color depth, and is of high toxicity, it causes severe environmental pollution and human health hazards if it is not treated properly before discharging into the natural water. Current treatment methods for dye wastewater include physical, chemical, and biological methods, and so on. Various removal methods have been studied by adsorption (Aljeboree 2019; Aljeboree, Al-Gubury *et al*., 2019), chemical coagulation, liquid membrane separation, electrolysis, biological treatments, oxidation, and other processes (Abbas, Al-Amer *et al*., 2016) . However, these processes vary in their effectiveness, costs, and environmental impacts (Adriano, Veredas *et al*., 2005). Among these processes, the adsorption process is much more competitive than other methods for its ready availability, lower cost, and wider range of applications. It is of vital importance to search for adsorbents which meet the requirements and standards of the water treatment industry and also are environmentally friendly, highly effective, low cost, and being available in tonnage quantities.

Activated carbon has been established as an effective adsorbent due to its large surface area, low density and chemical stability, Adsorption onto activated carbon has been found to be superior for wastewater treatment compared to other physical and chemical techniques, such as flocculation, coagulation, precipitation and zonation (Aljeboree 2015; Aljeboree 2016; Aljeboree, Alshirifi *et al*., 2017; Aljeboree, Alkaim *et al*., 2019). Activated carbon, also called activated charcoal, activated coal, or carbo activates, is a form of carbon processed to have small, low-volume pores that increase the surface area available for adsorption or chemical reactions (Aljeboree, Alshirifi *et al*., 2017). Activated is sometimes substituted with active (Aljebori 2012; Alkaim 2017).

Materials and Methods

Cristal Violet (CV) was obtained from M/s Merck. The respective chemical structures are shown in Fig. 1. For experimentation all the solutions were prepared after dilution of the stock solution, which was prepared in distilled water. . A stock solution of 1000 mg/L was prepared by dissolving 1 g as an appropriate quantity of textile dye Cristal Violet (CV) in 1 L double distilled water. Working solutions of desired concentrations were prepared by successive dilution. . The natural pH of CV dye solution was found to be 6.5.

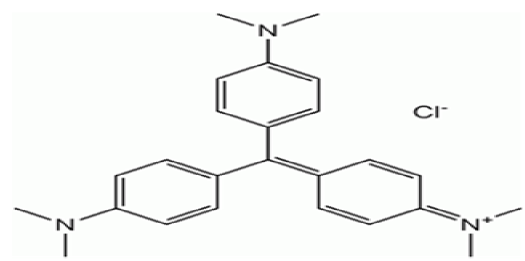


Fig. 1: Chemical structure of Cristal Violet (CV).

Preparation of activated coconut shell surface

Coconut shell was collected from Hilla market and the source of coconut under study is India, it was prepared by taking the shells and crushed very well, and put in the furnace for 2 hr at 300 0C, after this cooling at room temperature then sink in Hydrochloric acid (5% HCl), for 24 hr. The samples were washed by deionized water several times and dried in an oven at 105°C overnight and was ground into fine powder form before being used.

Effect of different parameters of adsorption processes of CV on Coconut Shell source Effect of initial dye concentration and contact time:

100 ml of dye solution with dye concentration (40 mg.L^{-1}) is to be prepared in Erlenmeyer flasks adsorbent concentration (0.075 g/100 ml) of coconut shell and kept inside the shaker water bath. Dye concentration to be estimated spectrophotometrically at the wavelength corresponding to maximum absorbance, λmax, using a spectrophotometer (Apel PD-303 uv (Japan)). The samples

with interval time separated by using centrifugation process. The absorbance of the solution is then measured, the dye concentration is to be measured after (10, 20, 30,40 and 50) mins until equilibrium will be reaches. A graph is to be plotted with qe vs time. The qe is expressed as (Baskaralingam, Pulikesi *et al*., 2006):

$$q_e = \frac{(C_0 - C_e) \times V_L}{m_{gm}} \quad ....(1)$$

Where: qe /Amount of dye adsorbed per unit mass of adsorbent (mg/g). Co/ Initial dye concentration (mg/L). Ce/Equilibrium dye concentration (mg/L). m / Dose of adsorbent (g). VL/ is the volume of solution (L)The percentage removal of the dye was calculated on the basis of reduction in absorbance at max value of the dye as follows: (Sakin, Ali et al. 2018).

$$\text{Dye Re moval}\,\% = \frac{C_0 - C_e}{C_0} \times 100 \quad ....(2)$$

Where: C_0 and C_e are initial and equilibrium dye concentrations, respectively

Effect of solution temperature

The effect of temperature to the adsorption capacity of Coconut Shell source was carried out at 15, 35, and 50 C in a constant temperature bath at natural solution pH 6, 200 rpm 0.75 gm of Coconut Shell source (particle size 50 nm) and 100 mL of dye concentration (10–50) mg/L.

