Nat. Volatiles & Essent. Oils, 2021; 8(4): 6734-6743

Nano Chitosan Adsorption Of Yellow (W6GS) Dye

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Abstract

The removal of yellow(W6GS) dye has been studied, by using Nano chitosan . Adsorption isotherms were studied under different Temperatures , the effect of salt ions and Equilibrium time were investigated . Adsorption isotherms were found to be comparable to the Langmuir equation .the adsorption results were evidently increased with the high temperature (Endothermic process). The functions were calculated (ΔH, ΔG, ΔS) were calculated. The Kinetics of the adsorption was studied. The results were treated according to (Lagergren equation). The Kinetic experimental data properly correlated with the pseudo First order kinetic model.

Key word :- Adsorption ,Nano chitosan ,yellow(W6GS) dye

Introduction

Nano chemistry is one of the new technologies with a huge appeal to focus on scientists' interests during life[1]. Nano chitosan normal polysaccharide prepared by the N-deacetylation of chitin [1] . it has widely used in Adsorption because of its significant chemical and biological properties such as biodegradability, biocompatibility,[2] chitosan nanoparticles have three active hydroxyl groups, a primary and one secondary hydroxy group for each repeated unit, and one amino group for each desacidstylized unit. Chitosan nanoparticles are a hydrophilic polymer with a positive charge. Chitosan is a beta-1, 4-linked unit of N-acetyl-D-glucosamine, The main factors that affect the adsorption capacity of nano chitosan are its particle size, surface area, molecular weight and degree of deacetylation[3]. Chitosan has one of the most popular adsorbents for removing metallic ions from aqueous solution and it is widely used in water treatment implementations[4] ,[5] chemical properties of the polyelectrolyte of nanochitosan with a pH between 2 to 6 and contribute to a higher solubility than that chitin.[6] . Limited application of Nano chitosan, such as physical aggregation and particle fusion , the concern is

only on the longtime of stocking. hance, the moisture content must be removed(Freeze- drying) is the most common method of changing solution to nano solids so they are stable when distribution and stored performance [7]. For many years, people used to use water for free, but the situation has changed in the recent period, as water shortage has become a threat to humans, Water is one of the most important resources for human life 60% of the total area of the earth is water [8]. Dyes Colors are one of the main classes of the pollutants in wastewaters that are used in various industries in order to paint related products. A large amount of wastewater is produced. The presence of these colors in the water, even in very low concentrations ,treatment water by adsorption onto Nano chitosan[9], [10] The presence of dye in the water increases oxygen demand, which negatively impacts the metabolic functions of phytoplankton, aquatic flora and wildlife by reducing light penetration and hence photosynthesis[11] dye, may cause irreversible damage to the brain, the nervous system and kidney system after entrering the human body[12]. Dyes are complex chemicals and are used in many industries and human uses. The origin of dyes is either natural or synthetic..[13]. Studies of the effect of pH of nano chitosan removed dye[14]. W6GSIS has a synthetic origin as well as molecular aromatic compound structures . It is known that waste waters contain different colors, Dyes are characterized by high toxicity, which causes a lot of problems for the environment [15-16]. The purpose of this work was to possibly a surface of Nano chitosan to remove the yellow dye(W-6GS) from the aqueous solution.

Experimental

Materials : (W6GS) obtained from the textile industry of Hilla. HCl and NaCl were supplied by (BDH)and deionized water had been used. Nano chitosan was supplied by (SHAANXI SANGHERB BIO-TECH INC), (Figure 1) shows the structures of chitosan, (Figure 2) shows the Infrared spectrum of chitosan that was sent by the supplier, and (Figure 3) shows the structures of (W6GS) dye

