Impression materials

Impression materials: The impression is a negative replica of the dental structure {used to make replicas (models or casts) of teeth and other oral tissues accurately}. In dentistry, we take impressions of teeth and their supporting structures (gingiva, alveolar bone or residual ridge, hard and soft palate, and frenum). The replicas are used to construct restorations and other appliances.

Sometimes impression materials are used to duplicate a cast or model that has been formed when more than one positive reproduction is required (Such impression materials are referred to as ***duplicating materials***).

The impression is a ***negative*** reproduction, whereas the replica (model or cast) is a ***positive*** reproduction.

Some are use simply to produce a physical model of the oral tissues for study, called a ***study model.*** Study models are used in diagnosis and treatment planning. Other uses require very exact replication of the size and shape of a preparation for the construction of a restoration or appliance, these replicas are called ***casts.*** A replica of a single tooth is called a ***die.***

Impression materials are generally transferred to the patient's mouth in an ***impression tray*** (stock or special tray). The tray is required because these materials are initially quite fluid and require support. Once positioned in the patient's mouth, the material undergoes setting either by physical or chemical process. After setting, the impression is removed from the patient's mouth. This negative replica is converted into a positive replica by pouring it with cast or die materials.

Ideal Requirements of impression materials

** No single material is ideal for all applications and none of the current materials completely satisfies the requirements**.**

1. Biological Requirements

- **Biocompatibility:** An ideal impression material should be non-toxic and nonirritant.

- **Disinfection:** It should be possible to decontaminate an impression to render it safe for further handling without affecting the accuracy or fine details.

2. Chemical Requirements

- **Not dissolve or disintegrate in oral conditions.**
- **hydrophilic for better reproduction of details. (Some are hydrophobic they require dry field of operation, otherwise this will result in the formation of 'blow hole or gap' in the impression.**
- **Compatible with cast or die materials**.

3. Rheological Requirements

Rheology is the science that explains the fluid or flow characteristics of materials.

- **Fluidity and viscosity:** Viscosity is the resistance offered by a fluid to flow. Impression material should have good flow property (***less viscosity***) before setting so that all finer details can be recorded and less flow property (***high viscosity***) after setting so that impression can be withdrawn from the mouth without any distortion. Based on viscosity, impression materials can be classified into mucostatic and mucocompressive materials.
  - **Mucostatic:** These are initially fluid and compress soft tissues to a lesser extent. They are more fluid so all the finer details can be recorded.
  - **Mucocompressive:** Initially more viscous, exert more pressure and displaces soft tissues to a greater extent. They are used to record primary or preliminary impression.

Mixing time, working time, and setting time

- Mixing time: Mixing time is the time from the start of mixing until a proper smooth creamy homogeneous mix is obtained.
- Working time: Working time is the time from the start of mixing until the material is no longer suitable for recording an impression. It is normally characterized by the time taken for the viscosity to increase by a given amount above that of freshly mixed material.
- Setting time: The setting time of an impression material may be defined in terms of the required time to complete the setting reaction or it is the time required to reach a certain degree of rigidity hardness or elasticity.

Ideally, an impression material should have longer working time and shorter setting time.

4. Mechanical Requirements

- Good dimensional stability
- Accuracy: Must be capable of reproducing all the finer details with greatest accuracy.
- Elasticity and Flexibility: Impression materials should be sufficiently elastic and flexible (after setting) on removing from the mouth so that no distortion will occur.
- Tear strength: The material should have sufficient tear strength to withstand such stresses without tearing.
- Adhesion or retention: Should be remain attached to the tray during recording the impression. Retention can be achieved by using tray adhesive (for elastomers) or by using a perforated tray (for hydrocolloids).
- Fluidity and viscosity: Impression material should have low viscosity before setting and high viscosity after setting so that impression can be withdrawn from the mouth without any distortion.

5.Thermal Requirements

- **Coefficient of thermal expansion:** Must be zero or minimum to minimize dimensional change on cooling or heating. On being withdrawing from the mouth at 37°C to room temperature of 27°C, the impression undergoes approximately 10°C cooling. This results in thermal contraction.

- **Thermal conductivity:** Should be a **good conductor** of heat so that it can soften or harden uniformly which minimizes distortion. But practically, all impression materials are poor conductors of heat. Hence, they do not set simultaneously.

- **Softening temperature:** In case of thermoplastic material, the range of softening temperature should not be greater than 50–55°C. Otherwise on placing it in patient's mouth it may burn the oral tissues. It should set or harden at or near mouth temperature.

