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THE EFFECT OF DIFFERENT PARAMETERS ON THE REMOVAL OF VITAMIN B12 DRUG (AS A MODEL BIOCHEMICAL POLLUTANTS) BY AC/ CLAY

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ABSTRACT : The adsorption of Methylcobalamin vitamin B12 drug by Activated Carbon/Clay (CAC) surface was studied manipulating different physiochemical parameters such as, time of contact, initial drug concentration 10-80 mg/L adsorbent dosage (0.01-0.1g) and temperature (10, 25, 35, 60^{0}C) were conducted.

The Methylcobalamin Vitamin B12 adsorption ofwas done at pH6. The adsorption uptake was proportional with initial drug concentration and contact time but decreased with the amount of adsorbent and temperature. Freundlich, model best described the uptake of Methylcobalamin Vitamin B12 drug. Also, the removal of a real sample (mixture of pharmaceuticals compounds) from aqueous solution found when time increase the absorption decrease that gave higher removal percentage of the targeted drug.

Key words : Vitamin B12 drug, clay, activated carbon, adsorption, isotherm model.

INTRODUCTION

Poor biodegradability of pharmaceuticals became one of important concerns as highly accumulated pollutants (Zhang *et al*, 2016; Aseel Musthaq Aljeboree, 2018) particularly antibiotics, anti-inflammatory agents and hormones that pass to the wastewaters mainly from drug factories and hospitals that affect human health and the aquatic life (Sun, 2015; Aseel M Aljerboree, 2018). Thus, these pollutants must be eliminated from wastewater.

Many physiochemical and biological methods have been used for pollutants removal from wastewater (Aseel M Aljeboree, 2018). Physiochemical methods include biodegradation (Xiong and Tong, 2017), biological treatments, biofiltration (Yang and Chen, 2012), ion exchange (Chen, 2002), ozonation (Gomes, 2017) chemical precipitation, advanced oxidation processes (AOPs) (Cheng and Zeng, 2016), photo catalytic degradation (Hu, 2016), electrocoagulation (Nariyan, 2017), electrochemical technologies (Zhang, 2015), ultrafiltration membrane (Sheng and Nnanna *et al*, ...), membrane filtration (Liu, 2017) adsorption (S.C.R. Marques, 2017).

Adsorption is considered simple, cheap, easily–handle operation, low cost and eco-friendly characters and most versatile technique for holding these pollutants (Moro, 2017). Nevertheless, an appropriate adsorbent is urgently needed (Zhou, 2017). Adsorbent with high surface area is favored and able to accumulate large amount of pollutants, like Activated carbon (Calisto, 2017), biochar (Lin, 2017), mesoporous silica (Liang, 2016), zeolite (Sun, 2017), chitosan (Kyzas, 2017), carbon nanotubes (CNTs), clays (Dordio, 2017), resin (Zhou and Zhang, 2015), biomass wastes (Zhou and Zhang, 2015), fly ash (Lu, 2009), aluminum hydroxide, iron-based compounds (Tanada, 2003) and Ca-based sorbents (Zhou, 2016) and graphene oxide (Shan, 2017).

The aim of this work to investigate for removal of biochemical pollutants from aqueous solutions in the presence of friendly surfaces.

MATERIALS AND METHODS

Calibration curve

Freshly prepared aqueous solution of the pure drugs, vitamin B12 drug standard solutions (100mg/L) was prepared by dissolving 0.1g of vitamin B12 drug in distilled water the solution was made up to 1000mL with distilled water. Different concentrations of working solutions were prepared. Standard samples containing different concentrations (10–80 mg/L) of vitamin B12 drug were prepared by simple dilution with distilled water of the stock solution (100mg/L). The absorbance were determined using UV-Visible Spectrophotometer (Fig. 1).

