

# Pharmaceutical chemistry

## Chapter—3 Inorganic pharmaceutical

### Unit-1— Haematinics.

**Haematinics** are those substances which provide the suitable condition for blood component formation and support the blood formation (Erythropoiesis). Its generally contains the iron/ferrous containing compounds, which are the essential substances required for the blood metabolism and provide the prevention against the deficiency syndrome of iron or ferrous. In haematinics also include the supporting elements for blood formation and maturation. Example- zinc, copper, vitamins, folic acid etc.

- **Bone marrow** is the area/zone of blood components formation (RBC, WBC, & PLATELETS). By the combination effects of blood substances provide the immunity against any disease.
- **Hemoglobin** is the iron rich red color protein which presents in the RBC and carry the oxygen from one place to another in the body.

**Classification of the Haematinics:** - On the basis of dosages and activity it is mainly divide into three categories.

1. **Iron containing substances:** - on the basis of dose administration it is divide into two parts-

→ **Oral iron**— Ferrous fumarate, ferrous sulphate, Carbonyl iron, Ferric ammonium citrate.

→ **Parenteral**— Iron dextran, ferrous sucrose.

2. **Maturation activity:** - Example- Vitamin B12, folic acid.
3. **Haematinics adjuvant:** - Example- copper, pyridoxine, riboflavin.

### Ferrous sulphate.

➤ **Chemical formula-**  $\text{FeSO}_4$

**Molar mass-** 151.91g/mol.

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- **Introduction**—ferrous sulphate is an iron salt preparation which is used to management the iron deficiency symptoms. It is popularly known as green vitriol, Melanterite, Copperas. Its hydrated form is used medically to treat iron deficiency, and also for industrial applications.
- **Properties:** -
  - Color and state**—It is the white crystals powder but their heptahydrate form is shows blue-green color.
  - Odor and taste**— It is odorless with metallic taste.
  - Solubility**— it is soluble in water but in alcohol, ethylene glycol it shows negligible solubility.
    - Chemically it is a reducing agent so in pharmaceutical it reduces the other substance in useful form.
- **Pharmaceutical preparation**—pharmaceutically it is prepared in the form of- tablet, capsule, syrup, pills oral drop etc.
- **Brand/Market Name**—Folfes- plus, Feosol, Ferroearth, E-Folifer kid etc.
- **Storage condition**—It is stored in well closed air resistance unopened container and keep away from incompatible materials at room temperature and also away from the light and moisture.
- **Uses/Applications**—
  - Ferrous sulfate (or sulphate) is a medicine used to treat and prevent iron deficiency anemia.
  - Ferrous sulfate provides the iron supplement during the pregnancy and maintains the iron status in both child and mother.
  - Its preparations are highly required during the menstruation.

### Ferrous fumarate.

- **Chemical formula-**  $C_4H_2FeO_4$                       **Molar mass-**169.90g/mol
- **Introduction**— Ferrous fumarate also known as Feostat, Iron (II) fumarate, is the iron (II) salt of fumaric acid. Pure form of ferrous fumarate

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has an iron content of 32.87%, therefore one tablet of 300mg iron fumarate will contain 98.6mg of iron. It is often taken orally as an iron supplement.

### ➤ **Properties-**

**Color and state**—It occurs as reddish-orange powder.

**Odor and taste**— It is odorless with metallic taste.

**Solubility**—It is slightly soluble in water and negligible soluble in ethanol.

➤ **Pharmaceutical preparation**— pharmaceutically it is prepared in the form of- tablet, capsule, syrup, pills, oral drop etc.

➤ **Brand/Market Name**— Ferroplus, Naviglobin, Livogen Z, Autrin etc.

➤ **Storage condition**— It is stored in well closed air resistance unopened container and keep away from incompatible materials at room temperature and also away from the light and moisture.

### ➤ **Uses/Applications-**

- Ferric fumarate is also used to treat iron deficiency anemia.
- Ferrous fumarate replace iron found in hemoglobin, myoglobin, and enzymes and allows for the transportation of oxygen via hemoglobin.
- Ferrous fumarate and folic acid is a combination medicine used to treat or prevent certain types of anemia (low red blood cells) caused by an iron or folate deficiency.

## Ferric ammonium citrate.

➤ **Chemical formula-**  $(\text{NH}_4)_5[\text{Fe}(\text{C}_6\text{H}_4\text{O}_7)_2]$       **Molar mass-** 488.16g/mol

➤ **Introduction-** In its crystal structure each moiety of citric acid has lost four protons. The deprotonated hydroxyl group and two of the carboxylate groups ligate to the ferric center, while the third carboxylate group coordinates with the ammonium. It is also known as ferriseltz.

- It is prepared by the reaction of ferric hydroxide with citric acid, followed by treatment with ammonium hydroxide, evaporating, and drying.

### ➤ **Properties-**

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**Color and state**—it is a yellowish brown to red solid crystals.

