Chem 120 / Dr. Rusay

PERCENT WATER IN A HYDRATE: Nomenclature / Calculations / Molecular Formulae

A hydrate is a solid substance, which contains water bound within the crystal lattice of a salt. Water molecules are present in definite proportions in hydrates. Epsom salts, also known as the mineral *epsomite*, is pure magnesium sulfate heptahydrate, $MgSO_4 \cdot 7\ H_2O$. There are seven water molecules present for every one molecule of the salt. Magnesium sulfate heptahydrate can react to produce other hydrates with one, two, three and six molecules of water respectively for each magnesium sulfate. The common name, Epsom salts, comes from the name of a small town in England where in the early 1600s the town's well water was regarded as being curative. Today, it is still regarded as being able to treat splinters, scrapes, insect bites, minor sprains and bruises, to produce lush, healthy lawns, vibrant plants and vegetables as well as a smoother softer skin, and to provide relief from everyday stress. In Shakespeare's 17th century, no one understood the therapeutic mystery of the town's water, and it wasn't until many, many decades later that modern chemistry identified the active mineral component as this particular hydrate.

The water, which is present in a hydrate, can be removed chemically by heating. In this experiment, you will be provided with an unknown solid that is a mixture of sodium chloride and barium chloride dihydrate. On heating the mixture, barium chloride dihydrate looses water through bond breaking and evaporation of water, *i.e.*, it dehydrates, and the sodium chloride remains unchanged in the heating.

$$BaCl_2 \cdot 2\ H_2O_{(s)} \longrightarrow BaCl_{2\ (s)} + 2\ H_2O_{(g)}$$

The unknown sample in this experiment will therefore weigh somewhat less after heating depending on the mass of water that has been evaporated. By accurately determining the mass lost and the mass of the original sample, the percent water in the original sample can be calculated as well as the amount of sodium chloride present. Before beginning the procedure, prepare a pre-lab report in your notebook following the required format for Dr. R.'s signature. (Don't forget units and significant figures.) Refer to pp. 12-13 in the DVC Chemistry 120 Experiments Lab manual for the Procedure. Consider using the following Data Table instead of the Table on pg. 12.

Unknown sample number	
1) Mass, crucible + lid + unknown sample	
2) Mass, crucible + lid	
Mass, unknown sample	
Mass, crucible + lid + anhydrous products, after first heating	
Mass, crucible + lid + anhydrous products, after second heating	
Mass, crucible + lid + anhydrous products, after third heating (if necessary)	
3) Mass, crucible + lid + anhydrous products, Constant Mass (Average of acceptable weighings)	
Mass, water lost [1) – 3)]	
Percent Water in unknown sample (Calculation: Final Report)	
Percent Sodium Chloride in unknown sample (Calculation: Final Report)	

Pre-Lab Questions: (Include answers in Pre-Lab write up. Place in Lab Notebook after Data Table.)

1) Name the following hydrates:

$CoSO_4 \cdot 6\ H_2O$

$MgCl_2 \cdot 6\ H_2O$

$CuSO_4 \cdot 5\ H_2O$

2) Write formulas for the following hydrates:

Sodium dihydrogenphosphate nonahydrate

Potassium chromate tetrahydrate

Lead (II) acetate trihydrate

Post-Lab Question:

Spectroscopic satellite analysis of the composition of the moon was completed during the Clementine and subsequent NASA missions. The data indicates that water is present on the moon and there may be enough to allow human colonization. The water is tied up in rock (hydrates) and as ice. A notable hydrate for its high water content is Glauber's salt, sodium sulfate decahydrate. If a human were to require the equivalent of 2 liters of water per day, how many kilograms of Glauber's salt would need to be processed per month to meet one person's need. Assume a month is 30 days and that all of the water in the salt is recovered in the process.