Aloha Chemical Sunset

Properties of Solutions

Introduction

Watch as the sun sets over a chemical reaction! The reaction of sodium thiosulfate with hydrochloric acid produces elemental sulfur, which precipitates from solution to form a colloidal mixture. When the reaction is carried out on an overhead projector, the light from the projector is scattered by the colloidal sulfur particles and produces a multicolored chemical sunset.

Concepts

- Colloid
- Light scattering
- Tyndall effect

Materials

Hydrochloric acid solution, 1 M, HCl, 8 mL
Sodium thiosulfate solution, 0.2 M, $Na_2S_2O_3$, 14 mL
Graduated cylinder, 25-mL
Paper
Petri dish, 100 × 15 mm
Overhead projector
Scissors
Tropical sunset cutout

Safety Precautions

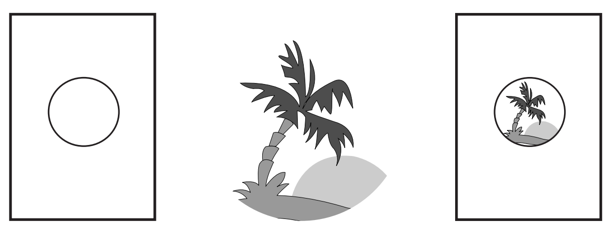
Hydrochloric acid is moderately toxic by ingestion and inhalation and is corrosive to eyes and skin. Sodium thiosulfate solution is a body tissue irritant. The sulfur produced in this reaction has low toxicity but may be a skin and mucous membrane irritant. The smell of the sulfur may become irritating—transfer the Petri dish to the hood when the demonstration is over. The reaction also produces sulfur dioxide gas, which is a skin and eye irritant. 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.

Preparation

Prepare 0.2 M sodium thiosulfate solution by dissolving 5.0 g of sodium thiosulfate pentahydrate, $Na_2S_2O_3 \cdot 5H_2O$, in 100 mL of distilled or deionized water.

Procedure

1. Trace a circle the size of the Petri dish on a piece of opaque paper and cut out the circle to provide a "frame" for the chemical sunset (Figure 1a). Place this frame on the overhead projector.
2. Obtain a photocopy of the tropical sunset picture and cut out along all of the outside edges to obtain a silhouette (Figure 1b).
3. Place the tropical sunset cutout inside its circular frame as shown in Figure 1c.
4. Place the Petri dish on the overhead projector and center the dish on top of the cutout.
5. Turn on the overhead projector and focus the tropical sunset picture on a projector screen or wall.
6. Measure 14 mL of 0.2 M sodium thiosulfate solution and pour it into the Petri dish.
7. Measure 8 mL 1 M of hydrochloric acid solution and pour it into the Petri dish. Stir the mixture.
8. Observe the color of the projected light on the screen or wall. (The color of the transmitted light will slowly change from red and orange to blue and green, and finally to dark gray.)



1a. 1b. 1c.

Figure 1.

Disposal

Publication No. 91333
061616

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. The insoluble sulfur may be separated by filtration and disposed of in a landfill according to Flinn Suggested Disposal Method #26a. The remaining filtrate may be neutralized with base according to Flinn Suggested Disposal Method #24b.

Tip

- Experiment with the volumes of reagents used and the rate at which hydrochloric acid is added to produce different special effects in the chemical sunset. Add flair to the presentation by playing Hawaiian music in the background as the demonstration is silently presented to the students.

Discussion

Reaction of sodium thiosulfate with hydrochloric acid produces elemental sulfur, according to the following overall reaction equation.

$$Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow S(s) + SO_2(aq) + H_2O(l) + 2NaCl$$

The solid sulfur forms a sol, a colloidal mixture that may appear uniform throughout. In contrast to the uniformly dispersed particles in a true solution, however, the dispersed particles in a colloid are relatively large and thus will scatter light that is passed through the mixture. The scattering of light by a colloid—called the Tyndall effect—makes it possible to view a beam of light as it passes through the mixture. As the colloidal sulfur particles grow, the light from the overhead projector is scattered. The changing colors of the sunset are produced because different wavelengths of visible light are scattered to different degrees. The shorter wavelengths of light (blue and green) are scattered more than the longer wavelengths (red and orange). The longer wavelengths of light pass through the mixture and produce a red-orange color in the projected (transmitted) light. As the amount and particle size of the colloidal sulfur increases, the wavelength dependence of the amount of light scattering diminishes and other colors are seen. Eventually the mixture becomes opaque and no light passes through—night falls and the sunset fades to black!

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
Content Standards: Grades 9–12
Content Standard B: Physical Science, structure of atoms, structure and properties of matter, chemical reactions

Acknowledgment

Special thanks to David Katz for bringing this demonstration to our attention.

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Aloha Chemical Sunset* activity, presented by Steve Long, is available in *Properties of Solutions*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *Aloha Chemical Sunset* are available from Flinn Scientific, Inc.

Catalog No.	Description
S0114	Sodium Thiosulfate, 500 g
H0013	Hydrochloric Acid Solution, 1 M, 500 mL
GP3019	Dish, Culture (Petri), Pyrex®, Borosilicate Glass, pkg. of 6

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