Program	:	B. Pharmacy
Semester	:	1st
Subject /Course	:	Pharmaceutical Inorganic Chemistry/ B. Pharmacy
Subject/Course ID	:	Pharmaceutical Inorganic Chemistry/ BP104T
Module No.	:	02
Module Title	:	Acid Base & Buffers, Electrolytes, Dental Products
Course coordinator	:	Ms. HarpreetKaur
Mobile No.	:	8437204973
Email id	:	harpreetrehal77@gmail.com

Learning Outcome of Module-2

LO	Particular	Course outcome module
1.	To gain knowledge about Dental Health & Dental products.	BP 104.2
2.	To understandAnticaries agents, Dentifrices & Desensitizing agents.	BP 104.2

Module Content Table

No.	Topic
1.	Concepts of Dental Hygiene.
2.	Anticaries Agents & Role of Fluoride.
3.	Dentifrices.
4.	Desensitizing agents.

DENTAL PRODUCTS

Dental hygiene has been considered as important since lone. In India, poor dental health is major problem and has been compounded by ignorance, poor literacy levels, and habits like chewing of tobacco, pan and pan masalas. In order to maintain dental hygiene, we have to take care of our teeth.

The teeth are accessory of digestive system. People use their teeth to bite and chew food. The long, sharp canine teeth tear up food, while the wide, flat, molar grinds mash up the food. It is the first step in the digestion of food. While chewing food, the tongue pushes it to the teeth and saliva helps in digestion and wets the food.

Tooth: Tooth consists of three layers of calcified tissue namely:

1. **Dentine:** This surrounds the pulp cavity and extends throughout the entire portion of tooth.
2. **Cementum:** A layer covering the portion of tooth 1lying buried in the gum.
3. **Enamel:** A white, hard material covering the portion of tooth projecting above thegum.

Vitamin A, C and D are all necessary for proper tooth formation. The deficiency of any of these can harm or affect the teeth.

A number of inorganic compounds and their preparations are used in monitoring the oral and dental hygiene. Most of them are Over The Counter (OTC) products. Dental products include anticaries agent (dentrifices and fluoride salts), polishing agents and desensitizing agents.

ANTICARIES AGENT

Dental caries is the medical term for tooth decay or cavities. It is caused by specific type of bacteria. They produce acid that destroys the tooth's enamel and the layer under it, the dentin. Many different types of bacteria normally live in the human mouth. They build up on the teeth in a sticky film called plaque. This plaque also contains saliva, bits of food and other natural substance. Plaque forms most easily in certain parts. These include cracks, pits or grooves in the back teeth, in between teeth and near the gum line.

Some of the plaque bacteria turn sugar and carbohydrate (starches) of the food into the acids. The acid dissolves minerals in the hard enamel that covers the tooth crown. The enamel erods or develops spits. They are too small to set at first. But they get larger over time. Acids can also seep through pores in the enamel. This is how decay begins in the softer dentin layer, the main

body of the tooth. As the dentin breaks down, the enamel over it can collapse, forming a cavity. A mucin-rich saliva has less cleansing action on tooth and therefore, helps to the development ot caries. Poor nutrition of the infant and the mother atthe time of infancy and childhood results in poor architecture of the teeth which becomesusceptible to the development of caries in the early age.

Dental caries can be prevented and oral and dental hygiene can be maintained with the help of dentifrices. Dentifrices are the products that enhance the removal of stains and dental plaque by the tooth brush. The most accepted approach to prevent caries including flossing and brushing accompanied by administration of fluoride and brushing accompanied by administration of fluoride either internally or topically the teeth.

Newer devices also have been developed to detect tooth decay. They are useful in some situations and they do not spread decay. The one most commonly used dental caries is a liquid dye or stain. The dentist brushes the nontoxic dye over your teeth, then rinse it off with water. It rinses always cleanly from healthy areas but sticks to the decayed area.

