Laboratory

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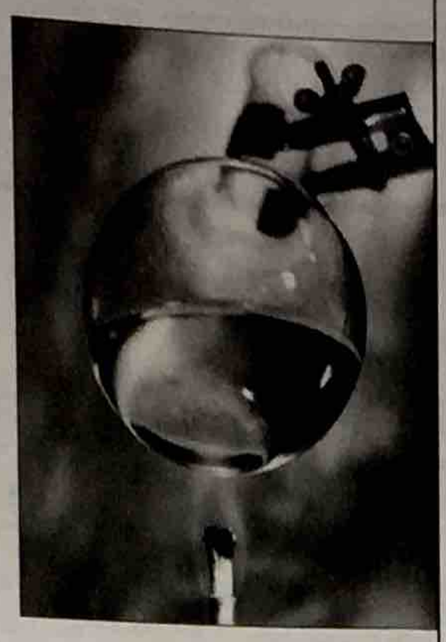

Properties of Hydrates

Objectives

- Explore the characteristics of hydrates
- Find the percentage of water contained in various hydrates
- Determine if dehydration is a reversible or irreversible change
- Determine the mathematical relationship between starting mass and mass lost

Equipment and Materials

- Hydrated copper sulfate
- Hydrated ferrous sulfate
- Hydrated cobalt sulfate
- Epsom salt
- Sugar
- 4 test tubes
- Test tube holder
- Test tube rack
- Ring stand
- Crucible and lid
- Iron ring
- Porcelain triangle
- Bunsen burner and striker
- Water bottle
- Magnifying glass
- Eye dropper

Introduction

Hydrates are chemicals that contain water molecules as part of their crystalline structure. The water molecules in a hydrate crystal can be removed by heating. Some compounds evolve water when heated, but do so due to decomposition.

Anywhere you see a numbered step in *italics* you should be recording information in your lab notebook.

PART I

Data Collection

Place a small amount (pea-sized) of the three hydrated salts and the sugar into separate test tubes. Set up a neatly organized table in your lab notebook to record your observations.

1. *Describe the appearance of each of the substances.*

Heat each of the test tubes gently over a Bunsen burner for about 1 minute. Be sure to hold your tube at an angle and not pointed at another student. **Do not allow the tube to become red hot.**

2. *Record any notable observations while the substance is heating.*

3. *Describe the appearance of each substance after heating.*

Allow the test tubes to cool in a beaker for a few minutes after heating. Using your eye dropper, add 2–3 drops of water to each test tube and record your observations for each substance in your lab notebook.

4. *How does the color of each substance after the added water compare to the starting color?*

Data Analysis

5. *What conclusions you can draw from your data? (Which reactions were reversible or irreversible?) Explain how your observations and data support these conclusions.*

PART II

Data Collection

Set up a data table in your lab notebook for five samples similar to the following:

Before Heating

Mass of crucible and sample:

Mass of crucible:

Mass of sample:

After Heating

Mass of crucible and sample:

Mass of crucible (from above):

Mass of sample:

Mass of water lost by dehydration:

Find the mass of a clean, dry crucible and record in your data table. Add 1–3 grams of hydrated copper sulfate to your crucible. Weigh and record the total mass in your table. Attach an iron ring to a ring stand and place the wire triangle on the iron ring. Set your crucible in the triangle. Heat the bottom of the crucible gently with the Bunsen burner. Be careful not to apply so much heat that the bottom of the crucible becomes red hot—that may cause the salt to react with oxygen and ruin the experiment.

6. *Record your observations on the appearance of the salt at different times during the heating.*

Once it appears that the salt has stopped changing color, heat the salt for an additional 5 minutes. Allow the sample to cool and find the total mass of the salt and crucible and record in your table.

Repeat this process with two new samples of copper sulfate, using different masses. You also need to get one set of data each from two different groups.

