Name: _____ Section: _____

Experiment 6 – Decomposition of Potassium Chlorate

Discussion

The percentage composition of a compound is the percent by mass of each element in the compound. This can be theoretically calculated using atomic masses found on the periodic table, and experimentally calculated from lab data. The percent composition is calculated by taking the mass of the part divided by the mass of the whole times 100.

In this experiment, solid potassium chlorate will be strongly heated. This causes it to decompose into solid potassium chloride and oxygen gas. The relative amount of potassium chloride (residue left behind) and oxygen gas (mass lost) are experimentally measured and compared to the theoretical values.

Percent error is calculated by finding the absolute value of the difference between the theoretical and experimental values and dividing that number by the "true" theoretical value and last multiplying the answer by 100.

Following the quantitative test, we will perform a qualitative test on the residue and known compounds of $KClO_3$ and KCl using silver nitrate solution. $AgNO_3$ solution is used as a general test for chloride ions. A positive test forms white solid AgCl and indicates the presence of Cl^- ions in a solution. Tap water contains chloride ions, so it is very important to perform this test with clean equipment that has been rinsed out with deionized water and to use deionized water in the test.

To obtain accurate and precise data you should do the following:

1. Use the same balance for all mass measurements.
2. Record data directly and immediately into the lab report.
3. Record data completely (to the nearest 0.001 g); do not round off the data.
4. If an error is made in data collection, do not scratch out or erase but simply draw a single line through the error and write the correction beside it.
5. Duplicate samples should be analyzed so that results can be compared and averaged.
6. Handle the crucibles with tongs not fingers.
7. The crucible must be covered while heating to avoid any loss due to splatter.

Name: _____ Section: _____

Procedure

A. Quantitative Determination of Percent Composition

1. Weigh a clean dry crucible and cover to the highest precision. Be sure that you use the same balance for all mass measurements within the same experiment to cancel out systematic errors.

2. Carefully read the label on the container and add between 1.0 to 1.5 grams of potassium chlorate, $KClO_3$, into the crucible and cover and weigh to the highest precision.

   NOTE: In part B of this lab, we will be using some potassium chloride. If you accidentally place KCl in your crucible, no mass will be lost on heating and you will have to start over and repeat the experiment correctly using $KClO_3$!

3. To a ring stand, attach a ring and place a clay triangle on the ring. Place the crucible with cover on the clay. Very gently heat with a Bunsen burner for about 8 minutes. Readjust the flame and continue heating more intensely now so that the bottom of the crucible glows red for another 10 minutes.

4. After this two step heating process (1^{st} heating) is complete, turn off the burner, close the crucible lid, and allow to cool about 10 minutes before weighing. It is important to have all mass measurements made at or near room temperature. Do not transfer the hot crucible to the tabletop; it is too hot and will permanently mark the table. Use the crucible cooling plates that are provided. Weigh your sample. The cooling period is a great time to start the second sample.

5. Heat the covered crucible and contents another 6 minutes at maximum temperature, then cool and reweigh (2^{nd} heating). If the results agree within $\pm$0.050 g, you are done and will not need to have a 3^{rd} heating. If the difference is greater than 0.050 g, repeat the heating for another 6 minutes (3^{rd} heating).

B. Qualitative Examination of the Residue

1. Place three clean test tubes in a rack. Put a pea sized quantity of KCl in test tube number 1 and a pea sized quantity of $KClO_3$ in the test tube number 2. Add 10 ml of deionized water to each and mix. Next, add 10 ml of deionized water to your residue in the crucible, mix, and transfer a portion to test tube number 3.

   NOTE: It is not necessary to dissolve and transfer the entire residue.

2. Add 3 drops of 6 M HNO_3 and 5 drops of 0.1 M $AgNO_3$ solution to each test tube. Record observations.

DISPOSE of solutions and precipitates containing silver in the waste container provided.

Name: _____ Section: _____

Data and Calculations for Experiment 6

A. Quantitative Determination of Percent Composition

1. When solid $KClO_3$ is heated above 400 °C, it decomposes to solid potassium chloride and elemental oxygen gas. Write the balanced equation for the decomposition of $KClO_3$ solid.

2. What is the remaining residue in the crucible after heating?

3. What substance is lost during the heating?

	Sample 1	Sample 2
4. Mass of crucible and cover		
5. Mass of crucible, cover and sample		
6. Mass of crucible, cover and sample after 1st heating		
7. Mass of crucible, cover and sample after 2nd heating		
8. Mass of crucible, cover and sample after 3rd heating		
9. Mass of original sample		
10. Mass of the residue		
11. Mass lost upon heating		

12. Experimental percentage of KCl in the $KClO_3$ sample.

    Sample 1:

    Sample 2:

13. Experimental percentage of oxygen in the $KClO_3$ sample.

    Sample 1:

    Sample 2:

Name: _____ Section: _____

14. Using the atomic masses from the periodic table, solve for the molar mass of $KClO_3$.

_____

15. Theoretical percentage of KCl in the $KClO_3$ sample _____

16. Theoretical percentage of oxygen in the $KClO_3$ sample _____

17. Percent error in oxygen determination

    Sample 1:

    Sample 2:

B. Qualitative Examination of the Residue

1. Record what you observed when $AgNO_3$ solution was added to the following:
    i. KCl

    ii. $KClO_3$

    iii. Residue

2. What does the evidence lead you to believe about the residue?

3. Does the evidence from the $AgNO_3$ test prove conclusively (without a doubt) that the residue is KCl? Explain.

Name: _____ Section: _____

Pre-Lab Assignment (to be completed before coming to lab)

1. a) Write the balanced equation for the decomposition of $Mg(ClO_3)_2$ solid.

   b) A student heated 1.228 grams of $Mg(ClO_3)_2$ until a stable weight was determined. The remaining residue weighed 0.584 grams. Solve for the experimental percentage of oxygen.

   c) Calculate the theoretical percentage of oxygen in $Mg(ClO_3)_2$.

   d) Calculate the percent error in oxygen determination.

2. Given the mass percent of each element:

   18.8% Na 29.0% Cl 52.2% O

   Solve for the empirical formula and name it.

3. Predict the products and balance the equations for the following decomposition reactions:

   a) $NaClO_3(s) \rightarrow$

   b) $Ca(ClO)_2(s) \rightarrow$

   c) $Al(ClO_3)_3(s) \rightarrow$

   d) $Mg(ClO_2)_2(s) \rightarrow$