UNIT – II (A) ACIDS, BASES AND BUFFERES

POINTS TO BE COVERED IN THIS TOPIC

- INTRODUCTION
- BUFFER EQUATIONS AND BUFFER CAPACITY IN GENERAL
- BUFFERS IN PHARMACEUTICAL SYSTEMS
- PREPARATION
- STABILITY
- BUFFERED ISOTONIC SOLUTIONS
- MEASUREMENTS OF TONICITY
- CALCULATIONS AND METHODS OF ADJUSTING ISOTONICITY

INTRODUCTION

➢ ACID

- An **acid** is any **hydrogen-containing substance** that is capable of **donating a proton (hydrogen ion)** to another substance.
- It converts **blue litmus** paper **into red**
- Having the **PH <7, taste** is **sour and react** with bases to form **salts and water.**
- E.g. - **Hydrochloric acid, Boric Acid, Citric Acid and Acetylsalicylic Acid**

Acid

Blue litmus turns red

➢ BASE

- A **base** is a **molecule or ion** able to accept a **hydrogen ion** from an **acid**
- It converts **red litmus paper** to **blue**
- Having the **PH >7, bitter** is **taste and react** with Acids to form **salts and water.**
- E.g. **Sodium Hydroxide, Calcium hydroxide, Magnesium hydroxide and Potassium oxide**

Base

Red litmus turns blue

➢ CONCEPTS OF ACID AND BASE

❖ ARRHENIUS THEORY

✓ **Acids**

- An **Acid** is a substance that can **release hydrogen ion (H+)** when **dissolved in water.**
- Example: $HCl \rightarrow H^+ + Cl^-$

✓ **Base**

- A **Base** is a substance that can **release a Hydroxyl ion (OH-)** when **dissolved in water.**
- Example :- $NaOH \rightarrow Na^+ + OH^-$

✓ **Limitation of Arrhenius theory**

- The theory **defines acids** and **bases** in term of **aqueous solutions** not in term of substance themselves.
- The theory does not **explain acidic and basic nature** of substance in **non- aqueous solutions.**
- Unable to **explain basic nature** of certain substances like Na_2CO_3, NH_3 which do **not possess hydroxyl groups** and inability to explain **acidic nature** of certain substances like CO_2, SO_2, SO_3 which do **not possess hydrogen.**
- Unable to **explain reaction** between **acids and bases** in absence of solvent.

❖ LOWRY BRONSTED THEORY

✓ **Acid**: **Acid** is the substance **which donate proton**. E.g. H^+, NH_4^+, BF_3

✓ **Base**: **Base** is the substance which **accept proton.** E.g. OH^-, NH_3^+

✓ **Conjugate acid base pair**

- **A pair of acid** and **base** which differ only by a **proton** is called as **conjugated acid base pair.**
- **Acid donates** or **loses a proton** to form **conjugated base.**
- **Base accepts** a proton to form a **conjugated acid.**
- E.g. – **Cl^- is a conjugated** base of **HCl**

  H_3O^+ is a conjugated acid of **base H_2O**

❖ LEWIS THEORY

✓ **Acid**: Acid is the **molecule or ion** that accept the **lone pair of electrons.**
E.g. H+, NH4+, Na+, Cu++, Al+++

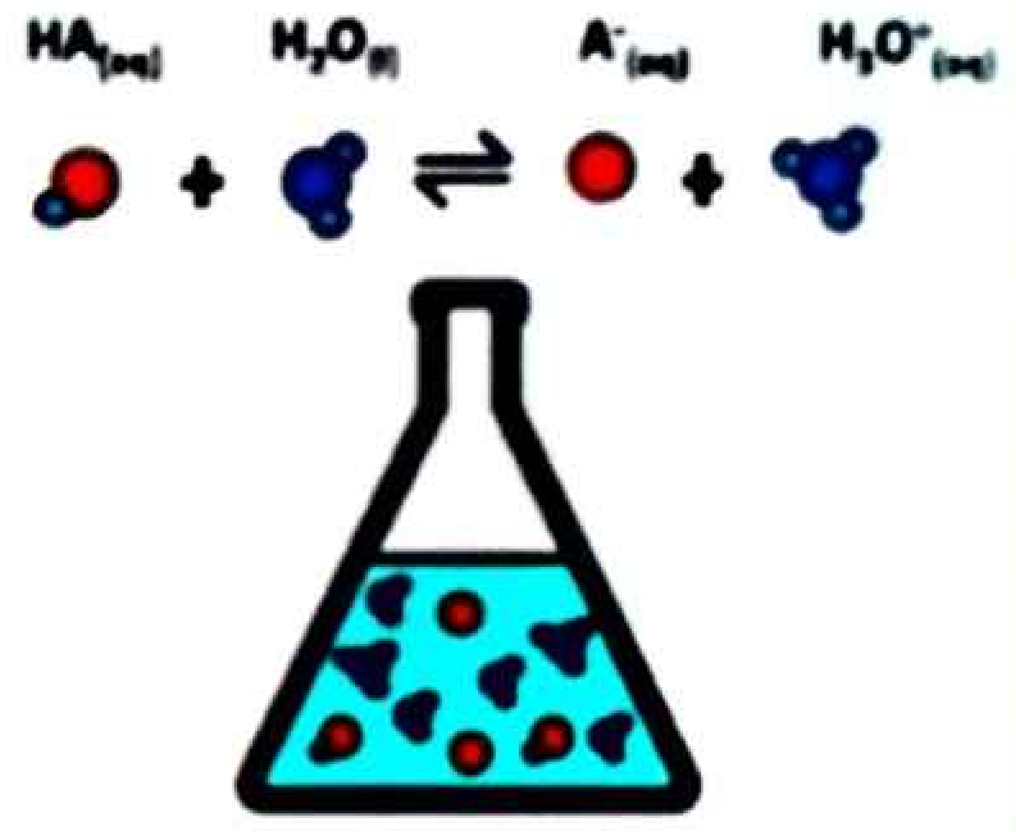
✓ **Base**: Base is the **molecule or ion** that donate the **lone pair of electrons.**
E.g. OH-, Cl-, CN-

