Teacher and Technician Sheet

In this practical students will:

- Write messages using an invisible ink.
- Change the conditions of the invisible ink to see if messages become visible.
- Use their knowledge of metal salts to explain how changing the conditions the ink is under affects its visibility.

Introduction for teachers:

(This topic could start with a group discussion about what chemical change is, what burning means, when things burn, what they need to burn, etc. During this discussion the teacher introduces the following ideas, especially the words in bold.)

In this student activity a message is written on to filter paper with **colourless, dilute, aqueous solutions** of metal nitrates. Applying a glowing taper to the start of the message makes the treated paper smoulder and the message is revealed as the glow spreads its way through the treated paper only.

Over time some compounds decompose either due to heat or light, and this change can result in, for example, a change in colour due to the formation of a new compound.

The activity follows on from the investigation on invisible inks. It can be used as an introduction or finale to a topic on burning. It could be used to introduce the fire triangle: the nitrate is the fuel, heat from the burning spill, and oxygen from the air and the thermal decomposition of the nitrate salt. With older students it could be used to revise equations for the decomposition of nitrates. It is also a nice end to a term, giving a little bit of fun but still staying on subject.

(This practical can be completed by students working in pairs).

Curriculum range:

All ages can take part in this activity since the aim is to gain some understanding of the thinking of the chemist and chemical change. It links with:

- setting up simple practical enquiries, comparative and fair tests;
- reporting on findings from enquiries and observations, including oral and written explanations, displays or presentations of results and conclusions;
- using straightforward scientific evidence to answer questions or to support their findings;
- building a more systematic understanding of chemical change;

- asking questions and developing a line of enquiry based on observations of the real world, alongside prior knowledge and experience;
- using appropriate techniques, apparatus, and materials during laboratory work, paying attention to health and safety;
- making and recording observations using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements;
- presenting observations using appropriate methods;
- interpreting observations and identify patterns using those observations to draw conclusions;
- presenting reasoned explanations, including explaining data in relation to predictions and hypotheses; and
- learning about the concept of thermal decomposition.

Hazard warnings:

Wear eye protection.

Wear disposable gloves.

Tie back long hair.

Ensure that the room is well ventilated.

It is the responsibility of teachers to carry out an appropriate risk assessment on the chemicals.

Equipment:

Per pair of students

- Large sheets of white filter paper, chromatography paper or blotting paper.
- Hair dryer (optional).
- Wooden taper (spill).
- Small paint brush.
- Saturated solution of **sodium nitrate** (sodium nitrate (V), $NaNO_3$). OXIDISING & HARMFUL

Or

- 1 large piece of filter paper, chromatography paper or blotting paper
- 1 wooden spill

- 1 small paint brush
- 1 pencil
- 1 paperclip
- Access to a hair dryer or warm radiator
- Access to a washing line
- 10 cm^3 saturated solution of **sodium nitrate** (sodium nitrate(V), $NaNO_3$) in water
- 100cm^3 beaker

Technical notes:

The small paint brushes should be about the size used for painting models. Wooden spills will do if these are not available.

You can make up a set of stock saturated solutions of sodium nitrate by adding about 10 g of solid to 10 cm^3 of water in a 100 cm^3 beakers and stirring. Then leave to settle.

Results:

When touched with a glowing taper or spill the nitrate begins to decompose and burns with the release of oxygen.

If the solution is weaker than a saturated one it will not burn the 'writing' but may set the paper on fire.

Going further:

Try other metal nitrates such as potassium nitrate and lithium nitrate.

- *What type of chemical is a metal nitrate?*
- *Why does the solution have to be saturated?*

You could use a more dilute solution to demonstrate the difference between the saturated solution and a weaker solution.)