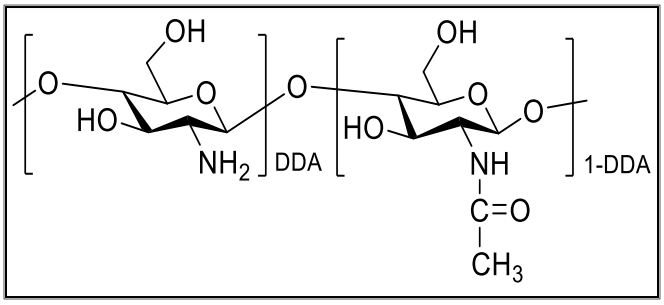

Figure 1: the structures of chitosan

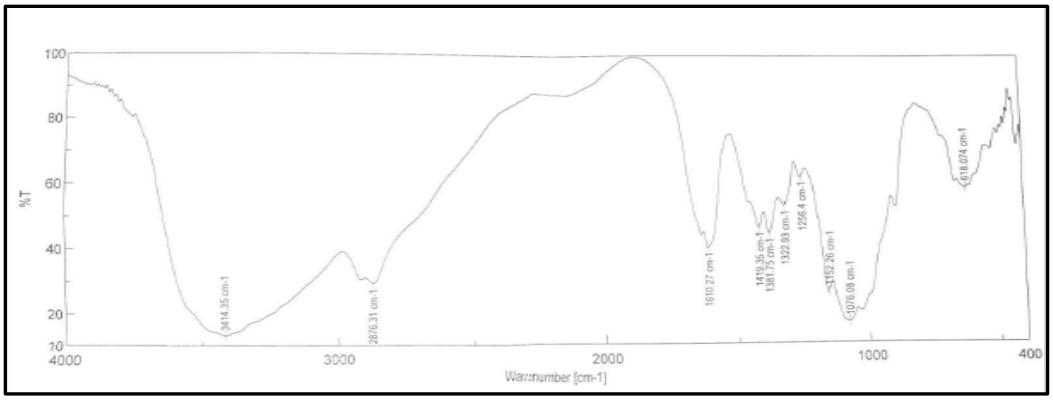

Figure 2 :the Infrared spectrum of nanochitosan

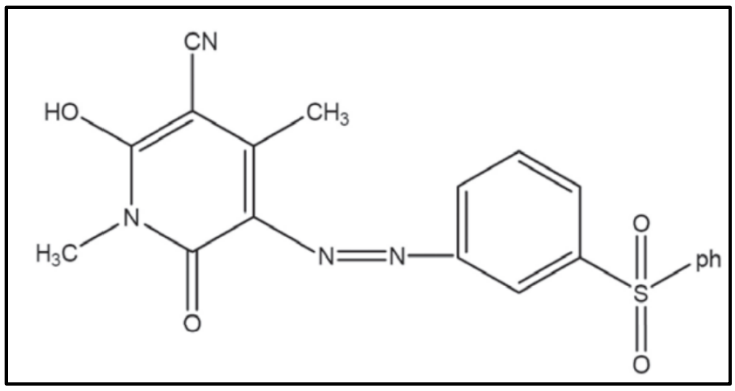

Figure 3: the structures of W6GS dye

Method

1.UV technique was used to determine the absorption as afunction for concentration. the wavelength of absorption of W6GS dye was(487nm).

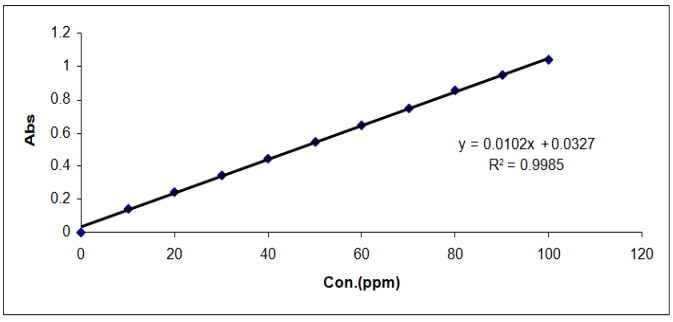

Figure 3: calibration curve of W6GS dye

2. Contact time was determined for equilibrium between adsorbent and adsorbate, some certain concentration was mixed with (0.04gm) of nano chitosan and they were put into a water bath shaker under 20 °C, samples were taken from the solution in different sequenced times to determine the change in the concentration with time passing.

3. Adsorption isotherms investigation by add (0.04gm)of the surface to six round bottom flasks which Contains (50ml) of W6GSdye solutions with certain concentration. These flasks were placed in a water bath at (20 °C) for (100min). After the separation of the mixture ,adsorption was absorbed by UV spectrophotometer .

The adsorption quantities were calculated by used following equation (17):

$$Q_e = \frac{(C_\circ - C_e)V}{m}$$

Q_e= the quantity of adsorbate(mg/g).

V= volume of solution (L).

$C_\circ$= initial concentration (mg/L).

C_e= equilibrium concentration(mg/L).

m= mass of the surfaces(g).

