**Background**: Hydrates are ionic compounds (salts) that take up specific amounts of water molecules as part of their crystal structure. This water can be driven off by the application of heat (vaporized).

Table salt usually contains a small amount of hydrated calcium chloride, CaCl2 • H2O, and a hydrated magnesium chloride, MgCl2•6H2O. On humid or rainy days these two impurities absorb moisture and cause the table salt to clump together, making it hard to pour. To prevent this, Morton Salt added an anti-caking agent so “when it rains, it [still] pours”.

**Purpose**: In this lab you will calculate the percent composition of water in a hydrate and determine the empirical formula of the hydrate you are working with.

**Pre-Lab Questions (Answer in complete sentences in your lab notebook, in ink)**

1. What two things make up hydrates?
2. In order to determine the percent composition and the empirical formula of a hydrate, you must know how much water is in the hydrate. As you cannot measure the mass of the water as it gets added to the salt, how can you determine this?
3. What is the formula for copper(II) sulfate?
4. What is the molar mass for anhydrous (without water) copper(II) sulfate?

**Safety**: Use goggles and apron at all times. Wash your hands thoroughly after handling chemical supplies!

**Materials**: Bunsen burner, ring stand, iron ring, clay triangle, crucible, crucible tongs, Copper(II) Sulfate Hydrate, analytical balance, stirring rod.

**Crucible Preparation:** The final results of this lab are dependent on getting accurate masses of the hydrate before and after it is dehydrated. In an analytical investigation that involves crucibles, the crucibles must first be cleaned from impurities. Even oils from your fingers as you touch the crucible can cause inaccurate masses. The typical process to clean a crucible is to heat it to constant mass, during which the impurities are burned away.

1. Set up the ring stand with ring clamp, clay triangle, crucible, and burner.
2. Adjust the height of the ring so it will be only a few inches above the top of the burner. With the burner off to the side, light the burner and adjust it to a proper heating flame. (A yellow-orange flame will produce soot on the crucible and counter the process of burning away the impurities.)
3. Place the burner under the crucible, lining up the inner cone with the bottom of the crucible and heat it vigorously for 5 minutes.
4. Turn off the burner and allow the crucible to cool. Only use the crucible tongs to touch/move the crucible from this step forward.
5. Once the crucible has cooled enough that no heat is detected with the back of your hand, carefully carry it to the analytical balance and find the mass of the empty crucible.
6. It is desirable to repeat the heating and massing steps with the crucible until the masses of two successive heatings match. However, due to the lack of time only one heating has to suffice.

**Dehydrating Procedures:**

1. Measure approximately 1 g of Copper(II) Sulfate Hydrate into the crucible and record the exact mass of the prepared crucible and hydrate using the analytical balance.
2. Removing, but keeping it close, set up the crucible (now with hydrate) over a burner adjusted to a heating flame, but use a smaller flame so the hydrate is heated gently.
3. Stirring carefully on occasion, observe the color of the hydrate. When the hydrate changes to a consistent white color, then the Copper(II) Sulfate is dehydrated. If the Copper(II) Sulfate starts turning brown it is being overheated!
4. Turn off the burner, and wait for the crucible to cool until no heat is detected with the back of your hand.
5. Carefully determine the mass of the Copper(II) Sulfate, crucible.

**Clean-up and disposal**: Copper(II) Sulfate is soluble in water. Return all equipment as directed.

*Wash your hands!*

**Data and Calculations (Show in a neat, organized, well labeled table, and use ink)**:

* Mass of purified crucible
* Mass of crucible and hydrate
* Mass of hydrate alone
* Mass of crucible and dehydrate
* Mass of dehydrate alone
* Moles of dehydrate
* Mass of water lost
* Moles of water lost
* Experimental % by mass of water in hydrate
* % error for the lab assuming the actual % by mass to be 36.1%

*Be sure to show your work for every calculation (after the table), labeling it well!*

**Post Lab Questions (Answer in complete sentences, in ink if not typed)**:

1. Empirical formula of the hydrate = \_\_\_ CuSO4 • \_\_\_\_ H2O.
2. Explain why the dehydration is only a physical change even though the compound changed from blue to white.
3. Summarize the process of getting a crucible to “constant mass” to know it is free of impurities.
4. What would be the necessary process to determine if the hydrate was completely dehydrated if a salt was used that did not change color? (Consider what would be done to determine if the crucible was completely clean of impurities.)
5. What would have happened to your results if during the dehydration some of the copper(II) sulfate splattered out of the crucible – would your results show more, less, or the same amount of water in the hydrate? Explain.