$$\underset{\text{Acid}}{HA\,(aq)} + \underset{\text{Base}}{H_2O\,(l)} \longrightarrow \underset{\text{Conjugated base}}{A^-(aq)} + \underset{\text{Hydronium ion}}{H_3O^+(aq)}$$

$$\underset{\text{Acid}}{B\,(aq)} + \underset{\text{Base}}{H_2O\,(l)} \longrightarrow \underset{\text{Conjugated acid}}{BH^+(aq)} + \underset{\text{Hydroxide ion}}{OH^-(aq)}$$

BUFFER EQUATIONS AND BUFFER CAPACITY IN GENERAL

➢ DEFINITION



- **Buffers are compounds** or mixtures of compounds that by their **presence** in the **solution resist** changes in the **pH** upon the addition of **small quantities** of **acid or alkali.**

➢ TYPES OF BUFFERS

- Generally buffers are of **two types**

❖ **Acidic Buffers:** An **acidic buffer** is a combination of **weak acid** and its **salt** with a **strong base**. i.e. **Weak acid & salt** with **strong base** (conjugate base).

E.g. **CH_3COOH** and **CH_3COONa, H_2CO_3** and **$NaHCO_3$, H_3PO_4** and **NaH_2PO_4, HCOOH** and **CH_3COONa**

❖ **Basic Buffers:** A **basic buffer** is a combination of **weak base** and its **salt with a strong acid**. i.e. **Weak base & salt** with strong acid (conjugate acid).

E.g. **NH_4OH and NH_4Cl, NH_3 and NH_4Cl,** NH_3 and $(NH_4)_2CO_3$

➢ BUFFER EQUATION

- **Buffers are characterized** by the fact that their **pH remains** constant are not affected by dilution , by the addition of **small amounts** of **acids or bases** and are not affected by **prolonged storage** of the solution.
- The **addition of small amounts** of acid or base to **moderate pH** solutions results in absorption by buffer with **minimal pH changes.**
- Calculations involving **weak acids require** a knowledge of the **pKa of the acid.**
- It is possible to **calculate the pH** of the **buffer solution** by rearranging the equation.
- For **dielectric constant**

$$[H_3O^+] = Ka\frac{[CH_3COOH]}{[CH_3COO^-]}$$

- A solutions acetic acid concentrations can be viewed as the total amount of acid in the solution since acetic acid is not readily ionized.
- In an alternate form the term [CH3COOH] may replace the term [acid] , as well as [CH3COOH] for salt.

$$[H_3O^+] = Ka \frac{[acid]}{[salt]}$$

- Calculating the pH of buffer solutions containing both acid and its conjugate base can be performed by rearranging and rewriting the dissociation constant equation as follows

$$[H^+] = Ka \frac{[HA]}{[A]}$$

- The acid concentration [HA] corresponds to its conjugate base concentration [A-] , in logarithmic form , equation 3 is

$$pH = pKa + \log \frac{[A^-]}{[HA]}$$

i.e.

$$pH = pKa + \log \frac{[Salt]}{[Acid]}$$

- Similar to weak acid buffers , weak base buffers can be derived from their corresponding salt equations so

$$[OH^-] = Kb \frac{[Base]}{[Salt]}$$

- Equation is derived by substituting value for OH^-

$$Kw/H3O^- = Kb \frac{[Base]}{[Salt]}$$

i.e.

$$= pKb + \log \frac{Salt}{Base}$$

Or

$$pH = pKw - pKb + \log \frac{Base}{Salt}$$

- **Salt , acid and base** are all represented by their **molar concentration.**
- A **pH of a solution** can be calculated using **Henderson – Hasselbalch equations** and **acid and base solutions.**

➤ BUFFER CAPACITY

- The **amount** of an **acid or base** that can be added to a **1 liter** of a **buffer solution** before its **pH changes** significantly.
- It is indicated by the term **buffer index (B).**
- Mathematically **buffer capacity is expressed as**

$$\beta = \Delta B / \Delta pH \ ....1$$

- ΔB = amount of acid or base added to change the pH by 1 unit
- ΔpH = change in pH

❖ FACTORS AFFECTING BUFFER CAPACITY

- **Ratio of [A-]/[HA]**
- **Total buffer concentration**
- **Temperature**
- **Ionic strength**

✓ RATIO OF [A-]/[HA]

- The **buffer capacity depends** essentially on the **ratio of the salt** to the **acid or base.**
- The actual concentrations of **A^- and HA influences** the **effectiveness of a buffer.**
- The more is the **A^- and HA** molecules available, the **less of an effect** of the addition of a **strong acid or base** on the **pH of a system.**

✓ TOTAL BUFFER CONCENTRATION

- **Buffer capacity** depends upon the **total buffer concentration**. For example, it will take **more acid or base** to deplete a 0.5 M buffer than a 0.05 M buffer. The relationship between **buffer capacity and buffer concentrations** is given by the Van Slyke equation:

$$\beta = 2.303C\left\{\frac{Ka[H_3O^+]}{\left(Ka+[H_3O^+]\right)^2}\right\}$$

✓ TEMPERATURE

- **Buffers are required** to be maintained at a **constant temperature**.
- Any change in the **temperature** of **the buffer results** in a reduction in the **effectiveness of the buffer.**
- Buffer **containing base** and its salt were found to show **greater changes** in **buffer capacity** with temperature.

