Hindenburg Day

Hydrogen and Oxygen Explosions

Introduction

Nothing gets a student's attention like an explosion. In this dramatic display of stoichiometry, relate chemistry to one of the most famous tragedies of the twentieth century, the Hindenburg disaster.

Concepts

- Hydrogen gas
- Combustion
- Stoichiometry

Materials (for each demonstration)

Gas cylinder of helium
Gas cylinder of hydrogen
Gas cylinder of oxygen
Balloons, latex, 4
Matches
Meter stick
Scissors
String
Transparent tape
Wood splint

Safety Precautions

This is not a demonstration for the inexperienced teacher. Hydrogen is a very flammable and potentially explosive gas but can be safely handled with proper safety procedures. Remove all sources of sparks, flames, and heat from the area where hydrogen gas is used. Do not scale this procedure up. Make sure there is ample room above the demonstration area, all observers are wearing eye protection and all flammable/combustible materials are removed from the area prior to lighting the balloons.

Preparation

1. Fill four balloons as follows;
   - Pure oxygen in balloon #1.
   - Pure hydrogen in balloon #2
   - Put a 2:1 ration of hydrogen to oxygen in balloon #3
   - Put pure helium in balloon #4.
2. Tie a string around each balloon and secure balloons #1, #3, and #4 to the table top with transparent tape.
3. Tape a wood splint to the end of the meter stick.

Procedure

1. Relate to the class the background story of the Hindenburg tragedy.
2. Tell the students they are to determine from their observations which balloon contains pure oxygen, which contains pure helium, which contains pure hydrogen, and which contains a two-to-one mixture of hydrogen and oxygen.
3. Light the wood splint on the end of the meter stick. Tell the students to cup their ears and ignite balloon #1.
4. Now ignite, in order, balloons #4, #2, and, finally, balloon #3.

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. Materials may be rinsed down the drain with plenty of water according to Flinn Suggested Disposal Method #26b.

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Tips

- Practice this demonstration before you attempt to do it in front of an audience.
- Warn students about the loud noise and the need to cup their ears. It is surprisingly loud.

Discussion

The reaction is:

$$H_2(g) + \tfrac{1}{2}O_2(g) \rightarrow H_2O(g) + 242\ kJ/mole_{H_2O}$$

Balloon #3 has a louder explosion than balloon #2, but the flame is bigger in balloon #2. The pure hydrogen in balloon #2 has to mix with air to get a complete reaction. This means the ignition of the hydrogen occurs over a longer period of time and the flame spreads out more when compared to the reaction of balloon #3. In balloon #3, the stoichiometric ratio is present and since most of the energy is released in a very short period of time, the explosion is louder.

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, properties and changes of properties in matter, transfer of energy

Content Standards: Grades 9–12
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 *Hindenburg Day* activity, presented by Lee Marek is available in *Hydrogen and Oxygen Explosions*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for the *Hindenburg Day* are available from Flinn Scientific, Inc.

Catalog No.	Description
AP1900	Balloons, 129 Round, 20/Pkg.
LB1065	Helium Gas, Refillable Cylinder
LB1070	Hyrogen Gas, Refillable Cylinder
LB1080	Oxygen Gas, Refillable Cylinder
LB1052	Control Valve, Stainless Steel

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