Composition of a Hydrate Lab

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1 Purpose

Determine the percentage of water in a hydrate

2 Hypothesis

There will be 34 percent of water in the copper (II) sulfate.

3 Materials

- Beaker

- Mortar and Pestles

- Scale

- Spatula

- Hot Plate

- Copper Sulfate (2 grams)

4 Procedure

1. Measure about 3 grams of Copper (II) Sulfate (CuSO4).

2. Crush and grind it with mortar and pestles.

3. Weigh the crushed CuSO4 on the scale.

4. Heat up the copper (II) sulfate powder.

5. Weigh the crystals after it has been decrepitation.

6. Calculate the amount of water that escaped.

5 Data

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3) Calculate error percentage

$\frac{-1}{36} \times 100$
↓
.0277 · 100 = [-2.8 % off!]

$CuSO_4 \cdot XH_2O$
① convert to moles (using molar mass):-

$\frac{(2.515g\ CuSO_4 \cdot 5H_2O)}{249.69\ g/mol}$ = 0.0101 mols of $CuSO_4 \cdot 5H_2O$

② convert H_2O to moles:- $\frac{.891\ g}{18.01\ g/mol}$ = 0.0494 mols of H_2O

4.) How many H_2O molecules are attached to $CuSO_4$? (to each compound)

$CuSO_4$ (molar mass) → 160g

H_2O (molar mass) → 18g

Find x (equation): $CuSO_4 \cdot XH_2O$

molar mass of $CuSO_4 \cdot 5H_2O$ = 249.69 g/mol

③ Ratio ⟶ .1 to 4.9

0.0101 : 0.494
$[\frac{.1\ mol}{of\ CuSO_4}]$ $\frac{.101}{.101}$ = $\frac{4.9}{mol\ of\ H_2O}$
$[\frac{.101}{5H_2O}]$

6   Discussion

Terms

1. **Deliquescent:** The process by which a substance absorbs moisture from the atmosphere until it dissolves in the absorbed water and forms a solution.

2. **Efflorescence:** Spontaneous loss of water by a hydrated salt, which occurs when the aqueous vapor pressure of the hydrate is greater than the partial pressure of the water vapor in the air.

3. **Decrepitation:** To heat a substance (salt) until it emits a crackling sound or until this sound stops.

4. **Hygroscopic:** A substance with the property of being able to absorb/absorb water from its surroundings.

5. **Hydrate:** A solid compound that contains a definite percentage of bound water.

6. **Hydration:** Reaction of a substance with water.

7. **Anhydrous:** A substance without water.

B) Results

After calculating the percentage of H2O in roughly 3g of CuSO4, I concluded that the crystal had 35 percent of H2O within it. When I compared my data with a more accurate

set of data, I calculated that I was off by 2.8 percent.

C) Questions

When crystals containing water are heated, tiny explosions occur and the mechanically enclosed water changes to steam and blows the crystals apart. This action is called **decrepitation**.

Sometimes the water of hydration is held loosely that the crystals do not have to be heated for the water to be released. This spontaneous loss of water at room temperature is called **efflorescence**.

Washing soda, sodium carbonate decahydrate ($NaCO_3$ x $10H_2O$) is an **efflorescent salt**. As water is lost, the crystals become anhydrous sodium carbonate.

Substances that absorb water from the atmosphere are **hygroscopic**.

When you round the molar amount of water in your crystals to the nearest whole number, do you have a pentahydrate? **4.9 rounds to 5. I have a pentahydrate.**

Anhydrous means **a substance without water.**

What happens when you add water to the anhydrous cupric sulfate? This process is called hydration. **The anhydrous cupric sulfate instantly dissolves into a liquid and regains its darker color scheme.**

D) Critique

When transitioning anhydrous crystals, the crystal is likely to have instantly absorbed water from its surroundings (from the air). This can possibly alter the weight of the $CuSO_4$ (after being heated).

7   Conclusion

A) The amount of H_2O in the $CuSO_4$ I worked with was 35 percent. My error percentage was 2.8 percent. I conclude I have a pentahydrate. In my hypothesis, I assumed

B) What I learned:

1. New Vocabulary

2. $CuSO_4$ is a hygroscopic

3. How to work with this new online software