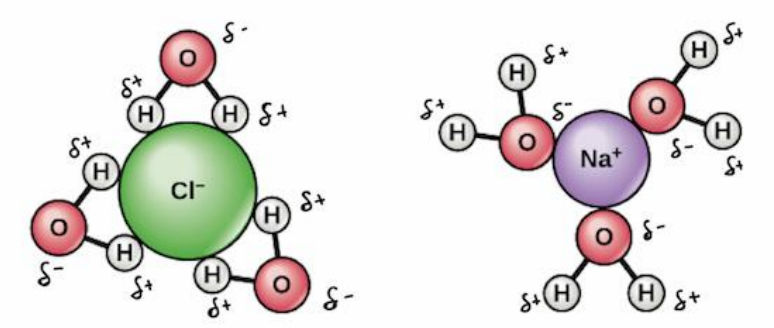
Waters of Hydration of a Ionic Compound



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Statement of Purpose

The **purpose** of this experiment is to determine the mass percent of water and number of water molecules in a hydrated ionic compound. During this experiment, two ionic compound substances are being heated and cooled down to room temperature to remove its waters of hydration and while manipulating the substances, the mass percentage and molecules of the water are being calculated. The **hypothesis t**o be addressed in this experiment is "can the number of water molecules be accurately determined in the unknown hydrated ionic compound used in this experiment"?

Background

Before proceeding, a little background information of this experiment is necessary to understand before continuing the experiment. Please note that it is necessary to take safety precautions when dealing with the crucibles because the crucibles can get very hot and burn your hands, which can cause a safety hazard. It is important to understand that ionic compounds unite chemically with polar molecules such as water. When this happens, the compounds become what is known as a hydrate and can essentially form a whole new substance (Admin., 2019). Now, when heat is being introduced into the experiment a hydrate may lose all its water of hydration. When that occurs, the compound will then revert to an anhydrous compound meaning that's the original compound without its waters of hydration.

Materials

The materials used in this experiment includes crucibles with covers, beakers, hot plate, triangle holder, a timer (to count the time), weight scale, graduated cylinders, and anhydrous compound-CuSO4.

Procedure

To begin, a porcelain crucible and cover was cleaned and dried by using water and a paper towel. The crucible and cover were put together and then placed on top of a triangle holder which was used to protect the crucible from touching the hot plate. The crucible was then sitting on the triangle holder, which was on the hot plate, waiting to turn into a cherry red-like color. Once that was completed, the crucible was taken off the hot plate and placed on the counter, waiting to cool to room temperature. After the crucible was cool at room temperature, it was weighed to the nearest 0.01 of a gram. After the previous operation, a second cleaned and dried crucible is being repeated with the same procedures as stated above. An unknown hydrate was then obtained, and about 1 to 1.5 grams of the hydrate was added to the crucible and the covered crucible was weighed with the sample. Once that was finished, the covered crucible was then placed with the sample on the triangle and it was gently heated for about 5 minutes so that there wouldn't be any loss of material from spattering. The heating was continued for 15 more minutes with the hottest part of the burner. The covered crucible was then able to cool until it reached room temperature and it was weighed along with the residue. The crucible was then reheated for 5 minutes, cooled, and then reweighed. The whole reheating, cooling, and reweighed process was repeated simultaneously until two consecutive weighing's were the same within 0.01 grams. While the first crucible was cooling, the entire process was then repeated with an unknown hydrate.

Data

The data shown in Table 1 below was collected from the Water of Hydration Experiment. In all cases, the measurements were repeated twice. Each sample value is the average of the two.

