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PHARMACEUTICAL INORGANIC CHEMISTRY (BP104T) UNIT – IV: Astringents

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❖ Defination:

- An astringent (occasional alternative: adstringent) substance is a chemical compound that tends to shrink or constrict body tissues and precipitate the protein and astringent form protective layer on the surface.
- Due to their protein action, astringents are able to reduce the cell permeability.
- This reduces local edema, exudation and inflammation.
- The word "*astringent*" derives from Latin "*adstringere*", meaning "*to bind fast*".
- They are usually applied to damaged skin topically or to the mucous membrane of GIT including the mouth.

❖ Characteristics:

- Affect only the superficial layer. Reduce cellular permeability.
- Make the surface mechanically strong, decrease exudation.
- Protect from external irritation.
- Possess local styptic and local antiseptic action.
- May interfere with the function of pain receptors. The pain relieving action is mild.
- Constrict the blood vessels to stop bleeding.

❖ Types of Astringents:

1) *Vegetable astringents*: Tannic acid, Gallic acid

2) *Metallic Astringents*:

- Aluminium salts: Alum [$\text{KAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$], Aluminium chloride (AlCl_3), Aluminium acetate
- Zinc salts: Zinc chloride (ZnCl_2), Zinc sulfate (ZnSO_4)
- Ferric chloride (FeCl_3)
- Strontium chloride
- Silver nitrate (AgNO_3)
- Copper sulfate (CuSO_4)

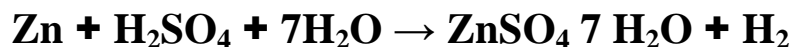
3) *Miscellaneous*: Very cold water, Alcohol

❖ Indications:

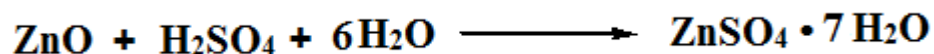
- Swollen, inflamed and/or leaky tissues.
- They are used to treated diarrhea or dysentery.
- During leukorrhea (thick white/yellowish vaginal discharge)
- During minor bleeding like Menorrhagia, Hemorrhoids.
- They promote healing process.
- They decrease sweating and possess deodorant properties.
- Mild astringent solutions are used in the relief of such minor skin irritations as those resulting from superficial cuts, allergies, insect bites, or fungal infections such as athlete's foot.

▪ Preparation

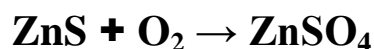
- Specific reactions the reaction of the metal with aqueous sulfuric acid



- Pharmaceutical grade zinc sulfate is produced by treating high purity zinc oxide with sulfuric acid



- Zinc sulfate also obtained by heating Zinc blende (Zinc sulphide) in presence of air

**▪ Uses**

- In medicine it is used together with Oral Rehydration Therapy (ORT) and an astringent
- Zinc sulfate is an inorganic compound and dietary supplement. As a supplement it is used to treat zinc deficiency.
- 0.25% Zinc sulfate used for ophthalmic purpose.
- Zinc sulfate acts as emetics.
- It is used as in electrolytes for zinc plating, as a mordant in dyeing, as a preservative for skins and leather.

▪ Side effects

- Side effects may include abdominal pain, vomiting (2-8 mg/Kg of body weight), headache and tiredness.

ALUM

- They are white crystalline double sulfates of univalent and trivalent atoms.
- Alum is both a specific chemical compound and a class of chemical compounds.
- Many trivalent metals are capable of forming alums. The general form of an alum is $AM^{III}(SO_4)_2 \cdot nH_2O$, where “A” is an alkali metal or ammonium, “M^{III}” is a trivalent metal, and “n” often is 12.
- In general, alums are easier formed when the alkali metal atom is larger. This rule was first stated by **Locke** in 1902.
- Double sulfates with the general formula $A_2SO_4 \cdot B_2(SO_4)_3 \cdot 24H_2O$, are known where “A” is a *monovalent cation* such as *sodium, potassium, rubidium, caesium, or thallium(I)*, or a *compound cation* such as *ammonium (NH⁺), methylammonium (CH₃NH₃⁺), hydroxylammonium (HONH₃⁺) or hydrazinium (N₂H₅⁺)*, “B” is a **trivalent metal ion**, such as *aluminium, chromium, titanium, manganese, vanadium, iron(III), cobalt(III), gallium, molybdenum, indium, ruthenium, rhodium, or iridium*.
- **Types of Alum:**

