The Liquid State

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Compressibility

In thermodynamics and fluid mechanics, compressibility also known as coefficient of compressibility or isothermal compressibility is a measure of the relative volume change of a fluid as a response to a pressure change. In its simple form, the compressibility β may be expressed as

$$\beta = -\frac{1}{V}\frac{\partial V}{\partial P}$$

Where V is volume and P is pressure. The choice to define compressibility as the negative of the fraction makes compressibility positive in the usual case that an increase in pressure induces a reduction in volume. The specification is incomplete because for any object or system the magnitude of the compressibility depends strongly on whether the process is isentropic or isothermal.

Accordingly isothermal compressibility is defined as

$$\beta_T = -\frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_T$$

Where T indicates that the partial differential is to be taken at Constant temperature.

Isentropic compressibility is defined:

$$\beta_S = -\frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_S,$$

Where S is the entropy.

Significance of Internal pressure

In liquid Cohesion is extremely important because the intermolecular interaction is intense in liquids. Liquids can be looked upon as different from one another only in cohesion. Though the origin of the cohesive forces is known all theories of liquids have failed to assess correctly these forces in a simple manner.

The internal Pressure is the resultant of the forces of attraction and the forces of repulsion between the molecules

in a liquid. Cohesion creates a pressure within a liquid of value between 10^3 to 10^4 atmospheres. The important factor is that the internal pressure is sensitive to external pressure also. As the liquid is compressed more and more, internal pressure decreases and goes to large negative values so that the repulsive forces become predominant. Non-polar liquids have low internal pressure of the order of two or three thousand atmospheres.

Solubility Parameters

The definition of solubility parameters is defined as the square root of heat of vaporisation divided by the molar volume of the substance.

Factors affecting solubility →

Temperature :- Basically solubility increases with temperature. It is the case for most of the solvents. With increase of the temp. they become less soluble in each other and in water but more soluble in organic solvents.

Polarity :- In most cases solutes dissolve in solvents that have a similar polarity.

Pressure :- For majority of liquid solutes, pressure does not affect solubility.

The maximum amount of a solute that can dissolve in a solvent at a specified temperature and pressure is its solubility. Even for very soluble substances, however there is usually a limit to how much solute can dissolve in a given quantity of a solvent.

X—X