Experiment No- 4

1. Objective

To determine the molecular weight of organic compound by depression in freezing point method (Rast method)

2. Introduction

It is observed that the freezing point of the solution is always lower than that of the pure solution .The decrease in freezing point is called depression in the freezing point. Freezing point of a liquid is the temperature when the solid and liquid phases co –exist. When a non volatile solute is dissolved in the liquid to give a solution of molality, m and the solution is sufficiently dilute, the depression in freezing point:

$\Delta T = Kc\ m$

Where Kc = Molal freezing point depression

$$\Delta T = K_f \frac{a\ X\ 1000}{b\ X\ M}$$

ΔT = Depression in freezing point
a= Wt of solute dissolved
b= Wt of solvent
M = Molecular weight of solute

The above equation may be utilized to find M (if K_f is known). Since freezing point of a liquid is not much affected by changes in pressure, freezing point measurement is more than boiling measurement, provided there is no super cooling.

Depression of freezing point of solvent is commonly employee 3d for the determination of molecular weight of a suitable solute in that solvent. In Rast method camphor is used as a solvent because:-

1. It has a very high (about 400) molecular depression constant. Hence even a small Amount of solute gives a very large depression of freezing point.
2. Small quantities of solute and solvent are needed.
3. No special apparatus is required as the camphor has a melting point and therefore ordinary melting point apparatus can be used.
4. Ordinary thermometer can be used in place of Beckmann thermometer, as the depression is greatly greater.
5. It is convenient and rapid as compared to other methods.

Disadvantages of the method

1. Molecular weight of the compound, which are insoluble in molten camphor cannot be determined.
2. Compounds, which undergo thermal decomposition or react with camphor, cannot be as solutes and therefore their molecular weights cannot be determined.

3. Requirements

Chemical

1. Camphor (2gm)
2. Acetanilide

Apparatus

1. Glass Bottle
2. Capillary tube
3. Glass stopper
4. Ordinary thermometer
5. Melting point measuring apparatus

4. Procedure

1. Weigh a clean dry weighing bottle
2. Place about 0.2 gms of acetanilide / given sample in it. (Determine the accurate weight)
3. Add approx. 2.0 gms powdered camphor and also determine the accurate weightof the mixture.
4. Put glass stopper on the bottle and gently heat on a flame to obtain a clear solution.
5. Shake the bottle to get a homogenous solution.
6. Cool and withdraw a small portion of solidified mixture (Keep in ice bath for the purpose)
7. Determine the melting point of the mixture in a capillary tube, repeat to obtain the satisfactory melting point.

5. Calculations

Weight of the Acetanilide/ given sample w= 0.2 gm.
Weight of camphor W= 2gm
Freezing point of mixture t_1 °C (mean of 2-3 determinations)= -------°C
Depression of freezing point of the camphor (t_2-t_1 °C)
Where, t2 is the melting point of the camphor

$$\text{Molecular Weight} = \frac{w \times Kf \times 1000}{W \times (t2 - t1)}$$

$$= \frac{0.2 \times 37.7 \times 1000}{2 \times (t2 - t1)}$$

6. Result

The calculated Value of the molecular weight of Acetanilide is ----------
(Theoretical value of the molecular weight of the Acetanilide is 135)