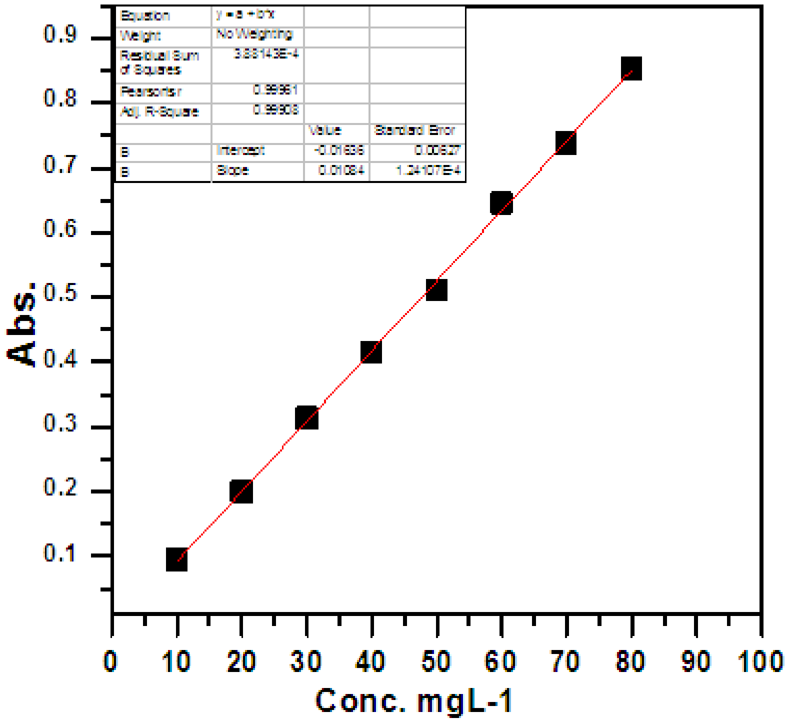

Fig. 1 : Calibration curve of Vitamin B12 drug.

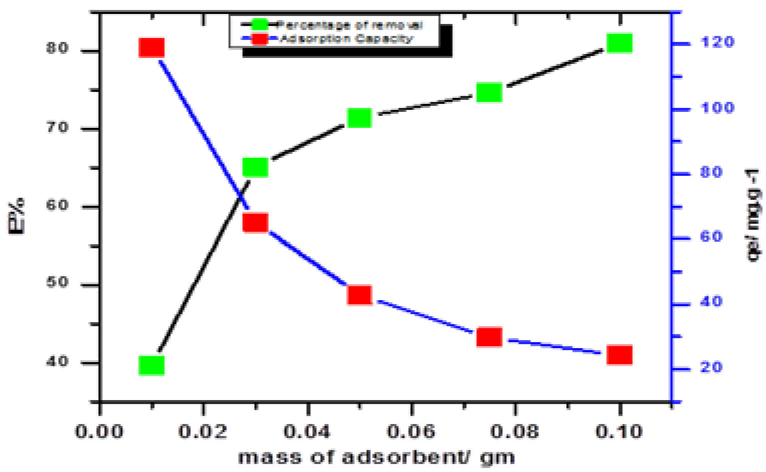

Fig. 2 : Effect of mass adsorbent on adsorption Vitamin B12 drug.

Preparation of Peanut Peelsactivated carbon / Claysurface (CAC)

Peanut peels was obtained from the local market at Hilla, Iraq. The peels were sieved through a 3-2mm sieve, washed by distilled water then dried at 100°C for 48 h. The peels are grounded to a powder with particle size <50 µm. After that using clay Atapulgite 4g in 150ml distilled water, was added with 2g AC powder and mixedfor 30min by magnetic stirrer. Then was put in an oven at 150ºC for 24h. The powder washed with distilled water several times with ultra-sonication until the pH of the wash became neutral (pH = 7). Finally, it was dried at 70ºC for 24h (done in our Lab of Nanotechnology, College of Science for Women, University of Babylon, Iraq).

The effect of different parameters on adsorption process

The effect of mass dose

Different masses (0.01, 0.03, 0.05, 0.75, and 0.1g), particle size 50µm of CAC and 100 mL of drug concentration (30 mg/L) were agitated using shaker water-bath at 25°C. The experiment was conducted at pH 6. Agitation was conducted for 60min contact time at 120rpm.

The effect of solution temperature

Different solution temperatures (10, 25, 35 and 60°C) were used, mass dosage 50 mg of CAC and 100 mL of drug concentration (30 mg/L) were agitated using shaker water-bath at pH 6 for 60 min at 120rpm.

The concentration in the adsorbent phase (qe(mg/g)) was calculated using the equationsreported by (Aljebori, 2012).

RESULTS AND DISCUSSION

The effect of CAC mass dosage

The effect of adsorbent dose on vitamin B12 drug removal was studied using different CAC dosage (0.01 to 0.1gm) at 30 mg/L drug initial concentration (Fig. 2).

