

Sodium Polyacrylate

Superabsorbent Polymers



Introduction

Water from one cup is poured into an “empty” cup (actually containing sodium polyacrylate) and the water “disappears!”

Concepts

- Polymers
- Superabsorbents
- Osmosis
- Industrial chemistry

Materials

Sodium polyacrylate, 0.5 g

Styrofoam[®] cups or other opaque containers, 2

Distilled or deionized water, 100 mL

Safety Precautions

Sodium polyacrylate is nontoxic. However, it is irritating to the eyes and also to nasal membranes if inhaled. Wear chemical splash goggles whenever working with chemicals, heat or glassware. Sodium polyacrylate is an obvious choice for student pranks. Be careful students do not have access to sodium polyacrylate outside of chemistry class. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.

Pre-Lab Preparation

Before the students come into the room, place 0.5 g of sodium polyacrylate in one of the Styrofoam cups.

Procedure

1. Add approximately 100 mL of distilled or deionized water to the second Styrofoam cup.
2. Tell the students that the water will “disappear” when poured into the other cup. (You can tip the cup forward somewhat to show that it is “empty”; it will be difficult to see the 0.5 g of sodium polyacrylate against the white Styrofoam cup.)
3. Slowly pour the water into the cup containing sodium polyacrylate. Swirl the cup a bit (give the sodium polyacrylate time to absorb the water).
4. Tip the cup downward slightly to show the students that the water has “disappeared”! (Don’t turn the cup upside down, or you may dump the jelly-like mass on the floor!)

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. Sodium polyacrylate and the gelled material may be placed in the trash according to Flinn Suggested Disposal Method #26a. Do not put sodium polyacrylate down the sink!

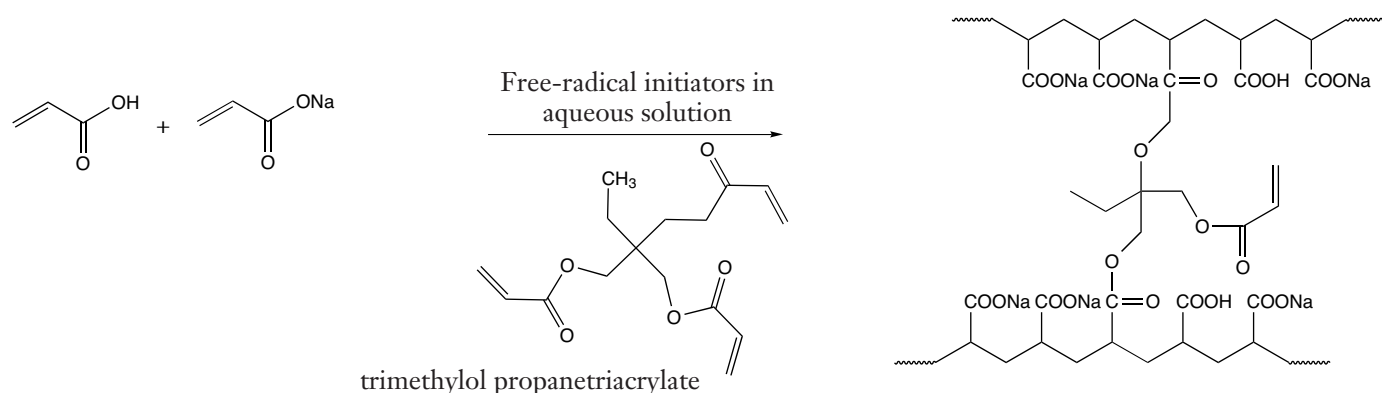
Tip

• After you have discussed with students what really happened in the demonstration, gradually add granulated salt to the gelled polymer. The addition of sodium chloride will break the gel as water leaves the polymer to dilute the salt concentration outside the polymer network. The result will be the apparent “deflation” of the gelled polymer.

Discussion

Sodium polyacrylate is an example of a superabsorbent polymer. Superabsorbents operate on the principle of osmosis—the passage of water through a membrane permeable only to the water. Here, osmotic pressure results from the difference in sodium ion concentration between the inside of the polymer and the solution in which it is immersed. This osmotic pressure forces water into the solid polymer lattice in an attempt to equilibrate sodium ion concentration inside and outside the polymer. The electrolyte concentration of the water will effect the osmotic pressure, subsequently affecting the amount of water absorbed by the polymer. For example, sodium polyacrylate will absorb approximately 800 times its own weight in distilled water, but will only absorb about 300 times its own weight in tap water, due to the high ion concentration of tap water. Sodium polyacrylate is manufactured by the free-radical polymerization of a mixture of sodium acrylate and acrylic acid, and a cross linker such as trimethylol propanetriacrylate

Sodium polyacrylate is the main ingredient in high-absorbency diapers. (It can absorb about 30 times its own weight in urine). It is also commonly used in alkaline batteries, feminine hygiene products, nursery potting soil, water beds, and as a fuel filtration material to remove moisture from automobile and jet fuels.



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 A: Science as Inquiry
- Content Standard B: Physical Science, properties and changes of properties in matter
- Content Standard F: Science in Personal and Social Perspectives; science and technology in society

Content Standards: Grades 9–12

- Content Standard A: Science as Inquiry
- Content Standard B: Physical Science, structure and properties of matter
- Content Standard F: Science in Personal and Social Perspectives, science and technology in local, national, and global challenges

Acknowledgment

Special thanks to Mr. Tom Dugdale, ARCO Chemical Corp., Newton Square, PA; and Mr. David Katz, Pima Community College, Tucson, AZ.

Reference

Buchholz, F. L. J. Chem. Ed. 1996, 73 (6), 512–515.

Materials for *Sodium Polyacrylate* are available from Flinn Scientific, Inc.

Catalog No.	Description
W0012	Sodium Polyacrylate, Powder, 25 g
W0013	Sodium Polyacrylate, Powder, 100 g
W0014	Sodium Polyacrylate, Powder, 500 g

Consult the [Flinn Scientific website](#) for current prices.