

# *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.

**Not all** impression materials are compatible with all model materials. Because impression materials are used for many purposes, a wide variety of products are available to make impressions of oral tissues.

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**

Many materials have been used for taking impressions. But ***none*** of them is perfect. Each material is superior to other in some respects. So useful to enumerate the properties, which should be possessed by an ideal impression material.

### **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

- **Inertness:** An ideal impression material should be:
  - Chemically inert in the mouth.
  - Not dissolve or disintegrate in oral conditions.
- **Moisture compatibility:** An ideal impression material should be *hydrophilic* for better reproduction of details. Some are hydrophobic they require dry field of operation, otherwise they may be repelled by moisture in a critical area of the impression. This normally results in the formation of 'blow hole' in the impression. For hydrophilic materials no special precautions are necessary.
- **Compatible with cast or die materials:** Impression material should be compatible with model and 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.

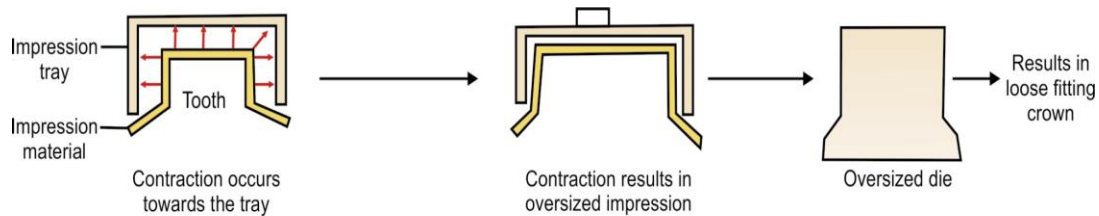
### **Mixing time, working time, and setting time**

- **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

- **Accuracy:** Must be capable of reproducing all the finer details with greatest accuracy. Material that expands during setting, results in under sized die or cast and vice-versa.



When impression material undergoes contraction, results in oversized die

- **Elasticity:** Impression materials should be sufficiently elastic (after setting) on removing from the mouth so that under cuts can be recorded without distortion or it should have large recovery and less permanent deformation.
- **Tear strength:** On removing the elastic impression material from undercut areas they are often put under a considerable tensile stress. So, the material should have sufficient tear strength to withstand such stresses without tearing.
- **Flexibility:** Should be sufficiently flexible to permit easy removal over undercuts.
- **Adhesion or retention:** Should be adhesive or remain attached to the tray during recording the impression. Partial detachment may cause distortion of the impression and will lead to ill-fitting of restorations. Retention can be achieved by using tray adhesive (for elastomers) or by using a perforated tray (for hydrocolloids).
- **Dimensional stability:** Should have no dimensional changes in or out of the mouth at all temperatures and humidity or should have perfect dimensional stability such that impression would retain its original accuracy indefinitely. Majority of material accuracy is best maintained by pouring gypsum cast soon after recording the impression.

#### 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.

## 6. 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.

## 7. 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 hence suitable material could be selected according.

# *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.

## **VII. 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

## **VIII. 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.

Type of Impression Material	Used for the Construction of							
	Elasticity	Setting Process	reaction	Hydrophilicity	Full Denture	Partial Denture	Crown, or bridge	Study Models
<b>impression Plaster</b>	Rigid	Chemical	Irreversible	Hydrophilic	Final	No	No	No
<b>impression Wax</b>	Rigid	Physical	reversible	Hydrophobic	Primary	No	No	No
<b>impression compound</b>	Rigid	Physical	reversible	Hydrophobic	Primary	No	No	No
<b>ZOE</b>	Rigid	Chemical	Irreversible	Hydrophobic	Final	No	No	No
<b>Reversible hydrocolloid (agar)</b>	Elastic	Physical	reversible	Hydrophilic	Not used	Yes	Yes	No
<b>Irreversible hydrocolloid (alginate)</b>	Elastic	Chemical	Irreversible	Hydrophilic	Primary	Yes	No	Yes
<b>Polysulfide</b>	Elastic	Chemical	Irreversible	Hydrophobic	Final	Yes	Yes	No
<b>Condensation silicone</b>	Elastic	Chemical	Irreversible	Hydrophobic	Final	Yes	Yes	No
<b>Addition silicone</b>	Elastic	Chemical	Irreversible	Hydrophobic	Final	Yes	Yes	No
<b>Polyether</b>	Elastic	Chemical	Irreversible	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 =0.6).

#### **Composition:**

1. **Calcium sulphate  $\beta$ - hemihydrates** ( $[CaSO_4]_{1/2} H_2O$ ): Main reactive ingredient.
2. **Accelerator Potassium sulphate** ( $K_2SO_4$ ): 4% to reduce expansion and to accelerate the setting reaction.
3. **Borax:** 0.04% retarder to reduce the rate of setting (counteract the accelerator).
4. **Alizarin:** 0.04% color pigment (to distinguish impression plaster and model plaster).
5. **Starch:** To render them soluble in water and permits rapid separation of the cast from the impression material (to help disintegration of impression on separation from the plaster/stone model). After cast hardens, the impression and the cast are put in hot water, the starch softens and swells in hot water and the impression disintegrate, making it easy to separate the cast from the impression.
6. **Flavoring agent:** To offset the bad taste of plaster.

Accelerator, borax, and alizarin dissolved in water and form a solution, called as **antiexpansion** solution.

Due to the addition of starch in plaster it is also called as **soluble plaster**.



## 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 60 ml. The water is placed into rubber bowl 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. Setting time  $4 \pm 1$  minutes.
2. The mixed impression plaster has very low viscosity which makes it possible to take impressions with a minimum force on the soft tissues (mucostatic technique).
3. It is hydrophilic (patient complain very dry sensation after having impression because of water absorption nature of this material) and thus adapts readily to soft tissue recording their surface details with great accuracy.
4. The material is best used in a special try made of acrylic (1-1.5 mm spacer).
5. Very good dimensional stability (dimensional change during setting about 0.06%).
6. A separating medium must be used between the cast and the impression plaster (rinse the impression plaster with solution of **sodium alginate or soap with water** before pouring the cast or using **alcoholic solutions of varnish**).
7. unpleasant taste
8. Rarely used these days as they are brittle and fractures very easily.
9. Setting expansion: Maximum 0.15%

## **Advantages:**

1. It reproduces good surface detail.
2. Rate of set is under the control of operator ( $4 \pm 1$  minutes).
3. Good Dimensional stability and accuracy if used with antiexpansion solution.
4. Compatible with all materials commonly used for making casts.
5. Stable on storage over long time if it is kept in a sealed condition.
6. Relatively inexpensive and easy to manipulate.
7. Easy to manipulated.

## **• Drawbacks**

1. Set impression is brittle and may fracture when removed from undercut areas.
2. Bad taste and rough feel.
3. Water absorbing nature of these materials often causes patients to complain about a very dry sensation after impression has been recorded.
4. Exothermic heat is disliked by many patients.
5. Requires a separator before pouring the cast in the lab, this may cause surface inaccuracy.
6. Able to flow to pharynges.
7. Cannot be used in undercut ridge (rigid impression material).

