Iraqi National Journal of Chemistry

Journal homepage:
http://iqnjc.com/Default.aspx

Adsorption of Cefixime on to Iraqi Bentonite

Elham Nghaimesh Mezaal

Department of Chemistry, College of Education for Pure Sciences -Ibn-Al- Haitham, University of Baghdad
Elham19690@gmail.com

Abstract

In this study the adsorption of cefixime on to selected Iraqi clay bentonite. The aim of this study is to search for selective active surface in adsorption of the drug and to act as physical antidotes in treatment of poisoning if the drug is taken in quantities higher than the recommended dosages. Quantitative estimation of the drug adsorption has been done by utilizing the technique of UV spectrophotometry in λ_{max} (273) nm at different conditions of temperature (25, 37, 45) ˚C found the adsorption decrease with increase the temperature. Study of clay weight of bentonite (0.1-1.5) gm found the adsorption increase with increase of clay weight, study effect of pH (1.2, 3, 5, 7) on adsorption of bentonite found the optimum adsorption at (pH = 5). Finally effect of ionic strength on adsorption used NaCl solution (0.1-0.3) M found decrease with increase of ionic strength. The results of adsorption isotherms fitted with freundlich isotherm.

Keywords: Adsorption, cefixime, bentonite.

Introduction

A cefixime has a broad antibacterial spectrum against various gram-positive bacteria and gram-negative bacteria, including hemophilia influenza[1,2], and is used as an antibacterial and especially against gram-negative, gram-positive and anaerobic bacteria pathogens including β-lactamase producing strains. It consists of high affinity for penicillin binding proteins with deceitful site of activity. It acts by inhibition of bacterial cell-wall synthesis. It is clinically used in the treatment of susceptible infections including gonorrhea, otitis media, pharyngitis, lower respiratory-tract infections such as bronchitis and urinary-tract infections[3]. Literature survey revealed the estimation. A structure of cefixime(CFX)[4].

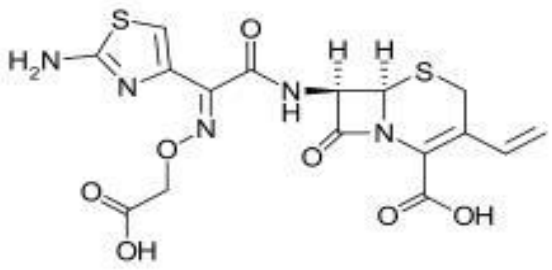

Figure (1): Chemical formula of cefixime

Bentonite is a natural clay consist mainly of montmorillonite a complex of colloid magnesium aluminium silicate with small amount of minerals[5]. Drug poisoning has been defined as a condition produced by any substance which when swallowed inhaled, injected or absorbed precutaneously is capable of causing death, injury, toxic or untoward reaction[6]. Methods of cefixime trihydrate or with other drugs by HPLC[7,8], colorimetric method[9], flow injection analysis[10] and HPTLC[11].

In this study adsorption of cefixime on bentonite clay and calculate the effect of factors like pH, ionic strength, contact time and weight of clay on percentage of removal of the drug.

Experimental

Apparatus

- UV-Vis spectrophotometer

A shimadzu double beam UV-Vis spectrophotometer model UV-1601 (Kyoto, Japan) working at wavelength of 190-1100 nm.

- pH meter

A micro processor pH meter 211 model (Triup International crop, Italy) pH-meter.

- Shaker bath (Labtech. Daihaiv. LTD).

Reagents

- Sodium chloride (Fluka AG Buchs SG)
- Sodium hydroxide (Fluka AG Buchs SG)
- Hydrochloric acid (Riedel-Dehaen AG)
- Cefixime (Iraq samara)
- Bentonite employed in this study were obtained from (the Geneva Company for Geological Survey and Mining), Baghdad**.**

Cefixime (1000 mg/L)

A stock solution of (1000 mg/L) of cefixime was prepared by dissolving (0.1 gm) in distilled water and then made up to (100 ml) in a volumetric flask with the same solvent working solution of (100 mg/L) was prepared by simple dilution for primary stock solution and was kept ambient bottle a way from sun light.

