Dragon Breath in a Dust Can

Introduction to Reaction Rates

Introduction

Have you ever heard of a dust explosion in your area? They are rather common in grain elevators, coal mines, and sawmills. A spark, even due to friction or flame, can set off burnable dust in air to produce a large explosion.This demonstration will illustrate the explosive nature of a powder through the construction of a mini grain elevator explosion. A small paint can will be used to represent a grain elevator. Lycopodium powder will be used as the dust. This explosion will wake up and fascinate even your lethargic students.

Concepts

- Surface Area
- Combustion

Materials

Lycopodium powder, 10 g or less
Beral pipet (extra large bulb works best)
Candle, short, approximately 1″ × 1″
Flat-head screwdriver
Hammer
Matches, fireplace (or wooden splints and regular short matches)
Nail, #10 finishing
Paint can with lid, quart size

Safety Precautions

Lycopodium powder is easily combustible/explosive, especially when dispersed through the air. Be careful not to allow the powder to become airborne. Keep all flammable materials away from the demonstration area. Do not stand over the can when doing the demonstration. The lid will be propelled into the air with great force and a relatively large flame will be produced. Lycopodium powder may cause allergic reactions so precautions should be taken not to let the powder get airborne. Inhalation and skin contact with the lycopodium powder should be avoided since the effect is not known. Wash any affected areas with running water. Wear chemical splash goggles, chemical-resistant gloves, and tie back any long hair or loose sleeves. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.

Procedure

1. Use the hammer and nail to punch a hole in the side of the paint can. The hole should be about 1 inch from the top and should be about the same size as the Beral pipet stem. Place the short candle inside the paint can.
2. Fill the Beral pipet with lycopodium powder by squeezing the bulb, and placing the tip of the pipet into a container of lycopodium powder. Release the bulb while it is immersed in the powder. Several tries may be needed to fill the Beral pipet. The Beral pipet should be at least 2/3 full for the best results.
3. Light the candle using fireplace matches or a burning splint.
4. Put the lid on the can using the hammer. Placing a block of wood across the top of the lid and striking the wood with the hammer is an easy way to quickly seal the lid. The tighter the lid, the louder the bang produced.
5. Make sure the lycopodium powder is near the open tip of the Beral pipet, and put the tip of the Beral pipet into the hole in the can. The pipet bulb must be tipped slightly downward (the tip tilted upward) so the lycopodium powder will be sprayed upward. Do not lean over the can. Wear your safety goggles. Stand as far back as possible.
6. Squeeze the pipet bulb. The lid should explode off the can with a loud bang. A blue flame will shoot out of the can several inches and a sweet smell will fill the air.
7. Several practice trials may be needed before you perfect your procedure. If the lid does not fly off, it is because your candle went out. Use the flat-head screwdriver to pry off the lid and try again!

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Disposal

Wipe up any spilled lycopodium powder with wet paper towels. Clean the paint can and the candle also using wet paper towels. Dispose of the paper towels in a waste container. Wash hands thoroughly. Please consult your current *Flinn Scientific Catalog/ Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste.

Tips

- The lid will shoot up and hit an 8½ foot ceiling with great force. You may opt to do the demonstration on the floor or outside, depending on the height and strength of your ceiling. The lid could easily dent soft ceiling tiles.
- If the Beral pipet is tilted downward instead of upward, the lycopodium powder may just put out the flame. By tilting it upward, you are dispersing the powder throughout the air above the flame.
- The candle will not stay lit very long when the lid is on the can and the can may get hot. Therefore, it is best to have everything ready and to put the lid on just seconds before you spray the lycopodium powder into the can.
- Larger plumber candles can be cut down to the height of 1 inch if short ones are not available.
- If lycopodium powder is not available, any fine powder such as a fine wood dust or ground cinnamon will work.

Discussion

Smaller particles have a greater surface area compared to an equal mass of larger particles. This greater surface area is exposed to and can react with more oxygen in the air leading to an accelerated combustion or explosion. Compare the length of time it takes to ignite and burn the following: log, split log, stick, woodchips, sawdust, and a powder. When moving from a log to a powder, surface area and rate of combustion increase.

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
Form and function
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

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Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Dragon Breath in a Dust Can* activity, presented by Lee Marek, is available in *Introduction to Reaction Rates*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *Dragon Breath in a Dust Can* are available from Flinn Scientific, Inc.

Catalog No.	Description
L0059	Lycopodium, 25 g
AP1720	Beral Pipets, Large Bulb, Pkg./20
C0192	Candles, 50 × 1¼0 Pkg./4 (will need to be cut down)
AP4444	Wood Splints, Pkg./100

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