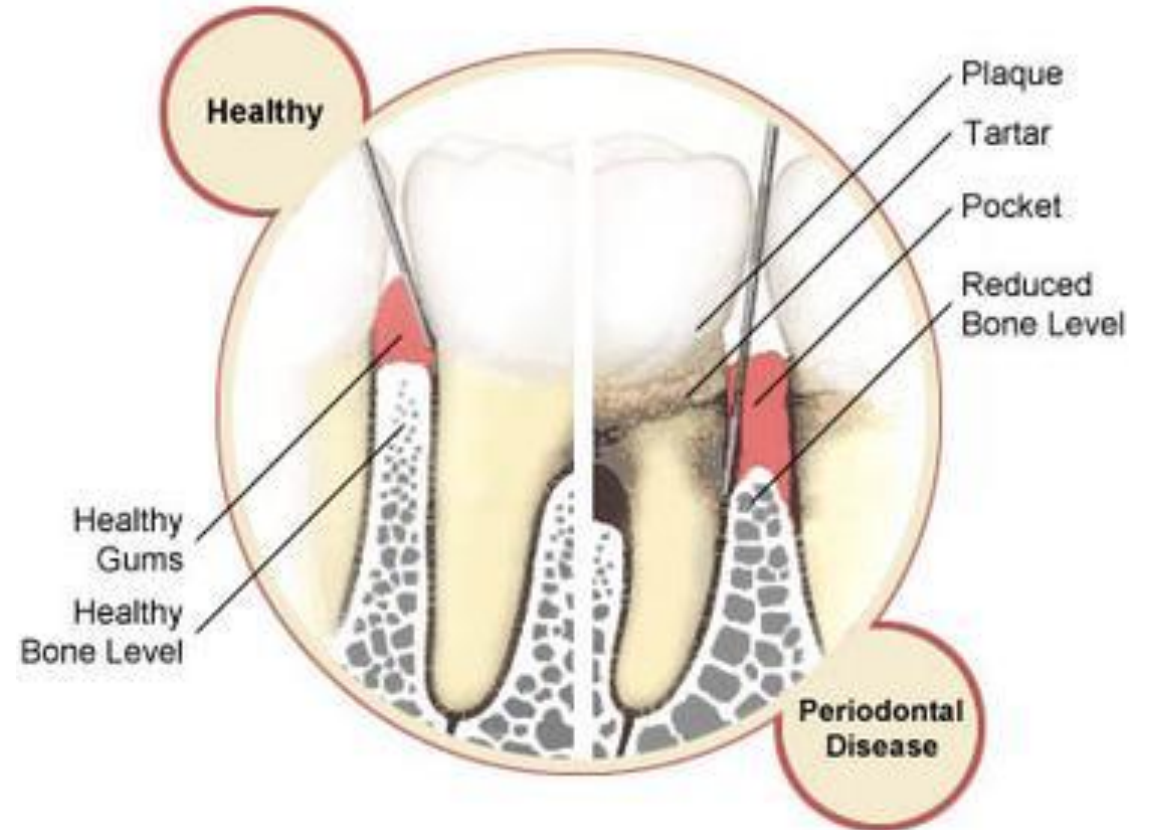
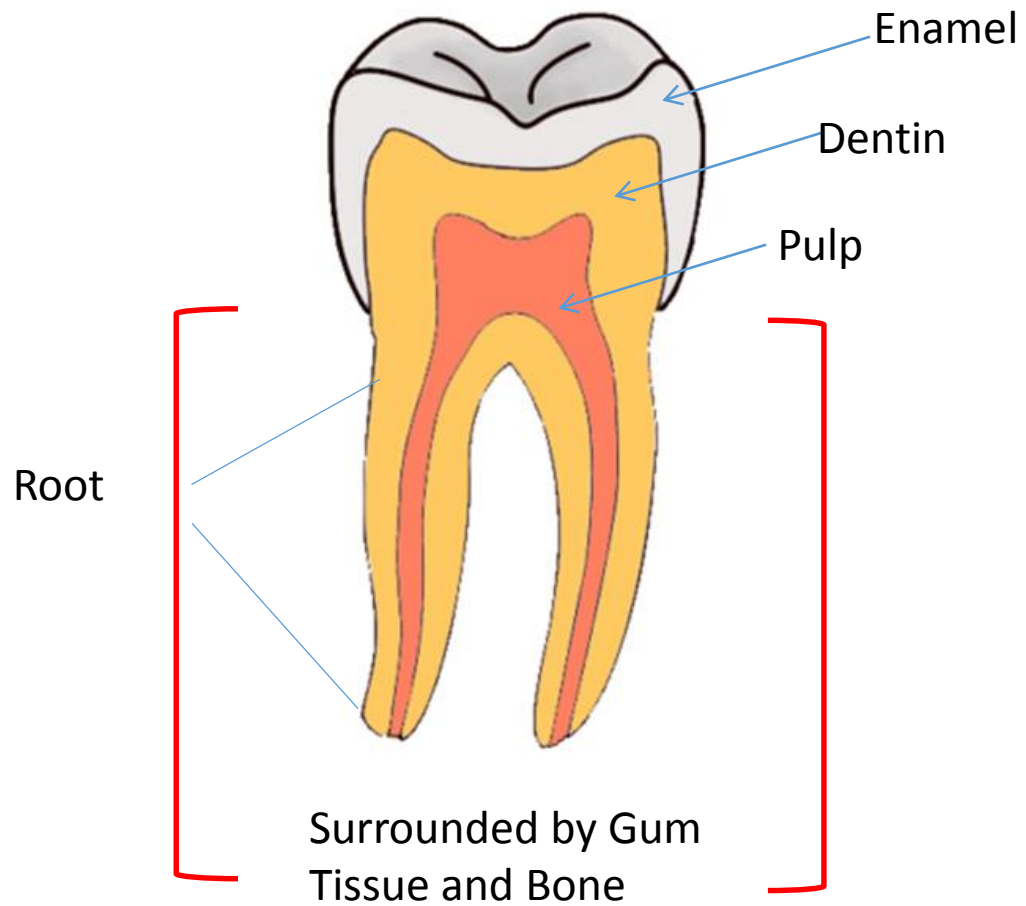


