Lab: Magnesium Oxide — Percentage Composition

Purpose: **To prepare a sample of magnesium oxide and calculate its percentage composition**.

Hypothesis:
State the Law of Constant Composition. According to this law, what should be true about the percent composition of magnesium oxide?

Materials:
Magnesium ribbon

Apparatus:
crucible and lid**,** crucible tongs, balance, clay triangle, retort stand, ring clamp, Bunsen burner, sandpaper

Procedure:

a) Obtain a piece of magnesium ribbon. If the ribbon is not shiny, use a piece of sandpaper or emery cloth to shine the surface.*(Why*)

b) Obtain a clean, dry crucible and lid. Find the mass of the crucible and lid and record it in a table.

c) Roll the magnesium into a coil, (*Why*), and place it in the crucible. Find the mass of the crucible, lid, and piece of magnesium and record it in your table.

d) Set up the retort stand with ring clamp and clay triangle as shown at the front of the class.

e) Place the crucible and contents on the triangle *with the lid completely on*. Begin heating the crucible slowly by moving the burner around underneath the crucible. Stop heating temporarily if a large amount of smoke comes out of the crucible.

f) After a few minutes (four or five) of direct heating with no smoke, remove the lid slightly with the tongs. If smoke comes out, cover the crucible and heat another two minutes and try again to remove the lid slightly. Heat the crucible to redness for four or five minutes. Finally, remove the lid completely and heat strongly for another four minutes. *(Why)*

g) Remove the heat and place the lid back on the crucible. Allow the crucible to cool to the point that you can touch it (*test this carefully!*). Add ten drops of water. (*Why)* Smell cautiously, and note any odour.(*Check the discussion for possible answer, you may recognise the smell from home !!!*). Put the crucible back on the ring stand and heat again for two minutes with the lid on completely and two minutes with the lid slightly ajar, (*Why?*). Allow to cool with the lid on.

h) Find the mass of the crucible, lid, and contents after they have cooled to room temperature.

i) Wash out the crucible, and return all equipment.

k) Repeat the experiment to consistent results. *Why?*

Data Collection:

1. In a table of quantitative observations, show the mass measurements that were made for this lab.
2. In a table of qualitative observations indicate any qualitative observations that you made in the course of the lab, such as: initial appearance of magnesium, observations during the course of the procedure (example: a change in appearance of the magnesium, any odour, any smoke) and appearance of the final product in the crucible.

Data Processing and Presentation:

1. Calculate the mass of magnesium, the mass of magnesium oxide, and then calculate the percentage composition, by mass, of magnesium in magnesium oxide:

% Mg in MgO % O in MgO

2. Calculate the theoretical percent composition of magnesium oxide.

3. Calculate your percent error.

$$\%\text{Error} = \frac{\text{expt.value} - \text{theo.value}}{\text{theo.value}} \text{ x}100\%$$

Conclusion and Evaluation:

1. Discuss the reason for certain steps in the procedure, where it is not obvious.

2. State your results for the percentage composition of magnesium oxide.

3. Discuss significant sources of error. For each source of error, if possible indicate whether the error would lead to a final result (%Mg) that would be too high, or too low, compared to the true value.

4. Evaluate the procedure and your results, identify the weaknesses and the limitations, and state realistic suggestions to improve the investigation.

5. Compare your result to other classmates. According to the Law of Constant Composition, what should be true about the class results? Was that the case? Why or why not?

6. Give a final summary statement. (It may be useful to summarize all your results in a Table!)

The following chemical equations may be of use in discussing the reasons for certain steps in the procedure:

When magnesium is heated in air (approximately 20 % oxygen, 80 % nitrogen) most of the magnesium reacts according to the following equation:

$$2\ Mg_{(s)} + O_{2(g)} \longrightarrow 2\ MgO_{(s)}$$

However some of the magnesium reacts with the nitrogen in the air, rather than with oxygen. The equation for this reaction is:

$$3\ Mg_{(s)} + N_{2\ (g)} \longrightarrow Mg_3N_{2\ (s)}$$

Magnesium nitride reacts with water according to the following equation:

$$Mg_3N_{2\ (s)} + 6\ H_2O_{(l)} \longrightarrow 2\ NH_{3\ (g)} + 3\ Mg(OH)_{2\ (s)}$$

When magnesium hydroxide is heated, the reaction is:

$$Mg(OH)_{2\ (s)} + \text{heat} \longrightarrow MgO_{(s)} + H_2O_{(g)}$$