✓ IONIC STRENGTH

- **Ionic strength** is reduced by dilution.
- Change in **ionic strength changes** the **pH of buffer solution** resulting in decreased **buffer capacity.**
- So, whenever the **pH of buffer solution** is mentioned **ionic strength** should be specified.

Temperature	Actual pH		
	Phthalate buffer	Phosphate buffer	Borate buffer
0	4.01	7.12	-
10	4.00	7.06	10.15
20	4.00	7.02	10.06
25	4.00	7.00	10.00
30	4.01	-	9.96
40	4.03	6.97	9.97
50	-	-	9.80
60	4.09	6.98	9.73

BUFFERS IN PHARMACEUTICAL SYSTEMS

❖ BUFFER IN PHARMACEUTICAL SYSTEMS

✓ **The In vivo biologic buffer system**

- In the **blood , pH** is maintained at **approximately 7.4.**
- As **buffer in the plasma** , **carbonic acid** and **bicarbonate** as well as **acid/ alkali sodium salts** of **phosphoric acid** are present in the **blood, plasma proteins**, which act as acids, can combine **with bases** to act as buffers.

✓ **Lacrimal fluids**

- It has been **found that lacrimal fluid**, also known as **tears,** can be diluted at **1:15 with neutral distilled water.**
- There is a **pH range of 7 to 8** or slightly above in tears, **ranging from 7.4 to 7.4.**
- The **cornea** is generally thought to be **unaffected by eye drops** with a **pH range from 4 to 10.**

✓ **Urine**

- **Normal 24 hour urine** collections of adults have a **pH averaging** about **6.0** , they may be as low as **4.5 or as high as 7.8.**
- Whenever urine **pH falls below** a normal level , **hydrogen ions** are excreted by the **kidneys.**
- The **kidneys retain hydrogen ions** in urine that have a **pH above 7.4** to return the **pH to a normal value.**

✓ **Pharmaceutical buffers**

▪ **Preparations for the eye (ophthalmic preparations)**

- The **pH range** of **lacrimal fluid** is generally maintained by buffers in **ophthalmic preparations.**
- Although **lacrimal fluid** has a **pH between 7 and 8** , it has a good **buffering capacity** and can tolerate preparations with pH values between **3.5 and 10.5 without** causing discomfort.

- **In creams and ointments**
  - A **buffer** is used to ensure the **stability of topical products .**
  - Among the **most common buffers** found in **creams and ointments** are **citric acid** and its **salt and phosphoric acid.**