4. SEM technique was used to scanning nano chitosan structures as shown in the (Figure 4)

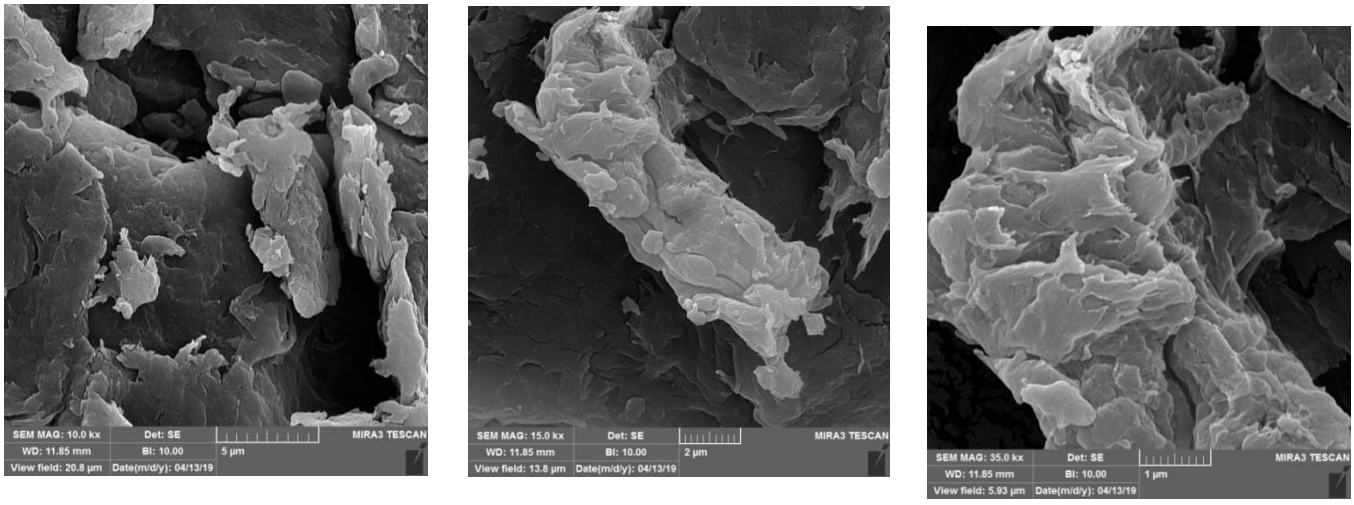

Figure 4 : the SEM image of nano chitosan

Results and Discussion

Adsorption isotherms

The adsorbed quantity (Q_e) for each equilibrium Concentration was calculated . $Q_e$against C_e plotted to show the general scheme of adsorption isotherms as show in(Figure 5) .

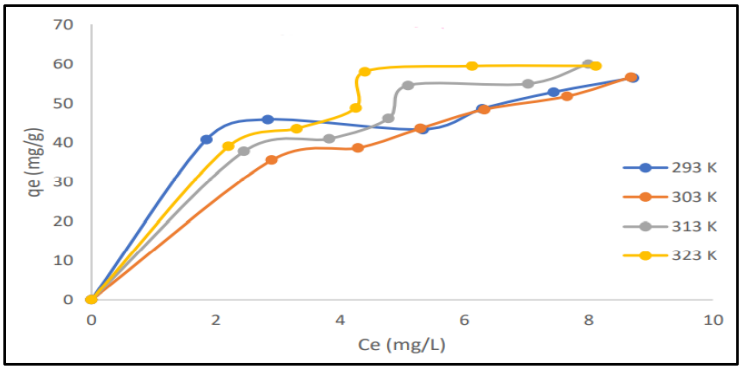

Figure 5 : Adsorption isotherms at different temperatures.

The scheme of adsorption process on the surface classification (L4) according to Giles. That is, in the sense of the precipitation of particles on the surface of the tread[18], increases gradually with increasing temperatures, an endothermic process.

Depend on Langmuir equation :.

$$Q_e = \frac{KC_e}{1 + aC_e}$$ ..... Langmuir equation

Where a ,K : Langmuir constants

C_e/Q_e Vs C_e was plotted as shown in (Figure 6) .Langmuir constant were calculate as shown in Table 2 .

$$\frac{C_e}{Q_e} = \frac{1}{K} + \frac{a}{K}C_e$$

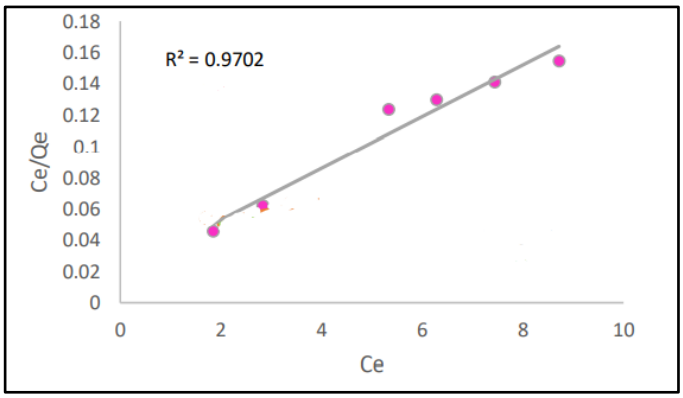

Figure 6 : Linear plot of Langmuir isotherm

Table 1 : The value of Langmuir constant (a,K) for adsorption

T	a	K	R^2
293K	1.05	52.63	0.9702

The adsorption quantity increases when increasing temperature (Endothermic process), The value of (ΔH) calculated by using Vant Hoff- Arrhenius equation :

$$\text{Ln Xm} = \frac{-\Delta H}{RT} + \text{Constant}$$

Where Xm : Maximum adsorbed quantity .

