

Cracking!

Education in Chemistry

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Technician notes

Kit

- Two 60 cm³ plastic syringes
- Heavy or medicinal paraffin oil (also known as mineral oil) or propan-2-ol (highly flammable), approx. 0.5 cm³
- Silicone tubing
- Aluminium oxide powder
- Glass Pasteur pipette
- Clamp stand with two clamps
- 0.002 M acidified potassium manganate(VII) solution, approx. 1 cm³
- 0.002 M bromine solution, approx. 1 cm³
- Small sample vials
- Sticky tack or two, 3-way Luer lock stopcocks

Choosing your substrate

CLEAPSS members should consult PP061 *Microscale Cracking of Liquid Paraffin*. If you wish to undertake a cracking reaction, ensure you use either heavy or medicinal paraffin oil, also known as mineral oil – the viscosity is reminiscent of glycerol. Some lighter, less-viscous mixtures, also labelled paraffin, give poor results. The paraffin, once cracked, will generate a gas mixture containing 50–60% alkenes.

If you want a purer alkene mixture in your gaseous product, you can dehydrate propan-2-ol using an almost identical set-up to generate propene.

Preparation

The Pasteur pipette can be converted into a microscale test tube by sealing the thin end in a Bunsen. For best results, break off the last few centimetres before sealing. This helps to avoid the thinnest section melting too quickly and bending, leading to a thin, weak seal.

Holding the tube vertically, drop around 0.5 cm³ of substrate oil into the base, with just enough mineral wool to absorb the liquid. This can be pushed into place with a microspatula or a wooden splint trimmed to fit. Drop a microspatula-load of aluminium oxide into the tube. For paraffin cracking this can be placed up against the mineral wool, but for propan-2-ol dehydration results are better when the heat is focused more on the catalyst than the wool: hold the tube level and tap gently to spread the powder out over 2–3 cm.

Use silicone tubing to connect the pipette to a delivery tube from which the gaseous products can be collected by downward displacement of water in a 60 cm³ syringe body (see diagram). Water can be drawn up into the syringe by another syringe through a 3-way Luer lock stopcock (alternatively you can use a two-way, Hoffman clamp or sticky tack).

In front of the class

Use an ethanol spirit burner for heating. This will burn hot enough to initiate the reaction, without melting the pipette. For best results in paraffin cracking, focus the flame where the mineral wool and catalyst meet. For dehydrating propan-2-ol, focus the flame on the catalyst 1–2 cm away from the mineral wool.

Almost immediately, the catalyst darkens as carbon deposits on the surface. The first few cm³ of gas, likely to consist mostly of expanded air, can be drawn up into the second syringe and expelled before continuing to collect the products. Over the next 10–15 minutes, the syringe will fill with gas. With paraffin, a viscous, dark-coloured mixture of hydrocarbons will collect in the pipette beyond the catalyst; with propan-2-ol, droplets of water and unreacted alcohol will condense on the sides.

Health and safety and disposal

- See PP061.
- Wear eye protection.
- All syringes and silicone tubing can be kept for re-use.
- Dispose of the Pasteur pipette in a broken glass/sharps bin.
- The product solution from the bromine water and acidified potassium manganate(VII) tests can be washed down the sink.