SAI International School
Lesson Notes
Subject - Chemistry
Ch-Acids, Bases & Salts
Topic- Study Of Salts – 4. Washing Soda
5. Plaster of Paris
Module -17

Suggested Videos-

1. https://youtu.be/SsUemSnD_-M **Washing Soda**
2. https://youtu.be/_JnF4ogNaZI **plaster of Paris**
3. https://youtu.be/BGhIPzx49ik **Water of Crystallization and Plaster of Paris**

To be done in CW Copy-

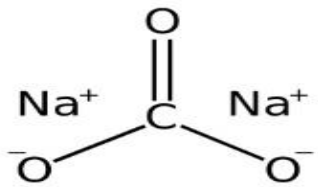
- **STUDY OF SALTS-**

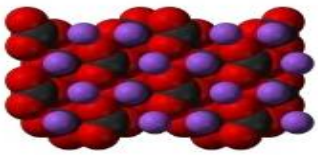
4. **Washing Soda (Common Name)**

OR

- **Chemical Name – Sodium Carbonate deca hydrate**
- **Chemical Formula – Na_2CO_3. 10 H_2O**

Washing Soda






∗ **Preparation of Washing Soda-**

- **Washing Soda** is prepared from **Baking Soda by heating it,** followed by **Recrystallization.**
- It takes place in **three steps.**

Step-1 $CO_2 + H_2O + NH_3 + NaCl \rightarrow \underset{\text{Baking soda}}{NaHCO_3} + \underset{\text{Ammonium chloride}}{NH_4Cl}$

Step-2 $\underset{\text{Baking Soda}}{2NaHCO_3} \xrightarrow{\text{--Heat-----}} \underset{\text{Sodium Carbonate}}{Na_2CO_3} + H_2O + CO_2$

Step-3 $Na_2CO_3 + 10H_2O \xrightarrow{\text{--recrystallization-}} Na_2CO_3 \cdot 10H_2O$

* **Properties of Washing Soda-**

1. It is a white transparent crystalline solid

Washing Soda

- It is soluble in water.
- The solution of **washing soda** in water is alkaline which turns red litmus to blue.
- Strong Base
- It has **cleansing properties** due to its **Alkaline nature**.
- When **Washing soda is heated strongly**, it **loses its water of crystallization** to form **dehydrated Sodium carbonate (Soda Ash).**

$$\underset{\text{Washing Soda}}{Na_2CO_3 \cdot 10H_2O} \xrightarrow{\text{--heat-}} \underset{\text{Soda Ash}}{Na_2CO_3} + 10H_2O$$

- When **Washing soda is left exposed to air**, it **loses nine of its water of crystallization** to form **Sodium carbonate mono hydrate.**

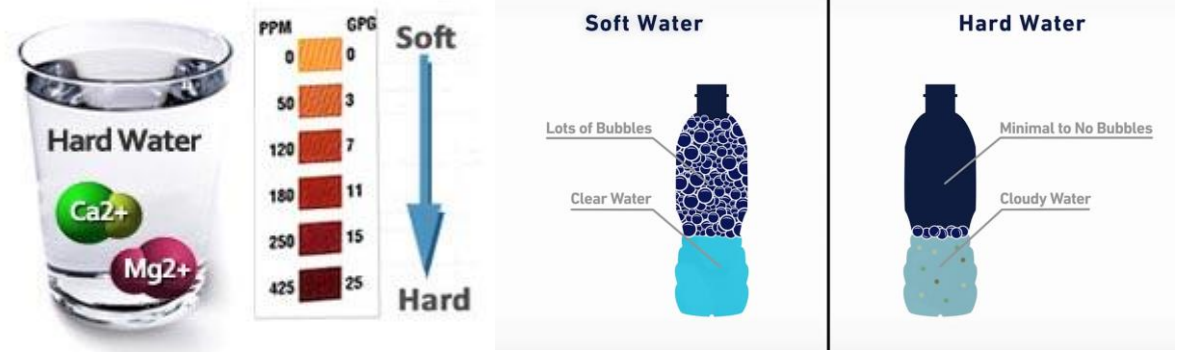
  This **processes of losing Water of crystallization** to the **atmosphere** when **left exposed to air, is known as *Efflorescence.***

$$\underset{\text{Washing Soda}}{Na_2CO_3 \cdot 10H_2O} \xrightarrow{\text{--exposed to atm--}} \underset{\text{sodium carbonate mono hydrate}}{Na_2CO_3 \cdot H_2O} + 9H_2O$$

* **Uses of Washing Soda:**

- **Sodium carbonate** (washing soda) is used in **glass, soap, and paper industries**.
- It is used in the **manufacture of sodium compounds such as Borax.**
- It is used to **remove Hardness of water** OR Make **Hard Water soft**.

