Flammable Ice

Reactions of Calcium Carbide—Combustion of Acetylene

Introduction

Acetylene burns brightly when calcium carbide reacts with ice.

Concepts

- Exothermic reactions

Materials

Calcium Carbide, CaC_2, 2.5 g
Ice
Crystallizing dish, should be borosilicate, 150 × 75 mm
Butane Safety Lighter
Safety Shield

Safety Precautions

When calcium carbide is exposed to water or moisture it evolves flammable acetylene gas which 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. Using an electronic balance, measure out 2.5 g of calcium carbide.
2. Place approximately 2.5 g of calcium carbide into a borosilicate glass crystallizing dish.
3. Fill the container half full with ice.
4. Remove all other flammable materials from the demonstration area.
5. Using caution, light the acetylene being formed from the reaction of calcium carbide and the ice.

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.

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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. 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 (1300 kJ/mole) and burns with a very hot flame.

$$H—C{\equiv}C—H \qquad \textit{Equation 2}$$

Connecting to the National Standards

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

Unifying Concepts and Processes: Grades K–12
Constancy, change, and measurement
Content Standards: Grades 5–8
Content Standard A: Science as Inquiry
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 A: Science as Inquiry
Content Standard B: Physical Science, structure and properties of matter, chemical reactions, conservation of energy and increase in disorder

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Flammable Ice* activity, presented by John Mauch, is available in *Reactions of Calcium Carbide—Combustion of Acetylene*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *Flammable Ice* are available from Flinn Scientific, Inc.

Catalog No.	Description
C0346	Calcium Carbide, 100 g
GP9172	Crystallizing Dish, Borosilicate Glass, 150 × 75 mm
AP8960	Safety Butane Lighter
SE260	Safety Shield

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