# *Dental Materials* **Dr. Aula Kamal**

# Impression Materials

A dental impression is a negative record of tissue of the mouth; it is used to reproduce the form of teeth and surrounding tissues. A positive reproduction is obtained by pouring dental stone or other suitable material into the impression and allowing it to harden. The positive reproduction of a single tooth is described as a die, when several teeth or a whole arch is reproduced; it is called a cast or model. The impression material is carried to the mouth in a tray which is either stock tray or special tray.

## *Classification of Impressions*

Preliminary impressions.
Final impressions.
Bite registrations.

## *Impression Trays*

**Quadrant tray:** Covers one half of the arch.
**Section tray:** Covers the anterior portion of the arch.
**Full arch tray:** Covers the entire arch.
**Perforated tray:** Holes in the tray create a mechanical lock to hold the material in place.
**Smooth tray:** Interior of the tray is painted or sprayed with an adhesive to hold the impression material.

## ***Requirements of an ideal Impression Material:***

1. Accurate reproduction of surface details; depend upon:
   - Low viscosity; should be sufficiently fluid upon placement to prevent displacement of soft tissue).
   - The material should be compatible with moisture and saliva (hydrophilic not hydrophobic).
2. Dimensional accuracy and stability; depend upon:
   - Type of tray.
   - Shrinkage of impression material.
   - Permanent set.
   - Storage stability.
   - Impression technique.
3. A placement taste and odor and esthetic color.
4. Freedom from toxic or irritant constituents.
5. Adequate shelf life for requirements of storage and distribution.
6. Easy of manipulation and reasonable cost.
7. Appropriate setting time and characteristics.
8. Adequate strength so that it will not break or tear on removal from mouth.
9. Compatibility with cast and die material.
10. Easily disinfected without loss of accuracy.

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

## ***Key Properties***

**Accuracy** = ability to replicate the intraoral surface details.

**Dimensional Stability** = ability to retain its absolute dimensional size over time.

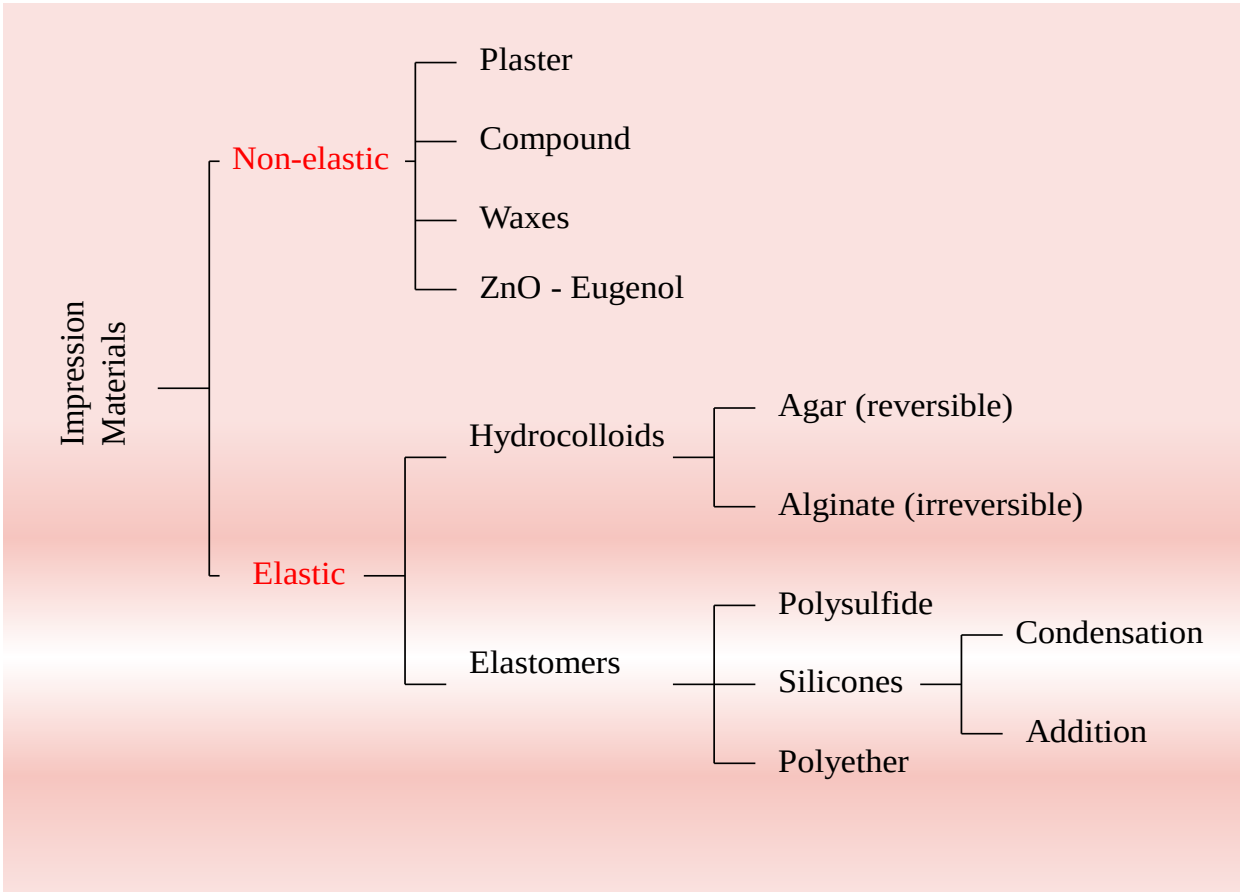
**Tear Resistance** = ability to resist tearing in thin sections.

