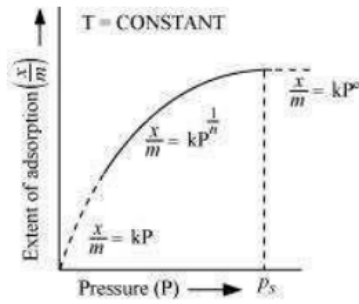


Question 5.5:

What is an adsorption isotherm? Describe Freundlich adsorption isotherm.

Answer



The plot between the extent of adsorption $\left(\frac{x}{m}\right)$ against the pressure of gas (P) at constant temperature (T) is called the adsorption isotherm.

Freundlich adsorption isotherm:

Freundlich adsorption isotherm gives an empirical relationship between the quantity of gas adsorbed by the unit mass of solid adsorbent and pressure at a specific temperature.

From the given plot it is clear that at pressure P_s , $\frac{x}{m}$ reaches the maximum value. P_s is called the saturation pressure. Three cases arise from the graph now.

Case I- At low pressure:

The plot is straight and sloping, indicating that the pressure is directly proportional to

$$\frac{x}{m} \text{ i.e., } \frac{x}{m} \propto P.$$

$$\frac{x}{m} = kP \quad (k \text{ is a constant})$$

Case II- At high pressure:

When pressure exceeds the saturated pressure, $\frac{x}{m}$ becomes independent of P values.

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

$$\frac{x}{m} = kP^0$$

Case III- At intermediate pressure:

At intermediate pressure, $\frac{x}{m}$ depends on P raised to the powers between 0 and 1. This relationship is known as the Freundlich adsorption isotherm.

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

$$\frac{x}{m} = kP^{\frac{1}{n}} \quad n > 1$$

Now, taking log:

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

On plotting the graph between $\log \left(\frac{x}{m} \right)$ and $\log P$, a straight line is obtained with the