**Odor and taste**—it shows ammonia like odor with saline or ferruginous taste.

**Solubility**—it is greatly soluble in water and insoluble in alcohol.

- **Pharmaceutical preparation**— pharmaceutically it is prepared in the form of- tablet, capsule, syrup, oral drop etc.
- **Brand/Market Name**— Ferigold, Cutifer, ferrous-M, Adrovit- plus etc.
- **Storage condition**— it is stored in well closed air resistance unopened container and keeps away from incompatible materials at room temperature and also away from the light and moisture.
- **Uses/Applications**—
  - Ferric citrate is also used to treat iron deficiency anemia.
  - Ferric ammonium citrate exerts hematinic action by replenishing iron, which is an essential constituent of hemoglobin formation.
  - Ferric citrate is used to control phosphorus levels in adults with chronic kidney disease.

### Ferrous ascorbate.

- **Chemical formula-**  $C_{12}H_{14}FeO_{12}$       **Molar mass-** 406.08g/mol
- **Introduction-** The alkali or alkaline earth metal salts or its hydroxides are reacted with ferrous sulfate then forms the corresponding ferrous salt, which is reacted with ascorbic acid in an aqueous medium at slightly acidic or neutral condition followed by filtration to get ferrous ascorbate in mother liquor. it is also known as ferrous ascorbate iron(2+) di-L-ascorbat , L-ascorbic acid.
- **Properties-**

**Color and state**— It is blue-violet color crystalline powder, containing 16% iron.

**Odor and taste**—it is odorless with metallic iron taste.

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**Solubility**—it is soluble in water, methanol, and ethanol.

- **Pharmaceutical preparation**— pharmaceutically it is prepared in the form of- tablet, capsule, syrup, pills, oral drop etc.
- **Brand/Market Name**—Firolin-XT, kryptofer-XT, Fericib-XT, Brisfer etc.
- **Storage condition**— It is stored in well closed air resistance unopened container and keep away from incompatible materials at room temperature and also away from the light and moisture.
- **Uses/Applications**—
  - Ferric citrate is used to control phosphorus levels in adults with chronic kidney disease.
  - Ferric citrate is also used to treat iron deficiency anemia.
  - Ferrous Ascorbate is a combination of iron and vitamin C used to manage the gastric problem and helps in the digestion.

### Carbonyl iron.

- **Chemical formula**- $\text{Fe}(\text{CO})_5$       **Molar mass**-195.9g/mol
- **Introduction**— Carbonyl iron is a highly pure iron, prepared by chemical decomposition of purified iron pentacarbonyl. In pharmaceuticals, carbonyl iron powder is used to treat iron deficiency and as an iron dietary supplement.
- **Properties-**
  - Color and state**— It is the pale yellow or straw color liquid.
  - Odor and taste**— It shows the pungent odor with metallic taste.
  - Solubility**—It is insoluble in water and ammonia, Soluble in organic solvents and slightly soluble in alcohol.
- **Pharmaceutical preparation**— pharmaceutically it is prepared in the form of- tablet, capsule, syrup, oral drop etc.
- **Brand/Market Name**—Irontic, Hefer-Z, Mycarb, Carvifol, Arfol-Z etc.

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- **Storage condition**— It is stored in well closed air resistance unopened container and keep away from incompatible materials at room temperature and also away from the light and moisture.
  
- **Uses/Applications**—
  - Carbonyl iron is a supplements used to treat or prevent low blood levels of iron (such as those caused by anemia or pregnancy).
  - Iron helps your body produce red blood cells that carry oxygen through your blood to tissues and organs.

# Pharmaceutical chemistry.

## Chapter—3 Inorganic pharmaceutical.

### Unit-2— Antacids.

**Antacids** are meant for neutralizing the gastric PH in stomach by binding or inhibiting the gastric receptor in our stomach. It inhibits the extra hydrochloric acid secretion in stomach and neutralizes the increasing level of hydrochloric acid.

Hydrochloric acid (HCl) is the highly acidic chemicals (PH about 1.5-2.5) which helps in the digestion process by activating the gastric enzymes. It is secreted by the parietal cells of the gastric gland. If concentration is increases then it may cause indigestion, heart burn, and gastric upset and gastrointestinal ulcer.

Most of antacids acts on H<sub>2</sub> receptor and proton pump inhibitor (PPI) in our gastric canal and maintain the H<sup>+</sup> ion concentration.

### Classification of Antacids

**On the basis of acting site it is divided into two categories—**

1. **H<sub>2</sub>-receptor antagonist**— Cimetidine, Ranitidine, Femeotide.
2. **Proton Pump Inhibitor**— Esomeprazole, Omeprazole, Pantoprazole.

**On the basis of inorganic elemental nature it is divided into many categories—**

1. **Calcium containing antacids**— Calcium carbonate, Tribasic calcium phosphate.
2. **Magnesium containing antacids**— Magnesium hydroxide, magnesium carbonate, magnesium oxide, magnesium trisilicate.
3. **Aluminium containing antacids**— Aluminium hydroxide, aluminium phosphate, aluminium carbonate, dihydroxy aluminium sodium carbonate.
4. **Sodium containing antacids**— Sodium bicarbonate.

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### 5. Combined antacids—

- Aluminium hydroxide gel and  $Mg(OH)_2$ .
- Aluminium hydroxide gel and Magnesium trisilicate.
- Aluminium hydroxide gel and calcium carbonate.

**Note:** - calcium and aluminium antacids may cause the constipation and magnesium and aluminium antacids may cause the laxative effects.

