Stoichiometry of precipitation reaction

[Profession](#)

Introduction

Stoichiometry is a branch of chemistry that deals with the quantitative relationships that exist among the reactants and products in chemical reactions To predict the amount of product produced in a precipitation reaction using stoichiometry, accurately measure the reactants and products of the reaction, determine the actual yield vs. the theoretical yield and to calculate the percent yield. The equation that will be used is: Ba(NO3)2 (aq) + CuSO4 (aq) > BaSO4 (s) + Cu(NO3)2 (aq) Method

Gather materials needed for experiment which included:

- Small test tube with lip
- Large beaker
- Small graduated cylinder
- Large graduated cylinder
- One 9in balloon
- Citric acid
- Sodium bicarbonate
- odium chloride

To start the experiment:

- Na2CO3(aq) + CaCl2. 2H2O(aq) a CaCO3(s) + 2NaCl(aq) + 2H2O
- Put on your goggles.
- Weigh out

Add 25 mL of distilled water and stir to form the calcium chloride solution. Use only distilled water since tap water may have impurities that interfere with the experiment.. Use stoichiometry to determine how much Na2CO3 you will need for a full reaction. Weigh the calculated amount of Na2CO3 and put it in a small paper cup. Add 25 mL of distilled water and stir to make a sodium carbonate solution.

- Pour the sodium carbonate solution from the paper cup into the beaker with the calcium chloride solution. A precipitate of calcium carbonate will form instantly.
- Use the following instructions to set up a filtration assembly.
- Swirl the contents of the beaker to dislodge any precipitate from the sides. Then, while holding the filter paper in place and open, slowly pour the content of the beaker into the filter paperlined funnel.
- Be careful to not let the solution overflow the level of the filter paper while pouring.
- Measure out 2 to 5 mL of distilled water into the graduated cylinder. Pour this down the sides of the beaker, swirl, and pour into the filter paper-lined funnel.

After all the liquid has drained from the funnel, lay the filter paper containing the precipitate on folded layers of paper towels and put this someplace where it will not be disturbed while the filter paper and its contents air-dry. Depending upon the humidity in your area this might take several hours or days. When the filter paper and the precipitated calcium carbonate are completely dry weigh them, subtract the original weight of the empty filter paper, and record the net weight of the calcium carbonate. This is your actual yield of calcium carbonate.

Now calculate the percent yield, using your theoretical yield and actual yield. Make sure to show all stoichiometric calculations and all data in your lab report.

Calculations

Step 1: Convert 2 g of Ba(NO3)2 to moles of Ba(NO3)2 2 g Ba(NO3)2 x 1 mol Ba(NO3)2 = 0. 00765 moles Ba(NO3)2 261. 4 g Ba(NO3)2 Step 2: Consider the mole ratios of Ba(NO3)2 and CuSO4.

The equation tells us that for 1 mole of Ba(NO3)2 we need 1 mole of CuSO4. Thus, since the mole ratio is 1: 1, if we have 0. 00765 moles of Ba(NO3)2 we will need 0. 00765 moles of CuSO4.

Step 3: Convert moles of CuSO4 to grams of CuSO4. 0. 00765 moles CuSO4 x 159. 6 g CuSO4 = 1. 22 g CuSO4 1 mole CuSO4 This means that we need 1. 22 g of CuSO4 to fully react with 2 g of Ba(NO3)2.

Step 4: How much BaSO4 can we expect? The mole ratio between Ba(NO3)2 and BaSO4(s) is also 1: 1. That means if we have 0. 00765 moles of Ba(NO3)2 we will also get 0. 00765 moles of BaSO4(s).

Step 5: Convert the moles of BaSO4 to grams of BaSO4. 0. 00765 moles BaSO4 x 233. 4 g BaSO4 = 1. 79 g BaSO4 1mole BaSO4 Step 6: Double check our results by calculating the amount of Cu(NO3)2 (aq). We don't really need to know the amount of Cu(NO3)2 (aq) for the experiment, but it helps us double check our other results. Since we know that the total mass of reactants must equal the total mass of products, we compute: 0. 00765 moles Cu(NO3)2 x 187. 55 g Cu(NO3)2 = 1. 43 g Cu(NO3)2 1 mole Cu(NO3)2

Thus, 2 g Ba(NO3)2 plus 1. 22 grams CuSO4, yields 1. 79 g BaSO4. plus 1. 43 g Cu(NO3)2.

We can verify our results by comparing the total mass of reactants, 3. 22 g, with the total mass of products, also 3. 22 g. This tells us that all our calculations are correct and we can confidently use them.

Step 7: Calculate the theoretical yield. From previous calculations we know that we started with 2 grams of Ba(NO3)2, and need 1. 22 grams of CuSO4 to complete the reaction from which we can expect a yield of 1. 79 grams of BaSO4. Yet this is only a theoretical yield, for we should realistically expect a little less due to expected experimental error such as some BaSO4 being lost as it passed through the filter paper.

Step 8: Determine the actual yield and percent yield. After the reaction is completed and the precipitate has formed, we need to filter and dry the precipitate before we can weigh it. If we assume that after drying we have 1. 65 grams of BaSO4, then: The theoretical yield is 1. 79 grams of BaSO4. The actual yield is 1. 65 grams of BaSO4. The percent yield is 1. 65 g/ 1. 79 g x 100 = 92. 2%. Conclusion After the testing each known and unknown of the experiment, finding the ratio of the substances wasn’t very hard. The percentage of the unknown was 85. 8 %.