Solubility of Gases

Saturated, Unsaturated, and Supersaturated Solutions

Introduction

Most solids are *more* soluble in hot water than in cold water so it comes as something of a surprise to learn that all gases become *less* soluble as water temperature rises.

Concepts

- Gas solubility
- Dissolved oxygen vs. temperature

Materials

Carbonated beverage, dark such as grape
Ice
Water, tap
Beakers, borosilicate glass, Berzelius, 1-L, 3
Rubber stoppers, one-hole, sized to fit test tubes, 3
Test tubes, large, 3

Safety Precautions

Hot water may scald skin. Wear chemical splash goggles. Wash hands thoroughly with soap and water before leaving the laboratory. Follow all laboratory safety guidelines. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.

Preparation

1. Place the dark carbonated beverage into an ice bath to reduce its temperature to about 0 °C.
2. Add 900 mL of tap water to two Berzelius (tall-form) borosilicate glass beakers.
3. Place one of the beakers on a hot plate until it reaches between 70 and 80 °C. The second beaker will serve as the room temperature water bath.
4. In the third Berzelius beaker, add 700 mL of water and 200 mL of ice.

Procedure

1. Fill each test tube to the top with the cold carbonated beverage and immediately stopper each tube.
2. Cover the hole in the stopper with a finger and quickly invert a filled test tube into each beaker. *Note:* This step should be completed simultaneously.
3. Uncover the stopper hole and slowly lower the test tube to the bottom of the beaker. Leave the test tube at an angle so that the carbonated beverage is able to escape the test tube.
4. Record any observations.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. The resulting solutions can be rinsed down the drain with an excess of water according to Flinn Suggested Disposal Method #26b.

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Tip

- A similar activity using Alka-Seltzer followed by quantitative titration may be requested from Flinn Scientific Inc. Request ChemFax 33.00.

Discussion

The carbonated beverage contains dissolved carbon dioxide (CO_2) gas. When the carbonated beverage is no longer contained within a pressurized can the dissolved carbon dioxide escapes from the liquid. When the test tubes containing the carbonated beverage are placed into the three different water baths, a marked difference in reaction rate is observed—fast reaction in hot water, slow reaction in cold water.

An important environmental application of the solubility of gases is dissolved oxygen in bodies of water. The amount of oxygen dissolved in water also varies greatly with temperature. Cold water is able to hold more oxygen that warm water. Certain species of aquatic animals require more dissolved oxygen to survive so any artificial or natural warming of the water will cause vast numbers to die of asphyxiation.

Connecting to the National Standards

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

Unifying Concepts and Processes: Grades K–12
Systems, order, and organization
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

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Solubility of Gases* activity, presented by Jeff Hepburn, Mike Heinz, and Penney Sconzo, is available in *Saturated, Unsaturated, and Supersaturated Solutions*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *Solubility of Gases* are available from Flinn Scientific, Inc.

Catalog No.	Description
GP1061	Beakers, Borosilicate Glass, Berzelius, 1-L
AP2300	Rubber Stoppers, One-hole, Size 0
GP6066	Test Tubes, without Rims, 16 × 150

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