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Research Article

INVESTIGATE THE ABILITY OF IRAQI CLAYS THE FLINT AND CAOLINE AS ANTIDOTE FOR SULPHAMETHOXAZOLE DRUGS OVERDOSE

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Abstract

Adsorption of excessive amounts of the drug sulphamethoxazole was carried out using flint and caoline Iraqi clays as poison antidote, adsorption processes were shown very efficient within 15 minutes with no back ward redsorption, H , G , S were also calculated and reported

Keywords: sulphamethoxazole, flint and caoline

Introduction

Adsorption is the adhesion of molecules, atoms, or ions, from a liquid, gas, or dissolved solid (adsorbate) to a surface of a solid materials (adsorbent) consequently the process is happened through altered isotherms such as Freundlich or Langmuir when forming a film of solo layer or multilayer of adsorbate due to different species of adsorbates and adsorbents on basis of Brunauer, Emmett and Teller's model of multilayer adsorption which is random spreading of molecules on the material surface [1, 2].

Clays and activated charcoals were usually used as poisons antidotes since ancient times for their adequate adsorption ability for hydrophobic materials [3, 4] currently they try to use them to detox radiation impurities therefore clays were of the suggested components used to bury the Chernobyl reactor for their recognized capability to diminish the escape of radiation through their defensive barrier [5,6,7].

Clays and activated charcoals antidotes act via many ways such as an passive formation complex, fast-track detoxification, diminish the toxic effects, receptor site competition, receptor site obstruction and toxic effect evade [7].

Newly nanoclays are widely used in present technology to create reinforced polymer nanocomposites for paints, inks, greases, automotive industry, cosmetics formulations, in waste water treatment, medicines such

as drug delivery vehicles, and textile industry to compensate the accelerating upward needs for peoples all over the world. The advance of multifunctional nanoparticles for biotechnological and biomedical applications may improve cancer therapy, targeted drug delivery, intravital imaging, DNA transfection, and enzyme [16].

The aim of this work is to investigate the ability of Iraqi clays the flint and caoline as antidote for drugs over dose

Experimental Part

(a) Instruments

The instruments used in this study were: uv/vis spectrophotometers UV – VIS Spectrometer RF1501 Shimadzu Japan, Cuvette/Quartz B.S. 3875, Centrifuge BS – 11 Hettich EBA -20 Germany Thermostated shaker bath BS – 11 Jeio Tech. / South Korea, PH meter (HANA/Romania) HI – 9811 -5, Digital balance Sartorius Lab. L 420 B.W. Germany, Oven / Heraeus (D-6450) Hanau and a muffle furnace (Phonenix).

(b) Materials :

Chemicals: HCl 36% w/w, sp.gr. (1.18), BDH, England.,

were obtained from, Sulphamethoxazole was obtained from the State Enterprise for Drug Industries and Medical Appliances (SDI), Samarra, Iraq. Flint and **Kaoline clays**: were obtained from the (General Company for Geological Survey and mining), Baghdad, Iraq.

(c) Methodology :

The clays were washed with excessive amounts of demineralized water many times to remove the soluble impurities, dried at 115°C for three hours (constants weight) , crushed with crusher machine, sieved by molecular sieves to the grades of 75, 80,150,200 and 250 µm then stored dry in sealed plastic containers.

Adsorption experiments were carried out by shaking each clay (0.1 gm of 75 µm particle size) with 10 ml of sulphamthoxazole solution with concentrations 5×10^{-5} , 5×10^{-4} , 5×10^{-3} and 10^{-3} M/L respectively in a thermostatic shaking water bath at 150 rpm.

Series of experiments were carried out to determine the best residence time for adsorption process at

from the State Enterprise for Drug Industries and 37.5°C, then to determine the kinetic physical constants such as Gibbs free energy (G), enthalpy (H) and entropy (S).

Samples for spectrophotometric analysis were centrifuged for 22 minutes at 5000 rpm, filtered by filter paper no. 42 then centrifuged again to get rid of any suspended particles in order to obtain accurate absorbency readings.