5. Esthetic Requirements

- **Color contrast:** Suitable colors are used to distinguish materials of different viscosities. Two paste materials must be supplied in contrasting colors so that it is easy to see when mixing has been completed satisfactorily, there are no streaks of individual color left in the mix.

6. Minor Requirements

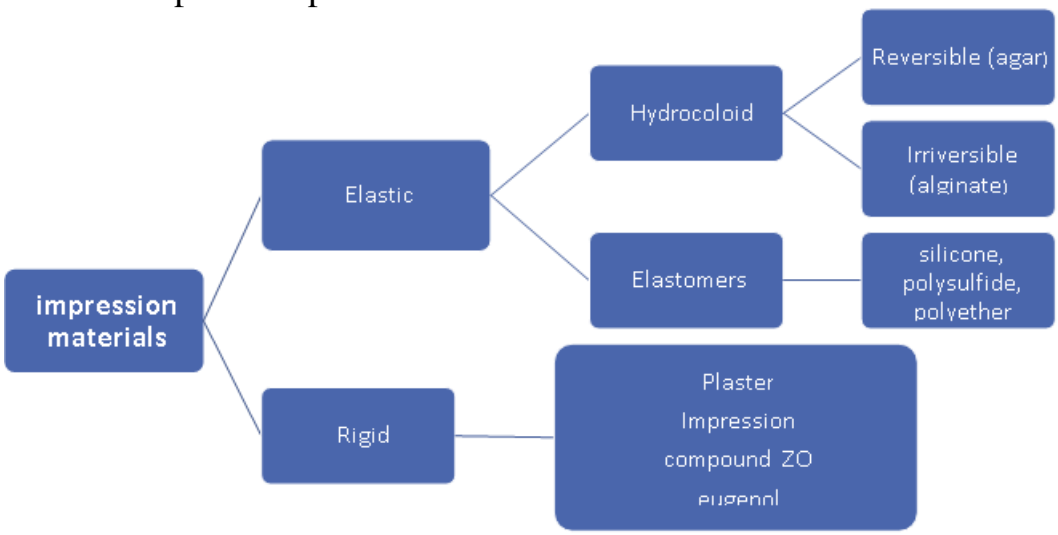
- **Acceptable taste and odor:** Materials should have good taste and odor.
- **Shelf-life:** Materials should have longer shelf-life so that the unused material can be stored.
- **Economic:** Be relatively inexpensive, simple, and easy to use.
- **Availability:** Be easily available.
- **Ease of manipulation:** Should be easy to proportionate, mix and clean. Should not require any elaborate equipment for manipulation.
- **Sterilization:** Should be easy to sterilize if used for more than once.
- **Reusability:** To be used again and again without any loss of useful properties of material. Should permit multiple die pours. Be capable of having additions made and insertion in the mouth without distortion. This will allow minor corrections to be made without having to take an entirely new impression.

None of the available materials satisfies all the above requirements.

Classification of Impression Materials

I. According to their mechanical properties–

1. Elastic
   - Hydrocolloids (Aqueous elastomeric impression materials)
     a) Reversible – Agar-Agar
     b) Irreversible – Alginate
   - Elastomers (Nonaqueous elastomeric impression materials)
     a) Polysulfides
     b) Polysilicones (Addition and condensation silicones)
     c) Polyether (Chemically activated and light activated)
2. Inelastic or rigid
   - Impression compound
   - Impression waxes
   - Impression plaster
   - ZOE impression paste



II. According to their chemical name–

1. Impression compound
2. Impression waxes
3. Impression plaster
4. ZOE impression paste
5. Hydrocolloids
   - Reversible – Agar-Agar
   - Irreversible – Alginate
6. Elastomers
   - Polysulfides

- Polysilicones (Addition and Condensation) silicones)
- Polyether (Chemically activated and light activated)

III. According to the mouth condition–

1. Edentulous arches—All impression materials can be used.
2. Dentulous arches—Hydrocolloids and elastomers.

IV. According to the force exerted on the soft tissues–

1. Mucostatic
    - Impression plaster
    - Agar-Agar
    - Alginate
    - Light body elastomer
    - Impression waxes
    - ZOE impression paste.
2. Mucocompressive
    - Impression compound
    - Putty elastomer

V. According to the nature of hardening or setting–

1. By a physical change
    - Impression compound
    - Impression waxes
    - Agar-Agar
2. By a chemical change
    - ZOE impression paste
    - Alginate
    - Impression plaster
    - Elastomers

VI. According to their clinical applications–

1. Preliminary impression of edentulous arches—impression compound
2. Secondary or corrective wash impression
    - ZOE impression paste
    - Impression plaster
    - Alginate
    - Light body elastomer.
3. Cavity preparations of inlays and onlays
    - Elastomers.