# ***Classification of impression materials***

## ***1. According to elasticity:***

***A-Elastic material:*** Show the properties of elasticity that will return to its original shape and dimensions after removal from the patient's mouth. This materials can engage undercuts, used in partially edentulous and may be used in fully edentulous patients.

***B- Rigid material:*** Show the properties of non-elastic and cannot engage undercuts. Their use is restricted to edentulous patient.



## ***2. According to setting reaction:***

***A- Physical reaction* ( reversible, thermoplastic material):** Means when we apply heat upon it will become soft, and when we remove it becomes hard. E.g. impression compound, agar and wax.

***B- Chemical reaction (irreversible):*** When the setting is by chemical reaction like most of other impression materials. This includes a change within the material structure; so can be used once. E.g. impression plaster, Zinc-oxide eugenol, alginate Polysulphide, Silicones, Polyether.

## ***3. According to reaction with saliva:***

***A- Hydrophilic:*** The impression material is compatible with moisture and saliva, this means that the impression material will completely absorb saliva from the patient's mouth and we get full adherence between the tissue and the material.

***B- Hydrophobic:*** Means the impression will not absorb saliva and repeal it; this means also any drop of saliva within the surface of patient's mouth will make a slight depression or concavity on the material, so the patient's mouth must be completely dried before taking impression.

## ***4- According to viscosity before setting:***

***A- Mucostatic:*** Not compress tissue during setting of impression.

***B- Mucocompressive:*** Compress tissue during setting of impression, the material more viscous.

***C- Pseudo-plastic:*** Material fairly viscous, whilst under low stress conditions may become fluid during recording of impression.

## ***Methods of making impression***

1. Stock tray with pressure (Mucocompressive). This technique used in primary impression for complete denture works using impression compound.
2. Resin custom tray without pressure (Mucostatic). This technique used in final impression for complete denture works using Zinc-oxide eugenol or impression plaster.
3. Stock tray (rim-lock, perforated or with adhesive) to taking the impression for partially edentulous ridge using hydrocolloids or elastomers (heavy body only).
4. Resin custom tray with 2-4 mm spacing (perforated or with adhesive) to taking the impression for crown& bridge works or partial denture (single mix technique) using regular body elastomers.
5. Resin custom tray with 2-4 mm spacing (perforated or with adhesive) to taking the impression for crown& bridge works or partial denture using heavy & light body elastomers
(Multi mix technique).
6. Stock tray (rim-lock, perforated or with adhesive) to taking the impression for crown& bridge works or partial denture (Two stage putty wash technique) using putty & light body elastomers.

# ***Rigid non – elastic impression materials***

## ***1.Impression plaster:***

- **Presentation:** Present as powder mixed with water (w/p=o.6).
- **Composition:**

1. Calcium sulphate β-hemihydrate.
2. Potassium sulphate (K2SO4) to reduce the setting expansion & accelerate the setting reaction.
3. Borax, Pigments is added also like alizarin (pink); to distinguish it from other gypsum products also flavoring agent.

