Thermodynamic Study of Para nitro Aniline (PNA) Adsorption using Kaolin Clay

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Abstract

The Adsorption of para nitro anline (PNA), by kaolin clay have been achieved investigation by study the effect of initial concentration temperature on this process.

The equilibrium concentration have been performed calculated spectrophoto metrically by using ultra violet-visible technique.

The thermodynamic parameters $(\Delta G, \Delta H, \Delta S)$ have been measured the adsorption is endothermic.

Keywords: Thermodynamic Study, Para PNA, Kaolin, Clay

Introduction

The Solid adsorbed represent a very extensive application both in the laboratory and industry, but is still not clearly understood (1, 2, 3, 4, 5)

Solids have property is quite marked in the case of porous and finely divided materials (6).

Adsorption occurs on the surface of a solid because of the attractive forces of the or molecules in the surface of the solid. Various forces are involved ranging from those, which are definitely in nature to those which referred as chemical (7)

Kaolin and effective in treating systemic endotoxamia in an experimental model of colitis by adsorbing the toxins. (8)

Studied the in-vitro adsorption of mebeverinc HCl on the Kaolin and found that the adsorption process independent of pH, and affected with the electrolyte concentration. She included two mechanisms for this behavior, with activity and physic sorption. She included two mechanisms for this behavior, activity and physic sorption. She pointed that the presence of kaolin with the table of the drug adversely affected the release rate HCl (9) .

The present work tends to thermodynamic study of the adsorption of para nitro aniline (PNA)using kaolin day at different conditions.

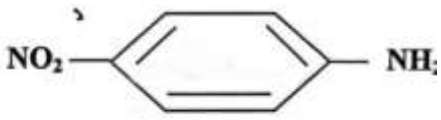

Figure (1): Structure for PNA

Instruments of this study were: Digital balance, Ultraviolet-visible, spectrophotometer (single Beam), Digital pH-meter, shaker water bath, and oven.

Experiments

The adsorption isotherms have been determined by allowing PNA to prepare different concentrations to be mixed with a suitable weight of kaolin clay in a closed flask at fix temperature and pH.

The weight of kaolin have been contained 0.05/25(ppm) gm/ml as solution percentage. By using a good mixing through constant temperature for 2 hours.(10)

Materials and methods

Materials

Kaolin obtained from (Dwaikhla) opened mine (North ofRutba) in the western desert.

It is a grayish -white, odorless, and has earthy taste. Practically in soluble in water, acids and alkali hydroxides. The main components of Kaolin were shown by this table :(1)

Table (1)
The chemical structure of each component in Kaolin Clay:

Compounds	Wt%
SiO_2	54.68
Al_2O_3	30.19
Fe_2O_3	1.02
TiO_2	1.00
Losson Ignition	10.94
Total	97.83

Para nitro aniline (PNA) obtained from B.D.H., (92% purity) the structural form of paranitro aniline (PNA) is given in figure(l).

The adsorption isotherms have been determined by allowing PNA solution of determined concentration to be mixed with accurate weight of kaolin clay in a closed flask at same temperature and pH.

The concentration of kaolin has been 0.05/25 gm/ml (ppm). the mixing was be done at fix temperature through water bath. The Kaolin-solution has been heated for 2 hours, The Clay suspensions have been filtrated and the filtrate solution was transfer to the analysis instrument: Ultraviolet-visible at 480nm.

Same experiment was repeated again at different concentrations, temperature to calculate different parameter for the study.(11)

Result and Discussion

The volume of PNA was adsorbed per unit weight of an adsorbent, Qe was found by the following formula:

$$Qe = \frac{(Co-Ce)V}{M} \quad \text{..... (1)}$$

Where, Co the initial concentration of PNA (mgl^{-1}), Ce: the equilibrium concentration of PNA in the mixture, m: the mass of clay kaolin per unit of volume (L).

The Results that Concerned

The results of PNA adsorption for Kaolin were presented in Figures (2,3,4).

