EXPERIMENT # 13
TABLE SALT FROM BAKING SODA

Purpose:

1. To obtain sodium chloride from sodium hydrogen carbonate (commonly called sodium bicarbonate)
2. To study the stoichiometry of this reaction.

Method:

Baking soda is the common name for sodium hydrogen carbonate ($NaHCO_3$). When sodium hydrogen carbonate is treated with hydrochloric acid ($HCl_{(aq)}$), it produces a white solid residue of sodium chloride (NaCl) more commonly called table salt and two gaseous products. The gaseous products are water vapor ($H_2O_{(g)}$) and carbon dioxide ($CO_{2(g)}$).

Procedure:

1. Mass a clean, dry, 50 mL beaker on the centigram balance. Add approximately 1.0g – 1.5g of $NaHCO_{3(s)}$ into the beaker.

DO NOT EXCEED 1.5g OF $NaHCO_{3(s)}$.

2. Determine the exact mass of the beaker and its contents on the centigram balance. Determine the exact mass of the $NaHCO_{3(s)}$ in the beaker by difference.

3. In the fume hood, measure out 4-5 mL of concentrated hydrochloric acid (12 M) in your small graduated cylinder. Record this volume to the nearest 0.1 mL **(You must measure out at least 4.0 mL)**.

CAUTION Concentrated HYDROCHLORIC ACID is HIGHLY CORROSIVE
CAUTION Concentrated HYDROCHLORIC ACID gives off NOXIOUS fumes

4. Transfer the concentrated hydrochloric acid to another small beaker and cover this beaker with a watch glass. Leave the beaker with the $HCl_{(aq)}$ in the fume hood.

DO NOT RETURN any of the Concentrated HYDROCHLORIC ACID to the original REAGENT BOTTLE
DO NOT REMOVE the Container with HYDROCHLORIC ACID FROM the FUME HOOD

If you measured out too much concentrated hydrochloric acid dispose of it into an appropriately labeled waste container found in the fume hood.

5. In the fume hood, add drop wise using a pipette, the concentrated hydrochloric acid from the second beaker to the $NaHCO_{3(s)}$ in the first beaker and observe the effervescence.

   If the effervescence is too vigorous, slow down the rate at which the concentrated hydrochloric acid is added, to avoid splattering of the sample. This step is completed when all of the concentrated hydrochloric acid has been added to the $NaHCO_{3(s)}$.

6. Heat the beaker containing the residue in the fume hood by placing the beaker on a wire gauze supported by a ring. Continue heating until the residue appears dry.

7. Remove the beaker from the hood and continue heating at your bench until constant mass is achieved (successive massings agree within 0.01 g).

   Adjust the height of the ring and of the flame in such a manner as not to heat too strongly. (The contents of the beaker should not splatter and the beaker should not turn red hot).

   If any trace of objectionable fumes is given off by the residue, return the beaker immediately to the fume hood and resume heating the beaker in the fume hood.

   If the contents of the beaker start to melt (glassy appearance) this indicates that the heating is too strong and the residue had probably been already heated to dryness and hence constant mass.

   Keep in mind that heating is done with the sole purpose to completely drive off the gaseous products and not to melt the residue.

8. Record the mass of the beaker and the residue (constant mass) and determine the mass of the residue.

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Table Salt from Baking Soda

Name: ______________________________

Date: ______________________________

Partner: ______________________________

DATA:

Mass of beaker .... __________ g

Mass of beaker and sample ($NaHCO_{3(s)}$)............ __________ g

Mass of sample ($NaHCO_{3(s)}$) .... ________________ g

Mass of beaker and residue (NaCl) 1st Heating... __________ g

Mass of beaker and residue (NaCl) 2nd Heating .. __________ g

Mass of beaker and residue (NaCl) 3rd Heating... __________ g

Mass of beaker and residue (NaCl) best .... ________________ g

Mass of residue (NaCl) .... ________________ g

Volume of conc. HCl added .... ________________ mL

CALCULATIONS:

Molar mass of $NaHCO_{3(s)}$ .... __________ g/mol

Number of moles of $NaHCO_{3(s)}$ added .... ________________ mol

Show calculations below:

Concentration of HCl (aq) .... ______________ M

Number of moles of HCl added .... ________________ mol

Show calculations below:

Write a balanced chemical equation for this chemical reaction. Include **state designations** for all reactants and products.

Assuming $NaHCO_{3(s)}$ is the limiting reactant. Use the number of moles of $NaHCO_{3(s)}$ from the previous page to calculate how many grams of $NaCl_{(s)}$ that could be produced from the amount of $NaHCO_{3(s)}$ used in this experiment?
(Show your calculations) ______________________ *g*

Assuming HCl is the limiting reactant. Use the number of moles of $HCl_{(aq)}$ from the previous page to calculate how many grams of $NaCl_{(s)}$ that could be produced from the amount of $HCl_{(aq)}$ used in this experiment?
(Show your calculations) ______________________ *g*

From your above calculations, which reactant is limiting?

From your above calculations, which reactant is excess?

Actual yield of NaCl .... ________________g

Theoretical yield of NaCl .... ________________g

Percent yield of NaCl .... ________________%
(Show your calculations)

Why must the first heating be done under the fume hood rather than at your bench?