4. Starch is added for easier separation of impression plaster from the cast. After cast harden, starch grains will swell when hot water is applied on it making it easy to separate the cast from the impression.

## ♦Manipulation:

Water is placed in to the rubber bowl and the powder is added, mix with spatula till the creamy mixture is formed the trey is filled and seated into the patients mouth where it is allowed to set.

## ♦Usage:

Used in taking final impression for edentulous arches or wash impression, used to mount cast on an articulator and for bite registration.

## ♦Properties:

1. Setting time 3-5 min.
2. The mixed material has a very low viscosity so it is mucostatic.
3. It is hydrophilic (patients complain very dry sensation after having impression because of water absorption nature of this material) thus adapt readily to the soft tissues, recording their surface detail with great accuracy.
4. The material is best to be user in a special tray made of acrylic (1-1.5 mm spacer).
5. The dimensional stability is very good (dimensional changes during setting 0.06%).
6. A separating medium must be used between the cast and the impression plaster (solution of sodium alginate or soap with water).
7. The material is rigid once set thus unable to record undercuts.

## ***2- Impression compound:***

Non-elastic, thermoplastic, hydrophobic, mucocompressive impression material. Used mainly for complete denture (primary impression) and other uses depending on its type.

### ♦ Composition:

1. *Waxes:* usually bees-waxes. This material is brittle and must be soften to be workable.
2. *Natural resin*: give the material thermoplastic properties. These materials after mixing will stay weak with tendency to tackiness so we add.
3. *Stearic acid (plasticizer)*: to overcome brittleness.
4. *Filler*: e.g. calcium carbonate and limestone which added to overcome tackiness, improve rigidity, control degree of flow and minimize shrinkage due to thermal contraction.

### ♦Types and uses:

***1.TypeI Impression compound (lower fusing ) :*** Supplied in sheets, stick form or cones. Sheet form material used to take primary impression for edentulous ridges using stock tray, softened using water bath (55-60Cº). Storage in hot water should not be so long to prevents leacheing of important constituents. Such as Stearic acid. Over heating make the compound sticky and difficult to handle. Stick form material used for border molding of an acrylic special tray, softened over flame. The compound should not be allowed to boil, otherwise the plasticizer are volatilized.

***2- TypeII Impression compound (higher fusing):*** It is stiffer and has less flow than regular impression compound. Used to make a special tray (now largely replaced by acrylic tray) into which another impression material is placed. This is done for complete dentures of edentulous arches.

## ♦Properties:

***1.Thermoplastic property***: So impression compound is softened when we heated it for 45Cº and becomes hard when it's cooled to 37Cº. There is no chemical reaction but only a physical reaction, so the material is reversible and can be reused a number of times (for the same patient only) in case of errors. Inaccurate portions can be remade without having to remake the entire impression.

***2.Poor dimensional stability:*** Material has a high value of coefficient of thermal expansion and undergo considerable shrinkage on removal from mouth (relaxation because stresses are introduced into the material during taking the impression or during removal of the impression-mucocompressive ). Then residual stress exists when cooling the impression. The gradual relief of internal stresses may cause distortion of impression so the impression should be chilled immediately in cold water to reduce the stress relaxation and poured as soon as possible (rigid once cooled).

***3.Thermal conductivity:*** Impression compound is poor thermal conductors, so it needs thorough heating, and a water bath is preferred to soften the impression compound. We should wait for certain time in order that all the material is softened. When we introduce it into the patient's mouth we should wait enough time till the outer and the inner portion of the impression compound is hard before we can remove it from the patient's mouth.

***4. Reproduction of surface detail:*** It is mucocompressive and most viscous impression material used; the reproduction of surface detail is not very good, also not used to record undercut.

**♦Disadvantages:**

✓ The handling of dental impression compound is very technique sensitive. If it is not prepared properly, volatiles can be lost on heating, or low-molecular-weight ingredients can be lost during immersion in a water bath.

✓ Excessive wet kneading can incorporate water into the mix and change the flow properties of the compound.

✓ Due to a high coefficient of thermal expansion, the dimensions of the impression are not likely to be the same as the dimensions in the mouth.

✓ These materials are non-elastic and may distort on removal from the mouth.

**♦Disinfection:** Dental impression compound can be disinfected by immersion in sodium hypochlorite. The manufacturer's recommendations for proper disinfection should be followed.

