Learning of Flame Test using Low Cost Experiment

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Abstract- *Flame test is most frequently used for qualitative analysis of some metal ions. In the flame test, samples in the form of paste with concentrated hydrochloric acid are introduced in a hot, non-luminous flame using platinum wire and the color of flame is observed. The characteristic color of the flame reliably gives information about the presence of a particular metal ion present in the sample. Platinum is a costly metal and therefore, the cost of experimentation is high. However, continuous laboratory practices of flame test have evolved some new experimental procedures without platinum wire. These experiments are easy to perform and low cost is attractive feature of them. In the present study a low cost flame test was identified from the literature and it was introduced in the practical sessions of B.Sc. B.Ed. Part-I students. Usefulness and impact of the low cost experiment on learning of students was studied and results of the study have been complied in the form of present research paper.*

Keywords: low cost, flame test, metals, color, pre-service teachers training.

Introduction

Qualitative analysis is performed to identify elemental composition of inorganic salts. A set of systematic procedures is followed for qualitative analysis of the salts. Preliminary tests play an important role in simplifying the procedure of analysis. Flame Test is an important and reliable preliminary test and it is most commonly performed in laboratories as initial step for identification of certain metal ions. Flame test is performed using a paste of the salt with concentrated HCl. In general, the paste is introduced in a hot flame using costly platinum wire and color of the flame is observed. Based on the emission spectra, characteristic colors for the metal ions are observed which are interpreted to ensure presence of a particular metal ion. Performing the flame test using platinum wire is a common method but increased experimental cost has hampered its use. Continuous laboratory practices aimed to reduce experimental costs have evolved new experimental procedures for flame test and nowadays low cost experiments are frequently used (Flinn Scientific Inc, Manual. 2004, Lange's Handbook of Chemistry. 1952, Michael, J. Sanger and Amy, J. Phelps. 2004, Michael, J. Sanger. 2004, Veljko, Dragojlovic and Richard, F. Jones. 1999). During the present study a low cost experiment available in the literature was used for flame test to develop alternative of Platinum wire in the normal laboratory practices of students. Usefulness and impact of the low cost flame test on learning of students has been studied and interesting results of the study are presented in the paper.

Methodology

Sample

Regional institute of Education, Ajmer is a constituent unit of NCERT and runs pre service teacher training programmes in the form of NCTE approved four year integrated B.Sc. B Ed. Programme/course. Students in the programme are admitted through a national level entrance test and most of the students admitted are highly meritorious. In the syllabus of B.Sc. B. Ed. first year programme inorganic qualitative analysis is an important part of the practical chemistry. Around 100 students of the programme perform the practicals in a group of 20 students each in different schedules. Exploration of new ideas to make the teaching learning effective is a regular practice in the institute and the present study is also a part of that process. To make the process effective and more student centered, each group of students is facilitated by at least two teachers at a time. During the present study a group of students was facilitated to perform the flame test by both the researchers.

Procedure

During the course of the present study preservice teachers of B.Sc. B.Ed. first year programme were advised to ensure safety measures while performing the qualitative analysis of inorganic mixtures. Theoretical basis of the set of procedures for qualitative analysis was explained in detail. The principle and role of the flame test in qualitative analysis of metal cations was also properly discussed. It was explained that the chemistry of flame testof an atom or cation depends on the electronic arrangement in the energy levels of the atom. Electron in an atom is found in the lower energy level called the ground state. However, they can be excited to higher energy level, if given the right amount of energy.The excited electron quickly loses the energy and if the emitted energy is from the visible region, colour is observed. Different species have different but characteristic emitted energy and therefore, a characteristic colour is observed for a particular chemical species. In the flame test energy is supplied in the form of heat by inserting the sample in flame and thus, a characteristic colour is observed in the flame. Color of some cations is summarised in the table -1