Formulation and building blocks  
of oral care products:  
Toothpaste, Teeth whitening,  
Mouthwash

# Basic tooth structure & gums



# TOOTH EROSION

- It is defined as the irreversible loss of tooth structure due to chemical dissolution by acids not of bacterial origin.
- The most common cause of erosion is by acidic foods and drinks. In general, foods and drinks with a pH below 5.0–5.7 have been known to trigger dental erosion effects.

## CAUSES

- Accumulation of food particles.
- Accumulation of bacteria in gelatinous mass. Called as “plaque”.
- Anaerobic fermentation of sugar in saliva.
- Release of lactic acid.
- Sensation occurs due to erosion of teeth by lactic acid.



# STAIN TEETH

Teeth can become discolored by stains on the surface or by changes inside the tooth. There are three main types of tooth discoloration:

- **Extrinsic**

This occurs when the outer layer of the tooth (the enamel) is stained. **Coffee, tobacco, wine, cola** or other **drinks** or **foods** can stain teeth. Smoking also causes extrinsic stains.

- **Intrinsic**

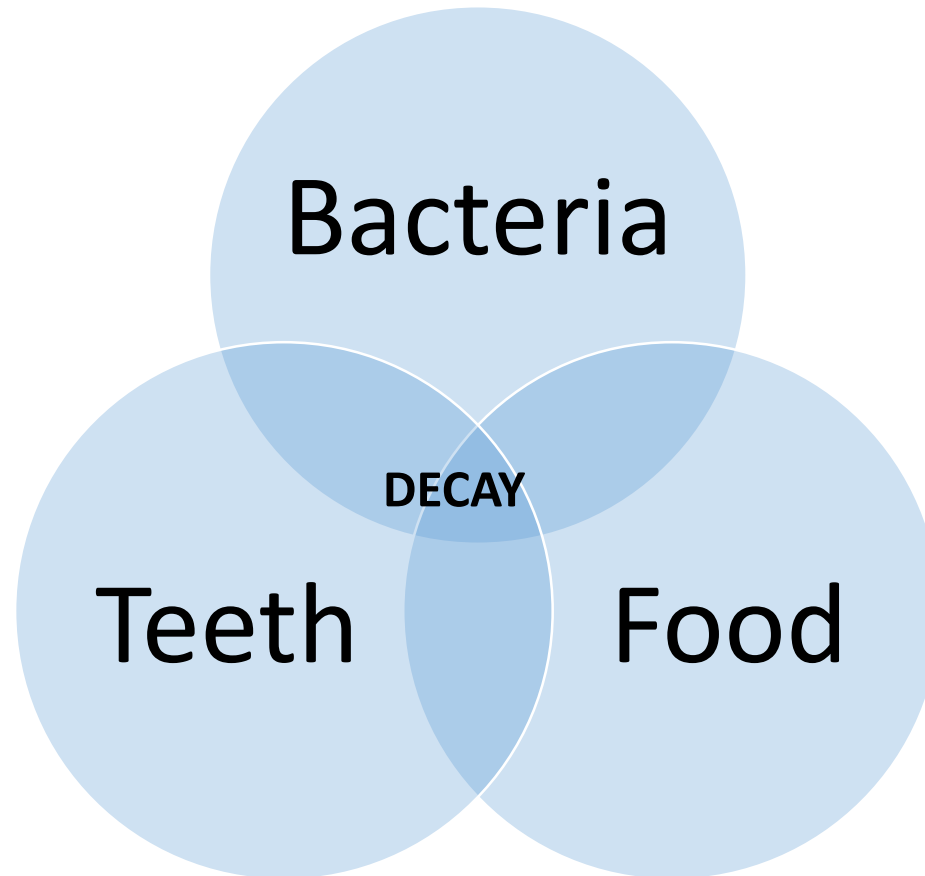
This is when the inner structure of the tooth (the dentin) darkens or gets a yellow tint.

- **Age-related**

This is a combination of extrinsic and intrinsic factors. Dentin naturally yellows over time. The enamel that covers the teeth gets thinner with age, which allows the dentin to show through. Foods and smoking also can stain teeth as people get older.



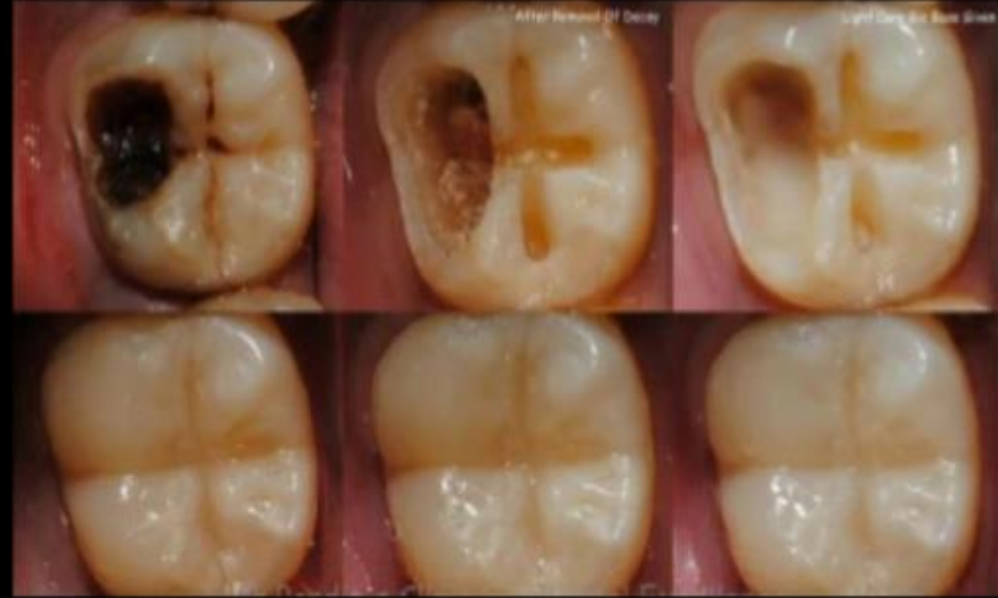
# Caries: How do teeth develop decay?



Bacteria break down food into acids that eat away at the tooth.

# CAVITIES

- A cavity, also called tooth decay, is a hole that forms in your tooth. Cavities start small and gradually become bigger when they're left untreated.