Sodium hydroxide (0.1 M)

This solution was prepared by dissolving (0.4 gm) of sodium hydroxide in distilled water and diluted to (100 ml) in a volumetric flask with the same solvent.

Hydrochloric acid (0.1 M)

This solution was prepared by diluting of (1.54 ml) of concentrated hydrochloric acid (37%) and diluted to (250 ml) in a volumetric flask by distilled water.

Sodium chloride (1 M)

This solution was prepared by dissolving (0.585 gm) of sodium chloride in distilled water and diluted to (10 ml) in a volumetric flask with the same solvent (0.1, 0.2, 0.3) M was prepared by simple dilution for (1 M) solution.

Recommended procedure

Was taken (0.1, 0.2, ….. 1.5) ml of standard solution of cefixime (100 mg/L) and it contained (2-30) mg/L they transferred to (5 ml) volumetric flask and complete the solution to the morl with distilled water later, determine the absorbance of solution at λ_{max} = 273 nm by using reagent solution as blank.

Results and Discussions

Absorption spectra

The drug of cefixime giving maximum absorbance at λ_{max} = 273 nm an in Fig. (2):

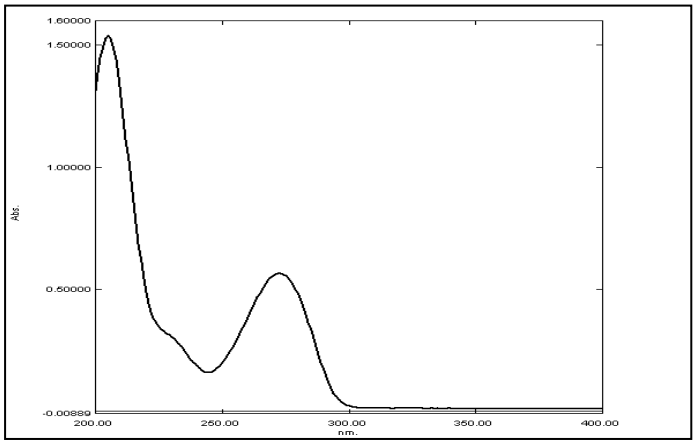

Fig. (2): Absorption spectra of (12 mg/L) of cefixime

Calibration graph

Employing the condition described in the procedure, a linear calibration graph for cefixime is obtained Fig. (3), which shows that Berr's law is obeyed over the concentration range of (2-30) mg/L.

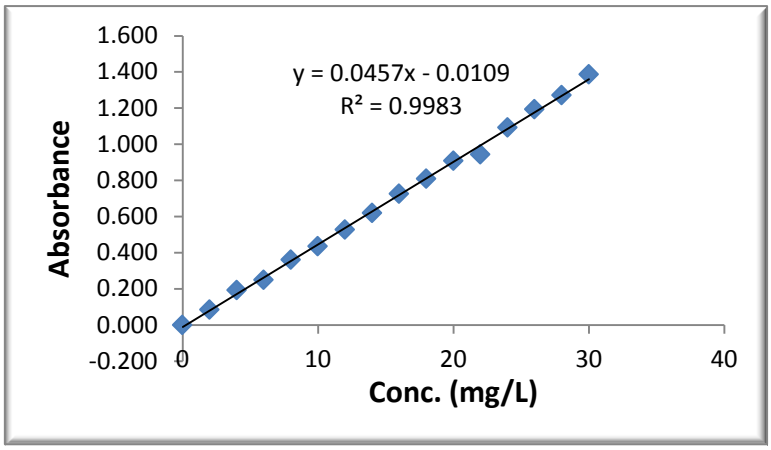

Fig. (3): Calibration graph of cefixime

Batch experiments

Batch experiments were done in (100 ml) a volumetric flask included (25 ml) of cefixime solution with concentration (10 mg/L) and (0.5 gm) of adsorbent surface. Experiments were performed in constant temperature of 37 ˚C to determine the equilibrium concentrations and the effect of contact time on cefixime adsorption on bentonite. pH values of cefixime solutions were adjusted by 0.1 N HCl and NaOH in the range between 1.2 to 7. Solution temperature was set between 25 to 45 ˚C to understand the temperature influence on adsorption process. The influence of ionic strength on bond and free salt solution was determined by adding (0.1, 0.2 and 0.3) M of sodium chloride. Concentration in solution before and after adsorption according to the equation:

