LAB 1

Density of Fluids

Calculation

1. Glycerol

- Mass of the empty beaker = 0.0489 Kg
- Mass of beaker filled with fluid = 0.1228 Kg
- Mass of the fluid

$$\text{Mass of fluid} = \text{Mass of beaker filled with fluid} - \text{Mass of the empty}$$

Or

$$\text{Mass of fluid} = 0.1228\ \text{Kg} — 0.0489\ \text{Kg}$$

Or

$$\text{Mass of fluid} = 0.0738\ \text{Kg}$$

(1 l = 1000 ml and 1 m^3 = 1000 l or 1 m^3= (1000*1000) ml)

- Volume =60 ml = $60\text{ml} * \left(\frac{1\text{m}^3}{1000*1000\ \text{ml}}\right) = 6 * 10^{-5}\ \text{m}^3$
- Density

$$\text{Density} = \frac{\text{Mass of the fluid}}{\text{Volume}}$$

Or

$$\text{Density} = \frac{(0.0738)\ \text{Kg}}{(6 * 10^{-5})\ \text{m}^3}$$

Or

$$\text{Density} = 1231.66 \frac{\text{Kg}}{\text{m}^3}$$

- Theoretical Density of Glycerol = 1260 $\frac{\text{Kg}}{\text{m}^3}$ (Anon, 2022)
- Percentage of Error

$$\text{Percentage of error} = \left|\frac{(\text{Experimental Density}) - (\text{Theoretical Density})}{(\text{Theoretical Density})}\right| * 100$$

Or

$$\text{Percentage of error} = \left|\frac{1231.66 - 1260}{1260}\right| * 100$$

Or

$$\text{Percentage of error} = 2.249\ \%$$

2. Water

- Mass of the empty beaker = 0.0334 Kg
- Mass of beaker filled with fluid = 0.0818 Kg
- Mass of the fluid

$$\text{Mass of fluid} = \text{Mass of beaker filled with fluid} - \text{Mass of the empty}$$

Or

$$\text{Mass of fluid} = 0.0818\ \text{Kg} — 0.0334\ \text{Kg}$$

Or

$$\text{Mass of fluid} = 0.0484\ \text{Kg}$$

(1 l = 1000 ml and 1 m^3 = 1000 l or 1 m^3= (1000*1000) ml)

- Volume =50 ml = $50\text{ml} * \left(\frac{1\text{m}^3}{1000*1000\ \text{ml}}\right) = 5 * 10^{-5}\ \text{m}^3$
- Density

$$\text{Density} = \frac{\text{Mass of the fluid}}{\text{Volume}}$$

Or

$$\text{Density} = \frac{(0.0484)\ \text{Kg}}{(5 * 10^{-5})\ \text{m}^3}$$

Or

$$\text{Density} = 968\frac{\text{Kg}}{\text{m}^3}$$

- Theoretical Density of Water = 997.77 $\frac{\text{Kg}}{\text{m}^3}$ (BYJUS, n.d.)
- Percentage of Error

$$\text{Percentage of error} = \left|\frac{(\text{Experimental Density}) - (\text{Theoretical Density})}{(\text{Theoretical Density})}\right| * 100$$

Or

$$\text{Percentage of error} = \left|\frac{968 - 997.77}{997.77}\right| * 100$$

Or

$$\text{Percentage of error} = 2.983\ \%$$

Discussion

Glycerol and water have experimental densities of 1231.66 kg/m3 and 968 kg/m3, respectively. The value of theoretical densities and experimental densities are different. Glycerol's experimental density value has a percentage error of 2.249%, and water's experimental density value has a percentage error of 2.983%. The gap between these values is negligibly tiny. It demonstrates the precision of the experiment's findings. The value of percentage error less than 10 % accuracy is acceptable because of this, these values are reasonable and this experiment has high accuracy. The primary source of error may be inaccuracy in weight and volume measurements. The errors may have been caused by the assumption that the room temperature is constant.

Conclusion

This experiment's objectives include measuring the density of fluid samples using a variety of methods, comparing the results to theoretical values, and evaluating the degree of precision of lab work in terms of error percentage. All of these goals have been achieved. The experimental results are highly precise and accurate. The accuracy of the result may be impacted by measurement errors when weight and volume are being measured. The weight of the empty beaker and the weight of the beaker with fluid must be measured using a digital weighing machine rather than an analogue weighing machine in order to eliminate this error. The digital scale has better accuracy. During the recording of the volume, parallax errors should be avoided to improve the accuracy of experiment.

Reference

2022. Fluid Mechanics and Hydraulics Laboratory Manual. Higher Colleges of Technology Dubai Men`s College Civil Engineering Division.

Anon, (2022). *What Is the Density of Glycerol? - Denseme*. [online] Available at: https://denseme.com/density-of-glycerol/ [Accessed 21 Jan. 2023].

BYJUS. (n.d.). *What is the Density of Water? - Factors, Experiment, Temperature Scales, FAQs*. [online] Available at: https://byjus.com/physics/density-of-water/#:~:text=The%20density%20of%20water%20at%20room%20temperature%20(i.e.%2C%2022%C2%B0.