Inhibition of Hydrogen Peroxide

Catalysis

Introduction

An inhibitor interferes with the function of the catalyst and thus causes the reaction to slow down or stop.

Concepts

- Catalysis
- Kinetics
- Inhibitors
- Hydrogen Peroxide

Materials

Iron(III) nitrate, 0.1 M, $Fe(NO_3)_3 \bullet 9H_2O$, 1 mL

Hydrogen peroxide, 30% solution, H_2O_2, 15–25 mL

Sodium phosphate, tribasic, 0.1 M, $Na_3PO_4 \bullet 12H_2O$, 1 mL

Beaker, 50 mL

Pipet

Safety Precautions

Hydrogen peroxide is severely corrosive to the skin, eyes and respiratory tract; a very strong oxidant; a dangerous fire and explosion risk. Iron(III) nitrate is a strong oxidizer and a skin and tissue irritant. Sodium phosphate, tribasic is moderately toxic by ingestion and a skin 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

1. To prepare the iron(III) nitrate solution, add 4 g of iron(III) nitrate to 100 mL of water.
2. To prepare the sodium phosphate tribasic solution add 3.8 g of sodium phosphate, tribasic to 100 mL of water.

Procedure

1. Pour 15 to 25 mL hydrogen peroxide into a 50-mL beaker.
2. Add a few drops of iron(III) nitrate solution to the flask.
3. The reaction will quickly develop producing enough heat energy to vaporize the water in the mixture. At this point add an equal number of drops of sodium phosphate solution.
4. The reaction will be brought to a crashing halt.

Disposal

Finish decomposing the hydrogen peroxide with iron(III) nitrate before it may be flushed down the drain with excess water. 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

A substance that interferes with catalysis is an inhibitor. Practically anything will cause hydrogen peroxide to decompose into water and oxygen gas:

$$H_2O_2(aq) \rightarrow H_2O(g) + \tfrac{1}{2}O_2(g)$$

Even dust particles and scratched or dirty glass containers will increase the rate of decomposition. To prevent decomposition during shipping and to prolong shelf life, manufacturers of hydrogen peroxide may add phosphate ion to slow the process. In this demonstration iron(III) nitrate acts as a catalyst that increases the rate of decomposition:

$$2H_2O_2 + Fe(NO_3)_3 \rightarrow 2H_2O + O_2 + Fe^{3+} + 3NO_3-$$

whereas sodium phosphate serves as an inhibitor of the catalytic reaction:

$$Fe^{3+} + PO_4^{3-} \rightarrow FePO_4(s)$$

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, chemical reactions, interactions of energy and matter

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Inhibition of Hydrogen Peroxide* activity, presented by George Gross, is available in *Catalysis*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *Inhibition of Hydrogen Peroxide* are available from Flinn Scientific, Inc.

Catalog No.	Description
H0037	Hydrogen Peroxide, H_2O_2, 30%, 100 mL
H0008	Hydrogen Peroxide, H_2O_2, 30%, 500 mL
F0008	Iron(III) nitrate, $Fe(NO_3)$, 100 g
S0101	Sodium phosphate, Na_3PO_4, tribasic, 500 g
S0250	Sodium phosphate, $NaPO_4 \bullet 12H_2O$, tribasic solution, 0.1 m, 500 mL

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