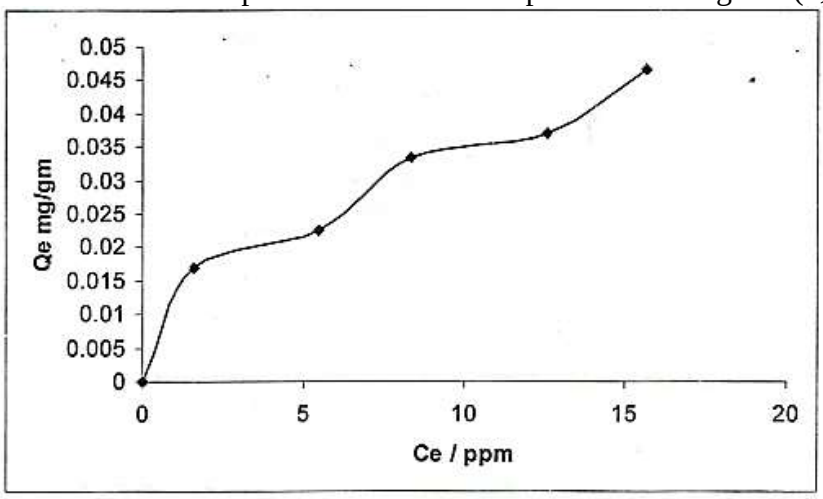

Figure (2): Adsorption isotherm of PNA on Kaolin surface at 295.15K.

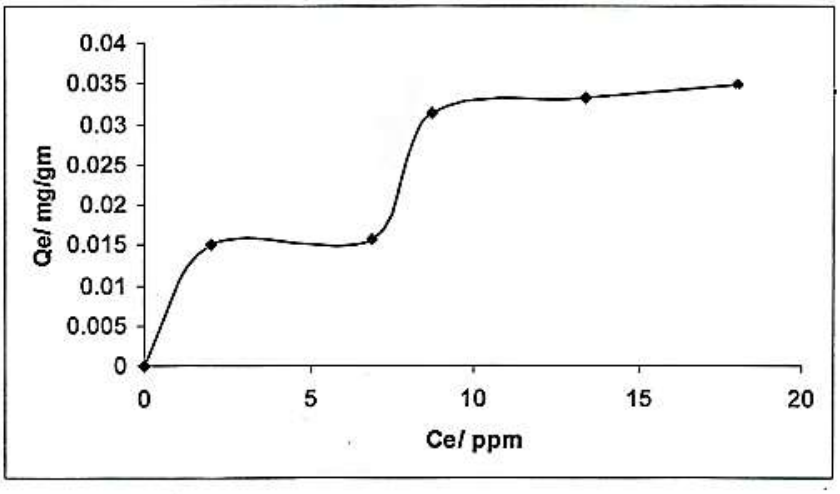

Figure (3): Adsorption isotherm of PNA on Kaolin surface at 305.15K.

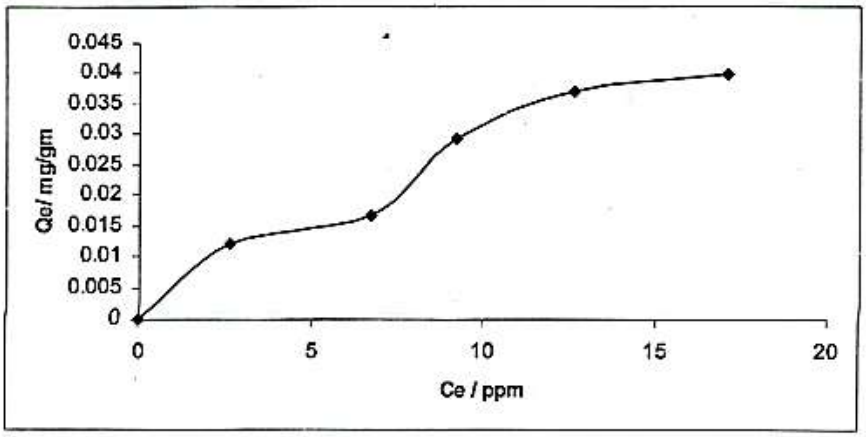

Figure (4): Adsorption isotherm of PNA on Kaolin surface at 315.15K.

