Analysis of measuring the Viscosity, Pressure and Density of Water by Varying Temperature

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Abstract: We focus on the measurements of the viscosity ,pressure and density of the water before and after heating a function of temperature. These measurements were made between some temperature level. These measurements shows that the viscosity, pressure and density of the liquids change when the temperature change.

IndexTerms - Viscosity, Density, Water, Temperature, pressure.

1. INTRODUCTION

The problem of temperature-varying properties of the fluid is more complex than that of constant properties. The different property ratio correlations of different fluids increase the complexity of the variable-temperature properties problem. It is also difficult to give a correction for the temperature dependent behavior of all viscous liquids in all tubes. The viscosity varies more markedly than the other thermo-physical properties for most liquids, so plenty of researcher on the variation of viscosity has been performed in the literature. A few studies on fluid flow and heat transfer for temperature-dependent thermo-physical properties in straight tubes with circular cross section have been carried out, e.g., by Shah and London (1978), Harms *et al*. (1998) and Kakac (1987). Shah and London reported the laminar flow and heat transfer of gases and liquids and Harms *et al*. gave reasonable predictions for many fluids with corrections based on different models for temperature-dependent behavior. However, both the range of temperature and the forms of geometries considered were limited. Kakac developed a correction for the temperature-dependent viscosity effect on Nusselt number and the friction factor of laminar flow.

1.1 Viscosity:

The viscosity of a fluid is a measure of its resistance to gradual deformation by shear stress or tensile stress. For liquids it corresponds to the informal concept of thickness for example honey has a much higher viscosity than water Newton's law of viscosity. For a given rate of angular viscosity. deformation of a fluid shear stress is directly proportional to temperature. Hence we expect hat Newton's law of viscosity can be any be written in the general (differential) form at any point of the fluid as

$$T = \mu \frac{du}{dy}$$

Zero viscosity is observes only at low temperature in super fluid. Otherwise all fluids have positive viscosity and are technically said to be viscous or viscid fluid.

1.2 Density:

The density of a fluid (or any other form of matter) is the amount of mass per unit volume. We first consider the average density of a finite volume of fluid Δv, and just as we did in the case of shear stress we apply a limit process in order o obtain the point wise volume of density. Hence Δm denote the mass of the volume Δv. The definition implies that

$$\bar{\rho} = \frac{\Delta m}{\Delta v}$$

and

$$\rho = \lim_{\Delta v \to 0} \frac{\Delta m}{\Delta v}$$

The density of the liquid is constant. Because, the density of the incompressible is constant (liquid is incompressible).Density is an important physical characteristic of any substance, and is a measure of the mass per unit of volume of that substance. It is an accepted fact that vegetable oil density decreases linearly with increasing temperature. This relationship can be expressed mathematically as

$$\rho = a + b.T$$

Where ρ is the density expressed in g cm^{-3}, T is the temperature expressed in ℃, a is the intercept and b is a negative slope

1.3 Pressure:

pressure is a normal force per unit area in a fluid. As we have done with other properties, we can define average pressure acting over a finite $area\ Aas$

$$\bar{p} = \frac{\Delta F}{\Delta A}$$

where Fn is the normal component of the force _F. Then the pressure at a point is given as

