MICRODENSITY OF PLASTICS[1]

LAB PP 2

INTRODUCTION

Density is defined as the mass per unit volume of a substance. It is one of the most important properties used in the identification of substances. However, if the sample of material is very small and of irregular shape, determination of the mass and volume of the sample may be difficult to accomplish.

Usually, density is found by massing the object, measuring its volume, and then dividing mass by volume. However, this lab demonstrates a different technique of determining density. It uses the relative densities of substances and the properties they demonstrate. An object with a low relative density will float on top of a liquid with a high relative density. However, if the liquid's density is somehow lowered, a point could be reached where the densities are equal. At this point, the object will be suspended in the liquid, neither sinking nor floating. This same idea is used for a relatively low-density liquid and a high-density object; only the liquid's density must be increased to suspend the material. Once the object is suspended, the object and the liquid possess exactly the same density. The density of the object can be determined indirectly by measuring the density of the liquid in which the object is suspended.

Practical application[2]: The most common type of plastics recycling in the United States is *mechanical recycling*. The mechanical recycling process refers to the direct recycling and conversion of plastics from discarded materials into plastic pellets. These recycled pellets are then reintroduced into the plastic production process to form new products.

Usually only PET and HDPE bottles are collected for recycling. During the mechanical recycling process, these bottles are chopped up into small pieces called “flake”, which are then washed to remove contaminants. The different plastics and contaminants are then separated using a Flotation Tank, which takes advantage of the differences in plastic densities. HDPE is less dense than water, therefore floats in the tank, while dirt and more dense plastic contaminants sink, and are removed. The reverse is true for PETE, which is more dense than water. In this case, the less dense contaminants are floated away.

[1]”Determination of the Density of a Plastic.” August 2001. http://services.juniata.edu/ScienceInMotion/chem/pp.htm (6 June 2002).
[2]”The Mechanical Recycling Process.” http://www.plasticsresource.com/recycling/index.html (20 May 2002).

PURPOSE

The purpose of this experiment is to find the density of a small piece of plastic, and to use the density to identify the type of plastic.

EQUIPMENT/MATERIALS

Small piece of known plastic
Small piece of unknown plastic
Saturated NaI
4" test tube
50 mL beaker
2 medicine droppers
Analytical balance
Forceps
Stirring rod
Scissors
Methanol
1 mL pipet
Weigh boats

SAFETY

- Always wear an apron and goggles in the lab.
- Never eat or drink in the lab.

PROCEDURE

1. Obtain a small bottle of methanol and a beaker.
2. Pour a small amount of methanol into the beaker.
3. Fill a test tube half full with water.
4. Obtain a sample of known plastic.
5. Bubbles can form on the plastic and change its apparent density. In order to reduce the number of bubbles, immerse the sample in methanol, and then use forceps to transfer the plastic to the test tube of water.
6.

If the plastic floats

- Add methanol - a few drops at a time - to the test tube, stopper it, and slowly tilt the test tube to mix until the liquid is homogeneous.
- Repeat this step until the plastic is suspended in the solution.

If the plastic sinks

- Obtain a small bottle of NaI solution.
- Add the NaI - a few drops at a time - to the test tube, stopper it, and slowly tilt the test tube to mix until the liquid is homogeneous.
- Repeat this step until the plastic is suspended in the solution.

Note: During the stirring process, be careful not to create tiny air bubbles that can attach to the piece of plastic. If this happens, the plastic will float regardless of the solution's density. Use the stirring rod to carefully remove the bubbles from the plastic piece.

7. When the plastic is suspended in the solution, the density of the plastic should equal that of the solution. Place a weigh boat on the analytical balance and tare. Remove 1.000 mL of the solution with a pipet and place it in the weigh boat. Record the mass of the solution in the appropriate Data Table.

8. Repeat steps 3 – 7 for second trial with the sample of known plastic and for two trials with a sample of unknown plastic.

Table 1: Density of Plastics

Symbols	Plastic Name	Density (g/mL)
1 = PETE	polyethylene terephtalate	1.39
2 = HDPE	high density polyethylene	0.95 - 0.97
3 = PVC	polyvinyl chloride	varies
4 = LDPE	low density polyethylene	0.92 - 0.94
5 = PP	polypropylene	0.90 - 0.91
6 = PS	polystyrene	1.05 - 1.07
7 = Other	(often a mixture)	varies

DATA SHEET

Name _____
Name _____
Period _____ Class _____
Date _____

MICRODENSITY OF PLASTICS

DATA TABLES

KNOWN PLASTIC

Code # _____ Code Letters _____ Name of Plastic _____

	Trial 1	**Trial 2**
Mass of solution		
Volume of solution		
Density of Solution		
Density of Plastic (experimental)		
Density of Plastic (accepted)		
Error		
Percentage Error		

CALCULATIONS

Show a sample of each of the following calculations from Trial 1:

1. Density of Solution

2. Error

3. Percent Error

UNKNOWN PLASTIC

Unknown # _____ Color _____

	Trial 1	**Trial 2**
Mass of solution		
Volume of solution		
Density of Solution		
Density of Plastic (experimental)		
Average Density of Plastic		
Identity of Unknown Plastic (Refer to Table 1)		

CALCULATIONS

Show a sample of each of the following calculations:

1. Density of Solution

2. Average Density of Plastic

QUESTIONS

1. Why is this method of determining density referred to as an indirect method?

2. What is the relative density of a piece of plastic if, when it is placed in water the piece is suspended?

3. What is the relative density of a piece of plastic if, when it is placed in water the piece floats?

4. If the plastic piece sinks in water, why is a saturated solution of sodium iodide added?

5. A student performed this same lab, but used a 5 mL volumetric pipet to obtain 5.00 mL of solution once the plastic was suspended. The mass of 5.00 mL of solution was 4.796 g. What is the density of this plastic?

6. What are sources of error in this experiment?