Moles in Space

Introduction to The Mole Concept

Introduction

Get a rise out of your students after they have been driven to near brain death by endless mole calculations!

Concepts

- Chemical reactions
- Combustion

Materials

Calcium carbide, CaC_2, granular, 2 to 3 pieces

Matches or safety lighter

Plastic bottle, 500-mL, with cork or rubber stopper

Wash bottle, filled with distilled water

Safety Precautions

When calcium carbide is exposed to water or moisture it evolves flammable acetylene gas that is corrosive to eyes and skin. Perform this demonstration in a well-ventilated area only. Make sure there are no flames in the area. Keep a fire extinguisher on hand and use a safety shield to help protect the student audience. Avoid contact of all chemicals with eyes and skin. Follow all laboratory safety guidelines. 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. Remember to wash hands thoroughly with soap and water before leaving the laboratory.

Procedure

1. Tape a small stuffed mole on top of the cork fitted to a plastic bottle.
2. Make a 0.5 cm hole in the bottle about 1-inch above the bottom of the bottle.
3. Add about 20 mL of water to the bottle using the wash bottle. Make sure the hole is not covered.
4. Pour out about 2 or 3 pieces of calcium carbide and add these pieces to the bottle. Place the stopper with the attached mole in the bottle opening.
5. Remove all other flammable materials from the demonstration area.
6. Ask the students to cup their ears. Wait 10 seconds, place the flame of a lit match to the small hole in the bottle and watch the mole rocket off!

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. After calcium carbide has reacted with the water, a basic solution is produced. Neutralize solution with 3 M hydrochloric acid and check with pH paper according to Flinn Suggested Disposal Method #10. Decant the neutral solution and flush it down the drain with at least a 20-fold excess of water. Dry any precipitate in the beaker and package it for disposal in a landfill suitable for chemical wastes according to Flinn Suggested Disposal Method #26a.

Tip

- We recommend that all students or other onlookers wear appropriate eye protection during any demonstration that has the potential to produce heat, gas or pressure. Also, instruct the students to cup their ears before igniting the mixture in the cannon.

Publication No. 91749
061616

Discussion

Calcium carbide, CaC_2, is primarily used to produce acetylene gas. Acetylene gas is a product of reacting calcium carbide with water. This reaction was utilized in carbide (miners') lamps where water dripped on the carbide producing acetylene gas which was ignited. See Equation 1. These lamps were commonly used in slate, copper and tin mines. Since acetylene gas is highly flammable, the carbide lamps were not used in coal mines, where they would be a serious hazard. Most carbide lamps have been replaced today by electric LED lamps.

$$CaC_2(s) + 2H_2O(l) \rightarrow C_2H_2(g) + Ca(OH)_2(aq) \qquad \textit{Equation 1}$$

Acetylene consists of two hydrogen atoms and two carbon atoms attached by a triple bond. When reacted with oxygen, like other hydrocarbons, carbon dioxide and water are formed. See Equation 2. Acetylene is often found as the fuel in torches as it burns brilliantly in air with very sooty flame. It has a very high heat of combustion (1300kJ/mole) and burns with a very hot flame.

$$2C_2H_2(g) + 5O_2(g) \rightarrow 4CO_2(g) + 2H_2O(l) \qquad \textit{Equation 2}$$

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12

Systems, order, and organization

Evidence, models, and explanation

Content Standards: Grades 5–8

Content Standard B: Physical Science, properties and changes of properties in matter, motions and forces, transfer of energy

Content Standards: Grades 9–12

Content Standard B: Physical Science, structure of atoms, structure and properties of matter, chemical reactions, motions and forces, conservation of energy and increase in disorder, interactions of energy and matter

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Moles in Space* activity, presented by Lee Marek, is available in *Introduction to The Mole Concept* and in *Classroom Fun*, part of Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *Moles in Space* are available from Flinn Scientific, Inc.

Catalog No.	Description
C0346	Calcium Carbide, 100 g

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