MICRODENSITY OF PLASTICS

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 mass and volume may be difficult to accomplish with precision.

4 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. But, 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.

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 plastic from home or from the teacher	forceps
4" test tube	scissors
50 mL beaker	methanol
saturated NaI (sodium iodide) solution	stirring rod
2 medicine droppers or Beral pipets	1 mL micropipet
weigh boats	analytical balance

Safety:

- **Always** wear safety glasses in the chemistry lab.
- **Never** eat or drink in the chemistry lab.

Procedure:

1. Obtain a small bottle of methanol in a beaker.
2. Fill a test tube half full with water.
3. Cut a piece of plastic approximately the size of a grain of rice from your sample.
4. Bubbles can form on the plastic and change its apparent density. In order to reduce the number of bubbles, immerse the sample in methanol. Then transfer the plastic to the test tube of water by using the forceps.
5.

If the plastic floats:

- Add methanol - a few drops at a time - to the test tube and carefully swirl or stir the solution until the liquid is homogeneous.
- Repeat this step until the plastic is suspended in the solution.

If the plastic sinks:

- Obtain a small bottle ofmL NaI solution.
- Add the NaI - a few drops at a time - to the test tube and carefully swirl or stir the solution until the solution 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 which can attach to the piece of plastic. If this happens, the plastic will float regardless of the solution's density. Using the stirring rod, carefully remove the bubbles from the plastic piece.

6. At this point, the density of the plastic should equal that of the solution. Place a weigh boat on the analytical balance and tare. Remove 1.00 mL of the solution and place it in the weigh boat. Record the mass of the solution.

Plastic		**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

Name_____
Name_____
Period_____
Date_____

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Data Table:

Known plastic

Identity of known plastic _____

Mass of solution _____

Volume of solution _____

Density of solution _____

Density of known plastic _____

Unknown plastic

Unknown plastic # _____

Mass of solution _____

Volume of solution _____

Density of solution _____

Density of plastic

Identity of unknown plastic _____

Name_____

Name_____

Period_____

Date_____

MICRODENSITY OF PLASTICS

Data Table:

Known plastic

Identity of known plastic _____

Mass of solution _____

Volume of solution _____

Density of solution _____

Density of known plastic _____

Unknown plastic

Unknown plastic # _____

Mass of solution _____

Volume of solution _____

Density of solution _____

Density of plastic _____

Identity of unknown plastic _____

Questions:

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

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

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

3. What is the purpose of dipping the piece of plastic in methanol prior to placing it in the test tube of water?

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

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TEACHER NOTES

Lab Time: approximately 30-45 minutes

Preparations:

Time: 20 minutes

Each lab group will need one set of the equipment and materials available. Other beaker and test tube sizes will fulfill the same purpose if needed.

Make one beaker available for each lab group at the site where the NaI solution will be kept.

Prepare the NaI solution by dissolving 185 g per 100 mL of water. This will be enough for at least 10 lab groups. This will also correspond to 150 mL of methanol.

Answers to Questions:

1. Why is this method of determining density referred to as an indirect method?
   The density of the plastic is being found but not by actually measuring the mass and volume of the piece of plastic.
2. a. What is the relative density of a piece of plastic if when it is placed in water the piece of plastic is suspended?
   It has the same density as the water.
   b. What is the relative density of a piece of plastic if when it is placed in water the piece of plastic floats?
   It has a density less than that of water.
3. What is the purpose of dipping the piece of plastic in methanol prior to placing it in the test tube of water?
   To prevent air bubbles from forming on the surface of the piece of plastic.
4. If the plastic piece sinks in water, why is a saturated solution of sodium iodide added?
   Sodium iodide is used to increase the density of the water, thus causing the piece of plastic to become suspended.

Considerations:

A lot of plastics are less dense than water, so the amount of NaI needed may not be too great. It may be useful to demonstrate to the students that if they pass up the point where the densities are equal, the addition of the other solution (of opposite relative density) to the test tube will exhibit the same result.