Catalytic Decomposition of H$_2$O$_2$ – Elephant’s Toothpaste

**Description:** The iodide ion (from KI or NaI) is used as a catalyst to decompose H$_2$O$_2$, liberating water, oxygen and heat.

**Materials:**
- 30% H$_2$O$_2$
- 1 L Graduated cylinder
- KI or NaI Food coloring
- Liquid dish detergent
- Large bin

**Procedure:**
1. Pour 50 mL of 30% H$_2$O$_2$ in the 1 L graduated cylinder. Add 3 drops of food coloring. Add a small layer of liquid dish soap to the colored H$_2$O$_2$ solution by adding the soap drop wise down the side of the graduated cylinder.

2. To generate toothpaste, add KI (or NaI) from a half-filled spatula to the H$_2$O$_2$ solution. Oxygen gas generated from this reaction will create large amounts of colored foam which will rise out of the graduated cylinder. To test for oxygen gas, a glowing wood splint can be reignited by placing it near the emerging foam.

3. A variation of this demonstration for a higher level chemistry class which also demonstrates an enzymatic decomposition of H$_2$O$_2$ is detailed in the Lister reference.

**Discussion:** The decomposition of hydrogen peroxide yields oxygen and water. The reaction is catalyzed by the iodide ion (I$^-$) from KI (or NaI) as shown in the two-step process below. The oxygen generated creates bubbles in the soap to produce a toothpaste like foam. A glowing splint can be used to test that the gas produced is oxygen. This experiment demonstrates the concept and utility of catalysts.

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\text{H}_2\text{O}_2 \text{ (aq)} + \text{I}^- \text{ (aq)} \rightarrow \text{H}_2\text{O} \text{ (l)} + \text{IO}^- \text{ (aq)}
$$

$$
\text{IO}^- \text{ (aq)} + \text{H}_2\text{O}_2 \text{ (aq)} \rightarrow \text{H}_2\text{O} \text{ (l)} + \text{O}_2 \text{ (g)} + \text{I}^- \text{ (aq)}
$$

**Overall Reaction:** 2 H$_2$O$_2$ (aq) $\rightarrow$ 2 H$_2$O (l) + O$_2$ (g)
Safety: Wear proper protective equipment including gloves and safety glasses when preparing and performing this demonstration. Concentrated hydrogen peroxide can cause burns.

Disposal: Remaining solution can be flushed down drain with plenty of water.

Reference:


Video:

http://www.youtube.com/watch?v=tnB-uU3w6g8

http://www.youtube.com/watch?v=ezsur0L0L1c