## SYMPTOMS OF TOOTH CAVITIES

- Tooth sensitivity
- [Tooth pain](#)
- A visible hole in your teeth
- [Black](#) or [white staining](#) on your teeth



# CAVITIES

## CAUSES OF TOOTH CAVITIES

- Tooth cavities are caused by plaque, a sticky substance that binds to teeth. Plaque is a combination of:
  - bacteria
  - saliva
  - acid
  - food particles

## TREATMENT

- Tooth fillings
- Crowns
- Root canal
- Early stage treatment
- Dealing with pain

## COMPLICATIONS FROM TOOTH CAVITIES

A tooth cavity can cause a variety of complications if it's left untreated. These include:

- Ongoing tooth pain
- The development of pus around the infected tooth
- An increased risk for breaking or chipping a tooth
- Difficulty chewing food

# Toothpaste

- cleaning
- anticaries
- antimicrobial
- tartar inhibition
- Contain many different substances which are necessary to obtain the desired effects i.e. abrasives, active components, motivators.



# DENTAL ANATOMY

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- Enamel: Crystalline calcium salts cover the crown to protect the tooth.
- Dentin: Largest part of the tooth beneath the enamel and protect pulp.
- Pulp: Consist of free nerve endings.
- Cementum: Bone like structure, cover the root and provide the attachment of the tooth with periodontal ligaments.



## **DENTAL PRODUCTS**

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Cleansing agents or Dentifrices

Desensitizing agent

Anticaries agents

Polishing agents

Oral antiseptic

Mouth washes

Cements and fillers

# DENTIFRICES

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According to American Dental Association Council on Dental Therapeutics:

“ A dentifrices is a substance used with a toothbrush for the purpose of cleaning the accessible surface of the teeth”

Types of dentifrices

1. Cosmetic dentifrices  
it must clean and polish teeth
2. Therapeutic dentifrices  
it must reduce disease process caries, sensitivity



# **DENTIFRICES**

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## **Forms of dentifrices**

Pastes

Tooth powder

Gels

## **Function of dentifrices**

Mouth freshner

Removal of stains

Anti-caries action

Minimizing plaque build up

# Ingredients

- Abrasives 20%-40% (Silicon Oxide, Aluminum Oxide, Granular polyvinyl Chloride)
- Water 20%-40%
- Humectants 20%-40% (Sorbitol, Mannitol, Propylene glycol, Glycerine)
- Foaming agents 1%-2% (Sodium lauryl sulfate, sodium N-lauroyl sarcosinate)
- Sweetening agent 2% (Sorbitol, Mannitol, Glycerine)
- Binding agent 2%
- Flavoring agent 2%
- Therapeutic agent (Fluoride, tetra sodium phosphate) 2%
- Preservative (benzoic acid) colouring agent 1%

# Ingredients

- **Abrasive agent: Helps to polish tooth by eliminating calculus food, particles stuck on tooth**
- Humectant: prevents drying of toothpaste and to maintain consistency of Toothpaste.
- Foaming agent: Aids in removal of food debris
- Flavoring agent: for Pleasant feel after mouth wash
- Antibacterial agent (Triclosan): For reduction of Gingivitis, calculus etc
- Fluorides(monofluoroPO<sub>4</sub>): To make teeth more resistant to the acids produce by bacteria
- Binding/Thickening agent (alginate, NaCMC, Sod Magnesium Silicate): Stability & consistency
- Anticalculus agents (Zinc Citrate, Zinc PO<sub>4</sub>, pyro PO<sub>4</sub>): To inhibit minerlization of Plague

# ANTICARIES AGENTS

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Definition:

Agents those are used to prevent the tooth decay (caries)

Dental Caries

- Tooth decay due to bacterial metabolism

- Due to action of lactic acid, where food is attaches

Example of anticaries agent

Sodium Fluoride, Stannous fluoride

# Fluoride in Toothpastes

- The first therapeutic addition to the basic dentifrice.
- Stannous fluoride ( $\text{SnF}_2$ )
- Sodium monofluorophosphate (Na MFP)
- Sodium fluoride ( $\text{NaF}$ )
- Sodium fluoride and Calcium Phosphate ( $\text{NaF}/\text{CaPO}_4$ )



# FLUORIDES

## Role of fluoride

- it is able to help in reducing and preventing dental caries
- a small quantity (1 ppm) of fluoride necessary to prevent caries
- addition of fluoride to the the municipal water supply known as *fluoridation*
- Topical fluoride can also provide antimicrobial action
- ❖ However, excessive fluoride intake during the period of tooth development can cause dental *fluorosis*.