The increased removal percentage is due to increased adsorption sites and surface area (Ghaedi, 2014), but with decreased adsorption capacity. This might be because of CAC aggregation that decreases surface area and binding sites leading to adsorption capacity decreasing (Aljebori, 2012).

The initial drug concentration effect

Different concentrations of Vitamin B12 drug10-80 mg/L were selected. The amounts of drug adsorbed at pH 6, adsorbent dosage 0.05g and 25°C are given in Fig. 3. With increasing initial concentration of Vitamin B12 drugfrom 10 to 80mg/L, the removal of drug molecules decreases from 90.47 to 40.59% after 1 hr of equilibrium adsorption time (Alkaim, 2013; Aljeboree, 2015).

The effect of temperature

The removal of vitamin B12 drug has been studied at a temperature of 10, 25, 35 and 60°C. Temperature change has a proportional effect on the adsorption capacity (Fig. 4). In this study, the vitamin B12 drug adsorption capacity increased from 21.904 to 50.476 and removal efficiency increased from 36.507% to 84.126% as the temperature

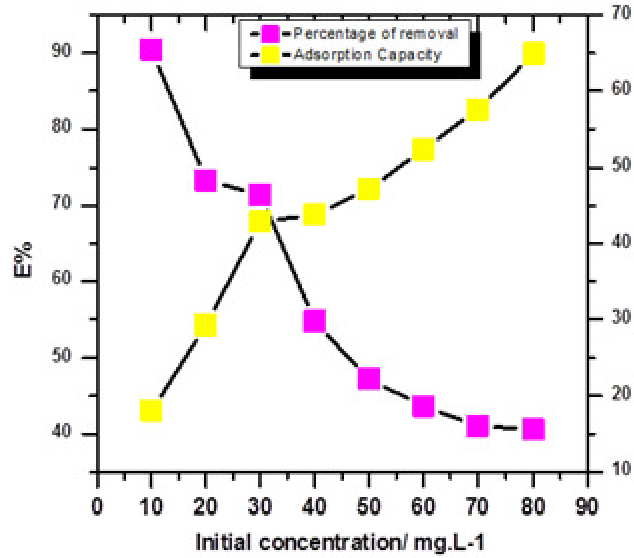

Fig. 3 : The effect of initial Vitamin B12 drug on its removal.

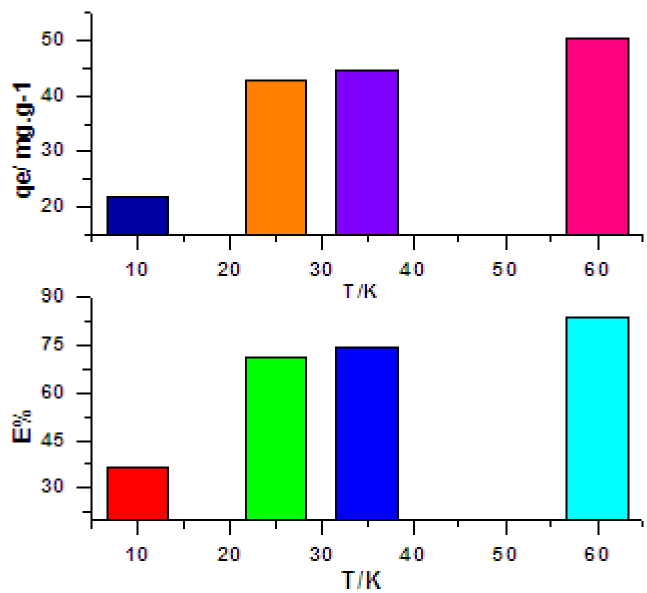

Fig. 4 : The effect of temperature on Vitamin B12 adsorption.

Table 1 : Langmuir andFreundlich model isotherms parameters for B12 drugadsorbed on CAC at 25°C.

Isotherm model	Parameter	AMX drug
Langmuir	qm ($mg.g^{-1}$)	62.3953±5.199
	K_L($L.mg^{-1}$)	0.2051±0.0788
	R^2	0.8397
Freundlich	K_F	18.9617±2.37
	1/n	0.3013±0.0375
	R^2	0.935

increased from 10°C to 60°C (Buasri, 2008; Maleki, Mohammad *et al*, 2018).

