PERFECTLY POLYMERIC SODAS

OBJECTIVE: The activity can be used to introduce or review different types of polymeric materials and different ways they can be processed.

AUDIENCE: Appropriate, with modifications, from middle school science to college level plastic / rubber / chemical technology. Students should be familiar with the basic methods of forming plastic products: extrusion, injection, and blow molding on p

SAFETY CONCERNS: Read the label for precautions when using the polyurethane foam. The freshly formed foam is about the stickiest stuff you will ever encounter. It should not be handled for 24 hours after making so that unpleasant vapors can dissipate.

TIME FRAME: Requires only half an hour of laboratory time for the students.

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CHEMISTRY: Although the two aerosol foams may seem similar in practice, chemically they are very different

The polymer in **GREAT STUFF** rigid polyurethane foam is ***formed by a chemical reaction*** between two separate monomers, as they mix on exiting the can. Typically the monomers would be a diisocyanate and a diol or polyol. [http://www.unionchem.co.kr/tech1.htm]

The **DAP** latex *already exists as a polymeric material* inside the aerosol can. Inside the pressurized can, the polymer is dissolved in a solvent of liquified butane. As the mix leaves the can, the butane turns into a gas at room pressure, causing the mixture to foam. The latex foam then undergoes a room temperature vulcanization (RTV), meaning that the polymer chains are cross-linked, becoming firmer and less sticky.
http://www.dap.com/retail/retail_detail.cfm?catid=1&subcatid=71&prodhdrid=11

PERFECTLY POLYMERIC SODAS

From an idea of Melanie Stewart, POLYMER AMBASSADOR,
at a PACT workshop, 1998.

MATERIALS:

1. Rigid POLYURETHANE FOAM. Sold at Home Depot-type stores to fill drafty cracks in home siding and window and door frames. GREAT STUFF is one brand.
2. DAPtex Latex Multi-Purpose Insulating Foam Sealant. [Home Depot]

DIRECTIONS:

IN ADVANCE Following directions on the foam can, make the "soda" in the clear drink cups. Because the foam continues to expand, you need to stop filling just below the rim of the cup. It takes practice, so plan to make extras. You should end up with about 22 useable 5 oz size sodas from a 16 oz can. Allow to harden [polymerize and de-gas] overnight.

SUPPLIES FOR EACH STUDENT;

3. One 5-9oz clear polyethylene terephthalte cup [recycle code #1].
4. 1-2 straws; cocktail straws or coffee stirrers
5. Red "pompom" from craft store
6. Brown colored plastic pieces; Cut small pieces to represent chocolate sprinkles from a Hersheys cocoa box, for example.
7. Plastic shredded film; "Snow" is available at craft stores during Christmas, or pearlescent cellulose acetate streamers from a party supply store, or bike handlebar streamers.
8. Small amount of white glue.

WITH STUDENTS

1. Use a pen or nail to poke a hole into the hardened polyurethane foam.
2. Push a straw into the hole you just made.
3. Spread some white glue atop the "soda".
4. Sprinkle small quantities of "choclate" and "coconut" on the glue.
5. Use the latex foam to squirt some "whipped creme" on top.
6. Gently, top off with the "cherry"

RESULTS: You've just made a "Perfectly Polymeric Soda"! There are eight chemically different polymeric materials in it. The different parts of the soda were made using eight different processes.

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BACKGROUND FOR TEACHERS

How are plastics made?

Forty years ago, anything made of plastic was considered "cheap." That's certainly not true today when plastics are used in thousands of products ranging from computers, automobile parts and important medical equipment to toys, cookware, sports equipment, and even clothes. And the plastics industry continues to grow rapidly. Just where do plastics come from?

What are plastics?

It may surprise students to learn that gutta-percha, shellac, and the horns of animals—all naturally occurring substances—were used as plastic material before the first synthetic plastics were produced. Gutta-percha is derived from the sap of certain trees, and shellac is made from the secretions of a tiny scale insect. Before horn can be used, however, it must be "plasticized," or softened, by being boiled in water or soaked in an alkaline solution.

The first synthetic plastic was made from the plant material cellulose. In 1869, John Wesley Hyatt, an American printer and inventor, found that cellulose nitrate could be used as an inexpensive substitute for ivory. The mixture could be plasticized with the addition of camphor. Celluloid, as this new material was called, became the only plastic of commercial importance for 30 years. It was used for eyeglass frames, combs, billiard balls, shirt collars, buttons, dentures, and photographic film.

