B.Sc. III, Paper-5

Freundlich adsorption isotherm :-

The relationship between amount of amount of gas absorbed on the surface of solid with pressure of gas or concentration in solution at constant temperature is called adsorption isotherm.

Freundlich adsorption isotherm is a classical adsorption isotherm. He gave an empirical formula regarding relation between amount of absorbate (gas) with pressure or concn at constant temperature. That is

$$\frac{x}{m} = k p^{\frac{1}{n}} \quad \text{---} \quad (i)$$

Where x is amount of gas adsorbed, m = amount of solid, P = pressure of gas and k and n are constant which is depend upon nature of gas and solid at constant temperature. Equation (i) is applicable to the adsorption of gases on solid.

Equation (i) can be written as

$$\frac{x}{m} = k c^{\frac{1}{n}} \quad \text{---} \quad (ii)$$

When absorbate is in solution form..

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Equation (i) and (ii) are called Freundlich adsorption isotherms.

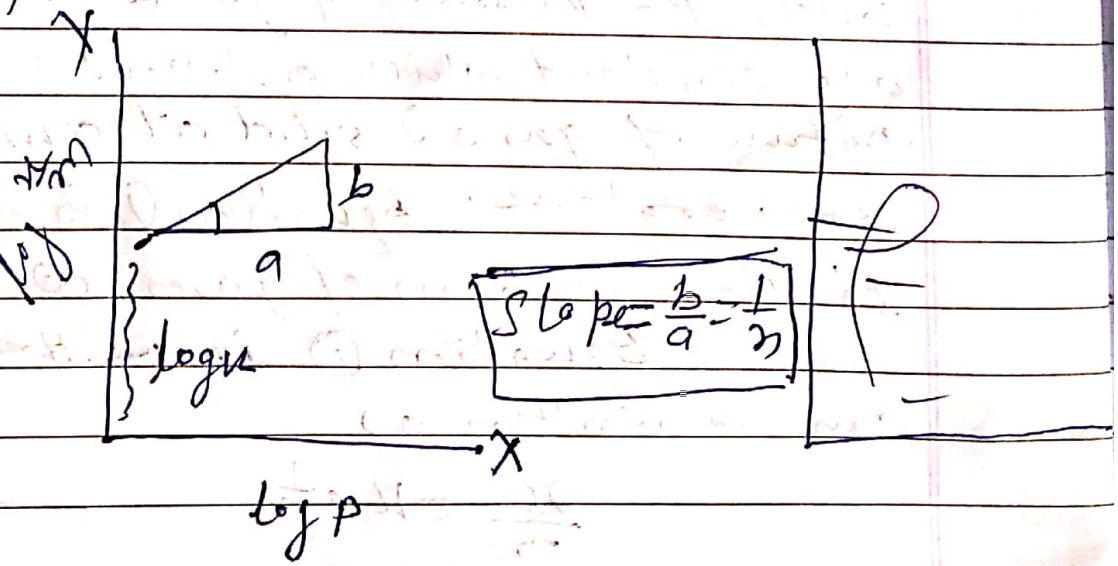
Taking logarithms of eqn (i), we get

$$\log \frac{x}{m} = \log K + \frac{1}{n} \log p \quad \text{(iii)}$$

and taking logarithm of eqn (ii)

$$\log \frac{x}{m} = \log K + \frac{1}{n} \log c \quad \text{(iv)}$$

Thus plotting graph between $\log \frac{x}{m}$ verses $\log p$ or $\log c$, a straight line is obtained. The slope of the line gives value of $\frac{1}{n}$ and intercept on the y axis give value of $\log K$.



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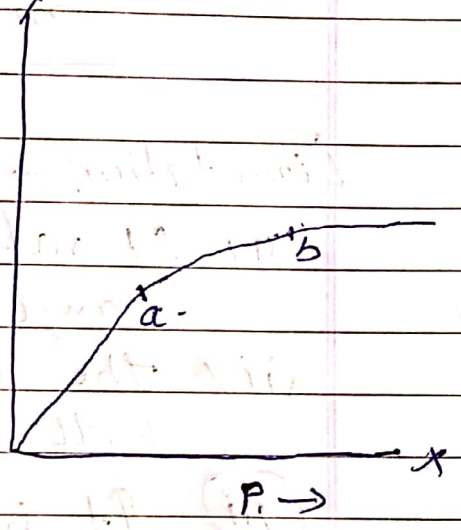
~~Taking plotting graph between $\frac{x}{m}$ verses P will be~~

Let us considered a graph between $\frac{x}{m}$ verses P according to equation (1) we get the graph.



It is seen that initialy at low pressure (upto point a) is linear i.e.

$$\frac{x}{m} \propto P$$

or $\frac{x}{m} \propto P^1$

For very high pressure (beyond point b) the adsorption becomes independent on pressure. i.e.

$$\frac{x}{m} \propto P^0$$

The state corresponding to the point b is called saturation state and corresponding pressure P is called the saturation pressure.

~~Thus Freundlich~~

Thus Freundlich equation

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For intermediate pressure, $\frac{x}{m}$ will be proportional to $p^{\frac{1}{n}}$ i.e power between 0 to 1, so eq can be written as:

$$\frac{x}{m} \propto p^{\frac{1}{n}} \text{ or } \frac{x}{m} = k p^{\frac{1}{n}}$$

Limitation:—

(i) It valid under certain range of pressure

(ii) The value of k and n vary with the temperature

(iii) It is purely a empirical adsorption equation without theoretical foundation.