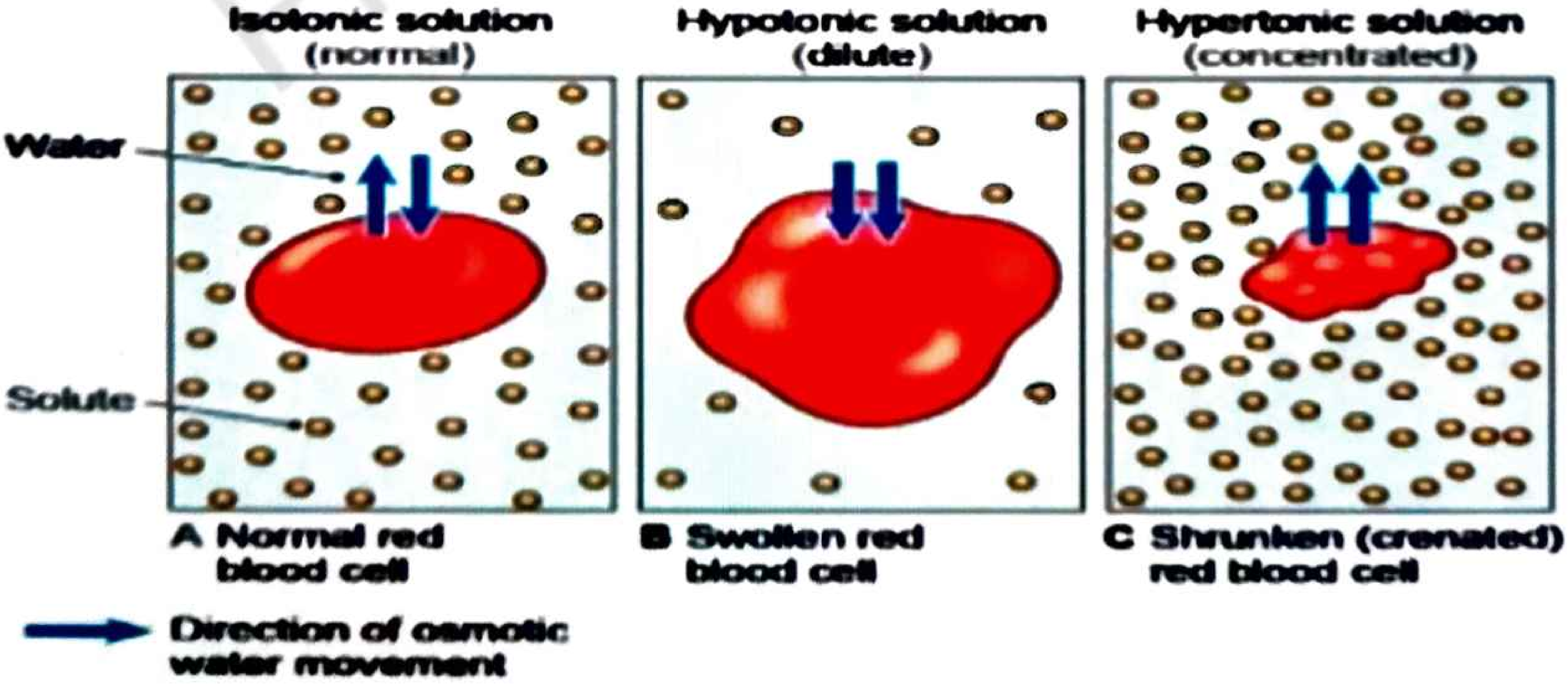
❖ PREPARATION OF BUFFER

- The **weak acid** should have a **pKa** that approximates that of the **pH** at which the **buffer should be used.**
- **Calculations** involving pH within the range of **4 to 10** can be approximated using the **buffer equation.** Use it to determine the **concentration of salt** and **weak acid** required to reach the **desired pH.**
- Obtain a **buffer capacity** that is appropriate by considering the individual **buffer salt** and acid concentrations. It is usually sufficient to use a **concentration of 0.05 to 0.5 M** and to use a **buffer with a capacity of 0.01 to 0.1.**
- In addition to **chemical availability**, sterility of the **final solution**, **stability of a drug** and buffer during aging, **cost of materials**, and **lack of toxicity** are also **important considerations** in selecting a pharmaceutical buffer. For instance, a **borate buffer, being toxic**, cannot be used as a **stabilizer for parenteral** or **oral administration.**
- Determine the **buffer capacity** and pH of the **completed buffered** solution with a **pH meter**. In some cases, pH papers can also be used as a gauge for **determining buffer capacity** and pH. pH can sometimes differ from the **experimental value** when the **electrolyte concentration** is high, especially when using the buffer equation. It is **reasonable** to expect this to occur when the **activity coefficient** is not taken into consideration, and this **emphasizes** the need to perform the **actual determination.**

BUFFERED ISOTONIC SOLUTIONS

- A **small amount** of blood mixed with **various toxicities** of aqueous **sodium chloride solutions** illustrates the need for **isotonic solutions** when applied to **delicate membranes.**

1. **Isotonic** - **0.9 g of NaCl** per **100 ml maintains** the normal size of cells if **blood is added** to the solution. **Solution and red blood cell** contents are essentially the same in terms of **salt concentration** and **osmotic pressure**
2. **Hypertonic** - The **red blood cells** floating in a **NaCl solution of 2.0%** are **hypertonic** by passing through their **cell membranes**, making an effort to dilute the **nearby salt solution. Cells shrink** as a result of this outward **flow of water** and become **wrinkled or crenated.**
3. **Hypotonic** - **Blood** that is mixed with **0.2% NaCl solution** or **distilled water** causes the **blood cells** to swell and eventually burst, **releasing hemoglobin.** The **concentration of salt** in this **scenario is understood** as being concerning the content of the **blood cells**. **Haemolysis** is a term used to describe this process.



MEASUREMENTS OF TONICITY

❖ HAEMOLYTIC METHOD

- In this method , RBC's are suspended in various solution and the appearance of RBC's is observed for swelling , bursting , shrinking and wrinkling of the blood cell.

❖ CRYOSCOPIC METHOD

- Freezing point depression property is most widely used.
- Freezing point is 0°c and when any substance such as NaCl is added, the freezing point decreases.
- Freezing point depression, ΔTf of blood is – 0.52°c. hence ΔTf value of the drug solution must be 0.52°c.

CALCULATIONS AND METHODS OF ADJUSTING ISOTONICITY

i. CLASS – I METHOD

- NaCl or some other substance is added to the solution of the drug to lower the freezing point of solution to -0.52° C and thus make the isotonic solution.
- e.g. Cryoscopic and NaCl equivalent

✓ NaCl equivalent method

- NaCl equivalent (E) of a drug is the amount of NaCl i.e. equivalent to 1 gm of the drug.
- PSA = 0.9 – (PSM × E of medicament)
- PSA = percentage strength of medicament
- PSM = percentage of NaCl for adjust tonicity

ii. CLASS - II METHOD

- H_2O is added to the drug in sufficient amount to make it isotonic. Then the preparation is brought to its final volume with an isotonic or buffer isotonic solution (0.9%NaCl).

✓ **White Vincent Method**

- This method involve **addition of H_2O** to a given amount of drug. The **volume of H_2O** that should be added in given amount of the it **isotonic solution.** It is calculated by using this formula

$$V = W \times E \times 111.1$$

  - Where, **V = Volume of H_2O** needed to make the solution. isotonic.
  - **W = Given weight.**
  - **E = NaCl equivalent** of the drug.