### Aluminium hydroxide gel.

**Chemical formula—**  $Al(OH)_3$

**Molar mass—** 78.00g/mol.

**Introduction—**It is also known as Aluminic acid, hydrated Alumina. It is the basic inorganic compounds which are reacts with the HCl and work quickly by lowering the acidic PH of gastric cavity. It does not affect on the acidic Production. Liquid antacids usually work faster/better than tablets or capsules.

**Properties—**

- **Color and state—**It is the white or pale yellow color amorphous powder.
- **Odor and taste—**it is the odorless with mucilaginous taste.
- **Solubility—**It is insoluble in water but soluble in acidic as well as basic medium.

**Pharmaceutical preparation—** Suspension, syrup, tablet, capsule, bolus.

**Brand/Market Name—** Digene, Gelusil, Vicid, Alquire, Asinil-T.

**Storage condition—** It is stored in well closed air resistance unopened container and keeps away from incompatible materials at room temperature and also away from the light and moisture.



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**Uses/Application**—Aluminium hydroxide is used to treat the gastric problem by neutralizing the increasing PH. It also provides relieve in heartburn, upset stomach, sour stomach.

Aluminium hydroxide is also used to reduce phosphate level in people with certain kidney conditions.

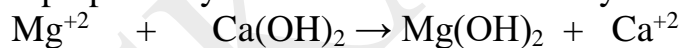
### Magnesium hydroxide.

**Chemical formula**—  $\text{Mg}(\text{OH})_2$

**Molar mass**— 58.32g/mol.

**Introduction**— It is also known as Milk of magnesia. It acts as the antacid by neutralizing the gastric PH since it reacts with the  $\text{H}^+$  of HCl and neutralize them and produce the water. It acts as laxative so increases the volume of feces in the intestine by stimulating the intestinal Motility.

On the commercial scale it is prepared by the reaction of calcium hydroxide or lime. Reaction—



**Properties**—

- **Color and state**—It is the white color crystalline solid or powder.
- **Odor and taste**—It is the odorless with milky taste or chalky taste.
- **Solubility**—It is slightly soluble in Water.

**Pharmaceutical preparation**— Suspension, syrup, tablet, capsule

**Brand/Market Name**— Digene, Gelusil, Antanil plus, Cremaffin, Maalox.

**Storage condition**— It is stored in well closed air resistance unopened container and keeps away from incompatible materials at room temperature and also away from the light and moisture.

**Uses/Application**—

- Magnesium hydroxide reduces stomach acid, and increase water in the intestines which may induce bowel movements.
- Magnesium hydroxide is used as a laxative to relieve the constipation.
- It is also used as antacid to relieve indigestion, sour stomach, and heartburn.

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### Magaldrate.

**Chemical formula**—  $\text{Al}(\text{OH})_3 \cdot \text{Mg}_2(\text{OH})_4 \cdot \text{H}_2\text{O}$       **Molar mass**— 212.67g/mol.

**Introduction**— Magaldrate is derived from the combination of the aluminium hydroxide and magnesium hydroxide so it is also called as Magnesium Aluminium monohydrate. it is widely uses in the gastric abnormalities. Magaldrate was first synthesized by the German Chemist Gunther Hallmann.

It is prepared by the reaction of active aluminium hydroxide and magnesium oxide/hydroxide in the presence of water, then obtain the megaldrate paste.

**Properties**—

- **Color and state**—it is the white color crystalline powder or paste.
- **Odor and taste**—It is the odorless with milky taste.
- **Solubility**—practically it is insoluble in water and ethanol and soluble in mineral acids.

**Pharmaceutical preparation**— Syrup, suspension, tablet, powder

**Brand/Market Name**—Gasorit, Novelta, metadrate, Pracid, Contacid.

**Storage condition**— It is stored in well closed air resistance unopened container and keeps away from incompatible materials at room temperature and also away from the light and moisture.

**Uses/Application**— Magaldrate is a common antacid drug that is used for the treatment of duodenal and gastric ulcers, esophagitis from gastroesophageal reflux disease (GERD).

It is also used during hyperphosphatemia.

### Sodium bicarbonate.

**Chemical formula**— $\text{NaHCO}_3$

**Molar mass**—84.01g/mol.

**Introduction**—Sodium bicarbonate commonly known as baking soda. It is the monosodium salt of carbonic acid shows antacid activity by neutralizing the excess gastric PH. Sodium bicarbonate and an acid agent react together to release  $\text{CO}_2$ , this property is used for the formulation of sparkling drinks.

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Large scale it is produced by the reaction of cold and concentrated solution of the sodium chloride (Brine solution) with ammonia and carbon dioxide in the presence of water.  $\text{NaCl} + \text{NH}_3 + \text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{NaHCO}_3 + \text{NH}_4\text{Cl}$ .

### Properties—

- **Color and state**—It is the white crystalline powder.
- **Odor and taste**—it is odorless with saline taste.
- **Solubility**—it is highly soluble in water, but practically insoluble in alcohol.
  - Sodium bicarbonate is a basic solution, if it is treated with the acid it gives effervescence due to release of  $\text{CO}_2$ .

**Pharmaceutical preparation**— Tablet, powder, ear drop, injection, capsule, sachet, syrup, suspension.

**Brand/Market Name**—Nodosis, Gaviscon, alka soda, rencarb, sodamint.

**Storage condition**— It is stored in well closed air resistance unopened container and keeps away from incompatible materials at room temperature and also away from the light and moisture.

