RUBBER

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Natural latex is found in the inner bark of many trees, especially those found in Brazil and the Far East. (See Figures 1 and 2) The white sticky sap of the milkweed is also a latex. Latex will turn into a rubbery mass within 12 hours after it is exposed to the air. The latex protects the tree or plant by covering the wound with a rubbery material like a bandage.

Figure 1. A rubber oplantation in Viet Nam

Figure 2. Collecting latex from a rubber tree.

The rubber consists of polymeric chains (See Figure 3) which are joined in a network structure and have a high degree of flexibility (See Figure 4). Upon application of a stress to a rubber material, such as stretching it, the polymer chain, which is randomly oriented, undergoes bond rotations allowing the chain to be extended or elongated (See Figure 5). The fact that the chains are joined in a network allows for elastomeric recoverability since the cross-linked chains cannot irreversibly slide over one another. The changes in arrangement are not constrained by chain rigidity due to crystallization or high viscosity due to a glassy state.

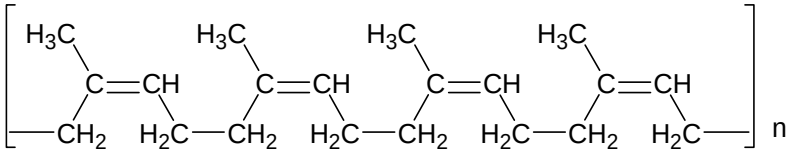

Figure 3. A rubber polymeric chain

Since latex will solidify in air, a stabilizer is added to prevent polymerization if the latex is to be stored or shipped. The stabilizer is usually 0.5 to 1% ammonia solution (also called ammonium hydroxide). When the ammonia is removed by evaporation or by neutralization, the latex will solidify into rubber.

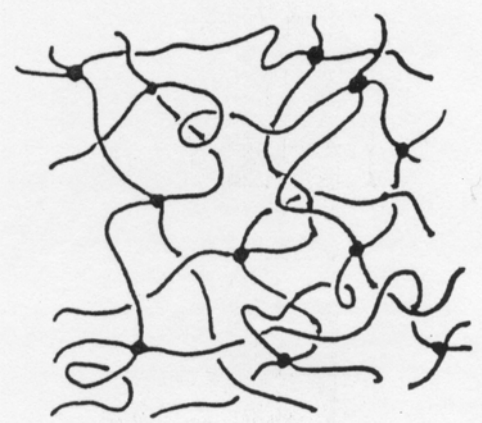

Figure 4. Schematic sketch of a typical elastomeric network.

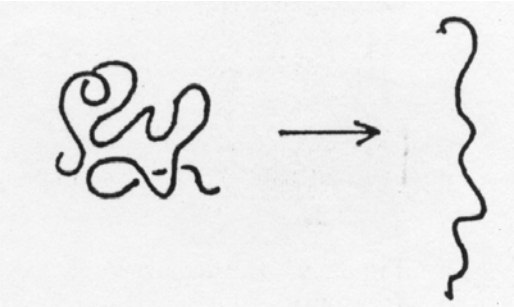

Figure 5. Elastic deformation of a rubber chain

PROCEDURE

1. Materials needed:

2 paper cups (5 ounce)
stirring rod (popsicle stick or equivalent)
small bucket or large beaker (1000 mL or larger)
measuring cups (small plastic beakers [50 mL] or plastic medicine cups)
20 mL rubber latex (available from art and craft stores or Flinn Scientific Co.)
20 mL vinegar
20 mL water
Optional: Rubber or plastic gloves.

2. Safety Precautions:

Wear safety goggles or glasses at all times in the laboratory.

The materials used in this experiment are considered to be non hazardous, however, some individuals may be allergic to rubber latex..

3. Disposal:

Materials can be safely disposed of in the trash. The latex solutions will clog drains, do NOT pour latex solutions down the drain, pour the waste liquid into the waste bottle provided..

4. Clean-up:

Latex spilled on non-porous surfaces can be allowed to dry and then peeled off. If spilled on clothing, latex can be removed using a cleaning fluid such as Afta. A dry cleaner can often remove most of a latex stain.

5. Experimental Procedure:

Measure 20 mL of latex into a paper cup.

Pour a few drops of latex onto the palm of your hand. Spread it out using your finger. What does it smell like? Describe its properties.

What happened to the stabilizer as you spread the latex around?

Obtain 20 mL of vinegar in a separate paper cup.

Dip the stirring rod into the vinegar, then into the latex, and then into the vinegar again. Remove the solidified latex. Stretch it. Describe the polymer.

What happened to the stabilizer when vinegar is added to the latex?

Add 20 mL of water to the latex and stir the mixture. Describe what happens.

Pour the 20 mL of vinegar into the cup of latex and stir the mixture. Describe what happens.

Remove the mass from the cup and stirring rod with your fingers. Carefully squeeze the mass while washing it under water in a small bucket. Form the mass into a ball. Dry it with a paper towel. Drop the mass on the floor and describe what happens.

Rubber latex, catalog number L0004, is available from Flinn Scientific Inc., P.O. Box 219; 770 N. Raddant Rd. Batavia, IL 60510. Telephone 800-452-1261 Flinn Scientific only ships to schools.