NEATH PORT TALBOT COLLEGE
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Science Practical

Estimation Of Copper In A Sample Of Copper (II) Sulfate Crystals

◆ Aim

To deduce the percentage of copper in a sample of copper (II) sulfate.

◆ Introduction

The amount of copper in a sample can be determined by adding excess potassium iodide to a sample of the salt. The iodide ions are oxidised to iodine while copper (II) ions are reduced to copper (I) which is precipitated out in the form of copper (I) iodide.

The relevant half equations are:

Reduction half equation: $Cu^{2+}_{(aq)} + e^- + I^-_{(aq)} \rightarrow CuI_{(s)}$

Oxidation half equation: $2I^-_{(aq)} \rightarrow I_{2(aq)} + 2e^-$

The liberated iodine can then be measured by titration against sodium thiosulfate.

Half equations:

Reduction half equation: $I_{2(aq)} + 2e^- \rightarrow 2I^-_{(aq)}$

Oxidation half equation: $2S_2O_3^{2-}{}_{(aq)} \rightarrow S_4O_6^{2-}{}_{(aq)} + 2e^-$

We can use these half equations to obtain a relationship between the no. of moles of copper (II) and no. of moles of thiosulfate.

It is important that the copper solution should be free of mineral acid. This is because the iodide is slowly oxidised to iodine by atmospheric oxygen when acid and copper (II) ions which act as catalyst, are present. This leads to an overestimation of copper (II). To prevent this effect a neutral or slightly neutral solution is used.

◆ Safety

Control Measures

- The wearing of **safety glasses and a laboratory coat** at all times will be sufficient to take account of most hazards and significant risks.
- You are reminded of the need of good laboratory practice in order to maintain a safe working environment.

Hazards

Harmful/ Irritant copper (II) sulfate, sodium thiosulfate, potassium iodide, sodium carbonate

♦ Procedure

1. Weigh out accurately about 6 g of copper (II) crystals.
2. Dissolve them in about 30 cm^3 of deionised water and transfer the solution to a 250 cm^3 volumetric flask.
3. Add a little sodium carbonate solution, dropwise, until a **slight** permanent bluish precipitate of copper (II) carbonate has formed.
4. Acidify the solution with dilute ethanoic acid, dropwise when a clear blue solution is obtained.
5. Make the solution up to 250 cm^3 with deionised water in the usual way and shake well.
6. Pipette 25.00 cm^3 of the solution into a conical flask and add about 15 cm^3 of a 10 % (w/v) KI solution.
7. Titrate the liberated iodine against the sodium thiosulfate in the usual manner - adding the starch solution when the colour becomes pale yellow.
8. Repeat the titration in the usual way.

◆ Questions

1. Write down a redox equation for the reaction between copper (II) and iodide ions.

2. Now write a redox equation for the reaction between iodine and thiosulfate ions.

3. Determine how many moles of copper (II) ions are equivalent to 1 mole of thiosulfate ions.

4. Use your titration results to determine the no. of moles of copper (II) in your original copper (II) sulfate sample and hence calculate the percentage of copper in the salt sample.

5. Calculate the theoretical moles of copper in a copper (II) sulfate sample. [Formula of copper (II) sulfate - $CuSO_4.5H_2O$]. *Obtain relative atomic masses from your periodic table.*

6. Explain what you understand by a 10 % (w/v) KI solution.

7. Calculate the conc. in mol dm^{-3} of a 10 % (w/v) KI. solution.