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Description of Fluid Characters

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ABSTRACT

This paper Description of Fluid characters is concerned with the study of motion of fluid. Either fluid mechanics is the study of fluids in motion or at rest and Fluid dynamics a branch of Fluid mechanics is the study of behaviour of fluids when they are in motion. This paper is intended to provide a survey of basic concepts in fluid dynamics as a preliminary to the study of dynamical meteorology. The scope of fluid mechanics is vast and has numerous applications in engineering and human activities. This paper designed to explain the fundamentals of fluid mechanics in the areas of properties of fluids. Fluid is a substance, which can flow. Technically the flow of any substance means a continuous relative motion between different particles of the substance The analysis of the behavior of fluids is based on the fundamental laws of mechanics which relate continuity of mass and energy with force and momentum together with the familiar solid mechanics properties. This paper begins with some basic characteristics of fluids, which are subsequently found useful in understanding various conceptual ideas of Fluid Mechanics.

Keywords: Fluids, Temperature, Density, Bernoulli's Equation

I. INTRODUCTION

To understand the different properties of fluids, it is necessary to understand what exactly is meant by the term fluids. By definition, anything that can flow is a fluid. The water we drink, the air we breathe are all examples of fluids. Essentially, all liquids and gases are fluids. Since fluids are, like solids, also a form of matter, they have certain properties. The study of the properties of fluids in fluid mechanics helps us to utilize them for useful purposes. An understanding of these properties is essential for us to apply basic principles of fluid mechanics to the solution of practical problems. The analysis of the behaviour of fluids is based on the fundamental laws of mechanics which relate continuity of mass and energy with force and momentum together with the familiar solid mechanics properties. The study of fluids under static conditions is called Fluid statistics. Matter exists in two states; the solid and the fluid, the fluid state being commonly divided into the liquid and gaseous states. Solids differ from liquids and liquids from gases.

II. METHODS AND MATERIAL

Properties of fluids

Any characteristic of a system is called a property. These properties are not only pressure P, temperature T, volume V, mass m. But also less familiar ones such as viscosity, thermal conductivity, modulus of elasticity, thermal expansion coefficient, electric resistivity velocity and elevation etc. Generally Properties are characterized in to either intensive or extensive. Intensive properties are those that are independent of the mass of a system, such as temperature, pressure, and density. Extensive properties are those whose values depend on the size of the system. Extensive properties are total mass, total volume V, and total momentum etc. Generally, uppercase letters are used to denote extensive properties .The state of a system is described by its properties

Different properties of fluids

There are some properties, which every fluid have
These properties can be categorized as

- Kinematic properties such as velocity and acceleration.
- Thermodynamic properties such as density, temperature, pressure, and specific weight.
- Physical properties are appearance, colour and odor..The state of a system is defined by the properties of the substance. A property is any characteristic of a substance which may be expressed as a quantity, e.g. temperature, pressure, mass.

Density

The amount of mass contained in a given volume is called density. Density describes how closely packed together the particles are in a substance. A substance is most dense when it is a solid and least dense when it is a gas. A solid is denser than a gas because the particles in a solid are much closer together

- Density is the ratio of mass to volume.
- The solid state of a substance is usually denser than the liquid state. The liquid state is denser thanthe gas state.
- The upward force exerted by a fluid is called the buoyant force.
- Archimedes' principle states that the buoyant force on an object is equal to the weight of the fluid displaced by the object.

The density of a substance is defined as the quantity of matter contained in a unit volume of the substance. It can be expressed in three different ways.

Mass Density ρ is defined as the mass of substance per unit volume.

Specific Weight ω , known as specific gravity is defined as the weight per unit volume.

The Relationship between g and ω can be determined by Newton's 2nd Law, since weight per unit volume = mass per unit volume g

$$\omega = \rho g$$

Relative Density, σ , is defined as the ratio of mass density of a substance to some standard mass density. For solids and liquids is the maximum mass density for water at atmospheric pressure.

$$\sigma = \frac{\rho_{substance}}{\rho_{H_2O(at 4^\circ c)}}$$

Viscosity, is the property of a fluid, due to cohesion and interaction between molecules, which offers resistance to sheer deformation. Different fluids deform at different rates under the same shear stress. Fluid with a high viscosity such as syrup, deforms more slowly than fluid with a low viscosity such as water. Viscosity is the resistance of a fluid to flow. Different fluids have different viscosities.

Viscosity, m, is the property of a fluid, due to cohesion and interaction between molecules, which offers resistance to sheer deformation. Different fluids deform at different rates under the same shear stress. Fluid with a high viscosity such as syrup, deforms more slowly than fluid with a low viscosity such as water.
All fluids are viscous, "Newtonian Fluids" obey the linear relationship

given by Newton's law of viscosity. $\tau = \mu \frac{du}{dy}$

where τ is the shear stress,is the velocity gradient or rate of shear strain, μ is the "coefficient of dynamic viscosity" .

