Determining the Percentage of Water in a Hydrate

Objective: To use two different methods to determine the percentage of water in the hydrate.

Equipment:
Bunsen burner, striker or matches, test tube, ring stand, test tube clamp, 50 mL beaker, spatula, evaporating dish, tongs

Procedure:
Part 1:

1. Record the mass of an empty evaporating dish.
2. Add two heaping spatulas of the hydrate to the dish and record the mass.
3. Attach a ring clamp to the ring stand. If necessary, place a wire gauze on top of the clamp. Otherwise, the dish may rest in the clamp on its own.
4. Make sure the Bunsen burner is positioned so that the hydrate receives plenty of heat.
5. Light the Bunsen burner and heat the dish in the flame. You may hold the burner by the base so that you can move the flame around the dish.
6. What do you notice happening? Record your observations in the table.
7. Use the spatula to carefully inspect the hydrate as it is heated. Make sure it does not burn (brown) but it is thoroughly heated. When you are sure of these things, turn off the gas to the Bunsen burner.
8. Use tongs to remove the dish from its position on the clamp. Near the open window in the room, allow the dish to cool.
9. After a few minutes, the dish will be cool, and it can be placed on the balance.
10 Observe what happened to the hydrate. Note any changes in the observation table.
11. Empty the solid hydrate into the trash. Clean the dish with soap and water.

Part 2:

1. Attach a test tube to a clamp and mass on a balance. Make sure no edges of the clamp are touching anything outside the balance.
2. Remove the test tube from the clamp and add two heaping spatulas of the hydrate.
3. Empty the hydrate into the test tube. Reattach to the clamp and record the mass of these two items in the data table.
4. Reattach the test tube on the clamp, making sure it is on an angle, but not one which allows the hydrate to fall out.
5. Place the beaker on the table underneath the mouth of the test tube.
6. In a hot flame, heat the hydrate with the Bunsen burner.
7. What do you notice happening? Record your observations in the table.
8. In a cold flame, warm the rest of the test tube. Are you able to collect any water in the beaker? Record your observations in the appropriate space.
9. After you have collected the water in the beaker, turn off the gas to the Bunsen burner.
10. Remove the clamp from the ring stand. Near the open window in the room, allow the test tube to cool from the draft inside.

11. After a few minutes, the test tube will be cool, and it can be placed on the balance.
12. Observe what happened to the hydrate. Note any changes in the observation table.
13. Empty the hydrate from the test tube into the evaporating dish. Add a few drops of water. What happened? Note this in the observation table.
14. Empty the solid hydrate into the trash. Clean the test tube with the test tube brush, soap, and water.
15. Reattach the test tube to the clamp and attach the clamp to the ring stand.

Data:

Part 1:	Mass (g)
1. mass of empty evaporating dish	25.36
2. mass of evaporating dish + hydrate (before heating)	31.25
3. mass of evaporating dish + salt (after heating)	28.79
4. appearance of hydrate before heating	light green/dull
5. appearance of hydrate after heating	white/lightbrown
6. appearance of hydrate after sprinkling with water	light green

Part 2:	Mass (g)
1. mass of empty test tube + clamp	87.58
2. mass of empty test tube + clamp + hydrate (before heating)	96.70
3. mass of empty test tube + clamp + salt (after heating)	93.02

Calculations:
The following should be determined for both parts:
1. Calculate the mass of water in the hydrate.
2. Calculate the percentage of water in the hydrate.

Conclusion:
1. What do you think would happen if water was sprinkled on the hydrate after it was heated?
2. Based on the information above, do you think the hydrate is: magnesium sulfate heptahydrate, cobalt(II) chloride hexahydrate, aluminum sulfate octadecahydrate, iron(II) sulfate heptahydrate, manganese(II) sulfate monohydrate, or copper(II) sulfate pentahydrate? Support your answer with calculations and data given in the lab.
3. Calculate percent error for trials one and 2 based on your answer to number two.