Table 1. Water of Hydration Experimental Data

Sample 1	Sample 2
49.18g	53.34g
50.21g	56.35g
1.03g	1.01g
50.09g	56.30g
0.91g	0.96g
0.12g	0.05g
11.65%	4.95%
2.16 mol	.9 mol
223.153 g/mol	223.153 g/mol
.004 mol	.004 mol
540	225

Results and Data Treatment

Table 1 is showing the calculations from the Waters of Hydration Lab. The data shows how much water was inside the substance, CuSO4. To reveal the detailed information of the chart above and to explain the calculations it is as follows: row 1 is the mass of the crucible and cover, row 2 is the mass of crucible, cover and sample, row 3 is the mass of the hydrated compound = 2-1, row 4 is the mass of the crucible, cover and sample after heating, row 5 is the mass of the anhydrous compound = 4 – 2, row 6 is the mass of water = 3-5, row 7 is the percentage of water = 6/3 x 100%, row 8 is the moles of water = number 6/18 g/mol, row 9 is the molar mass of anhydrous compound, row 10 is the moles of anhydrous compound = 5/9, row 11 is the waters of hydration (n) = 8/10.

Discussion and Conclusion

Overall discussing this experiment, this experiment was very interesting due to the fact of manipulating and measuring the substances above. The experiment has shown accurate data, but there are some variables that can go into play when validating the accuracy of the data. Some factors that may inhibit the accuracy of the data could be time. For example, when conducting the experiment there was an exact time to heat the crucible, but when cooling there wasn't. So, when deciding to heat and cool the crucibles with the covers, they were not exactly done with the same time, so that could have probably played a role to the validity of how accurate the data is. Every lab experiment and data are not going to be the same, which is understandable.

"Hydrates are crystal salts that contain water of hydration" (Helmenstein, 2018). From looking at the data and comparing both samples, a noticeable change in the water of hydration is observed. That means the experiment was a success because as stated above our hypothesis was

to allow the covered crucibles heat and cool, and when added with substances calculate the mass and from the data, we saw a change in the mass, therefore our hypothesis was proven correctly. “In these examples, the liquid water is not actually vanishing—it is evaporating into a gas, called water vapor” (National, 2019). This statement is accurately describing what evaporation is and how when the steam is blowing that is the water being evaporated into gas.

During the experiment, it can be agreed that evaporation played a role, when heating the covered crucible with the substance was on the hotplate. An error or limitation that can stated is also the temperature of the hot plate used. There wasn’t a specific temperature that it was always supposed to be. This limitation could also raise questions about the accuracy of the data. There is just some small multiple way the experiment overall could have been improved to prevent having not so much accurate data. While performing the experiment, evaporation was well observed.

“An anhydrous compound (an anhydrate) is a compound with no water in its structure” (Gillepsie, 2018). In the experiment, it was necessary for the heating portion because that allowed the hydrate to lose all its waters of hydration, which is what was intended. Gentle heating during the procedure was necessary so that one wouldn’t use too much heat and cause a loss of material from spattering. During the experiment there wasn’t a time on how long the evaporation should be occurring either, and even after the fact of allowing the crucible to cool down for about roughly 5 minutes until it got to room temperature, or just cool down who is to say that both crucibles had the same exact room temperature.

When calculating the molar masses, they could have been improved due to the environmental and temperature standards because according to an observation, “molar mass can change depending on the temperature by up to 50 percent (Admin, 2019). Also, it was observed that the weighing’s were different as well because one may have added 1 gram to the

covered crucible, while another one may have added 1.5 g or even in between those numbers. There wasn't an exact measurement between the two crucibles, because to begin with, both crucibles had different masses as seen in our data, so that may have caused an accuracy issue as well. "They may be made of clay, graphite, porcelain, or a relatively infusible metal" (Tikkanen, 2018). The author was discussing how crucibles can be made from a variety of things, so all crucibles aren't made with the same thing or with the same exact measurements, so that is another indicator as to why the two crucibles had different masses to begin with.

This is just the discussion part of the experiment, and how things could have gone along to help produce accurate information. Seeing these limitations such as time, measurements, and temperature these all can play a big role in how accurate the data really is. To conclude, the experiment was not a failed experiment, there is always ways to improve an experiment for the future and within the guidelines of the procedure, the data is not just all the way wrong, there were just some variables that could have been tweaked to perform a better experiment and hopefully collect more accurate data.

Works Cited Page

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