## Routes of administration

- Orally
- Topically

- Public water supply containing 0.5 to 1 ppm (should not more than 1 ppm)
- For topical application 2 percent solution is generally used on teeth.

## MODE OF ACTION

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When a fluoride having salt or solution is taken internally, it is readily absorbed, transported and deposited in the bone or developing teeth and remained get excreted by kidneys.

The deposited fluoride on the surface of teeth does not allow the action of acids or enzymes.

# DESENSITIZING AGENTS

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Teeth are somewhat sensitive to hot and cold  
Especially during teeth decay or in toothache

Therefore, some desensitizing agents are used in dental preparations so as to reduce sensitivity of teeth to hot and cold.

## Mechanism of action

Exact mechanism of action of desensitizing agent is not known with certainty.

However they act probably like local anaesthetic.

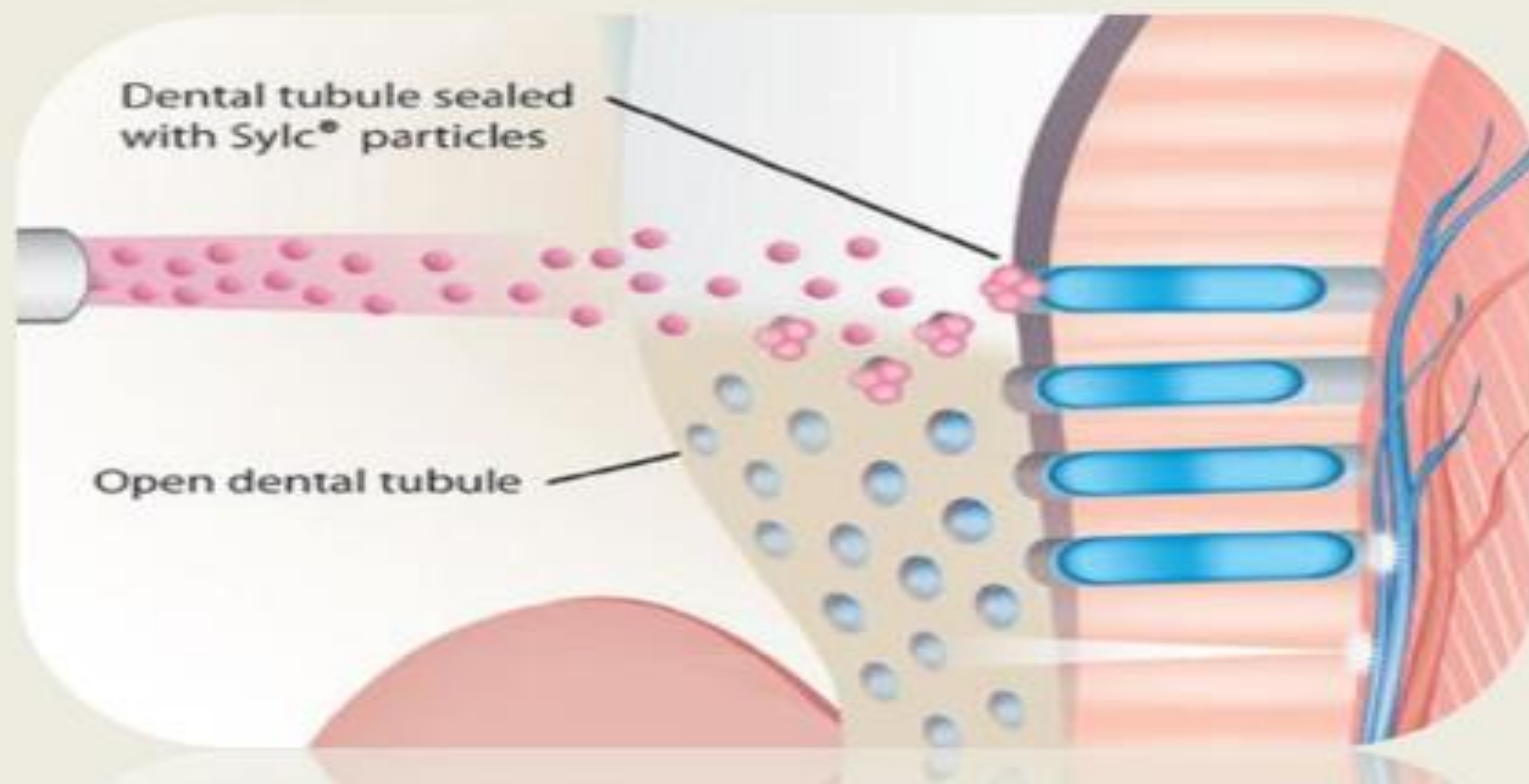
Examples: Strontium chloride and Zinc chloride



