SUMMER INSTITUTE FOR ENGINEERING AND TECHNOLOGY EDUCATION

MATERIALS ENGINEERING - STUDENT MODULE 7

MAKING A SUPER BALL

CONCEPTS

Formation of a long chin, tetrahedral polymer cross-linked with ethyl alcohol to produce rubbery substance

OBJECTIVE

The student will be able to create an inorganic silicone polymer that behaves like bouncy rubber.

INTRODUCTION

Two common liquids are mixed, and the reaction makes a solid that has the properties of rubber. The solid is a polymer. Chemists identify polymers as long chains in which molecules have linked up and twisted around each other, much like the paper chains people make for their Christmas trees. Nylon, polyethylene, wood (cellulose), proteins, and most plastics and rubbers are all polymers of particular molecules.

SCIENCE PROCESS SKILLS

- Identifying
- Measuring
- Observing
- Predicting
- Experimenting
- Collecting and interpreting data
- Analyzing data

MATERIALS

1. Sodium silicate (water glass) solution, 20 ml.
2. Ethyl or isopropyl alcohol, 5-10 ml.
3. Small paper cup for each solution.
4. Stirring stick.
5. Paper towels.
6. Food coloring
7. Optional: litmus paper or pH paper for secondary procedure
8. Safety glasses
9. Aprons
10. Gloves

SAFETY PRECAUTIONS

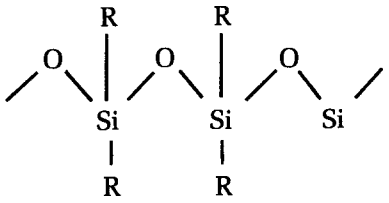
Sodium Silicate is corrosive; students must wear safety glasses and gloves. All alcohols are flammable. Extinguish all flames in the room.

PROCEDURE

1. Measure 20 ml of sodium silicate solution and pour it into a small paper cup. Avoid contact with your skin.
2. Place 5 ml of ethyl alcohol in another paper cup. Alcohol is flammable. Extinguish all flames in the room.
3. Add the alcohol to the sodium silicate solution.
4. Using a circular motion, stir with the stick until the substance formed is solid.
5. Place the polymer in the palm of your hand and gently press with the palm of the other hand until a spherical ball that no longer crumbles is formed. Be patient. Discover a technique! Moisten the ball occasionally by holding it in a small stream of water from the faucet.
6. Bounce your ball!
7. Investigate as many property differences as you can between the two liquids and the solid polymer bouncy ball. Check the acid-base nature of each of the substances, as well as solubility in water and density.
8. Store the ball in a small plastic bag. If it crumbles, it can be re-formed.

REACTION

Silicon is a very interesting type of atom. Find its position on the periodic table of the elements. Like carbon, silicon makes four chemical bonds and can branch out in that many directions to make long chains. In sodium silicate, the silicon atom is bonded to four oxygen atoms and is not linked in any chains. The ethyl alcohol molecule is very simple and has just two carbon atoms. When sodium silicate and ethyl alcohol are put together, the silicate particles begin to link up with each other to form long chains as the ethyl groups (sometimes shown as "R") replace oxygen atoms in the silicate ion. Some become cross-linked between chains. Water molecules are byproducts of the formation of the polymerization bond.



QUESTIONS

1. How did you know that a chemical reaction had taken place when the two liquids were mixed?

2. How could you find out what liquid was pressed out of the mass of crumbled solid as you formed the ball?
3. Compare your ball with those of the other members of the class. How many properties can you compare (e.g., diameter of sphere versus height of bounce)? List and compare them.