Characterization and Analysis of Hydrated Salt

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1 Introduction

In this experiment, the hydrated salt synthesized in the first part of the lab will be characterized using qualitative and quantitative analysis. If you did not attend the first week or the synthesis failed, salt will be provided. Ensure you record the mass of your synthesized salt and aluminum, or use the provided sample data.

2 Qualitative Analysis

2.1 Procedure

Dissolve approximately 0.3 g of your hydrated salt in 5 mL of deionized water in a test tube. Agitate until fully dissolved.

1. **Flame Test:** Perform a flame test on the solution. If a colored flame is not visible, add up to 0.5 g more salt. Record observations.
   Discussion: What metal ion is confirmed by the flame color?

2. **Reaction with Barium Chloride:** Transfer 1 mL of the solution to a clean test tube. Add a few drops of 0.1 M $BaCl_2$. Record any visible reaction.
   Discussion: What ion is confirmed? Write the net ionic equation for the reaction if a precipitate forms.

3. **Reaction with Sodium Hydroxide:** Transfer 1 mL of the solution to another clean test tube. Add a few drops of 0.1 M NaOH, recording any appearance change. Add a few drops of 1 M NaOH, agitate, and repeat until appearance changes again. Record observations.
   Discussion: What ion is confirmed? How do the results differ with concentration? What is the net ionic equation?

4. Perform any other qualitative tests to confirm the ions present.

2.2 Flame Test Background

In a flame test, metal ions emit characteristic colors due to the excitation of electrons. These emissions help identify the metal ion in the salt.

3 Quantitative Analysis: Gravimetric Analysis

Before proceeding, ensure no organic solvents are nearby, and always handle open flames with care.

3.1 Procedure

1. **Crucible Preparation:** Clean a porcelain crucible using a few drops of 1 M NH_3 and a paper towel. Rinse with deionized water and dry thoroughly.

2. **Heating:** Heat the crucible in a clay triangle with a Bunsen burner until the base glows dull red (approx. 5 minutes). Allow to cool in the triangle before transferring to the benchtop. Record a warning in your notes: Hot crucibles look the same as cold ones.

3. **Weighing:** Measure the mass of the clean, empty crucible on an analytical balance, recording the value.

4. **Adding Salt:** Weigh approximately 1 g of the synthesized salt using weighing paper. Record the total mass of the crucible and salt.

5. **Heating Hydrated Salt:** Begin heating the salt in the crucible gently, increasing intensity after a few minutes. After 10 minutes of strong heating, record your observations. Continue heating in intervals until the mass stabilizes within 0.050 g of the previous measurement. Record the mass after each heating.

6. **Calculations:** Determine the mass of water lost and calculate the number of water molecules in the formula.

3.2 Discussion: Why an Analytical Balance?

The analytical balance provides higher precision than a top-loading balance, critical for detecting small mass changes, particularly when calculating water content.

4 Melting Point Determination

1. Pack a melting point tube with hydrated salt crystals.

2. Record two temperatures: (1) when melting begins and (2) when complete. If either value is missed, repeat the measurement.

3. Dispose of used tubes in the glass waste bin.

5 Safety

Wear gloves, goggles, and lab coats at all times. Handle the synthesis product with gloves. Dispose of waste in labeled containers. Do not pour chemicals down the sink. All reactions, especially involving heating, should be performed in the fume hood. Never leave a flame unattended. Dispose of broken glassware in the appropriate container.

6 Waste Disposal

Dispose of all aqueous solutions in the waste drum. Unused salt can be disposed of in a separate container. Clean and return all shared equipment.

7 Conclusion

This experiment involves both qualitative and quantitative techniques to confirm the identity of the synthesized hydrated salt. Through flame tests, reaction with reagents like $BaCl_2$ and NaOH, and gravimetric analysis, the ions and water of hydration can be identified and confirmed.