Composition of Hydrates — Lab 11

PRE-LAB DISCUSSION

Hydrates are ionic compounds that have a definite amount of water as part of their structure. The water is chemically combined with the salt in a definite ratio. Ratios vary in different hydrates but are specific for any given hydrate.

The formula of a hydrate is represented in a special manner. The hydrate of copper sulfate in this experiment has the formula $CuSO_4 \cdot X\ H_2O$. The unit formula of the salt appears first, and the water formula is last. The raised dot means that the water is loosely bonded to the salt. The coefficient x stands for the number of molecules of water bonded to one unit of salt.

When hydrates are heated, the water is released as vapor. The general reaction for heating a hydrate is:

$$\text{hydrate} \xrightarrow{\Delta} \text{anhydrous salt} + \text{water}$$

In this experiment, as was mentioned, a hydrate of copper sulfate will be studied. The change from hydrate to anhydrous salt is accompanied by a change in color:

$$\underset{\text{blue}}{CuSO_4 \cdot X\ H_2O} \xrightarrow{\Delta} \underset{\text{white}}{CuSO_4} + X\ H_2O$$

PURPOSE

Determine the percentage of water; find the number of molecules of water in a hydrate.

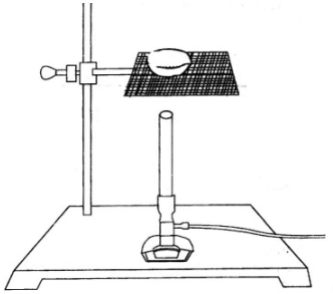
EQUIPMENT

evaporating dish
crucible tongs
laboratory balance
iron ring
lab burner
porcelain
micro spatula
ring stand
wire gauze

MATERIALS

copper sulfate hydrate, $CuSO_4$ *X* H_2O

PROCEDURE



(figure 1)

1. Prepare the setup shown aside: (figure 1)
2. Heat the dish with the hottest part of the flame for 3 minutes. (figure 1)
3. Using crucible tongs, remove the evaporating dish from the apparatus, allow it to cool for a few minutes.
4. Measure and record the mass of the evaporating dish.
5. With the evaporating dish on the balance, measure into it exactly 2,00 gr of copper sulfate hydrate. Record the data below.
6. Place the evaporating dish + hydrate on the wire gauze. Gently heat the dish by moving the burner back and forth around the base. Increase the heat gradually. Avoid any popping and spattering.
7. Heat strongly for 5 minutes or until the blue color disappears.
8. Allow the evaporating dish to cool for about a minute. Immediately find the mass of the dish + anhydrous salt, and record the data below.

OBSERVATIONS AND DATA

1. Mass of evaporating dish ..... g.
2. Mass of (evaporating dish + hydrate)..... g.
3. Mass of (evaporating dish + anhydrous salt)..... g.

CALCULATIONS:

1. Find the mass of hydrate used (2-1)
2. Find the mass of water lost (2-3)
3. Find the percentage of water in hydrate.

$$\text{percent } H_2O = \frac{\text{mass water}}{\text{mass hydrate}} \times 100$$

4. Find the unknown number *X*.

CONCLUSION AND QUESTIONS

1. Calculate your experimental error after learning the real values from your teacher. Explain your percentage error.
2. Why must you allow the evaporating dish to cool before measuring its mass?
3. Why must you measure the mass of the anhydrous salt immediately upon cooling?
4. If the mass percentage of water in $FeSO_4$ *X* H_2O is 45,3 %, find the number X?
5. How can $CuSO_4$ be used to detect presence of water in a medium?