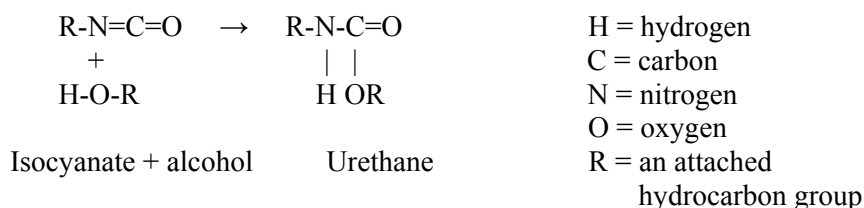


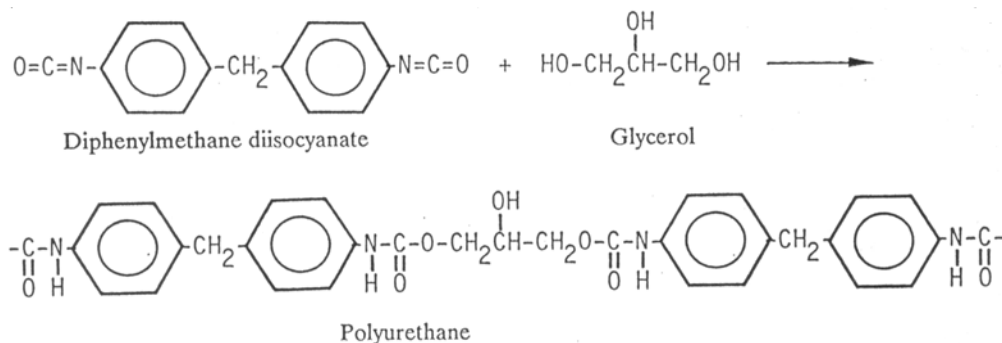
# POLYURETHANE FOAM (Craft Cast™)

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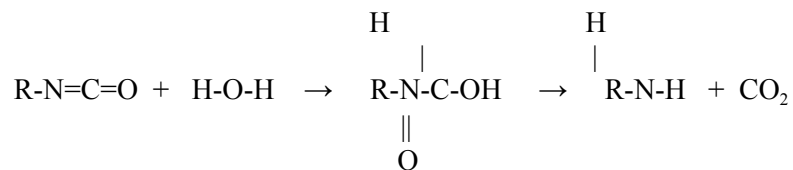
Polyurethane foam (sold in some hobby shops under the name Craft Cast™) is made from a two-part liquid material that, when mixed in equal amounts, produces a rigid foam that can be used to make mushrooms, castings of objects, for insulating and soundproofing, or other craft uses. Part A consists of a polymeric diol or triol (glycerin is usually used), a blowing agent, a silicone surfactant, a catalyst, and a Freon (trichlorofluoromethane). Part B contains a polyisocyanate (diphenylmethane diisocyanate). Upon mixing, a polymerization reaction occurs in three directions leading to a large molecule that is rigidly held into a three-dimensional structure. At the same time, the small amount of water present causes a decomposition of some of the isocyanate and the evolution of carbon dioxide which results in the foaming. The freon, which boils at 23.7°C (75°F), is vaporized by the heat of the reaction and also contributes to the foaming. The carbon dioxide and Freon bubbles create pores in the viscous mixture as the foam sets into a rigid mass. (Note: due to environmental concerns, Freon may not have been added to recent versions of this material.) The cell size and structure of the foam is controlled by the silicone surfactant. A generalized reaction scheme is:



The actual reaction of the diphenylmethane diisocyanate to form polyurethane with glycerol is:



The generalized reaction forming the carbon dioxide is:



Part B, which contains diphenylmethane diisocyanate (MDI), is toxic as well as an irritant to the skin and eyes. It may also cause an allergic response. This material should only be used with good ventilation.

A variation of the polyurethane foam is a product called String Confetti manufactured in France. This is an aerosol spray producing instant streamers of colored foam that utilizes a propellant as a blowing agent. The String Confetti material becomes hardened on exposure to air.