Table-1: Flame coloration for different metals

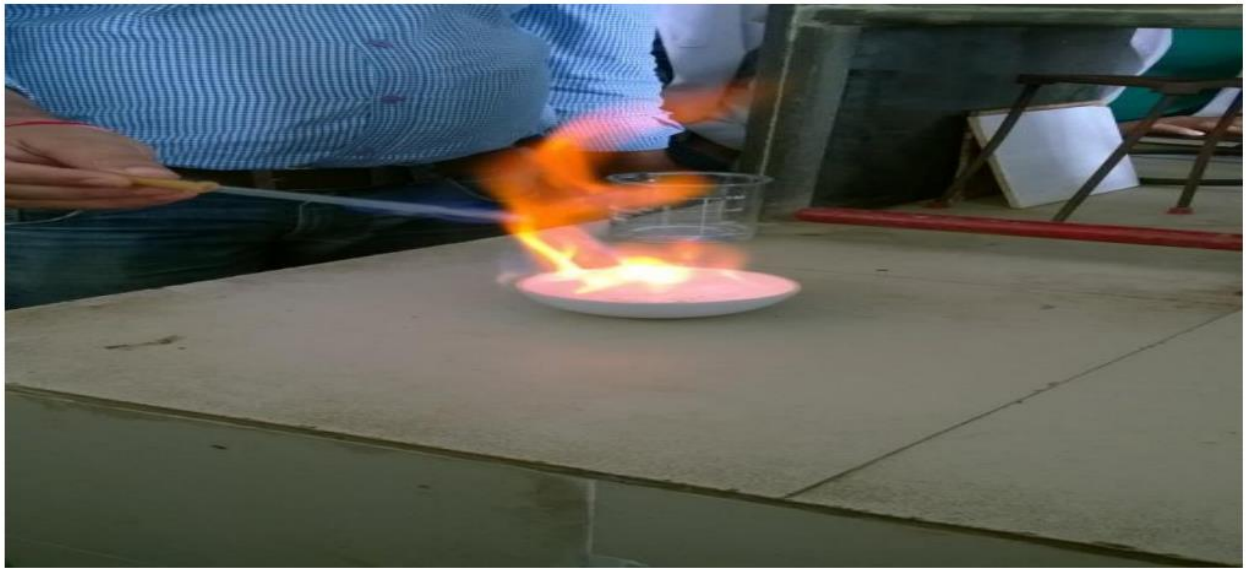
S. No.	Metal ions	Flame color
1	Na^{+}	Yellow
2	K^{+}	Violet
3	Ca^{2+}	Brick Red
4	Sr^{2+}	Carmine-red
5	Ba^{2+}	Apple-Green

A systematic approach to conduct flame test using platinum wire was explained. Demonstration of flame test using the platinum wire was also done for proper understanding of students about the role of color in identification of certain metal ions. It was explained that platinum is a costly metal so we should use the low cost material to perform the flame test.

Students were made aware about some low cost flame tests available in the literature. Flame test using ethanol was explained in detail Following procedure was explained to perform the low cost flame test:

- Take a cleaned watch glass and place 0.5- 1.0g of salt.
- Put nearly 10 -15 drops of ethanol over it with a plastic dropper.
- Ensure that the salt is properly moisturized with alcohol.
- Now lighten the heap with a match box. Flame will appear from the heap and may appear for about a minute or more depending on the amount of alcohol added.
- Observe color of the flame and record it.

Demonstration of the flame test using above procedure was also done and then students were facilitated to perform the test. Accordingly, students performed the experiment and recorded their observations. These observations were properly interpreted in terms of identification of cation present in the mixture.



Photograph-1: Demonstration of low cost flame test

Feedback of learners

After completion of the flame test for qualitative analysis of inorganic mixture, feedback of students was taken through interview of the individuals. As per feedback of the students this method of flame test was found to be easy to perform. Students reported that the flame test through this method was apparent and they were able to clearly identify the metal ion present in the mixture on the basis of coloration of the flame. They also reported that performing flame test using low cost material was enjoyable for them. On the whole this was highly appreciated by the students and they were motivated to use low cost experiments further. Authors found the overall procedure useful and important for further use in the coming sessions of qualitative analysis.

Conclusion

Feedback of the students clearly indicates that this method is the best alternative to the traditional method of flame test using Platinum wire. This test does not require any specific or sophisticated arrangement and it can be demonstrated easily in laboratory conditions. Thus, such type of low cost experiments should be designed and encouraged in day to day practical classes.

Acknowledgement

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