**Uses/Application**—It is used for the treatment of metabolic acidosis in severe renal disease, uncontrolled diabetes, circulatory insufficiency due to shock or severe dehydration. It is also used to relieve heartburn, sour stomach, or acid indigestion by neutralizing excess stomach acid.

## Calcium Carbonate.

**Chemical formula**—  $\text{CaCO}_3$

**Molar mass**—100.0869g/mol.

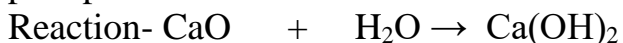
**Introduction**—It is also known as aragonite, calcite, and limestone, marble. Calcium carbonate shows wide range of activity in our body for healthy bones, muscles, nervous system and heart etc, by providing the calcium ion in our body. Calcium carbonate is widely used in the antacids preparation for relieving the heartburn, indigestion, and upset stomach. Calcium ions are also used in the water treatment and agricultural aspects. Overdose of calcium cause the hypercalcaemia and digestive problems.

- Calcium carbonate is prepared by the reaction of calcium oxide with water and carbon dioxide. Initially water is added to calcium oxide then it forms

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calcium hydroxide the carbon dioxide is passed through this solution to precipitate the desired calcium carbonate.



### Properties—

- **Color and state**— it is the whitish or milky crystalline powder.
- **Odor and taste**— it is odorless with bitter taste.
- **Solubility**— it is practically insoluble in water and ethanol.

**Pharmaceutical preparation**— Tablet, syrup, capsule, pills, Tooth paste, tooth powder, oral drop.

**Brand/Market Name**— Shelcal, calvitan, Acidocid SF, calcimax P etc.

**Storage condition**—It is stored in well closed air resistance unopened container and keep away from incompatible materials at room temperature and also away from the light and moisture.

### Uses/Application—

- It is used for water treatment. In water treatment it forms the complexes with other harmful metals.
- Calcium plays a vital role for the growth and maturation of the body like muscles, bones, teeth, and organs.
- Calcium carbonates acts as antacid and neutralizes the acidic PH and prevents the indigestion, heartburn, and gastric problems.

# Pharmaceutical Chemistry | Chapter—3 Inorganic Pharmaceutical

## Unit-3 — Anti-microbial Agents

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**Antimicrobial** are those agents which prevent the growth of microorganisms (Bacteria, fungus, virus, parasites). In the pharmaceutical and hospital it is widely used as cleaner and dressing for removing the microbes and maintain the sterilize area. In the co-vi-d pandemic many antimicrobial agents are used in the preparation of sterilize solution, sanitizer, hand washes etc. In medicinal value, antimicrobial are widely used to prevent the infection in human body or animals. Antimicrobial are used as both, the antiseptic (living tissues) and disinfectants (non-living objects) for reducing or killing the microbes.

**Classification of the antimicrobial agents**— on the basis of their activity and chemical nature it is categorized into many parts—

1. **Antibiotics agents**— Those agent which is work against the bacterial infection.
2. **Antifungal agents**— Those agent which is work against the fungal infection.
3. **Antiviral agents**— Those agent which is work against the viral infection.
4. **Antiparasitic agents**— Those agent which is work against the parasitic infection.

### Silver Nitrate.

**Chemical formula**—  $\text{AgNO}_3$

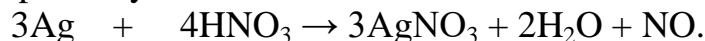
**Molar mass**— 169.87g/mol.

**Introduction**— Silver nitrate widely shows the antimicrobial or antiseptic properties. In the compound silver are attached to the nitrate by ionic bond, during the mechanism of action ionic bond break and release the free silver ions. These silver ions are binds to the tissue proteins of microbes and destroy the cellular activity.

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Silver nitrate is prepared by the reaction of free silver with nitric acid.



### Properties—

- **Color and state**— it is a colorless crystalline powder or solid.
- **Odor and taste**— it is odorless and shows bitter metallic taste.
- **Solubility**— it is soluble in water and glycerol.

**Pharmaceutical preparation**— Cream, gel, solution.

**Brand/Market Name**— Silverex, Burn Heal, Sivacure+.

**Storage condition**— It is stored in well closed air resistance unopened container and keeps away from incompatible materials (like copper) at room temperature, and also away from the light and moisture. It is very sensitive for heat and decomposes in their ionic form.

**Uses/Application**— By precipitating the microbial surface protein it acts as an antibacterial and antiseptic characteristics. It is widely used a burning cream and cleaning agent. In the co-vid pandemic it is also used to manufacturing the sanitizer and cleaner preparation. Silver nitrate can also help create a scab to help stop bleeding from a minor skin wound.

## Ionic Silver.

**Chemical formula**—  $\text{Ag}^+$

**Molar mass**— 107.868g/mol

**Introduction**— Ionic silver is widely used in the manufacturing unit. Free silver ions are easily binds to the surface proteins of the microbes and forms the complexes/precipitate. Ionic silver are also used as the precursor for other metal extraction. Very dilute solutions of ionic silver act as an astringent and mildly antiseptic. It is also called as silver cation and it is very sensitive for the anion like chloride.  $\text{Ag}^+ + \text{Cl}^- \rightarrow \text{AgCl}_{(s)}$

### Properties—

- **Color and state**— It is present in the form of clear colorless liquids.
- **Odor and taste**— it is odorless and shows metallic taste.
- **Solubility**— Under normal conditions silver is insoluble in water.

