Spontaneous exothermic reaction

In this demonstration experiment, a mixture of glycerol (propane-1,2,3-triol) and potassium manganate(VII) crystals bursts into flame, giving off clouds of steam, after a short time lag.

Lesson organisation

This reaction can be used as a fun demonstration to show a spontaneous reaction, or as an example of the redox reaction between a fuel and a powerful oxidising agent.

The time lag illustrates the speeding up of an initially slow exothermic reaction as the energy given out raises the temperature of the mixture.

Apparatus and chemicals

Eye protection
Safety screens

The teacher requires:
Clean metal lid from a tin can or jar (see note 1)
Heat resistant mat

The quantities of chemicals given are for one demonstration.
Access to:
Potassium manganate(VII) (Oxidising agent, Harmful, Dangerous to the environment), 2-3 g in the form of fine crystals (see note 2)
Glycerol (propane-1,2,3-triol) (Low hazard), about 1 cm³ in a test-tube (see note 3)

Technical notes

Potassium manganate(VII) (Oxidising agent, Harmful, Dangerous for the environment) Refer to CLEAPSS® Hazcard 81
Glycerol (propane-1,2,3-triol) (Low hazard) Refer to CLEAPSS® Hazcard 37

1 If the lid from a jar has a plastic lining, this should be scraped off. Alternatively, use a small foil cake case which has been cleaned and dried.
2 Fine crystals of potassium manganate(VII) work much better than larger ones. Use a pestle to grind large crystals in a clean mortar, if necessary.
3 Old samples of glycerol are sometimes ineffective, possibly because of absorbed water from the air.
Procedure

**HEALTH & SAFETY:** Wear eye protection (teacher and students). Use safety screens.

a  Put 2-3 g of potassium manganate(VII) in a small pile on the tin lid standing on the heatproof mat. Make a small hollow in the centre of the pile.

b  Pour about 1 cm³ of glycerol into the hollow in the pile of potassium manganate(VII).

It is sometimes better if the glycerol is warmed just before use. After about 20 seconds (but beware – it can be much longer), the mixture starts to give off steam. The glycerol in the mixture then ignites, burning with a bright, pinkish (lilac) flame for a few seconds more, leaving a dark brown or black residue.

Teaching notes

Eye protection and safety screens are essential. Small particles of potassium manganate(VII) may fly out.

A white background is useful. The reaction is even more spectacular in a darkened room.

Point out that the pink (lilac) colour of the flame is characteristic of potassium salts.

Redox chemistry

At advanced level, the redox nature of the reaction can be explored. Do this by allowing the residue to cool down and then dissolving it in water. This produces a green solution suggesting the presence of a Mn(VI) species, as well as a brown solid, manganese(IV) oxide. This confirms the reduction of the manganate(VII) ion; the glycerol has been oxidised to water (hence the steam) and carbon dioxide.

Reference

This experiment has been reproduced from Practical Chemistry:  

Useful resource

This website has a movie showing the experiment ‘Oxidation of glycerine by potassium permanganate’:  
http://www.jce.divched.org/JCEsoft/CCA/CCA1/R1MAIN/CD1R1870.HTM#1920