Al-Mustaqbal University
College of Engineering and Engineering Technologies
Department of Chemical Engineering and Petroleum Industries

EXPERIMENTS(1)

SECOND CLASS

1ND SEMESTER

PHYSICAL CHEMISTRY LABORATORY

By

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Experiment No. (1): ***Surface Chemistry Adsorption by Solid from Solution***

Object of Experiment:

Determination the adsorption isotherm of oxalic acid on bone charcoal.

Theory:

The molecular forces at the surface of solid and liquid are usually unbalanced or unsaturated. As a result of this unsaturated exposed surface tends to satisfy their residual forces by attracting and retaining onto other substances with which they come in contact, the phenomenon is known as adsorption.

Solids may adsorb dissolved substances from solutions, as well as gases. In sugars refining For example, colored materials and impurities may be removed by filtering through adsorbents such as charcoal. Adsorption of solutes from solution involves the establishment of equilibrium between the amount adsorbed and the concentration of substance in solution. The variation of the amount adsorbed with concentration may be represented by an isotherm of the Freundlich type.

$$\frac{X}{m} = KC^{\frac{1}{n}} \dots \dots \dots \quad (1)$$

Where:

x = The amount of adsorbate for one gm of adsorbent.

C = The equilibrium concentration of solute in solution.

K & n = Are constants.

The relation may be written in the form:

$$log\frac{x}{m} = logK + \frac{1}{n}logC \ldots\ldots\ldots \quad (2)$$

A plot of log $\frac{x}{m}$ against log C should therefore be as straight line of slope $\frac{1}{n}$ and intercept log K.

Procedure:

1- Clean and dried 4 round conical flasks, then introduce the following solutions:

a. 10 ml of 0.1 *N* oxalic acid

b. 7.5 ml of 0.1 *N* oxalic acid + 2.5 ml of H_2O

c. 5 ml of 0.1 *N* oxalic acid + 5 ml of H_2O

d. 2.5 ml of 0.1 *N* oxalic acid + 7.5 ml of H_2O

2- Add for each conical flask 0.3 gm of charcoal and then shake them for 30 min.

3- Filtrate the solutions by using filter paper.

4- Add 5 ml of 2 *N* H_2SO_4 to each 5 ml of filtrate, and then titrate with 0.1 N $KMnO_4$.

Calculations:

1. Calculate the normality of original oxalic acid for each flask before adding 3 gm of charcoal :-

Flask (1) (without adding water):

(before dilute) (after dilute)

$N_O * V_O = N_{O1} * V$

$0.1 * 10 = N_{O1} * 10$

V = Final volume of solution (Oxalic + Water)

$N_{O1} = 0.1\ N$

Flask (2) (7.5 ml oxalic acid + 2.5 ml water):

$N_O * V_O = N_{O2} * V$

$0.1 * 7.5 = N_{O2} * 10$

$N_{O2} = 0.075\ N$

Flask (3) (5 ml oxalic acid + 5 ml water):

$N_O * V_O = N_{O3} * V$

$0.1 * 5 = N_{O3} * 10$

$N_{O3} = 0.05\ N$

Flask (4) (2.5 ml oxalic acid + 7.5 ml water):

$N_O * V_O = N_{O4} * V$

$0.1 * 2.5 = N_{O4} * 10$

$N_{O4} = 0.025\ N$

2. After adding charcoal to the oxalic acid and filtrate it, the normality of oxalic acid can be calculated from:-

Flask (1)

(oxalic acid) ($KMnO_4$)

$N_1 * V = N_2 * V_2$

$N_1 * 10 = 0.1 *$ (from burette)

N1 = ⬭

Normality of oxalic acid before adding charcoal	-	Normality of oxalic acid after adding charcoal	=	Oxalic acid adsorbed

$$N_{O1} - N_1 = N$$

4- Weight of Oxalic acid ($H_2C_2O_4.H_2O$) adsorbed (X):-

$$X / eq.wt. = N * V / 1000 \iff N = \frac{X * 1000}{eq.wt. * V}$$

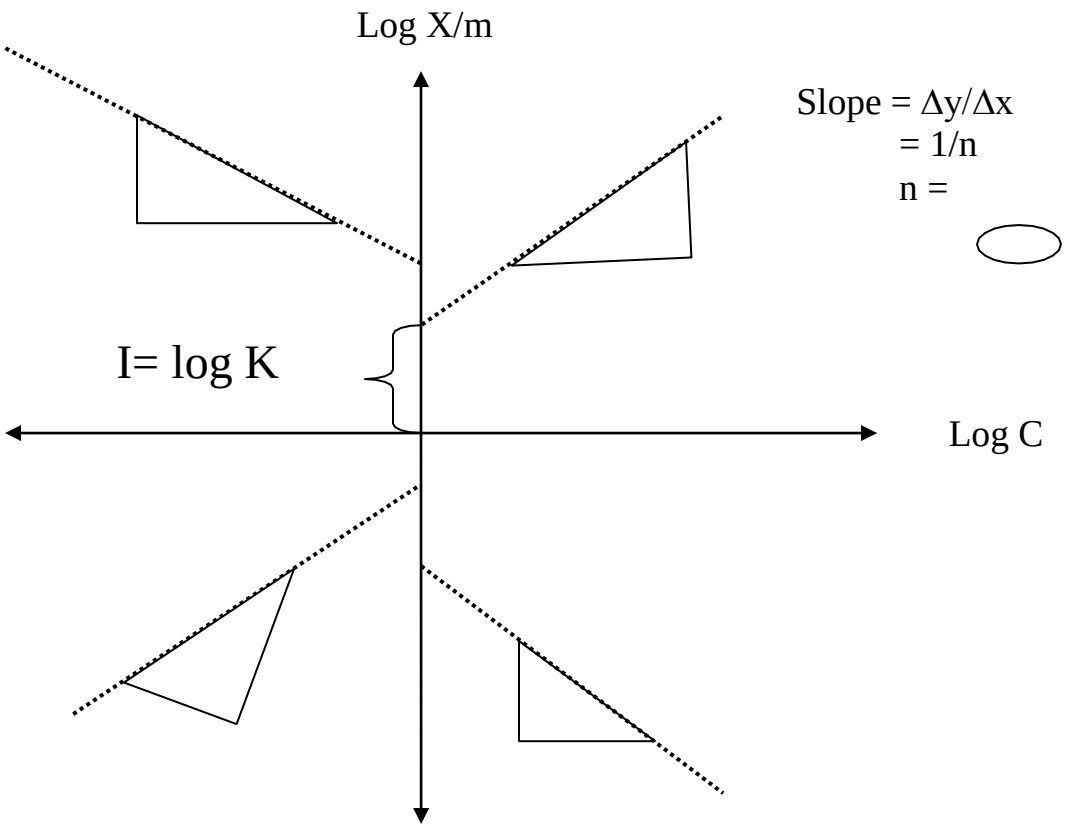
eq.wt. = Mwt / Valancy

- Concentration of Oxalic acid (C) = N * eq. wt.

(Repeat the previous calculations for the remaining flasks)

Table of results:

Run	X / m	C	Log X/ m	Log C
1				
2				
3				
4				



Discussion:

1. What are the behaviors of KMnO and oxalic acid?
2. What is the benefit of using charcoal in experiment?
3. What is the different between adsorption and absorption?
4. What is the reason for the instability of KMnO4 color during the titration?