Laboratory 1 Sample Protocol

Contents

CE 3105 - Mechanics of Fluids Laboratory
Laboratory 1 - Fluid Properties

Title: Measurement of Fluid Properties: Density, Specific Gravity, and Viscosity

Objective

To establish a repeatable and safe protocol for measuring density, specific gravity, and viscosity of fluids.

Materials

1. Precision balance (±0.01 g accuracy)
2. Graduated cylinder (±1 mL accuracy)
3. Calibrated hydrometer
4. Tall column of fluid for viscosity measurement

5. Steel spheres of varying diameters
6. Stopwatch (±0.01 s accuracy)
7. Thermometer (±0.1°C accuracy)
8. Beakers (100 mL and 500 mL capacities)

Experimental Procedure

Part I - Density Measurement

1. Ensure the balance is calibrated before use.
2. Record the empty beaker's mass (tare).
3. Add the assigned fluid to the beaker and record the combined mass.
4. Measure the fluid's volume using a graduated cylinder.
5. Repeat the above steps three times for each assigned fluid.
6. Record the ambient temperature of the room.

Part II - Specific Gravity

1. Fill a tall, transparent container with the assigned fluid.
2. Gently submerge the calibrated hydrometer into the fluid.
3. Wait until the hydrometer stabilizes and record the specific gravity at the lower meniscus.
4. Repeat the process three times for each assigned fluid.

Part III - Viscosity

1. Select a steel sphere and measure its diameter using a micrometer.
2. Drop the sphere into the tall column of fluid at the guide.
3. Start the stopwatch when the sphere passes the first marker and stop it at the second marker.

4. Record the time taken for the sphere to travel the marked distance.
5. Repeat the steps three times for each sphere.

Safety Precautions

1. Ensure all glassware is handled carefully to avoid breakage.
2. Wear safety goggles to protect from splashes.
3. Handle fluids and steel spheres with clean, dry hands to avoid contamination.
4. Maintain a clean workspace to avoid cross-contamination of samples.

Expected Data and Analysis

1. Compute density using (ho = rac{m}{V}).
2. Tabulate specific gravity values and compare hydrometer readings with calculated values.
3. Calculate dynamic viscosity using Stoke's Law: [\mu = rac{2r^2 (ho_s - ho_f) g}{9v}] where (ho_s) is the sphere density, (ho_f) is the fluid density, (g) is gravitational acceleration, and (v) is the terminal velocity.
4. Analyze results for mean, standard deviation, and correlations between variables.

References

1. Cleveland, T. G. (2024) Fluid Mechanics Laboratory Notes to accompany CE-3105, Department of Civil, Environmental, and Construction Engineering, Whitacre College of Engineering.
2. Holman, J.P. (2012). *Experimental Methods for Engineers*, 8th Ed.