$$Qe = \frac{(Co-Ce)V}{w} \quad \ldots\ldots (1)$$

And the percentage of drug removal was determined using the equation:

$$\% \text{ of removal} = \frac{Co-Ce}{Co} \times 100 \quad \ldots\ldots (2)$$

Where Co and Ce are the initial and final concentration in (mg/L), V is the solution volume in (L) and W is the mass of clay sample used (g).

Factors affecting efficiency of cefixime adsorption on bentonite

Effect of contact time

Table (1) and in Fig. (4) is showing the relation between contact time and adsorption of cefixime on bentonite. As result, a direct association is observed among these two factors at first, which means time decreases and after some time adsorption rate changes more slowly and ultimately since reaching equilibrium time, it remained unmoving. Time 15 min. is chosen as equilibrium time and other experiments were done at this time. As it is shown in Table (1) in Fig. (4).

Table (1): Effect of contact time on adsorption of cefixime on bentonite, Co (10 mg/L), volume (25 ml), weight of clay (0.5 gm), temperature (25 ˚C)

Time (min.)	Ce (mg/L)	Qe (mg/g)	% Removed
15	1.133	0.4333	88.68
30	1.955	0.4022	80.45
45	2.933	0.3533	70.45
60	2.977	0.3511	70.23
75	2.088	0.3956	79.12
90	2.500	0.3750	75.00
105	2.600	0.3700	74.00
120	3.266	0.3367	67.34

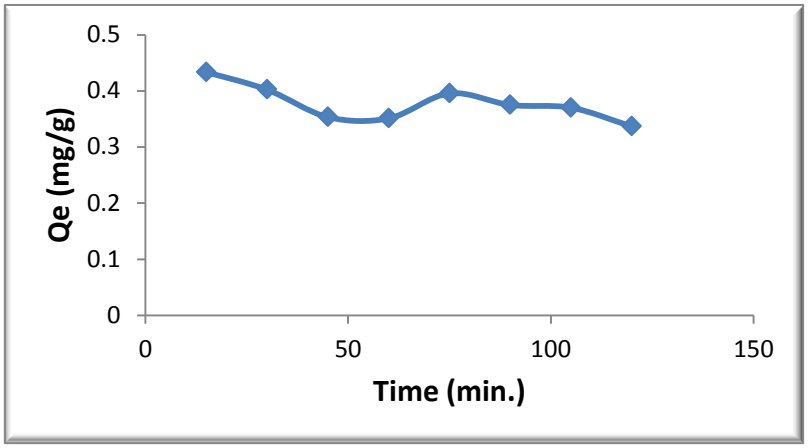

Fig. (4): Effect of the contact time on the adsorption of cefixime on bentonite

Effect of temperature

The effect of temperature on the adsorption of cefixime on bentonite at three different temperatures 25, 37 and 45 ˚C. The results obtained are listed in Table (2) and Fig. (5). The equilibrium adsorption capacities slightly decreased with an increase of temperature from 25 to 45 ˚C.

Table (2): Effect of temperature on the adsorption of cefixime on bentonite, volume (25 ml), weight of clay (0.5 gm)

Co (mg/L)	25 ˚C		37 ˚C		45 ˚C	
	Ce (mg/L)	Qe (mg/g)	Ce (mg/L)	Qe (mg/g)	Ce (mg/L)	Qe (mg/g)
0	0	0	0	0	0	0
10	03.6660	0.3167	07.9550	0.1022	06.0880	0.1956
14	05.0880	0.4456	10.8440	0.1578	08.1550	0.2922
18	06.5111	0.5744	12.5110	0.2744	10.3330	0.3833
22	08.4666	0.6766	14.8440	0.3578	11.8660	0.5067
26	10.6440	0.7677	15.7770	0.5111	13.7110	0.6144
30	11.7110	0.9144	17.2880	0.6350	17.2660	0.6366