Samples of the clays were ignited at 1100C° with the aid of a muffle furnace for 3 hours to determine the weight loss of each clay .

Results and Discussion

Flint and Kaoline clays proved to be very efficient as antidote for overdose of sulphamethoxazole drug within 15 minutes contact time at 37.5° C and showing no re desorption (reverse reaction) during all the reaction time which last 120 minutes (Fig 1 & 2).

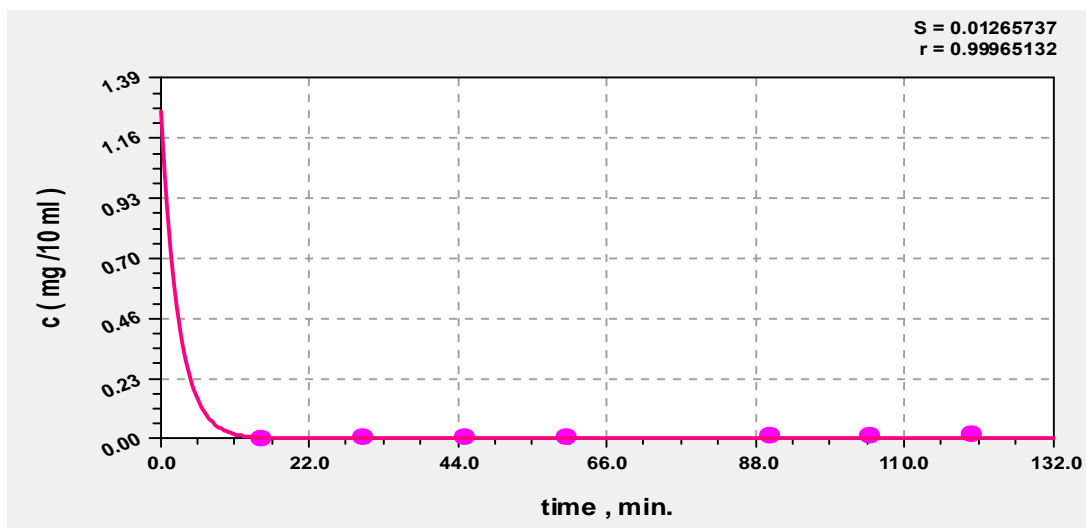


Fig.-1 Adsorption capacity for flint along contact time .

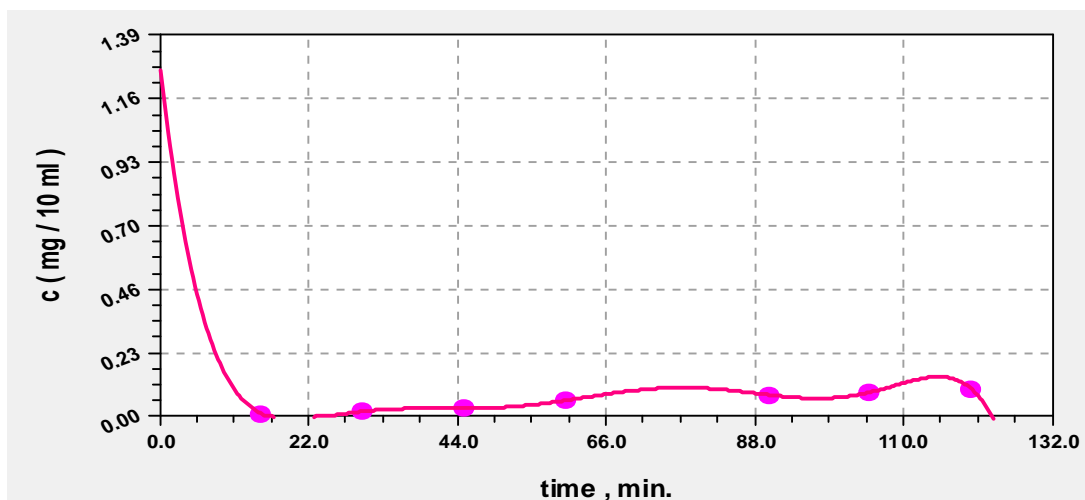


Fig - 2 Adsorption capacity for caoline along contact time.

