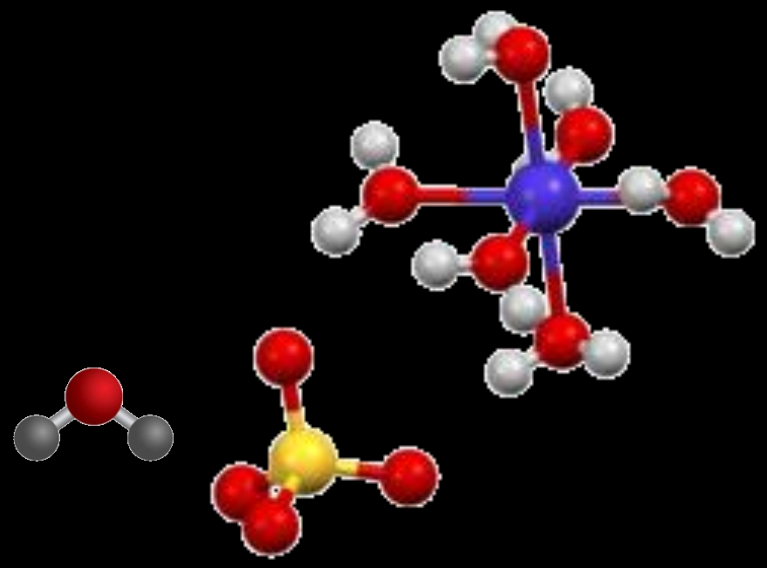
% Water in Magnesium Sulfate

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

Hydrates

Absorb water from atmosphere

Water becomes associated with structure



$MgSO_4 \bullet 7\ H_2O$

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

Methane Hydrates (Clathrates)

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

Global warming releasing the methane

Desiccants

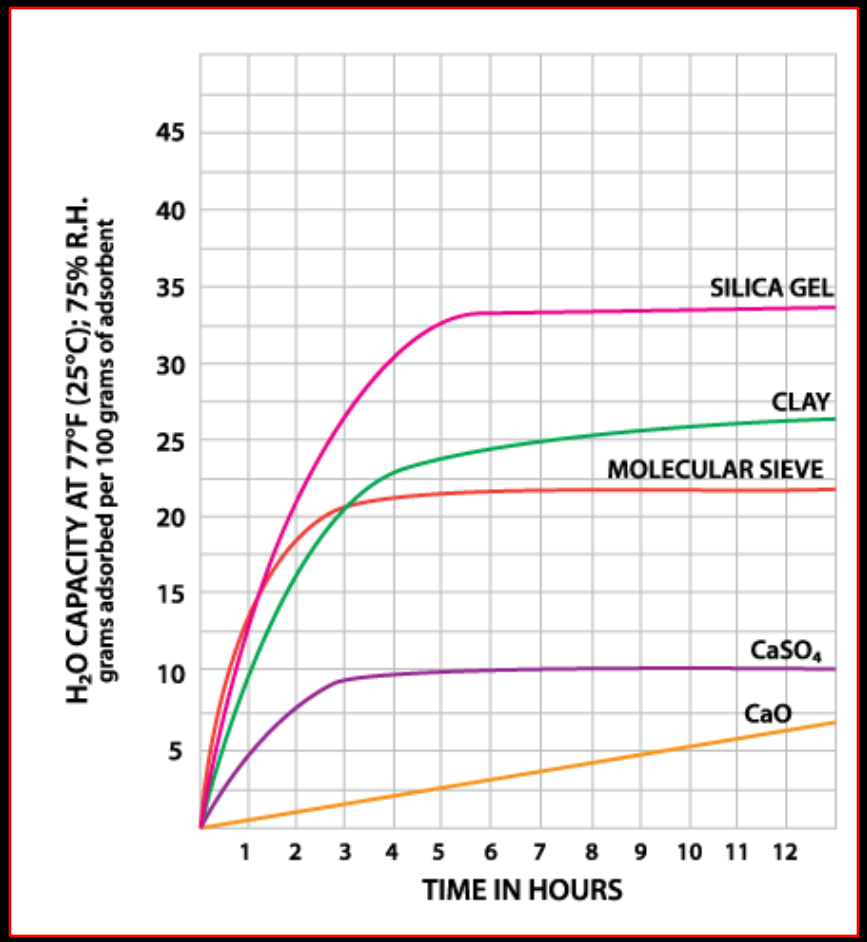
Compounds that absorb water to form hydrates

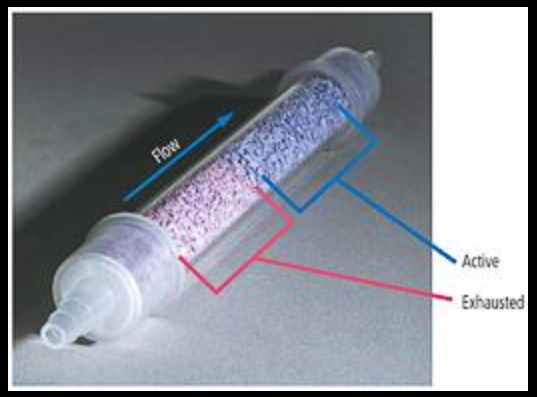
Used to protect variety of commercial products

