

Burning milk powder

Introduction

A pile of dried milk powder will not ignite even if a roaring Bunsen flame is played onto it. However, if the powder is sprinkled onto a flame, a spectacular fireball is produced because of the increased surface area.

Equipment

Apparatus

- Eye protection
- Bunsen burner
- Heatproof mats
- Metre rule
- Wooden splints
- Sellotape
- Stand with bosses and clamps, x 2
- Wooden cubes (Tillich's bricks), 1 cm × 1 cm × 1 cm, x 8

Chemicals

- Powdered milk

Health, safety and technical notes

- Read our standard health and safety guidance here <https://rsc.li/3TZTKam>
- Always wear eye protection.
- Your employer's risk assessment should be consulted before carrying out this activity.
- Take care to ensure that no lampshades, ceiling hangings or any other flammable materials are within reach of the flames.
- A preliminary fire-alarm check is advised.
- Please advise pupils not repeat this experiment at home.

Procedure

Before the demonstration

1. Attach a wooden splint to the end of a metre rule using Sellotape so that most of the splint projects beyond the end of the rule.

The demonstration

1. Protect the bench with heatproof mats – enough to cover approximately 1 m² of bench.
2. Place a little milk powder in a pile on a heatproof mat or metal tray.
3. The pile should be compact and form a cone about 1 cm high and 2 cm in diameter.
4. Now aim a roaring Bunsen flame at the pile of powder, using the hottest part of the flame just beyond the blue cone.
5. The milk powder will char, but will not continue to burn once the flame is removed.
6. Now use the two stands and clamps to support the metre rule horizontally about 5 - 10 cm above the bench so that the spill is above the heatproof mats.
7. Light the spill.
8. From a height of about ½ m, pour milk powder onto the lighted spill. A small fireball will form as the powder comes into contact with the flame.
9. It is possible for large fireballs to reach the ceiling, so this may require protection

Notes

Take care to transfer the milk powder from the full container to a smaller vessel first to avoid setting the entire tin alight.

The higher the powder is sprinkled from, the bigger the fireball, so it is wise to experiment starting from a small height until you can produce a fireball that is large enough to be spectacular but small enough for you to be comfortable with.

There will be some 'fallout' of burnt powder, so have a brush or vacuum cleaner ready to clear up the bench.

Some students may have difficulty with the idea that a powder has a greater total surface area than the corresponding solid, since each speck of a powder clearly has a very small surface area.

The following model may help.

1. Use eight Tillich's bricks to make a $2 \times 2 \times 2$ cube.
2. Find the surface area by counting the exposed squares – it will be 24 cm^2 .
3. Now dismantle the cube into eight bricks and again find the total surface area of the bricks – it will be 48 cm^2 .
4. Alternatively, chalk over the outside of the $2 \times 2 \times 2$ cube and then dismantle it into the eight smaller cubes.
5. Each will have three of its six sides chalked and three newly-exposed sides