Some dentists also use high tech devices such as lasers to detect cavities. Under many conditions, these devices can detect very early tooth decay, which actually can be reversed.

ROLE OF 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.

SODIUM FLUORIDE

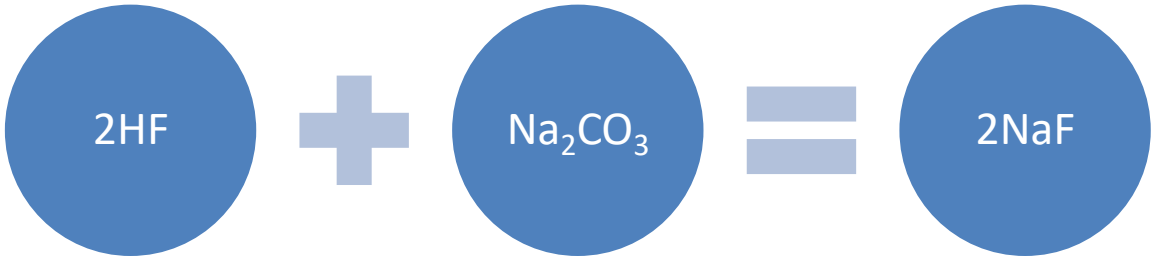
Chemical Formula:NaF

Molecular Weight: 41.99

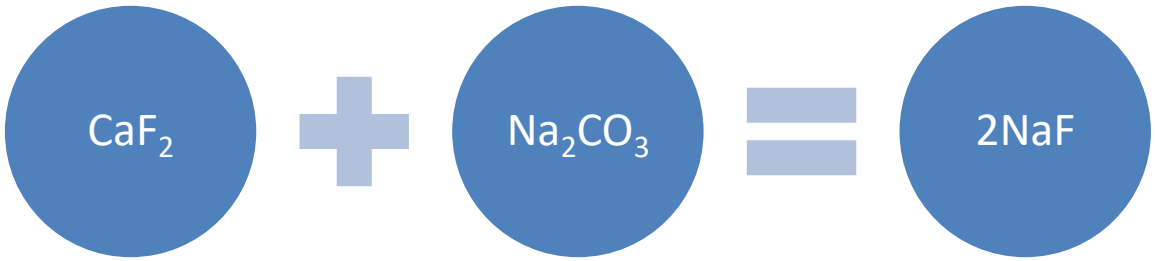
It is having not less than 98.0% of Sodium fluoride and not more than 100.5% of Sodium fluoride, calculated with reference to the dried substance.

Preparation:

lt is prepared by reacting hydrofluoric acid with Sodium Carbonate. Sodium fluoride being not very soluble precipitates out.



Alternatively, the another method involves the double decomposition of Calcium Fluoride with Sodium Carbonate.



Here, insoluble calcium carbonate can be removed by filtration.

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 ispoisonous. 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 prevention of dental caries because of its fluoride ion concentration.
- It is aconstitutent of some insecticides and rodenticides.

- It is used in the preparation of a tooth pastes which constitutes about 75% of Sodium Fluoride and 25% of glycerol.

DENTRIFICES OR CLEANING AGENTS

A dentifrice is a substance used with a tooth brush for the purpose of cleaning the accessible surfaces of the teeth. Commercial dentifrices are available in the form of pastes and powders. Many dentifrices contain flavours and soap or detergent. The powders and pastes contain abrasives such as Calcium Carbonate, Calcium Phosphates, Calcium Sulphate, insoluble Sodium Metaphosphate, Calcium Carbonate and Sodium Chloride. Tooth pastes contain liquids (e.g. glycerin, propylene glycol, sorbitol solution, water and alcohol) and thickners(e.g. starch, tragcanth, algin and cellulose derivative).

Dentifrices or tooth pastes are responsible for physically removing plaque and debris. They may also contain some sweetening agents. Certain individual may need an abrasive containing dentifrices.