## ***3. Impression waxes:***

Impression waxes are rarely used to record complete impression but are used to correct small imperfection in other impression. These materials consisted from a mixture of low melting paraffin and bees waxes in ratio about 3:1. Waxes have high flow and larger coefficient of thermal expansion, so it will distort when removed from undercut area. It's used in ranging consistencies soft, medium, hard, and extra hard.

## ***4.Zinc oxide- eugenol:***

The reaction between zinc oxide (ZnO) and eugenol yields a relatively hard mass that has medical advantages, and also mechanical properties that make it usable in certain dental fields.

## ♦Uses:

**1.** A final impression for edentulous arches.
**2.** Bite registration paste.
**3.** Temporary relining material for dentures.
**4.** Temporary filling.
**5.** Surgical pack in periodontal surgical procedure.
**6.** Root canal filling.
**7.** Cementation and insulating medium.

## ♦Composition:

***Base paste:*** Zinc oxide 87% as a reactive component with vegetable and mineral oil 13% which act as a plasticizer and reduce the burning sensation of eugenol. Water essential either to Base or Accelerator

***Accelerator paste***: Eugenol (oil of cloves) 12% (reactive component). Accelerators CaCl2. Filler (silica type) 20%. Gum or polymerized rosin 50% (speed the reaction). Lanolin 3%. Resinous balsam 10% (improves flow and mixing properties). Coloring agent 5%.

## ♦Chemical reaction:

$$ZnO + eugenol \xrightarrow{H_2O} Zinc\ eugenolate + Unreacted\ ZnO$$

The set material consists of a mixture of amorphous zinc eugenolate matrix which hold unreacted zinc oxide particles together.

## ♦Types of (ZnO-eugenol): According to ADA specification no. 16

***Type I:*** hard, I.S.T = (3-6) minutes, F. S.T =10 minutes
***Type II:*** soft, I.S.T = (3-6) minutes, F. S.T =15 minutes

♦**Manipulation :** two strips of equal length are squeezed from each tube on paper pad or glass slab , mixed by a spatula till the tow colors blend together. Mixing is for about (60 sec) the (2) strips are combined together from the 1st sweep of spatula. Then the mixture is filled into the special tray. After setting of the gypsum, the impression and the stone is placed in warm water for easier separation of zinc oxide from the cast.

## ♦Properties:

**1. Setting time**

***<u>Factors controlling the S.T:</u>***

a) Few drops of H2O to the eugenol paste shorten the S.T ,also zinc acetate or acetic acid shorten the S.T.

b) Cooling the spatula and glass slab or adding small amount of oils or waxes prolong S.T.

c) Varying the length of the two pastes, this results in either increase or decrease of S.T.

d) Extent the mixing time (within limit) will shorten the S.T.

e) High atmospheric temperature and humidity shorten the S.T.

**2.** Rigid non-elastic and should not be used for partially edentulous arches, its fractured when removed from undercut area.

**3.** Accurate registration for surface details due to good flow (mucostatic) property (recording tissue in uncompressed state).

**4.** The paste tends to adhere to skin, so that patient's lips and cheek should be vazalined. It requires a special tray for impression making.

**5.** It has advantage of being dimensionally stable. A negligible shrinkage (less than 0.1%) may occur during hardening.

**6.** No separating medium is needed for making the cast.

**7.** Eugenol can cause burning sensation and tissue irritation. Non-eugenol paste was developed; here the zinc oxide reacts with a carboxylic acid.

♦**Advantages:** The advantages of zinc oxide-eugenol include high accuracy of soft tissue impressions due to its low viscosity. The material is stable after setting, has good surface detail reproduction, and is inexpensive. It also adheres well to dental impression compound.

♦**Disadvantages:**The disadvantages of this material are messiness and a variable setting time due to temperature and humidity. Eugenol is irritating to soft tissues. This material is non- elastic and may fracture if undercuts are present.

# Elastic Impression Materials

## 1.Hydrocolloid Impression Materials

The colloid can exist in the form of a viscous liquid known as a sol, or a solid described as a gel. If the particles are suspended in water, the suspension is called hydrocolloid.

Hydrocolloid impression materials are based on colloidal suspension of polysaccharide in water. In sol form means there is random arrangement of polysaccharide chain; while in gel form means the long polysaccharide chain becomes aligned and material becomes viscous and develop elastic properties. Gelation means the conversion of sol form to gel form.

