

CHEM-1020
Basic Skills for Chemistry
Experiment No. 7
Percent Water In A Solid

INTRODUCTION

Most solid materials absorb water onto their surfaces when they are exposed to the atmosphere. Usually, the absorbed water is present in small amounts and can be removed by gentle heating. For that reason, many laboratory experiments that involve heating must begin by heating the vessels to drive off any moisture whose mass may affect the results.

On the other hand, certain chemicals such as ionic salts contain larger amounts of water bonded strongly and stoichiometrically to the compound. Usually, water molecules bond to cations in small whole number ratios such as 1:4 or 1:6. The per cent water by mass is a constant value for each particular compound. Examples of hydrated salts are copper (II) sulfate pentahydrate $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ and tin(II) chloride dihydrate $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$.

Water molecules incorporated in ionic salts can also be removed by heating, but high temperatures are usually required. This chemically bound water in ionic salts is given a special name, *water of hydration*. In this experiment, you will remove water of hydration from an ionic compound by strong heating. If you know the mass of the hydrated solid at the beginning of an experiment and the mass of dehydrated solid after heating, you can determine the percent of water in the solid.

Your instructor will demonstrate the safe use of the laboratory Bunsen burner and will show you how to set up a clay triangle and ring stand. Follow directions exactly to avoid burns or other mishaps.

PROCEDURE:

Obtain an unknown ionic solid and record its name and number. From this name, you are to write the formulas of the anhydrous salt and the hydrated salt.

Place a porcelain crucible and cover on a clay triangle supported by an iron ring and ring stand. Heat the crucible and cover with a Bunsen burner flame, to redness for five minutes to drive off absorbed moisture from the porcelain. Preheating will avoid errors due to the loss of absorbed water from the crucible. From this point, handle the crucible and cover only with clean tongs to avoid getting skin oil and moisture on them. Remove the crucible and cover from the clay triangle and let them cool to room temperature. Weigh the *cooled* crucible and cover on a hanging pan balance to 0.001 g. Add between 0.9 and 1.1 g of your hydrated solid to the crucible and weigh the crucible, cover and solid together. Calculate and record the mass of the hydrated solid.

Place the crucible on the clay triangle and cover it off-center as shown by the instructor to allow water vapor to escape. Heat the crucible with an intense blue flame for 10 minutes to drive water of hydration from the solid. If you hear or see spattering, pull the flame away and heat with a smaller flame until the solid is dry and no longer spatters. Then heat with a stronger flame to redness. Place the crucible and cover on a wire gauze and allow them to cool. When they are at room temperature, weigh the crucible, the cover and contents on the same balance as before. Do not touch the crucible or cover with your fingers.

Repeat the heating, cooling and weighing process at least one more time to ensure all water has been driven from the hydrated solid. You may assume that all water has been driven off when two successive heatings and weighings agree to within 0.005 g.

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Ionic solid Number: _____

Ionic solid Name: _____

Mass of crucible and cover after heating

Mass of crucible, cover and hydrated solid

Mass of crucible, cover and dehydrated solid (first heating)

Mass of crucible, cover and dehydrated solid (second heating)

Mass of crucible, cover and dehydrated solid (third heating)*

Mass of crucible, cover and dehydrated solid (forth heating)*

*The third and forth heatings may not be necessary.

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Mass of hydrated solid

Mass of dehydrated solid

Mass of water lost (3 points)

% water in the unknown hydrated solid
(Show your setup) (6 points)

Name of compound

Formula of anhydrous salt (3 points)

Formula of hydrated salt (3 points)

Question:

If you had not dried the crucible and cover before the experiment, how would that affect the apparent percent of water of hydration in your unknown solid? Explain your answer. (5 points)