

Percent Potassium Chlorate in a Mixture

Potassium chlorate (KClO_3) decomposes on heating to produce potassium chloride and oxygen. The Law of Conservation of Mass states that the mass of the reactants (potassium chlorate) will equal the mass of the products (potassium chloride and oxygen). Since oxygen is a gas, the mass of the final solid will be less than the starting weight. The mass loss is equal to the mass of oxygen.

In this experiment, you will begin with a sample that is a mixture of potassium chlorate and potassium chloride. Your objective is to determine the percentage by mass of potassium chlorate in the original mixture. Upon heating, only the potassium chlorate will decompose. Using the balanced equation and the fact that all the mass that is lost is oxygen gas, you can use stoichiometry to calculate the mass of potassium chlorate in the original mixture.

A catalyst, manganese(IV) oxide, is added to the reaction mixture in order to speed up the reaction. Like all catalysts, the same amount of catalyst is present at the end of the reaction as in the beginning. Therefore, we will include the mass of the catalyst in with the mass of the crucible.

To ensure that the decomposition is complete, the product must be heated to a constant weight. After the first heating, cooling and weighing, the sample must be heated again, cooled and reweighed. This process is continued until two successive weights are within 5 mg of each other (up to four heating cycles.)

PROCEDURE: - *You must wear safety goggles while performing this lab! All mass measurements should be recorded to the milligram (0.001 g.)*

1. Set up a ring stand with a triangle as demonstrated by your teacher. The small white crucible should fit inside the triangle.
2. Place about 0.5 g of manganese(IV) oxide into a clean, dry small white crucible. Heat the crucible and catalyst with a Bunsen burner for about 3 minutes to drive off any moisture that may be in the catalyst or crucible. Wear safety glasses at all times if a Bunsen burner is operational at your lab bench!
3. When the crucible is cool enough to touch, record the entire mass to the nearest 0.001g.
4. Add between 2.0 to 2.5 grams of the unknown mixture to the crucible. Mix the contents to obtain a somewhat uniform mixture. Record the mass of the crucible plus catalyst plus mixture to the nearest 0.001 g. Be sure to also record your unknown number!
5. Begin heating the crucible gently at first followed by a more aggressive treatment for a total of 10 minutes. Be aware that the sample may begin to bubble and spurt; if this happens, turn the flame down a bit.
6. Allow the sample to cool to room temperature. Record the mass to the nearest 0.001 g.
7. Reheat your sample for 5 minutes. Cool and record the mass. If your mass is within 0.005 g of the mass after the first heating, congratulations, you can move on to calculations. If not, you must reheat, cool, and weigh until you have two successive masses within 0.005 g of each other. Clean up and put away your equipment (all waste in this lab can be washed down the drain with water.)

CALCULATIONS: *Remember to show relevant calculations in your lab report*

1. Write a balanced equation for the decomposition of potassium chlorate.
2. Determine the **mass of oxygen lost** (α , below in the equation).
3. Use the balanced equation to determine the mass of potassium chlorate decomposed (λ , below, in the equation.) You will also need to calculate the **molar mass of O₂** (β , below) and the **molar mass of KClO₃** (δ , below).
4. Determine the percentage of potassium chlorate in the original white mixture.

The following equation might prove useful for this lab:

$$\lambda \text{ g KClO}_3 = (\alpha \text{ g O}_2 \text{ lost}) * \left(\frac{\text{mol O}_2}{\beta \text{ g O}_2} \right) * \left(\frac{2 \text{ mol KClO}_3}{3 \text{ mol O}_2} \right) * \left(\frac{\delta \text{ g KClO}_3}{1 \text{ mol KClO}_3} \right)$$

POSTLAB QUESTIONS:

1. A white powder is a mixture of magnesium carbonate and magnesium oxide. Upon heating, the magnesium carbonate decomposes into magnesium oxide and carbon dioxide. If you have 1.897 g of the mixture and after heating are left with 1.494 g of magnesium oxide, calculate the weight percent of magnesium carbonate in the original mixture.
2. Calculate the % oxygen by mass for the following (show calculations): a) LiNO₃ b) NaHCO₃