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## The Quantitative Production and Recovery of Sodium Sulfate

Introduction: Chemists are not only interested in what type of reactions can occur, but they also want to know "how much?". How much reactant is required? - How much product will be formed? In this lab, we will investigate the stoichiometry (fancy word for how much) of the following precipitation reaction:

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\mathrm{CuSO}_{4}(\mathrm{aq})+\mathrm{Na}_{2} \mathrm{CO}_{3}(\mathrm{aq}) \rightarrow \mathrm{CuCO}_{3}(\mathrm{~s})+\mathrm{Na}_{2} \mathrm{SO}_{4}(\mathrm{aq})
$$

We will investigate how much $\mathrm{Na}_{2} \mathrm{SO}_{4}(\mathrm{aq})$ can be formed from a given amount of $\mathrm{CuSO}_{4}(\mathrm{aq})$ and $\mathrm{Na}_{2} \mathrm{CO}_{3}(\mathrm{aq})$. It is important to measure carefully and follow all the directions.

Materials: $\mathrm{CuSO}_{4} \quad \mathrm{Na}_{2} \mathrm{CO}_{3}$ evaporating dish, funnel, filter paper, Bunsen burner, wire stand, graduated cylinder, 2 beakers/group, stirring rod

## Procedure

1. Measure the mass of a clean and dry evaporating dish.
2. Using a clean spatula, add 0.39 g of copper (II) sulfate $\left(\mathrm{CuSO}_{4} \times 5 \mathrm{H}_{2} \mathrm{O}\right)$ to small beaker. Dissolve the sample in about 10 mL of distilled water measured from a graduated cylinder. If any of the powder adheres to the walls, try to wash it down when adding the water. Use a stirring rod to mix the water and powder.
3. Using a clean spatula, add 0.25 g of sodium carbonate into a second 100 mL . Dissolve the sample in about 10 mL of distilled water. Use a stirring rod to mix the water and powder.

## Using the formula above, calculate the number of moles of each reactant you have used. Predict the amount of $\mathrm{Na}_{2} \mathrm{SO}_{4}$ that will form:

4. Make sure both reagents are completely dissolved before continuing to the next steps.
5. Pour the contents of one of the beakers into the other. A precipitate should form immediately. Rinse the empty beaker with $1-2 \mathrm{~mL}$ of distilled water. Add this rinse to the beaker containing the precipitate.
6. You are now ready for filtering. Use a stirring rod to guide the liquid mixture into the filter paper cone. Collect the filtrate in your pre-massed evaporating dish. Wash the filter paper with 2 mL water and collect with the rest of the filtrate.
7. Pass the filtrate at least one additional time through a clean filter cone. Once again collect the filtrate in your pre-massed evaporating dish.
8. Heat the $\mathrm{Na}_{2} \mathrm{SO}_{4}$ (contained in the filtrate) to dryness. Be careful at the latter stages of heating as the salt crystals can easily splatter out of the dish. Once the evaporating dish has cooled, measure the mass of the evaporating dish and contents.

## Data:

Mass of the empty evaporating dish $\qquad$
Mass of the dish plus $\mathrm{Na}_{2} \mathrm{SO}_{4}$
Mass of the $\mathrm{Na}_{2} \mathrm{SO}_{4}$ $\square$

## Analysis:

1. Was your prediction accurate? Did all the reactants form products?
2. Average your class results. If you discard extremes, is there a clear answer?
3. What are two ways you could encourage more the product to form?
4. What were sources of error in this experiment?
5. How could errors be better avoided?

## Conclusion:

