Design and Construction of a Simple Viscometer for Incompressible Fluid and Performance Study

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Viscosity refers to the fluid property which is defined as the resistance to flow. This work investigated the design and construction of a simple viscometer for incompressible fluid. To evaluate viscosity exactly viscometer is necessary. But it is not available and cheap. So a simple and cheap viscometer can solve the problem. By means of dc motors, adaptor, pulley, and belt and by other available electrical equipments viscosity has been measured.

Keyword: Fluid, Viscosity, incompressible Fluid, and Viscometer.

1. Introduction

Viscosity is an internal property of a fluid that offers resistance to flow. For example, pushing a spoon with a small force moves it easily through a bowl of water, but the same force moves mashed potatoes very slowly.

Although there can be no shear stresses in a fluid at rest, shear stresses are developed when the fluid is in motion, if the particles of the fluid move relative to each other so that they have different velocities, causing the original shape of the fluid to become distorted. If, on the other hand, the velocity of the fluid is the same at very point, no shear stresses will be produced, since the fluid particles are at rest relative to each other.

Usually, we are concerned with flow past a solid boundary. The fluid in contact with the boundary adheres to it and will, therefore, have the same velocity as the boundary. Considering successive layers parallel to the boundary (Fig 1.1), the velocity of the fluid will vary from layer to layer as y increases.

If a body represents an element in a fluid, then the force \( F \) will act over an area \( A \) equal to \( \delta x \delta y \).

\[ \tau = \mu \frac{dV}{dy} \]

Which is Newton's law of viscosity. The value of \( \mu \) depends upon the fluid under consideration.

![Fig 1: Variation of velocity with distance from a solid boundary](image)

The force per unit area \( F/A \) is the shear stress \( \tau \) and the deformation, measured by the angle \( \phi \) (the shear strain), will be proportional to the shear stress.

In a solid, \( \phi \) will be a fixed quantity for a given value of \( \tau \), since a solid can resist shear stress permanently. In a fluid, the shear strain \( \phi \) will continue to increase with time and the fluid will flow. It is found experimentally that, in a true fluid, the rate of shear strain (or shear strain per unit time) is directly proportional to the shear stress, then we get the following equation [1]

\[ \tau = \mu \frac{dV}{dy} \]

[1]

In the equation the term \( dV = \omega R \).

![Fig 2: Horizontal section of the concentric cylinder](image)

The three main types of viscometer are the tube, rotational instruments and micro beam [2]. The former observe the rate of flow through tubes due to a known