Chem 110 Experiment 24: Why (or How) Do Plastics Get Sorted for Recycling?

Prelab Lecture
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What is the purpose of this lab?

The purpose of this lab is to collect a set of data that will allow you to sort an unknown set of plastic samples so that they can be properly recycled.

Properly recycled? Why can't they all be mixed together ?

Plastics are a type of material called polymers. That means that they are made up of simple molecules linked together. The fact that they are made this way is apparent in some of the names of the plastics that we most commonly use. Polyethylene for example is made up of ethylene molecules linked together. Polyvinyl chloride is made up of vinyl chloride molecules linked together.

The properties of these plastics depend on the molecule they're made of. This includes their hardness, their resistance to melting, and other useful properties. If they're mixed with other plastics their properties can change drastically, to the point where they will no longer be useful. This means that in order to recycle plastics they must be sorted first.

What are the main kinds of plastics?

There are six that make up fully 70% of all plastics, polyethylene terephthalate (PET) (1), high-density polyethylene (2), polyvinyl chloride (3), low-density polyethylene(4), polypropylene (5) and polystyrene (6).

Why did you put those numbers next to the plastics?

Those are codes that are used to identify various plastics, and are found typically on the bottoms of things manufactured from plastics inside a little triangle made of arrows.

So what's the problem? Why can't we just use those little numbers on the bottom of the plastic containers to identify the plastics?

They can be used some of the time.

Some of the time? Why only some of the time?

Because manufacturers are not required to label their plastics.

What can we do to figure out which plastic is which?

You can measure a set of properties for each plastic. Hopefully, each plastic will have a set of properties that will uniquely identify it.

Can't we just look at them?

Not usually. However, the kind of cloudy plastic that milk jugs are made of it is usually high-density polyethylene, and the plastic used for soda bottles is usually polyethylene perephthalate. Note however the careful use of the word "usually". Visual tests are not definitive.

What properties will we be using to characterize the plastics?

Density (mass per unit volume); whether it melts, whether it burns and the properties of the vapor, and a hot wire test.

How do we measure the density?

We do it by trying to float the plastics in liquids with different known densities. If the plastic is denser than the liquid it will sink. If it's less dense it will float. Therefore what we're really finding out is whether each plastic is more dense or less dense than each of the liquids.

How do we test melting?

We'll put a small piece of plastic on the end of a spatula and gently heat it with a flame until the plastic melts. We'll make observations on what the plastic looks like as it melts, and what it looks like and how flexible it is after it rehardens.

What about the burn test?

We'll take a small piece of our plastic, walk carefully over to the hood, hold it in a tong and set it on fire with a small flame. We'll look at the color of the smoke or vapor given off, whether it continues to burn when removed from the flame, and whether the smoke or vapor is acidic.

How can we tell if the vapor is acidic?

We'll hold a piece of wet litmus paper over the smoke or vapor and see if it turns red. If it turns red, the vapor or smoke is acidic.

Why wet litmus?

Two reasons. First the vapor will dissolve in the water, and if it's acidic, the litmus will reveal the acidity more readily. Second, a piece of dry litmus paper over a flame can catch fire.

What's our last test?

We'll melt a small amount of plastic onto a piece of copper wire, and then put it in the flame and look for a flash of color. If the flash is green, the plastic contains chlorine atoms.

What do we do then?

You'll look at your results and decide what combinations of the four tests you'll use to identify each plastic.

Then you'll test your plan using two pieces of plastic you brought to class today.

Once you've confirmed that your test works, we'll give you each two unknown pieces of plastic, which you'll (try to) identify.

What do we do for our report?

The data sheet on page 169, and questions 1-5 on page 168. Of course all work can be done collaboratively with your lab partner(s).