The abrasive dislodges the dental plaques and helps to remove them. It should be mildly abrasive for this purpose.

CALCIUM CARBONATE

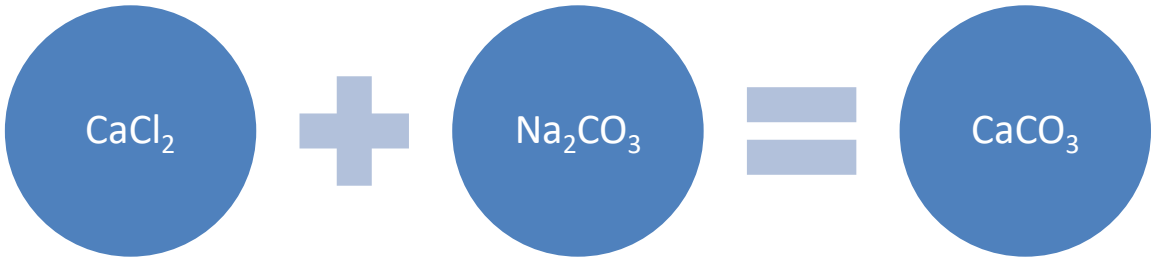
Chemical Formula: $CaCO_3$

Molecular Weight: 100.09

It is the most abundant and widely distributed in nature as limestone and shells of sea animals.

Method of Preparation

Calcium carbonate when come in contact with sodium carbonate leads to the formation of calcium carbonate and sodium chloride.



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 waterand alcohol.
- It dissolves in aqueous phosphoric acid & the solution on evaporation deposits crystals ofcalcium dihydrogen.

Assay

It is assayed by complexometric assay.

The sample is dissolved in water and hydrochloric acid

↓

A known excess of 0.1M disodium edetate is added

↓

diluted with water

↓

It is neutralized with strong ammonia solution, ammonia buffer pH 10

mordant black II mixture areadded

↓

the titration is continued till be change of colour from pink to full blue takes place

at the end point.

Calconmixture consist of calcon (mordant black) and freshly ignited anhydrous sodium sulphate. It gives a purple-red colour with calcium ions in alkaline solution.

Uses

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

DESENSITIZERS

The desensitizers tend to decrease hypersensitivity of the teeth. When applied to their outer surface, especially where erosion has occurred near the gum line, they reduce the sensitivity of the teeth to heat and cold.

Inorganic compounds of desensitizers are Strontium Chloride and Zinc chloride.

ZINC EUGENOL CEMENT

Zinc Oxide Eugenol(ZOE) is material created by the combination of Zinc Oxide and eugenol contained in oil of cloves. An acid-base reaction takes place with the formation of zinc eugenol chelate. The reaction is catalyzed by water.

Advantages:

1) Dimensional stabilitv

2) Good surface

Disadvantages:

1) Eugenolallergy in some tients.

2) Cannot be used in very deep undercuts.

Composition:

Liquid

Eugenol (react with zinc oxide)

Olive oil (plasticizer)

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 itis used for temporary filling not be more then few days.
- It has adhesive eftect on exposed dentin. It is least irritating than other dental cements.

Uses

- For temporary filings.

- Pulp-capping agents.
- Zinc oxide eugenol is used as an antimicrobial additive in paint.
- It is used as an impression material during construction of complete dentures and is used in the mucostatic technique ot taking impressions.

