

## Fire stopper

### *Education in Chemistry*

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[rsc.li/2P1r16t](https://rsc.li/2P1r16t)

## Technician notes

### Kit

- 10 g calcium carbonate powder
- 100 cm<sup>3</sup> 2 M hydrogen chloride\*
- Large beaker or jug with volume of at least 2 dm<sup>3</sup>
- Piece of card or plastic to cover beaker and act as a loose barrier
- 250 cm<sup>3</sup> beaker
- 1 m section of guttering
- Tea light candles
- Clamp stand with clamp
- Sticky tack or plasticine
- Indicator (optional)

### Preparation

Weigh out 10 g (0.1 M) of calcium carbonate powder into a 250 cm<sup>3</sup> beaker. Measure out the acid and (optionally) add a few drops of indicator. Use a clamp stand or pile of books to raise one end of the guttering approximately 25 cm off the desk. Place tea lights along the length of the guttering, using sticky tack or plasticine on the downslope side to secure them in position and hold them level.

### In front of the class

Wear eye protection. Place the 250 cm<sup>3</sup> beaker containing the calcium carbonate into the large beaker. Add approximately 50 cm<sup>3</sup> of the acid to demonstrate to the class the acid neutralisation and production of the gas. Immediately place a piece of card or plastic over the top of the beaker as a loose barrier to minimise the release of aerosolised acid droplets and reduce losses to diffusion.

Wait for the bubbles to subside before adding the remaining acid and replacing the screen. Don't be tempted to add all the acid together – the foam tends to spill out into the larger beaker. Remove the smaller beaker and ask the class what they think is in the larger beaker. It will appear 'empty' to them, but of course the relatively high density of the carbon dioxide keeps it in the beaker.

Light the tea lights on the guttering and pour the gas from the beaker down from the top of the guttering. The wave of gas will displace the air around each candle and extinguish them in sequence.

### Disposal

The resulting calcium chloride solution can be disposed of down the sink.

### Alternative approaches

Demonstration #56 from [Classic Chemistry Demonstrations](#) describes using dry ice or a CO<sub>2</sub> cylinder as an alternative to producing the gas by neutralisation. On the small scale, this can be poured over a single tea light in a 100 cm<sup>3</sup> beaker to illustrate trapping the gas within. Attempts to relight the candle with a splint will fail due to the gas that pools in the beaker. This can be scaled up with a 5–10 L transparent storage box. These commonly have a base of approximately 20 x 30 cm, so a large number of tea lights can be placed in the base and extinguished by the 2 L beaker of carbon dioxide, which will displace air to a height of around 3 cm.

**\*Acid notes**

Alternatively, you can use 200 cm<sup>3</sup> of 1 M hydrogen chloride. However, finding beakers of proportions that will accommodate the liquid and fit inside the larger beaker is challenging. The demonstration can be simplified by adding the carbonate and acid into the base of the larger beaker – but sometimes liquid can drip out as you pour, reducing the visual impact of the demonstration.