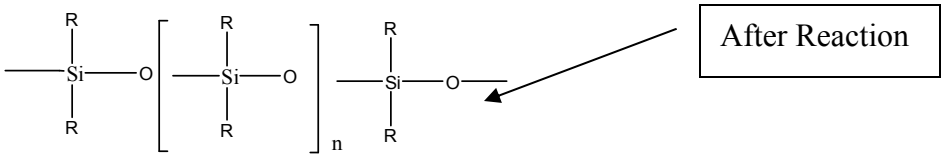
SILICONE SUPER BALL STUDENT HANDOUT

Silicone polymers do not have carbon as part of the backbone structure. Although silicon is in the same group as carbon in the periodic table, it has quite different chemistry. Many silanes are known which are *analogous* to the hydrocarbons with Si-Si bonds. These compounds are not very stable and hence not very useful. Silicones on the other hand have an alternating -Si-O- type structure. This basic structural unit is found in many rocks and minerals in nature including common sand. Various organic groups such as methyl or the benzene ring may be bonded to the silicon. Silicones are characterized by wide-range thermal stability, high lubricity, extreme water repellence and physiochemical inertness. Silicones have a number of medical applications because they are chemically *inert*. Their wide-ranging used include adhesives, lubricants, protective coatings, paints, electrical insulation, synthetic rubber, and prosthetic replacements for body parts, including implants. Sodium silicate solution is produced by fusing sand $(SiO_2)_n$ and soda ash (Na_2CO_3) in a furnace at about 1300°C. The final product, $Na_2O(SiO_2)_n$ is also called water glass. The reaction with ethyl alcohol produces a superball which is most likely a silicone elastomer where the R is $(-O-CH_2CH_3)$.

Before Reaction

[-Si-O-Si-O-Si-O-Si-O-] silicone



After Reaction

Silicones are water repellent, heat stable, and very resistant to chemical attack. They find many uses in oils, greases, and rubber-like materials. Silicone oils are very desirable since they do not decompose at high temperature and do not become viscous. Other silicones are used in hydraulic fluids, electrical insulators and moisture proofing agent in fabrics.

Material taken from the following sources:

http://www.elmhurst.edu/~chm/vchembook/404silicone.html

Flinn Scientific. Silicone Super Ball (1996).

Side Note: A good deal of controversy has involved the use of silicone in polyurethane bags as breast implants. Again they were used because they were thought to be very inert and resistant to dissolving or other reactions. Reports have cited increased cancer risk and severe immune responses from possible leakage of the silicone from the implants. Some scientists dispute these findings.

Silicone Super Ball Student Sheet

Explanation:

In this activity we will concentrate on the element silicon. Silicon is found in sand and is a major element found in computer chips as you read previously. The liquids solution of Sodium silicate is already in the form polymer. The silicate is alternating atoms of silicon and oxygen. These long chains are called the polymers. When the ethanol is added, it bridges and connects the chains by cross-linking them. The analogy of a chain-link fence is a good picture of the idea of chains that are cross linked. That is what the ethanol and the silicate are doing to form this super ball.

Materials:

sodium silicate solution (40%)

ethanol

food coloring (optional)

stirring rod

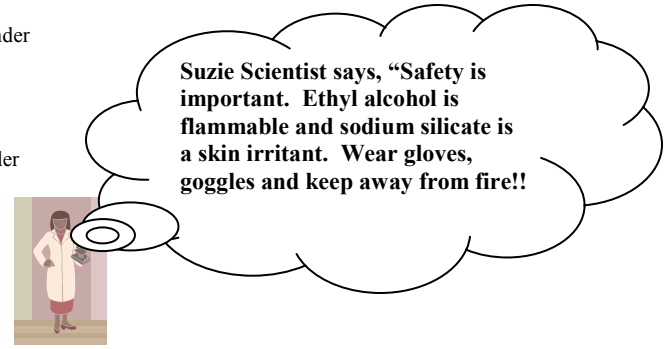
100 mL graduated cylinder

400 mL beaker

10 mL graduated cylinder

latex gloves

paper towels



Directions:

1. Measure 20 mL of sodium silicate solution in the 100 mL graduated cylinder.

2. Pour the sodium silicate solution into the 400 mL beaker.

3. Add food coloring, if desired, to the sodium silicate solution.

4. Measure 5 mL of ethanol in the 10 mL graduated cylinder.

5. Add the ethanol to the sodium silicate solution.

6. Stir the solutions quickly as the solid begins to form.

7. When mixture is solid, remove from beaker using latex gloves. If the mixture still has not formed a solid, add 5 mL more of ethanol.

8. Start molding the mixture into a ball, using paper towels to dry it as you work.

Be careful not to mold it too hard as it will crumble.

Disposal: If there is any excess of the rubber ball, it must be disposed of in the garbage.

Student Questions:

1. Describe some physical characteristics of the sodium silicate solution and ethyl alcohol.

2. What happens to the viscosity of sodium silicate during the time ethyl alcohol was being added?

3. How does the final product compare with the reactants? Do you think there might be more than one product? If so, explain.

4. Derive an analogy other than the given one that would be a good description of cross-linking.

5. Would you describe cross-linking of sodium as a chemical change or a physical change? Explain your answer.