The Coefficient of Dynamic Viscosity, μ , is defined as the shear force, per unit area, required to drag one layer of fluid with unit velocity past another layer a unit distance away.

$$\mu = \tau \Big/ \frac{du}{dy} = \frac{\text{Force}}{\text{Area}} \Big/ \frac{\text{Velocity}}{\text{Distance}} = \frac{\text{Force} \times \text{Time}}{\text{Area}} = \frac{\text{Mass}}{\text{Length} \times \text{Area}}$$

Kinematic Viscosity, ν , is defined as the ratio of dynamic viscosity to mass density.

$$\nu = \frac{\mu}{\rho}$$

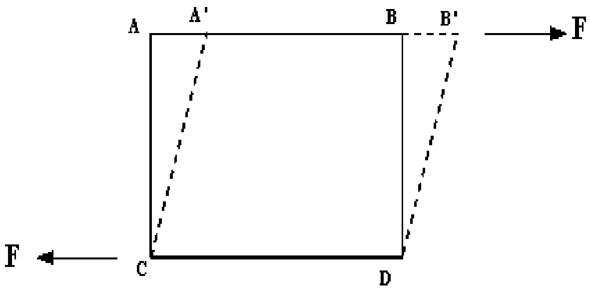
Chemical properties It is desirable to keep track of certain chemical species present in a fluid flow. Example to determine how air pollutants are carried along the wind or how toxic chemicals move through underground aquifer that supplies portable water. In an automobile engine the fuel is evaporated and mixed with air in precise portions to ensure that the mixture will be burn rapidly when ignited by the spark

Significance

Man is involved with fluids breathing air, drinking water, blood circulation in human body , irrigation in field are fluid flow problems . Examples are medical studies of breathing and blood flow, oceanography, hydrology, energy generation. Other engineering applications include fans, turbines, pumps, missiles, airplanes etc. The understanding of this subject helps us to explain a variety of fascinating phenomena around us. To utilize available water resources there is a need to predict flow rates of water in rivers in different seasons.

Kinematics of Fluid flow

The major feature of a fluid is that it flows when acted upon by some force. This characteristic makes a fluid much different than a solid, which may be distorted by a force but will not start to flow. Typically, the force is that of gravity, but other forces can also apply.



Fluids flow can be steady, or turbulent. The fluid passing through a given point maintains a steady velocity then the flow is steady or, if the speed and the direction of the flow vary then it is turbulent flow. In steady flow, the motion can be represented with streamlines in the direction the water flows in different areas. The density of the streamlines increases as the velocity increases.

1) The equation of continuity

The equation of continuity states that for an incompressible fluid flowing in a tube of varying cross-section, the mass flow rate is the same everywhere in the tube. The mass flow rate is the rate at which mass flows past a given point, hence the total mass flowing past divided by the time interval. The equation of continuity can be

$$\rho_1 A_1 v_1 = \rho_2 A_2 v_2 \qquad \text{(r = density, A = cross-sectional area, v = velocity)}$$

The density is constant and then the flow rate Av is also constant.

2) Making fluids flow

Generally there are two ways to make fluid flow through a pipe. One way is to tilt the pipe so that the flow is downhill, another way is to make the pressure at one end of the pipe larger than that of the pressure at the other end.

If the fluid flow is steady, and the fluid is non-viscous , incompressible, the flow can be looked from an energy perspective.. The equation is very useful, and can be used to explain things such as how airplanes fly, and how baseballs curve.

3) Bernoulli's equation

The pressure, speed, and height y at two points in a steady-flowing, non-viscous, incompressible fluid are related by the equation:

$$P_1 + 1/2\,\rho v_1^2 + \rho g y_1 = P_2 + 1/2\,\rho v_2^2 + \rho g y_2$$

III. RESULTS AND DISCUSSION

For a more quantitative description we need to establish whether a mathematical relationship exists between the variables. The basic information was collected from standard text books of Fluid Mechanics and graphical representations were analyzed from journal papers. A clear picture reveals several things of data alone and provides a clear understanding to a change in one variable lead to a change in the other.

Density and Temperature

A substance can have different densities, depending on its temperature. Example, swimming in a lake on a hot summer day. The water on the surface of the lake is warmer than the water below it. The warm water floats on the cold water because it has a lower density than that of cold water.

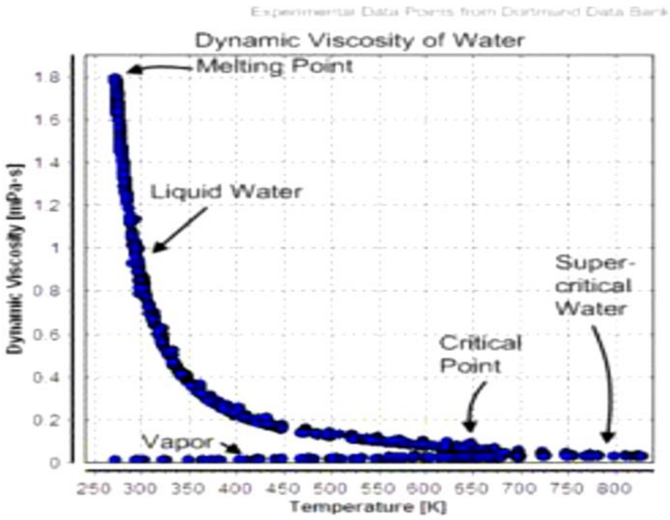
The air in a room is warmer toward the ceiling and cooler toward the floor. The warmer air has a lower density, so it rises above the cooler, higher density air along the floor. According to the particle theory, particles in a substance move more quickly when energy is added.