## ♣ Types of hydrocolloid impression materials:

Based on the mode of gelation, they are classified as:

1. **Reversible hydrocolloids:** set by lowering the temperature, e.g. Agar; this make them reusable.
2. **Irreversible hydrocolloids:** set by chemical reaction, e.g. Alginate; once set it is usually permanent.

## ◘ Reversible hydrocolloids ~ Agar

It was the first successful elastic impression material to be used in dentistry. It has been largely replaced by alginate hydrocolloid and rubber impression materials.

- **Uses:**
  1. Cast duplication (during fabrication of cast metal removable partial denture).
  2. Full mouth impression without deep undercuts.
  3. Crown & bridge impression before elastomers came to the market.
  4. As tissue conditioner.

- **Supplied as:**
  1. Gel in collapsible tube for impression, used with water cooled impression tray.
  2. A number of cylinders in a glass jar (syringe material).
  3. In bulk containers.

- **Composition:**

***** Gel tray type:**

| Component | Amount | Purpose |
|---|---|---|
| Agar | 12% | colloid |
| Borax | 0.2% | improve the strength of the gel |
| Potassium sulphate | 1-2% | ensure proper setting of gypsum cast against agar (accelerator for model material) |
| Alkyl benzoate | 0.1% | preservatives |
| Dyes of flavoring | trace | appearance & taste |
| Water | 85% | acts as dispersion medium |

***** Syringe applied material:** has the same component but a lower concentration of agar (6-8%).

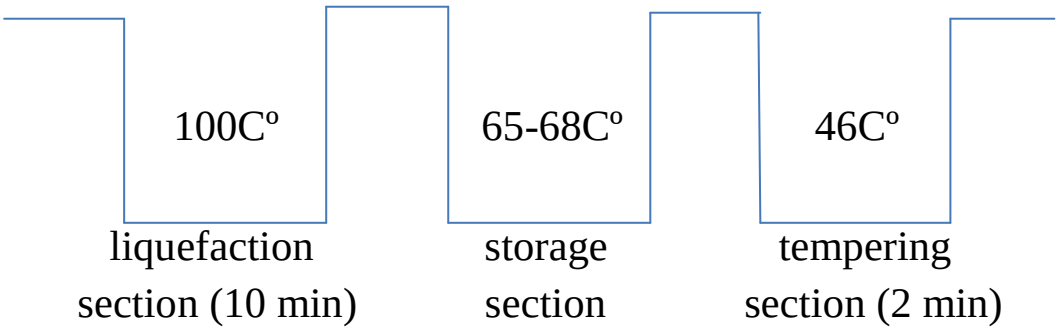
- **Manipulation:**

Agar hydrocolloid requires special equipment:

**A.** Hydrocolloid conditioner.

**B.** Water cooled rim lock trays.

****** A.** Agar is normally conditioned prior to use, using specially designed conditioning bath (Temperature controlled water bath), the conditioning bath consists of three compartments each hold at different temperature.



1. **Boiling section or liquefaction section:** tube of gel converted to viscous liquid after tem minutes in boiling water 100Cº. The sol should be homogeneous and free of lumps. Every material the material is re-liquefied, three minutes should be added; this because it is more difficult to break down the agar brush heap structure after a previous use. It should not be re-heated more than four times.
2. **Storage section:** 65-68Cº temperature is ideal when agar can be stored in the sol condition till needed.
3. **Tempering section:** 46Cº for about two minutes with material loaded in the tray. This is done to reduce the temperature so that it can be tolerated by the sensitive oral tissue. It also makes the material viscous.

****B.** The tray containing the tempered material is removed from the bath, the outer surface of the agar sol is scraped off, then the water supply is connected to the tray and the tray is positioned in the mouth. Water is circulated at 18-21Cº through the tray until gelation occurs (rapid cooling; e.g. ice cold water, is not recommended as it can induce distortion.

- **Properties:**

1. It is hydrocolloid and mucostatic impression.
2. It provides very accurate reproduction of surface detail because in sol form agar is sufficiently fluid. In gel form agar is sufficiently flexible to be easily removed.
3. Agar impression is highly accurate at the time of removal from the mouth. Storage of agar impression is to be avoided; the cast should be poured immediately. Storage in air results in dehydration (shrinkage) and storage in water results in swelling of the impression; it absorbs water by process known as (imbibition), the gel may also loose water by exuding of fluid in a process known as (syneresis). During syneresis droplets of exudate are formed on the surface of hydrocolloid and the

process occur irrespective of the humidity of surrounding atmosphere. If storage is unavoidable, it should be limited to one hour in 100% relative humidity (by wrapping it in a wet towel) which results in least dimensional changes.