**Pharmaceutical preparation**— Cream, gel, solution.

**Brand/Market Name**— Sulfhex, sildaflo, AgNeon, silvebel.

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**Storage condition**— It is stored in well closed air resistance unopened container and keeps away from incompatible materials (like copper) at room temperature, and also away from the light and moisture. It is very sensitive for heat and decomposes in their ionic form.

**Uses/Application**— it is used in the manufacturing of antiseptic cream, solution, liquids etc. Silver is reduce or prevent infection have been seen in the topical treatment of burns and chronic wounds and in its use as a coating for many medical devices. It is also used in the toothpaste manufacturing.

## Chlorhexidine Gluconate.

**Chemical formula**—  $C_{34}H_{54}C_{12}N_{10}O_{14}$       **Molar mass**— 897.75g/mol.

**Introduction**— Chlorhexidine gluconate and Chlorhexidine digluconate is a disinfectant and antimicrobial agents that is used for skin disinfection before surgery and to sterilize surgical instruments. It is also used for cleaning wounds, prevents dental plaque, treating yeast infections of the mouth. It is general known as Chlorhexidine. Chlorhexidine gluconate is positively charged and reacts with the negatively charged microbial cell surface, thereby destroying the integrity of the cell membrane.

**Properties**—

- **Color and state**— it is present in the form of colorless or pale yellow color powder or solution.
- **Odor and taste**— It is odorless and shows bitter taste.
- **Solubility**— Practically it is insoluble in water but it salt is easily soluble in water.

**Pharmaceutical preparation**— Mouth washes, gel, lozenges, solution, gauges.

**Brand/Market Name**— Hexidine, hexigel, septlon, cuticell, bactigras.

**Storage condition**— It is stored in well closed air resistance (generally amber colored) unopened container and keeps away from incompatible materials at room temperature, and also away from the light and moisture.

**Uses/Application**— Chlorhexidine is widely used in the dental preparation for treating the dental carries. Due to their antimicrobial property it is also used as cleaning agent, wound healing agents etc.

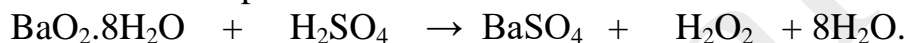
### Hydrogen peroxide.

**Chemical formula—**  $\text{H}_2\text{O}_2$

**Molar mass—** 34.02g/mol.

**Introduction—** Hydrogen peroxide shows the good antibacterial property and it widely used for the wound washing or cleaning. It is also uses as an oxidizer, bleaching agent and antiseptic.

It is prepared by, acidifying barium peroxide and removing excess water by evaporation under reduced pressure.



**Properties—**

- **Color and state—** It is almost colorless or pale yellow color liquid.
- **Odor and taste—** It is odorless and shows bitter taste.
- **Solubility—** It is soluble in water in all proportions.

**Pharmaceutical preparation—** Solution, cream

**Brand/Market Name—** Peroxida, crystacide, hydrogen peroxide solution.

**Storage condition—** It is stored in well closed air resistance (generally amber colored) unopened container and keeps away from incompatible materials at room temperature, and also away from the light and moisture.

**Uses/Application—** Hydrogen peroxide is primarily used for washing/cleaning the wound. Hydrogen peroxide is a mild antiseptic used on the skin to prevent infection of minor cuts, scrapes, and burns. It also used in the ear wax treatment or loosing for the ear wax.

### Boric acid.

**Chemical formula—**  $\text{H}_3\text{BO}_3$

**Molar mass—** 61.83g/mol.

**Introduction—** Boric acid is widely used as an antimicrobial agent for very sensitive area and infection.

Chemically boric acid is a weak monobasic acid. It is not a protonic acid but acts as a lewis acid by accepting electrons from a hydroxyl ion. On heating boric acid above 370k from metaboric acid ( $\text{HBO}_2$ ), which on further heating yields boric oxide  $\text{B}_2\text{O}_3$ .



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### Properties—

- **Color and state**— it is almost white crystalline powder with soapy touch.
- **Odor and taste**— it show foul odor with slightly acidic taste.
- **Solubility**— It is sparingly soluble in water but highly soluble in hot water.

**Pharmaceutical preparation**— Powder, ointment, drops, suppositories.

**Brand/Market Name**— Boricada, borexa, boricap, boric acid powder.

**Storage condition**— It is stored in well closed air resistance unopened container and keeps away from incompatible materials at room temperature, and also away from the light and moisture.

**Uses/Application**— Boric acid is widely used for antiseptic washing to control the infection. It is used during the eye infection, irritation, inflammation. Boric acid suppositories prevents the vaginal infections and maintain the vaginal PH. In many skin diseases boric acid are used as large scale like rashes, irritation, dermatitis etc.

