Sudsy Kinetics

A Foamey Chemical Demonstration

Introduction

Teach kinetics concepts in a fun and sudsy way! This demonstration provides an interesting twist on the traditional "Old Foamey" or "Elephant Toothpaste" reaction. Not only will your students be amazed at the sudsy eruption—they will learn kinetics concepts along the way!

Concepts

- Kinetics/Catalysts
- Reaction intermediates
- Decomposition reactions
- Test for oxygen gas

Materials

Alconox® detergent, 3–4 g

Hydrogen peroxide, H_2O_2, 30%, 10%, 3%, 20 mL of each

Sodium iodide solution, NaI, 2 *M*, 4–5 mL

Graduated cylinders, 10-mL and 100-mL, 3 of each

Graduated cylinder, 500-mL

Large, plastic demonstration tray, several inches deep

Lighter or matches and wood splint

Spoon or scoop

Safety Precautions

Hydrogen peroxide solution, 30%, is a strong oxidizing agent and a dangerous fire and explosion risk; it is severely corrosive to the skin, eyes, and respiratory tract. Do not heat this substance. Sodium iodide solution is slightly toxic by ingestion. Do not stand over the reaction; steam and oxygen are produced quickly. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Wash hands thoroughly with soap and water before leaving the laboratory. Follow all normal laboratory guidelines. Please review current Safety Data Sheets for additional safety, handling, and disposal information.

Procedure

Part 1. Effect of Concentration on the Rate of the Reaction

1. Place three 100-mL graduated cylinders in a large, plastic demonstration tray. Add 20 mL of 30% hydrogen peroxide to the first cylinder, 20 mL of 10% hydrogen peroxide to the second cylinder, and 20 mL of 3% hydrogen peroxide to the third cylinder.
2. Add 1 small scoop (3–4 g) of solid Alconox® detergent to each cylinder and swirl to dissolve the detergent.
3. Measure out 5 mL of 2 *M* sodium iodide solution in each of three 10-mL graduated cylinders. Ask your students to predict the rate at which each of the peroxide solutions will react with the iodide.
4. Ask for three student volunteers. Make sure the students are wearing chemical splash goggles; warn them to step back as soon as they pour. Have the students simultaneously pour the sodium iodide solution into the three cylinders containing the differing concentrations of hydrogen peroxide. Make observations. White foam erupts from the cylinder with the 30% peroxide the fastest, the 10% peroxide next, and only slowly rises up from the cylinder with 3% peroxide.

Part 2. Old Foamey—Observing a Reaction Intermediate and Products

1. Place a 500-mL graduated cylinder in a large, plastic demonstration tray. Measure out 20 mL of 30% hydrogen peroxide and add it to the cylinder.
2. Add 1 small scoop (3–4 g) of solid Alconox® detergent to the cylinder and swirl the mixture to dissolve the detergent.
3. Measure out 5 mL of 2 *M* sodium iodide solution and, quickly but carefully, pour this into the cylinder. In a few seconds, copious amounts of white foam will be produced. Observe closely at the beginning of the reaction. A brown

Publication No. 10216
061616

foam is produced at first but then turns white before it erupts out of the cylinder. This is due to the presence of the free iodine produced by the extreme oxidizing ability of the 30% hydrogen peroxide.

4. Notice the steam coming off the foam—this indicates that the decomposition reaction is quite exothermic. Light a wood splint and blow out the flame. Insert the glowing wood splint into the foam. The wood splint will re-ignite in the foam—this indicates that the gas in the foam is pure oxygen. Take the glowing splint out of the foam, re-insert it, and watch it re-ignite again. This can be repeated numerous times.

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 foam and any solution left in the cylinder or on the plastic tray may be rinsed down the drain with excess water according to Flinn Suggested Disposal Method #26b.

NGSS Alignment

This laboratory activity relates to the following Next Generation Science Standards (2013):

Disciplinary Core Ideas: Middle School
MS-PS1 Matter and Its Interactions
PS1.A: Structure and Properties of Matter
PS1.B: Chemical Reactions
Disciplinary Core Ideas: High School
HS-PS1 Matter and Its Interactions
PS1.A: Structure and Properties of Matter
PS1.B: Chemical Reactions

Science and Engineering Practices
Constructing explanations and designing solutions

Crosscutting Concepts
Cause and effect
Scale, proportion, and quantity
Stability and change

Discussion

Hydrogen peroxide decomposes to produce oxygen and water according to the decomposition reaction shown below:

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g) + \text{Energy}$$

The reaction is quite slow unless catalyzed by a substance such as iodide ions, manganese metal, manganese dioxide, ferric ions, and many other substances such as yeast or even blood. A *catalyst* is a substance that, when added to a reaction mixture, participates in the reaction and speeds it up, but is not itself consumed in the reaction. The iodide ion is used as a catalyst in this demonstration.

Acknowledgment

Special thanks to Walter Rohr of Eastchester High School in Eastchester, NY for bringing this demonstration to our attention.

Materials for *Sudsy Kinetics* are available from Flinn Scientific, Inc.

Catalog No.	Description
A0126	Alconox, 4 lb
H0037	Hydrogen Peroxide, 30%, 100 mL
H0028	Hydrogen Peroxide, 6%, 500 mL
H0009	Hydrogen Peroxide, 3%, 500 mL
S0084	Sodium Iodide, 100 g
AP8599	Hydrometer Cylinder
AP5429	Demonstration Tray
AP4866	Sudsy Kinetics—Chemical Demonstration Kit

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