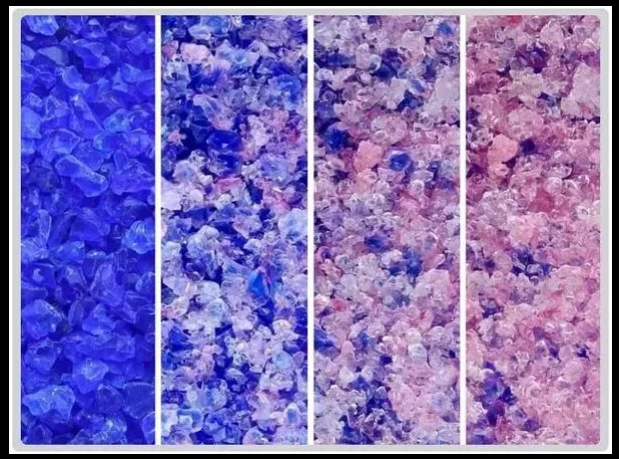
Keep desiccants in containers until contents consumed

Desiccants

Five Common Types



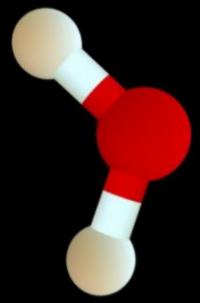


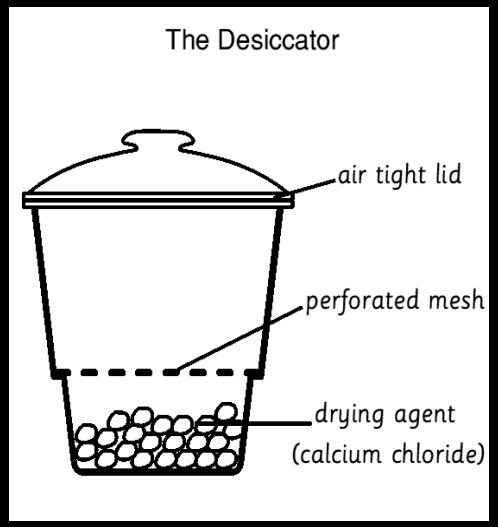


Color Change shows absorption

Lab Desiccators

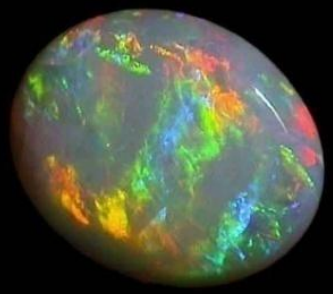
Used to Keep Sensitive Chemicals Dry





Often stored under vacuum and sometimes in the cold (-78 ^{o}C)

Color of Many Gems From Hydrates



Never store in dehydrating conditions
Or
Underwater

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

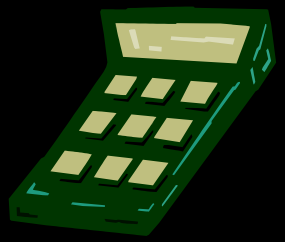
Total = 159.62

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

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

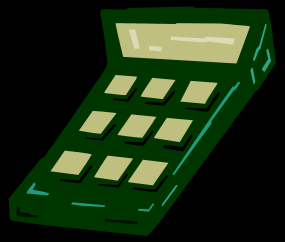
Total = 120.38

14 H = 14.11
7 O = 112.00

Total = 126.11

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

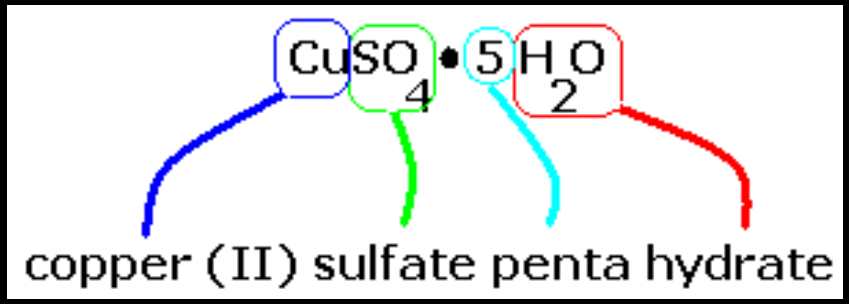
(246.49)



51.24 % = 0.5124

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

Desiccants keep my wraps dry

LPT

% Water in Magnesium Sulfate Heptahydrate

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

Hydrate Lab

Purpose

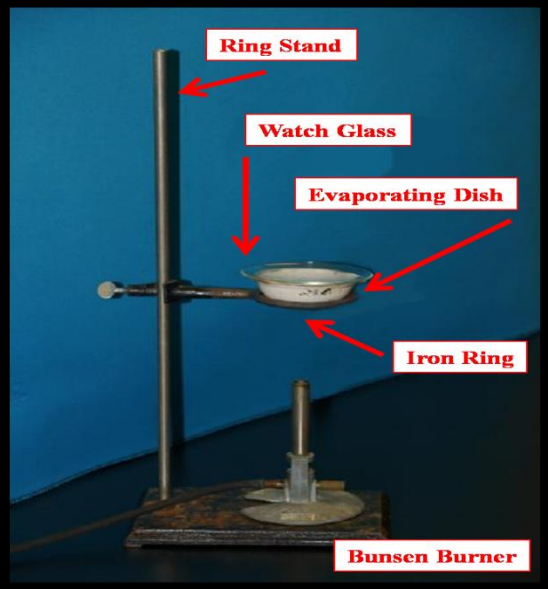
Determine the percentage of water in a given hydrate

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

LPT

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

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

Let’s Boldly Go Explore Today’s Lab