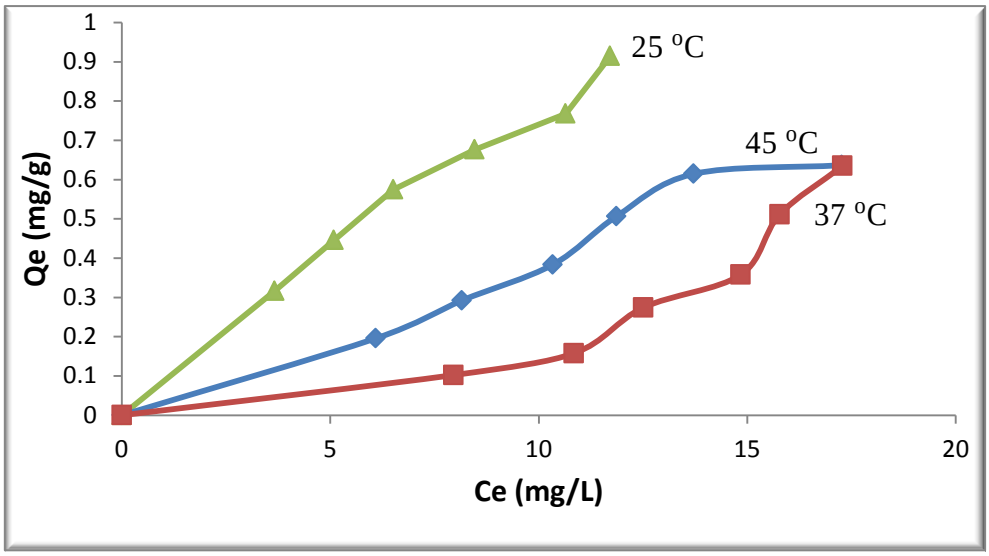

Fig. (5): Effect of temperature on adsorption of cefixime on bentonite

Effect of weight of clay

Dependency of cefixime sorption process from different weight of bentonite (0.1-1.5) gm at temperature (37 ˚C). The results are given in Table (3) and Fig. (6). The examination of data reveals that sorption percentage increases with increases of weight of bentonite in solution.

Table (3): Effect of weight of clay on adsorption of cefixime on bentonite, Co (10 mg/L), temperature (37 ˚C), volume (25 ml)

Weight of clay (gm)	Ce (mg/L)	Qe (mg/g)	% Removed
0.1	9.577	0.1057	04.23
0.3	9.288	0.0593	07.12
0.5	7.955	0.1022	20.45
0.7	6.755	0.1158	32.45
0.9	6.688	0.0920	33.12
1.1	6.555	0.0782	34.45
1.3	5.422	0.0880	45.78
1.5	6.288	0.0618	37.12

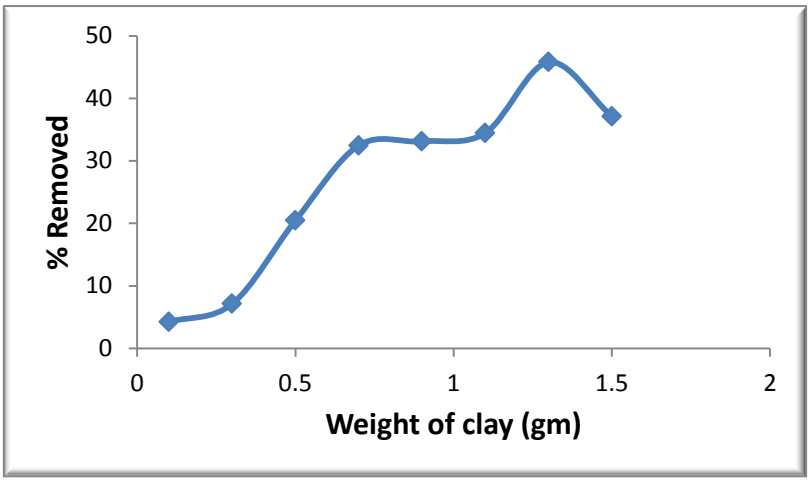

Fig. (6): Effect of weight of clay on adsorption of cefixime on bentonite

Effect of pH

pH is one of the most striking parameter on adsorption process. H^+ competition with probable existing cation to occupy the active sites, influence on sorbent surface properties and sorbate solubility are the main reasons for functionality of pH. As it can be seen in Table (4) and Fig. (7), pH = 5 is the optimum pH value in cefixime sorption.

