CHAPTER 7
MATERIALS OF COMMON USE

NOTES

SOURCES OF COMMON SALT (NaCl)

- Rock salt.
- Brine contains 2.5% of NaCl.
- Brine wells are found at Ningel, Chandrakhong and Waikhong villages of Thoubal District in Manipur.
- Sea water contains 2.5% of common salt.

Preparation:

- Pure Sodium Chloride is prepared by passing hydrochloric acid gas into a saturated solution of impure salt. The pure salt is precipitated and obtained on filtration. It is then dried.
- Table salt is iodised in order to prevent iodine deficiency diseases.

USES OF COMMON USES SALT

- Common salt gives a characteristic flavour to food.
- It is used in preserving fish, meat, pickles etc.
- It is used for salting out of soap, regenerating water softeners and in the "Salt glazing" of earthen wares.

COMMON SALT – A RAW MATERIAL FOR VARIOUS CHEMICALS

- Common Salt is used in the preparation of useful chemicals such as Sodium hydroxide, Sodium Carbonate, Sodium, Chlorine, Bleaching Powder, Sodium Bicarbonate, Sodium Sulphate, Sodium hypochlorite, Sodium Chlorate etc.

PREPARATION OF SODIUM HYDROXIDE (NaOH)

- On Passing electricity through brine solution (an aqueous solution of sodium chloride), sodium chloride is decomposed to give sodium hydroxide, hydrogen and chlorine.
- Chlorine gas is given off at the anode,
- Hydrogen gas is given off at the cathode.
- Sodium hydroxide solution is formed near the cathode.
- The reaction that takes place is as follows:

$$\underset{\text{Sodium Chloride}}{2NaCl(aq)} + 2H_2O(l) \xrightarrow{\text{Electricity}} \underset{\text{Sodium Hydroxide}}{2NaOH(aq)} + Cl_2(g) + H_2(g)$$

PREPARATION OF SODIUM HYPOCHLORITE SOLUTION (NaOCl)

- NaOH combines with Chlorine gas to form Sodium Hypochlorite.
- The reaction is as follows:-

$$2\ NaOH\ (aq) + Cl_2(g) \longrightarrow NaCl\ (aq)\downarrow + Na\ OCl\ (aq) + H_2O\ (l)$$

(Sodium hypochlorite solution)

- Sodium hypochlorite is the basic ingredient of all commercial bleaching solutions sold in the market.

PREPARATION OF BLEACHING POWDER

- Chemically bleaching powder is calcium chloro hypochlorite.

a. Bleaching powder is synthesized by the action of chlorine gas (produced from the chlor-alkali process) on dry slaked lime $Ca(OH)_2$ at about 35□. - 45□.

$$Ca(OH)_2 + Cl_2 \xrightarrow[35^{\circ} - 45^{\circ}C]{HEAT} Ca(OCl)Cl + H_2O$$

Slaked Lime — Bleaching powder

- **The uses of Bleaching powder are:**

a. It is used as a disinfectant and for sterilizing water to make water free from disease causing germs and bacteria.

b. It is used for bleaching pulp in paper industry, linen and cotton in textile industry.

c. It is used as an oxidizing agent in chemical industries.

PREPARATION OF BAKING SODA (Sodium hydrogen carbonate).$NaHCO_3$

a. The chemical name of baking soda is sodium hydrogen carbonate with the formula$NaHCO_3$.

- **It is prepared as follows:**
- When an excess of carbon dioxide is bubbled through a nearly saturated solution of common salt containing ammonia, ammonium hydrogen carbonate is formed. This reacts with more of sodium chloride to form sparingly soluble sodium hydrogen carbonate and ammonium chloride and sodium hydrogen carbonate is separated by filtration.

$$NaCl + H_2O + CO_2 + NH_3 \longrightarrow NH_4Cl + NaHCO_3$$

Uses:

- It is used as an ingredient in antacids.
- It is also, used in soda - acid fire extinguishers
- Baking powder can be prepared as a mixture of baking soda and a mild edible acid such as tartaric acid.

