The University of Texas at Austin
Department of Chemistry
College of Natural Sciences

Elephant's Toothpaste

Performer's Version

Safety Hazards

- Personal Protective Equipment:
  - Safety glasses/goggles
  - Nitrile gloves
  - Chemical & flame retardant lab coat
- Physical Hazards:
  - Extremely exothermic and may cause skin burns.
  - Hydrogen peroxide is extremely flammable and may intensify fire.
- Chemical Hazards:
  - Hydrogen peroxide is harmful if swallowed or inhaled and may irritate skin and eyes.
  - Potassium iodide causes damage to thyroid through prolonged and repeated exposure.

Materials

- Erlenmeyer flask
- 30% hydrogen peroxide
- Potassium iodide (solid)
- Deionized water
- Dawn dish soap
- Food coloring

Safety Data Sheet(s)

- Potassium iodide
- Hydrogen peroxide

Procedure

1. Place your Erlenmeyer flask in the center of the table.
2. Pour the entire aliquot of 30% hydrogen peroxide into the flask.
3. Add the dish soap to the flask. Securely hold the flask by the neck and gently swirl the liquids to mix them.
4. Add several drops of your desired food coloring. Add the drops down the sides of the flask (four equally spaced lines down the inside of the flask) to allow the foam to stripe as it comes out.
5. Pour the correct volume of deionized water into the container of solid potassium iodide. Tightly close the lid and shake vigorously. The bottle should feel cold to the touch.
6. When you are ready and the potassium iodide seems fully dissolved, pour the entire potassium iodide solution into the flask and quickly step back and out of the way. As the hydrogen peroxide decomposes, oxygen gas is released and transforms the soapy solution to a colored foam resembling toothpaste that will expand rapidly out of the container.

Flask Size	Volume of 30% Hydrogen Peroxide	Mass of Potassium Iodide	Volume of DI Water for Catalyst
2 L	125 mL	50 g (25 g for half cat.)	40 to 50 mL
4 L	250 mL	100 g (50 g for half cat.)	80 to 100 mL
6 L	375 mL	150 g (75 g for half cat.)	125 to 150 mL

Pedagogy/Chemical Info

The catalyzed decomposition of 30% hydrogen peroxide, showcased in the Elephant's Toothpaste demonstration, is a visually striking chemical reaction. This reaction typically involves the addition of a catalyst, such as potassium iodide, to accelerate the decomposition of hydrogen peroxide into water and oxygen gas. This process releases a large volume of oxygen gas, causing the characteristic foamy eruption seen in the Elephant's Toothpaste demonstration. The catalyzed decomposition of hydrogen peroxide can be expressed as the below reaction:

$$2H_2O_2\,(\ell) \xrightarrow{KI} 2H_2O\,(\ell) + O_2\,(g)$$

Beyond its spectacular use in demonstrations, the catalyzed decomposition of hydrogen peroxide has several practical applications in the real world. One of the most prominent applications is in the field of rocketry. Hydrogen peroxide can be used as a propellant in rockets, and its decomposition provides the necessary oxygen for combustion. By adding a catalyst, such as potassium iodide, the decomposition process can be controlled and accelerated, making it suitable for propulsion systems in rockets and missiles.

Additionally, this reaction finds application in the manufacturing of various products. It is used in the production of foam plastics, where the rapid release of oxygen gas helps create the desired foam structure. The reaction is also utilized in wastewater treatment plants to efficiently break down organic contaminants. Furthermore, it plays a role in certain medical and dental applications, such as teeth whitening products and antiseptic solutions, where hydrogen peroxide serves as a disinfectant or bleaching agent. Overall, the catalyzed decomposition of hydrogen peroxide has diverse applications across industries, from aerospace to healthcare, owing to its ability to generate oxygen gas rapidly and efficiently in controlled environments.

VOLUNTEERS ALLOWED

Volunteers can prepare and pour the catalyst while wearing proper personal protective equipment (PPE).

Volunteers must be closely supervised.