Experimental Determination of the Formula of a Hydrate

Hydrates are commonly found crystalline substances which contain water molecules in the molecular structure. Often, the water may be removed by heating the substance, leaving the anhydrous salt. The number of water molecules attached to a particle of anhydrous salt is a constant for most substances. In this experiment, you will be able to determine the formula for a hydrate.

Some anhydrous compounds absorb water vapor from the air and become hydrates. These are used as moisture reducing agents. You might find them in bottles with pills that could decompose if moisture was present. These compounds are called hygroscopic.

Procedure:

1. Take a clean dry evaporating dish and place it on an iron ring (attached to a ring stand). Heat with a nonluminous (blue) flame for 2-3 minutes. Remove the evaporating dish from the ring stand, set on black portion of the counter to cool. Remember, the evaporating dish is hot. Handle with tongs at all times
2. Allow the evaporating dish to cool.
3. When the evaporating dish is cool, find the mass and record.
4. Fill the evaporating dish with approximately 3.0 grams of hydrate. Record the mass of the hydrate and evaporating dish. Also record your observations in the data section.
5. Place the evaporating dish and contents on the ring stand. Heat gently for the first minute and then heat with a blue flame for 8-10 minutes. When you have completed the heating and the blue color is gone, turn off the gas and let the dish cool.
6. As soon as the dish is cool enough to touch, determine the mass of the evaporating dish and contents. Record. Also record your observations of the appearance of the solid.
7. Add 4 drops of water to the solid in the evaporating dish and record your results.
8. When completed, place the waste in the garbage or the glass dish on your table.

Data:

1. Mass of evaporating dish (after first heating) __________ g
2. Mass of evaporating dish and hydrate (before heating) __________ g
   Observations of solid hydrate substance (before heating):
3. Mass of evaporating dish and solid after heating __________ g
   Observations of solid after heating:
4. Observations of the solid after adding 4 drops of water:
Questions and Calculations:

1. What is the formula and name of the anhydrous salt you used? (The teacher will tell you.)

2. Calculate the formula mass of the anhydrous salt.

3. What is the mass of the anhydrous salt remaining in the crucible after heating? (#3 - #1 from data)

4. Calculate the number of moles of anhydrous salt used in the experiment? (#3 above / #2 above)

5. What is the mass of the water released during the heating? (#2 - #3 from data)

6. Calculate the number of moles of water released during heating?

7. What is the mole ratio of water to anhydrous salt? (#6 / #4 from above)

8. Predict the formula of your hydrate?

9. What is the molar mass of your hydrate?

10. Why was it necessary to heat the empty crucible prior to finding its mass?

11. Why do you weight the crucible when it is just cool enough to touch, but before it is completely cooled?

12. What is a possible source of error in this experiment? Would this increase or decrease the ratio of water to anhydrous salt?