

# Flame tests (wooden splint method)

Teachers have traditionally used nichrome wire for carrying out flame tests. The main problems with this method are:

- the need to use concentrated hydrochloric acid (**Corrosive, Respiratory irritant**). This presents considerable hazard that often deters teachers from using the procedure with students,
- the problem of contamination of wires which are then difficult to clean,
- the cost of regularly renewing wires.

## Lesson organisation

The method described in this experiment is intended for students to carry out and avoids the need for the use of concentrated hydrochloric acid. It also avoids the cost and contamination problems associated with the use of nichrome or platinum wires. A circus arrangement for the procedure would make classroom management much easier than if every group of students have to collect and test all the solutions at their own workstation. The time taken will depend on the number of tests to be carried out, but 30 minutes should be sufficient.

## Apparatus and chemicals

- Eye protection
- Bunsen burners
- Heat resistant mat(s)
- Boiling tube racks
- Boiling tubes
- Wooden splints
- Distilled water

A selection from solutions of the following salts

0.5 mol dm<sup>-3</sup> Lithium chloride solution (**Low hazard**) (see Technical notes)

0.5 mol dm<sup>-3</sup> Sodium chloride (**Low hazard**)

0.5 mol dm<sup>-3</sup> Potassium chloride (**Low hazard**) (see Technical notes)

0.5 mol dm<sup>-3</sup> Rubidium chloride (**Low hazard**)

0.5 mol dm<sup>-3</sup> Caesium chloride (**Low hazard**)

0.5 mol dm<sup>-3</sup> Calcium chloride (**Low hazard**)

0.5 mol dm<sup>-3</sup> Strontium chloride (**Causes eye damage**)

0.1 mol dm<sup>-3</sup> Barium chloride (**Low hazard** at this concentration)

0.5 mol dm<sup>-3</sup> Copper chloride (**Harmful, Danger to the environment**)

## Technical notes

Wear eye protection.



Lithium chloride is **Harmful if swallowed and a skin/eye irritant**. Refer to SSERC or CLEAPSS Hazcard.

Sodium chloride is **Low hazard**. Refer to SSERC or CLEAPSS Hazcard.

Potassium chloride is **Low hazard**. Refer to SSERC or CLEAPSS Hazcard.

Rubidium chloride is **Low hazard**. Refer to SSERC or CLEAPSS Hazcard. Caesium chloride is **Low hazard**. Refer to SSERC or CLEAPSS Hazcard. Calcium chloride is an **Eye Irritant** but **Low Hazard** at the concentration used. Refer to SSERC or CLEAPSS Hazcard.

Strontium chloride causes serious eye damage but is **Low Hazard** at 0.1 mol dm<sup>-3</sup> and below.

Barium chloride is **Low hazard** at the concentration used. Refer to SSERC or CLEAPSS Hazcard.

Copper chloride is **Harmful, skin/eye/respiratory irritant and Danger to the environment**. Refer to SSERC or CLEAPSS Hazcard.

**1** Lead salts are best avoided. They carry an extra risk and the flame test result is not that impressive.

**2** The chlorides of metals give the best results but other salts, such as sulfates, also work. Nitrates are best avoided to avoid production of toxic nitrogen oxides.

**3** Potassium iodide and lithium iodide can be used instead of the chlorides. As a general rule, chlorides are usually suggested, since they tend to be more volatile and more readily available. These two are in fact a little more volatile than the chloride, and potassium iodide is certainly likely to be available. Refer to SSERC or CLEAPSS Hazcard.

## Procedure

**HEALTH & SAFETY:** Wear safety goggles.

**a** Well before the lesson in which they are to be used, thoroughly soak a supply of wooden splints in distilled water.

**b** Sets of boiling tubes should be up to half-filled with the solutions of the salts.

**c** Each 'station' around the laboratory should then consist of a boiling tube containing one of the above solutions, held in a test tube rack. Each should be labelled with the name and symbol of the metal ion present plus appropriate hazard warnings. There should also be as many pre-soaked splints as there are working groups. These should be immersed in the solution.

**d** Students hold a soaked splint in a blue Bunsen flame to reveal the flame colour. It is important not to let the splint start to burn too vigorously. Bunsen burners could be clamped at an angle if desired: this helps avoid contamination caused by dripping onto the mouth of burner (but care is needed in the direction of the flame).

**e** A container (such as a beaker half filled with water) for the disposal of used splints will be needed at each workstation.

**f** One station could be set up with distilled water as a control and another with a solution labelled as 'unknown' if wanted.

## Reference

This experiment was written on behalf of the RSC

### Useful resource

See also experiment: *Flame colours – a demonstration* for teaching notes and useful resources.



## Credits

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*Health & safety checked January 2018*

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