R : gas constant .

T: temperature .

lnXm Vs Inverted temperature (1/T) was plotted as show in (Figure 6) andTable 3.

Table 3: The value of lnXm and T

T(K)	Xm (mg/g)When C_e=6 (mg/L)	Ln Xm
293	46	3.83
303	48	3.89
313	55	4.01
323	60	4.09

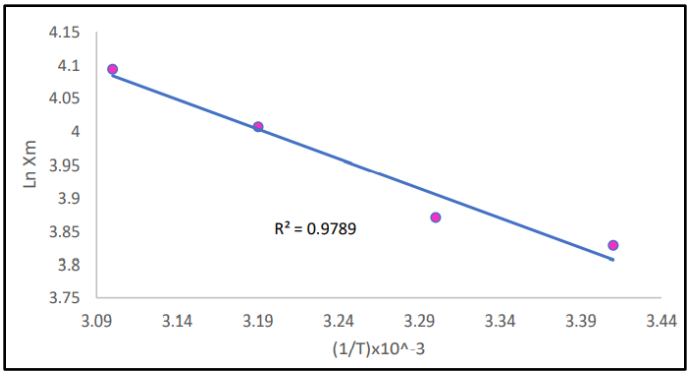

Figure 6 : Vant Hoff curves for adsorption

The value of (ΔG,ΔS) were calculated as shown in Table 4, depending on following equations:

$$\Delta G = -\frac{nRTLnQe}{Ce}$$

$$\Delta G = \Delta H - T\Delta S$$

Table 4: The values of the thermodynamic functions of the dyes at (293 K)

Δ H (J\mole)	Δ G (J\mole)	Δ S (J\mole.K)
7501	-5009.7	40.7

The positive value of (ΔH,ΔS) while (ΔG) were negative values show that the adsorbent molecules are less uniform on the surface than inside the solution [19].

Effect of add salt

The adsorption was studied in different salt media (0.01M, 0.03 M of NaCl) as shown in (Figure 7).

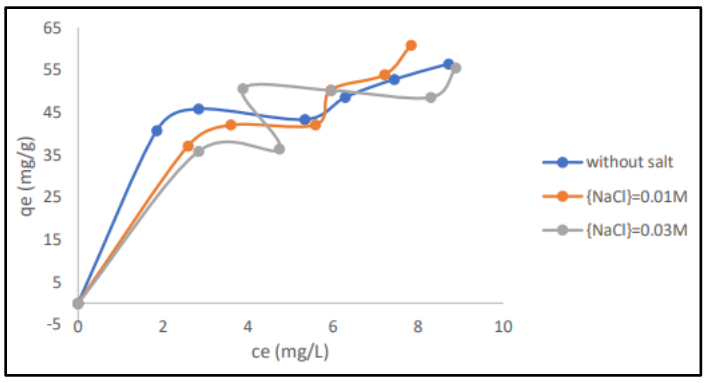

Figure 7 : Effect of add salt on Adsorption at T = 293 K

Adsorption Kinetic

Kinetic studies were investigated by used Largergreen equation [20] :

ln (q e – qt) = lnqe – kad

where qe and qt : are the adsorption capacity at equilibrium and at time (t) respectively (mg/L).

Ked : the rate constant of pseudo firs- order kinetic adsorption (min^{-1}).

The kinetics results followed pseudo first- order kinetics model , as shown in (Figure 8),

The value of rate constant of adsorption k_{ad} equal 0.032 min^{-1}

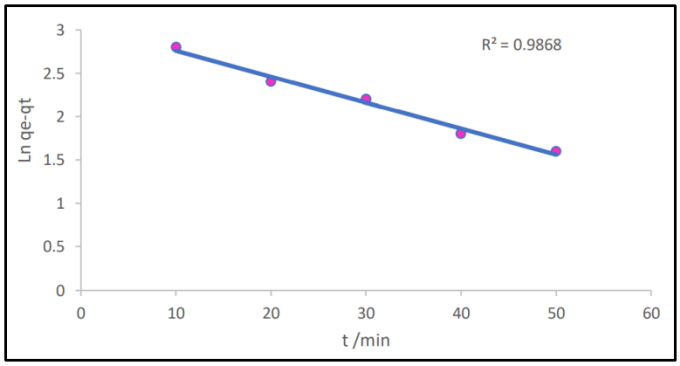

Figure 8: The first- order kinetics model of adsorption

Conclusions

The conclusions of our research were as follows: The presence of a high susceptibility of nano-chitosan to the adsorption of the dye, and the adsorption increases with increasing temperature. It was also found that the adsorption obeys the Langmuir equation for adsorption. It was also found that the presence of ionic strength in the solution with different concentrations of sodium chloride salt had no effect on adsorption, and it showed Kinetic results that the adsorption follows the pseudo-first-order equation

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