IMPRESSION MATERIALS

- Classification of impression materials:

Mode of setting adn Elasticity	Tissue displacement during impression procedure	Uses in dentistry

1) **According to mode of setting and elasticity:**

Mode of Setting	Rigid	Elastic
Set by chemical reaction(irreversible)	Impression plaster, Zinc oxide eugenol	Alginate, hydrocolloid, nonaqueos elastomers
Set by temperature change	Compound waxes	Agar, hydrocolloid

2) **According to tissue displacement:**
   - Depending on whether tissues are displaced while making impression , it can be:
     a) **Mucostatic** : they produce minimum displacement while making an impression. Ex: plaster, zinc oxide eugenol
     b) **Mucocompressive**: they produce displacement of tissues while recording. Ex: compound, high viscosity alginate
3) **According to their uses in dentistry:**
   - Impression material used for **complete denture prosthesis** i.e. these cannot be removed from undercuts without the impression being fractured. That's why they are used for edentulous mouth. Ex: Impression plaster, Impression compound.

   - Impression materials used for **dentulous mouth**: the materials which can be easily withdrawn from undercuts. These include the elastic impression material which is used for removable and fixed denture prosthesis.

- Impression Compound:
  - ↠ It is one of the oldest dental impression materials. It is rigid, reversible impression material which sets by physical change.
  - ↠ **Classification:**
    Type I - impression compound
    Type II- Tray compound

  - ↠ **Supplied as**:
    - Sheets

- Sticks
- Cakes in a variety of colours

↠ **Application:**

1) For making a preliminary impression in an edentulous mouth.
2) For impression of full crown preparation where gingival tissues must be displaced.
3) Peripheral tracing or border moulding.
4) To check undercuts in inlay preparation.
5) To make a special tray

↠ **Manipulation:**

- Sticks: the stick compound is softened over a flame.
- Cakes:
  i. The cake is kept in a thermostatically controlled water bath (whose temperature is around 65-77°C.
  ii. After the cake ids removed from water bath, it is kneaded with the fingers to get uniform plasticity throughout the mass.
  iii. A slightly oversized tray is used.
  iv. The material is loaded on to the tray and quickly seated onto the tissues to be recorded.
  v. The lips are manipulated to mould the borders of the impression while it is still soft.
  vi. Any delay can cause the impression to harden prematurely.
  vii. The impression is removed from the tissue once it is cooled and hardened.
  viii. The disinfection of the impression occurs while 2% glutaraldehyde.
  ix. Finally, the cast is poured. The cast is then separated from the impression by immersing it in warm water until it is soft enough.

↠ **Precautions:**

1. If the impression is immersed in water for long period of time, then the compound becomes brittle and grainy, because some of the ingredient may leach out.
2. The compound becomes sticky if it is overheated in water.

↠ **Properties:**

a) Fusion temperature:

- Impression compounds exhibit fusion temperature.
- The temperature at which the material loses its hardness or brittleness on heating or forms a rigid mass upon cooling is referred to as fusion temperature.
- At or above 43.5°C, the material softens and flows to a plastic mass which can easily be manipulated.

b) Thermal Properties:

- Impression compound has low thermal conductivity.
- During softening of the impression compound, the outside will soften first followed by the inside to ensure uniform softening; the material is kept in a water bath for sufficient time. Also kneading the material ensures further softening.
- During cooling, the layer adjacent to the oral tissues cools faster than inside. To avoid distortion, it is important for the compound to cool thoroughly before it is removed from the mouth.

c) Flow:

- It has a good flow.
- The softened material should flow into all the details of tissue contour.
- He compound after getting hardened should have minimum flow to avoid distortion.

d) **Dimensional stability**:

- The release of strain is unavoidable; the safest way to prevent distortion is to pour the cast immediately or within an hour.

e) Detail reproduction:

- This is less because of high viscosity and low flow.

• Zinc Oxide Eugenol Paste:

↠ **Classification**:

ADA specification number 16:

1. Type or Hard
2. Type II or Soft

↠ **Applications:**

1. Cementing and insulating medium
2. Temporary filing material
3. Root canal filling material
4. Surgical pack in periodontal surgical procedures
5. Bite registration paste
6. Temporary relining material for dentures
7. Impression for edentulous patients

↠ **Mode of supply:**

In paste form in two tubes:

- Base paste (white in colour)
- Accelerator or reactor or catalyst paste (red in colour)

↠ **Composition**:

Base paste	Accelerator
Ingredient	Ingredient
✓ Zinc oxide ✓ Vegetable or mineral oil	✓ Oil of cloves/eugenol ✓ Gum or polymerized resin ✓ Filler ✓ Lanolin ✓ Resinous balsam ✓ Calcium chloride and colour

- Zinc oxide should be finely divided and contain slight amount of water.
- Fixed vegetable oil acts as a plasticiser and masks the action of eugenol as an irritant.
- Oil of cloves contains 70-85%; it is preferred over eugenol because it reduces burning sensation.
- Canada and Peru balsam improves flow and mixing properties.
- Calcium chloride acts as an accelerator.

