# *Experiment No. 7.1*

**Investigate the adsorption of oxalic acid on charcoal and prove the validity of Freundlich, s adsorption isotherm.**

**Apparatus & Chemicals:** Burette, pipette, reagents bottles, charcoal, phenolphthalein, oxalic acid, sodium hydroxide, shaker etc.

**Principle:** Certain solids such as charcoal, fuller's earth, colloidal hydroxide have the property of holding the molecules at the surface. This phenomenon of adsorption takes place in the boundary surface between two phases and this is especially the case if the second phase is a solid with a large surface and is in contact with a gas or solution. This phenomenon of concentration at the interface of two phases is called adsorption. We know that amount adsorbed is dependent on pressure and temperature. Hence we can say that the amount ($a$) adsorbed is a function of pressure (P) and temperature (T).

$$a = f(P, T)$$

A plot of P and $a$, keeping temperature constant is known as adsorption isotherm. Freundlich has studied this phenomenon quantitatively and derived one equation which is known as adsorption isotherm.

$$a = x/m = k\, C^{1/n}$$

Where x = amount of solute adsorbed

m = amount of adsorbing material

C = equilibrium concentration of adsorbate in sulation

k = constant depending upon the nature of adsorbent and adsorbate

n = another constant depending upon the nature of adsorbate,the value of l/n is less then unity.

On taking logarithms of above equation we get:

$$\log x/m = \log k + \frac{1}{n} \log C$$

If the value of log x/m is plotted as ordinate against log C as abscissa, we get a straight line with a slop l/n and intercept on ordinate log k.

**Procedure:** (i) Prepare 250 $cm^3$ 0.5*N* oxalic acid and 250 $cm^3$ of 0.1*N* NaOH by dilution method.

(ii) Take five stoppered reagent bottles clean and dry them, then label them as No.1, 2, 3, 4 and 5. Now prepare the following solutions in each respective bottle.

| Bottle No. | 0.5*N* oxalic acid ($cm^3$) | Water ($cm^3$) | Charcoal (g) | Initial normality of oxalic acid (*N*) |
|---|---|---|---|---|
| 1 | 50 | 0 | 1 | 0.5 |
| 2 | 40 | 10 | 1 | 0.4 |
| 3 | 30 | 20 | 1 | 0.3 |
| 4 | 20 | 30 | 1 | 0.2 |
| 5 | 10 | 40 | 1 | 0.1 |

(iii) Now stopper each bottle and shake well each bottle for an hour, then allow them to stand.

(iv) Filter each solution through a filter paper and collect the filtrate in numbered beakers.

Reject the first 5 $cm^3$ of each filtrate.

(v) Now pipette out 10 $cm^3$ of each filtered solution in a conical flask and titrate it against 0.1*N* NaOH solution using phenolphthalein as an indicator. Take two readings for each solution.

**Observations &Calculations:**

| Bottle No. | Initial conc. ($C_o$) | Equilibrium conc. ($C_e$) | Amount Adsorbed $x = (C_o - C_e)$ | $\frac{x}{m}$ | $\log \frac{x}{m}$ | $\log C_e$ |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |

Plot a graph between log x/m as ordinate and log Ce as abscissa, a straight line will be obtained with slope 1/n and intercept log k

**Result:** Since the graph between log x/m as ordinate and log Ce as abscissa is a straight, hence 0.5*N* solution of oxalic acid proves the validity of Freundlich adsorption isotherm

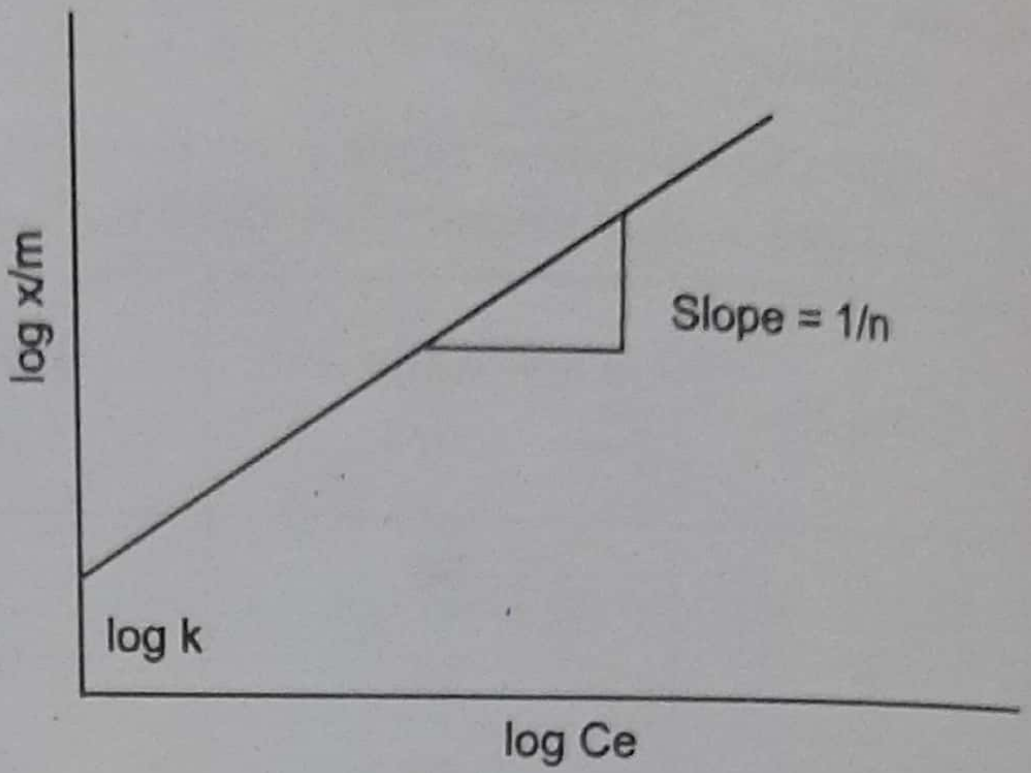


Fig. 7.1. Validity of Freundlich adsoption isolhem.

**Precautions:** (i) Shake the bottles regularly with equal time.

(ii) Filtration of the sample should be done carefully.

(iii) Low concentration of the oxalic acid in the rage of 0.5 to 0.8 is used.

(iv) Standard solution of NaOH is used.