VISCOUS FORCES AND INERTIAL FORCES

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Abstract

Viscosity is the property of a liquid/gas which opposes the flow of it. These properties easily defined by the degree of flow. For example if water pour on a smooth surface it easily flow and if pour on rough surface it is difficult to flow. And inertia is the tendency of a object to oppose the motion.

Keyword

Viscosity, viscous force, inertia inertial force, gravity, friction, electromagnetic, Newton's law, virtual forces.

Introduction

Viscous forces are the forces due to the friction between the layers of any real fluid. In the fluid mechanics, we take the as in the continuum condition, which means fluid particle are very clearly packed so necessary there is friction between layers of fluid.

Consider a parcel of fluid various forces act on this fluid parcel some to list are:

A) Force due to pressure from surrounding fluid.
B) Viscous forces due to friction by surrounding fluid.
C) Force due to gravity.
D) Electromagnetic forces etc.

Sum total of these forces as per Newton's second law of motion must be equal to mass(m) times acceleration(a) of fluid parcel. One side of Newton's law is sum total of actual forces acting on fluid parcel. The other side mass times acceleration is assumed to be a kind of virtual forces which is referred to as inertial force owing to the fact that it is derived from mass.

"Mass is the measure of inertia"

Newton's first law of motion state that "An object at rest stays at rest and an object is motion stays with the same speed and in the same direction unless acted upon by an unbalanced force. Objects tend to "keep on doing what they are doing". In fact, it is the natural tendency of objects to resist change in their state of motion, is described as inertia.

Inertia: Tendency of an object to resist any change in its state to rest or of uniform motion is called Inertia.

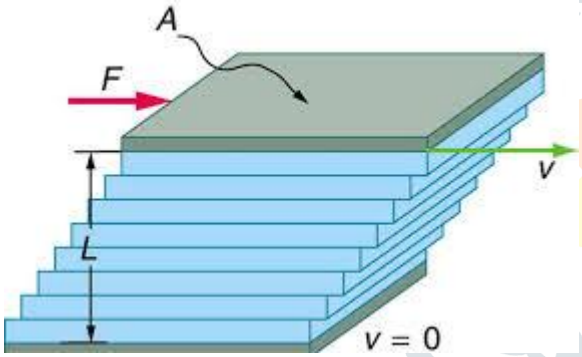
Mass is the measure of inertia: All objects resist change in their state of motion i.e. they have inertia. But the tendency of an object to resist change in its state of motion varies with mass. Mass is that quantity that is solely dependent upon the inertia of an object. The more inertia

that an object has the more mass that it has. A more massive object has a greater tendency to resist change in its state of motion.

Example: Two seemingly identical bricks at rest on the table. Yet one brick consists of mortar and another bricks consists of Styrofoam. Without lifting the brick how could you tell which brick was the Styrofoam brick. You could give the bricks an identical push in an effect to change their state of motion. The bricks that offers least resistance is the brick with least inertia and therefore the brick with the least mass (Styrofoam bricks).

Viscous force formula: In case of steady flow of a fluid, when a layer of fluid slips or tends to slip an adjacent layer in contact, the two layers exerts tangential force on each other which tries to destroy the relative motion between them. The property of a fluid due to which it opposes the relative motion between them its different layers is called viscosity (or fluid friction or internal friction) and force between the layers opposing the relative motion is called viscous force.

Accordingly to Newton's Hypothesis, the tangential force 'F' acting on a plane parallel layers is proportional to the area of the plane A and the velocity gradient $\frac{dv}{dx}$ normal to the layer as shown in fig.



F α A and F α $\frac{dv}{dx}$

⇒ F α A$\frac{dv}{dx}$

⇒ F = μA$\frac{dv}{dx}$

$\tau = \frac{F}{A} = \mu A\frac{dv}{dx}$

$\tau \approx \frac{F_V}{h^2} = \mu\frac{v}{h}$ ⇒ $F_V = \mu Vh$

Reynolds Number: In fluid mechanics, Reynolds number(Re) is dimensionless quantity that is used to help predict flow pattern in different fluid flow situation.

Different is the Reynold no. different will be the flow pattern.

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