# DESENSITIZING AGENTS

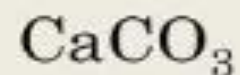
## MECHANISM OF ACTION of $\text{SrCl}_2$

$\text{SrCl}_2$  forms a barrier and blocks the openings of dentinal tubules, thus not allowing fluid movement within the tubules.



## CALCIUM CARBONATE

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Mol. Wt 100.086

Is an ingredient using in our toothpaste since 1975.

Is a common substance found in rocks.

It's most common natural forms are chalk, limestone, and marble.

It is also a component of harder organic materials like the shells of clams and eggshells.

Is a white, odourless powder or colourless crystals. Practically insoluble in water.

Calcium carbonate is a mild abrasive which helps to safely remove plaque when brushing and gently polishes away surface stains

Some alternatives include hydrated silica gels, hydrated aluminium oxides, magnesium carbonate, phosphate salts and silicates.

## CALCIUM CARBONATE

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While excess calcium from supplements, fortified food and high-calcium diets, is known to cause milk-alkali syndrome under certain circumstances

There is no known toxicity or associated risk in using a calcium carbonate toothpaste

# ZINC OXIDE EUGENOL CEMENT

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Zinc oxide eugenol (ZOE) cement have been used 1858

Protective, sedative lining in deep cavities

For temporary filling

Temporary cementing

Pulp capping

Root canal filling

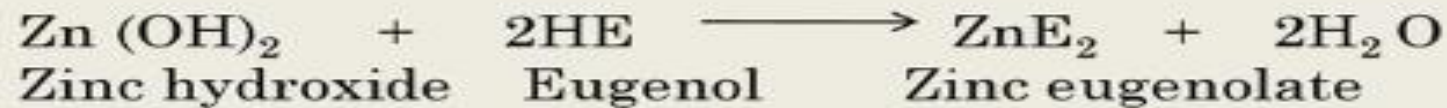
## ZINC OXIDE EUGENOL CEMENT

### SETTING REACTION:

A) Hydrolysis of Zinc Oxide to its hydroxide takes place. Water is essential for the reaction (dehydrated zinc oxide will not react with eugenol)



Reaction proceeds as typical acid-base reaction



The chelate formed is an amorphous gel that tends to crystallize imparting strength to the set mass.

Structure of set cement: The set cement consist of particles of zinc oxide embedded in a matrix of zinc eugenolate.

Setting time is around 4 to 10 min.



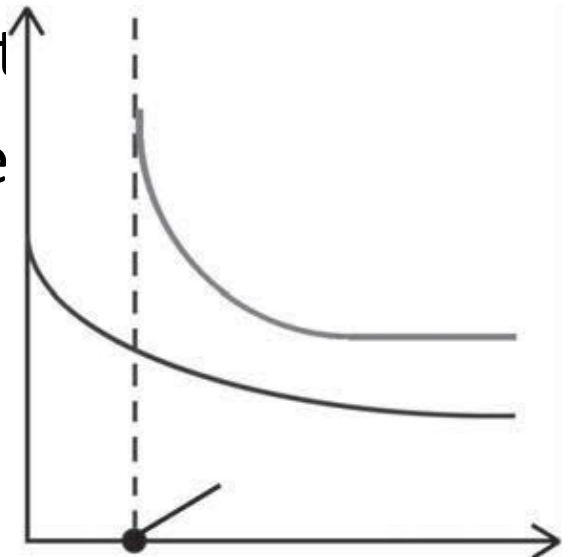
# Whitening Ingredients: Tooth whitening or bleaching Agents

- non-bleaching ingredients and
- Bleaching ingredients.
- **Non-bleaching** whitening agents that work by physical or chemical action to help remove surface stains only.
- Toothpaste containing abrasives provide whitening action as they remove stains from the teeth.
- For more efficient results, chemical action may also be utilized where positively charged ingredients (e.g., SHMP) bind to the negatively charged stain molecules

- **Bleaching** agents actually change the natural tooth color. They contain peroxides, such as hydrogen peroxide and carbamide peroxide, that help remove deep (intrinsic) and surface (extrinsic) stains.