MULTIPLE CHOICE QUESTIONS

1. Fluoride inhibits carries formation via?

a. Downward acid solubility of enamel
b. Bacterial inhibition
c. **Both a and b**
d. None of these

2. Hydroxyapatite is a mixture Ca^{+2} salt of?

a. CO_3^-
b. PO_4^-
c. OH
d. **All of these**

3. Dental caries is a medical term of of?

a. Cleaning action
b. **Tooth decay or cavities**
c. Polishing action
d. None of these

4. Fluoride can be administrated either?

a. Orally
b. Topically
c. **Both a and b**
d. None of these

5. Sodium Metaphosphate is also known as?

a. Precipitated chalk
b. **Mandrel's salt**
c. Both a and b

d. None of these

6. Desensitizers tend to?

a. **Downward hypersensitivity of the teeth**
b. Upward hypersensitivity of e teeth
c. Bacterial inhibition
d. None of these

7. Example of Desensitizer is?

a. **Zinc chloride**
b. Sodium fluoride
c. Calcium carbonate
d. Stannous fluoride

8. Butter of Zinc is also known as?

a. **Zinc chloride**
b. Zinc bicarbonate
c. Zinc carbonate
d. None of these

9. Which vitamin is necessary for tooth formation?

a. Vitamin A
b. Vitamin C
c. Vitamin D
d. **All of the above**

10. Phosphate is used as?

a. **Cleansing agent**
b. Removing stains
c. Flossing agent
d. None of these

LONG ANSWER QUESTIONS

Q.1. Explain in detail about the Dental hygiene?

Ans. Dental hygiene has been considered as important since lone. In India, poor dental health is major problem and has been compounded by ignorance, poor literacy levels, and habits like chewing of tobacco, pan and pan masalas. In order to maintain dental hygiene, we have to take care of our teeth.

The teeth are accessory of digestive system. People use their teeth to bite and chew food. The long, sharp canine teeth tear up food, while the wide, flat, molar grinds mash up the food. It is the first step in the digestion of food. While chewing food, the tongue pushes it to the teeth and saliva helps in digestion and wets the food.

Tooth: Tooth consists of three layers of calcified tissue namely:

1. **Dentine:** This surrounds the pulp cavity and extends throughout the entire portion of tooth.

2. **Cementum:** A layer covering the portion of tooth 1lying buried in the gum.

3. **Enamel:** A white, hard material covering the portion of tooth projecting above thegum.

Vitamin A, C and D are all necessary for proper tooth formation. The deficiency of any of these can harm or affect the teeth.

A number of inorganic compounds and their preparations are used in monitoring the oral and dental hygiene. Most of them are Over The Counter (OTC) products. Dental products include anticaries agent (dentrifices and fluoride salts), polishing agents and desensitizing agents.

Q.2. Write a short note on 'Anticaries Agent'?

Ans. Dental caries is the medical term for tooth decay or cavities. It is caused by specific type of bacteria. They produce acid that destroys the tooth's enamel and the layer under it, the dentin. Many different types of bacteria normally live in the human mouth. They build up on the teeth in a sticky film called plaque. This plaque also contains saliva, bits of food and other natural substance. Plaque forms most easily in certain parts. These include cracks, pits or grooves in the back teeth, in between teeth and near the gum line.

Some of the plaque bacteria turn sugar and carbohydrate (starches) of the food into the acids. The acid dissolves minerals in the hard enamel that covers the tooth crown. The enamel erods or develops spits. They are too small to set at first. But they get larger over time. Acids can also

seep through pores in the enamel. This is how decay begins in the softer dentin layer, the main body of the tooth. As the dentin breaks down, the enamel over it can collapse, forming a cavity. A mucin-rich saliva has less cleansing action on tooth and therefore, helps to the development ot caries. Poor nutrition of the infant and the mother atthe time of infancy and childhood results in poor architecture of the teeth which becomesusceptible to the development of caries in the early age.

Dental caries can be prevented and oral and dental hygiene can be maintained with the help of dentifrices. Dentifrices are the products that enhance the removal of stains and dental plaque by the tooth brush. The most accepted approach to prevent caries including flossing and brushing accompanied by administration of fluoride and brushing accompanied by administration of fluoride either internally or topically the teeth.

Newer devices also have been developed to detect tooth decay. They are useful in some situations and they do not spread decay. The one most commonly used dental caries is a liquid dye or stain. The dentist brushes the nontoxic dye over your teeth, then rinse it off with water. It rinses always cleanly from healthy areas but sticks to the decayed area.

