% Water in Magnesium Sulfate

$MgSO_4 \cdot 7\ H_2O \rightarrow MgSO_4 + 7\ H_2O$

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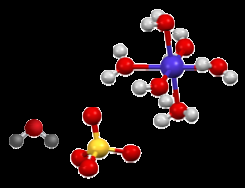
Hydrates

Absorb water from atmosphere

Water becomes associated with structure



$MgSO_4 \bullet 7\ H_2O$

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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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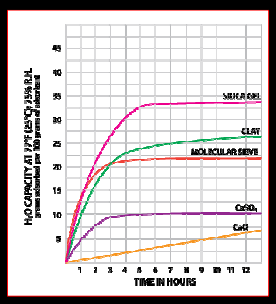
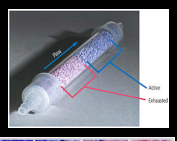
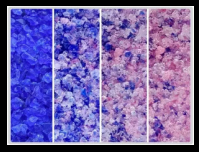
Desiccants

Five Common Types







Color Change shows absorption

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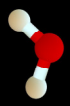
Lab Desiccators

Used to Keep Sensitive Chemicals Dry



Often stored under vacuum and sometimes in the cold (-78 °C)

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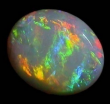
Color of Many Gems From Hydrates



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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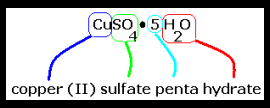
Naming Hydrates

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



$CuSO_4 \cdot 5\ H_2O$
copper (II) sulfate pentahydrate

$Na_2CO_3 \cdot 10\ H_2O$
sodium carbonate decahydrate

$CaSO_4 \cdot 2\ H_2O$
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

$MgSO_4 \cdot 7\ H_2O$ → $MgSO_4 + 7\ H_2O$

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Hydrate Lab

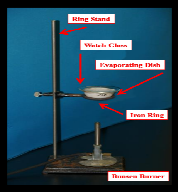
Purpose

Determine the percentage of water in a given hydrate

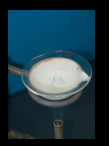
Procedure

Weigh materials "by difference"

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



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: $\frac{(\text{mass } H_2O \text{ lost})}{(\text{mass initial heptahydrate})} \times 100$

Results

Tabulate the answers to your calculations

Conclusion

State % water in $MgSO_4 \cdot 7\ H_2O$

Compare your experimental value to the theoretical

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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 $MgSO_4$)

$$(n) = \frac{\text{Moles water lost}}{\text{Moles anhydrous magnesium heptahydrate}}$$

n is closest small, whole number

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Let's Boldly Go Explore Today's Lab

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