Mass and Mole Relationships

In a balanced chemical equation, all reactants and products must be represented by symbols or formulas. The total number of atoms of each element must be the same on each side of the equation to satisfy the Law of Conservation of Mass. A Calculation of the formula mass of a reactant or product enables us to convert from mole relationship given by the coefficients of the balanced equation then allows us to calculate how many moles of every other substance will take part in the reaction.

In this experiment, we will investigate the quantitative relationships in the reaction:

$NaHCO_3(s) + HCl\ (aq) \rightarrow NaCl\ (aq) + CO_2\ (g) + H_2O\ (g)$

A known mass of sodium hydrogen carbonate will be reacted with excess hydrochloric acid. Knowing the mass of $NaHCO_3(s)$ that reacts, we can determine from the balanced equation the mass of NaCl that should be produced. We can compare this theoretical value with the actual experimental mass of NaCl produced. This experiment should aid in the understanding of the mole-mass relationships that exist in a chemical reaction and in the interpretation of a balanced chemical equation.

PURPOSE

Compare the experimental mass of a product of a chemical reaction with the mass predicted for that product by calculation.

EQUIPMENT

balance
dropper pipet
evaporating dish
watch glass
micro spatula
hot plate
safety glasses

MATERIALS

6 *M* hydrochloric acid (HCl)
sodium hydrogen carbonate ($NaHCO_3$)

PROCEDURE

1. Find the combined mass of the evaporating dish plus a watch glass. This is mass (a) in your data table.
2. Leaving the watch glass and evaporating dish on the balance, move the riders to measure an additional 2.50 g. Using a micro spatula, add sodium hydrogen carbonate ($NaHCO_3$) to evaporating dish until the scale balances. Record this mass as (b) in your data table.
3. Get a hot plate
4. Obtain about 5mL of 6 *M* hydrochloric acid (HCl) in a clean, dry test tube. CAUTION: *Handle this acid carefully. It can cause painful burns if it touches your skin.* Using a dropper pipet, slowly add HCl to the $NaHCO_3$ in the evaporating dish, a few drops at a time. (See figure 17-2.) Continue adding acid until the reaction (bubbling) stops. Carefully tilt the evaporating dish back and forth a few times to make sure the acid has contacted all of the $NaHCO_3$. After making sure that all the bubbling has stopped, remove the watch glass and place it curved side down on the lab bench.
5. Place the evaporating dish on the hot plate and *gently* heat the evaporating dish. When almost all of the liquid is gone, turn off the hotplate and replace the watch glass on the evaporating dish leaving a small opening for the vapor to escape. Heat gently again until no liquid remains. Allow the dish to cool.
6. Find the combined mass of the watch glass, evaporating dish and contents (NaCl). Record this mass (c) in your data table.