The artificial bow is the result of placing the LSD in the white light before it enters the prism. The upper part of the arc has lost its circularity because it has been cast on a plane screen.

Figure 5 *The artificial bow*

Other rainbows can be made by placing LSD after the prism and turning the plane of the LSD to an oblique orientation with respect to the optical radiation. It is possible to make a bow that circles back down to the horizon.

An Oscillating Reaction

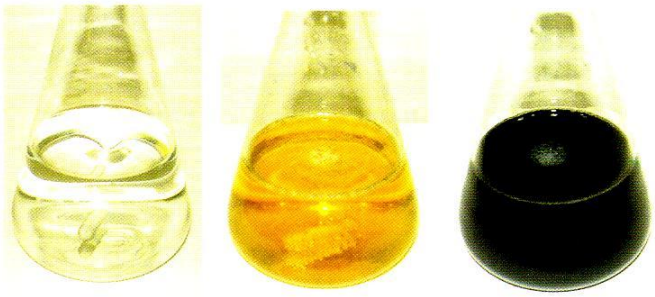

Figure 1 *Oscillating reaction shown at the start and the two colours evident when the reaction starts to oscillate.*

Introduction

This oscillating reaction is known as the Briggs-Rauscher (BR) reaction.

The mechanism is very complex and involves iodide ions and iodine molecules. The species HOI is formed in one reaction and consumed in another. As its concentration rises and falls, it triggers oscillations in the I^- and I_2 concentrations. It is thought that the colourless solution arises when I_2 is low and I^- is high; it is yellow when I_2 is high and I^- is low; and blue when I_2 and I^- concentrations are both high (when both are high they form pentaiodide ions which gives rise to the blue complex with starch).

The reaction can be used in S2 to show changes in appearance due to chemical reactions (5-14 Guidelines, Science, Target ES-F3.2, Changing Materials, Level E; in Standard Grade, Intermediate 1 and 2 to show chemical reactions and in Higher to show a reversible reaction. It also makes an eye-catching demonstration for an open evening/parents' night and has the advantage of not depending on expensive transition metal catalysts for it to work. The oscillations can last for about 5 minutes.

What you will need

Chemicals

hydrogen peroxide solution, 100 vol.
manganese(II) sulphate mono-hydrate
sulphuric acid, 0.1M
potassium iodate
malonic acid
starch, soluble
distilled water

Equipment

conical flasks, 4 x 250 ml
measuring cylinders, 3 x 50 cm^3
stirring rod or magnetic stirrer with follower
balance (0.1 g resolution)

Preparation of solutions

Forget the complex recipes you may have seen elsewhere and follow this simplified one which we know works well. Always use distilled water as the chloride ions in tap water can interfere with the reaction.

Solution 1 - Weigh out 4.3 g of potassium iodate (OXIDISING, IRRITANT, HARMFUL) and dissolve in 100 cm^3 of 0.1M sulphuric acid (IRRITANT) in one of the conical flasks.

Solution 2 - Prepare 100 cm^3 of a 0.1% solution of soluble starch.

Weigh out 1.5 g malonic acid (OXIDISING, IRRITANT, HARMFUL) and 0.4 g magnesium sulphate and dissolve these in the cold starch solution.

Solution 3 - Prepare a solution of hydrogen peroxide by diluting 30 cm^3 of 100 volume hydrogen peroxide (CORROSIVE) to a total volume of 100 cm^3 with distilled water.

The demonstration

Measure out 50 cm^3 of each solution (1 to 3) in three separate measuring cylinders. Add them to a 250 cm^3 conical flask and stir with a stirring rod or magnetic stirrer. Once the solutions are mixed thoroughly, ask the students/observers to describe and record what happens and when.

Note - The preparation of the solutions and reaction should be done in a well-ventilated lab.

After the reactions have oscillated back and forth the solution remains as a blue-black mixture with the smell of iodine. Occasionally some purple fumes of iodine can be seen (HARMFUL & DANGEROUS FOR THE ENVIRONMENT). Care should therefore be taken if the demonstration is scaled up.

It is also possible to scale the reaction down. We have successfully used 30 cm^3 "disposable" universal plastic containers for 5 cm^3 portions of each of the three solutions. This allows the reaction to be carried out by individual students. Make sure the universal container has a screw cap to avoid spillage. Once shaken, the container can be placed on the bench and the oscillations studied dfor up to 5 minutes.