LAB 2 – MEASUREMENT OF FLUID PROPERTIES

LEARNING OUTCOMES

1. Define properties of fluid
2. Measure the fluid properties such as density, specific gravity, surface tension and viscosity
3. Determine the uncertainty with each measurement

In this experiment, we will use three different fluids and measure their fluid properties. The three different types of fluids we will use in this lab are: water, saltwater, and soap water. The fluid properties that will be used to measure in the laboratory are density, specific gravity, surface tension and viscosity. The fluids will already be prepared and will be placed in three different buckets.

1. Density

Density of a fluid is defined as the ratio of mass to its volume. This is measured in a laboratory using pycnometer, shown in Figure 1. The pyconometer is a glass flask with a close-fitting glass stopper with a capillary hole through it. Follow the procedure outlined below to measure the density of water using the pycnometer flask.

1. Weigh the Pycnometer to determine the empty mass of the flask (M_{pyc}).
2. Fill the pycnometer with water and weigh the pycnometer again ($M_{pyc+water}$)
3. The volume of water (V_{water}) can be determined by the label on the flask or can be measured using a graduated cylinder
4. The density of the water can be measured using the formula below

$$\rho_{water} = \frac{M_{pyc+water} - M_{pyc}}{V_{water}}$$

5. Repeat the above steps for the remaining fluids

Figure 1: A standard 50 ml Pycnometer

Sample Collection Table

Mass of Pycnometer flask (M_{pyc}) = _____

Sample	Mass of Fluid+Pycnometer	Mass of Fluid	Density of Fluid

2. Specific Gravity

Specific gravity is the ratio of the density of the fluid to the density of water. In a laboratory, the specific gravity of various fluids can be measured using a hydrometer, shown in Figure 2. Since the density of water is known, this measurement can be used to quickly measure the density of any fluid. The procedure to measure the specific gravity of water is outlined below

1. Fill a 1000 ml beaker with water
2. Immerse the hydrometer into the liquid and wait for it to stabilize in the water
3. Take the measurement once the hydrometer and the liquid are in equilibrium
4. Try different hydrometers if the first hydrometer submerges below the calibrated level
5. Repeat the above steps for different fluids

Figure 2. Picture of a hydrometer used for measuring specific gravity

3. Surface Tension

Surface tension is the elastic tendency of a fluid surface which makes it acquire the least surface area possible. This can be measured in a laboratory using a tensiometer, shown in Figure 3. The procedure to measure the surface tension of water is outlined below

1. Pour the sample of your water into a clean shallow dish and record the temperature
2. Raise the sample assembly until the ring is immersed well into the liquid using screw B
3. Lower the assembly until the ring is below the surface of the liquid
4. Ensure the index is at zero by looking at the mirror and the needle
5. Lower the sample further and the needle will deflect
6. Rotate knob A to bring the needle back to the index zero position
7. Continue adjusting B and A to slowly raise the ring from the liquid surface while keeping the needle at the zero position (a thin liquid film will cling to the ring)
8. Repeat the process in small increments until the ring breaks free from the liquid surface.

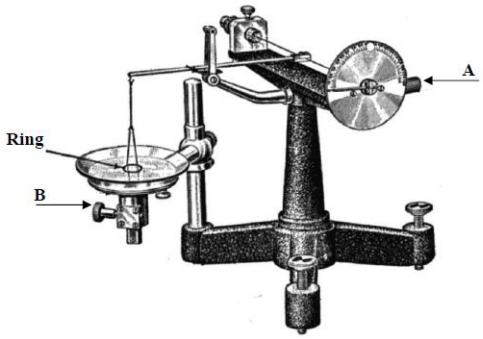

Figure 3. Picture of a Du Nuoy Ring Tensiometer

4. Viscosity

Viscosity is a measure of resistance of the fluid to shear stress. This is measured in the laboratory using a viscometer (shown in Figure 4) or a rheometer. The procedure for measuring viscosity of water in laboratory is outlined below

1. Pour water into a beaker and record the temperature. Ensure that there are no bubbles present in the fluid
2. Turn on the viscometer and follow the directions for auto zeroing
3. Choose a spindle from the case and dip it in the fluid. Make sure no bubbles are trapped under the spindle
4. Attach the spindle to the viscometer
5. Using the gear knob, lift the viscometer until the fluid is level with the notch on the spindle
6. Enter the spindle code (you will find it on the spindle) using the select spindle button and the up and down arrows. Press the select spindle button at the end of the selection
7. Now set the speed using the up and down arrows and pressing the set speed at the end.
8. Turn the motor on now and take the reading
9. The percentage reading should be between 10 and 100%. If it is higher than 100%, reduce the speed or try a smaller spindle. If a negative reading appears, turn off the viscometer and auto zero it again
10. Repeat the steps for other fluids

Figure 4. Picture of a Viscometer

DELIVERABLES

One team lab report containing the following

1. Letter of Transmittal (example: http://users.rowan.edu/~jagadish/resources/LoT_Example.pdf)

2. Materials and Methods (in paragraph format explain what materials you used and the procedure for collecting data)
3. Results and Discussion
    a. Present your results in neatly organized tables
    b. Compare your results with the existing information. Cite your sources. If your results are different from existing information, why is there a discrepancy?
    c. Discuss the error associated with measurement. Where is error introduced? Are the instruments you used accurate? What is the lower significant digit this instrument can measure?
4. Conclusions
    a. Briefly summarize your results and explain what you learned.