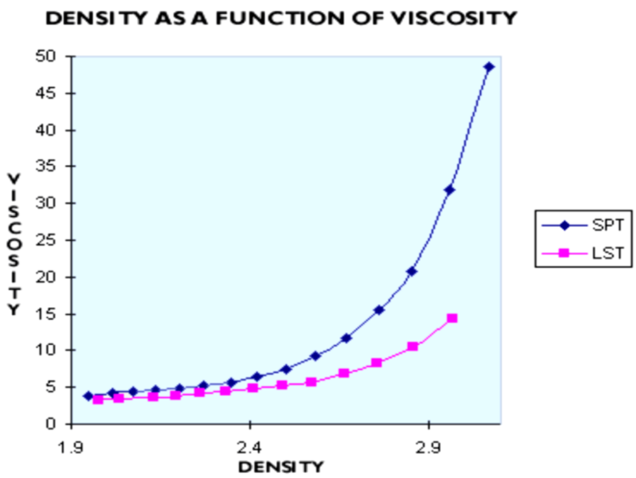
As a substance warms up, the particles move faster and farther apart. This causes the volume to increase even though the number of particles stays the same. With the same number of particles in a larger volume, the density decreases. Generally a substance has a greater density in its solid state than in its liquid state and gas state. One exception to this is water

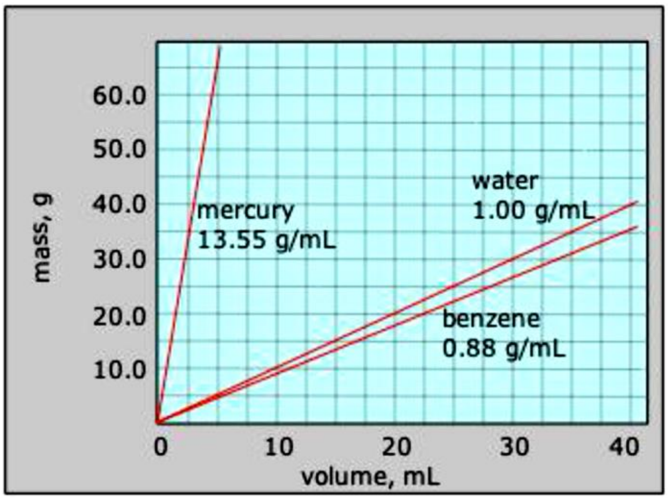
- As the temperature of a liquid decreases, the viscosity increases. As the temperature of a gas decreases, the viscosity decreases.
- Flow rate is a measure of the speed at which a fluid flows from one point to another. The higher the flow rate, the lower the viscosity

The thickness or thinness of a fluid is a property called viscosity. Viscosity is the resistance of a fluid to flow. Fluids with high viscosity do not flow as easily as fluids with a low viscosity. Temperature is one factor that can have a big effect on viscosity. The viscosity of a fluid can change as the fluid is heated up or cooled down. As the temperature of a liquid increases, its viscosity decreases. As a result, the fluid flows more easily. As the temperature of a liquid decreases, the viscosity increases. The cooler the liquid, the slower it flows. When heat is added to the liquid, the particles move faster and spread farther apart. Since the distance between particles has increased, there is less attraction between the particles. This allows the particles to move past each other more freely. Different substances have different viscosities because they are made of different particles with different forces of attraction between them. One way to compare the viscosity of different fluids is to compare their flow rates. The flow rate of a fluid is a measure of the speed at which a fluid flows from one point to another. Flow rate is determined by measuring the amount of fluid that flows past a given point in a given time. The greater the viscosity, the lower the flow rate. If we drop a grape into water, The grape sinks. However, if we drop the grape into corn syrup, it floats. If the density of a substance is greater than the density of the fluid, the substance will sink.

The substance will float if the density of a substance is less than that of the fluid, By drawing a graph of water with temperature on X-axis and viscosity on Y- axis the shape of the graph is a straight line as shown below.







IV. CONCLUSION

Thus, Fluid has important applications in diverse, branches of mechanical, civil, Chemical Engineering. A Sound knowledge of fluid mechanics is essential in the design of dams, irrigation structures a civil engineer can construct dams, and pipelines across countries for transportation of oil, petrol, gases, etc. in these cases we should know the behavior of fluids so that structures could be designed in such possible manner for ease of flow of fluids. Fluid mechanics serves this purpose. Applications of fluid mechanics include a variety of machines, ranging from the water wheel to the airplane.

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