

Edexcel Chemistry IGCSE

Practical 2.42: Prepare a sample of pure, dry hydrated copper(II) sulfate crystals starting from copper(II) oxide

Notes



Preparing Copper Sulfate from Copper Oxide

Aim

To use various separation techniques to prepare a pure, dry sample of hydrated copper(II) sulfate crystals starting from copper(II) oxide.

Equipment list

- 250 cm³ beaker
- Boiling tube
- Weighing boat
- 100 cm³ conical flask
- Measuring cylinder
- Crystallizing dish
- Bunsen burner
- Funnel and filter paper
- Tripod and gauze
- Heat proof mat
- Digital balance
- Kettle
- Tongs

Chemicals required

- Sulfuric acid
- Copper(II) oxide

Method

1. Using the kettle, half fill the 250 cm³ beaker with boiling water.
2. Add 15 cm³ of sulfuric acid into a boiling tube and place in the hot water.
3. Weigh 2.0 g of copper(II) oxide into a weighing boat.
4. Add a quarter of the copper oxide to the boiling tube with sulfuric acid. Lift the tube and agitate (shake) the mixture before returning it to the beaker of hot water. Repeat this 3 more times until all the copper(II) oxide has been added.
5. Replace the water in the beaker with fresh boiling water and leave the boiling tube for 5 minutes, agitating the mixture every minute.

Purification of copper(II) sulfate solution:

6. Put the filter paper into the funnel then place the funnel over a conical flask.
7. Pour the mixture from the boiling tube into the funnel and leave until all the liquid has run through the funnel.

Production of hydrated copper(II) sulfate crystals:

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

Measuring the mass of copper sulfate:



12. After the crystals have been left for at least 24 hours to dry, measure the mass of the crystals in the crystallizing dish. Subtract the mass of the empty crystallizing dish to find the mass of crystals formed.

Key points

- The equation for this reaction is: $\text{CuO} + \text{H}_2\text{SO}_4 \rightarrow \text{CuSO}_4 + \text{H}_2\text{O}$
- Do not allow the copper sulfate solution to boil until dry in step 9.
- The test tube reaction between sulfuric acid and copper oxide is carried out in boiling water to speed up the rate of reaction.
- Possible errors:
 - The copper sulfate solution may not have been fully transferred to the crystallizing dish so some may be lost. To improve this, the conical flask should be washed with deionised water and this should be added to the solution in the crystallizing 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.

Diagrams

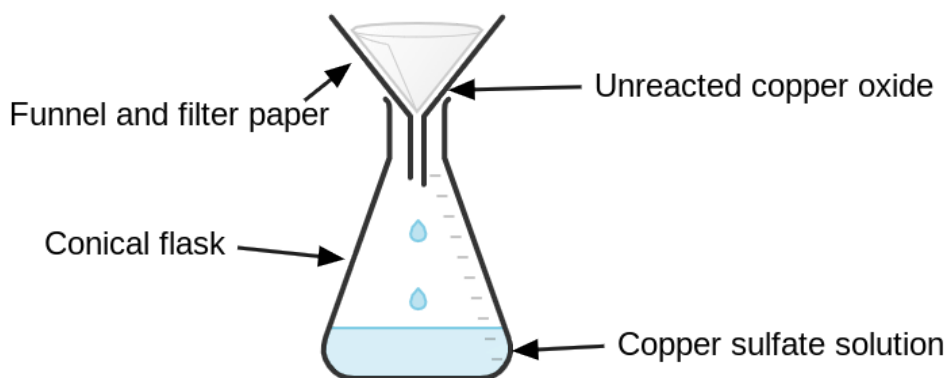


Figure 1 Filtration Process Setup

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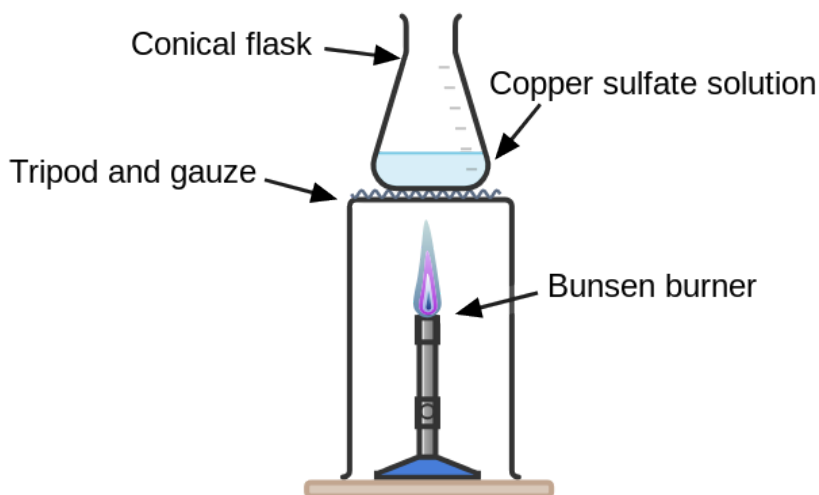


Figure 2 Initial Crystallisation Process Setup

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Safety Precautions

- Clear up any chemical spillages immediately.
- Sulfuric acid is an irritant so wear safety glasses and wash your hands after use.
- Copper(II) oxide is harmful if ingested so wash hands after use.
- Copper(II) sulfate crystals produced cause skin and eye irritation. Avoid touching and wash hands immediately if there is any contact with skin.
- Take care when using the Bunsen burner. Tie back long hair. 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 of the burn.

Analysis of results

The mass of copper sulfate crystals can be calculated.

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

$$\text{Percentage yield} = \frac{\text{Yield}}{\text{Theoretical yield}} \times 100$$

