IDENTIFICATION OF COMMON THERMOPLASTIC POLYMERS

BACKGROUND

More than 60,000 kinds of plastics are manufactured; yet in this country six plastics account for 70% of those used. The plastics industry has adopted a code for use in identification of these six polymers. The symbol on the bottom of the plastic is a triangle of arrows following each other with a number in the middle of the triangle. Thus recycling should be made easier for the consumer by making it easier to identify the type of plastic.
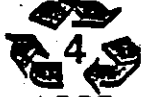
Recycling Symbol   **Name of Polymer**

1 PETE   1. Polyethylene Terephthalate

2 HDPE   2. High Density Polyethylene

3 V   3. Polyvinyl Chloride

4 LDPE   4. Low Density Polyethylene

5 PP   5. Polypropylene

6 PS   6. Polystyrene

7 other   7. all other Polymers

Without code numbers these plastics are difficult to separate or classify by appearance. In this lab you will examine some properties of these common plastics by using a few simple tests to develop a plastic classification and identification key. You will determine the relative densities of the thermoplastics. In the second test you will melt the plastic. All of the most common plastics melt reversibly. When they are cooled they harden and may regain their original properties. If a plastic sample does not melt, remember that it is a **thermosetting plastic**. The third test will be to burn the plastic. This <u>must</u> be performed under the hood. All common plastics burn (some only if held directly in the flame). The last test is the copper wire test and will determine if a halogen such as chlorine is part of the polymer.

PROCEDURE

1. Cut your 6 collected plastics into small squares and long strips. You will need 5 squares and 1 long strip. Make extras. *Note: Have your instructor check your plastics for suitability for use in lab.*

2. DENSITY TEST
    a. Get out your test tube rack and put into 3 test tubes about 5 mL of each of the following liquids. Be sure to label your test tubes.
        water 1.0 g/mL;   1:1 ethyl alcohol/water .94 g/mL;   10% NaCl (aq) 1.08 g/mL
    b. Place a square of plastic into each test tube containing a density liquid. Push it under the liquid with a glass stirring rod. If the sample floats, it has a density lower than that of the liquid. If it sinks, it has a density greater than that of the liquid.
    c. Test each of the six plastics. Record whether each **sinks or floats** in the density DATA TABLE. Then sort the six plastics by their densities.

3. MELT TEST
    a. Use a fresh sheet of aluminum foil to cover the bottom of the pan. Place your six samples of plastic in the pan and place the pan on the hotplate. Set the temperature to medium. **Do not heat strongly.**
    b. Observe the plastic as it warms and finally melts. Do any of the plastics become opaque or shrink substantially? Do any become transparent just before they melt? Record your observations in the data table.
    c. Carefully remove the pan from the hotplate when the samples have all melted. Cool the samples and examine them for appearance and flexibility by bending them. Record your observations in the data table.

4. IGNITION TEST
   a. A Bunsen burner has been placed in the hood on a large sheet of aluminum foil along with a large beaker of water. When your tests are completed, replace the aluminum foil and decant off the water and discard the plastics in the beaker. Refill the beaker.
   b. Use the forceps provided and hold one end of your long strip of plastic directly in the Bunsen burner flame. Allow your plastic to burn. Observe the color of the flame and its characteristics. Is there a lot of smoke --black smoke--given off? Does the plastic continue to burn after it is removed from the flame or is it self-extinguishing? **Very carefully, using correct procedure** observe the odor of burning LDPE and PP. *Do not smell any other plastics.*
   c. Test the vapors given off for acidic properties by holding a piece of <u>wet</u> blue litmus paper in the vapors from the burning plastic. If the paper turns red, acidic fumes are being formed as the plastic burns. Record your observations in the data table.

5. COPPER WIRE TEST
   a. Push the end of a 6 inch piece of copper wire into a cork.
   b. Use the cork as a handle and heat the free end of the wire in a Bunsen burner flame until the flame has no green color.
   c. Touch the hot copper wire to one of your plastic squares and then return the wire to the flame. (A tiny bit of plastic should have been picked up by the hot wire.)
   d. Watch for the appearance of a green flame or green color in the flame. The green color indicates the presence of chlorine in the plastic. Record your observations in the data table.

6. IDENTIFICATION OF UNKNOWN PLASTICS
   a. Obtain 2 unknown plastic samples. **Be sure to record the number of each.**
   b. Cut your unknowns into small squares and long strips as before.
   c. Perform all tests on your unknowns. Identify your unknowns. Be sure to specify the name of each.

DENSITY DATA TABLE

PLASTIC	1:1 ethyl alcohol/ water 0.94 g/mL	water 1.0 g/mL	10% NaCl(aq) 1.08 g/mL
PET			
HDPE			
V			
LDPE			
PP			
PS			
Unknown 1#_____			
Unknown 2#_____			

***Summarize your results below*

PLASTIC DENSITY CATEGORIES

Less than 0.94 g/mL	Less than 1.0 g/mL	Less than 1.08 g/mL	More than 1.08 g/mL

MELTING, IGNITION and COPPER WIRE TESTS

PLASTIC	MELTING	IGNITION	COPPER WIRE
PET			
HDPE			
V			
LDPE			
PP			
PS			
Unknown 1#_____			
Unknown 2#_____			

CONCLUSION and QUESTIONS:

1. Identify your 2 unknowns by name:

   Unknown 1 #_____is_____.

   Unknown 2 #_____is_____.

2. Suppose you had to add two other plastics to your scheme, poly(methyl-methacrylate) [density: 1.18-1.20 g/cm^3] and poly(4-methyl-1-pentene) [density: 0.83 g/cm^3]. Where would they fit in your scheme?

3. Plastic recyclers use density as their separation method. Polyethylene terphthalate is the most valuable waste plastic at the present time. Suggest a way to separate it commercially from other waste plastics.

4. Plastic recyclers are very concerned about identifying polymers and not mixing them together. Why do you suppose this is so?