Effect of mass dosage

The effect of mass dosage was studied by agitating in different masses (0.01, 0.025, 0.05, 0.075 and 0.1 g), at 35 C, 200 rpm, 0.75 mg of Coconut Shell source (particle size 50 nm) and 100 mL of (CV) dye concentration (40) mg/L

Results and Discussion

SEM characterization for adsorbent/adsorbate

Scanning electron microscopy (SEM) has been a primary tool for characterizing the surface morphology and fundamental physical properties of the adsorbent. SEM of adsorbent material were taken before and after dye adsorption on coconut shell surfaces (Figs. 2 and Fig 3).

From Figs. 2-3, it is clear, there is a good possibility for dyes to be trapped and adsorbed into these pores. The SEM pictures of adsorbed samples show very distinguished dark spots which can be taken as a sign for effective adsorption of dye molecules in the cavities and pores of this adsorbent.

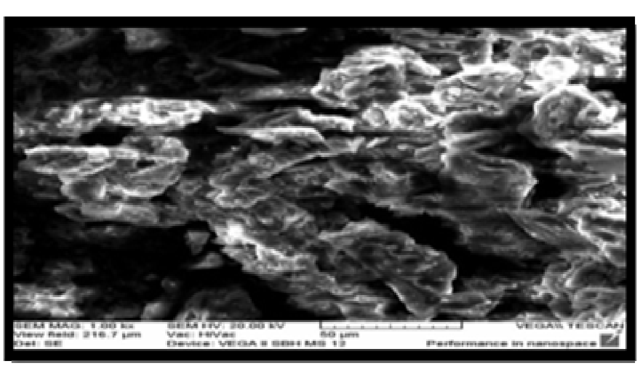


Fig. 2: SEM image for Coconut shell surface before adsorption.

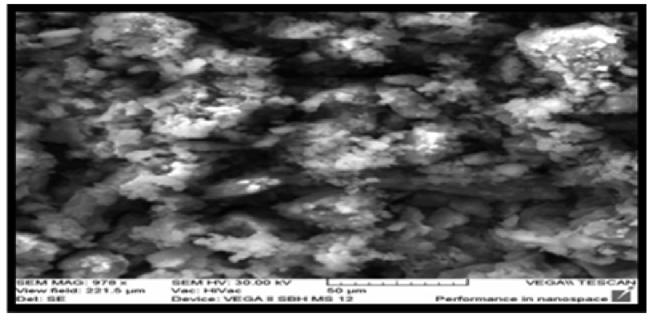


Fig. 3: SEM image for Coconut shell surface after adsorption.

Effect of Initial Dye Concentration

The plot of the quantities of dye adsorbed (qe) and (R%) dye removal versus initial concentration C0 at different experimental conditions. From the Fig.4 it can be seen that the amount of dye adsorbed varies with varying initial dye concentration and increases with increase in initial dye concentration, but also the percentage of removal decreased with increasing in the dye concentrations an increasing the initial dye concentration increases the number of collisions between dye ions and the Activated carbon (Coconut Shell), which enhances the adsorption process. The effect of initial dye concentration on the Activated carbon (Coconut Shell) capacity has been found to be of considerable significance for the basic dye used (Aljeboree, Alshirifi *et al.* 2017; Aljeboree, Alkaim *et al*., 2015).

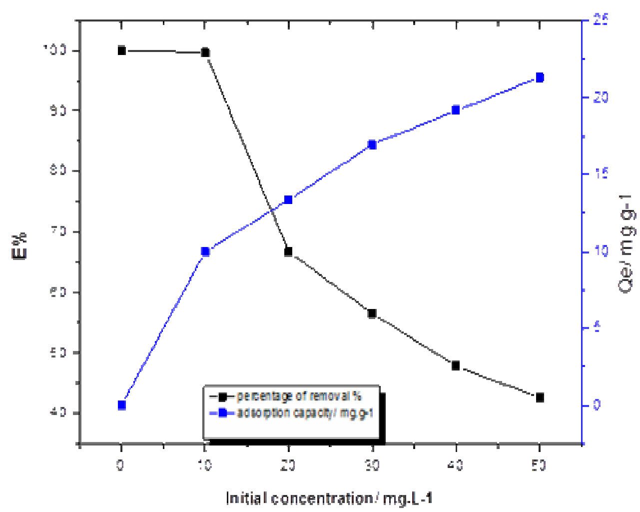


Fig. 4: Effect of initial concentration on the percent removal CV dye onto *Coconut Shell*
(Exp. Condition: Temp. = 30 °C, contact time 24 h, and pH of solution 6.5).