Difference in **appearance** of Hard & soft water



- **Hard** And **Soft water**. ..

. **Soft water**: **Water** that produces lather with soap readily is called **soft water**.
For ex: Rain **water** ,distilled **water** ,demineralised **water**

Hard water: **Water** which does not produce lather with soap readily is called **hard water**.
Hard water... is that **water** which contains an appreciable quantity of dissolved minerals (**like calcium and magnesium salts of Bicarbonates/Chlorides/Sulphates)**

For ex: Tube well **water** & Open well **water** ,.

• ***Signs of hard water in your home include:***
1. White scaling on faucets.
2. Soap scum on tubs and sinks.
3. Dingy whites from your laundry.
4. Mineral residue left on dishes and glassware.
Temporary Hard water consists of – Ca(HCO3)2 or Mg(HCO3)2
Permanent Hard Water may contain Chlorides of Ca/Mg – CaCl2 or MgCl2, OR Sulphates of Ca/Mg – CaSO4 or MgSO4

Washing soda reacts with hard water to form insoluble ppt of Ca & Mg such that they get separated from the hard water, making it soft:

(i) Temporary hardness :

$$\underset{\text{washing soda}}{Na_2CO_3} + \underset{\text{temporary hardness}}{Ca(HCO_3)_2} \longrightarrow CaCO_3 \downarrow + 2NaHCO_3$$

$$\underset{\text{washing soda}}{Na_2CO_3} + \underset{\text{temporary hardness}}{Mg(HCO_3)_2} \longrightarrow MgCO_3 \downarrow + 2NaHCO_3$$

(ii) Permanent hardness :

$$\underset{\text{washing soda}}{Na_2CO_3} + \underset{\text{permanent hardness}}{CaSO_4} \longrightarrow Na_2SO_4 + \underset{\text{insoluble}}{CaCO_3 \downarrow}$$

$$\underset{\text{washing soda}}{Na_2CO_3} + \underset{\text{permanent hardness}}{MgCl_2} \longrightarrow \underset{\text{insoluble}}{MgCO_3 \downarrow} + 2NaCl$$

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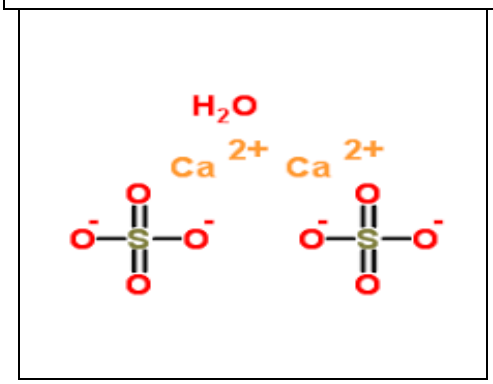
5. Plaster of Paris (Common Name)

OR

- **Chemical Name – Calcium Sulphate Hemi Hydrate**
- **Chemical Formula – $CaSO_4.½\ H_2O$**

Please Note that it is not possible to have half a molecule of water.
The Formula actually means that two molecules (or two formula units of CaSO4) share one molecule of water so that the effective water of crystallization for one CaSO4 unit comes to half molecule of water



