Experiment 8 Limiting Reactant. *Prelaboratory Assignment*

1. The limiting reactant is determined in this experiment.
   a. What are the reactants (and their molar masses) in the experiment?
   b. What is the product (and its molar mass) that is used for determining the limiting reactant?
   c. Write the molecular eqn and the net ionic eqn
   d. How is the limiting reactant determined in the experiment?

10 سلايد 2. Experimental Procedure, Part A.2. What is the procedure and purpose of "digesting the precipitate?

3. Two special steps in the Experimental Procedure are incorporated (دمج) to reduce (تقليل) the loss of the calcium oxalate precipitate. Identify the steps in the procedure and the reason for each step.

Answer:

Digest the precipitate (ppt) and a fine porosity filter paper is used for filtering the ppt

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4. A 0.972-g sample of a $CaCl_2 2H_2O/K_2C_2O_4 H_2O$ solid salt mixture is dissolved in 150 mL of deionized water, previously adjusted to a pH that is basic. The precipitate, after having been filtered and *air-dried*, has a mass of 0.375 g. The limiting reactant in the salt mixture was later determined to be $CaCl_2 2H_2O$.

a. What is the percent by mass of $CaCl_2 2H_2O$ in the salt mixture?
b. How many grams of the excess reactant, $K_2C_2O_4 H_2O$, *reacted* in the mixture?
c. How many grams of the $K_2C_2O_4 H_2O$ in the salt mixture remain *unreacted*?.

Answer:

a. $0.375\ g\ CaC_2O_4 \cdot H_2O \times \frac{mol}{146.12\ g} \times \frac{1\ mol\ CaCl_2 \cdot 2H_2O}{1\ mol\ CaC_2O_4 \cdot H_2O} \times \frac{147.02\ g}{mol}$

$= 0.377\ g\ CaCl_2 \cdot 2H_2O$

$\%\ CaCl_2 \cdot 2H_2O = \frac{0.377\ g}{0.972\ g} \times 100 =$ **38.8% $CaCl_2 \cdot 2H_2O$**

b. $0.375\ g\ CaC_2O_4 \cdot H_2O \times \frac{mol}{146.12\ g} \times \frac{1\ mol\ K_2C_2O_4 \cdot H_2O}{1\ mol\ CaC_2O_4 \cdot H_2O} \times \frac{184.24\ g}{mol}$

$= 0.473\ g\ K_2C_2O_4 \cdot H_2O$ that reacts

c. The mass of *excess* $K_2C_2O_4 \cdot H_2O = 0.972 - (0.377\ g + 0.473\ g)$

$= 0.122\ g$ *excess* $K_2C_2O_4 \cdot H_2O$

5. 1.009-g mixture of the solid salts Na_2SO_4 (molar mass 142.04 g/mol) and $Pb(NO_3)_2$ (molar mass 331.20 g/mol) forms an aqueous solution with the precipitation of $PbSO_4$ (molar mass 303.26 g/mol). The precipitate was filtered and dried, and its mass was determined to be 0.471 g. The limiting reactant was determined to be Na_2SO_4.

a. Write the molecular form of the equation for the reaction.

b. Write the net ionic equation for the reaction.

c. How many moles and grams of Na_2SO_4 are in the reaction mixture?

d. How many moles and grams of $Pb(NO_3)_2$ reacted in the reaction mixture?

e. What is the percent by mass of each salt in the mixture?.

Answer:

a. $Na_2SO_4 + Pb(NO_3)_2 \rightarrow PbSO_4 + 2\,NaNO_3$

b. $Pb^{+2}(aq) + SO_4^{-2}(aq) \rightarrow PbSO_4(s)$

c. $0.471\text{g } PbSO_4 \times \frac{\text{mol } PbSO_4}{303.26\text{ g}} \times \frac{1\text{ mol } Na_2SO_4}{1\text{ mol } PbSO_4} = 1.55 \times 10^{-3}\text{ mol } Na_2SO_4$

$1.55 \times 10^{-3}\text{ mol } Na_2SO_4 \times \frac{142.04\text{ g } Na_2SO_4}{\text{mol}} = 0.221\text{ g } Na_2SO_4$

d. $0.471\text{g } PbSO_4 \times \frac{\text{mol } PbSO_4}{303.26\text{ g}} \times \frac{1\text{ mol } Pb(NO_3)_2}{1\text{ mol } PbSO_4} = 1.55 \times 10^{-3}\text{ mol } Pb(NO_3)_2$

$1.55 \times 10^{-3}\text{ mol } Pb(NO_3)_2 \times \frac{331.20\text{ g } Na_2SO_4}{\text{mol}} = 0.514\text{ g } Pb(NO_3)_2\ \textit{reacted}$

e. $\frac{0.221\text{ g } Na_2SO_4}{1.009\text{ g sample}} \times 100 = 21.9\%\ Na_2SO_4;\ 78.1\%\ Pb(NO_3)_2$

Experiment 3
Limiting Reactant
Laboratory Questions

Name : ..... **Section No.** ..... **Date :** .....

1. Part A.2. If the step for digesting the precipitate were omitted, what would be the probable consequence of reporting the "percent limiting reactant" in the salt mixture? Explain.

more product whould be lost through the filtering process.

2. Part A.3. A couple of drops of water were accidentally placed on the properly folded filter paper before its mass was measured. However, in Part A.6, the $BaSO_4$ precipitate and the filter paper were dry. How does this sloppy technique affect the reported mass of the limiting reactant in the original salt mixture? Explain.

→ too low

3. Part A.5. Because of the porosity of the filter paper and the finely divided precipitate, some of the $BaSO_4$ precipitate passes through the filter paper. Will the reported percent of the limiting reactant in the original salt mixture be reported too high or too low? Explain.

→ washed some of ppt dissolved

4. Part A.5: Excessive quantities of wash water are added to the $BaSO_4$ precipitate. How does this affect the mass of $BaSO_4$ precipitate reported in Part A.6?

→ too low

5. Part A.6: The $BaSO_4$ precipitate is not completely dry when its "dried" mass is determined. Will the reported mass of the limiting reactant in the original salt mixture be reported too high or too low? Explain.

too high