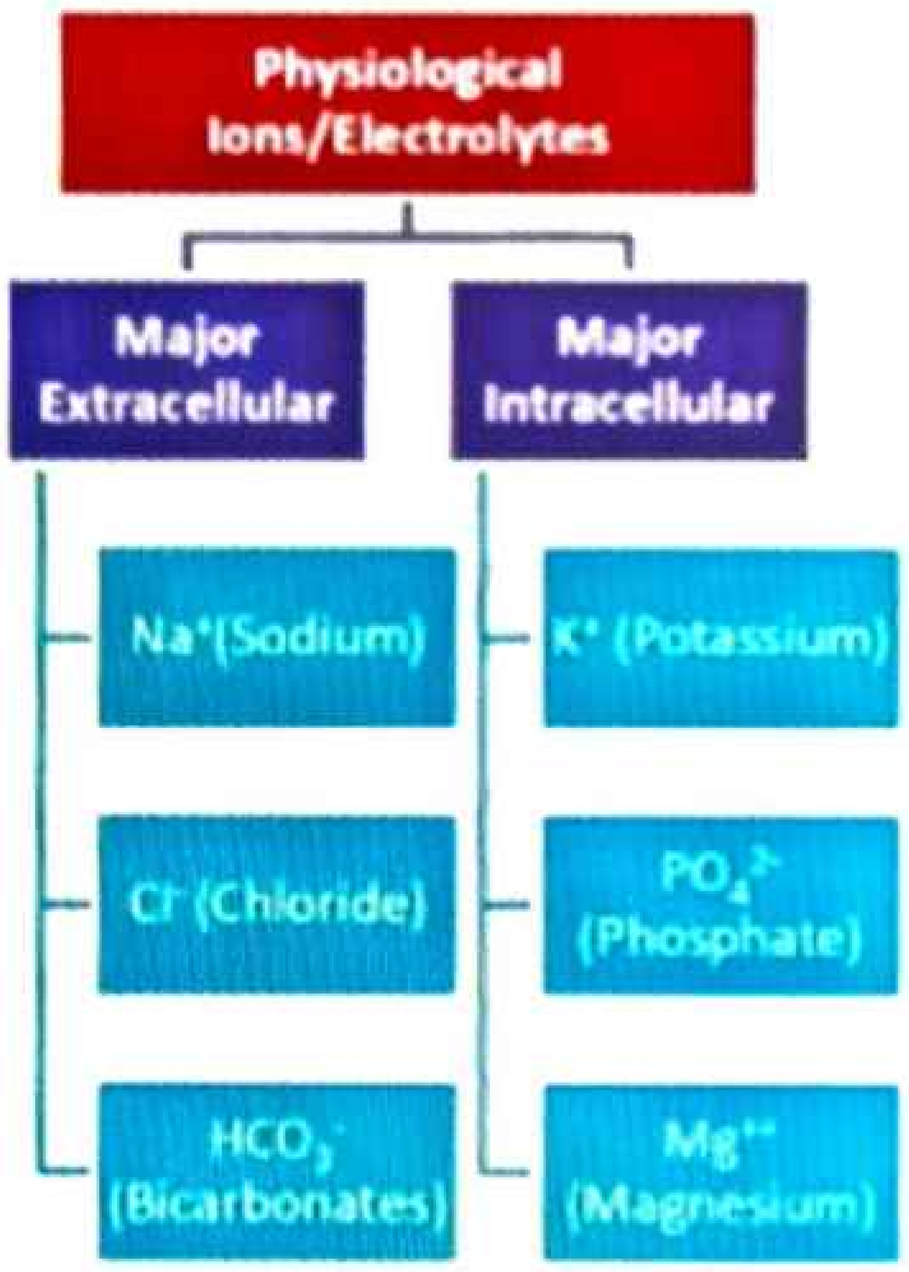
UNIT – II (B) MAJOR EXTRA AND INTRACELLULAR ELECTROLYTES

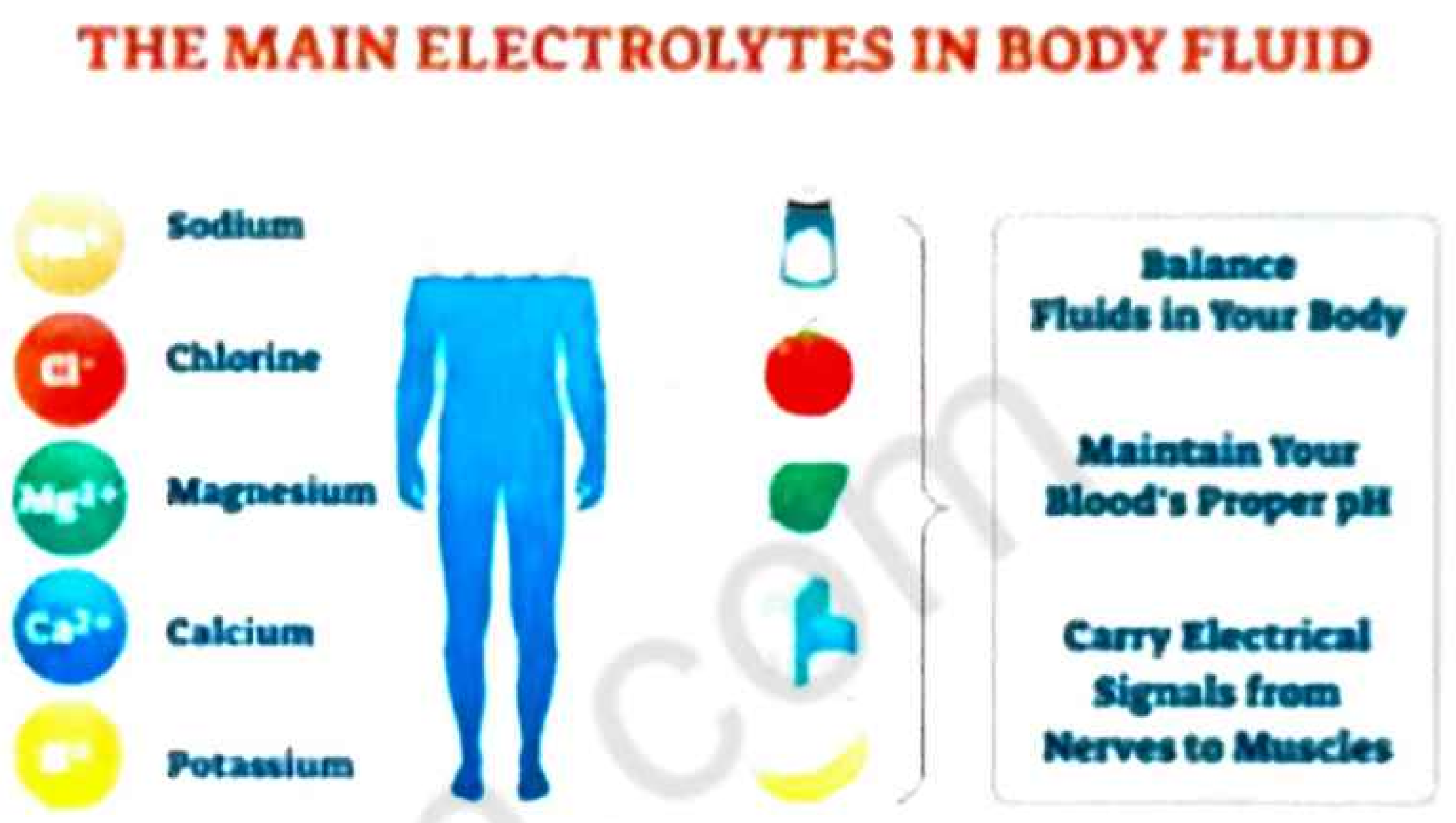
POINTS TO BE COVERED IN THIS TOPIC

- INTRODUCTION
- FUNCTIONS OF MAJOR PHYSIOLOGICAL IONS
- ELECTROLYTES USED IN THE REPLACEMENT THERAPY
- PHYSIOLOGICAL ACID BASE BALANCE

INTRODUCTION

- An **electrolyte** is any substance that **dissociates** into ions in **aqueous solution.**
- Ions can be **positively charged (cations)** or **negatively charged (anions).**
- The **major electrolytes** found in the **human body are:**





FUNCTIONS OF MAJOR PHYSIOLOGICAL IONS

❖ ROLE OF SODIUM

- This **plays a crucial** role in the excitability of **muscles and neurons** . It is also of **crucial importance** in **regulating fluid balance** in the body.
- **Sodium levels** are **extremely closely** regulated by kidney function.
- Major factors that **control the GFR** include the blood pressure at the glomerulus and the stimulation of **renal arteriole** by the **sympathetic nervous system.**

❖ ROLE OF POTASSIUM

- Its **main role** in the body is to help **maintain normal levels** of fluid inside our cells.
- Sodium, its **counterpart, maintains** normal fluid levels outside of cells.
- **Potassium** also helps muscles to **contract and supports** normal blood pressure.

❖ ROLE OF CALCIUM

- It helps form and **maintain healthy teeth** and **bones.**
- A **proper level of calcium** in the body over a lifetime can help **prevent osteoporosis.**
- Besides **transmitting nerve impulses** across synapse , calcium is essential for **clotting blood** and **contracting muscles.**

❖ ROLE OF PHOSPHATE

- **Nucleic acids and high-energy** molecules such as **ATP require** phosphorus for synthesis.
- Furthermore, it **contribute to maintaining** the **pH balance of the body.**

❖ ROLE OF MAGNESIUM

- Among the **functions of magnesium** within cells are to assist **sodium-potassium pumps** and **aid enzymes.**
- It has an important role in **muscle contraction, conduction of action potentials**, and the production of **bone and teeth.**

❖ ROLE OF CHLORIDE

- **Cl- channels** reside both in the **plasma membrane** and in intracellular organelles.
- Their functions range from ion **homeostasis** to cell volume regulation, **transepithelial transport**, and regulation of **electrical excitability.**