$NaHCO_3 + H^+$ (from tartaric acid) ⟶ Na- tartarate (Salt) + $H_2O + CO_2$

Baking powder is used in preparation of bread or cake to make them soft and spongy.

PREPARATION OF WASHING SODA (sodium Carbonate), $Na_2CO_3.10H_2O$

Nicholas Leblanc's process

(i) NaCl is treated with Conc. H_2SO_4 to form (Sodium Sulphate) Na_2SO_4 which is called salt cake.

$$2NaCl + H_2SO_4 \longrightarrow Na_2SO_4 + 2HCl$$

(ii) $Na_2SO_4$is grounded and mixed with its own weight of limestone and half its weight of Coal and heated to 800ºC-1000ºC Na_2SO_4 is reduced by coke to sodium sulphide, Na_2S which then react with calcium carbonate ($CaCO_3$) to form sodium carbonate.

$$Na_2SO_4 + 4C \longrightarrow Na_2S + 4CO$$

$$Na_2S + CaCO_3 \longrightarrow Na_2CO_3 + Ca\ S$$

Ammonia Soda or Solvay process

Washing soda is synthesized through ***Solvay's process.*** Solvay's process involves the reaction of sodium chloride, ammonia and carbon dioxide in water. Carbon dioxide involved is produced through calcium carbonate and the calcium oxide left is used in recovering ammonia from ammonium chloride.

At first, sodium bicarbonate is obtained which is then converted to sodium carbonate on heating. Finally, washing soda is produced by recrystallization of sodium carbonate.

i) $NaCl + NH_3 + CO_2 + H_2O \rightarrow NaHCO_3 + NH_4Cl$

ii) $2\ NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$

iii) $Na_2CO_3 + 10H_2O \rightarrow Na_2CO_3.10H_2O$

Uses of Washing Soda

- It is used as cleansing agent for domestic purposes.
- It is prominently used in soap, glass and paper industries.
- It also helps in the removal of permanent hardness of the water.
- It acts as a raw material in the manufacturing of various sodium compounds, for example, borax.

WATER OF CRYSTALLISATION

- The fixed number of water molecules present in one formula unit of a salt is called water of crystallisation.
- For instance, there are five molecules of water in one formula unit of copper sulphate and hence the chemical formula for hydrated copper sulphate is $CuSO_4.5H_2O$
- Water of crystallisation may be removed by heat and can be regained when the salt is treated with water.
- Many salts contain water of crystallisation
- **Examples are:** Green vitriol $FeSO_2.7H_2O$, (Ferrous sulphate), white vitriol $ZnSO_4.7H_2O$, Gypsum $CaSO_4.2H_2O$.

PREPARATION OF PLASTER OF PARIS, $2CaSO_4.H_2O$ (calcium sulphate hemihydrate)

- The compound plaster of Paris is prepared by heating gypsum at 120^oC - 130^oC.

$$\underset{\text{Gypsum}}{2CaSO_4.H_2O} \xrightarrow[\text{Heat}]{120^oC - 130^oC} \underset{\text{Plaster of Paris}}{CaSO_4.H_2O} + 3H_2O$$

Uses of plaster of Paris:

- Plaster of Paris sets into a hard solid mass when treated with water due to the reformation of gypsum..
- It is used for making casts in moulds.
- As plaster in surgical dressing.
- It is also used for wall plaster.

SOAPS AND DETERGENTS

- Soap is a sodium or potassium salt of long chain fatty acids having cleansing action in water.
- Soap is made from oils or fats.

Preparation of soap:

When fats and oils are heated with a solution of sodium hydroxide, soap is formed along with glycerol.

$$\underset{\text{Fat}}{(C_{15}H_{31}COO)_3.C_3H_5} + 3NaOH \longrightarrow \underset{\text{Soap}}{3C_{15}H_{31}COONa} + \underset{\text{Glycerol}}{C_3H_5(OH)_3}$$

- **Salting out of soap:** It is the addition of common salt in soap solution to precipitate out the soap.
- **Micelle -** It is a spherical aggregate of soap molecules.

