CONSERVATION OF MASS LAB

Whenever a chemical reaction is carried out you must be concerned with the separation and identification of the products. According to the Law of Conservation of Mass, the total mass of the reactants must equal the total mass of the products.

Consider the reaction between copper (II) sulfate and sodium carbonate. These compounds are soluble in water and when dissolved form charged particles called **ions**. This process is called **dissociation**. These ions are then free to react in solution when mixed, forming definite products. The process of dissolving these compounds in water may be represented by:

$CuSO_4 + H_2O \rightarrow Cu^{2+} + SO_4^{2-} + H_2O$

$Na_2CO_3 + H_2O \rightarrow 2Na^{1+} + CO_3^{2-} + H_2O$

The dissolved particles may react when the two solutions are combined. The mixture of these solutions form an intermediate solution of ions which will react immediately.

$Cu^{2+} + SO_4^{2-} + 2Na^{1+} + CO_3^{2-} \rightarrow CuCO_3\,(s) + 2Na^{1+} + SO_4^{2-}$

Separation of the solid product in this reaction may be accomplished with little difficulty by filtration. The second product may be isolated by evaporation of the water causing a solid compound to reform. The final representation of the reaction may be expressed as:

$CuSO_4\,(aq) + Na_2CO_3\,(aq) \rightarrow CuCO_3\,(s) + Na_2SO_4\,(aq)$

In order to simplify the weighing process, the copper (II) sulfate has been dissolved in water for you. You should recognize that the water does not enter into this reaction; it is to be considered as the medium for the reaction to proceed. The concentration of copper (II) sulfate is **1.6 g** in 40.0 mL of water, and the concentration of sodium carbonate is **1.06 g** in 40.0 mL of water. You will need to make up this solution.

Procedure:

1. Rinse the pipet with tap water (then dry the outside). Transfer 40.0 mL of distilled water into the **plastic beaker** and then add **1.06 g** of sodium carbonate (use the centigram scales). Stir till all solute is dissolved (add a few drops of distilled water down the stirring rod to rinse it). Using pipet add 40.0 mL of copper (II) sulfate solution into **plastic beaker**. Stir till the reaction is complete.

2. Mass a 250 mL Erlenmeyer flask and two pieces of filter paper. Record this data. Prepare the funnel and filter paper for filtration into this flask (one piece of filter paper will be used to cover the flask during evaporation.

3. Pour the reaction mixture into the funnel carefully. Collect the filtrate in the Erlenmeyer flask. Keep the level of the mixture at least 2 cm below the top of the filter paper. If any

solid material remains in the beaker, use some of the filtrate, or a small amount of water to rinse out **all** the solid into the funnel.

4. When the filtration appears complete, remove the filter paper and residue from the funnel. Open up the folds and place it on a sheet of notebook paper with your names and station number. Give this to me to dry overnight.

5. Begin to evaporate the water from the filtrate by gently heating the solution. **CAUTION**: Excessive heat will decompose your solid, or cause it to leave the flask.

6. Allow the flask to cool fully, then mass and record. Mass and record the dry solid on the filter paper the next class period.

7. Clean and organize all equipment.

8. After completing the above work and measurements, use the computer to complete the math calculations. You will need to enter 4 pieces of information into the spreadsheet. Then print out an individual copy of your data and calculations.

LABORATORY DEFINITIONS

1. solution - the dispersion of one or more substances in another, usually a liquid, so as to form a homogeneous mixture (which appears uniform throughout.)

2. solute (sol' ut) - that part of a solution in least concentration, usually the substance dissolved in a solution.

3. solvent - that part of a solution in greatest concentration, usually the substance used for dissolving another substance.

4. reactants - any of the substances involved in a chemical reaction

5. products - any substance resulting from a chemical change

6. filtrate - that solution (here containing dissolved ions in water) that has passed through a filter.

7. precipitate - a solid produced from a reaction occurring in an aqueous solution.

SAMPLE DATA SHEET - Conservation of Mass

mass of $CuSO_4$ ..... _____g

mass of Na_2CO_3 ..... _____g

total mass of reactants ..... _____g

mass of $CuCO_3$ and filter paper .. _____g

mass of sheet of filter paper _____g

mass of $CuCO_3$ ..... _____g

mass of Na_2SO_4 flask, fp ..... _____g

mass of filter paper..... _____g

mass of flask ..... _____g

mass of Na_2SO_4..... _____g

TOTAL MASS OF PRODUCTS . _____g

Calculations:

% recovery (total) = $\frac{\text{total mass of products}}{2.66 \text{ grams}} \times 100 =$ _____%

% error (total) = $\frac{|\ 2.66\ g - \text{total mass of products}\ |}{2.66 \text{ grams}} \times 100 =$ _____

% error (for each product): see printout for results

Questions:

1. What effects would melting, freezing, or boiling have on the conservation of mass during a lab?

2. Using the rules for solubility, explain why one product became insoluble and precipitated and the other remained in solution.

3. Describe what happened when you added the copper sulfate solution to the sodium carbonate solution.

4. Why did we heat the sodium sulfate solution?

5. Why were the original solutions homogeneous?

6. Suggest ways in which your experimental technique could be improved.

7. By looking at the balanced chemical equation can you suggest a possible way to predict what the results should have been. If so, calculate these actual values and check your percentage errors.

Writeup procedure: Include brief abstract, notecard, observations made during lab, all calculations, answers to above questions, and printout.