❖ ROLE OF BICARBONATE

- It serves as a **component** of the major **buffer system**, thereby playing a critical role in **pH homeostasis.**
- **Bicarbonate** can also be utilized by a variety of ion transporters, often working in **coupled systems,** to transport other ions and **organic substrates** across **cell membranes.**

ELECTROLYTES USED IN THE REPLACEMENT THERAPY

1. SODIUM CHLORIDE

- **Molecular formula** - NaCl
- **Molecular weight** - 58.44

❖ PHYSICAL PROPERTIES

- **Appearance** - Sodium chloride is a white crystalline crystal
- **Odour** - Odourless
- **Melting Point** - 801° C (1,474° F)
- **Boiling Point** - 1,413° C (2,575° F)
- **Density** - 2.16 g/cm3

❖ CHEMICAL PROPERTIES

- Freely soluble in **water, glycerine**
- **Nonreactive stable** compounds
- **Saline in taste**

❖ PREPARATION

- Naturally It can be **obtained from Rock salt strata** & **Sea water**. But from these sources it can be obtained in **impure form**. The pure form of salt can be obtained by the **filtration process** & finally the dried form can be collected by **evaporation process.**
- It can also be **prepared in laboratory** in small scale by the **acid- base reaction.**

❖ USES

- It is used **as electrolyte replenisher.**
- Its **0.9% solution** is isotonic (having same osmotic pressure) as blood.
- It is also used as **taste enhancer** in the preparation of dishes.
- It is also used in **Wet dressings & irrigation of body cavities.**

2. Potassium Chloride (Potassium muriate, Potash muriate)

- **Molecular formula**- KCl
- **Molecular weight**- 74.5513 g/mol

❖ PROPERTIES

- Strong **saline taste**
- It is **odorless** and has a **white vitreous crystal** or **colorless appearance**.
- **KCl is highly soluble** in water and a variety of polar solvents, and **insoluble** in many organic solvents.

❖ USES

- It is used as **electrolytes replenisher.**
- **pH buffers**
- Preparation of **fertilizers, explosives, potassium metal** and **potassium hydroxide.**
- In **treatment of hypokalemia** (potassium deficiencydisorder)
- Used in treatment of **digitalis poisoning**
- Used in treatment of **myasthenia gravis**

❖ PREPARATIONS

- In the **laboratory, KCl** can be prepared by reacting bases of **potassium with hydrochloric acid.**
- The ensuing **acid-base neutralization reaction** will yield water and **potassium chloride** as the products.