4. Partial denture impressions – Hydrocolloids and elastomers.
5. Special uses
   - Syringe material, e.g. Light body elastomer.
   - Tray material, e.g. Tray compound, heavy body and putty body elastomers.
6. High viscosity—Impression compound and putty body elastomer
7. Medium viscosity—Regular body elastomers
8. Low viscosity—Impression plaster
   ZOE impression paste
   Hydrocolloids
   Light body elastomers

VII. According to their dispensing system–

1. Cakes, cylinders, sticks, and cones – Impression compound and impression wax
2. Powder – Impression plaster and alginate
3. Two-paste system – ZOE impression paste, poly- sulfide, and polysilicone.
4. Three-paste system – Chemically activated polyether.
5. Single paste system – Light activated polyether.

VIII. According to their viscosity

1. High viscosity—Impression compound and putty body elastomer
2. Medium viscosity—Regular body elastomers
3. Low viscosity—Impression plaster

   ZOE impression paste
   Hydrocolloids
   Light body elastomers

Type of Impression Material	Elasticity	Setting Process	reaction	Hydrophilicity	Used for the Construction of			
					Full Denture	Partial Denture	Crown, or bridge	Study Models
impression compound	Rigid	Physical	reversible	Hydrophobic	Primary	No	No	No
ZOE	Rigid	Chemical	Irreversible	Hydrophobic	Final	No	No	No
Irreversible hydrocolloid (alginate)	Elastic	Chemical	Irreversible	Hydrophilic	Primary	Yes	No	Yes
Condensation silicone	Elastic	Chemical	Irreversible	Hydrophobic	Final	Yes	Yes	No
Addition silicone	Elastic	Chemical	Irreversible	Hydrophobic Hydrophilic	Final	Yes	Yes	No

Rigid impression material (inelastic)

1. Impression plaster.
2. Impression waxes.
3. Impression compound.
4. Zinc oxide eugenol impression material.

1. Impression Plaster

is described as a rigid, muco-static, Hydrophilic, irreversible impression material which set by chemical reaction.

The impression plaster has the same setting reaction and properties as the gypsum products that used for models and casts. The major difference is that impression plaster has flavors added and it sets more quickly to minimize the time that the material is in the mouth. When impression plaster sets, it is hard and brittle.

Presentation: present as powder mixed with water (w/p =0.5).

Composition:

1. Calcium sulphate β- hemihydrates.

2. Accelerator Potassium sulphate to reduce expansion and to accelerate the setting reaction.

3. Retarder (Borax) to reduce the rate of setting (counteract the accelerator).

4. Starch: To permits rapid separation of the cast from the impression material

5. Color pigment (to distinguish impression plaster and model plaster) and flavoring agent

Uses:

1. Making final impression of the edentulous arches (constructing complete dentures).
2. It is primarily used when excess saliva produced by the patient (accessory palatine gland).

Manipulation:

The impression plaster should be mixed with water or an anti-expansion solution in the ratio of 100 g to 50 ml. The water is placed into rubber bowel and the powder is added, mixing them till the creamy mixture is formed then thin layer of mix

impression plaster is placed in the special tray (thickness of 1-1.5 mm) that filled and seated into the patient mouth where it is allowed to set.

After the material has set it is removed from the mouth, washed free of saliva and then the surface of the impression is painted with a separating medium (**e.g. alcoholic solutions of varnish),** Failure to do so results in bonding the cast to the surface of the impression material.

Properties:

1.It reproduces good surface detail

2.Very good dimensional stability.

3.Setting time 3-5 minutes.

4.It is hydrophilic, the patient complain of dry sensation after taking impression because of water absorption.

5.The material is best used in a special try made of acrylic (1-1.5 mm spacer).

6.A separating medium most be used between the impression and model material.

7.Long shelf life, relatively inexpensive and easy to manipulate.

8.Unpleasant taste and rough.

9.Rarely used these days as they are brittle and fractures very easily.

Advantages	Disadvantages
It reproduces good surface detail	Cannot be used in undercut ridge
Very good dimensional stability.	Heat due to reaction
Short setting time and easy to manipulate	Rigid and brittle
Long shelf life and cheap	Need to use separator
Low viscosity (mucastatic)	Dry sensation in the mouth