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PHARMACEUTICAL INORGANIC CHEMISTRY

UNIT 3

TOPIC :

- **Cathartics** : Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite



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CATHARTICS

→ Cathartics are the drugs or agents that are used to relieve constipation by promoting bowel movements and accelerating the process of defecation.

→ They work by:

- Increasing the **fluid content** of feces
- Softening the stool
- Increasing **intestinal motility (movement)**
- Stimulating bowel evacuation

Types of Cathartics

→ Cathartics are mainly classified into two categories

- Laxative
- Purgative

Laxative

→ Laxatives are mild acting cathartics

→ They work by either

- Increasing intestinal movement
- Increasing stool bulk
- Make stool softer

→ Prolong use of laxative may cause habit or dependency

Purgative

- They are strong cathartics
- They are given in very serious conditions.
- They are generally given to completely remove solid materials from intestine before surgery.

Classification of Cathartics (Based on Mechanism of Action)

1. Stimulant Cathartics

- **Mechanism:** Directly stimulate intestinal mucosa, increasing peristalsis (movement).
- **Examples:** Senna, Bisacodyl, Castor oil

2. Lubricant Cathartics (Stool Softeners)

- **Mechanism:** Coat the stool and intestinal wall with a slippery film to ease passage.
- **Examples:** Liquid paraffin, Mineral oil

3. Bulk-forming Cathartics

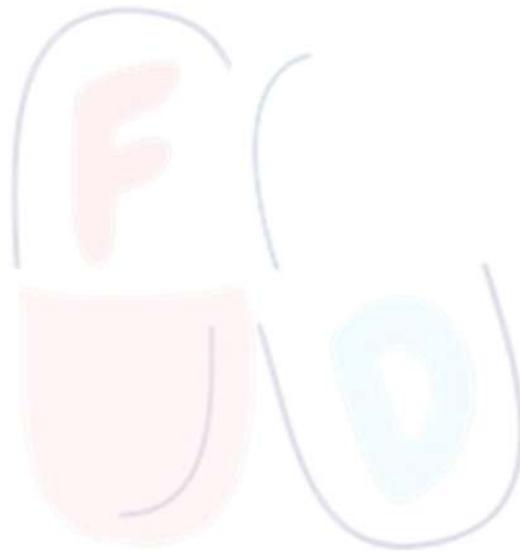
- **Mechanism:** Absorb water and **increase bulk** of stool, stimulating bowel movement.
- Must be taken with **plenty of water**.
- **Examples:** Psyllium husk (Isabgol), Methylcellulose

4. Saline Cathartics (Osmotic Cathartics)

- **Mechanism:** Increase osmotic pressure in intestine → draw water → soften stool and promote evacuation.
- **Examples:** Magnesium sulfate, Sodium phosphate, Milk of magnesia
- Act **rapidly**, often used for **bowel cleansing** before surgery

Uses of Cathartics

- To relieve acute or chronic constipation
- For bowel clearance before surgery or colonoscopy
- To ease defecation in rectal diseases like hemorrhoids
- To avoid straining during bowel movements (especially in heart patients)
- Used in poisoning cases (to remove toxins from GI tract — under medical supervision)



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Magnesium Sulphate

- Chemical Formula: $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$
- Molecular Weight: 246.47 g/mol
- Synonym: Epsom Salt

Method of Preparation

Magnesium sulphate can be prepared by the reaction of **magnesium carbonate** (MgCO_3) with **dilute sulphuric acid** (H_2SO_4):



Alternatively, it can also be obtained from natural mineral sources like **Epsomite**

Physical Properties

- Appears as white crystalline powder or colorless crystals
- Odourless
- Has a cool, saline, and bitter taste
- Soluble in water
- Sparingly soluble in alcohol
- Effloresces in dry air (loses water)

Chemical Properties

- Decomposes upon strong heating, losing water of crystallization.
- Forms double salts with other sulfates (e.g., Tutton's salts).

Uses

1. Used as a saline cathartic (osmotic laxative)
→ Draws water into the intestines and promotes bowel movement.
2. Used in agriculture as a magnesium fertilizer
→ Supplies magnesium and sulfur to the soil.
3. Used medically to control seizures in eclampsia (pregnancy-induced seizures)
→ Acts as a central nervous system depressant.
4. Used in bathing solutions for muscle relaxation and pain relief
5. Used in electrolyte replacement therapy

Sodium Orthophosphate

- Chemical Formula: $\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$
- Molecular Weight: 358.14 g/mol

Preparation

Sodium orthophosphate is prepared by the reaction of sodium carbonate (Na_2CO_3) with a hot solution of phosphoric acid (H_3PO_4):



Physical Properties

- Occurs as colourless, transparent crystals
- Odourless
- Has a saline taste
- Soluble in water
- Insoluble in alcohol

Chemical Properties

Reaction with Acids

- Acts as a weak base and reacts with strong acids to form **acidic phosphates**.



Uses

1. Used as a saline cathartic
→ Promotes bowel evacuation by drawing water into the intestines.
2. Used in the preparation of buffer solutions
→ Helps maintain pH stability in pharmaceutical and laboratory preparations.
3. Used in water treatment and detergents (industrial use)

Kaolin

- Chemical Formula: $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$
- Molecular Weight: 258.16 g/mol
- Synonym: China Clay

Preparation

Kaolin is a naturally occurring hydrated aluminum silicate. It is prepared from natural clay by:

- Powdering
- Washing and sedimentation
- Purification to remove grit, sand, and other impurities

Physical Properties

- Appears as a light, white amorphous powder
- Odourless
- Tasteless
- Insoluble in water and organic solvents
- Smooth and soft texture

Chemical Properties

- **Chemically inert** (does not react easily)
- Can adsorb toxins and gases from the gastrointestinal tract
- Does not dissolve or disintegrate in acids or alkalis

Uses

1. Used as a mild cathartic
→ Helps in treating diarrhea by adsorbing toxins and bacteria.
2. Used in food poisoning and gastrointestinal infections
→ Adsorbs harmful substances in the gut.
3. Used in dusting powders and skin preparations
→ Acts as a protective and absorbent in dermatological products.

Bentonite

- Chemical Formula: $\text{Al}_2\text{O}_3 \cdot 4\text{SiO}_2 \cdot \text{H}_2\text{O}$
- Molecular Weight: 360.31 g/mol
- Synonym: Clay

Preparation

Bentonite is a naturally occurring colloidal hydrated aluminum silicate, derived from volcanic ash.

It is obtained by:

- Mining natural clay deposits
- Followed by grinding, purification, and drying

Physical Properties

- Occurs as a very fine, cream-colored powder
- Odourless
- Tasteless
- Swells in water and forms a gel-like suspension
- Insoluble in water but highly absorbent

Chemical Properties

- Colloidal nature: forms suspensions in water
- High swelling capacity due to layered structure
- Can adsorb toxins, gases, and bacteria from the GIT
- Chemically inert in normal pH range

Uses

1. Used as a bulk-forming cathartic
→ Helps relieve constipation by absorbing water and increasing stool volume.
2. Used as an emulsifying agent
→ Stabilizes emulsions and suspensions in pharmaceutical formulations.
3. Used as a protective
→ Forms a coating over inflamed mucous membranes in the gastrointestinal tract.
4. Also used in:
 - Toothpastes and cosmetic products
 - Tablet formulation as a disintegrant or binder