Physical Pharmacy

Viscosity measurement

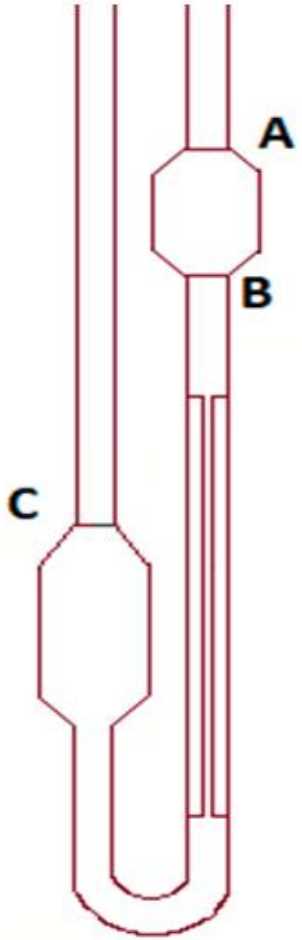
Khalid T Maaroof

2022

Viscosity

- Viscosity is the resistance of a fluid to flow; the higher the viscosity, the greater is the resistance. The unit of viscosity is the poise (p) and centipoise (cp).
- Capillary viscometer is used for the determination of viscosity of Newtonian systems (systems with single viscosity values).

Ostwald Viscometer



Ostwald viscometer

- It is a u-shaped glass apparatus with a wide arm and a narrow one that contain a capillary tube. There are two marks in the narrow part; above and below the bulb. By this method, the viscosity of an unknown liquid (η1) can be determined in relation to another liquid of known viscosity (η2) (usually water).

Procedure

- Prepare 50 mL solutions of different volume fractions (ϕ) of glycerin in water: 0.05, 0.1, 0.15, 0.2, and 0.25 from 0.5 glycerin solution (stock solution).
- Measure the viscosity of water and the solutions by capillary viscometer:
  - Fill the viscometer from the wide arm, with the liquid being measured until its level reaches the stop mark.
  - Using a sucker bulb (or pump), suck the liquid from the stop mark to the start mark. After that, put your finger on the tip of the viscometer to prevent the liquid form going down.
  - Leave the liquid to descend from the start mark to the stop mark and record the time.
- Repeat the above procedure for the unknown liquid.

Calculation

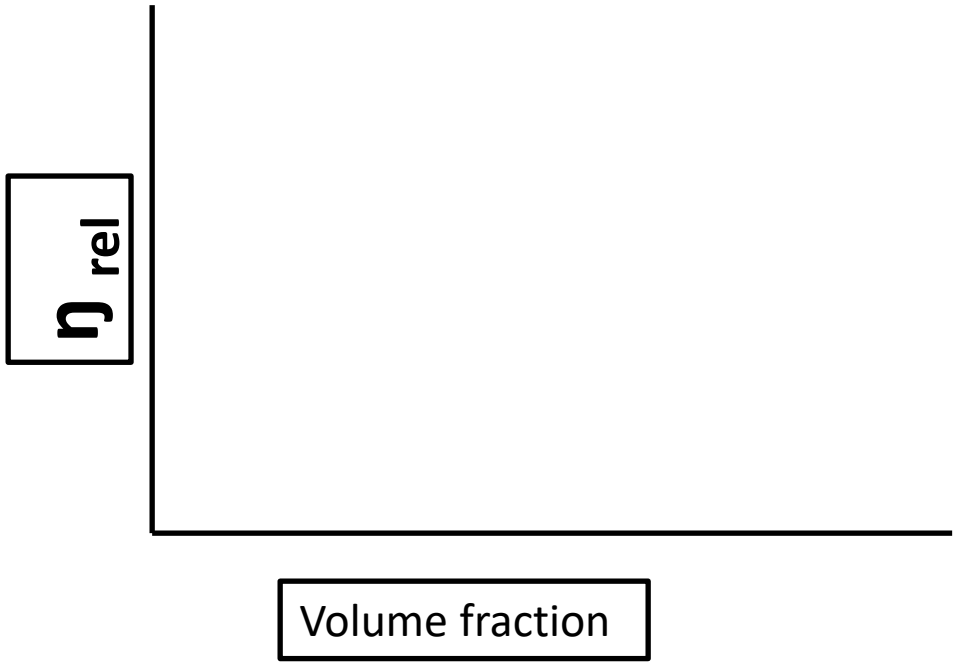
- The viscosity (in cp) of the liquid under test (η1) can be calculated by measuring the time (in sec) (t1) required for this liquid to pass between the two marks as it flows by gravity through the vertical capillary tube. This time is compared with the time (t2) required for a liquid of known viscosity (η2) (usually water) to pass between the two marks.

$$\eta_{rel} = \frac{\eta_1}{\eta_2} = \frac{\rho_1 . t_1}{\rho_2 . t_2}$$

- p1, p2 are the densities of the measured liquid and water respectively.
- The densities of the prepared solutions can determined by using a pycnometer.

Plot

- Plot a graph of relative viscosity against the volume fraction (or percentage) for the prepared solutions.



Questions?