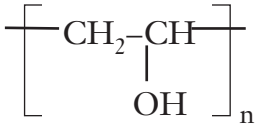
PVA Rope

Introduction

Ropes of polyvinyl alcohol (PVA) can be produced from aqueous solutions of PVA and acetone. PVA is soluble in water but insoluble in acetone. Layering acetone over a 4% solution of PVA creates a white interface of PVA fibers which can be pulled upwards through the acetone to produce a PVA rope. This demonstration is similar to the nylon demonstration but it is less expensive and uses less hazardous materials.

Polyvinyl alcohol is a polymer with a repeating vinyl alcohol unit. Its molecular weight can range from 25,000 to 300,000 depending on its viscosity.



PVA is the world's largest volume, synthetic, water soluble plastic. It is used in many adhesives, films and elastomers. Its most popular use in schools is the preparation of slime. (See Flinn Chemfax #608.00)

Concepts

- Polymers

Materials

Polyvinyl alcohol solution, 4%, 50 mL
Acetone, 30 mL
Aluminum foil, ~30 × 30 cm
Beaker, 150-mL
Paper towels (optional)
Tweezers or forceps

Safety Precautions

Polyvinyl alcohol purchased by Flinn Scientific is FDA approved for indirect food use (food packaging) and is not considered hazardous. 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. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.

Procedure

1. Pour 50 mL of 4% PVA 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 to 40 mL of acetone on top of the PVA solution. It helps if the beaker containing PVA is slightly tipped and the acetone is poured along the side of the beaker from another beaker or graduated cylinder. A white interface of PVA 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 PVA 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 PVA rope near the solution and continues to pull. The first section of PVA rope can then be doubled over.
4. More ropes can be pulled out of the PVA solution. Slightly stirring the PVA solution helps. The first rope is usually the longest and most impressive.
5. Lay the PVA ropes out on paper towels or aluminum foil in a fume hood overnight to dry.
6. After drying overnight, additional demonstrations of PVA as a polymer are possible. For example, PVA is flexible but inelastic when dry; however, if dipped briefly in water, it becomes elastic.
7. Alternative demonstration: Squirting aqueous PVA solutions into acetone precipitates PVA as a fibrous mass. These

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fiber balls can be removed with forceps and dried overnight.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. The acetone can be poured off the PVA solution and evaporated in a fume hood. For additional directions, see 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
Form and function
Content Standards: Grades 5–8
Content Standard B: Physical Science, properties and changes of properties in matter
Content Standard E: Science and Technology
Content Standard F: Science in Personal and Social Perspectives; science and technology in society
Content Standards: Grades 9–12
Content Standard B: Physical Science, structure of atoms, structure and properties of matter, chemical reactions
Content Standard E: Science and Technology
Content Standard F: Science in Personal and Social Perspectives, science and technology in local, national, and global challenges

Reference

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

Materials for *PVA Rope* 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

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