Viscosity Encyclopedia Article

Viscosity

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Viscosity

The viscosity of a fluid is a measure of its resistance to continuous deformation caused by sliding or shearing forces. Imagine a fluid between two flat plates; one plate is stationary and the other is being moved by a **force** at a constant **velocity** parallel to the first plate. The applied force per unit area of the plate is called the shear stress. The applied shear stress keeps the plate in **motion** and, when the plate velocity is steady, this shear stress is in **equilibrium** with the frictional and drag forces within the fluid. The shear stress is proportional to the speed of the plate and inversely proportional to the distance between the plates. The proportionality factor between the shear stress and the velocity difference between the plates is defined as the coefficient of viscosity or simply the viscosity of the fluid. Thick **fluids** such as tar or honey have a high viscosity; thin fluids such as water or alcohol have a low viscosity.

In general, viscosity is a function of **temperature** and **pressure**; however, in some fluids viscosity is dependent on the rate of shear and time. When brushed on (sheared) quickly, fluids such as paint have a low viscosity and flow easily. After paint is applied, only the slow and steady pull of its **weight** causes it to flow; at this slow shear rate the viscosity of paint is high and its resists the tendency to flow or sag. Fluids that behave in this manner are called non-Newtonian fluids. Other examples are liquid plastics and mud. For gases and non-polymeric liquids like water, viscosity is independent of the fluid's shear stress and history. These are called Newtonian fluids. In the case of gases, the viscosity increases with temperature because of the increased molecular activity at higher temperatures. Liquids, conversely, generally show decreasing viscosity with increasing temperature.

The flow of liquids in pipes, the performance of oil-lubricated bearings in engines or oil-filled automotive shock absorbers, and the air resistance on a moving car or airplane are all dependent on the viscosity of the fluids involved.