Adsorption process for flint and aoline clays as seen by Figures 3 & 4 was going along Freundlich and Küster isotherm (1894) since the relationship of Q_e (mg of adsorbate / g of clay) against C_e (mg / L) the equilibrium concentration of the adsorption reaction showing a straight line for both clays according to the following empirical formula (Eq. 3&4) which could be

applied for gaseous or solid adsorbates where C is the concentration of the adsorbate , (x / m) the mass ratio of adsorbate to adsorbent (Q_e), k and n are empirical constants :

$$\frac{x}{m} = k C^{1/n} \quad \dots \text{Eq.- 1}$$

$$\text{Log } Q_e = \text{log } K_f + \frac{1}{n} \text{ log } C_e \quad \dots \text{Eq. 2}$$

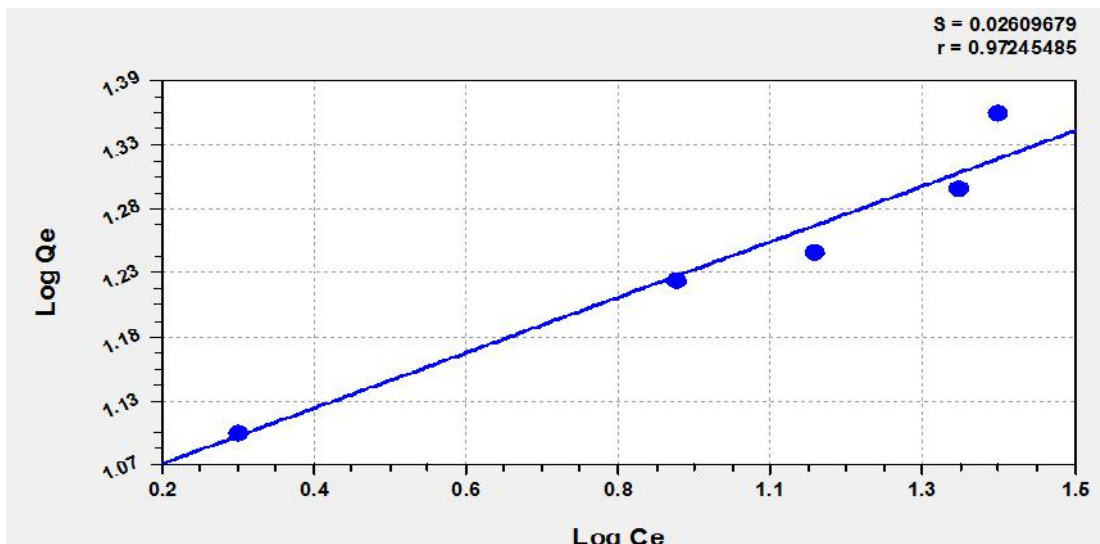


Fig.-3 Adsorption isotherm for sulphamethoxazole by Flint clay .

