Viscous Flow

Viscosity →

An Ideal fluid is that substance which is incapable of sustaining shearing stress (tangential force) In the motion of such fluids, only normal forces (pressure) acts on the fluids. or We can say A perfect fluid is one which exerts no internal resistance to change is shape or form.

However in nature ideal fluids do not exists, they are only a Mathematical Concept.

So In this chapter We shall study actual (real) fluids.

Actual (real) fluids exert internal resistance whenever there is some alteration in shape or form and this property of exerting internal resistance to a change in shape or form is Known as Viscosity

Thus Viscosity can be said to be an internal friction

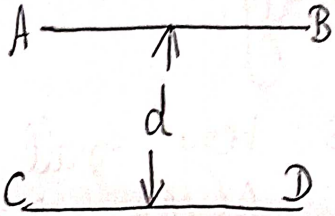
Since In case of Ideal fluids, there is no tangential force, there exists a difference in relative tangential velocities on the boundary between a perfect fluid and a solid wall i.e there is a slip hence and there is no internal resistance or shearing stress

But In case of real fluid, due to intermolecular attract there is an adhesion of the fluid to the solid wall instead of a slip and it results in a shearing stress.

difference between the perfect and a fluid is that,

Case of real fluid there is a shearing stress and a position of 'no slip'. which is absent in case of Ideal fluids.

Coefficient of Viscosity →



Consider the motion of a fluid in between two parallel plates AB and CD at a distance d apart. The lower plate CD is at rest while the plate AB is moving with uniform velocity V parallel to itself. Here velocity gradient is V/d

Here the fluid is actual so there is no slip on the surface when the fluid is in contact with a solid. The velocity will decreases as we go downwards from AB to Zero in Contact with CD. In order to maintain the motion of the plate AB, a horizontal force proportional to V/d per unit area AB is required. If we denote the force by $\mu V/d$, then μ is called coefficient of viscosity of the fluid.

μ depends upon pressure & Temperature.
It is independent of pressure at ordinary temperature.

If We write $\frac{\mu}{\rho} = \nu$

then ν is called Kinematic Coefficient of Viscosity.

μ is very small for water, gases, alcohal but not negligible but μ is very large in case of oil, glycerine.