Effect the mass of Activated carbon (Coconut Shell)

The study was carried out to examine the effect of Activated carbon (Coconut Shell) dose on the CV dye removal (adsorption) at 30^{o}C. Fig. 5 exhibits that the percentage removal of dye increased with an increase in the Activated carbon (Coconut Shell) dose (0.01–0.1g). It is apparent that by increasing the adsorbent dose the amount of adsorbed dye increases but adsorption capacity, the amount adsorbed per unit mass, decreases. It is readily understood that the number of available adsorption sites increases by increasing the adsorbent dose and it, therefore, results in an increase of the amount of adsorbed dye. The decrease in adsorption capacity with an increase in the adsorbent dose is mainly because of adsorption sites remain unsaturated during the adsorption reaction whereas the number of sites available for adsorption site increases by increasing the adsorbent dose(Gecgel U 2012).

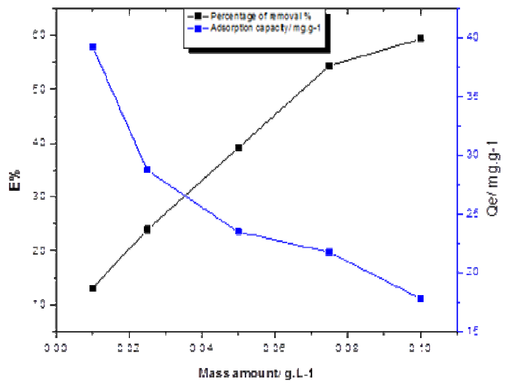
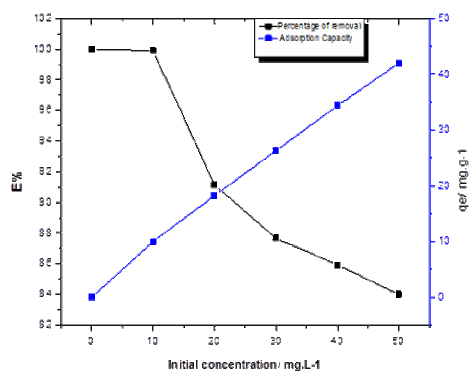
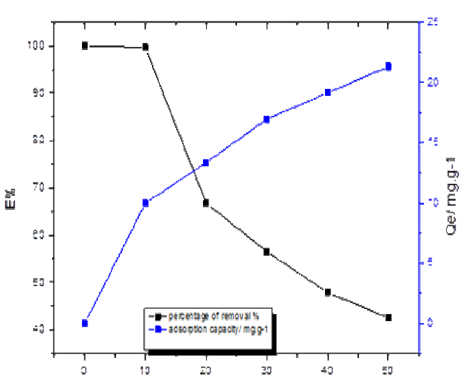


Fig. 5: Effect of mass amount of adsorbent Coconut Shell on the percent removal and amount of adsorbed CV dye.
(Exp. Condition: Temp. = 30 °C, contact time 24 h, and pH of solution 6.5).

Effect of solution temperature

The influence of solution temperature (291to 323K) On drug uptake CV dye using Coconut Shell, shows (Fig. 5a, 5b and 5c). The results indicate that the adsorption efficiency and percentage removal E% of CV dye onto the adsorbent surface of Coconut Shell was found depended of the temperature. It is clear that the percentage removal E% and adsorption efficiency increased because the solution temperature increased. That percentage removal E% (35-99%), (45-99.6%) and (85-99.5%) adsorption efficiency (2-22mg·g^{-1}), (2.2-23 mg·g^{-1}) and (4-44 mg·g^{-1}) at temperature (291to 323K) at the same order (Ji, Liu *et al*., 2010; Arya and Philip 2016; Aljeboree 2019).





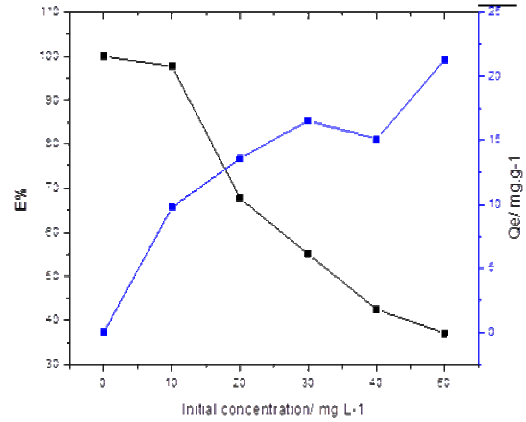


Fig. 5: Influence of resolution temperature on adsorption of TCs drug using The exterior of TiO_2 a)Temp 15^{o}C b) Temp 25^{o}C C) Temp 50^{o}C

