Planning Lab: Formula of a Hydrate

Prelab Discussion

The strong dipole of water, which causes it to be an excellent solvent for ionic substances, also causes water molecules to attach themselves to ions. Such ions are ***hydrated ions***. When some solutions of hydrated ions are evaporated, the water molecules are so strongly attracted to the ions in solution that they remain attached as crystallization occurs. Water molecules are incorporated into the crystal structure. This water is called ***water of hydration***.

Crystals that have formed in this way appear to be perfectly dry, yet when heated yield large quantities of water. The crystals change form, sometimes, even color, as the water is driven off. This indicates that the water was present as an integral part of the crystal structure, Such compounds are called ***hydrates***. The number of water molecules present per molecule of anhydrous salt is usually some simple number.

$$\mathbf{MgSO_4 . xH_2O_{(s)} \quad ---> \quad MgSO_{4\,(s)} \quad + \quad xH_2O}$$

Prelab Assignment

1. From the Prelab discussion, formulate a problem statement to determine the formula of Epsom salt, a hydrate of magnesium sulphate.
2. List the equipment and materials necessary.
3. State the hypothesis of your experiment.

Procedure

You will be given Epsom salt, a hydrate of magnesium .

Design an experiment to determine the formula of a hydrate given by your teacher.

Data Collection

Prepare an appropriate data table to record all the experimental results as soon as you obtain them whilst performing the experiment (raw data table), both qualitative and quantitative, including units and uncertainties.

Data Processing and Presentation

1. Use your data to calculate the formula of a hydrate.
2. Write a chemical formula for the hydrate.
3. How many molecules of water are associated with one molecule of the anhydrous salt?
4. Summarize your data processing in a suitable summary table.

Conclusion and Evaluation

1. Respond to the problem you proposed in the Prelab Assignment.
2. Do your results agree exactly with those for a definite hydrate? If not, what are some plausible explanations for the deviation?
3. Suggest reasons why the above method might not be suitable for all hydrates.
4. Suggest any errors that may have been incurred in this experiment, *show how each error may have affected your results*. Suggest methods of improving your procedure to reduce these errors.
5. Other than water loss from the crystals, what else might be causing the change in mass on heating?
6. Copper (II) sulphate pentahydrate, $CuSO_4 \cdot 5H_2O$, is blue, on heating it becomes a white powder. Explain how copper (II) sulphate pentahydrate can be used to test for water.