# Rheology of Toothpaste Formulations

- **Toothpaste is a non-Newtonian fluid that has a special rheological behavior, and is called a “Bingham plastic.”**
- Bingham plastics behave as a solid (which does not flow) at rest. However, when a minimum force is applied on them, they start moving as a viscous fluid.
- The minimum force needed to flow is referred to as  $\tau_0$
- “stress.” As soon as the force (i.e., squeezing the tube) turns back into a solid form.



# MOUTHWASH

- **Mouthwash is a clear, colored solution that is aimed to refresh the breath by swishing the product around the mouth, followed by spitting it out.**
- **Benefits- prevention against tooth decay, gingivitis, plaque formation, or tartar formation, or a combination of these.**
- It is usually a hydroalcoholic solution in which flavors, essential oils, and other agents are combined to provide long-term breath deodorization.
- Palatability can be improved by polyhydric alcohol, such as glycerine or sorbitol.
- Anionic and nonionic surfactants can also be used to help solubilize the flavors and help remove debris and bacteria from the mouth

# Mouthwash

- Mouthwash is a simple solution containing
  - ***Active & Inactive Ingredients***
- ***Active Ingredients*** : antibacterial, anticavity, antihypersensitivity, antiplaque, antitartar, and whitening ingredients.

# MOUTHWASH : *Active Ingredients* :

- **Anticaries Agents:** sodium fluoride, stannous fluoride, and sodium monofluorophosphate
- **Antihypersensitivity Agents:** potassium nitrate and strontium chloride
- **Antiplaque/Antigingivitis Agents:** Chlorhexidine (which is a very effective agent to reduce plaque formation and gingivitis; its disadvantages include staining of the teeth, taste modification, and increased calculus formulation); essential oils; cetylpyridinium chloride (its disadvantage is that anionic surfactants
- **Antitartar Agents:** Pyrophosphates, PVM/MA
- **Whitening Agents:** Non-bleaching agents, such as SHMP, and bleaching agents, such as peroxides.

## **MOUTHWASH : *Inactive Ingredients***

- 1. Solvents** function as a vehicle. Two main solvents are water and alcohol (i.e., ethanol). Alcohol has an antibacterial activity, acts as an astringent, and contributes to the fresh feeling provided by the product. It may also help stabilize the product by solubilizing the flavoring oils.
- 2. Humectants** increase the viscosity of the product and result in a good mouthfeel. They also inhibit “crystallization” around the closure. Without these ingredients, the products would have a harsh chemical-like taste/feel. They may also contribute to the sweetness. Examples for frequently used humectants include glycerin and sorbitol.
- 3. Surfactants** are used to solubilize the flavoring oils and stabilize the products. They can provide foaming action on use, contribute to the cleansing effect of the product. Ex. poloxamers and polysorbates, such as polysorbate 80, as well as anionic components, such as sodium methyl cocoyl taurate and sodium lauryl sulfate.

## **MOUTHWASH : *Inactive Ingredients***

**4. Astringents** can serve as deodorizers that mask bad breath. Examples include zinc chloride, ethanol, and witch hazel.

**5. Preservatives:** Although alcohol has an antibacterial activity, its antibacterial profile may not cover all microorganisms. Mouthwashes are basically water/humectants systems, which is a perfect environment for microbial growth. Therefore, most formulations contain additional preservatives as well. Examples include ethanol; benzoates, such as benzoic acid and sodium benzoate and parabens.

**6. Flavoring Agents:** As with toothpastes, taste has a key importance from a consumer perspective. It also contributes to the refreshing effect of the product and provides a pleasant note over the breath aroma. Some flavors may also have antibacterial action. Examples - mint, menthol, peppermint oil, eucalyptol, methyl salicylate, thymol, and bubble gum. Many flavors listed under toothpaste formulations could also be taken as examples for mouthwash formulations.

**7. Sweeteners** are also usually added to adjust the taste of the formulations.

**8. Colorants** are also an important part of mouthwashes. Only a tiny amount of water-soluble dyes are added. Colors may vary from blue to green to purple or can also be yellow and red.