Some dentists also use high tech devices such as lasers to detect cavities. Under many conditions, these devices can detect very early tooth decay, which actually can be reversed.

Q.3. Describe the role of fluoride as anticaries agent?

Ans. 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.

Q.4. Give the method of preparation, properties and uses of Sodium fluoride?

Ans.SODIUM FLUORIDE

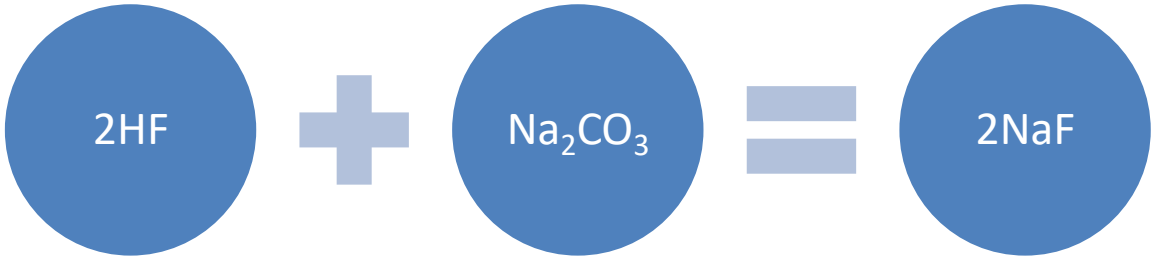
Chemical Formula:NaF

Molecular Weight: 41.99

It is having not less than 98.0% of Sodium fluoride and not more than 100.5% of Sodium fluoride, calculated with reference to the dried substance.

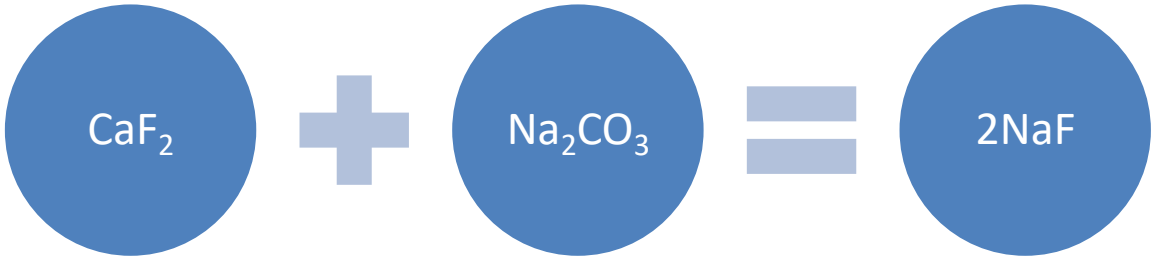
Preparation:

lt is prepared by reacting hydrofluoric acid with Sodium Carbonate. Sodium fluoride being not very soluble precipitates out.



Alternatively, the another method involves the double decomposition of Calcium Fluoride

with Sodium Carbonate.



Here, insoluble calcium carbonate can be removed by filtration.

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 ispoisonous. 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 prevention of dental caries because of its fluoride ion concentration.
- It is aconstitutent of some insecticides and rodenticides.
- It is used in the preparation of a tooth pastes which constitutes about 75% of Sodium Fluoride and 25% of glycerol.

Q.5. Give a brief account on the cleaning agent or dentrifices?

Ans.A dentifrice is a substance used with a tooth brush for the purpose of cleaning the accessible surfaces of the teeth. Commercial dentifrices are available in the form of pastes and powders. Many dentifrices contain flavours and soap or detergent. The powders and pastes contain abrasives such as Calcium Carbonate, Calcium Phosphates, Calcium Sulphate, insoluble Sodium Metaphosphate, Calcium Carbonate and Sodium Chloride. Tooth pastes contain liquids (e.g. glycerin, propylene glycol, sorbitol solution, water and alcohol) and thickners(e.g. starch, tragcanth, algin and cellulose derivative).