↠ **Setting reaction:**

- It is a typical acid-base reaction. The reaction is also called chelating and the product is called zinc eugenolate.
  1. $ZnO + H_2O \rightarrow Zn(OH)_2$
  2. $Zn(OH)_2 + 2HE \longrightarrow ZnE_2 + 2H_2O$

     (Acid) (Salt)

     (Eugenol) (Zinc Eugenolate)

↠ **Microstructure**:

- A core of zinc oxide particles are surrounded by a matrix of zinc eugenolate.
- The zinc eugenolate matrix forms an amorphous gel which crystallises to form a set mass.

↠ **Setting time:**

- Initial setting time: the period from the beginning of the mixing until the material ceases to pull away when its surface is touched with a metal rod of specified dimensions.
- The final set occurs when a needle fails to penetrate the surface of the specimen.
- Factors controlling setting time:
  i. Particle size: if the particle size is small and coated with acid, then setting time is less.
  ii. Setting time can be decreased by adding zinc acetate or a drop of water or acetic acid.

iii. Longer the mixing time, shorter is the setting time.
iv. High atmospheric pressure and humidity accelerate setting.

↠ **Manipulation:**

- Mixing is done on a glass slab/ oil- impervious paper.
- Two ropes of paste of same length and width, one from each tube are squeezed onto the mixing slab.
- Stainless steel spatula is used. The two ropes are collected with spatula and mixed until uniform colour is obtained.
- Mixing time:- 1 minutes
- Custom impression tray made of stable resin is recommended for zinc oxide eugenol. The material adheres to the tray so no special adhesive is required.
- Biological consideration: some patients experience burning sensation in the mouth due to eugenol.
- The material is loaded into the tray by swiping on to the tray.
- The impression is rinsed and placed in disinfectant solution which is 2% glutaraldehyde.
- The pouring of the cast should not be delayed.
- After setting, the impression is removed off the cast after softening it through immersion in hot water.

↠ **Properties:**

I. Consistency and flow:

- Paste of thick consistency compresses the tissues.
- According to ADA specification number 16, the spread is :
  - Type I Paste - 30-50mm
  - Type II Paste – 20-45mm
- These materials have a very good flow.

II.Detail reproduction:

- Register surface details quite accurately.

III. Rigidity and strength:

- Impression resists distortion and fracture.

IV. Dimensional Stability:

- Negligible shrinkage occurs during hardening.

V. Advantages and Disadvantages:

↠ **Advantages:**

i. Good consistency
ii. Sufficient working time

iii. Register details accurately
iv. It is dimensionally stable
v. Does not require separating medium

↠ **Disadvantages:**

i. Requires a special tray for impression making
ii. It is sticky in nature and adhere to tissues
iii. Eugenol causes burning sensation and tissue irritation

- **Hydrocolloid Impression Materials:**
  - ↠ It is a colloid in which water is the dispersion medium and the gelatine particles are the dispersed particles.
  - ↠ They exist in two different forms known as 'Sol' and 'Gel'
  - ↠ The sol is a thick viscous liquid and gel is an elastic semisolid. Gel is, produced from sol by a process called gelation.

  - **Classification:**
    - ➢ Based on the mode of elation, they are classified as:
      i. **Reversible hydrocolloid** – they are reversible because their physical state can be reversed i.e. sol ⇌ gel Eg- Agar
      ii. **Irreversible hydrocolloid**: - here the physical state cannot be reversed. Eg- Alginate. i.e. sol ⟶ gel

  - **Reversible Hydrocolloid – Agar**
    - ➢ Agar hydrocolloid was the first successful elastic impression material. It is an organic hydrophilic colloid which is extracted from a type of seaweed.

  - **Composition:**

Ingredient	Wt%
↠ Agar	↠ 13-17%
↠ Borates	↠ 0.2-0.5%
↠ Potassium sulphate	↠ 1-2%
↠ Wax, hard	↠ 0.5-1%
↠ Thixotrophic materials	↠ 0.3-0.5%
↠ Alkyl benzoates	↠ 0.1%
↠ Colouring and flavouring agents	↠ Traces
↠ Water	↠ Balance

  - ➢ Functions of each ingredient:
    i. **Agar**: basic constituent 13-17& for tray material, 6-8% for syringe material.
    ii. **Borates** : improves the strength of the gel

iii. **Potassium sulphate**: counters retarding effect of borates, thereby ensures proper setting of the cast or die.
iv. **Hard wax**: acts as filler. Thereby it increases the strength, viscosity, rigidity.
v. **Thixotrophic material**: acts as a plasticizer
vi. **Alkyl benzoates**: acts as a preservative.
vii. **Water:** acts as a dispersion medium.

