

Experiment 3

AIM

To determine the density of a liquid (other than water) by using a spring balance and a measuring cylinder.

THEORY

The density (ρ) of a given substance is the mass of its unit volume. For a substance of mass M and volume V , the density is given by the ratio:

$$\rho = \frac{M}{V}$$

In this experiment the density of a liquid will be determined by finding the mass of its known volume.

MATERIALS REQUIRED



A spring balance (0 – 500 g), measuring cylinder (100 mL), polythene bag according to the size of the measuring cylinder, and the given liquid (kerosene, turpentine oil or any other).

PROCEDURE

1. Find the range and least count of the spring balance and the measuring cylinder. (**Hint:** To determine the least count of a spring balance or a

measuring cylinder, note the value of the physical quantity measured by it between any of its two adjacent numerically marked divisions. Dividing this value by the number of smaller divisions between them gives the least count of the device.)

2. Hold the spring balance vertically and ensure that its pointer is at zero mark. Place the empty cylinder in a polythene bag and suspend it from the spring balance as shown in Fig. 3.1. Note the reading, M_1 of spring balance.
3. Place the measuring cylinder on a horizontal surface like a table. Pour the given liquid (whose density is to be determined) in the measuring cylinder. Note the volume, V , of the liquid (Fig. 3.2).
4. Put the liquid-filled cylinder in the polythene bag and again suspend it from the spring balance. Note the reading, M_2 , of the spring balance.



Fig. 3.1 : Measurement of mass of a measuring cylinder using a spring balance

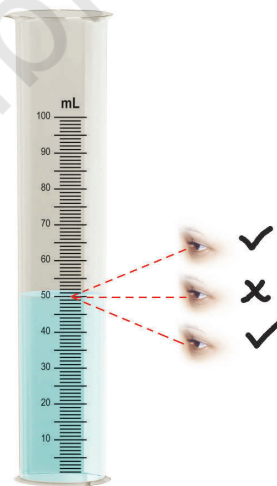


Fig. 3.2 : Measurement of volume of given liquid

OBSERVATIONS



- Range of the spring balance
- Least count of the spring balance
- Range of the measuring cylinder
- Least count of the measuring cylinder

= _____ g

= _____ g

= _____ mL

= _____ mL

(v) Mass (M) of the given liquid:

- (i) Mass of the empty cylinder in the polythene bag, M_1 = _____ g
 (ii) Mass of the liquid-filled cylinder (in the bag) M_2 = _____ g
 (iii) Mass of the liquid, $M (= M_2 - M_1)$ = _____ g
 (vi) Volume of the given liquid, V = _____ mL

CALCULATIONS

Volume of the given liquid V = _____ mL

Mass of the given liquid M = _____ g

Density of the liquid $\rho = \frac{M}{V}$ = _____ g/mL
 = _____ kg/m³ (1kg/m³ = 0.001 g/mL)

RESULTS AND DISCUSSION



The density of the given liquid is _____ kg/m³.

Find the standard value of density of the given liquid and compare it with the observed result (see Appendix – C).

PRECAUTIONS



- The measuring cylinder must be clean and dry.
- The measuring cylinder should be placed on a horizontal surface while measuring volume of the given liquid.
- While observing the liquid meniscus the line-of-sight should be at the same horizontal level as that of the lowest meniscus.
- There should be no air bubble in the liquid while measuring its volume.
- The spring balance should be held vertical while taking measurement.
- Before making use of spring balance it must be ensured that its pointer is at the zero mark.
- The readings of the spring balance should be noted only when its pointer comes to rest.

SOURCES OF ERROR

- The graduations marked on the measuring cylinder and on spring balance may not be evenly spaced.
- A spring balance is primarily meant for measuring the weight (force) of a body. However in laboratories, a spring balance is often used to measure the mass of a body. It should be remembered that the

calibration of spring balance scale is done at the place of its manufacture and depends on the value of acceleration due to gravity (g) at that place. Therefore, if a spring balance is used to measure mass at any other place where the value of g is different, an error in the measurement of mass will appear.

QUESTIONS

- A spring balance calibrated in newton, reads 19.6 N. What will be its mass in grams at your place?
- You are given two measuring cylinders of least count 1.0 mL and 2.5 mL, respectively. Which one will you prefer to determine the density more accurately?
- Write two precautions that you will observe while measuring the volume of a liquid with the help of a measuring cylinder.
- Two bottles of equal volume are filled with glycerine and water respectively. Which of the bottle will be heavier? Give reason for your answer.
- Why is the density of water at 80 °C less than its density at 30 °C?