Al- mustaqbal University College
Anesthesia Techniques Department
First stage /medical physics
Five lecture by Asst. Lecturer Fatema Sattar

Viscosity of liquid

Objective:

To determine the viscosity of medium by using a small sphere falls with a constant terminal velocity.

Apparatus:

1. A long glass tube about (50 cm) long closed at one end.
2. Glycerine.
3. Meter scale.
4. Small sphere.
5. Rubber bands.
6. Magnet.
7. Stop-Watch.

Theory:

The **viscosity of liquid (**η) is a resistance to flow of a liquid. All liquids appear resistance to flow change from liquid to another, the water faster flow than glycerin, subsequently the viscosity of water less than glycerin at same temperature. Viscosity occurs as a result of contact liquid layers with each other. While the **Relative Viscosity** is the ratio of the viscosity of the fluid on the viscosity of water at a certain temperature. In the SI unit of η is Newton-second per square meter (Ns. m^{-2}) or Pascal-seconds (Pa .s)

$$\eta_{relative} = \frac{\eta_1}{\eta_{H_2O}}$$

The **viscosity coefficient** is defined as the force of friction that is required to maintain a velocity of 1cm/s between parallel layers of fluid at distance ($1\ cm^2$).

The factors effect on the viscosity:

1. Effect of Temperature:

The temperature of the liquid fluid increases so its viscosity decreases. But In gases it's opposite, the viscosity of the gases fluids increases as the temperature of the gas increases.

2. Molecular weight:

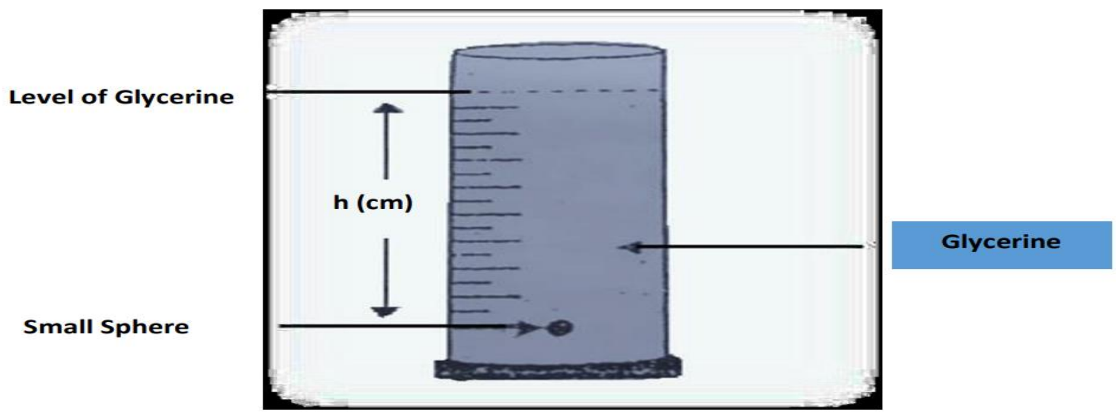
The molecular weight of the liquid increases so its viscosity increases.

3. Pressure:

When increase the pressure on liquids, the viscosity increase because increase the attraction force between the molecules of liquid.

Experimental part:

1. Adjust the distance between the rubber bands.
2. Record the distance (h) between them (About 30 cm).
3. Drop a sphere centrally down the tube and with stop-watch find the time it takes to traverse the distance between the rubber bands.
4. Obtain two values of the time of fall.
5. Repeat the experience for the different values of (h) and obtain two values of the time of fall for each new distance apart.



Distance between the rubber bands h (cm)	Time of fall		
	T1 (Sec)	T2 (Sec)	T mean (Sec)

Plot a graph with value of (h cm) as ordinates against the corresponding values of T (Sec). From the graph calculate the terminal velocity. Slope = h/T = velocity (cm/sec). To conclude the velocity (ɳ) for liquid, use the following equation:

$$\eta = \frac{g(\rho - \sigma).d^2}{18.V}$$

g = 980 cm/ sec^2.

p = Density of sphere gm/cm^3.

σ = Density of liquid gm/ cm^3.

d = Diameter of sphere.

V = Velocity (slope).