Data Analysis

7. *What trends do you see in the data table? Try graphing two pieces of data against one another and establish an algebraic equation that relates the two quantities.*

8. *Using the data from* ***your*** *experiments, find the mass% of water in each sample of the original hydrate.*

9. *Find the mass% of water in each sample for your shared data.*

Interpretation

10. *Examine the results from your hydrate samples. Are the mass percentages from your samples consistent? Should they be? Are they similar to the samples from other groups' data? Explain your answers.*

11. *The actual formula for the hydrated copper sulfate is* $CuSO_4 \cdot 5H_2O$. *Calculate the mass percentage of water in copper sulfate. Are your values higher or lower? What could account for the error? What could you do differently in the experiment to get more accurate results?*

PART III

Data Collection

Place a pea-sized amount of Epsom salt in a test tube.

12. *Describe the appearance of the salt. What is the chemical formula of Epsom salt?*

As in Part I, heat your test tube gently over a Bunsen burner for about 1 minute. Be sure to hold your tube at an angle and not pointed at another student. **Do not allow the tube to become red hot.**

13. *Record any notable observations while the salt is heating.*

14. *Describe the appearance of the salt after heating. What differences do you notice between heating this salt and the original three salts?*

15. *In Part II you used a constant color of the salt to determine when the salt was finished losing water. Propose an experimental method you could use to determine when the Epsom salt is finished dehydrating.*

In the Conclusions section of your lab report, be sure to discuss how the concepts in this lab relate to the conservation of mass, potential sources of error, and how those errors would impact your results.

What was done? (Briefly explain the title)

Why was it done? (Purpose)

How was it done? (Name the technique(s)/ methods used)

Why should I care? (Practical applications)

Procedure and Observations (5 pts)

Length: 2-3 paragraphs of what was done and what was observed when you did it.

Sufficient details provided- experiment could be reproduced using write up.

Third person impersonal voice. Past tense!

This should be written in *your own words*! Do not plagiarize.

Data (3 pts)

The section should start with at least one sentence explaining what the data is/ where it came from. Data are *not interpreted in this section*! Data are *solely* shown and explained.

Tables of data / figures are clearly and correctly labeled **including units and a caption**.

Data should be reported with the correct sig figs.

Data Analysis and Calculations (6 pts)

Include any relevant chemical formulas and sample calculations:

Calculations should be written step by step. A unit analysis equation should be followed by a numerical equation. See example provided.

Appropriate units should be included.

If a theoretical value is provided (or if you can find a theoretical value online) you must calculate the percent error. Error *ANALYSIS* will be included in the conclusion.

A sample calculation is not needed when the weight of a substance is found (i.e. If you find the mass of a graduated cylinder, find the mass of the graduated cylinder with water, and subtract the values to determine the mass of the water.)

A *unique* equation number should be included. See the example provided.

Interpret your results for their meaning in the context of the experimental purpose

Outline the chemistry involved and tell me what you expected to see. Are the results what were expected?

Conclusion (4 pts)

Restate the purpose of the experiment

Lab Reports

- Due Monday September 10th (or 13th) *IN LAB*
- Size 12 font, Times New Roman, *double-spaced*
- Headers need to be **bold** and Capitalized
- Must be written in the third person, passive voice
  - No contractions and no I, we, he, she, they, ect…
  - Do not write in an instructive manner. No recepies
  - Example:
    - The reaction was treated with…
    - 5 grams of copper was added

Going Through the Rubric

- Introduction (2)- students include basic chemical principles applied in this experiment, explain the methods being used and cite real world examples.
- Procedure and Observations (5)- The procedure should outline what you did during lab. The observations should be present in the lab reports.
- Data (3)- Organization makes it easier on both you and me
- Data Analysis and Calculations (6)- Calculations need to be correct **WITH UNITS**. But calculations are not enough on their own, explain what the calculations and observations made mean!!!
- Conclusions (4)- restates the purpose of the lab and weather or not you succeeded. Must contain possible sources of error. **HUMAN ERROR IS NOT AN OK SOURCE OF ERROR**