

Bright sparks: the spontaneous combustion of high surface area iron

Education in Chemistry

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Technician notes

Kit to prepare iron(II) ethanedioate

- 6.7 g sodium ethanedioate (oxalate) (harmful if swallowed and on contact with skin)
- 13.9 g iron(II) sulfate(VI)-7-water (harmful if swallowed, causes skin irritation, causes serious eye irritation)
- 100 cm³ 1M sulfuric acid (causes skin and eye irritation)
- two 500 cm³ beakers
- filter paper and funnel
- sample vial

Preparation

Wear eye protection. Dissolve 6.7 g (approx. 0.05 moles) of sodium ethanedioate in at least 200 cm³ of water. The solubility is 3.7 g/100 cm³ at room temperature so some gentle heating may be required to speed up dissolution – extra water is well tolerated but will require longer to filter.

Dissolve 13.9 g (approx. 0.05 moles) of iron(II) sulfate(VI)-7-water in at least 100 cm³ of 1M sulfuric acid (see CLEAPSS recipe RB 051 for guidance). When the two solutions are mixed, a bright yellow precipitate of iron(II) ethanedioate is formed which can be collected by filtration and left overnight to air dry. You will obtain 8–9 g of product, enough for four demonstrations.

If making up and using the solution immediately, use only a few drops of 1M H₂SO₄ for instant precipitation. As well as preventing oxidation of the iron(II), the acid inhibits the precipitation, so the solution made up in 1M H₂SO₄ can take at least one hour to fully precipitate.

Kit to demonstrate the reaction

- approx. 2 g iron(II) ethanedioate (harmful by ingestion, and in contact with skin)
- borosilicate boiling tube
- Bunsen burner
- mineral wool
- test tube holder
- heat-resistant mat

Safety note

Carbon monoxide is an extremely flammable gas:

- toxic if inhaled;
- may damage the unborn child;
- causes damage to organs through prolonged or repeated exposure.

It has no taste or smell and can be very difficult to detect. Quantities produced in this demonstration are small but uncertain because of the complexity of the reactions which take place. The decomposition of the iron(II) ethanedioate should be carried out in a ducted fume cupboard. The filters in school re-circulatory fume cupboards do not absorb carbon monoxide. You could use such a cupboard if there is very good room ventilation, since the cupboard would disperse the fumes very rapidly through the room, so the concentration would be below the workplace exposure limit.

In front of the class

Wear eye protection and work in a ducted fume cupboard (see safety note). Place the iron(II) ethanedioate in the boiling tube and loosely plug the end with mineral wool. This allows vapours to escape while preventing the fine powder from spraying out. Heat the end of the tube in a Bunsen flame. The yellow solid will turn black and, as carbon dioxide and carbon monoxide are evolved from the fine grains, may appear to have 'liquefied'.

Droplets of water will condense on the walls of the tube as water of crystallisation is driven off. Once the thermal decomposition is complete, leave the boiling tube on a heat-resistant mat to cool. The pyrophoric nature of the resulting finely-powdered iron can be demonstrated simply by pouring the cooled contents out onto the heat-resistant mat from a height. Dim the lights in the room for the best effect.

Following the reaction, the powder can be inspected to reveal the rusty colour of the resulting iron oxide.