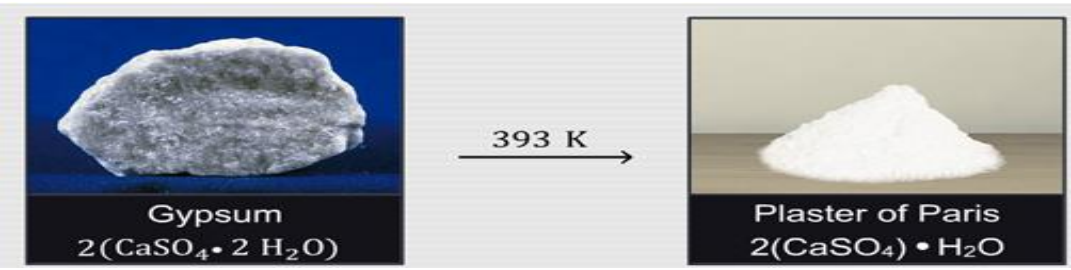
2 $CaSO_4$ sharing one molecule of H_2O in POP

Plaster of Paris stands for calcium sulphate hemihydrate which is obtained by heating the mineral gyspum
Paris then had rich deposits of gyspum which was heated in large quantities to manufacture plaster and make it strong enough to withstand weight of massive buildings and hence the name Plaster of Paris .

* **Preparation of Plaster of Paris-**

- **Plaster of Paris** is prepared from **Gypsum by heating it in a controlled manner at a temperature is 373K/100^oC,**
- Chemical Equation for the preparation of POP**:**

$$\underset{\text{Gypsum}}{CaSO_4.2H_2O} \xrightarrow[373K/100^oC]{\text{---heat}} \underset{\text{Plaster of Paris}}{CaSO_4.½\ H2O} + 1½\ H_2O$$



* **Properties of Plaster of Paris-**

- Calcium sulfate is an **odorless, white amorphous or crystalline solid**.
- Its **melting point** is **1460 ºC** and in higher temperature it decomposes.
- It is **poorly soluble in water** (0.21 g/100 mL at 20 ºC).
- It **sets into a hard mass** when **mixed with water and left to dry.**
  (It reacts with water to give back Gypsum, which is the hard mass.)

$$\underset{\text{POP}}{CaSO_4.\,½\,H_2O} + 1½\,H_2O \rightarrow \underset{\text{Gypsum (hard mass)}}{CaSO_4.2H_2O}$$

* **Uses of Plaster of Paris-**

- It is commonly used to **precast and hold parts of ornamental plaster work** placed on ceilings and cornices**.**

Precasting parts of ornamental plaster work, in molds to get the final motifs.

- It is also used in medicine to make **plaster casts to immobilize broken bones while they heal as well as make molds of teeth for making artificial teeth.**

Plaster casts to immobilize broken bones

Mold of teeth for making artificial teeth.

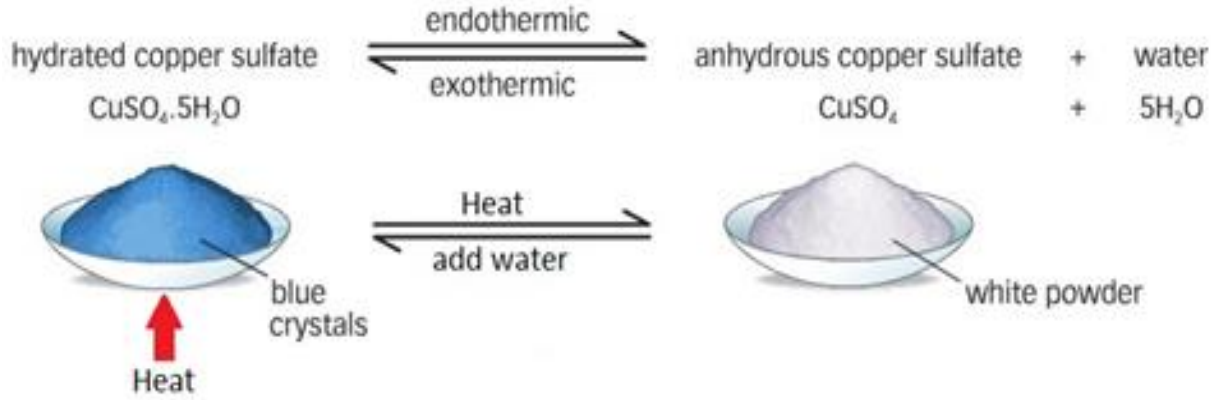
- It is used to make **decorative articles, statues and toys by shaping them in molds.**

Artisans making statues of Idol of Ganesh before Ganesh Puja using POP.

