B. Sc Chemistry Hons) - III

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Adsorption Isotherm

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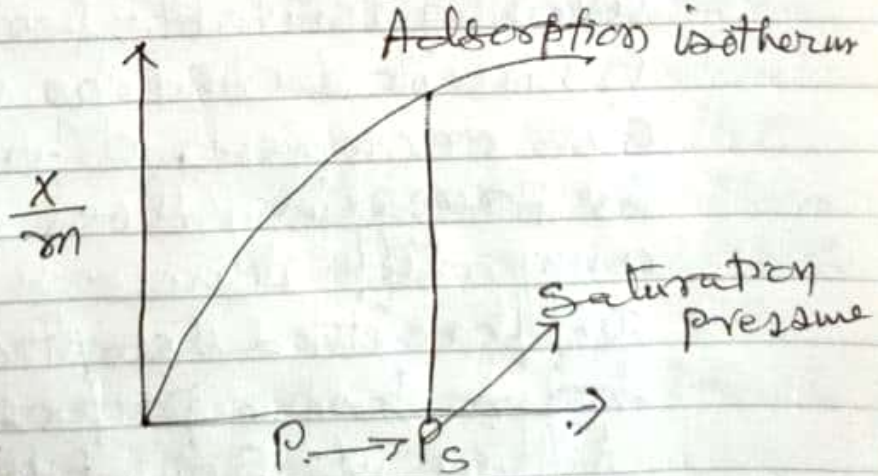
Adsorption isotherms have been of immence importance of researchers dealing with environmental protection and adsorption techniques. The two primary methods used for predicting the adsorption capacity of a given material are known as Freundlich and Langmuir isotherms.

An adsorption isotherm is a graph that represents the variation in the amount of adsorbate (x)



adsorbed on the surface of the adsorbent with the change in pressure at a constant temperature.

As we know from Le Chatelier's principle, the direction of equilibrium in a reaction shifts in the direction in which stress is relieved. So, we can see that upon application of excess pressure on the system, the equilibrium shifts in the direction where the no. of molecules decreases so that the pressure in the system decreases.

From the graph we also observe that after attaining a pressure P_s that is the saturation pressure, the variation in the amount of adsorbent adhering to the adsorbate becomes zero. This happens because the surface area available for adsorption is limited and as all the sites are occupied, a further increase in pressure does not cause any difference.

Different adsorption isotherms have been proposed by different scientists namely:-

1) Langmuir isotherm
2) Freundlich isotherm
3) BET Theory

Langmuir Adsorption Isotherms:-

The Freundlich adsorption isotherm is followed by Langmuir isotherms. The Langmuir adsorption isotherms predicts linear adsorption at low adsorption densities and a maximum surface coverage at higher solute metal concentrations.

The Langmuir adsorption isotherm has the form

$$X/M = abc(1+ac)$$

Where X- is the weight of a solute sorbed by M grams of solid
c = is the equilibrium solute concentration.
a & b = are constants
1/a equals the concentration when ½ of the available adsorption sites.

The Langmuir adsorption is applicable for monolayer adsorption into a homogeneous surface when no interaction occurs between adsorbed species.

Applications of Adsorption

following are the applications :-

(1) Gas Masks :- Poisonous gases get adsorbed at the surface of the mask and prevent its encounter when used by coal miners.

(2) Production of Vaccum :- Traces of air are adsorbed on charcoal and removed from devices undergoing the process of evacuation.

(3) Removal of Moisture :- Silica gel pellets are used for the adsorption of moisture in medicines and new plastic bottles in order to control the humidity.

(4) Removal of Colour :- The juice extracted from cane is treated with animal charcoal for the removal of coloring agent in order to get a clear liquid solution.

(5) As Catalysts :- Suitable materials are used as a catalyst such that reactants get adhered to its surface thus enabling the reaction to proceed at a faster rate and increasing the rate of reaction.

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