- **Manipulation:**
  - The equipment and material required for an agar impression are:

i.Hydrocolloid conditioner:

- ✓ It has 3 chambers
  - Liquefaction section
  - Storage section
  - Tempering section
- ✓ **Liquefaction section:**
  - ❖ The material is kept in this section for 10 minutes at 100°C.
  - ❖ Every time the material is liquefied, 3 minutes are added.
- ✓ **Storage section**: 65-68°C temperature. It can be stored in the sol solution.
- ✓ **Tempering section**:-
  - ❖ 46°C for about 2minutes with the material loaded in the tray.
  - ❖ Here, the temperature is brought to a temperature which is tolerated by the oral tissues.
  - ❖ Thus, the material becomes more viscous.

ii. Water cooled rim lock trays
iii. Impression syringes
iv. Connecting water hose
v. Agar tray material in tubes
vi. Agar syringe material

- **Impression trays:**
  - Rim lock trays with water circulating devices are used.
  - It has an inlet and outlet for connecting the water hoses.
  - The tray containing the tempered material is removed from the bath.
  - Then the water hoses are connected.
  - Water is circulated at 18-21°C through the tray until gelation occurs.
  - The tray is positioned in the mouth by the dentist. The tray should allow a space of 30mm occlusally and laterally and extend distally to cover all teeth.
  - The cooling tubes are on the periphery, because of which; the material sets from the periphery towards the teeth surfaces.
  - Rapid cooling is not recommended as it can induce distortion.
  - To guide the tray into position, three stops of the compound are prepared.

- **Working and setting time:**
  - The working tissue ranges between 7 minutes and 15 minutes.
  - The setting time is about 5 minutes.
  - Both can be controlled by regulating the flow of water through the cooling tubes.

- **Removal of impression:**
  - When the agar has gelled, the peripheral seal is broken, and the impressions removed from the mouth rapidly.
  - Later it is rinsed thoroughly with water and the excess water is removed by shaking the impression.

- **Storage of agar impression:**
  - Storage should be avoidable at all costs.
  - If stored in air then it will result in dehydration.
  - If stored in water then there will be swelling.
  - If storage becomes necessary it should be stored at 100% humidity.

- **Laminate technique**:
  - Also known as agar-alginate impression because agar and alginate are used together to get an impression.
  - Syringe agar is injected to the teeth which have to be recorded.
  - Over the syringe agar material an impression tray containing chilled alginate is placed.
  - Alginate sets by chemical reaction which agar sets because it is in contact with chilled alginate.

    - **Advantages:**
      1. The syringe agar gives better details.
      2. Less air bubbles.
      3. Water cooled trays are not required.
      4. It sets faster than the regular agar techniques.

- **Wet field technique:**
  - The tooth whose impression needs to be taken is flooded with warm water and the syringe material agar is placed over this.
  - An impression tray containing the agar tray material as force into the syringe material.
  - Due to the hydraulic pressure produced by warm water the syringe material will flow into the deep undercuts and thus the impression is made.

- **Alginate material:**
  - The word alginate comes from alginic acid which is a mucous extract yielded by species of brown seaweed.
  - **Types:**
    - Type I – Fast setting
    - Type II – Normal setting

  - **Supplied as:**
    - A powder that is packed in bulk in tins, bins or sachets.
    - A plastic scoop is supplied for dispensing the bulk powder and a plastic cylinder is supplied for measuring the water.

  - **Composition:**

Ingredients	Wt%	Function
✓ Sodium or potassium or triethanolamine alginate	✓ 15%	✓ Dissolves in water and reacts with calcium ions
✓ Calcium sulphate (reactor)	✓ 16%	✓ Reacts with potassium alginate and forms insoluble calcium alginate
✓ Zinc oxide	✓ 4%	✓ Acts as a filler
✓ Potassium titanium fluoride	✓ 3%	✓ Gypsum hardener
✓ Diatomaceous earth	✓ 60%	✓ Acts as a filler
✓ Sodium phosphate(retarder)	✓ 2%	✓ Reacts preferentially with calcium sulphate
✓ Colouring and flavouring agent	✓ Traces	✓ Ex: Peppermint