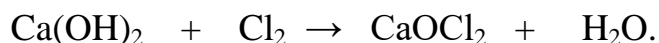
## Bleaching powder

**Chemical formula**—  $\text{CaOCl}_2$

**Molar mass**— 142.98g/mol

**Introduction**— It is used as disinfectant and antimicrobial agent for disinfecting water to make potable water. In hospital it is used for sterilizing the equipment and laboratory platform. It is also called calcium oxychloride and it is the main ingredient of commercial products called bleaching powder, chlorine powder, or chlorinated lime.

It is widely prepared by the chemical reaction of calcium hydroxide/slaked lime and chlorine.



### Properties—

- **Color and state**— It is a yellowish white colored crystalline powder.
- **Odor and taste**— It shows the chlorine like odor and taste.
- **Solubility**— It is soluble in the polar solvents like water but insoluble in non-polar solvents like ether.

**Pharmaceutical preparation**— Powder, solution.

**Brand/Market Name**— Aquafit, hth granules.

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**Storage condition**— It is stored in well closed air resistance, unopened container and keeps away from incompatible materials at room temperature, and also away from the light and moisture.

**Uses/Application**— Bleaching powder is used as disinfectant and germicide especially in the sterilization of drinking water. Bleaching powder is mainly used for the chlorine sources in the pharmaceutical or chemical industries.

## Potassium permanganate.

**Chemical formula**—  $\text{KMnO}_4$

**Molar mass**— 158.03g/mol.

**Introduction**— Potassium permanganate is used as antibacterial agent to care of the skin infection, wound infections, fungal infection etc. It is also used as a regeneration chemical in well water treatment for the removal of hydrogen sulphide and iron.

It is prepared by the chemical reaction potassium manganate and hydrochloric acid.



**Properties**—

- **Color and state**— It is present in the dark purple color crystal solids.
- **Odor and taste**— It is odorless and shows sweet taste.
- **Solubility**— It is water soluble and more soluble in hot water.

**Pharmaceutical preparation**— Solution, powder.

**Brand/Market Name**— potassium permanganate crystals.

**Storage condition**— It is stored in well closed air resistance unopened container and keeps away from incompatible materials (flammables, combustibles and reducing agents) at room temperature, and also away from the light and moisture.

**Uses/Application**— Potassium permanganate is used for infections of the foot, superficial wounds, dermatitis, and topical ulcers. Potassium permanganate is a mild antiseptic with astringent properties. It is used in dermatology to treat weeping skin conditions. Potassium permanganate tablets are commonly used in clinical practice.

# Pharmaceutical chemistry

## Chapter—3 Inorganic pharmaceutical

### Unit-4 — Dental products.

**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.

**Dental caries**— it is defined as, demineralization or destruction of inorganic and organic matrix from the calcified tissue of the tooth by the activity of microbes. In this process of tooth destruction of the mineral phase, consisting primarily of hydroxyl apatite crystals by organic acids produced by bacterial growth.

**Dental plaque**—plaque is defined as whitish or pale yellowish soft accumulations of bacterial colony (mainly Streptococci) and their substrate which deposits on the teeth while not cleaned adequately.

**Gingivitis**—Gingivitis is a form of gum disease that happens when plaque, a naturally occurring sticky film containing bacteria, builds up on teeth and causes the inflammation of the surrounding gum tissue.

- In dental products many abrasive is used for abrading, grinding or polishing. Abrasive are most often found as crystals, small and small particles that are preferred to avoid tooth wear. Hydrated silica is a common abrasive in dentifrice, alumina and calcium carbonate may also be used.

### **Dental products Classification.**

On the basis of their activity it is divided into five parts-

1. **Anti plaque agent**— Example: - Triclosan, delmiopinol, phenolic compounds
2. **Anticaries agent**—Example: - Sodium fluoride, stannous fluoride.
3. **Cleaning/dentifrice agent** —Example: - Calcium carbonate, calcium phosphate, sodium metaphosphate.
4. **Desensitizing agent**—Example: - Strontium chloride, zinc chloride.
5. **Mouth washes**—Example:- Chlorhexidine gluconate, potassium nitrate.

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## Calcium carbonate.

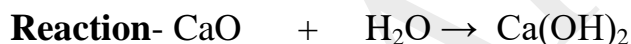
**Chemical formula**—  $\text{CaCO}_3$

**Molar mass**—100.0869g/mol

**Introduction**—It is also known as aragonite, calcite, and limestone, marble.

Calcium carbonate shows wide range of activity in our body by providing the calcium ion in our body. Teeth enamel is mainly made by calcium salts so calcium carbonate plays a major role in tooth development and provides the strength of tissues. Calcium ions are also used in the water treatment and agricultural aspects. Overdose of calcium cause the hypocalcaemia and digestive problems.

- Calcium carbonate is prepared by the reaction of calcium oxide with water and carbon dioxide. Initially water is added to calcium oxide then it forms calcium hydroxide the carbon dioxide is passed through this solution to precipitate the desired calcium carbonate.



### **Properties**—

- **Color and state**—it is the whitish or milky crystalline powder.
- **Odor and taste**—it is odorless with bitter taste.
- **Solubility**—it is practically insoluble in water and ethanol.

**Pharmaceutical preparation**—Tablet, syrup, capsule, pills, Tooth paste, tooth powder, oral drop.

**Brand/Market Name**— Coolwhite, Emoform, denti fresh etc.

**Storage condition**—It is stored in well closed air resistance unopened container and keep away from incompatible materials at room temperature and also away from the light and moisture.

