Finding the Percent Yield in the Reaction and Decomposition of Copper Compounds

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Abstract

The principles of stoichiometry are a central idea throughout all of chemistry. In this experiment, stoichiometry was used to determine the theoretical and percent yields of the reaction and decomposition of $CuSO_4 \cdot 5H_2O$ into CuO. The experimental yield of CuO was determined by first reacting $CuSO_4 \cdot 5H_2O$ with a base and heating the mixture until it completely decomposed. The theoretical yield of the reaction was then determined by stoichiometry, allowing for a final calculation of the percent yield. The starting amount of $CuSO_4 \cdot 5H_2O$ used in the reaction was found to yield approximately 1 g of black CuO at the end of the reaction. The amount of CuO produced was mostly consistent with the theoretical yield showing a percent yield of over 50% for a single trial of the reaction.

Introduction

Start typing the Introduction here. Introduce what you are doing in the lab first. Follow this with a discussion of the background information. Include cited sources for all information, but feel free to elaborate or explain the concepts in your own words as well. It is suggested that you write this entire section in the present tense.

In the second half of your Introduction, you should discuss the purpose of your experiment. Elaborate by explaining, in general, what your experiment is, what you are trying to find, and how the background information helps to prepare for this experiment. Be careful not to explain actual procedures, as they will need to be found in the Methods section. Remember that you will be introducing your reader to the basic scientific concepts throughout the introduction,

and that you will also be introducing your experiment in its entirety. Spend time developing this section appropriately.

Use the rest of this sample paper to get an idea of the content and format expected of a lab report or scientific paper. Most sections include a sample of an actual experiment, while the Introduction and Discussion sections include tips for writing a successful paper.

Methods

Mass of $CuSO_4 \cdot 5H_2O$

For each trial, approximately 1.80-2.20 g of $CuSO_4 \cdot 5H_2O$ was weighed on a centigram (0.01 g) balance. The $CuSO_4 \cdot 5H_2O$ was transferred to a 150-mL beaker for the following reaction.

Reaction with NaOH

A total of 10.00 mL of distilled water was added to the beaker of $CuSO_4 \cdot 5H_2O$ and stirred to completely dissolve the solid. For the reaction a total of 10.00 mL of 6.00 M NaOH solution was added to the $CuSO_4 \cdot 5H_2O$ solution and carefully stirred to generate the $Cu(OH)_2$ product.

Decomposition of $Cu(OH)_2$

The 150-mL beaker now containing the $Cu(OH)_2$ was placed on a hot plate and heated until the mixture began to boil. The beaker was covered with a watch glass to prevent any splattering. When splattering did occur, the watch glass was rinsed with a small amount of distilled water to return any chemicals to the beaker. Once the blue $Cu(OH)_2$ completely

decomposed into the black CuO precipitate, the beaker was removed from the hot plate and allowed to cool.

Isolating CuO

A piece of filter paper was weighed and then used in gravity filtration to separate the CuO product from water. The isolated product was rinsed with distilled water 2-3 times to remove any water-soluble impurities. The CuO was allowed to dry for 24 hours to remove excess water. The dried CuO and filter paper was weighed on a centigram balance, and the final mass of CuO was determined by difference of mass.

Determining Percent Yield

The mass of CuO was used as the experimental yield. The theoretical yield was determined by stoichiometry. Both of these values were used to calculate the percent yield for the reaction.

Results

To begin the reaction the starting amounts of both $CuSO_4 \cdot 5H_2O$ and 6 M NaOH were measured. Because NaOH was known to react in excess, only the number of moles of $CuSO_4 \cdot 5H_2O$ was calculated using its molar mass. The measured and calculated was recorded according to Table 1.

Once mixed, the $CuSO_4 \cdot 5H_2O$ solution and the 6 M NaOH produced a blue precipitate that was then heated on a hot plate until it decomposed into black CuO precipitate. The mass of a piece of filter paper was recorded before and after filtering and drying the CuO product. The

mass was determined by difference using the data recorded in Table 2. The experimental yield of the reaction was equal to the calculation of the mass of CuO.

Table 1. *Starting Amounts of Reactants*

Chemical	Amount	Moles
$CuSO_4 \cdot 5H_2O$	1.95 g	0.00781 mol
6 M NaOH	10.00 mL	0.06000 mol

Table 2. *Mass Difference of CuO*

Chemical	Mass
Filter Paper and CuO	1.76 g
Filter Paper and CuO	0.80 g
Mass Difference (CuO)	0.96 g

The theoretical yield of the reaction was calculated beginning with the starting amount of 0.00781 mol $CuSO_4 \cdot 5H_2O$ and using stoichiometry to convert moles of $CuSO_4 \cdot 5H_2O$ to moles of CuO according to the following equation:

Reaction 1: $CuSO_4 + 2\ NaOH \rightarrow Cu(OH)_2 + Na_2SO_4$

Reaction 2: $Cu(OH)_2 \rightarrow CuO + 2\ H_2O$

Overall Reaction: $CuSO_4 \cdot 5H_2O + 2\ NaOH \rightarrow CuO + Na_2SO_4 + 6\ H_2O$

This calculation yielded a result of 0.00781 mol CuO, or 0.621 g CuO.

The percent yield of the reaction was calculated by comparing both the experimental yield and theoretical yield values as previously stated. The percent yield of CuO was found to be 55 %.

Discussion

Literature Cited