24. Chemistry and environment – microscale experiments workshop

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Microscale chemistry is described by various authors as a way of carrying out chemical processes with small quantities of chemicals. This reduces waste and increases safety. Besides, it facilitates the use of experimental work in 'normal' classrooms, where pupils become involved in cooperative work (Pereira, 1995). When Pike introduced the NMC[2] (New Microscale Chemistry Centre), he stated that it could offer a cultural change in the way that chemists use chemicals (Ross, 1993).
CIFEC (Centre International Francophone pour l'Enseignement de la Chimie), in collaboration with UNESCO, carried out several workshops in the 80's to disseminate small scale material and experiments (Cròs, 1985). The value of this approach was recognised in several countries. For example, in South Africa, Prof. J. Bradley, Director of the RADMASTE Centre, University of Witwatersrand, who developed a large work with microscale chemistry in schools, was awarded a prize by Mr. N. Mandela.

The microscale approach can be used in traditional and in open practical work. In this workshop, that took place during the 6th ECRICE in Aveiro, Portugal (Pereira and Maia, 2001), an investigative practical work was proposed, aiming at discussing the use of microscale chemistry equipment in an environmental education activity. Participants were presented the following scenario inspired in Bell (2000) and Zhegin and Titova (1997):

Scenario An industrial plant is releasing noxious gases into the atmosphere.

Task 1 – Determine which factors influence the effect of air pollution on the water in the area.

– Suggest how to disperse air pollution from the plant

Note Simulate the industrial plant, and the region around it with (1) the comboplate®, and other material of the RADMASTE Microchemistry kit, and (2) the plastic box given

Ask for other material and chemicals you may need.

Task 2 Suggest how to explore this activity with your pupils.

Participants were told to design experiments, and ask for appropriate equipment and chemicals to implement them, since “you don’t know the difficulties inherent to a particular task until you try it” and “One must learn by doing the thing. For though you think you know it, you have no certainty until you try” (Sophocles, BC 495-406). Among the material and chemicals available was the following:

Comboplate®
Syringe
Propette
Microburner
Straw
Microspatula spoons
Lids for vials
Vials
1 L round plastic box

Hydrochloric acid
Sodium hidrogenosulphite
Sodium hidrogenocarbonate
Sulphur
Activated charcoal
Universal indicator
Red cabbage indicator
Bookmarks with the range of pH values and colours for each indicator.

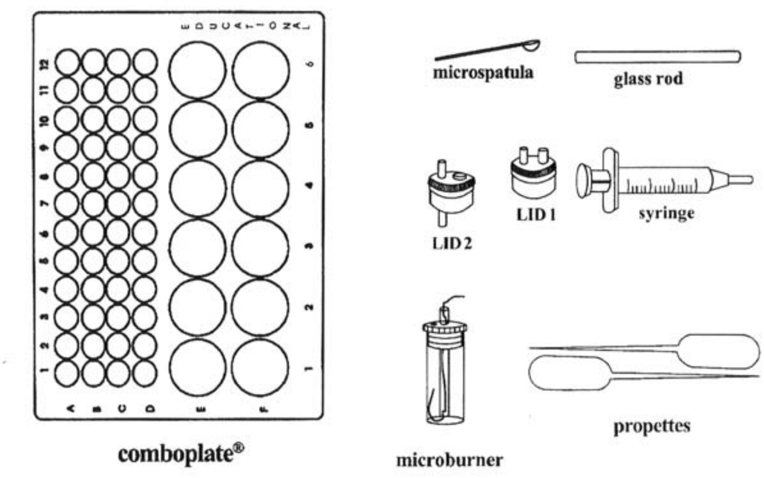

Fig.1
Materials of the RADMASTE Microchemistry kit

After enthusiastic discussions carried out in groups, some participants proposed to use the following set-up (Fig. 2):

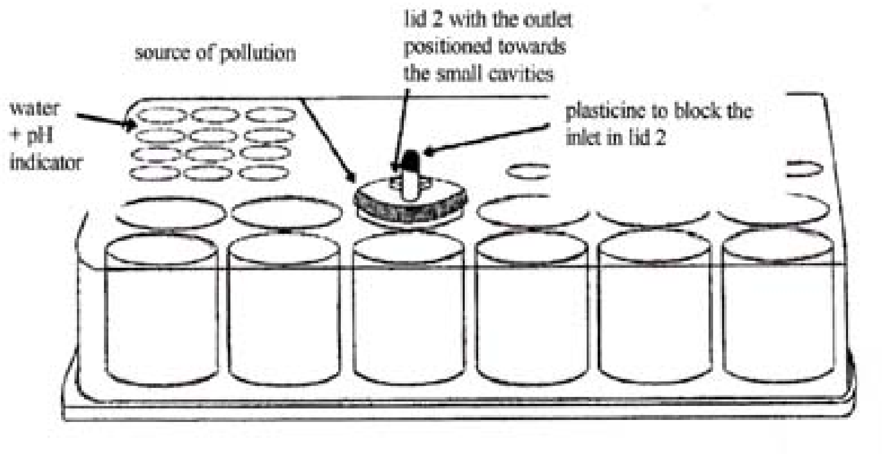

Fig. 2
Set-up for the experiment proposed by a participant.

This set up was similar to Bradley's suggestion that was only presented to participants after the group discussion and experimentation. Then a whole group discussion was carried out.

Participants used both indicators. Although the change of colours in the area affected by the release of sulphur dioxide was more striking with universal indicator (as expected), the red cabbage indicator was also considered appropriate. It was stressed that its price is much less than that of the commercial universal indicator.

An alternative (suggested by E. Maia) was also used: in a round white plastic box, two microspatula spoons of solid sodium hydrogen sulphite were put in the centre, surrounded by circles of water drops with indicator. Then, hydrochloric acid was added to react with the solid. To simulate a chimney to disperse the sulphur dioxide an inverted funnel above the reaction spot was suggested.

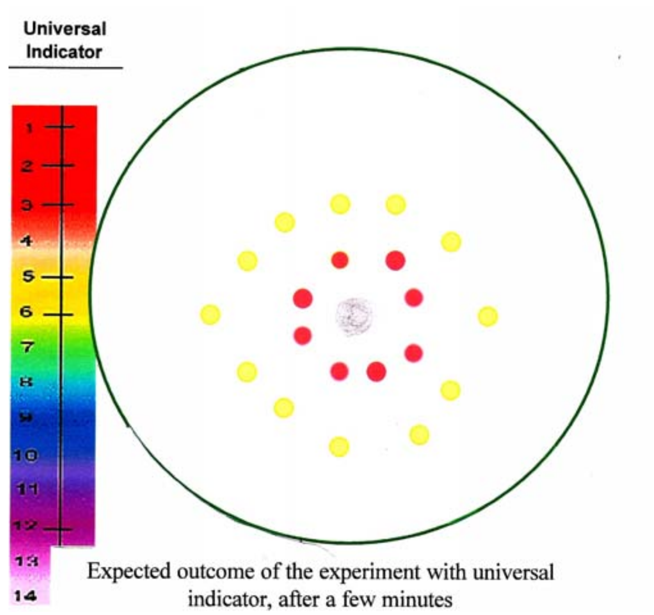

Fig. 3

Since misconceptions reported in the literature indicate that pupils think that acid rain is caused by carbon dioxide emissions (Dove, 1996), a comparison was made using sodium hydrogen carbonate instead of sodium hydrogen sulphite. In this case no change of colour of the pH indicator was noticed. These experiments can be introduced, for instance, when conceptual change activities are planned (Pereira and Vilela, 2000).

Participants appreciated the potentialities of the use of the microscale equipment, with very small amounts of chemicals involved. It was pointed out that several groups working with a noxious gas felt no harm, although not needing to use a fume cupboard.

Taking into account the very small amounts of chemicals involved in these experiments, the waste produced was also very small. Nevertheless the opportunity of stressing the problems of residues in school labs was taken and the idea of the THINK tank (Gardner, 1988) was introduced. This is an acronym for "Throw Harmful Ingredients iN Kontainers". Large empty plastic buckets which originally contained laundry detergent or biological specimens, make sturdy chemical waste disposal containers. Placed on each laboratory table or in another common location and labelled 'THINK' they can be used to collect the waste produced. This acronym may also be written into student procedures, as a way of making students aware of the importance of thinking about waste management.

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