### **Uses/Application**—

- It is used for water treatment. In water treatment it forms the complexes with other harmful metals.
- Calcium plays a vital role for the growth and maturation of the body like muscles, bones, teeth, and organs.

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- Calcium carbonates acts as antacid and neutralizes the acidic PH and prevents the indigestion, heartburn, and gastric problems.

### Sodium fluoride

**Chemical formula**— NaF

**Molar mass**— 41.99g/mol

**Introduction**— Sodium fluoride is an inorganic chemical which is widely used for fluoride ion in dental products preparations. It protects the teeth from acid demineralization during bacterial growth. It provides the strength for tooth enamel and prevents the tooth decay. Minor quantity of sodium fluoride is used in drinking water.

- It is prepared by reaction of hydrofluoric acid with sodium carbonate and finally obtained a insoluble precipitation.



**Properties**—

- **Color and state**—it is colorless crystalline powder.
- **Odor and taste**—it is odorless with salty taste.
- **Solubility**—it is readily soluble in water but insoluble in alcohol.

**Pharmaceutical preparation**—Tablet, solution, drops, toothpaste.

**Brand/Market Name**—Optifresh, NuNof, D Flour, Vinaflour.

**Storage condition**— It is stored in well closed air resistance unopened container and keeps away from incompatible materials at room temperature and also away from the light and moisture.

**Uses/Application**—

- Sodium fluoride is an ingredient of various dental preparations used to support tooth mineralization and the prevention of dental caries.
- It is also used in water treatment.

### Denture cleaners

The word **denture** referred as, a removable plate or frame holding one or more artificial teeth or false teeth. It replaces our missing teeth by adding the false teeth and it is surrounded by soft and hard tissue of oral cavity.

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**Denture cleaners** are those substances or equipments which are designed to safety removal of stains, deposits, debris from the denture or mouth caused by diet, tobacco, coffee and tea drinking etc. The main use is to control the growth of microorganism (*Candida albicans* a yeast) on the dentures thereby preventing dentures related stomatitis.

In our personal hygiene, denture cleaners play an important role to maintain the hygienic conditions of our mouth. It also helps in removing the mouth odor and keep freshness as long time. Now a day, many spray denture cleaners are widely used.

The process by which denture accumulate plaque (Biofilm), stain and calculus is approximately similar to the process which takes place on natural teeth. On the basis of using process it is divided mainly into two categories.

- **Chemical method**

- Alkaline peroxide and alkaline hypochlorite
- Disinfectants- Chlorhexidine
- Dilute organic and inorganic acid- Hydrochloric acid, acetic acid.
- Enzymes- Glycoprotein, muco-polysaccharides

- **Mechanical method**

- Brushing
- Tooth paste & tooth powder
- Ultrasonic agitation

**Pharmaceutical preparation**— Paste, powder, liquid, and cleaning Brush.

**Market/ Brand Name**—Dentural, Polident, steradent(Peroxide).

### Denture adhesives

**Denture adhesive** are those substances which act as adhesive materials between the gum and denture. It allows for a sticky layer between the tissue and

the denture surface that helps to keep the denture in place while function and helps stop any movements.

The absorption of saliva or mouth liquids expands the adhesive which results in 'filling the empty space' that aids in more adhesion. In market denture adhesive is present in the form of paste, powder, strip made from a non-toxic, non-irritant water soluble material that are placed between the denture and gum line.

Before wear of denture proper cleaning and hygiene are required. Denture adhesive should only be used to improve function of denture that are properly fitted and give a natural confidence. On the basis of physical state it divides into three categories—

1. **Denture adhesive cream**— Cream or paste typically comes in a tube and, is applied in small amounts on wet dentures directly to the part of the denture that connects with the bone tissue. Denture cream has a higher adhesive strength than adhesive powder.
2. **Denture adhesive powder**— Adhesive powder is applied by sprinkling the powder directly on wet dentures, specifically to the part of the denture that connects with the bone tissue. Unlike denture adhesive cream, powder covers the entirety of the surface that connects with tissue.
3. **Denture adhesive strip**— These strips either one whole piece or multiple smaller strips, depending on the brand are applied to dry dentures before being placed in the mouth.

#### **Composition of denture include as—**

**Zinc**—this mineral helps the adhesive create that grip you need. (**Zinc can be toxic if you ingest too much of it**)

**Mineral oil**—this ingredient delivers the right denture cream consistency.

**Petroleum**—like mineral oil this helps with consistency.

**Cellulose gum**—this ingredient helps the denture stick in place.

**Silica**—it also works to help create the right consistency.

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**Pharmaceutical preparation**— Cream or paste, powder, strip.

**Market/brand Name**—Fixodent, poligrip (zinc free), Fittydent, Seabond

**Storage condition**— It is stored in well closed air resistance unopened container and keeps away from incompatible materials at room temperature and also away from the light and moisture.

### Mouth washes.

**Mouth washes** is the liquid preparation meant for preventing the dental caries and oral contamination. It removes the bad breath and keeps freshness at long time. Mouth washes are the antiseptic solution intended to reduce the microbial activity and reduces the mouth infections healing the wound rapidly.

Mouth washes is held in mouth directly or diluting form passively and swilled around the mouth by contraction of the perioral muscles and may be gargled.

