DETERMINATION OF VISCOSITY COEFFICIENT OF A LIQUID

AIM: To determine the viscosity coefficient of the given liquid using Ostwald's viscometer.

Principle: Viscosity of a liquid may be defined as the resistance that one part of a fluid offers to the flow of another part of the liquid. Viscosity is produced by the shearing effect of moving one layer of the fluid past another. It may be thought as caused by the internal friction of the molecules between themselves. When a liquid is in laminar flow through a tube the layer close to the surface of the tube is almost stationary and the layer at the axis of the tube moves faster than any other layer. A slow moving layer exerts a friction on its nearest layer. The coefficient of the viscosity (η) is defined as the force per unit area required to move a layér of fluid with unit velocity difference past another parallel layer at unit distance away. In cgs system of units, the viscosity coefficient of the fluid is expressed in poises . The viscosity of the liquid is given by poiseuille's equation.

$$\eta = \frac{\pi P r^4 t}{8vl} = \frac{\pi h d g r^4 t}{8vl}$$

Where v is the volume of the liquid of viscosity coefficient η which flows in time t through a capillary tube of radius r and length l under a pressure head of P.

P=hdg

Where

h= height

d= density

g= acceleration due to gravity.

If equal volumes of two liquids are allowed to flow through the same capillary under identical conditions,

$$\frac{\eta_1}{\eta_2} = \frac{\pi h d_1 g r^4 t_1}{8vl} \times \frac{8vl}{\pi h d_2 g r^4 t_2} = \frac{d_1 t_1}{d_2 t_2}$$

The flow times for the liquid and water are determined on an Ostwald's viscometer. Knowing the densities of the liquid and water and also knowing the viscometer coefficient of the water, viscosity coefficient of the liquid can be calculated. Since viscosity is dependent on temperature, the experiment has to be carried out at constant temperature. Therefore viscometer should be dipped in a jar containing water in such a way that the mark above the upper bulb is always below water, so that, the liquid level inside the viscometer is inside water. Small variation in atmospheric temperature will not be felt by the liquid when the viscometer is inside the water.

Procedure: Take a clean and dry viscometer and fix it vertically to stand in water taken in a jar, in such a way that the mark above the upper bulb is below the water level. Pipette out a definite known volume (10ml or 20ml depending upon the size of the upper bulb) of the liquid into the lower bulb.

With the help of rubber tubing fitted to the limb containing the upper bulb, suck the liquid into the upper bulb and above the mark A of the viscometer. Allow it to flow freely through the capillary. When the level of the liquid just crosses the mark A , start a stop clock. Stop the clock when the liquid crosses the lower mark B. note the flow time in seconds. Repeat for two more times. Remove the liquid from the viscometer, rinse with acetone and dry it. Now pipette out the same known volume of distilled water as before into the lower bulb of the viscometer and find out the flow time as before.

Observations and calculations:

Density of water, $d_1 = 1 gm/cm^3$

Viscosity coefficient of water, $\eta_1 = 0.001$ centipoise

Density of liquid, $d_2 = 0.79 gm/cm^3$

To determine the flow time:

	Time of flow (seconds)			
	Trial 1	Trial 2	Trial 3	Mean
Liquid				
Water				

$$\frac{\eta_1}{\eta_2} = \frac{d_1 t_1}{d_2 t_2}$$

Viscosity coefficient of the liquid, $\eta_2 = \frac{d_2 t_2}{d_1 t_1} \times \eta_1$

Result: Viscosity coefficient of the given liquid = ________________