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Flame testing: What would be considered safer for Year 8 students attempting flame testing of chemicals? Using a small quantity of solid chemical in a flame on a metal loop, or a chemical solution sprayed into the flame? Or would this be better carried out as a teacher demonstration?

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Asked By: Anonymous
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- flame test
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Flame testing

Submitted by Science ASSIST ... on Mon, 2016-05-02 13:59

Expert Answer

Answer reviewed 22 February 2023

There are a number of different methods that could be used to show the colours of various cations, each having its own risks. These risks include handling hazardous chemicals or chemical solutions. The various cations that can be observed include lithium, calcium, sodium, barium, copper and potassium, usually in the form of their chloride salts. Some of these are classified as having significant health hazards or acute toxicity, so careful handling is required. Methods that generate significant, uncontained levels of aerosols in

the laboratory are not recommended, and in particular, we do not recommend the spraying of the solution into the flame for student activities.

We strongly advise against methods using flammable liquids.[1]

Any method employed requires a site-specific “risk assessment” to be performed. This should take into account the skills and behaviour of the students, as well as the learning outcome, to decide which method is considered most appropriate and whether to conduct the flame test as a teacher demonstration or a student activity.

If this activity is to engage the interest of students, then we suggest that a teacher demonstration may be the most appropriate approach for this activity for Year 8 students, with a student activity perhaps better suited for more meaningful curriculum applications in later years.

Different methods

Below are some methods that could be considered; they are listed in order, with the first being the preferred method, due to containment of the chemicals used. It is suggested that the different chemicals are set up in different stations around the classroom for methods 1–3, to minimise the opportunity for cross-contamination.

1. Flame test using PET bottle method

Science ASSIST has developed an SOP and an accompanying video demonstration which describes this method, see SOP: Demonstrating the flame test using a PET bottle[2] and video presentation.[3] In brief, a Bunsen burner is fitted into the neck of a 2 L soft drink bottle with a hole for the Bunsen tubing and another hole for a garden spray bottle, which contains the aqueous test solution (~0.5–1.0 M). A fine mist is sprayed from the spray bottle into the air intake of the Bunsen burner. The colour of the flame changes to the characteristic colour of the cation in the spray bottle.

The advantage of this method is that the majority of the sprayed cation solution (many of which contain 'heavy metals') is contained within the experimental setup, minimising the spread and inhalation of aerosols in the laboratory environment. It also provides for the containment and collection of any overspray, which can be collected and reused. It also produces a longer-lasting colour in the flame for observation with the naked eye or with a spectroscope.

2. Flame test using wooden paddle-pop sticks/toothpicks (or similar)

1. Wooden paddle-pop sticks or toothpicks are soaked in distilled or deionised water overnight. The following day, a stick is removed and dipped into the solid chemical to be tested. It is then passed through a blue Bunsen flame allowing the solid to burn and produce a colour change in the flame. A different stick is used for each chemical.
2. Wooden paddle-pop sticks or toothpicks are soaked overnight to a depth of about 1cm of the stick in a concentrated (1–2 M) aqueous solution of the cation to be tested. The following day, the sticks are removed and passed through a blue Bunsen flame and the flame colour observed.

Disadvantages of these methods

- The production of only a brief flash of colour, which may be missed by inexperienced students and cannot be observed with a spectroscope.
- The possibility that the stick may ignite and interfere with the flame colour.
- The solid chemical, when heated, may spit over the bench and students.
- Aerosols produced from the cation solutions are not contained and may be spread throughout the laboratory.
- Recommend setting up individual stations for each solid chemical and students to rotate . This minimises the risk of contamination of the solid chemical.

3. Flame test using a wire loop method

An inoculating loop made from either platinum or nichrome wire is generally used. The metal loop needs to be cleaned in between the different chemicals. In the class setting this is best achieved by burning the loop to burn off any previous chemical. The cleaned loop is then dipped into the solid chemical to be tested and then passed through the blue flame of a Bunsen burner. The flame colour is observed.

Disadvantages of this method

- The production of only a brief flash of colour, which may be missed by inexperienced students and cannot be observed with a spectroscope.
- Solid chemical may spit over the bench and students when heated.
- Recommend setting up individual stations for each solid chemical and students to rotate . This minimises the risk of contamination of the solid chemical; and the students do not have to clean the loop after each use.

4. Flame test spraying directly into a Bunsen flame with a spray bottle

A fine mist of the test chemical in an aqueous solution is sprayed directly into a blue Bunsen flame from a spray bottle and any colour change observed. **This is the least recommended method and should only be conducted as a teacher demonstration.**

Disadvantages of this method.

- No control over where the spray will go.
- Aerosols produced from the cation solutions are not contained and would be spread throughout the laboratory resulting in a significant clean up procedure. The production of only a brief flash of colour, which may be missed by inexperienced students and cannot be observed with a spectroscope.

References

1 American Chemical Society Institute. (nd). The Flame Test, Retrieved (23 February 2023) from the American Chemical Society Institute website: https://institute.acs.org/acs-center/lab-safety/education-training/safer... (Scroll down to find Safety Alert: The Rainbow Demonstration as well as other useful information)

2 Science ASSIST. 2016. *SOP: Demonstrating the flame test using a PET bottle,* Retrieved from the Science ASSIST website, https://assist.asta.edu.au/resource/3950/sop-demonstrating-flame-test-us...

3 ASTA YouTube Videos. (2016, July 13). Demonstrating metal ion flame tests using a PET bottle laboratory rig. YouTube. https://youtu.be/kzWbIcpZUi8

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Submitted by Anonymous (not verified) on Tue, 2016-07-26 09:11

☆☆☆☆☆
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Dear Teresa, Thanks for the answer to the question. The answer will be definitely helpful to lot of users as it is very common experiment in chemistry. Can you please provide the link to the Science ASSIST SOP for the same in the answer if ready and available for use? Thanks With regards Nehal Trivedi
by Teresa Gigengack (labsupport) on 26 July 2016

Thanks, I have included the link.

Thank you for submitting an answer to this question. Your response has been sent to our administration team for moderation.