Cleansing action of Soap:

The dirt present on clothes is organic in nature and insoluble in water. Therefore, it cannot be removed by only washing with water. When soap is dissolved in water, its hydrophobic ends attach themselves to the dirt and remove it from the cloth. Then, the molecules of soap arrange in micelle formation and trap the dirt at the centre of the cluster. These micelles remain suspended in the water. Hence, the dust particles are rinsed away by water easily.

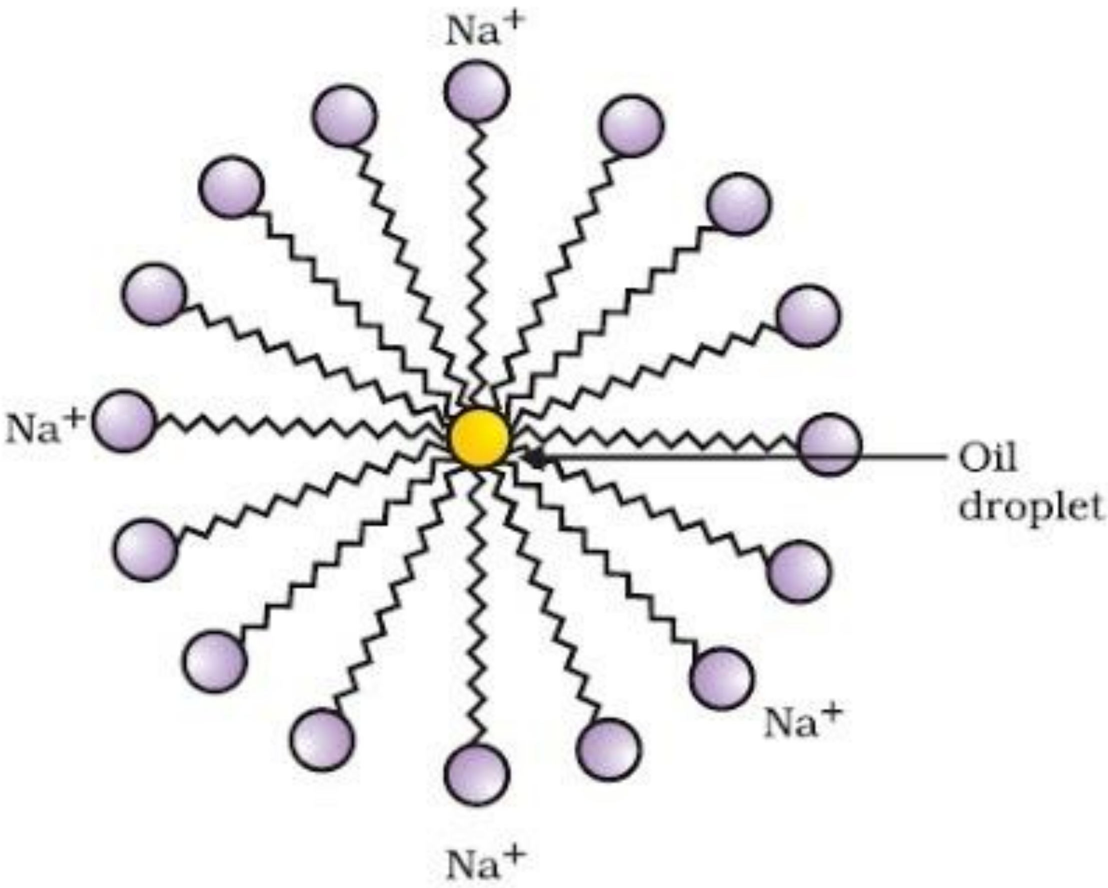

Fig: Formation of Micelles

Soaps:

(1) Soaps are sodium or potassium salts of long chain fatty acid (carboxylic acids).
(2) Soaps have lesser cleansing action or quality as compared to detergents.
(3) Soaps are made from animal or plant fats.
(4) Soaps are more biodegradable.

Detergents :

1. Detergents are ammonium or sulphonate salts of long chain hydrocarbons.

2. Detergents have better cleansing action as compared to soaps.

3. Detergents are made from petrochemicals. Detergents are not biodegradable.

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