



Benzoic Acid Blizzard in a Bottle

A Winter Lab

Introduction

Create a "snowflake crystal" scene in a jar while learning about solubility principles. This lab had a serendipitous beginning when a supersaturated solution of benzoic acid was forgotten on a lab bench and allowed to cool! Voila! "Snow"!

Concepts

- Solubility
- Saturation
- Supersaturation

Materials

| | |
|----------------------------|-------------------------------|
| Benzoic acid, 1 g | Hot glue gun |
| Water, tap | Hot plate |
| Beaker, 250-mL | Ointment jar or baby food jar |
| Electrical tape | Plastic figurine, 1" tall |
| Forceps | Stirring rod |
| Graduated cylinder, 100-mL | |

Safety Precautions

Benzoic acid is moderately toxic by ingestion. Avoid contact with skin, eyes, clothing, and respiratory tract as it is a severe irritant. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Use exhaust ventilation to keep airborne concentrations low. Keep the bottle capped to avoid breathing the vapors. Be sure to warn the students not to allow younger family members to take the jar apart or to ingest the solution. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information. Wash hands thoroughly with soap and water before leaving the laboratory.

Procedure

1. Slowly heat 75 mL of tap water in a 250-mL beaker using a hot plate. Do not allow the water to boil.
2. As the water is heating, add about 1 gram of benzoic acid. Continue to heat and stir the mixture until the benzoic acid completely dissolves. The solution does not have to come to a boil.
3. Remove the beaker from the hot plate and allow the solution to begin cooling.
4. Thoroughly clean and dry a baby food jar or a 4-oz ointment jar.
5. Hot glue a plastic figurine inside the baby food jar bottom. Use a pair of forceps to hold the figurine by its top. Put some hot glue on the bottom of the figurine and immediately place the figurine on the bottom of the baby food jar. Hold it in place for a few seconds. Allow the glue to cool for several minutes.
6. Watch the benzoic acid solution as it begins to cool. Snowy-looking crystals will appear.
7. After the solution has completely cooled to room temperature and the figurine is secure at the bottom of the jar, stir the snow mixture, and then quickly pour it into the baby food jar.
8. Use a graduated cylinder to slowly fill the jar to the brim with tap water. Try to leave as little air as possible in the jar.
9. Cap the jar tightly. Turn the snow scene upside down and watch your figurine get buried in the blizzard of benzoic acid "snow."

10. If desired, use some electrical tape around the jar lid to seal it completely. If the figurine comes loose, it can be repaired by opening the jar, pouring the solution into a disposable cup, regluing the figurine, and then replacing the solution. If any solution is lost, add a little more tap water.

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 benzoic acid solution may be neutralized according to Flinn Suggested Disposal Method #24a.

Tips

- Either a 4- or 6-oz baby food jar will work; however, because the seal on a baby food jar is not tight, consider purchasing 4-oz ointment jar style bottles from Flinn (AP8445).
- Stress to the students the need to fill the jar to the brim with water. Air pockets tend to cause the benzoic acid to clump at the top.
- Encourage students to bring in their own figurines (whatever they find interesting). Solid plastic figurines work the best. Inexpensive figurines can be purchased at a local discount or craft store.
- Do not try to speed up the cooling process of the supersaturated solution by using ice; beautiful crystals form when the solution cools slowly.
- If the solution is still hot when added to the jar, the figurine will have a good chance of falling off. Be patient.

Discussion

A solution is formed by dissolving a *solute* such as benzoic acid in a *solvent* such as water. A *saturated* solution contains as much solute as possible at a given temperature and pressure. A solution is said to be *unsaturated* when it contains a lower concentration of solute than a saturated solution. When the temperature is increased, the solubility increases and more solute will dissolve. If a hot, saturated solution is then cooled, the “extra” solute that dissolved with heat will once again precipitate. This is the chemical phenomenon occurring when the benzoic acid precipitates out as “snow” in this lab.

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, chemical reactions

Acknowledgment

Special thanks to Richard Chapleau, Lancaster High School, Lancaster, CA for providing Flinn Scientific with this lab.

Materials for *Benzoic Acid Blizzard in a Bottle* are available from Flinn Scientific, Inc.

| Catalog No. | Description |
|-------------|----------------------------------|
| B0197 | Benzoic acid, 100 g |
| AP8445 | Bottle, 4 oz, ointment jar-style |
| AP9011 | Glue gun |

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