

Empirical Formula of Copper Salt

In this experiment, we will determine the empirical formula of a copper salt.

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Components

In this salt, there are three components: copper, chloride ion, and water. Through this experiment, we will determine the mass percent of each of these components, and that data can then be used to determine the empirical formula.

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Mass Percent

First, we need to look at the definition of mass percent. The mass percent of any component – here we use the example A – equals the mass of A over the total mass of the substance times 100.

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Mass Percent of Water

When we're determining the mass percent of the water, we're going to do something very simple: we're going to dry the sample. If we determine the mass before and after heating and drying the sample, we can determine what the difference of mass is. That difference will be the mass of water lost in the drying process. Don't forget when you're putting your sample in the crucible in the oven that you need to label it, and also when you get your sample out make sure you get the correct sample out of the oven.

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Mass Percent of Copper

Determining the mass percent of copper will be slightly more complicated because we have to do a chemical reaction in order to isolate the copper. The reaction shown here is unbalanced and shows the general formula for this reaction. We don't include the water as part of the copper chloride because this is dissolved in water and we've indicated this by aqueous. We will determine the mass of copper produced by this reaction. Once we've dried the copper we will be able to determine the mass percent of copper in our sample. You need to be careful when you're calculating the mass percents. You will have two original samples of the copper salt: one to determine the water, one to determine the copper. You need to determine the mass percent based on the correct sample.

When you're running the reaction and need to stir the sample, you always want to use a glass stirring rod; do not use a spatula, as this will introduce a metal into the experiment, and could interfere with your results.

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Mass Percent of Cl

The mass percent of chloride is probably the easiest one to determine. If it's not copper, and it's not water, then everything else is going to be chloride.

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Determine Empirical Formula

You'll use these mass percents to determine the empirical formula. Some information on calculating empirical formulas is in your lab manual as well as in your textbook from lecture. If you need help, don't be afraid to ask questions. Part of your data analysis question asks you for the empirical formula mass. It's calculated just like the molar mass, but we can't really call it the molar mass because we aren't positive that what we're looking at is the molar formula; we have to assume that it's an empirical formula.

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Waste

The waste from this experiment does need to be separated and disposed of properly. There will be containers in the hood for the used – or dried – copper salt, the used aluminum wire, and the copper produced from the reaction. Remember, if you have leftover copper salt, do not put it back in the stock containers because this leads to contamination. Try not to get too much extra, but any extra can be disposed of in the copper salt waste container.

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General Tips for Experiment

A few general tips for this experiment: The aluminum wire needs to be completely submerged in solution so that the reaction goes as quickly as possible. You also need to be patient and allow the samples to dry completely; if you weigh wet samples it will interfere with your results and cause confusion when you're doing your data analysis questions. When you're taking your sample out of the oven, use the crucible tongs, and use a piece of folded paper towel as a hot pad to help balance the crucible. Please be careful, as hot glassware looks exactly the same as cold glassware.

There is additional information on this experiment on Blackboard under the area "Experiments". As with all experiments, if you have questions, see your TA, go to the Learning Center, or talk to the lab supervisor.