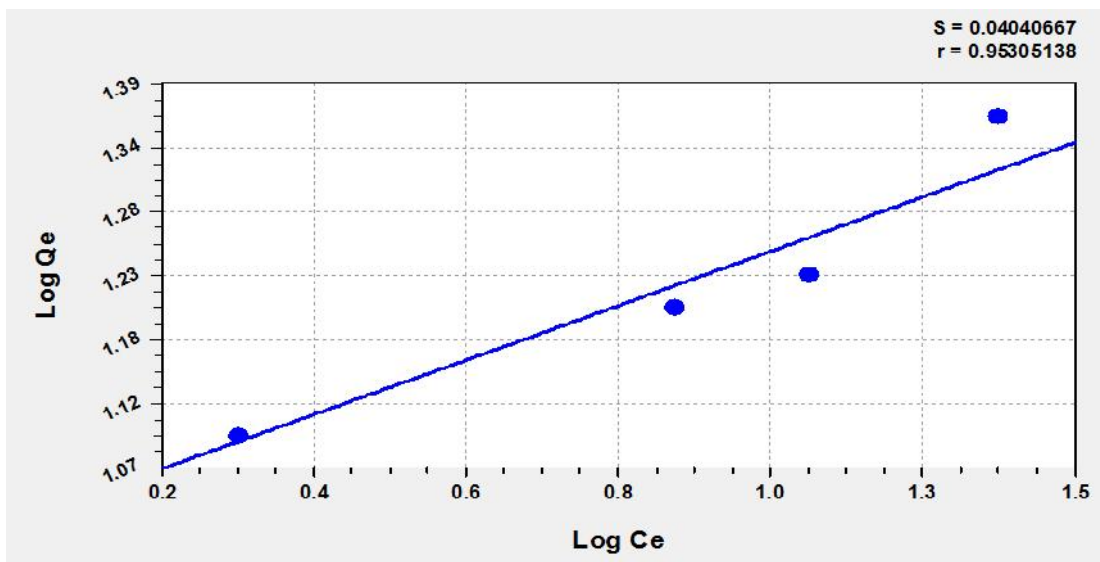


Fig. - 4 Adsorption isotherm for sulphamethoxazole by caoline

The empirical constants as seen in table – 1 reveals that adsorption of sulphamthoxazole depends greatly upon the active sites of the clay surface as Si ---O or Al---O as well as their hydrogen bonding formed

thereof by clays elemental compositions (Table -2) because the values of $(1/n)$ is small therefore the drug concentration does not affect the adsorption rate extensively.

Table – 1 The empirical constants for flint and caoline for sulphamthoxazole adsorption.

Clay type	1/n	K _f	n	r
Flint	0.20825	10.85	4.789	0.972
caolin	0.2112	10.69	4.735	0.953

Clay	Al ₂ O ₃ %	SiO ₂ %	Fe ₂ O ₃ %	MgO	TiO ₂ %	K ₂ O %	CaO %
Flint **	34	46	1				
caoline**	35.05	48.57	1.34	0.77	1.19	0.08	0.6

** The General Company for Geological Survey and mining, Baghdad, Iraq.

According to Vant Hoff – Arrhenius equation :

$$\log X_m = \frac{-\Delta H}{2.303 RT} + \frac{\Delta S}{R} \dots \dots \dots \text{Eq. 3}$$

Enthalpy (H) and entropy (S) changes could be calculated using (Fig 5 & 6) where:

X_m is the maximum amount of adsorbate .
 X_m = maximum amount of adsorbate (mg) by one gram of adsorbent.

Gibbs free energy change is also calculated using the following equation at 310.5 K :

$$G = H - T S \dots \dots \dots \text{Eq. 5}$$

The values of the physical constants are shown in table-3 conclude that the adsorption process occurred spontaneously for the negative values of G, meanwhile H attapulgitite is negative for Flint and caoline, the overall free energy proceed the adsorption reaction readily spontaneously