Thermodynamic variables:

The thermodynamic. variables for the adsorption of PNA by Kaolin such as the enthalpy change (ΔH^0), So, the Gibbs free energy (ΔG^0) and the entropy change (ΔS^0) can be calculated by the following thermodynamic relations: (11)

$$\ln K_e = A - \frac{\Delta H^0}{RT} \quad \ldots\ldots\ldots\ldots (2)$$

$$\ln K_e = \frac{\Delta G^0}{RT} \quad \ldots\ldots\ldots\ldots (3)$$

$$\Delta S^0 = \left(\frac{\Delta H^0 - \Delta G^0}{T}\right) \quad \ldots\ldots\ldots\ldots (4)$$

According to equation (2), the mean value of the enthalpy change due to the Adsorption of PNA as the Kaolin in different temperatures that studied can be determined graphically by the linear plotting of Ink against 1/T using least squares analysis, shown by the figures (5). (12)

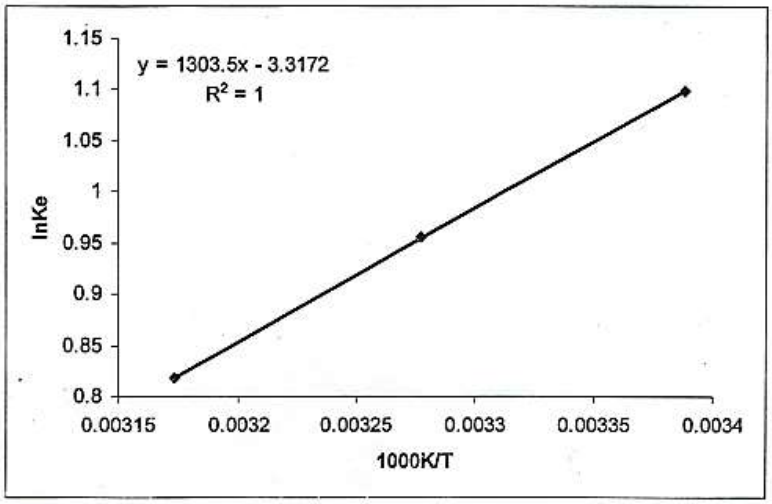

Figure (5): Van't Hoff equation for adsorption of PNA on Kaolin surface at different temperature

As an important result can be obtained from table (2) is appear (ΔG^0) Gibbs free energy decrease with increasing temperature. The values:

Table (2): thermodynamic values for the adsorption of PNA on the Kaolin clay

T/K	$\Delta H^0.(Kj/mole)$ Mean Value	$\Delta G^0(Kj/mole)$	$\Delta S^0 J/K.mole$ Mean value
295.15	27.58407	10837.3	2695.86
305.15	27.57054	10837.3	2424.149
315.15	27.58432	10837.3	2144.102

Through the plotting Qe against Ce, the curve will be obtained as linear relationship.. The values of Xm and K calculated for the slopes intercept of the Longmuir plots and the correlation coefficients R6. So through this study the adsorption is obay the Longmuir equation with correlation coefficients R2> 1.0. (13)

The adsorption curves were also applied to Freundlich equation in figure (2,3,4). The Freundlich isotherm is given by this equation: (14)

$$Q_e = KfC_e^{1/n} \quad \text{..... (7)}$$

Conflict of Interests.

There are non-conflicts of interest .

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الخلاصة

تم دراسة امتزاز مركب–نايتروانيلين باستخدام طين الكاؤولين كدالة للتركيز ودرجة الحرارة وبظروف مختلفة. تم احتساب تراكيز الاتزاز طيفيا باستخدام تقنية الاشعة المرئية– فوق البنفسجية، تم احتساب الدوال الثروديناميكية $(\Delta G, \Delta H, \Delta S)$ على عملية الامتزاز وان عملية الامتزاز ماصة حراريا.

الكلمات الدالة: ثرموديناميك، بارا نايتروانيلين ، كاؤولين ، الطين