Boiling Point

- The boiling point of a liquid is the temperature at which that liquids is converted to a gaseous state .
- Boiling point is formally defined as the temperature at which the vapor pressure of the liquid becomes equal to the pressure at the surface of the liquid .

Since pure substances have a distinct boiling point , boiling points are sometimes used to determine the purity of substances .

The boiling points of organic compounds can give important information about their physical properties and structural characteristics .

Boiling point helps identify and characterize a compound . A liquid boils when its vapor pressure is equal to the atmospheric pressure .

Vapor pressure is determined by the kinetic energy of a molecule .When the temperature increases, the average kinetic energy of particles also increases . when the temperature reaches the boiling point , the average kinetic energy becomes sufficient to overcome the force of attraction between the liquid particles .

As the force of attraction decreases , the molecules in the liquid state escape from the surface and turn into gas .

The boiling point of a liquid varies with the surrounding atmospheric pressure . A liquid at a higher pressure has a higher a boiling point than when that liquid is at lower atmospheric pressure .

The normal boiling point of a compound an indicator of the volatility of that compound . The higher the boiling point, the less volatile is the compound . Conversely , the lower the boiling point, the more volatile is the compound .

The general trends that effect the boiling point

1.Strength of Intermolecular Forces

The relative strength of intermolecular forces such as ionic , hydrogen bonding , dipole-dipole interaction and Vanderwaals dispersion force affects the boiling point of a compound . The influence of these forces depends on the functional group present .

n- butane (C_4 H_{10}) contains no polar functional group . The only attraction between the butane molecules is weak vanderwaals dispersion forces . In the case of diethyl ether , the molecules are held together by dipole-dipole interaction which a rises due to the

polarized C-O bond. Its boiling point is 35^{o}C . .The boiling point of .butanol is 117^{o}C. The greatly increased boiling point is due to the fact that butanol contains hydroxyl group, which is capable of hydrogen bonding .

The intermolecular forces go in the order

Hydrogen bonding > dipole-dipole > vanderwaals

2.Length of Carbon-Carbon chain

As the number of carbon atoms increases or the length of Carbon-Carbon chain increases, the boiling point also increases. This is because the force of attraction between the molecules increases as the molecule gets longer and has more electrons . It takes more energy to overcome the force of attraction and so the boiling point rises .

3.Branching Decrease the Boiling Point

Branching in molecules decreases the surface area thereby decreasing the attractive force between individual molecules. As a result , the boiling point decreases.

n- pentane neopentane

B.P=36 ^{o}C B.p=9 ^{o}C

The boiling point of neo pentane is much lower than that of n-pentane

4.Polarity

Polarity of the molecule determines the force of attraction between the molecules in the liquid state. In polar compounds ,the positive end of one molecule is attracted by the negative end of another molecule. That means polar molecules are attracted by opposite charge effect. The polarity of a molecule is determined by its functional group . The greater the polarity ,the higher is the boiling point

Glycerol Benzyl alcohol phenol

B.p=290 ^{o}C B.p=205 ^{o}C B.p=182 ^{o}C