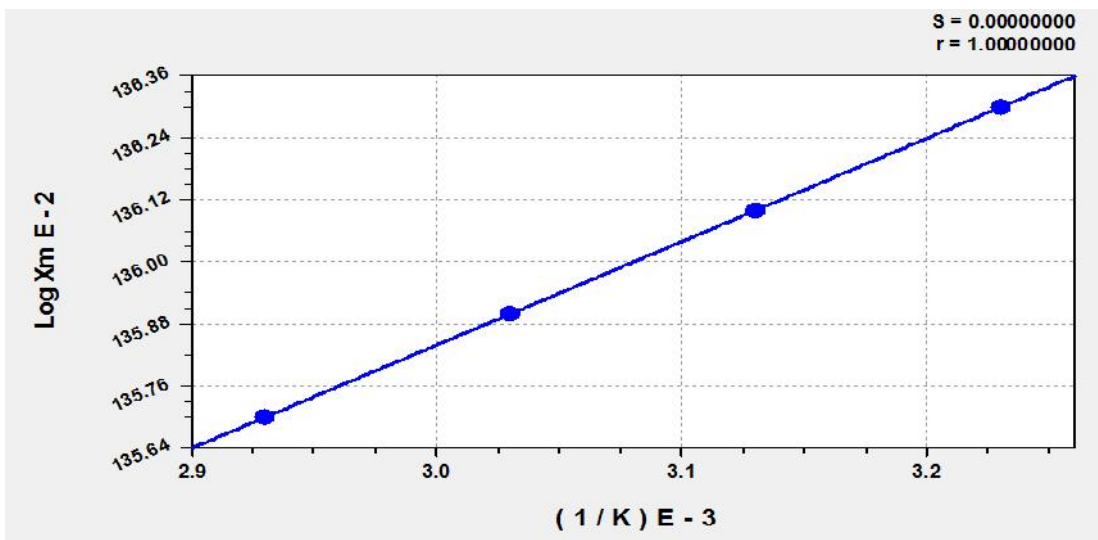


Fig .- 5 Adsorption capacity of sulphamethoxazole by Flint at different temperature degrees .

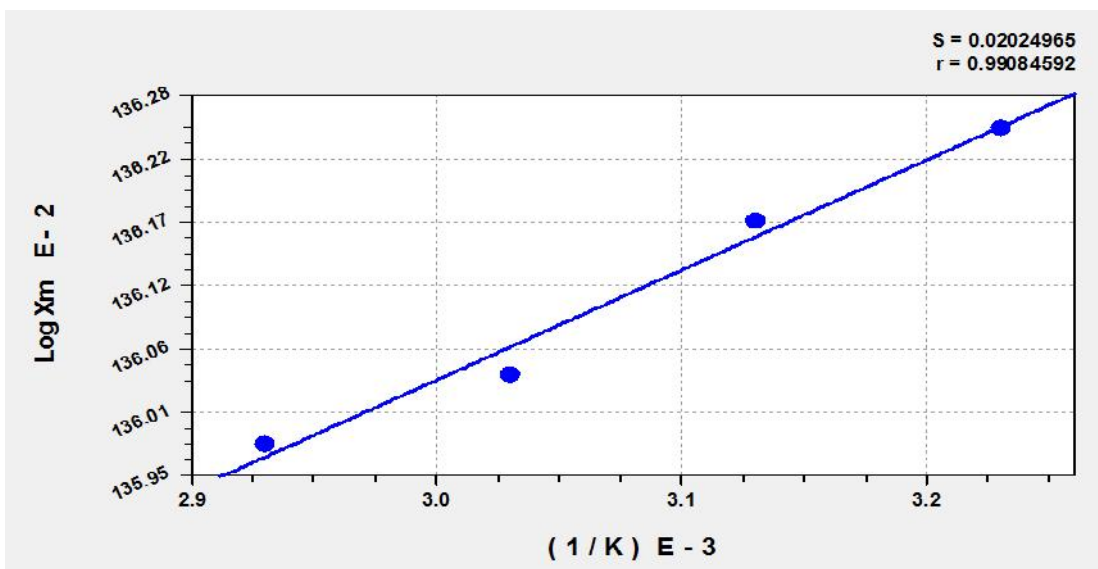


Fig .- 6 Adsorption capacity for sulphamethoxazole by caoline at different temperature degrees .

Clay type	H , Kj/M	G ,Kj/M	S ,J
Flint	-0.383	- 5.916	10.8
caoline	-0.180	- 5.918	11.078

The clays were ignited by a muffle furnace at 1100 C° for 3 hours therefore the properties of the clays were changed as seen in (Table – 4) for the adsorption capacity (Qe) of both clays became lower

after ignition due to alteration of the active sites on the surface of the clays because the weight loss due to the destruction and decomposition of organic and inorganic inclusions of the clays

Table – 4 Effect of clays ignition on their adsorption capacity .

Clay	Weight loss %	Qe (mg / g) Before igitintion	Qe (mg / g) After hgnition
Flint	13.751	22.866	20.656
caoline	10	23	20.799

Conclusion

This study revealed that the loading capacity of each clay (Qe) is up to 23 mg/g of adsorbent clay, which is acceptable value but it is worth to increase this ability up to hundreds folds by convert the clays to nanoparticles for surfaces area increase by thousands times fold therefore the adsorbing active sites of the clays which is responsible for attraction of adsorbate molecules and/ or ions are greatly increased .

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