Conclusion

The adsorption of the CV dye on the Coconut Shell was studied in a batch mode operation for the parameters initial dye concentration, temperature, and adsorbent dosage. The results showed that adsorption of the dye increased with increase in initial dye concentrations, temperature while it decreased with increase in adsorbent mass and the adsorption efficiency (2-22 mg·g^{-1}), (2.2-23 mg·g^{-1}) and (4-44 mg·g^{-1}) at temperature (291to 323K). Best result of pH 6.5 percentage removal E% (99.6 %) Highlighting the mechanism of adsorption and adsorption efficiencies.

Reference

Abbas, A. and Al-Amer, A.M. (2016). Heavy metal removal from aqueous solution by advanced carbon nanotubes: critical review of adsorption applications. Separ. Purif. Technol., 157: 141-161.

Adriano, W.S. and Veredas, V. (2005). Adsorption of amoxicillin on chitosan beads: Kinetics, equilibrium and validation of finite bath models. Biochemical Engineering Journal, 27(2): 132-137.

Aljeboree, A.M. (2015). Adsorption of methylene blue dye by using modified Fe/Attapulgite clay, Research Journal of Pharmaceutical, Biological and Chemical Sciences, 6(4): 778.

Aljeboree, A.M. (2016). Adsorption of crystal violet dye by Fugas Sawdust from aqueous solution. International Journal of ChemTech Research, 9: 412-423.

Aljeboree, A.M. (2019). Removal of Vitamin B6 (Pyridoxine) Antibiotics Pharmaceuticals From Aqueous Systems By ZnO. International Journal of Drug Delivery Technology, 9(2): 125-129.

Aljeboree, A.M. (2019). Adsorption and Removal of pharmaceutical Riboflavin (RF) by Rice husks Activated Carbon. International Journal of Pharmaceutical Research, 11(2): 255-261.

Aljeboree, A.M.; and Al-Gubury, H.Y. (2019). The effect of different parameters on the removal of vitamin B12 drug (as a model biochemical pollutants) by ac/ clay. Biochem. Cell. Arch., 19(1): 755-759.

Aljeboree, A.M. and Alkaim, A.F. (2019). Spectrophotometric Determination of Pharmaceutical by Oxidative Coupling of 4-Aminoantipyrine: A Short Review. Journal of Engineering and Applied Sciences 14(2): 5561-5569.

Aljeboree, A.M. and Alkaim, A.F. (2015). Adsorption isotherm, kinetic modeling and thermodynamics of crystal violet dye on coconut husk-based activated carbon. Desalination and Water Treatment, 53(13): 3656-3667.

Aljeboree, A.M. and Alshirifi, A.N. (2017). Kinetics and equilibrium study for the adsorption of textile dyes on coconut shell activated carbon. Arabian Journal of Chemistry 10: S3381-S3393.

Aljebori, A.M.K.A. and Abbas, N. (2012). Effect of Different Parameters on the Adsorption of Textile Dye Maxilon Blue GRL from Aqueous Solution by Using White Marble. Asian Journal of Chemistry, 24(12): 5813-5816.

Alkaim, A.F.; Alrobayi, E.M., Algubili, A.M. and Aljeboree, A.M. (2017). Synthesis, characterization, and photocatalytic activity of sonochemical/hydration–dehydration prepared ZnO rod-like architecture nano/microstructures assisted by a biotemplate. Environmental technology 38(17): 2119-2129.

Arya, V. and Philip, L. (2016). Adsorption of pharmaceuticals in water using Fe_3O_4 coated polymer clay composite. Microporous and Mesoporous Materials, 232: 273-280.

Baskaralingam, P. and Pulikesi, M. (2006). Adsorption of acid dye onto organobentonite. J. Hazard. Mater., 128: 138-144.

Gecgel U.K.H. (2012). Adsorption of Remazol Brilliant Blue R on activated carbon prepared from a pine cone. Nat Prod Res., 26: 659-664.

Ji, L. and Liu, F. (2010). Adsorption of pharmaceutical antibiotics on template-synthesized ordered micro- and mesoporous carbons. Environ. Sci. Technol., 44: 3116-3122.

Sakin, O., Ali, H.M. (2018). Adsorption thermodynamics of cationic dyes (methylene blue and crystal violet) to a natural clay mineral from aqueous solution between 293.15 and 323.15 K. Arabian Journal of Chemistry 11(5): 615-623.