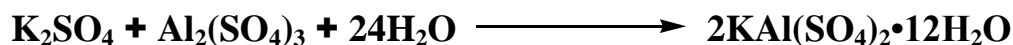
Class	Chemical Name	Synonym	Formula
Potassium alum	Aluminum potassium sulfate	potash alum	KAl(SO ₄) ₂ ·12H ₂ O
	Potassium aluminium sulfate	alunite	KAl(SO ₄) ₂ ·2Al(OH) ₃
	Potassium aluminium sulfate	kalinite	KAl(SO ₄) ₂ ·11H ₂ O
	<ul style="list-style-type: none"> ▪ Uses: It is also used in so-called "crystal" deodorants and water purification. 		
Sodium alum	Soda alum	mendozite	NaAl(SO ₄) ₂ ·12H ₂ O
	<ul style="list-style-type: none"> ▪ Uses: Soda alum is used in the acidulent (<i>being sour to the taste</i>) of food as well as in the manufacture of baking powder. 		
Ammonium alum	Ammonium aluminum sulfate	Tschermigite	NH ₄ Al(SO ₄) ₂ ·12H ₂ O
	<ul style="list-style-type: none"> ▪ Uses: Used in water purification, in vegetable glues, in porcelain cements, in deodorants, in tanning, dyeing and in fireproofing textiles. 		
Chrome alum	Chromium(III) potassium sulfate	Chromium alum	KCr(SO ₄) ₂ ·12H ₂ O
	<ul style="list-style-type: none"> ▪ Uses: It is a <i>dark violet crystalline</i> and used in tanning. 		

Potash Alum

General formula	$KAl(SO_4)_2 \cdot xH_2O$	Synonym	Molecular formula	Molecular Wt.
	Aluminum potassium sulfate	potash alum	$KAl(SO_4)_2 \cdot 12H_2O$	474.07
	Potassium aluminium sulfate	alunite	$KAl(SO_4)_2 \cdot 2Al(OH)_3$	414.03
	Potassium aluminium sulfate	kalinite	$KAl(SO_4)_2 \cdot 11H_2O$	456.07
<i>Atomic Weight:</i> K = 39.09; Al = 26.98; S = 32.06; O = 16; H = 1				

■ Preparation:

- Potash alum obtained by adding a concentrated solution of potassium sulfate to a hot solution of an equimolecular proportion of aluminium sulfate.
- When the solution is concentrated and cooled, characteristic octahedral separated out.



■ Properties:

- Colorless, transparent, crystalline structure.
- It readily dissolves in water and the solution thus obtained is slightly sweetish in taste.
- It is acidic in nature and an alum powder solution turns a litmus paper red.
- On heating, alum powder changes to liquid first and if heated further, then the salt starts swells up to form froths.
- Alum crystals are found all over the world, as stated in Potassium Alum, but the major location is in the Andes Mountains in South America in Bolivia, Argentina and Chile. In the United States, alum crystals are found in Tennessee, Nevada and Arizona. In the places where large deposits of alum are found, they are extracted in a mine.

■ Uses:

- Alum is used as an **adjuvant** in many subunit vaccines, such as include hepatitis A, hepatitis B, and Diphtheria Tetanus Pertussis (DTP) in order to augment the body's response to immunogens.

(An *Adjuvant* is an agent that may stimulate the immune system and increase the response to a vaccine. Adjuvants having aluminum have been proven to make some vaccines last for longer period of time and to help generate more antibodies to fight against disease.)

- Alum in rock form is used as an aftershave. If it is rubbed on a freshly shaved face, its astringent property helps to prevent and reduce bleeding in minor cuts and abrasions.
- Alum's has a strong antibacterial property and so it is useful as a natural deodorant by inhibiting the growth of the bacteria responsible for body odor.
- Alum is listed as an ingredient of toothpaste or toothpowder and pharmaceutical aid..
- Alum acts also as a styptic to contract organic tissues and stop or reduce hemorrhage and bleeding.
- It is also used as an emetic agent to induce vomiting when a person has swallowed poison.