Table (4): Effect of pH on adsorption of cefixime on bentonite Co (10 mg/L), volume (25 ml), temperature (37 ˚C), weight of clay (0.5 gm)

pH	Ce (mg/L)	Qe (mg/g)	% Removed
1.2	8.1211	0.0939	18.7890
3.0	8.0000	0.1000	20.0000
5.0	7.9550	0.1022	20.4500
7.0	8.0120	0.0994	19.8800

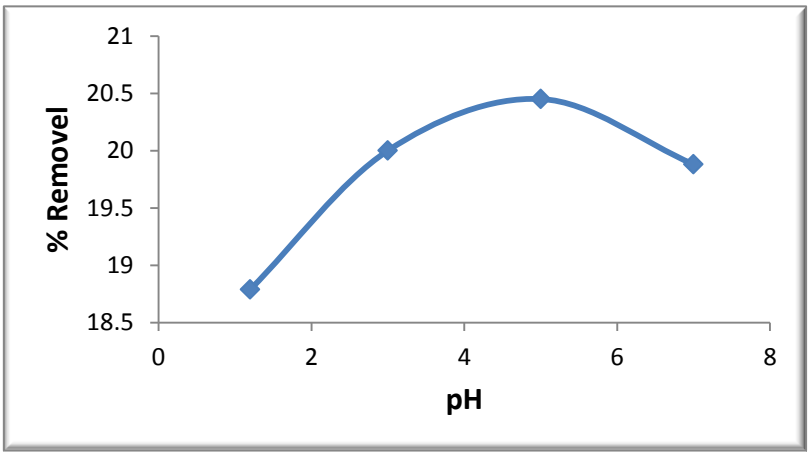

Fig. (7): Effect of pH on adsorption of cefixime on bentonite

Effect of ionic strength

The result obtained for both free and supported catalyst are given in Table (5) and Fig. (8). The clay supported catalyst appears significantly less active at high ionic strength than the free salt solution (aqueous solution) and the percentage of removal will decrease Table (5). Hence, the adsorption of catalyst given less stabilization to the active site against electrostatic interactions. The influence of ionic strength on bond and free salt solution was determined by adding (0.1, 0.2 and 0.3) M sodium chloride to the reaction medium at constant pH and temperatures. These results show that when the ionic strength was increased, the activity of the immobilized catalyst reduced more than the activity of the free catalyst.

Table (5): Effect of ionic strength on adsorption of cefixime on bentonite, Co (10 mg/L), volume (25 ml), temperature (37 ˚C), weight of clay (0.5 gm)

Conc. (M)	Ce (mg/L)	Qe (mg/g)	% Removed
without	7.9550	0.10225	20.450
0.1	8.0000	0.10000	20.000
0.2	8.1111	0.09440	18.889
0.3	8.1555	0.09220	18.445