* **Water of Crystallization –**

- **Water of crystallisation is a fixed number of water molecules present in one formula unit of a salt. Such salts are denoted as hydrated compounds.**

Example **-** One formula unit of copper sulphate contains five water molecules (5H20). ...



- **Are the Crystals of Salts really Dry?**

Activity 2.15 page-32

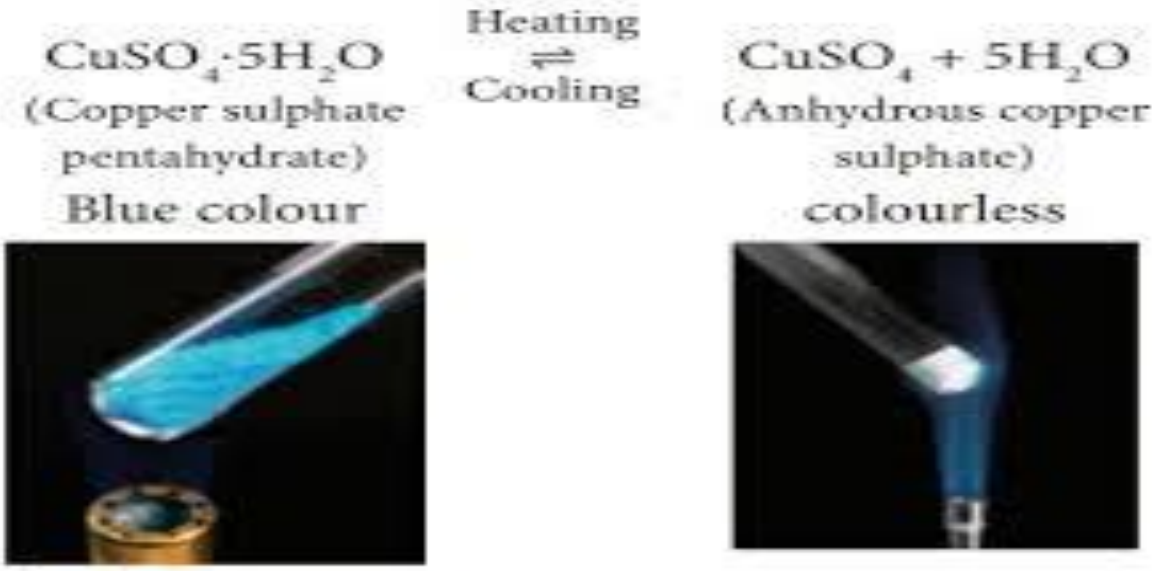


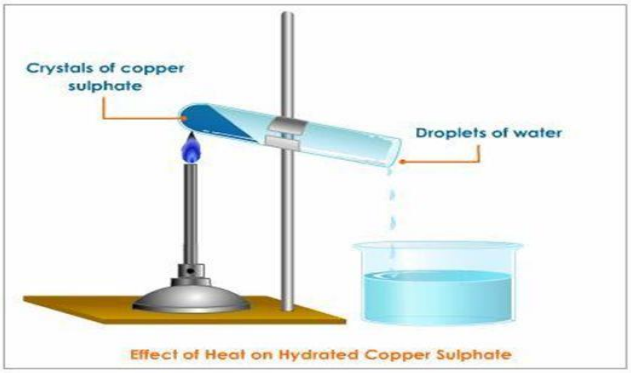
Figure 9.8 Copper sulphate heating before and after

When hydrated salts are **heated strongly, they lose their water of crystallisation and colour gets discharged (turns colourless).**

On adding **water to the decolourised** and **dehydrated copper sulphate,** it regains its **blue colour.**

On heating, hydrous crystals lose their water of crystallization and turn into a powder. They are then said to be anhydrous.

Sometimes they may also lose their colour.



- Examples of some salts having water of crystallization-
  1. $FeSO_4.7H_2O$
  2. $CaSO_4.2H_2O$
  3. $CaSO_4.1/2\ H_2O$
  4. $Na_2CO_3.10H_2O$
  5. $Al_2O_3.2H_2O$