  - **Setting reaction:**

    3 components play very important role:
    a) Base – sodium/ potassium alginate
    b) Reactor – calcium sulphate
    c) Retarder – sodium phosphate

    - The final gel i.e. calcium alginate is produced when soluble sodium alginate reacts with calcium sulphate but this reaction proceeds too fast i.e. the working time is less.
    - So, the reaction is delayed by addition of retarder.
    - Therefore 2 main reaction occur during setting

      Reaction 1 - $Na_3PO_4 + 3CaSO_4 \longrightarrow Ca_3(Po_4)_2 + 3Na_2SO_4$

      Reaction 2 – Sodium alginate + $CaSO_4 + H_2O \longrightarrow$ Ca alginate + Na_2SO_4
      (Powder) (Gel)

- **Manipulation:**
  - The container is fluffed several times. This ensures uniform distribution of the filler before mixing.
  - The lid is removed carefully to prevent silica particles from being inhaled.
  - The mixing equipments include a clean flexible plastic bowl and a clean bladed stiff metal spatula.
  - The proper water/powder ratio as specified by the manufacturer should be used. The powder is sprinkled in to the water in the rubber mixing bowl.
  - At first, the powder and the water is stirred to wet the powder with water. After that rapid spatulation by swiping against the bowl. A vigorous figure '8' motion is also used.
  - Figure '8' motion helps:
    - To remove most of the air bubbles
    - To remove the superficial dissolved layer of alginate and exposes the un-dissolved part gets dissolved.
  - Proper mix is smooth and creamy with minimum voids and does not drip off the spatula when it is raised from the bowl.

- **Mixing time:**
  - ⇾ Type I – 45 seconds
  - ⇾ Type II – 60 seconds
  - Over or under mixing results in
    - Reduced strength
    - Reduced working time

- **Working time:**
  - Fast set alginate: 1min 15 sec
  - Normal set alginate: 2 minutes

- **Gelation time:**
  - Type I - 1.5mm – 2mm
  - Type II – 8 - 4.5mm

- **Control of gelation tissue:**
  i. Manufacture controlled where retarders are added.
  ii. The gelation time is best controlled by the dentist by altering the temperature of the water for mixing alginate material.
    - ❖ Colder the water, longer the gelation tissue
    - ❖ Warmer the water, shorter the gelation tissue

- **Tray selection:**

- Perforated trays are used because holed provide mechanical interlocking between alginate and tray.
- The tray should cover the entire impression and provide a space of at least 3mm on all sides.

- **Loading the tray:**
  - The mixed alginate is pressed and swiped into the perforated rim lock trays.
  - The surface of the alginate in the tray may be smothered out using a moist finger.

- **Seating the tray:**
  - Once the tray is seated, it must be held in place without any movement.
  - Any movement during gelation result in distortion.

- **Time of removal and test for set:**
  - The material loses its tackiness when set. It will rebound fully when provided with blunt instrument.

- **Removal of the impression:**
  - The tray is removed from the mouth by holding the tray handle and then applying a sudden, jerky motion.
  - After removal from mouth, the impression is
    - Washed with cold water to remove saliva.
    - Disinfected by immersing it in a suitable disinfectant.

- **Storage of alginate impression:**
  - Such impressions must be poured as soon as possible. If it becomes necessary to store the impression then
    - The impression is wrapped lightly with a moist towel or
    - Keep the impression in a sealed plastic bag.

- **Construction of cast:**
  - Freshly mixed stone is placed at one end of the impression.
  - The impression is rotated to facilitate the flow of stone around the arch.
  - By doing so, the stone displaces the water and wets the surface of the impression as it flows.
  - The stone cast should be removed in one hour.

- **Properties:**
  1. **Taste and odour**: Alginate has pleasant smell and taste.

2. **Flexibility**: it is about 14%. If the water/powder ratio decreases the flexibility also decreases.
3. **Elasticity and elastic recovery**: elastic recovery occurs by 98.2%. Permanent deformation is less if the set impression is removed from the mouth quickly.
4. **Reproduction of tissue detail**: detail reproduction is lowered when compared to agar hydrocolloid.
5. **Strength:**
    a) **Compressible strength:** ranges from 0.5-0.9MPa
    b) **Tear strength**: ranges from 0.4-0.7KN/m
    c) Factors affecting strength are:
        i. **Water/powder ratio**: too much or too less water reduces gel strength
        ii. **Mixing time**: over and under mixing reduces strength.

6. **Syneresis and imbibition**: like agar-agar; alginate exhibits the properties of syneresis and imbibition.
7. **Dimensional stability**: it is poor.
8. **Adhesion**: does not adhere well to the tray