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| Chemical Demonstrations |
| Aluminium iodine reaction |



This reaction can be applied to curriculum for excellence.

*Through experimentation, I can identify indicators of chemical reactions having occurred ...*

SCN 3-19a

CfE Higher – Chemistry in Society

*Oxidising or reducing agents*

**Introduction**

The chemical properties of iodine are very similar to those of bromine and chlorine. It is, however, much less reactive. It can also act as an oxidising agent that can reduce a number of elements such as phosphorus, aluminium, zinc and iron Usually, though, high temperatures are required.

Aluminium, despite its normal inert behaviour, is a very reactive metal. The inactivity that is normal is due to a generally impermeable layer of aluminium oxide on the surface.

The oxidation of finely powdered aluminium by iodine can be started by simply using a few drops of water, which starts a spectacular reaction that produces clouds of purple smoke.

This smoke is a bit of a problem. The iodine vapour is too toxic for the reaction to be done in the open lab. A (ducted)fume cupboard is fine but you will end up with iodine deposited all over the inside that needs to be cleaned off. Sometimes people avoid this by going outside but the reaction is a little temperamental and it is not unknown for it to go off while being carried out (or back after the reaction has not seemed to work. In addition, a capricious breeze could blow the iodine vapour unexpectedly at the audience – so we do not recommend this method.

**Health and Safety**

Iodine vapour is harmful (Cat 4) by inhalation and by skin contact.

Wear gloves and eye protection. Carry out the experiment in a fume cupboard.

**Small scale method – in a flask**

**You will need**

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| 0.1g Aluminium powder (fine)\* | Iodine (solid) 0.4g\* |
| Pipette with warm water | Metal bottle cap (crown cork – plastic removed) |
| 2 l conical flask | Bung with one hole in |
| Pestle and mortar | Sodium thiosulphate solution |
| Fermentation lock |  |

**To do**

1. Grind up the iodine with a pestle and mortar.
2. Carefully mix the iodine with the aluminium powder.
3. Place the mixture in a pile in the bottle cap and make a small dent in the top of the pile. (in reality, the amount is too small for this – just scrape it together into a pile)
4. With the flask on its side, slide the bottle cap in and then slowly, with a bit of agitation, raise the flask so the bottle cap with the reaction mixture slides down to the bottom. A bit of gentle nudging should get it into the middle of the base of the flask.
5. Put some sodium thiosulphate solution ~ 1 mol l-1 in the fermentation lock and have it to hand.
6. Use a pipette to add two or three drops of warm water to the top of the pile. (To get control, it is best to use a long dropping pipette that will reach near the bottom of the flask.
7. Immediately fit the fermentation lock.
8. There will be a delay, usually of around 10- 15s and then clouds of purple iodine vapour will start to appear.
9. The mixture then bursts into flame producing white smoke along with the purple iodine vapour. It soon goes out to leave a glowing white residue of aluminium iodide.

**Disposal**

Allow the residue to cool. Then add some 1 mol l-1 sodium carbonate solution. With these quantities there should be minimal problems with frothing. Once it is all finished, the mixture can be washed to waste with large quantities of cold water.

**Notes**

It is important to try this experiment with the bottle of aluminium powder that you will be using before doing it as a demonstration. Different samples of aluminium powder can react differently. If the powder is too coarse, it may not work at all.

The induction period for the reaction can be quite long. If it does not work, add another couple of drops of water.

Adding a drop or two of detergent to the water will help with the wetting and speed up the incubation period of the reaction.

If the reaction is not initiating, leave it in the flask – with the fermentation lock in place – until you have time to clear up. **DO NOT** leave it in the open lab. It has been known for these mixtures to suddenly react after a very long delay. If this happens in an open lab, there could be significant contamination with iodine.

**The Chemistry**

The reaction is:

**2Al(s) + 3I2(s) → Al2I6(s)**

It is catalysed by water.

The anhydrous iodide produced here, reacts vigorously with water, sometimes violently if freshly prepared and still hot, releasing fumes of hydrogen iodide.

The heat produced by this exothermic reaction causes some of the solid iodine to sublime into purple vapour.