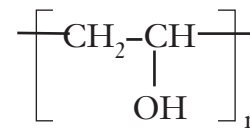


Polyvinyl Alcohol Activities



Introduction

Polyvinyl alcohol (PVA) is the world's largest volume, synthetic, water soluble polymer. PVA is nonhazardous and is used in many adhesives, films and elastomers. Its most popular use in schools is in the preparation of "slime." Another good activity that demonstrates the polymeric nature of polyvinyl alcohol is polyvinyl rope. PVA is a polymer with a repeating vinyl alcohol unit and its molecular weight can range from 25,000 to 300,000.



Concepts

- Polymers
- Hydrogen bonding

The Preparation of Slime

Materials

Polyvinyl alcohol, 4% solution, 50 mL	Graduated cylinder, 10-mL
Sodium borate, 4% saturated solution, $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$, 5 mL	Graduated cylinder, 50-mL
Cup, disposable	Wooden stick
Food coloring (optional)	

Safety Precautions

Students should be warned not to ingest the material and to use it only for the purposes intended. Do not allow slime to remain on clothing, upholstery, carpet, or wood surfaces. The food color in the slime will stain many surfaces. Clean up any slime spills as soon as possible. Wear chemical splash goggles. Please review current Safety Data Sheets for additional safety, handling, and disposal information.

Procedure

1. Place 50 mL of 4% polyvinyl alcohol solution into a disposable cup. Add a couple drops of food coloring and stir with a wooden stick.
2. Pour 5 mL of saturated sodium borate solution (4%) into the cup while stirring (saturated sodium borate is about 4 g per 100 mL of water). The mixture will gel almost immediately but keep stirring until smooth.
3. To observe the properties of slime, knead it into a ball. Hold a small part of the ball and watch it stretch without breaking. Try stretching the slime quickly and see how it will break under these conditions. Slime will also pick up ink from paper.
4. The slime will last two days to a week. Store it in an air tight, plastic sandwich bag. When the slime starts to mold, dispose of it in a waste container.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures, and review all federal, state and local regulations that may apply, before proceeding. Slime, polyvinyl alcohol solution, cups, and wooden sticks may be placed in the trash. Leftover sodium borate solution may be saved for later use or rinsed down the drain with water according to Flinn Suggested Disposal Method #26b.

Polyvinyl Alcohol Rope

Materials

Acetone, 30 mL

Polyvinyl alcohol, 4% solution, 50 mL

Aluminum foil or paper towels

Beaker, 150-mL, 2

Food coloring (optional)

Tweezers or forceps

Safety Precautions

Acetone is flammable and a dangerous fire risk; toxic by ingestion and inhalation: a skin and eye irritant. Due to the amount of acetone used, adequate ventilation is necessary and a fume hood is recommended. Wear chemical splash goggles and chemical-resistant gloves. Wash hands thoroughly with soap and water before leaving the laboratory. Please review current Safety Data Sheets for additional safety, handling, and disposal information.

Procedure

1. Pour 50 mL of 4% polyvinyl alcohol solution into a 150-mL beaker. *Optional:* Add a drop or two of food coloring (green will be a big hit!) and stir.
2. Carefully pour 30–40 mL of acetone on top of the polyvinyl alcohol solution. It helps if the beaker containing polyvinyl alcohol is slightly tipped and the acetone is poured along the side of the beaker from another beaker or graduated cylinder. A white interface of polyvinyl alcohol will immediately appear between the two liquids.
3. Using a pair of tweezers or forceps, pick up the interface layer and slowly pull it straight upwards from the beaker. A strand of polyvinyl alcohol rope, 30 to 40 cm in length, can easily be pulled out. Longer strands are possible if after 30 to 40 cm, a second pair of tweezers (or gloved hand) pinches the polyvinyl alcohol rope near the solution and continues to pull. The first section of polyvinyl alcohol rope can then be doubled over.
4. More ropes can be pulled out of the polyvinyl alcohol solution. Slightly stirring the polyvinyl alcohol solution helps. The first rope is usually the longest and most impressive. Lay the ropes out on paper towels or aluminum foil in a fume hood overnight to dry.
5. After drying overnight, additional demonstrations of polyvinyl alcohol as a polymer are possible. For example, polyvinyl alcohol is flexible but inelastic when dry; however, if dipped briefly in water, it becomes elastic.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures, and review all federal, state and local regulations that may apply, before proceeding. The acetone can be poured off the polyvinyl alcohol solution and evaporated in a fume hood according to Flinn Suggested Disposal Method #18a. The aqueous solutions can be flushed down the drain with excess water.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12

Evidence, models, and explanation

Content Standards: Grades 5–8

Content Standard B: Physical Science, properties and changes of properties in matter

Content Standards: Grades 9–12

Content Standard B: Physical Science, structure and properties of matter

Reference

Sherman, M. C. *J. Chem. Ed.*, **1992**, 69, 883.

Materials for *Polyvinyl Alcohol Activities* are available from Flinn Scientific, Inc.

Catalog No.	Description
A0009	Acetone, 500 mL
P0209	Polyvinyl alcohol solution, 500 mL
P0210	Polyvinyl alcohol solution, 1 L
S0334	Sodium borate, tetra, 100 g
S0363	Sodium borate solution
V0003	Food coloring, set of 4

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.