Removal of a real sample (mixture of pharmaceuticals compounds) by using (CAC)

A real sample 100 ml of pharmaceutical pollutants

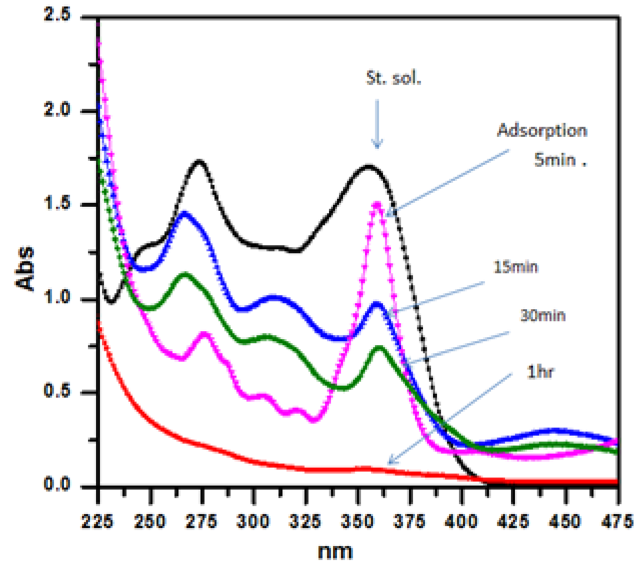

Fig. 5 : Effect Removal of a real sample (mixture of pharmaceuticals compounds) by using (CAC).

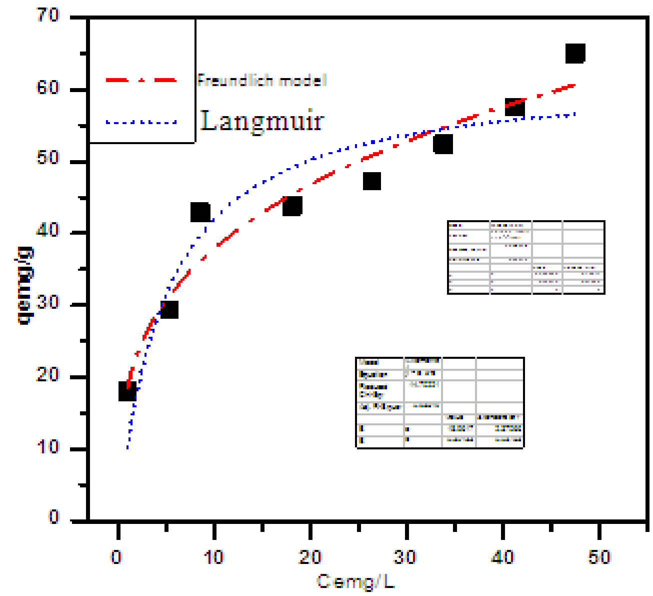

Fig. 6 : Different nonlinear fit adsorption isotherm models for adsorption of B12drug on (CAC).

with a refry concentration were using in this study, then added to aconical flask (Erlemyer)in the presence of 0.1 gm from prepared (CAC), after that the mixture were putting in a Shaker water bath for 1 hr, after that the supernatant were separated by centrifuge and measured the remaining concentration by using UV-Visible spectrophotometer at a chosen wavelength show in fig 5 andfound when time increase the absorption decrease and gave higher percentage removal.

The adsorption isotherms

Although, many isotherm models are available, Langmuir single-layer and Freundlich models are more suitable for solid-liquid adsorption systems (Freundlich, 1939).

The equilibrium for the adsorption of vitamin B6 was analyzed by the Langmuir and Freundlich isotherm equations mentioned by Thitame (2016).

The adsorption of vitamin B12 increases until equilibrium with no further change (Fig. 6). As seen, high coefficient regression correlation was by the Freundlich model (R= 0.935), which indicates that itis very suitable for describing the sorption of B12 drug compared to Langmuir model (R = 0.8397). The parameters of the two models are listed in Table 1.

CONCLUSION

CAC is considered an environmentally friendly adsorbent of vitamin B12 drug from aqueous solution. Adsorption capacity increased from 21.904 to 50.476 and as the temperature was increased from 10°C to 60°C and the adsorption process has nearly reached equilibrium in 1hr. The experimental data are fitted well to Freundlich model.

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