**Science in School – issue 29**

**Become a water quality analyst**

**Worksheet 2: Determining the concentration of thiocyanates using iron(III) chloride**

Thiocyanate ions react with iron(III) ions in solution to form a complex ion with an intense red colour:

Fe3+(aq) + SCN−(aq) → [FeSCN]2+(aq)

or, more fully,

[Fe(H2O)6]3+(aq) + SCN−(aq) → [Fe(H2O)5SCN]2+(aq) + H2O(l)

This reaction is an easy method to test for the presence of thiocyanate ions and to measure their concentration. By using a colorimeter, you can measure the absorbance at 480 nm of the complex formed, [Fe(H2O)5SCN]2+, and deduce the precise concentration of thiocyanate ions, provided it is not too high.You can also use simple colour matching, although the results will be less precise and only qualitative.

**Materials**

* Burette
* 100 cm3 volumetric flasks (7)
* colorimeter and suitable filter (blue) – a solution of the complex displays maximum absorption at 480 nm
* 30 cm3 of a solution of potassium thiocyanate at 250 mg/dm3 for thethiocyanate ions (250 ppm)
* 70 cm3 of a solution of iron(III) chloride solution at 0.41 mol/dm3
* 10 cm3 of a solution of unknown thiocyanate concentration (which you will need to test in your role as a quality analyst)

**Procedure**

Care: Wear eye protection. Iron(III) chloride solution is an irritant.

1. **Create a calibration graph**
2. Fill three burettes, one with the potassium thiocyanate solution containing 250 ppm thiocyanate, one with distilled water, and one with iron(III) chloride solution.
3. To six 100 cm3 volumetric flasks, add 0.0, 2.0, 4.0, 6.0, 8.0 and 10.0 cm3 of the solution of potassium thiocyanate at 250 mg/dm3 and label them A to F.
4. Add distilled water to each flask to bring the volume up to about 80 cm3.
5. To each flask, add 10 cm3 iron(III) chloride solution and then add distilled water to bring the volume up to 100 cm3. Mix the solutions thoroughly.

Flask A B C D E F

Volume of

potassium 0.0 2.0 4.0 6.0 8.0 10.0

thiocyante

solution/cm3

Thiocyanate 0 5 10 15 20 25

(ppm)

1. Measure the absorbance of each solution using a colorimeter.
2. Plot a graph of absorbance (*y* axis) against thiocyanate concentration (in ppm thiocyanate) (*x* axis) for the six solutions.

**2. Analyse the sample**
3. Add 10 cm3 of the solution of unknown thiocyanate concentration to a 100 cm3 volumetric flask and add distilled water to bring the volume up to about 80 cm3.
4. Add 10 cm3 of iron(III) chloride solution to the flask and then add distilled water to bring the volume up to 100 cm3. Mix the solution thoroughly.
5. Measure the absorbance of the solution using a colorimeter.
6. Use the graph to find the concentration of thiocyanate ions (as ppm) in the unknown solution.

**Safety note**

You should wear suitable eye and hand protection to handle acids and thiocyanates.

You can check the safety guidelines on the Science in School website (www.scienceinschool.org/safety) and at the end of this print issue.