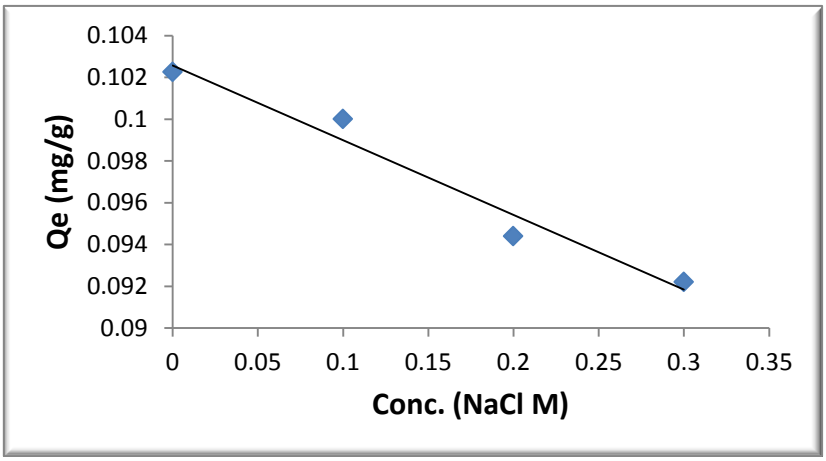

Fig. (8): Effect of ionic strength on adsorption of cefixime on bentonite

Adsorption isotherms

The adsorption isotherm indicates how the adsorbed molecules distribute between the liquid phase and the solid phase when the adsorption process reached an equilibrium state. Langmuir and Freundlich are two common adsorption isotherms which are studied in this present work and the results are shown in Tables (6) and Figs. (9,10).

Table (6): Freundlich constants for adsorption of cefixime on bentonite

n	k_f	R^2
0.6238	0.0067	0.9870

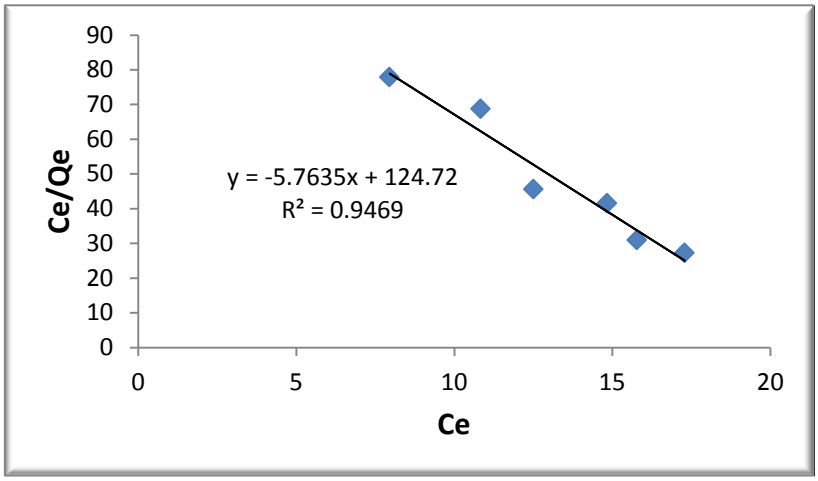

Fig. (9): Langmuir isotherm curve

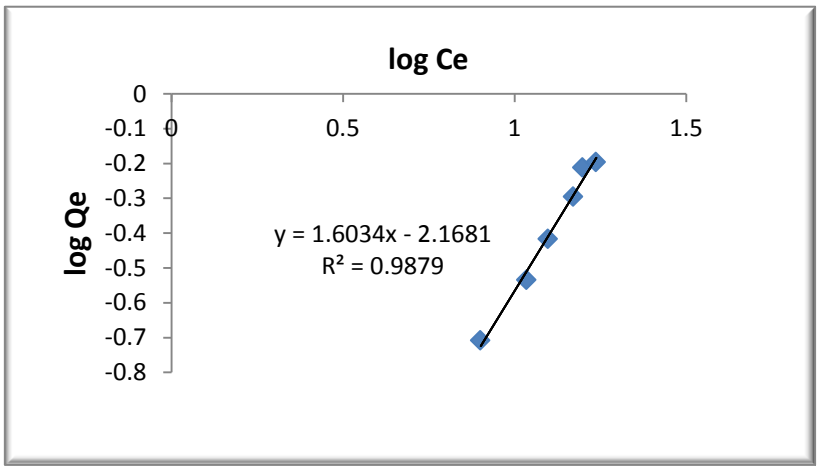

Fig. (10): Freundlich isotherm curve

Conclusion

The sorption of drug on the adsorbents was affected by the parameters such as pH, contact time and adsorbent dosage. The equilibrium sorption data fitted the Freundlich isotherm model better than the Langmuir.

References

[1] Bhangel P.G., Meherez A.P. and Katolkarz P.P., "Devlopment of UV spectrophotometer method of cefixime in bulk and pharmaceutical tablet dosage formulation", International Journal of Research and Development in Pharmacy and Life Sciences April-May, 2013, 2(3), 460-463.

