Soda Pop Shower

Properties of Solutions

Introduction

Although we have all seen this demonstration many times, we never tire of witnessing this nucleation phenomenon of Mentos and diet Coke!

Concepts

- Henry's Law—solubility/pressure relationship of a gas

Materials (for each demonstration)

Diet soda, 2-Liter bottle, 3	Soda can, 12-oz, 2
Mentos candy, 4 pieces	String with washer attached
Wintergreen breath mints, 4 pieces	Tape
Extension cord and outdoor electrical outlet (optional)	Ultrasound cleaner (optional)

Safety Precautions

Follow all laboratory safety guidelines. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information. Remember to wash hands thoroughly with soap and water before leaving the laboratory.

Procedure

Part 1 — Soda Can

1. Place the two soda cans on the table.
2. Open one of the cans. Ask the students to explain the hissing sound.
3. Now shake up the other can. Ask the students to predict what will happen when the can is opened. Why is this "release" of gas more dramatic?

Part 2 – 2-Liter Diet soda

1. Drill a $^{5}/_{16}$″ hole in the cap of each 2-Liter soda bottle, Do this right before starting the demo. Drill a hole through 2 of the Mentos candy pieces and, if needed, two of the breath mints.
2. Thread the pieces through the string, slide the pieces down to the washer, thread the string through a bottle cap, pull the candy pieces to the cap and fix the string to the outside of the cap with tape. Replace the cap on the soda bottle so that the candy pieces are suspended above the soda.
3. Take this demonstration outdoors.
4. If using an ultrasonic cleaner, follow the instructions on its operation. Place the two bottles without the candy in the cleaner. Turn on the cleaner, stand back, and watch the soda geyser eruption!
5. Set the bottle with the candy pieces down.
6. Remove the tape, drop the string into the liquid and presto, instant soda fountain!

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste.

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Discussion

Carbonated beverages are prepared by dissolving carbon dioxide gas in water under high pressure. At atmospheric pressure, carbon dioxide solubility is very low. However, this solubility increases with increasing pressure according to Henry's Law

$$s_g = k_H P_g \qquad \textit{Equation 1}$$

where s is the solubility of the gas, P is the pressure above the liquid, and k is a constant unique to the specific gas. Once the can or bottle is opened, the pressure above the liquid diminishes and the solubility of the gas decreases. That is the hissing sound when a non-agitated bottle is opened. Over time, the still supersaturated solution will equilibrate with the atmospheric CO_2, leaving the soda "flat". This equilibration is quickened by first shaking the can or bottle. Just like adding a seed crystal to a supersaturated solution, shaking provides a sight for gas molecules to quickly come out of solution.

In part 2, this shaking is quickened by using ultrasound. The ultrasonic waves create up to 40,000 shakes per second. This results in all the carbon dioxide being released at once, creating the geyser effect. This effect is duplicated by the rough surfaced candies. The surfaces of the candies have many small holes. Carbon dioxide bubbles are formed at these sites very quickly and in great volume, thus creating the same fountain effect.

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
Constancy, change, and measurement
Content Standards: Grades 9–12
Content Standard A: Science as Inquiry
Content Standard B: Physical Science, structure and properties of matter, motions and forces, interactions of energy and matter

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Soda Pop Shower* activity, presented by Lee Marek is available in *Properties of Solutions* and in *Classroom Fun*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.