4. Poor mechanical properties and low tear resistance but it is better than alginate.
5. The material is viscoelastic, so it is important that the tray is removed by a rapid snap action, this enhanced the elastic recovery and reduce the permanent deformation.
6. It is necessary to have reasonable thickness of impression material to limit the extent of deformation arising on removal from the undercut.
7. It is cheap and used in some laboratories for making duplicate models as it can be recycled up to four times.

- **Disadvantages:**

1. Need special equipment such as water cooled tray which is very bulky and temperature controlled bath and there is an initial cost in providing this equipment.
2. Great care must be exercised to ensure that the water baths do not get contamination.

## ◘ Irreversible hydrocolloids ~ Alginate

It is one of the most widely used dental impression material. It is supplied as powder mixed with water. A plastic scope is provided for dispending the bulk powder, a plastic cylinder is supplied for measurement of water. A wide blade, stiff spatula is used to mix powder and water. Used widely for taking impression of partial dentures and not recommended for crown and bridge work.

## ❧ Composition:

Ingredients and their function in alginate powder as follow:

| | Ingredient | % | Function |
|---|---|---|---|
| **1.** | Sodium alginate | 18 | Hydrogel former (dissolve in water & reacts with calcium ions) |
| **2.** | Calcium sulphate dihydrate | 14 | Provides calcium ions of the cross linking reaction that converts sol to gel |
| **3.** | Sodium phosphate (Na3PO4) | 2 | Control working time, serve as retarder react with calcium sulphate |
| **4.** | Potassium sulphate (KSO4) | 10 | Counteract the inhibition effect of alginate on the setting of gypsum model material |
| **5.** | Filler (diatomaceous earth or silicate powder) | 56 | Control consistency of the mix |
| **6.** | Organic glycol | small amount | Coast the powder particles to minimize dust during dispending |
| **7.** | Pigments | trace | Provide color |
| **8.** | Quaternary ammonium | trace | Provide self-disinfection |
| **9.** | Reactive indicator (present in some product) | | Give color change when setting is complete |

## ❧ Chemical reaction:

when mixed powder and water, a chemical reaction occurs that cross links the polymer chain forming a three dimensional network structure.

chemical reaction

sol (powder+water) ⟶ gel

+water

sodium + calcium sulphate ⟶ sodium sulphate + calcium alginate

alginate dihydrate alginate gel

The calcium alginate precipitates into fibrous network with water occupying the intervening capillary spaces.

## ❧ Mixing:

Powder should be mixed thoroughly before use, to eliminate the segregation of component that may occur during storage. When mixed powder with water a vigorous figure eight motion is the best with the mix being swiped against the side of the rubber bowel with intermitted rotation of spatula to press out air bubbles. The mix should be smooth, creamy with minimum of voids and does not drip off the spatula when it is raised from the rubber bowel.

## ❧ Properties:

**1.** It has a well controlled working time but does vary from product to product. There are regular setting (setting time 2-4.5 minutes) and fast setting (setting time 1-2 minutes) versions of this impression material. Lengthening of setting time is better accomplished by reducing the temperature of the water used with mix (18-24C$^{o}$). The clinical setting time can be detected by the loss of tackiness of the surface.

**2.** The material is mucostatic and also hydrophilic.

**3.** The material should be left in place for 2-3 minutes after tackiness has gone from the surface, since the tear strength and resistance to permanent deformation increase significantly during this period.

**4.** The surface production with alginate is not as good as that with agar or elastomers, they are not recommended for crown & bridge work, they are popular for partial denture work.

**5.** Alginate is susceptible to evaporation, syneresis and imbibition; giving poor dimensional stability, therefore the cast should be poured

immediately, if storage is unavoidable; keeping in humid atmosphere of 100% relative humidity no more than one hour.

**6.** It is a highly viscoelastic material (like agar), a snap removal technique need to be employed in order to get an elastic response. The permanent deformation is somewhat higher than agar.

