% Water in Magnesium Sulfate
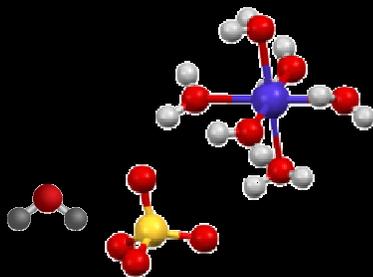

$MgSO_4 \cdot 7\,H_2O$

$MgSO_4 + 7\,H_2O$

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Hydrates

Absorb water from atmosphere
Water becomes associated with structure

$MgSO_4 \cdot 7\,H_2O$

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Hydrates

Compound + water ➜ hydrate

reversible

Hydrate ➜ compound + water

$$CuSO_4 \cdot 5\ H_2O \rightleftharpoons CuSO_4 + 5\ H_2O$$

$$MgSO_4 \cdot 7\ H_2O \rightleftharpoons MgSO_4 + 7\ H_2O$$

Reactants and Products are chemically different:
Color change indicates chemical change
These reactions represent chemical changes

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Methane Hydrates (Clathrates)

At cold temperatures:
Methane trapped by ice
Abundant in tundra and ocean bottoms

Global warming releasing the methane

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Desiccants
Compounds that absorb water to form hydrates

Used to protect variety of commercial products

Keep desiccants in containers until contents consumed

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Desiccants
Five Common Types
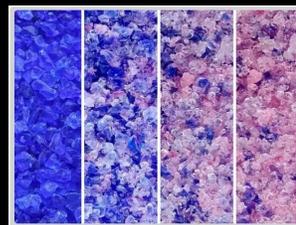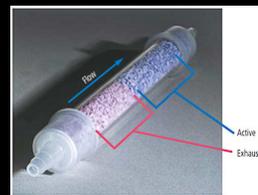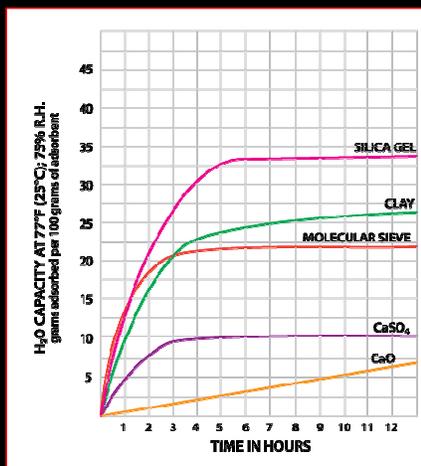
Color Change shows absorption

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Lab Desiccators
Used to Keep Sensitive Chemicals Dry

The Desiccator

air tight lid

perforated mesh

drying agent
(calcium chloride)
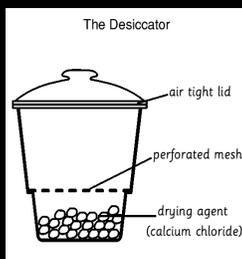
Often stored under vacuum and sometimes in the cold (-78 °C)

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Color of Many Gems From Hydrates
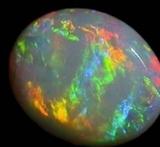
Never store in dehydrating conditions
Or
Underwater

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Composition Calculations

Find the percent water present in the hydrate $CuSO_4 \cdot 5\ H_2O$

Cu = 63.55
S = 32.07
4 O = 64.00
——————
Total = 159.62

10 H = 10.08
5 O = 80.00
——————
Total = 90.08

$$\% \text{ Water} = \frac{90.08}{159.62 + 90.08} \times 100 = 36.08$$
(249.70)

36.08 % = 0.3608

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Composition Calculations

Find the percent water present in the hydrate $MgSO_4 \cdot 7\ H_2O$

Mg = 24.31
S = 32.07
4 O = 64.00
——————
Total = 120.38

14 H = 14.11
7 O = 112.00
——————
Total = 126.11

$$\% \text{ Water} = \frac{126.11}{120.38 + 126.11} \times 100 = 51.24$$
(246.49)

51.24 % = 0.5124

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Naming Hydrates

Anhydrous (without water) name "• n H_2O's"

copper (II) sulfate penta hydrate
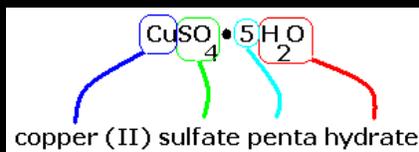
$CuSO_4 • 5 H_2O$
   copper (II) sulfate pentahydrate

$Na_2CO_3 • 10 H_2O$
   sodium carbonate decahydrate

$CaSO_4 • 2 H_2O$
   calcium sulfate dihydrate

• **Indicates distinct chemical entities held together**

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Desiccants keep my wraps dry

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% Water in Magnesium Sulfate Heptahydrate

$$MgSO_4 \cdot 7\,H_2O \longrightarrow MgSO_4 + 7\,H_2O$$

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Hydrate Lab

Purpose

Determine the percentage of water in a given hydrate

Procedure

> **Weigh materials "by difference"**

Weight of evaporating dish, watch glass, & hydrate
- Weight of evaporating dish & watch glass
_____
Weight of hydrate

Ring Stand
Watch Glass
Evaporating Dish
Iron Ring
Bunsen Burner

Water driven away by heat
Watch glass minimizes splattering
Heat until all water is gone

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Calculations

Show all your work

Mass of a any substance (weighing by difference)

(Substance g + Container g) – Container g = Substance g

Theoretical Water loss: initial heptahydrate x % H_2O

Water Lost: Initial – final weight of the magnesium hydrate

Experimental % Water: $\dfrac{(mass \quad H_2O\ lost)}{(mass\ initial\ heptahydrate)}$ x 100

Results

Tabulate the answers to your calculations

Conclusion

State % water in $MgSO_4 \cdot 7\ H_2O$
Compare your experimental value to the theoretical

Determine n

Calculate the value of n for $MgSO_4 \bullet n\ H_2O$

N is the ratio of moles water to moles anhydrous salt
Experiment measures grams … need moles for this ratio

Convert grams water lost to moles (via molar mass of one H_2O)
Convert grams $MgSO_4$ remaining to moles (via molar mass $MgSO_4$)

(n) = $\dfrac{Moles \qquad\qquad water\ lost}{Moles\ anhydrous\ magnesium\ heptahydrate}$

n is closest small, whole number

Let's Boldly Go Explore Today's Lab

promethius: ed giddings ejl@scifi-art.org

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