3. Calcium gluconate

- **Molecular formula** - $C_{12}H_{22}CaO_{14}$
- **Molecular weight** - 430.373 g/mol

❖ PROPERTIES

- **Stable in air.**
- Loses water **at 120 °C.**
- **Calcium gluconate** is decomposed by dilute **mineral acids into gluconic acid** and the calcium salt of the **mineral acid used.**
- It is precipitated from its **aqueous solution** by the **addition of alcohol.**

❖ USES

- **Calcium gluconate** is a medication used to **manage hypocalcemia**, **cardiac arrest,** and **cardiotoxicity** due to hyperkalemia or hypermagneseia.

❖ PREPARATION

- It is prepared by **boiling a solution** of **gluconic acid** with excess of **calcium carbonate**, **filtering and crystallising** the substance from filtrate.

$$2CH_2(OH)(CHOH)_4COOH + CaCO_3 + CaCO_3 + CO_2 + H_2O$$

4. ORAL REHYDRATION SALT

- **Oral rehydration salt** contain **anhydrous glucose**, **sodium chloride, potassium chloride** and either **sodium bicarbonate or sodium citrate.**
- These **dry preparations** are to be mixed in **specific amounts of water** along with certain **flavouring agents** and a suitable agents for **free flow of powder.**
- These are used for **oral rehydration therapy**. In **ancient times**, homemade ORS is used which constitutes of **one tablespoonful of salt**, **two tablespoonful of sugar** in **1 litre of water.**
- The following **three formulations** are usually prepared. When glucose is used, **sodium bicarbonate** is packed separately. The quantities given below are preparing **1 litre solution.**

Ingredients	Formula I	Formula II	Formula III
Sodium chloride	1.0 gm	3.5 gm	3.5 gm
Potassium chloride	1.5 gm	1.5 gm	1.5 gm
Sodium bicarbonate	1.5 gm	2.5 gm	-
Sodium citrate	-	-	2.9 gm
Anhydrous glucose	36.4 gm	20.0 gm	20.0 gm
glucose	40.0 gm	22.0 gm	-

PHYSIOLOGICAL ACID BASE BALANCE

- **Body fluids** are having **balanced quantity** of **acids and bases** and this quantity is maintained by **intricate mechanism.**
- The maintenance of this **balance quantity** is necessary for **biochemical reaction** talking places in body, because **biochemical reaction** are very sensitive to **even small change of acids** and **bases.**
- Example: **Low pH value** in **stomach is requiring** for functioning of enzyme pepsin which is useful for **digestion of food.**
- The **pH values** of **certain body fluids are:**

Body fluids	pH value
Gastric juice	1.5 – 3.5
Urine	4.5 – 8.0
Saliva	5.4 – 7.5
Bile	6.0 – 8.5
Semen	7.2 – 7.6
Blood	7.4 – 7.5

- Body is having its **own buffer system** which prevents **drastic change** in the **pH value of blood.**
- It also helps to **convert strong acids** and bases into **weak acids or bases.**
- **Lungs and kidney** are the main organ which helps to **maintain buffer system in the body.**

❖ CONDITIONS WHERE METABOLIC ALKALOSIS OCCURS:

1. **Loss** of chloride ions
2. **Administration of diuretics**
3. Excessive **ingestion of alkaline drugs**
4. **Endocrine disorder**

❖ CONDITIONS WHERE METABOLIC ACIDOSIS OCCURS:

1. **Absorption** of excess metabolic acids
2. **Formation of excessive quantities** of metabolic acids like carbonic acids.
3. Failure to **excrete metabolic acids.**
4. **Loss of base** from body fluids
5. **Diabetes mellitus**
6. **Diarrhoea**
7. **Uremia**
8. **Excess vomiting**

UNIT – II (C) DENTAL PRODUCTS

POINTS TO BE COVERED IN THIS TOPIC

- INTRODUCTION
- ROLE OF SODIUM FLUORIDE
- CALCIUM CARBONATE
- SODIUM FLUORIDE
- ZINC EUGENOL CEMENT

INTRODUCTION

- **Dental products** are those substances which **prevent the dental caries, dental decay** and give the **freshness and cleanness** to the mouth and teeth.
- In market it is mainly available in the **form of toothpaste, tooth powder, mouthwash, tooth gel, dentifrice etc.**

➢ TYPES OF DENTAL PRODUCTS

- **Anticaries agent**
- **Dentifrices**
- **Desensiting agents**
- **Cement and fillers**
- **Abrasive**

❖ ANTICARIES AGENT

- **Dental caries** or **tooth decay** is more or **less a disease** of the **teeth** caused by acids produced by the action of **microorganisms on carbohydrates.**
- Example – **Sodium fluoride , Stannous fluoride**

❖ DENTIFRICES

- **Dentifrices** are the substances that are used along with the **toothbrush** for **cleaning and polishing** accessible surfaces of **teeth.**
- These are **generally** in the form of **paste , powder , gel** or **liquid.**
- Examples – **calcium carbonate** , **dibasic calcium phosphate** , **calcium phosphate** , **sodium metaphosphate.**

