Honors Chemistry Lab 12: Vacuum-Assisted Gravimetric Analysis

As you know, the unit of measure for a substance is the mole. A mole is 6.02×10^{23} particles (such as atoms, molecules, molecules, ions, photons, etc.). The mass of one more of any substance is found using the periodic table to calculate the molar mass. Gravimetric analysis is a quantitative method for determining the amount of a substance by selective precipitation of the substance from a solution. The precipitate is separated from the remaining aqueous solution by filtration and is then dried and weighed. If the chemical formula for the precipitate is known and that the reaction goes all the way to completion, then the mass of the substance in the original sample can be determined. The purpose of this lab is to measure chemical quantities using the mole, observe evidence of a chemical change, utilize gravimetric analysis, and review the concept of the mole. You will need to read through the entire procedure and answer the pre-lab questions before beginning this lab.

ASK: How can I experimentally determine the moles of precipitation and percentage yield in a double replacement reaction using vacuum-assisted filtration?

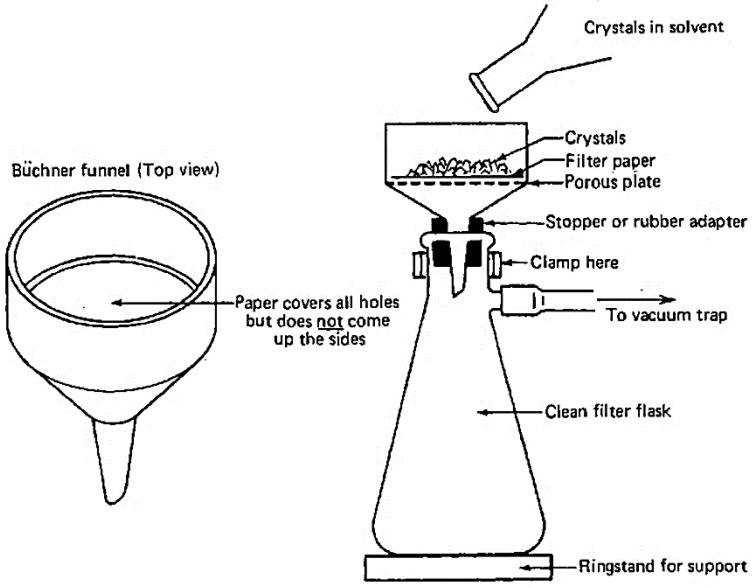
Materials: analytical balance, weigh boat, $CaCl_2$, Na_2SO_4, dH_2O, two beakers (100-250 mL), Büchner funnel, filter paper, Erlenmeyer flask (~150 mL), drying oven

Pre- lab Questions:

P1. Convert 0.0183 moles of calcium chloride to grams (0.0001 g).

P2. Convert 0.0142 moles of sodium sulfate to grams (0.0001 g).

P3. Predict the products and write the balanced equation for the reaction. Next write the complete and net ionic equations for this reaction.



RESEARCH:

1. Weigh 0.0183 moles of calcium chloride and place in one 100-250 mL beaker
2. Weigh 0.0142 moles of sodium sulfate and place in another 100-250 mL beaker
3. Add 25 mL of distilled water (dH_2O) to each beaker.
4. Stir each mixture with a glass stirring rod until the chemical inside it dissolves. After both substances have **completely** dissolved pour the sodium sulfate solution into the calcium chloride solution.
5. Record qualitative observations while continuing to stir for another 5 minutes. At this time your lab partner needs to clean your lab bench. Also clean and return the beaker that is not being used.
6. You should see evidence of a chemical reaction. Record more qualitative data as appropriate.
7. Obtain the appropriate size filter paper as shown in the schematic above.
8. Obtain the mass of the filter paper and record this data for later use. Also write your initials on the filter paper.
9. Place a Büchner funnel into the Erlenmeyer flask and place the filter paper into the funnel.
10. Start filtering the solution using vacuum filtration. Rinse the filter paper with small amounts of dH_2O to ensure that the entire chemical product is as pure as possible. Carefully rinse the product towards the center. Remove the labeled filter paper and place filter on a weighing boat and into an incubator oven overnight.
11. Clean everything in you work area and dispose of remaining solutions with copious water.
12. Next day: Obtain the mass of the filter paper with the chemical product. Record this data. Record the mass of the actual $CaSO_4$. Dispose of the product in the trashcan.

MAKE your claim and SUMMARIZE: (include the following questions in your summary).

Q1. What is the evidence that a chemical reaction occurred during this lab? In general, what are some other signs that a chemical reaction has occurred? Are there any of these signs that you feel always indicate a chemical reaction has occurred? Justify your response.

Q2. Calculate the number of moles of $CaSO_4$ that were experimentally formed in your reaction. Show all work.

Q3. Do you feel that the calculations that you used in Q3 were accurate? Please defend your response and be sure to expound on any potential systematic or random sources of error in your methodology.

Extension: If you have covered stoichiometry, I would like for you to include the following questions and calculations in your STEM journals.

Q4. Determine the limiting and excess reactants for this reaction.

Q5. Calculate the theoretical yield for the precipitate.

Q6. Calculate the percentage yield for the reaction.

Please self-assess your STEM journal using the rubric/checklist