Mouth washes contains the antibacterial agents, alcohol, glycerin, sweetening agent, flavoring agents and coloring agents. Normally we use the home made mouth wash by adding the NaCl salts in hot water or normal saline. On the basis of mouth washes activity it is divide into many parts: -

1. Antiseptic— Chlorhexidine, Listerine mouth wash.
2. Anti allergic—Benadryl mouth washes.
3. Anti haemostatic—Traneximic acid mouth washes.
4. Analgesic—Lidocaine mouth wash.
5. Steroid mouth wash—Triamcinolone Acetonide.

**Pharmaceutical preparation**—Solution, sprays.

**Market/brand Name**—Listerine, Hexadine, Gargilin, Unifresh.

**Storage condition**— it is stored in well closed air resistance unopened container and keeps away from incompatible materials at room temperature and also away from the light and moisture.



# Medicinal gases

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**Medicinal gases** is defined as the preparation for intended and uses for the patient diagnosis and treatment during the emergency conditions.

Naturally many useful gaseous are present in the environment but due to our activities like society development, more deforestation, pollution etc ,cause lowering the concentration of the these gaseous.

So, need of medical gases preparation is very important for us for medically as well as experimentally.

The therapeutic gases include oxygen, nitrous oxide, helium, and nitrogen etc these gases are usually given to the pre-operate, intra-operate, and post-operate patients and to the patients in case of emergency.

## Oxygen

**Chemical formula-**  $O_2$ .

**Molar mass:** 32 g/mol

**Introduction** - Oxygen are present in gases in the form of dioxygen with formula  $O_2$ .

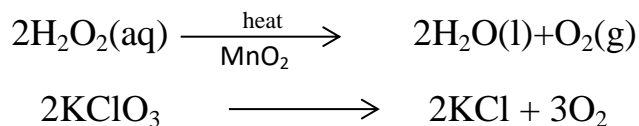
Oxygen is the most abundant of all the elements on earth. Oxygen forms about 46.6% by mass of earth's crust. Dry air contains 20.946% oxygen by volume.

Naturally it is prepare by the green plants in the presence of light energy and it helps in our respiratory mechanism . In our body it is transported by the blood and participate in the metabolism.

Oxygen is the most critical factor on the earth for most of the aerobics living organisms.

### Laboratory it is prepared by:

Hydrogen peroxide is readily decomposed into water and dioxygen by catalysts such as finely divided metals and manganese dioxide.



Industrially, dioxygen is obtained from air by first removing carbon dioxide and water vapour and then, the remaining gases are liquefied and fractionally distilled to give dinitrogen and dioxygen.

### Properties-

- It is colourless diatomic gas.
- It is odourless and tasteless.
- Solubility -it is easily soluble in the water.

### Uses/ Application-

- Oxygen is used in most of the surgical and emergency conditions to full the oxygen demand to body.
- In the COVID pandemic oxygen is most uses by the hospitals and nursing homes to treat the patients.

### Storage conditions-

- Oxygen are stored in the oxygen cylinder ( made by steel and aluminium alloys) at environmental conditions.
- Oxygen are very reactive towards the inflammable material so it is store away from inflammable material.

# Carbon dioxide

**Chemical formula-** CO<sub>2</sub>

**Molar mass-** 41.01 g/mol

- Carbon dioxide is the organic compound is used in the pharmaceutical production as a replacement to organic solvents and also applied in the production of superficial fluid chromatography or in PH control of waste water.
- It is commonly used as an insufflation gas for minimal invasive surgery like endoscopy to enlarge and stabilise body cavities to provide better visibility of the surgical analysis.

**In laboratory it is prepared BY--**

On commercial scale it is prepared by lime stone heating.



**Properties--**

- It is colourless gas. It can be obtained as a solid in the form of dry ice
- It is odourless and slightly sour in taste
- It is less soluble in water.

**Uses-**

- It is used as replacement solvent in the pharmaceutical industry.
- It is also used as PH controller in the water.
- It is also used in the soft drinks preparation.

**Storage conditions**

- Store in a cool, well-ventilated place. Store and use with adequate ventilation.
- Store only where **temperature** will not exceed 125°F (52°C)

# Nitrous oxide

**Chemical formula-**N<sub>2</sub>O

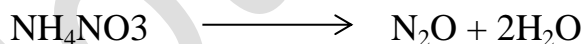
**Molar mass-** 44.03 g/mol

- Nitrous oxide is also known as laughing gas or dinitrogen oxide. It is used as anaesthesia during surgical process because it provide the pleasure or excitement sensation.
- Nitrous oxide are also used in some medicinal preparation.
- When inhaled in a small amount it causes mirth and euphoria. It is the world's number one inhaled anaesthetic as it works as a quick pain reliever. It can cause a narcotic effect at higher concentrations and lead to death by asphyxia.

### Preparations:-

Nitrous oxide is prepared by heating

1. A solutions of ammonium nitrate acidified with HCL
2. Lead nitrate
3. Ammonium nitrite



### Properties-

- It is the colourless gas
- It shows sweet smell and tasteless.
- It is insoluble in water.

### Uses--

- It is used as anaesthesia during surgical process.
- It is used as oxidant for organic compounds.

**Storage conditions:** Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials.