CHEMISTRY LAB: HYDRATED CRYSTALS

WHAT TO TURN IN:	Hypothesis, Data Table, Calculations (5), Error Analysis, Conclusion, Questions (4)

OBJECTIVES

- To review and observe the characteristics of a hydrate
- To find the experimental and theoretical moles of water in the hydrate
- To calculate the formula for the hydrated compound

BACKGROUND INFORMATION

Many compounds are formed in reactions that take place in water (aqueous) solutions. The water is then evaporated to obtain the crystalline compound. In some cases, water molecules are weakly attracted to the ions or molecules that make up the compound and are retained within the crystal structure. Crystalline compounds that retain water during evaporation are referred to as being *hydrated* or are said to contain *water of hydration*. The ratio of moles of water to moles of compound is a small whole number.

Example: $BaCl_2 \cdot 2H_2O$ Mole ratio: 1:2 Name: barium chloride dihydrate

THIS LAB: $CuSO_4 \cdot$ _?_H_2O Mole ratio: 1: _?_ Name: copper(II) sulfate _?_hydrate

The ratio of compound-to-water can be determined experimentally in most cases by heating to remove the water. The compound with the water removed is *anhydrous*. In this experiment, you will determine the formula for a hydrate of copper(II) sulfate. The formula is determined by comparing the mass of the hydrated and anhydrous forms of the compound.

MATERIALS

Setup #1:
safety glasses
hot plate
evaporating dish
forceps/crucible tongs
balance
watch glass
stirring rod
ceramic tile
copper(II) sulfate (hydrated form)

Alternate Setup #2:
safety glasses
burner with tubing
ring stand
ring clamp
clay triangle
crucible and cover, crucible tongs
stirring rod
ceramic tile

PROCEDURE

1) Turn the hotplate on high and allow it to warm up.
2) Wipe out an evaporating dish; make sure it is clean and dry.
3) Measure the mass of the evaporating dish to as many decimal places as the balance reads. Record in data table.
4) Add about 3.00 g (2.50 – 3.50 g is acceptable) of hydrate crystals to the dish and mass it again. Record in data table.
5) Place the evaporating dish on the hot plate. Cover with a watch glass, concave side facing up, like a U. Observe the inside of the cover for a few minutes.
6) Carefully remove the cover and continue heating for 10-15 minutes.
7) Remove the dish and set it in a designated spot. *Let the evaporating dish cool completely.*
8) Measure the mass. Record in data table.
9) When finished, dispose of the waste in the container provided by the teacher.

DATA TABLE

MASSES before heating (g)

1) evaporating dish _____

2) evaporating dish and hydrated compound _____

3) hydrated compound _____

MASSES after heating and cooling (g)

4) evaporating dish and anhydrous compound _____

5) anhydrous compound _____

6) mass of water (in the hydrate, that was driven away) _____

MOLES

7) moles of anhydrous compound _____

8) moles of water _____

9) mole ratio of $CuSO_4$:H_2O (LAB DATA) _____ : _____

10) mole ratio of $CuSO_4$:H_2O (WHOLE NUMBERS) _____ : _____

11) NAME of hydrate: _____

12) CHEMICAL FORMULA of hydrate: _____

CALCULATIONS – Show all units.

1) Mass of hydrated compound
2) Mass of anhydrous compound
3) Moles of anhydrous compound
4) Moles of water
5) Mole ratio of lab data

QUESTIONS

1) Are hydrates true crystalline solids or amorphous solids? Explain.
2) Hydrates contain water, but they are not wet to the touch. Why not?
3) How are moles related to this lab?
4) List the ten prefixes used to specify the number of water molecules per unit of hydrate.