Bernoulli's Equation for streamline flow

According to the Bernoulli's theorem, when a non-viscous, incompressible fluid flows from one point to another in a stream-line condition without any frictional or resistive force, the total energy of the fluid (i.e K.E. + P.E. + Pressure energy) remains constant at each point of its flow i.e

Kinetic energy + potential energy + pressure energy = constant

- $\frac{1}{2}\rho v^2 + \rho g h + P = \text{constant}$

- Bernoulli's theorem is law of conservation of energy for a flowing fluid

$P + \rho g h$ → is also known a static pressure

$\frac{1}{2}\rho v^2$ → dynamic pressure

- If a liquid flows in a streamline motion in a non-uniform tube, since velocity of flow in the narrower part of the tube is more than in the wider part of the tube (by eqn of continuity), therefore the pressure of liquid is less in the narrower part than in the wider part of the tube.

Viscosity

The frictional force between the layers of fluid, is called the internal frictional force or the viscous force.

The property of fluids by virtue of which there is a tendency to oppose the relative motion between its different layers, is called the viscosity. This property of fluid arises due to the cohesive forces between its molecules.

- Viscosity of liquid $\propto \frac{1}{\sqrt{T}}$
- Viscosity of gas $\propto \sqrt{T}$

$$F = -\eta A \frac{\Delta v}{\Delta z}$$ where F = viscous force

η = coefficient of viscosity of liquid

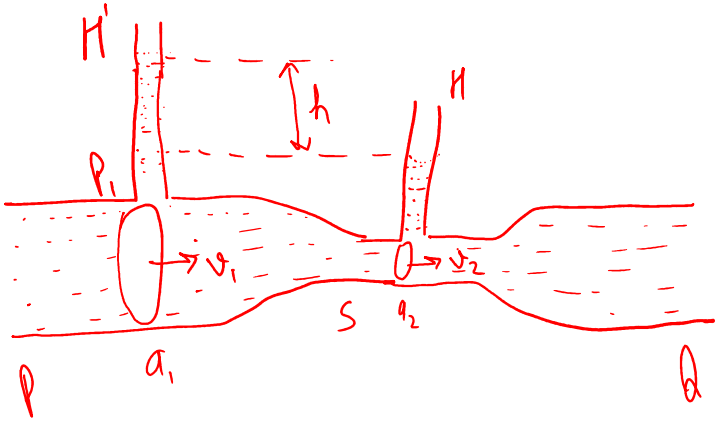
$\frac{\Delta v}{\Delta z}$ = velocity gradient along z direction

- Dimension of coefficient of viscosity

$$\eta = [ML^{-1}T^{-1}]$$

& unit of $\eta = \frac{kg}{m \times s} = kg\,m^{-1}s^{-1}$

Venturimeter :—



$$v_1 = a_2 \sqrt{\frac{2gh}{a_1^2 - a_2^2}}$$

volume of liquid flowing out per second through the tube $PQ = a_1 a_2 \sqrt{\frac{2gh}{a_1^2 - a_2^2}}$

Surface Tension

"Surface tension is the tension of the surface film of a liquid caused by the attraction of the particles in the surface layer by the bulk of the liquid, which tends to minimise surface area"

- Cohesive force – The force of attraction between the molecules of the same substance is called the cohesive force.
- Adhesive force – The force of attraction between the molecules of different substance is called the adhesive force.

Surface tension is the tendency of fluid surfaces to shrink into the minimum surface area possible. Have you noticed when you fill a glass up to the brim with water, you can still add a few more drops till it spills out? Or have you ever broken a thermometer and observed how the fallen mercury behaves? All these happen due to the surface tension of the surface.

Surface tension is typically measured in dynes/cm, the force in dynes is required to break a film of length 1 cm

Dimension of Surface Tension

The dimensional formula of surface tension is $\mathbf{MT^{-2}}$

Angle of contact

The angle which the tangent make to the free surface of the liquid at the point of contact with the walls of the vessel inside the liquid is called the angle of contact, or it is defined as the angle subtended between the tangents drawn at the liquid surface and the solid surface inside the liquid at the point of contact is called the angle of contact (θ).

- The angle of contact depends upon the liquid's nature and the solid in contact and the medium which exists above the free surface of the liquid.
- The angle of contact increases with an increase in the temperature of the liquid.
- The angle of contact decreases on adding soluble impurity to a liquid.

Importance of angle of contact

The contact angle determines whether a liquid will spread on the surface of a solid or form droplets on it.

- If the Angle of contact is **obtuse**: then a droplet will be formed.
- If the Angle of contact is **acute**: then the water will spread.