**7.** It has lower tear strength than agar and has poor mechanical properties.

**8.** Set gypsum model should not remain in contact with the alginate impression for a period of hours because contact of slightly soluble calcium sulphate dihydrate with alginate gel containing a great deal of water is detrimental to the surface quality of model.

**9.** Thin layers of alginate are weak. The thickness of alginate impression between the tray and tissue should be at least 3mm.

**10.** Retention means to hold the material to the tray is needed, therefore perforated tray or rim lock tray is needed.

**11.** They restrict the choice of model and die materials to those of gypsum type (cannot prepare metal dies).

**12.** Low cost. Alginate hydrocolloid is highly elastic but less when compare to agar.

# Elastomeric Impression Materials

They are liquid polymers which can be converted to solid rubber at room temperature. By mixing with a suitable catalyst they undergo polymerization and/or cross linking (by condensation or addition) reaction to produce firm elastic solid.

## *Terminology:*

***Polymerization:*** chemical reaction that transforms small molecules into large polymer chains.

***Addition reaction:*** Polymerization reaction in which each polymer chain grows to maximum length in sequence and there is no by-product.

***Condensation reaction:*** Polymerization reaction in which the polymer chains all grow simultaneously and by-product is formed.

***Cross-linking:*** the reaction that links or joins polymer chain to form a network structure called a gel.

***Catalyst:*** a component of reaction that facilitates the reaction and usually does not become part of the final product.

***Accelerator:*** a component of the polymerization reaction that is similar to the catalyst but also speeds up the reaction.

***Vulcanization:*** the process of heating natural rubber with sulfur to produce cross-linking.

***Viscosity:*** is a property that controls the flow characteristic of materials.

## There are three types of elastomers:

1. Polysulphide.
2. Silicone (condensation, addition).
3. Polyether.

## Each type may be further divided into four viscosities:

**A.** Light body or syringe consistency.

**B.** Medium or regular body.

**C.** Heavy body or tray consistency.

**D.** Very heavy or putty consistency.

## ***Polysulphide***

This was the first elastomeric impression material to be introduced. It is also known as Mercaptan or Thiokol.

♦ **Application:** polysulphides are commonly used for crown and bridge and occasionally for dentures work.

♦ **Supplied as:** paste in collapsed tubes as base and accelerator.

**Base:** white colored.

**Accelerator:** brown or gray colored.

♦ **Available:** in three viscosities by controlling the filler in its composition:

~ Light bodied ~ Medium bodied ~ Heavy bodied

The higher the filler percentage the higher the viscosity and the less setting contraction, less thermal contraction and more dimensional stability.

## ♦ Composition:

### "Base paste"

| Component | Function |
|---|---|
| *Liquid polysulphide polymer with terminal &pendant thiol (-SH) groups | This is further polymerized and cross-linked to form rubber |
| *Inert filler (silica or titanium dioxide) | To give body, control viscosity & modify physical properties |

### "Catalyst paste"

| Component | Function |
|---|---|
| *Lead dioxide | React with thiol groups causing setting |
| *Dibutyl phthalate | Plasticizer |
| *Sulfur | To enhance reaction |
| *Magnesium stearate | Retarder & deodorant |

The lead dioxide react with the polysulphide polymer causing chain lengthening by oxidation of terminal –SH groups, and cross linking by oxidation of pendant –SH groups. The reaction is exothermic 3-4C$^{o}$rise in temperature. It is accelerated by heat and moisture.

Mercaptan + Lead dioxide $\longrightarrow$ Polysulphide + Water

## ♦ Manipulation:

Equal lengths of (2) tubes are mixed on a paper pad or glass slab with a stiff spatula until the(2) colors blend will together with no streak . Over-mixing has an effect on the elasticity it is used with a special tray, better adherence to the tray is achieved by using adhesive on the inner side of the tray the adhesive should be thin & dried first, pouring the cast should be within the 1$^{st}$ hour, S.T is about (12.5-16) minutes. Be careful of glove powder contamination of the impression.

## ♦ Properties:

1. Unpleasant odor and color, stains the cloths and messy to work with.
2. It has long setting time of 12.5 minutes.
3. Excellent reproduction of surface detail.
4. Dimensional stability is not good: the curing shrinkage is high 0.45% and continues even after setting, loss of the by-product (water) also causes shrinkage. It has the highest permanent deformation among the elastomers. This improves with time so pouring of the model should be delayed by half an hour; further delay is avoided to minimize curing shrinkage.
5. It has high tear strength, good flexibility, good shelf life and inexpensive to use.
6. It is hydrophobic so the mouth should be dried before making an impression.
7. Requires a custom tray which should be painted with thin layer of adhesive.

