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Experiment 1 – Separation of Copper(II) Sulfate from Sand

Discussion

Mixtures are a combination of substances in which the components keep their individual characteristics. Mixtures have variable proportions and can be separated by simple physical means. The mixture's components have different physical properties like melting point, boiling point, or solubility that allow us to selectively remove individual components from the mixture. Once separated, the percentage of each component in the original mixture can be calculated.

In this experiment, you will separate a mixture of copper(II) sulfate and sand using the physical property of solubility. You will learn about certain methods of separation that include decantation, filtration, and evaporation. Finally, the Law of Conservation of Mass will be applied to check the validity of your final calculations.

Procedure

1. Weigh about 4 –5 grams of the $CuSO_4$/sand mixture in a 100 mL beaker on the laboratory balance by taring (your instructor will explain and demonstrate).

2. Add 10–15 mL of D.I. water to the beaker, and swirl. Next, weigh and record the weight of a piece of filter paper AND an evaporating dish separately. Then assemble the filter apparatus as demonstrated by the instructor, filter the mixture, and collect the filtrate (liquid) onto the evaporating dish. Use your wash bottle (filled with D.I. water) to transfer all the undissolved solid from the beaker to the filter paper. After all the liquid has drained through the filter, wash the filter with small portions of D.I. water from the wash bottle until the washings are colorless. Again, make sure you collect ALL the filtrate and washings in the evaporating dish. Try to use small amounts of water. You will be evaporating the liquid; the more water you add, the longer it will take!

3. Prepare a steam bath by placing a 250 mL beaker, 2/3 full of water with 4 – 5 boiling chips, on a wire screen on a ring stand. Place the evaporating dish carefully on the beaker and heat the water to boiling. Heat the steam bath until the filtrate has completely evaporated. Do NOT let the steam bath boil to dryness; you may have to refill the water in the beaker occasionally. If the beaker goes dry, it must be cooled before adding water to prevent the beaker from cracking!

4. Open the filter paper onto a large watch glass that has been labeled with your drawer number using a permanent marker. Dry the sand on the filter paper/watch glass in the drying oven, set at 150 °C, for 20 minutes. Afterwards, carefully remove the watch glass, allow it to cool, and weigh the filter paper with the sand by placing it into a TARED weighing boat on the analytical balance. Calculate the mass of your sand.

5. Once your filtrate has completely evaporated and your salt remains on the evaporating dish, weigh the evaporating dish with the salt sample. Compute the weight of the $CuSO_4$ sample by difference.

6. Calculate the weight percent $CuSO_4$ and sand in the sample.

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Data and Calculations for Experiment 1

Mass of $CuSO_4$/sand mixture _____

Mass of empty evaporating dish _____

Mass of evaporating dish and dry $CuSO_4$ _____

Mass of $CuSO_4$ _____

Mass of filter paper _____

Mass of filter paper and sand _____

Mass of sand _____

Total mass of recovered sand and $CuSO_4$ _____

Calculated total percent recovery _____

Percent by mass of $CuSO_4$:

Show Calculation _____

Percent by mass of sand:

Show Calculation _____

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Questions

1. Many students do NOT recover 100% of the original mixture. Describe at least TWO possible problems that could cause LESS than 100% recovery of the mixture.

2. A student obtained the following data:

Mass of beaker	25.87 g
Mass of beaker with mixture sample	28.12 g
Mass of evaporating dish	146.36 g
Mass of evaporating dish with dried salt	147.10 g
Mass of beaker with dried sand	???

   However, this student spills her sand sample out of the evaporating dish before weighing it. If the student believes in the Law of Conservation of Mass, what should have been the weight of the beaker with the dried sand in it? Show all your work.

3. A student receives a sample of a mixture with three components: (1) solid iodine that is first removed from the mixture by evaporation, (2) solid salt that is dissolved to separate it from the third component, and (3) solid sand. The salt and sand are dried and weighed, but the iodine escapes as a gas and is not recovered. The student starts with 4.25 g of the mixture and recovers 1.16 g of salt and 2.40 g of sand. What is the percent of each component in the original mixture? Show all your work.