

Lab- Hydrate Ratio of Epsom Salt

Goggles must be worn!

Overview:

Epsom salt (aka magnesium sulfate) is a combination of MgSO_4 and H_2O . Many ionic compounds incorporate a fixed number of water molecules into their crystal structures. These are called **hydrates**. Heat can be used to **dehydrate** a hydrated salt causing the H_2O molecules to evaporate and produce an **anhydrous** salt which often will appear different than its hydrate.

When expressing the formula for a hydrate, it is necessary to notate the fixed number of H_2O molecules. A large dot is placed between the formula and the H_2O molecules following the formula for the ionic compound.

For example: $\text{CuSO}_4 \cdot 5 \text{H}_2\text{O}$ is the formula for copper sulfate. This formula indicates that for every 1 mole of CuSO_4 , 5 moles of H_2O are present.

Purpose: 1) Dehydrate Epsom salt using chemistry procedures and determine the amount of water it contains 2) Use your math skills to determine the mole ratio, or how many moles of H_2O there are compared to moles of MgSO_4 (Epsom salt) 3) Compare your lab determined mole ratio to the real mole ratio on the box of Epsom salt.

Materials:

- Bunsen burner
- Wire screen (or triangle)
- Scale
- Ring stand w/ ring
- Evaporating dish (or crucible)
- Tongs
- Epsom salt (MgSO_4)

Procedure:

1. Put on your goggles. Secure the iron ring on the ring stand a couple of inches above the height of the burner. Place the triangle/ screen on the ring.

2. Place clean crucible or evaporating dish on the set-up. Light the burner and heat for a couple of minutes to make certain container is thoroughly dry. Turn off burner and cool the container for several minutes until it is comfortable to touch. Record the mass of the dry container.

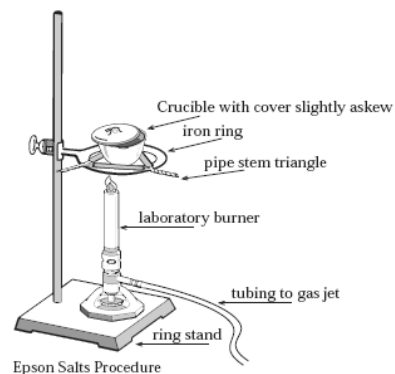
3. Add about 5 grams of Epsom salt to the container. Record the mass of the container and Epsom salt.

4. Place the container back on the set-up and heat gently with hot flame until the water has been released from the hydrate. This will require about 5 minutes. (see illustration)

5. When no more H_2O appears to be coming from the **hydrate**, turn off the burner and cool for several minutes until container is comfortable to the touch. Record the mass of the container and salt.

6. If time allows, reheat the container with **salt**, cool and find the mass again. If the two final masses agree, you can be confident that you have indeed released all of the H_2O . If not, continue the heating and cooling as directed in this lab to make sure all the water is released.

7. Put your excess Epsom salt into the trash can and carefully clean out your crucible. All other lab materials need to be ready for the next class.



Data / Observations:

Mass of Epsom Salt before and after heating	
1. Mass of a clean, dry, empty container	g
2. Mass of container & hydrated salt (before heating)	g
3a. Mass of container & anhydrous salt (after heating 1 st time)	g
3b. Mass of container & anhydrous salt (2 nd time) *repeat until no change in mass	g
3c. Mass of container & anhydrous salt (3 rd time) *repeat until no change in mass	g

Calculations/ Analysis (must show work):

- Determine mass (g) of H₂O lost from your salt (how much did you "cook out?"): Using your data table, determine the numbers to subtract in order to figure out mass (g) H₂O.
 - Determine mass (g) of the anhydrous MgSO₄ used in this lab (just the anhydrous salt- not the molar mass). Using your data table, calculate the mass of the anhydrous MgSO₄ used.
- Calculate how many moles of H₂O were dehydrated from your salt. Use dimensional analysis to convert your grams of H₂O (found in 1a) to moles of H₂O.
 - Calculate how many moles of MgSO₄ salt. Use dimensional analysis to convert your grams of MgSO₄ (found in 1b) to moles of MgSO₄.
- Determine the mole ratio of H₂O molecules to MgSO₄ particles. Divide the moles of H₂O (calculated in 2a) by the moles of MgSO₄ (calculated in 2b) to determine the ratio of moles of H₂O to moles of salt (moles H₂O / moles MgSO₄). Round your answer to the nearest small whole number.
 - Write the correct formula for your hydrate using the ratios $1\text{MgSO}_4 \cdot \underline{\hspace{1cm}}\text{H}_2\text{O}$ (use your answer from #3 to fill in the blank).

Questions for Discussion:

- Copper Nitrate is a hydrate with the following formula: Cu(NO₃)₂ · 3 H₂O. What is the ratio between moles of copper nitrate and moles of water in this hydrate?
- Why might you need to reheat the salt several times before getting the final mass of the salt?
- Assume your salt sample released 4.5 grams of water. How many moles of water were in your sample? (Yes, you must use your calculator and dimensional analysis!)

Conclusion: Write a 3-4 sentence paragraph describing the purpose of this lab and your results.