

Experiment: composition of potassium chloride



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The aim of the experiment was to look for the percentage composition of the elements present in the decomposition of potassium chlorate (KClO₃) and to find out what the residue after heating was. After performing the experiment the researchers found out that there were about 66.14% of potassium chloride (KCl) in KClO₃ and they also deduced that the residue was actually KCl.

Introduction

Total mass of the Element = Compound (Part)/Total mass of Compound (Whole) * 100

The formula above is the formula used to determine the percentage composition of an individual element in a compound. In this experiment, the researchers are both going to solve the theoretical percentage composition and the experimental percentage composition of elements/ ions. The theoretical percent composition is solved using a known formula compound and an experimental percent composition is solved using data identified in the experiment.

The goal of this experiment is to formulate a diminutive percentage error as possible, which is solved using the formula below.

(Theoretical value-Experimental value)/Theoretical value * 100

The compound that they are going to use in this experiment is KCl or potassium chlorate. Potassium chlorate, when heated to high temperatures would form this equation: $2\text{KClO}_3 (\text{s}) \rightarrow \Delta 2\text{KCl} (\text{s}) + 3\text{O}_2 (\text{g})$

Procedure The experiment was composed of two parts. The first part was for determining the percentage composition of potassium chlorate.

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First, the researchers made sure that the crucible, which would be used throughout the experiment, was dry, so they heated it on a clay triangle for 2-3 minutes. Next, they let the crucible cool down a bit and then weighed it together with its cover. Then they added 1.196 g of potassium chlorate into the crucible, placed its lid, and then weighed it. After that, they heated the crucible again on the clay triangle for 8 minutes with its bottom 2.5-3 inches away from the flame. They heated it for another 10 minutes, that time adding a little bit of distance between the flame and crucible bottom.

They allowed the crucible to cool for about 10 minutes. Then they reweighed the sample for 6 more minutes, cooled it, and then weighed it again. In the second part of the experiment, they took 3 test tubes, one containing a small amount of potassium chloride, one with a like amount of potassium chlorate, and one that contained a solution obtained from adding distilled water to the crucible, that was used in the first part of the experiment and heated it for about a minute, and then they added 10 ml of distilled water to each and stirred.

In each of the tubes, they added 5 drops of dilute (6 M) nitric acid and 5 drops of 0.1 M silver nitrate solution, then stirred each test tube and observed carefully.

Results and Discussion

In the first part of the experiment, the researchers started off with the crucible with the sample that weighed 37.184 g. , after the first heating, the mass decreased and became 37.093 g. , after the second heating, the mass decreased again and became 36.787 g. , the difference between the two wasn't less than 0.05 g. , so they had to reheat.

After the third heating, the weight became 36. 779 g. , their difference was within 0. 05 g. so no more heating is required. After calculating, the researchers found out that the theoretical percentage of oxygen in KClO_3 is 39. 17% and that the experimental percentage of oxygen they got in KClO_3 was 33. 86%. On the other hand, they also found out that the theoretical percentage of KCl in KClO_3 is 60. 83% and that their experimental percentage of KCl in KClO_3 was 66. 14%. and that the experimental attempt to get the percentage of oxygen in KClO_3 had an error of 8. 3%. On the second part of the experiment when 5 drops of dilute (6 M) nitric acid and 5 drops of (0. 1 M) silver nitrate solution were added to the solution of the residue and distilled water, potassium chloride solution, and potassium chlorate solution, all of them turned cloudy with white precipitate in them which indicated that chloride ions were present which lead to the deduction that the residue was actually KCl.

1. Mass of crucible + cover	35. 988 g.
2. Mass of crucible + cover + sample before heating	37. 84 g.
3. Mass of	37.

crucible + cover + residue after 1st heating	093 g.
4. Mass of crucible + cover + residue after 2nd heating	36. 787 g.
5. Mass of crucible + cover + residue after 3rd heating	36. 779 g.
6. Mass of original sample = 184 - 35. 988 =	1. 196 g. 1. 196

7. Total mass lost during heating = 37.184 - 36.779 = 0.405 g.	0.405
8. Final mass of residue = 1.196 - 0.405 = 0.791 g.	0.791
9. Experimental percent oxygen in $KClO_3 = \frac{0.405}{1.196} \times 100 = 33.86\%$	33.86%
10.	66.14%

<p>Experimenta l percent KCl in KClO₃ = 0. 791/1. 196 * 100 = 0. 6614 * 100 = 66. 14%</p>	<p>14%</p>
<p>11. Theoretical percent oxygen in KClO₃ = 3(16. 00)/39. 10+35. 45+3(16. 00) * 100 = 48/122. 55 * 100 = 0. 3917 * 100 = 39. 17%</p>	<p>39. 17%</p>
<p>12.</p>	<p>60.</p>

<p>Theoretical percent KCl in $\text{KClO}_3 = \frac{39.10 + 35.45}{39.10 + 35.45 + 3(16.00)} \times 100 = \frac{74.55}{122.55} \times 100 = 60.83\%$</p>	83%
<p>13. Percent error in experimental % oxygen determination = $\frac{60.83 - 66.14}{60.83} \times 100 = -8.73\%$</p>	8.73%

73%	
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Conclusion and Recommendation

As seen above, the experimental percent gotten by the researchers wasn't that far off from the theoretical value, and they ended up with a percent error of 8.73%. That's not a high percent error, but in chemistry, where accuracy is very vital, that amount is already considered high. One of the factors that led them to a high percentage error was that they used a different balance for the weighing of #4 and #5 in the table. For further experimentation, the researchers suggest that only one balance would be used throughout the experiment.

It is also important to keep the crucible steady so that spattering won't happen during heating. Because when spattering does happen, the mass loss would no longer be accurate.

References:

1. Book: Hein, MORRIS, et al. , FOUNDATIONS OF CHEMISTRY IN THE LABORATORY FOR SCIENCES (CUSTOM EDITION), 12th ed. , Singapore129809, 2009

Appendix

1. Mass of original sample = (mass of the crucible + cover + sample before heating) -

(mass of crucible
+ cover)

2. Total mass lost
during heating=
(mass of the
crucible + cover
+ sample before
heating) - (mass
of the crucible +
cover + after 3rd
heating)

3. Final mass of
residue= mass of
the original
sample - total
mass lost during
heating

4. Experimental
percent oxygen in
 KClO_3 = total
mass lost during
heating/mass of
original sample *

100
5. Experimental percent KCl in KClO ₃ = final mass of residue/mass of original sample * 100
6. Theoretical percent oxygen in KClO ₃ = molar mass of O ₂ / molar mass of KClO ₃ * 100
7. Theoretical percent KCl in KClO ₃ = molar mass of KCl/molar mass of KClO ₃ * 100
8. Percent error in experimental %

oxygen

determination=(t

heoretical value-

experimental

value)/theoretical

value * 100