$$P = \lim_{\Delta A \to 0} \frac{\Delta F}{\Delta A}$$

2. RESULTS AND GRAPHS

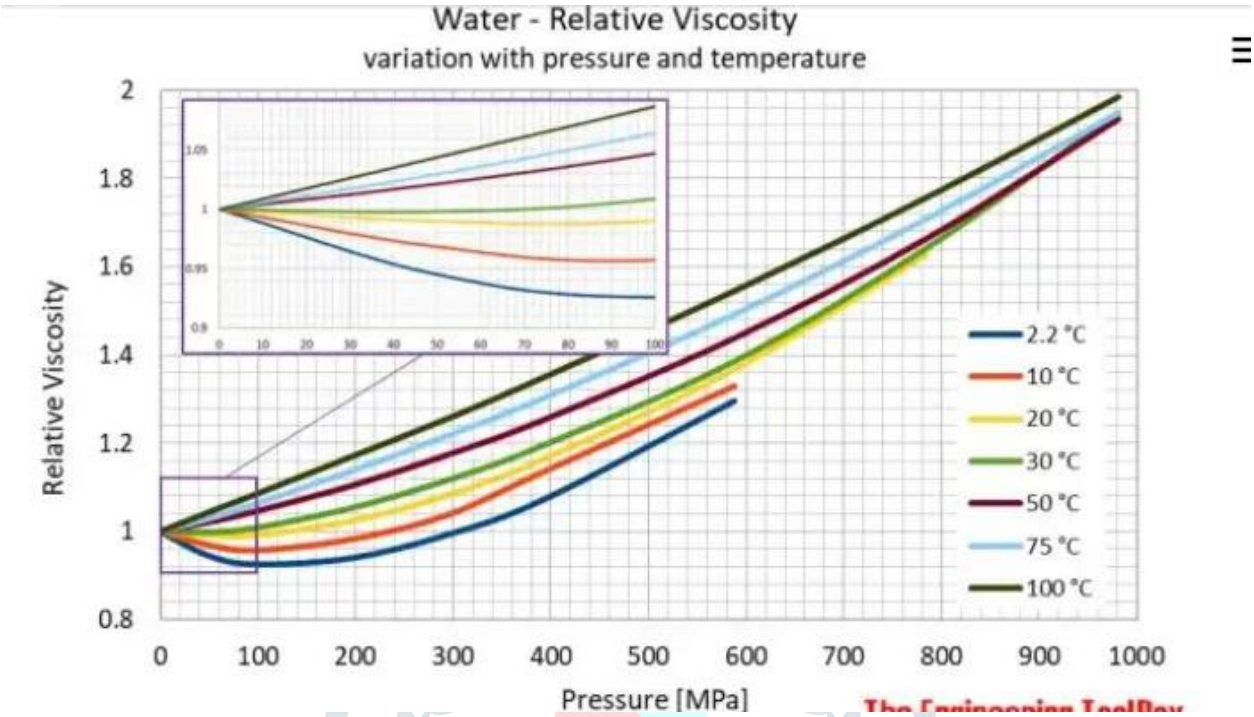

Figure.1 shows viscosity, pressure at different temperature.

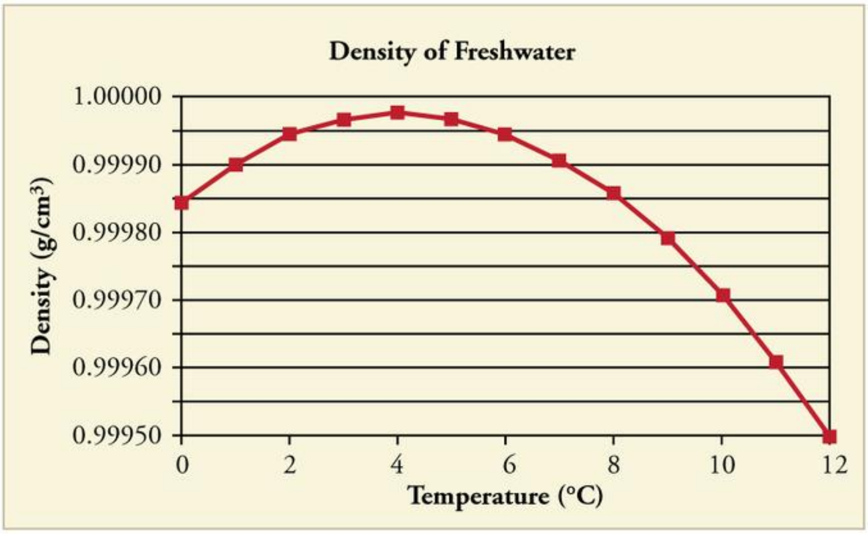

Figure.2 shows density at different temperature

3.Conclusion:

Viscosity tends to fall as temperature increases in water viscosity goes from 1.79 cP to 0.28 cP in the temperature range from 0 °C to 100 °C see temperature dependence of liquid viscosity for more details. The density increase whenever the temperature decrease that is ρ~ $\frac{1}{T}$ (charle's law), . The density increase whenever the pressure increase that is ρ~ P (boyle's law), The pressure increase whenever the temperature increase that is p~T (gay- lussac's law) combining all together P~ρ× T. also we have the pressure increased whenever viscosity is increases that is μ~P.Finally we getting is μ~ ρ× T.

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