OCR (B) Chemistry GCSE

PAG 3 (chemistry) / PAG C3 (combined science): Separation Techniques

Notes

Separation in Synthesis

Aim

To use a variety of separation techniques to produce hydrated copper(II) sulfate crystals.

Equipment list

- 250 cm^3 beaker
- Boiling tube
- Weighing boat
- 100 cm^3 conical flask
- Measuring cylinder
- Crystallizing dish
- Bunsen burner
- Funnel with filter paper
- Tripod, gauze and heat proof mat
- Digital balance
- Kettle
- Tongs

Chemicals required

- Sulfuric acid
- Copper(II) oxide

Method

1. Half fill the 250 cm^3 beaker with boiling water from a kettle.
2. Add 15 cm^3 of sulfuric acid to a boiling tube and place in the beaker of hot water.
3. Weigh out 2.00 g of copper(II) oxide onto a weighing boat.
4. Add a quarter of the copper oxide to the boiling tube with sulfuric acid. Lift the tube and agitate the mixture before returning it to the water.
5. Add the remaining copper(II) oxide to the boiling tube in three equal amounts, agitating the mixture between each addition.
6. Leave the boiling tube for 5 minutes, agitating the mixture every minute.

Purification of copper(II) sulfate solution:

7. Place the filter paper in the funnel and place the funnel over the conical flask.
8. Pour the mixture from the boiling tube through the funnel, into the conical flask.

Production of hydrated copper(II) sulfate crystals:

9. Record the mass of the crystallising dish.
10. Boil the solution in the conical flask for 3 minutes using the Bunsen burner and tripod.
11. Using tongs pour the solution from the conical flask into the crystallising dish.
12. Allow the solution to cool for 5 minutes

Measuring the mass of copper sulfate:

13. After the crystals have been left for at least 24 hours to dry, measure the mass of the crystals in the crystallising dish. To calculate the mass of crystals that have formed, subtract the mass of the empty crystallising dish from this new mass.

Key points

- The equation for this reaction is: $CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$
- When boiling the solution in the conical flask do not allow the solution to boil until dry.
- Placing the reaction mixture in a beaker of boiling water speeds up the rate of reaction.
- Possible errors:
    - The solution may not have been fully transferred to the crystallising dish so some copper sulfate may be lost. To improve this, deionised water should be used to rinse the conical flask. Add washings to the solution in the crystallising dish.
    - Some anhydrous copper sulfate may be produced during evaporation of the solvent, this can be improved by reducing the time that the Bunsen burner heats the solution for.

Diagram

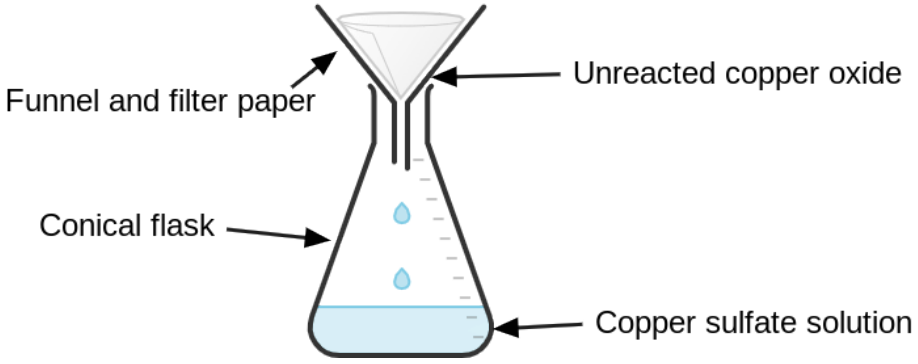

Figure 1 Experiment Setup of Filtration Process

Chemix

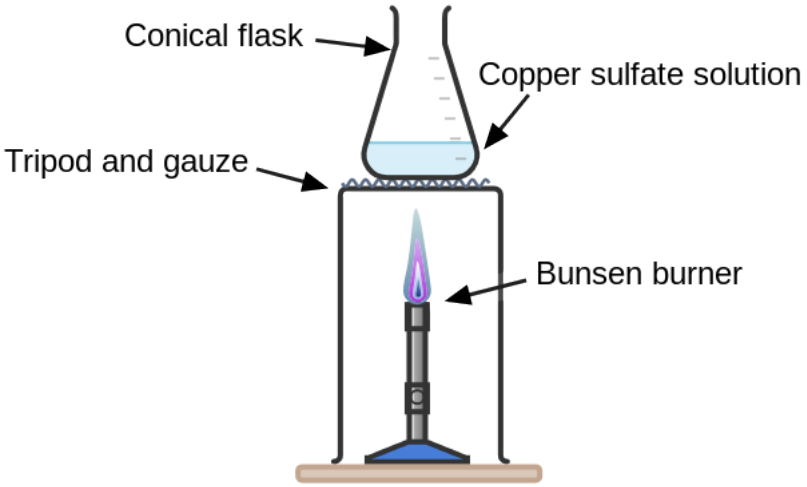

Figure 2 Initial Experiment Setup for Crystallisation

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Safety Precautions

- Sulfuric acid is an irritant so wear safety glasses and wash your hands after using it.
- Copper(II) oxide is harmful if ingested so wash hands after use and use in a well ventilated lab.
- Copper(II) sulfate crystals cause skin and eye irritation. Avoid touching and wash hands immediately if there is any contact with skin.
- Clear up any chemical spillages or broken glassware immediately.
- Take care when using the Bunsen burner. Tie hair back. Leave on the orange safety flame or turn gas off when not in use.
- The conical flask will be hot after heating so only touch it with the tongs. If the flask is touched, hold the burn under cold running water for up to 10 minutes, depending on the severity.

Analysis of results

Calculate the mass of copper sulfate crystals.

If you know the theoretical yield, you can calculate the percentage yield by:

$$\text{Percentage yield} = (\text{yield} \div \text{theoretical yield}) \times 100$$