### **Procedure**

For this experiment, a commercially available material is used to produce the polyurethane foam. This material is stabilized and has caused no problems to users when used according to directions.

#### **Apparatus required**

- paper cup, 3 or 5-ounce (or 7-9 ounce cup for Part B)
- stirring rod (popsicle stick or equivalent)
- paper towel
- disposable plastic gloves (recommended)
- soda straw (for Part B)

#### **Reagents Required**

- Polyurethane foam system Part A, Flinn Scientific Inc, Catalog no. C0335A
- Polyurethane foam system Part B, Flinn Scientific Inc, Catalog no. C0335B (Note: This component contains acetone and may dry out during storage after opening. If the reaction between Parts A and B are slow and the foam product is too stiff, add small amounts of 100% acetone to Part B until desired results are achieved.)
- food color (optional)

### **Safety Precautions**

Wear safety goggles or glasses while performing this experiment.

Wear disposable gloves when performing this experiment.

DO NOT PERFORM THIS PREPARATION UNLESS THE ROOM HAS ADEQUATE VENTILATION

Polyurethane foam system Part A contains a poly ether polyol, a tertiary amine, and a silicone surfactant. This material may be an irritant to the skin and eyes. Avoid breathing the vapor. Keep the containers tightly closed when not in use.

Polyurethane foam system Part B contains polyfunctional isocyanates. This material may be an irritant to the skin and eyes. Avoid breathing the vapor. It may cause an allergic response. Keep the containers tightly closed when not in use.

### **Disposal:**

Mix the foam (parts A and B) and dispose of the solid in the trash. Do not incinerate it.

## Experimental Procedure

### Part A: Make a Foam Mushroom:

Measure 10 mL of Polyurethane foam system Part A . Pour it into a 3 or 5-ounce paper cup. (See Note below)

If desired, add up to 3 drops of food color to the paper cup containing Polyurethane foam system Part A. Avoid a large amount of food color as it will weaken the final foam. Stir the mixture with a stirring rod.

Measure 10 mL of Polyurethane foam system Part B. Pour it into the paper cup containing the Polyurethane foam system Part A.

Spread a paper towel flat on the bench top. Place the paper cup of liquid in the center of the towel. Stir the liquid thoroughly until the mixture is uniform in color. Remove the stirring rod. Does the cup feel warm? Describe what occurs as the mixture expands.

Do not touch the foam. It is very sticky and it may contain some unreacted material. It will take about 5 to 10 minutes to surface set and up to 24 hours to cure.

Note: Depending on the size of the paper cup used, the amounts of Polyurethane foam system Parts A and B may have to be varied between 5 to 15 mL.



### Part B: Make a Foam “Soda”

Measure 5 mL of Polyurethane foam system Part A. Pour it into a 7 or 9-ounce paper or plastic cup.

If desired, add 2 drops of food color to the cup containing Polyurethane foam system Part A. Avoid a large amount of food color as it will weaken the final foam. Stir the mixture with a stirring rod.

Measure 5 mL of Polyurethane foam system Part B. Pour it into the cup containing the Polyurethane foam system Part A.

Spread a paper towel flat on the bench top. Place the paper cup of liquid in the center of the towel. Stir the liquid thoroughly until the mixture is uniform in color. Remove the stirring rod. Does the cup feel warm? Describe what occurs as the mixture expands.

When the mixture has risen about half-way up the cup, add the soda straw.



Do not touch the foam. It is very sticky and it may contain some unreacted material. It will take about 5 to 10 minutes to surface set and up to 24 hours to cure.

## **Clean-up**

If any material is spilled on the bench top it can be cleaned up as follows:

Polyurethane foam system Part A or Part B can be cleaned up with acetone (nail polish remover). Test the surface before using acetone as it can damage plastics or painted surfaces. Use small amounts of acetone with good ventilation. CAUTION: Acetone is flammable. Avoid any sparks or flames.

Spilled foam should be allowed to harden. Scrape with a wood or plastic stick. Wipe up any residue with a small amount of acetone.