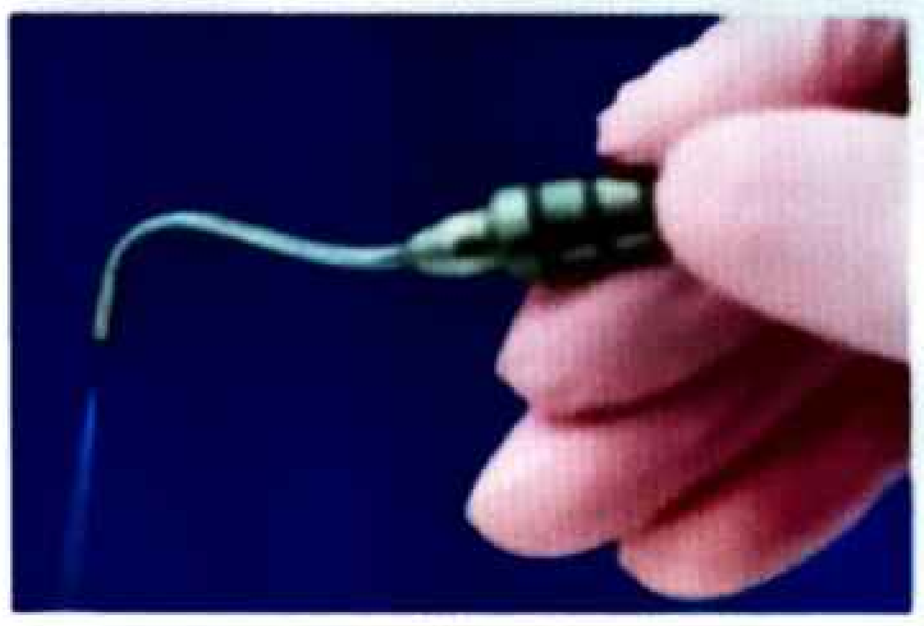
❖ DESENSITIZING AGENT

- The **desensitizers** tend to **decrease hypersensitivity** of the **teeth** when applied to their **outer surface** , **especially were erosion** has occurred near the **gum line.**
- Example – **Strontium chloride** , **zinc chloride**

❖ CEMENT AND FILLERS

- Dental cements are used to temporarily cover protection that had gone operation.
- It is applied as paste which solidify later.
- Eugenol is antiseptic and act as local anaesthetic is used in cement as a mediated product.
- Gold and silver are used as permanent filling.

❖ ABRASIVE



- A dental abrasive is an important part of dental services.
- This specialty deals with the finishing and polishing of dental appliances like complete dentures, removable partial dentures, crown and bridges and the direct dental restorative materials.

ROLE OF SODIUM FLUORIDE

- Fluoride is anticariogenic as it replaces the hydroxyl ion in hydroxy apatite with the fluoride ion to form fluorapatite in the outer surface of the enamel.
- It can be administrated by two routes- Orally and Topically.
- Fluoride in low concentration (1-2 parts per million), if present in drinking water, also causes, the decrease in development of incidence of caries in the population.
- Fluoride can also be administrated orally as Sodium Fluoride tablets or drops added in water or fruit juice.
- But it is not beneficial as such. A 2% aqueous solution of sodium fluoride and 8% solution of stannous fluoride are extensively used for topical application.
- Two such well established fluorides are Sodium fluoride and Stannous fluoride.

CALCIUM CARBONATE

- **Chemical formula** - $CaCO_3$
- **Molecular weight** – 100.09

❖ METHOD OF PREPARATION

- **Calcium carbonate** is precipitated when **carbon dioxide** is passed through **lime water** or a solution of **sodium carbonate** is added to **calcium chloride** which results into the formation of calcium carbonate.

$$CaCO_3 + CO_2 + H_2O \rightarrow Ca(HCO_3)_2$$

$$CaCl_2 + Na_2CO_3 \rightarrow CaCO_3 + 2\,NaCl$$

❖ PHYSICAL PROPERTIES

- **Calcium carbonate** occurs as a white, **odourless, tasteless, micro crystalline powder** which is stable in air.
- It is practically soluble in **dilute hydrochloric acid** and **nitric acid** but is insoluble in **water and alcohol.**

❖ USES

- It is used **externally as dentrifice**, as a dental cleaning **polishing agent** for most **tooth paste** and **tooth powders.**
- It is used as **insecticides.**
- Due to its **fast action, calcium carbonate** is used as an antacid, as a **calcium supplement** in deficiency states; as **a food additive.**
- It is also used in the preparation of **homoepathic medicine.**

SODIUM FLUORIDE

- **Chemical formula** – NaF
- **Molecular weight** – 41.99

❖ PREPARATION

- It is prepared by **reacting hydrofluoric acid** with **sodium carbonate.**
- **Sodium fluoride** being not very soluble **precipitates out.**

$$2HF + Na_2CO_3 \rightarrow 2NaF + H_2O + CO_2\uparrow$$

- Alternatively , the **another method involves** the double decomposition of **calcium fluoride with sodium carbonate.**

$$CaF_2 + Na_2CO_3 \rightarrow 2NaF + CaCO_3$$

❖ PROPERTIES

- It occurs as **colourless, odourless crystals** or as **white powder.**
- It is **soluble in water** but is **insoluble in alcohol.**
- On acidification of **salt solution**, **hydrofluoric acid** is produced.
- This is weak acid and is **poisonous.**
- Aqueous solution of salt yields **alkaline solution.**

❖ STORAGE

- Aqueous solution of **Sodium Fluoride** corrodes **ordinary glass bottles** and hence the solution should be prepared in **distilled water** and stored in dark, **pyrex bottles.**

❖ USES

- It is used in the preparation of **dental caries** because of its **fluoride ion concentration.**
- It is a constituent of some **insecticides and rodenticides.**
- It is used in the preparation of a **tooth paste** which constituent about **75 % of sodium fluoride** and **25% of glycerol.**

ZINC EUGENOL CEMENT

❖ COMPOSITION

a. Liquid

- **Eugenol (react with zinc oxide)**
- **Olive oil (plasticizer)**

b. Powder

- **Zinc oxide** (principal ingredient)
- **Zinc stearate** (accelerator, plasticizer)
- **Zinc acetate** (accelerator, improve strength)
- **White rosin** (to reduce brittleness of set cement)

❖ PROPERTIES

- It is the **cement of low strength**, **low abrasive resistance**, and low flow after setting, so it is used for **temporary filling** not be more then few days.
- It has **adhesive effect** on **exposed dentin.**
- It is least irritating than other dental cements.

❖ USES

- It is used as an **impression material** during construction of **complete dentures** and is used in the **mucostatic technique** of taking impressions.