[2] Mohammed M.A., Mezaal E.N. and Sadiq K.A. "Simultaneous determination of cephalexin and cefixime by first and second derivative ultraviolet spectrophotometry", Journal of the College of Basic Education, 2016, 22(93), 89-100.
[3] Budavari S. Eds. In. The Merck Index and Co., Inc; 13th Ed: Whitehouse Station, NJ; 2001, 1213 and 1229.
[4] Jafari M., Aghamiri S.F. and Khaghanic G., "Batch adsorption of cephalosporins antibiotics from aqueous solution by means of multi-walled carbon nanotubes", World Applied Sciences Journal, 2011, 14(11), 1642-1650.
[5] Alkhazrajy O.S., Abdul Latif M.H. and Al-Abayaji M.A., "Adsorption of metoclopramide hydrochloride on to burned initiated Iraqi bentonite", Journal of Al-Nahrain University, June, 2012, 15(2),35-46.
[6] Goth A., "Medical Pharmacology", 11th ed., the C.V. Mosby Company, Toron, 1984, 721-722.
[7] Arshad H.M., Gauhar S., Bano R. and Muhammad I.N. "Development of HPLC-UV method of analysis of cefixime in raw materials and capsule", Jordan Journal of Pharmaceutical Sciences, 2009, 2(1), 53-65.
[8] Khandagle K.S., Gandhi S.V., Deshpande P.B. and Gaikwad N.V., "A simple and sensitive RP-HPLC for simultaneous estimation of cefixime and of loxacin in combind tablet dosage form", International Journal of Pharmacy and Pharmaceutical Sciences, 2011, 3(1), 46-48.
[9] Kumar R., Singh P. and Singh H., "Development of colorimetric method for the analysis of pharmaceutical formulation containing both ofloxacin and cefixime", International Journal of Pharmacy and Pharmaceutical Sciences, 2011, 3, 152-155.
[10] Al- Momani I.F."Spectrophotometric determination of selected cephalosporins in drug formulation using flow injection analysis", Journal of Pharmaceutical and Biomedical analysis, 2001, 25, 751-757.
[11] Khandagle K.S., Gandhi S.V., Deshpande P.B. and Gaikwad V.N., "High performance thin layer chromatographic determination of cefixime and ofloxacin in combind tablet dosage form", Journal of Chemical and Pharmaceutical Research, 2010, 5, 92-96.

امتزاز السفكسيم على سطح البنتونايت العراقي

الهام نغيمش مزعل

جامعة بغداد / كلية التربية للعلوم الصرفة - ابن الهيثم / قسم الكيمياء

الخلاصة

يتناول موضوع هذا البحث دراسة امتزاز السفكسيم على سطح طين عراقي متوفر محليا" هو البنتونايت للبحث عن سطح انتقائي ذو فعالية في امتزاز هذه المادة الدوائية التي تسبب التسمم في حالة تعاطيها بجرعات تفوق الجرعات الاعتيادية. تم استخدام تقنية مطيافية الاشعة فوق البنفسجية عند طول موجي (٢٧٣) نانوميتر لمعرفة كميات امتزاز هذا الدواء على سطح البنتونايت وعند ظروف متباينة من درجة الحرارة (٢٥، ٣٧، ٤٥) °م حيث وجد أنه يقل الامتزاز بزيادة درجة الحرارة. وتم دراسة تأثير وزن سطح البنتونايت على الامتزاز وجد ان الامتزاز يزداد بزيادة وزن السطح من (٠.١-١.٥) غرام، ودراسة تأثير الـ pH (١.٢، ٣، ٥، ٧) على الامتزاز حيث وجد ان اعظم امتزاز عند (pH = ٥). واخيرا" دراسة الشدة الايونية باستخدام محلول NaCl بتركيز (٠.١-٠.٣) مولاري حيث يقل الامتزاز بزيادة تركيز الملح. ان نتائج ايزوثرمات الامتزاز تطابق ايزوثرم فريندلش.

الكلمات المفتاحية: أمتزاز، سفكسيم، بنتونايت.