Dentifrices or tooth pastes are responsible for physically removing plaque and debris. They may also contain some sweetening agents. Certain individual may need an abrasive containing dentifrices.

The abrasive dislodges the dental plaques and helps to remove them. It should be mildly abrasive for this purpose.

Q.6. What is the difference between Dentrifices and Desensitizers?

Ans.

Q.7. Explain in detail about the method of preparation, properties and uses of Calcium carbonate?

Ans.CALCIUM CARBONATE

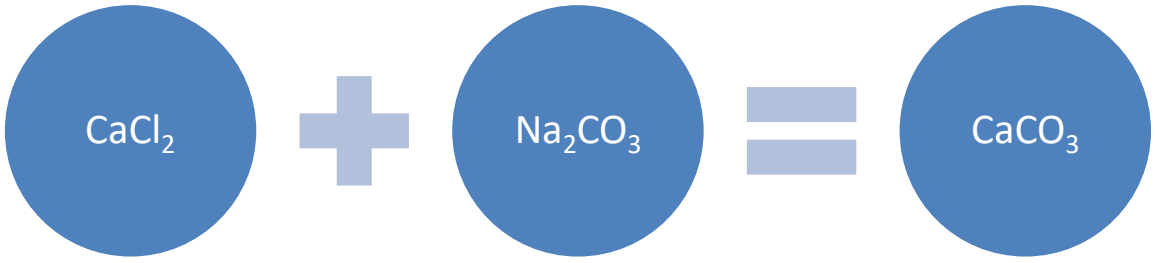
Chemical Formula: $CaCO_3$

Molecular Weight: 100.09

It is the most abundant and widely distributed in nature as limestone and shells of sea animals.

Method of Preparation

Calcium carbonate when come in contact with sodium carbonate leads to the formation of calcium carbonate and sodium chloride.



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 waterand alcohol.
- It dissolves in aqueous phosphoric acid & the solution on evaporation deposits crystals ofcalcium dihydrogen.

Assay

It is assayed by complexometric assay.

The sample is dissolved in water and hydrochloric acid

↓

A known excess of 0.1M disodium edetate is added

↓

diluted with water

↓

It is neutralized with strong ammonia solution, ammonia buffer pH 10

mordant black II mixture areadded

↓

the titration is continued till be change of colour from pink to full blue takes place at the end point.

Calconmixture consist of calcon (mordant black) and freshly ignited anhydrous sodium sulphate. It gives a purple-red colour with calcium ions in alkaline solution.

Uses

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

Q.8. Explain in detail about the method of preparation, properties and uses of Zinc eugenol cement?

Ans. The desensitizers tend to decrease hypersensitivity of the teeth. When applied to their outer surface, especially where erosion has occurred near the gum line, they reduce the sensitivity of the teeth to heat and cold.

Inorganic compounds of desensitizers are Strontium Chloride and Zinc chloride.

ZINC EUGENOL CEMENT

Zinc Oxide Eugenol(ZOE) is material created by the combination of Zinc Oxide and eugenol contained in oil of cloves. An acid-base reaction takes place with the formation of zinc eugenol chelate. The reaction is catalyzed by water.

Advantages:

1) Dimensional stabilitv

2) Good surface

Disadvantages:

1) Eugenolallergy in some tients.

2) Cannot be used in very deep undercuts.

Composition:

Liquid

Eugenol (react with zinc oxide)

Olive oil (plasticizer)

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 itis used for temporary filling not be more then few days.
- It has adhesive eftect on exposed dentin. It is least irritating than other dental cements.

Uses

- For temporary filings.
- Pulp-capping agents.
- Zinc oxide eugenol is used as an antimicrobial additive in paint.
- It is used as an impression material during construction of complete dentures and is used in the mucostatic technique ot taking impressions.