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# Making Copper Sulphate Crystals

CfE

*Through experimentation, I can identify indicators of chemical reactions having occurred. ...*

**SCN 3-19a**

*Having taken part in practical activities to compare the properties of acids and bases . . .*

**SCN 3-18a**

## Introduction

The reaction of acids with bases to form salts is a common one in preparative chemistry, showcasing showcases a range of activities and skills.

Here we look at one of the most common variants, the reaction of dilute sulphuric acid with copper II oxide with to produce blue crystals of hydrated copper II sulphate.

This method (adapted by CLEAPSS) is a safer version that uses a boiling water bath rather than a Bunsen burner for the initial neutralization.

## You will need

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| Boiling tube | Beaker (~400 cm3) for a water bath |
| Access to a kettle | Access to a balance |
| Weigh boat (or similar) | Spatula |
| 100 cm3 conical flask | Bunsen burner, tripod and gauze |
| Funnel & filter paper | Evaporating dish, Petri dish or similar |
| Coppe II sulphate | 1.4 mol l-1 sulphuric acid |

1. Measure 15 cm3 of 1.4 mol l-1 sulphuric acid into a boiling tube. Stand the tube in a beaker, half-filled with just-boiled water from a kettle. Leave to warm for a few minutes while you continue with the next steps.
2. Weigh out between 1.8 and 2.0 g of black copper II oxide powder.
3. Add about half of the copper oxide powder to the warm acid. Agitate gently then put tube back into the hot water.

*Once it is warm, the reaction between the acid and copper oxide is quite rapid. The solution will quickly turn blue.*

1. When the copper oxide has disappeared and you are left with a blue solution, add the second portion of copper II oxide.

*Again the reaction will be quite rapid but this time there will be a small amount of unreacted solid will be visible at the bottom of the tube. This is intentional.*

*If there is no copper oxide in the bottom, add a bit more. It is important that* ***all*** *the sulphuric acid has been neutralized.*

1. Set up your apparatus for filtering and filter the contents of the boiling tube into a 100 cm3 conical flask.
2. Add 2-3 anti-bump granules to the flask. Stand it on a tripod and gauze and heat the solution with the Bunsen burner until just boiling.
3. Simmer gently for 2 minutes. If you hear a spitting or popping noise before the time is up, immediately turn off the heat. Never allow the solution to boil dry.
4. Turn off the Bunsen. Carefully lift the hot flask off the tripod and place it on a bench mat.
5. Carefully, pour the hot solution into an evaporating dish, crystallising dish or Petri dish\*. Crystals should start to form within 5 minutes,

*\* Using a Petri dish, especially if it is an old or scratched one, will help as the scratches provide nucleation sites for the crystals to start forming.*

*If there is no sign of crystals, place a wooden splint on the rim of the dish with one end dipping into the liquid. This provides a rough surface for the crystals to grow on.*

## What is happening

The solubility of copper II sulphate-5-water is about 1.3 mol l-1 at room temperature. Using 1.4 mol l-1 acid (rather than 1 mol l-1 as is often suggested) means that the copper sulphate solution produced is close to saturation. Minimal heating is then needed to evaporate some water. Crystals usually form as the solution begins to cool.

The reaction between copper II oxide and the acid is rapid above 80°C so just-boiled water is sufficient for the reaction to take place at a reasonable rate. This avoids the risk of learners scalding or burning themselves, as they do not need to stir boiling acid over a Bunsen flame.

15 cm3 of 1.4 mol l-1 sulphuric acid contains 0.021 mol of H2SO4.

CuO + H2SO4 CuSO4 + H2O

From the 1:1 reaction stoichiometry, 0.021 mol (1.68 g) of copper II oxide is required to completely react with and neutralise the acid.

The measured quantity used (1.8-2.0 g) means there is only a slight excess, thus minimising waste while ensuring all the acid is neutralised.

## Health & Safety

It is important to make sure that the acid has been completely neutralized.

If it is not, then the residual acid can decompose on heating, producing toxic sulphur dioxide/trioxide gases.