In 1951, two young research chemists for Phillips Petroleum Company (now ConocoPhillips) in Bartlesville, Okla., made discoveries that revolutionized the plastics world. Today, the plastics they discovered—polypropylene and polyethylene—are used to produce the vast majority of the thousands of plastics products all over the world. (Read more about their discoveries in "Serendipity, Science & Discoveries" in this publication.)

The source for today's wide variety of plastics? Petroleum.

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For more information or to send comments, please send an e-mail to teach@conocophillips.com.

www.teachingtools.com/Slinky/plastics.html

Petroleum to Plastics

The technological road from oil field to finished plastic product has numerous fascinating side trips. Here’’s the route taken in the petroleum-to-plastics process:

1. Petroleum is drilled and transported to a refinery.

2. Crude oil and natural gas are refined into ethane, propane, hundreds of other petrochemical products and, of course, fuel for your car.

3. Ethane and propane are "cracked" into ethylene and propylene, using high-temperature furnaces.

4. Catalyst is combined with ethylene or propylene in a reactor, resulting in "fluff," a powdered material (polymer) resembling laundry detergent.

5. Fluff is combined with additives in a continuous blender.

6. Polymer is fed to an extruder where it is melted.

7. Melted plastic is cooled then fed to a pelletizer that cuts the product into small pellets.

8. Pellets are shipped to customers.

9. Customers manufacture plastic products by using processes such as extrusion, injection molding, blow molding, etc.

Plastics Processing Methods

EXTRUSION MOLDING -- the main process used to form plastics. A heated plastic compound is forced continuously through a forming die made in the desired shape (like squeezing toothpaste from a tube, it produces a long, usually narrow, continuous product). The formed plastic cools under blown air or in a water bath and hardens on a moving belt. Rods, tubes, pipes, Slinkys®®, and sheet and thin film (such as food wraps) are extruded then coiled or cut to desired lengths. Plastic fibers also are made by an extrusion process. Liquid resin is squeezed through thousands of tiny holes called spinnerets to produce the fine threads from which plastic fabrics are woven.
www.teachingtools.com/Slinky/plastics.html

INJECTION MOLDING – is the second most widely used process to form plastics. The plastic compound, heated to a semi-fluid state, is squirted into a mold under great pressure and hardens quickly. The mold then opens and the part is released. This process can be repeated as many times as necessary and is particularly suited to mass production methods. Injection molding is used for a wide variety of plastic products, from small cups and toys to large objects weighing 30 pounds or more.
www.teachingtools.com/Slinky/plastics.html

BLOW MOLDING -- pressure is used to form hollow objects, such as the soda pop bottle or two-gallon milk bottle, in a direct or indirect method. In the direct blow-molding method, a partially shaped, heated plastic form is inserted into a mold. Air is blown into the form, forcing it to expand to the shape of the mold. In the indirect method, a plastic sheet or special shape is heated then clamped between a die and a cover. Air is forced between the plastic and the cover and presses the material into the shape of the die.
http://www.petcore.org/kids_intro_05.html

RECYCLE CODES

Further information on the recyle codes can be found at:

http://www.packaginggraphics.net/plastic-recycle-logo-identification.htm

Familiar packaging plastics are described at:

http://americanplasticscouncil.org/s_apc/sec.asp?TRACKID=&CID=313&DID=931

For more plastic and polymer websites, check both
MORE POLYMER EDUCATION SITES and
POLYMERS are EVERYWHERE
links on my webpage.

If you aren't already at the webpage, it's

http://www.geocities.com/lynhiggins@sbcglobal.net/

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PERFECTLY POLYMERIC SODA

SODA PART	POLYMER	PROCESS
CUP	polyethylene terephthalate(#1)	sheet, vacuum formed
SODA	rigid polyurethane foam	LRM (liquid resin molded)
STRAW	low density polyethylene (#4)	extrusion, tube
GLUE	polyvinyl acetate solution	evaporation of water
TOPPING	cellulose acetate	blown film, chopped
CHOCOLATE	high density polyethylene(#2)	extrusion, strand
CREME	"latex" (MSDS hints at a polyvinyl acetate and acrylic latex copolymer)	RTV (room temperature vulcanization)
CHERRY	polyacrylonitrile	acrylic spun fiber

From an idea of Melanie Stewart, POLYMER AMBASSADOR emeritus, at a Miami U PACT workshop in 1998.

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