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Investigation of Langmuir, Freundlich and Temkin Isotherms Adsorption of Furosemide (Diuretic Drug) by Multi-Wall Carbon Nanotube.

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ABSTRACT

In this experimental research the adsorption of the isotherm of Furosmide is studied on the multi-wall carbon nanotube with the spectrophotometer. The amount of adsorption in various conceterations was calculated and its related diagram was drawn. The result, which was obtained by Langmuir, Freundlich and Temkin in 296±2 K, compared coefficient parameters show that the Freundlich has the most accordance.
Keywords: Adsorption, Isotherm, Multi-wall carbon nanotube, Furosemid.

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INTRODUCTION

Carbon nanotubes (CNTs) are allotropes of carbon with a cylindrical nanostructure. Nanotubes have been constructed with length-to-diameter ratio of up to 132,000,000:1[1], significantly larger than for any other material. These cylindrical carbon molecules have unusual properties, which are valuable for nanotechnology, electronics, optics and other fields of materials science and technology. In particular, owing to their extraordinary thermal conductivity and mechanical and electrical properties, carbon nanotubes may find applications as additives to various structural materials. Multiwalled carbon nanotubes (MWCNTs) can adsorb many atoms and molecules on their surface such as adsorption of metallic elements. Adsorption characteristic of MWCNTs is breather for adsorption of gases such as hydrogen and other gases. All of the compounds on the surface of MWCNTs adsorbed two main covalent bonds and non-covalent bonds [2,3]. Non-steroidal drugs (NSAIDs) are drugs that inflammation, pain and reduce fever. These drugs are among the most widely used drugs that are prescribed to treat various diseases and conditions. Furosemide belongs to a group of medicines called loop diuretics (also known as water pills). Furosemide is given to help treat fluid retention (edema) and swelling that is caused by congestive heart failure, liver disease, kidney disease, or other medical conditions. It works by acting on the kidneys to increase the flow of urine. Furosemide is also used alone or together with other medicines to treat high blood pressure (hypertension). High blood pressure adds to the workload of the heart and arteries. If it continues for a long time, the heart and arteries may not function properly. This can damage the blood vessels of the brain, heart, and kidneys, resulting in a stroke, heart failure, or kidney failure. High blood pressure may also increase the risk of heart attacks. These problems may be less likely to occur if blood pressure is controlled[3,4]. In this research, some non-steroidal anti-inflammation on multi walled carbon nanotube were studied and tried to find out how this drugs can be adsorbed by carbon nanotube.

EXPERIMENTAL

At first we solved 0.01 g of Furosemide in 100 ml of water and make (100 ppm) solution. After dilution of this solution the consistencies (10, 20, 30, 40) ppm were produced. 10 ml of each concentration was taken and 0.01 g of multi-walled carbon nanotube (MWCNT) was added to each part. This solution was mixed about 10 min with magnetic stirrer. Then amount of concentration was measured with spectrophoto before and after adding carbon nanotube.

RESULT AND DISCUSSION

Adsorption isotherms

Equilibrium study on adsorption provides information on the capacity of the adsorbent. An adsorption isotherm is characterized by certain constant values, which express the surface properties and affinity of the adsorbent and can also be used to compare the adsorptive capacities of the adsorbent for different pollutants. Equilibrium data can be analyzed using commonly known adsorption systems. Several mathematical models can be used to describe experimental data of adsorption isotherms. The Freundlich, Langmuir and Temkin models are employed to analysis adsorption occurred in the experiment.

Langmuir model

The Langmuir adsorption model is the most common model used to quantify the amount of adsorbate on an adsorbent as a function of partial pressure or concentration at a given temperature. This equation expressed by relation.

$$C_e/q_e = 1/q_m + 1/q_m b \; C_e \qquad (1)$$

In this equation, q_e (mg. g^{-1}) is the solution was adsorbed the surface and q_e is equilibrium constant of adsorption and b is the capacity of adsorption in saturated single layer and c_e (mg. l^{-1}) is solution in equilibrium state(fig 1) and its calculated parameters can be seen in table 1.
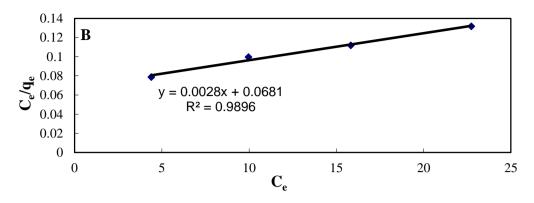
fig.1: Langmuir isotherm of Furosmide on CNT

Freundlich model

The Freundlich equation or Freundlich adsorption isotherm is an adsorption isotherm, which is a curve relating the concentration of a solute on the surface of an adsorbent, to the concentration of the solute in the liquid with which it is in contact. In 1909, Freundlich gave an empirical expression representing the isothermal variation of adsorption of a quantity of gas adsorbed by unit mass of solid adsorbent with pressure. This equation is known as Freundlich Adsorption Isotherm or Freundlich Adsorption equation. This model is specified with equation.

$$q_e = k_f C_e^{1/n} \rightarrow \qquad ln q_e = ln k_f + 1/n \; ln \; C_e \qquad (2)$$

In this equation, q_e (mg.g^{-1}) is amount of absorbed material in absorbent surface, K, n in arrangement are adsorption capacity an adsorption intensification (fig 2) and its calculated parameters can be seen in table 1.
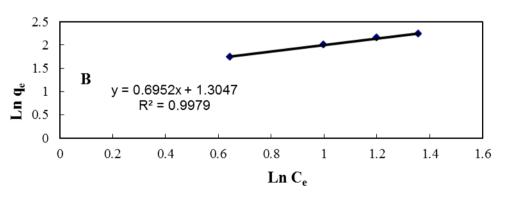

Fig. 2: Freundlich isotherm of Furosmide on CNT

Temkin model

The Temkin model is linearly represented as equation (3) and generally applied in the form:

$$q_e = B \; ln \; A + B \; ln \; C_e \qquad (3)$$

Where A and B are the Temkin isotherm constant (L/g) and heat of sorption (J/mol) respectively. R is the gas constant (J/mol/k), b is the Temkin isotherm constant linked to the energy parameter, B, as shown on equation:

$$b = RT/B \qquad (4)$$

T is the absolute temperature in kelvin (fig 3) and its calculated parameters can be seen in table 1.

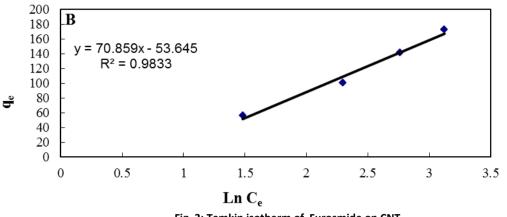**Fig. 3: Temkin isotherm of Furosmide on CNT**

Table 1: Parameters and Correlation Coefficient of Langmuer, Temkin and Freundlich for Furosmid

Langmuir			FREUNDLICH			Temkin		
K_a(L/mg)	Q_m(mg/g)	R^2	n	K_f(mg/g)	R^2	K_t(L/mg)	B	R^2
0.041116006	357.1428571	0.9896	1.438434983	$10^{1.3047}$	0.9979	$e^{0.757193864}$	70.859	0.9833

CONCLUSION

The results of this survey show the correlation coefficient of Freundlich isotherm equation has the best accordance and its adsorption energy is high. The result of parameters show the suitable efficiency of multi-wall carbon nanotube in adsorption of furosemide.

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