To determine the relative viscosity of a given liquid at laboratory temperature using an Ostwald viscometer

Requirements

1. Ostwald viscometer, 2. Relative density (RD) bottle, 3. Beakers 4. Electronic weighing balance 5. Distilled water, 6. Supplied solution

Theory:

The determination of relative viscosity of a liquid is based on Poiseuille's equation related to the flow of a liquid through a capillary tube:

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

$\eta = viscosity\ coefficient, p = pressure,$
$r = radius\ of\ the\ capillary, t = time\ of\ flow,$
$v = volume\ of\ the\ liquid, l = length\ of\ the\ capillary,$
$h = height\ of\ the\ capillary\ column, d = density\ of\ liquid,$
$g = gravitational\ constant$

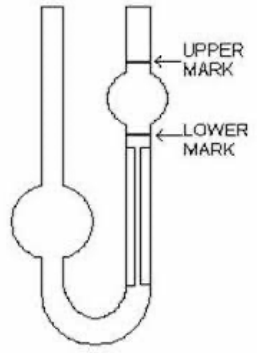

Figure 1 Ostwald viscometer

If we like to determine the viscosity of a liquid with respect to water, then we have:

$$\frac{\eta_l}{\eta_w} = \frac{d_l t_l}{d_w t_w}$$

Measurement of relative density using RD bottle:

Mass of the empty RD bottle = m_1
Mass of RD bottle with water = m_2
So, mass of water filled in = $m_2 - m_1$
Mass of RD bottle with liquid = m_3
Therefore, mass of liquid filled in = $m_3 - m_1$

Figure 2 Relative density bottle

So, the relative density of the liquid

$$\frac{d_l}{d_w} = \frac{m_3 - m_1}{m_2 - m_1}$$

Procedure:

Note: The viscometer should be fitted vertically upright and there should not be any air bubbles in the liquid.

1. The Ostwald viscometer was cleaned and filled up with distilled water up to the upper mark (initial mark) by sucking through a rubber tube fitted with the viscometer.
2. Water was then allowed to come down to the lower mark of the viscometer and time was noted for a fixed volume of liquid.
3. Step 2 was repeated for 3 times.

4. Then the viscometer was rinsed with provided liquid and time of flow for unknown liquid was noted without changing the setup. The process was repeated for 3 times.
5. To determine the relative density of the liquid, weight of an empty RD bottle was taken. Then weight of the RD bottle filled with distilled water and supplied liquid were taken separately.

Observations:

Laboratory temperature = ……. ^{o}C. **(Report temperature reading up to 1 place of decimal)**

Table 1: Measurement of relative density of supplied liquid with reference to distilled water

Weight of empty RD bottle (m_1)(g)	Weight of RD bottle with distilled water (m_2)(g)	Weight of RD bottle with supplied liquid (m_3)(g)
Report weight reading up to 3 places of decimal		

Table 2: Measurement of time of flow for distilled water

Sl. No.	Time of flow for distilled water (s)	Average time of flow for distilled water (s)
1 2 3	**Report time of flow reading in seconds as per the stopwatch**	

Table 3: Measurement of time of flow for unknown/supplied liquid

Sl. No.	Time of flow for liquid (s)	Average time of flow of liquid (s)
1 2 3		

Calculations:

Given η_w= 1.005 cP at 20.0^{o}C {**use value as per the laboratory temperature**}

The relative density of the liquid :

$$\frac{d_l}{d_w} = \frac{m_3 - m_1}{m_2 - m_1}$$

$$\eta_l = \frac{d_l t_l}{d_w t_w} \times \eta_w$$

Result: The relative viscosity of supplied liquid at laboratory temperature …….^{o}C was found to be …… cP