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Explosions of Lycopodium and Other Powders

When lycopodium powder is dispersed and then ignited in a metal can, an explosion blows off the lid of the can [*1*]. In a second procedure, balloons filled with either oxygen or compressed air and one of several powders explode when ignited.

MATERIALS FOR PROCEDURE A

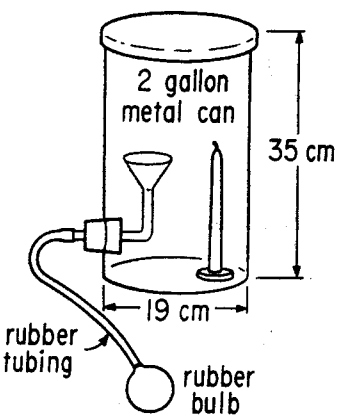
0.5 g to 1.0 g lycopodium powder
glass-bending torch
long-stem glass funnel, 7 cm in diameter at top
1-hole rubber stopper
2-gallon metal can, ca. 35 cm high and 19 cm in diameter
1 m rubber tubing, to fit funnel stem
rubber bulb
candle
spatula
tongs
rubber dam, 25 cm × 25 cm

MATERIALS FOR PROCEDURE B

0.5 g to 1.0 g lycopodium powder
2 g corn starch
2 g flour
compressed air
oxygen cylinder, with valve and tubing
powder funnel
6 balloons (2 sets of 3 colors)
ring stand and ring
candle, mounted on a meter stick

PROCEDURE A

First, assemble the explosion can. Using a torch, bend the stem of the funnel at a right angle about 2 cm below the cone of the funnel. Insert the funnel stem in the rubber stopper with the large end of the stopper toward the cone. Near the bottom of the metal can, make a round hole in the side wall of the can to fit the small diameter of the rubber stopper. Place the stopper-funnel assembly tightly in the hole from inside the can so that the funnel is vertical. Attach the rubber tubing to the funnel stem and the rubber bulb to the other end of the tubing. Squeeze the bulb several times to make sure that all connections are tight and that air blows through the funnel. Place the candle in the can, so that the wick is approximately level with the funnel top (see figure).



Lycopodium powder is highly combustible when dispersed. With a spatula, add the lycopodium powder to the funnel. Using tongs to hold the match, light the candle. Place the rubber dam over the top of the can and firmly press the lid on, using the rubber dam to make the seal uniformly tight. So that the candle does not burn the dam, quickly pick up the bulb, move away from the can as far as practical, and squeeze the bulb firmly. An explosion, accompanied by flame, will blow the lid high in the air. A slight, pleasant odor is produced. If preferred, leave the lid off and show how the powder burns when dispersed over the candle flame.

PROCEDURE B

Place about 0.5 g (about 1 teaspoon) of lycopodium powder in each of two like-colored balloons, about 1 g (about 1 teaspoon) of corn starch in each of two more balloons, and about 1 g (about 1 teaspoon) of flour in the last two balloons. Inflate one balloon in each pair with compressed air and the other with oxygen. In sequence, place each balloon on a ring attached to a stand and ignite with a candle mounted on a meter stick. Observe each explosion and note the differences in sound intensity and flame size. Note the effect of combustion in the oxygen-filled balloons compared to the air-filled balloons.

Although Reinstein and Shaver [2] suggest using additional solids, such as powdered milk, powdered sugar, and coal (ground with methanol and allowed to dry), we have not had success with these substances.

HAZARDS

Since lycopodium powder is flammable when dispersed in air, it should be handled carefully. The powder will not burn unless it is air-borne as dust. The flame accompanying the explosion can start a fire if combustible materials are in the immediate vicinity. Inhaling the powder or its dust should be avoided, since its effect is not known.

DISPOSAL

The combustion of dispersed lycopodium powder leaves no residue. Any spilled powder should be wiped up with a damp cloth and discarded in a waste container.

DISCUSSION

The undetermined chemical nature of lycopodium powder precludes the writing of specific combustion reactions. Derived from club-moss spores, the yellow powder is odorless and tasteless. It is easily dispersed, and upon ignition its dust explodes violently.

This demonstration illustrates that a combustible material, when finely divided and dispersed in air, will explode upon ignition. The exothermic reaction releases energy in the forms of heat and sound. The safety concern for dust explosions in coal mines, flour mills, and grain elevators is based on this effect.

REFERENCES

1. Alyea, H. N.; Dutton, F. B., Eds. "Tested Demonstrations in Chemistry"; Journal of Chemical Education: Easton, Pennsylvania, 1965; p 8.
2. Reinstein, J.; Shaver, R. "Chemical Demonstrations Proceedings"; Western Illinois University and Quincy-Keokuk Section of the American Chemical Society, 1978; p 33.