## ***silicone rubber impression material:***

There are two types of silicone rubber impression material based on the type of polymerization reaction occurring during its setting:

**Condensation silicone** **Addition silicone**

## • Condensation silicone:

This was the earlier of the two silicone impression materials; available in three viscosities: light bodied, medium bodied & putty.

## ♣ Application:

Condensation silicone rubber impression materials are commonly used for crown and bridge and occasionally for partial denture.

## ♣ Supplied as:

1. Two pastes system for light & medium bodied: base & catalyst pastes.
2. Putty: supplied in a single large plastic jar, the same catalyst paste may be used or sometimes it may be supplied as liquid.

They come in variety of colors (contrasting colors aid mixing).

## ♣ Composition:

**Base:** Polydimethyl siloxane (hydroxyl terminated).
Inert filler colloidal silica or metal oxide filler 35-75% depending on viscosity.
Color pigments.

**Catalyst:** Orthoethyl silicate (cross-linking agent).
Stannous octoate (catalyst).

## ♣ Setting reaction:

It is a condensation reaction, polymerization occurs as a result of cross-linking between the orthoethyl silicate and the terminal hydroxyl group of the dimethyl siloxane to form a three dimensional network. Stannous octoate act as a catalyst. The reaction is exothermic 1C$^{o}$ rise. Ethyl alcohol formed as by product evaporates gradually from the set rubber leading to shrinkage.

Dimethyl + Orthoethyl $\longrightarrow$ Silicone + Ethyl
siloxane silicate stannous octoate rubber alcohol

## ♣ Properties:

1. Pleasant color and odor, cleaner to handle than polysulphide.
2. Direct skin contact should be avoided to prevent any allergic reaction.
3. Setting time shorter than polysulphide 8-9 minutes.
4. Excellent reproduction of surface details, very good elastic property, elasticity develop earlier than polysulphide, but it is stiffer and harder than polysulphide.

5. Dimensional stability is comparatively less because of high curing shrinkage (0.4 -0.6 %) also due to evaporation of the ethyl alcohol by-product. Dimensional change is greater than that of polysulphide but less that of alginate. To avoid this cast should be poured immediately.
6. Adequate tear strength but it is lower than polysulphide.
7. It is hydrophobic; the impression field should be dried well before making an impression.
8. Shelf life is slightly less than polysulphide due to the usable nature of the orthoethyl silicate.
9. Slightly more expensive than polysulphide.
10. They are most widely used with stock tray (putty consistency) offering an advantage over polysulphide which is used with special tray only, the special tray needed to be painted with adhesive.

- **Addition silicone:**

It was introduced later. It has better properties than condensation silicone. It is also known as polyvinyl siloxane, available in four viscosities: light bodied, medium bodied, heavy bodied & putty.

## ◘ Supplied as:

**1- Two pastes system**: base and catalyst pastes come in equal size tube (unlike condensation silicones)

**2- Putty jars:** two equal size plastic jars, one containing the base and other the catalyst.

## ◘Composition:

**Base:** Polymethyl hydrogen siloxane, other siloxane prepolymers and fillers.

**Catalyst:** Divinyl poly siloxane, other siloxane prepolymers, Platinum salt as activator (catalyst, chloroplatinic acid), palladium or hydrogen absorber, retarders and fillers.

## ◘Chemical reaction

It is addition reaction in which silane (hydride group) of polymethyl hydrogen siloxane (base) is replaced by silane group of the other paste (catalyst), the reaction is activated by the platinum salt. Sulfur contamination from latex gloves retard the setting of silicones, vinyl gloves should be used, there is no by product.

| Silane siloxane | + | Vinyl siloxane | → chloroplatinic acid | Silicone rubber |
|---|---|---|---|---|

## ◘Properties:

1. Pleasant odor and color.
2. Cause allergic reaction so direct skin contact should be avoided.
3. Excellent reproduction of surface details.
4. Setting time is 5-9 minutes.
5. It has the best dimensional stability among the elastomers even after one week. It has a low curing shrinkage 0.17% and the lowest permanent deformation 0.05-0.3%.
6. It has good tear strength.
7. It is hydrophilic, similar care should be taken while making the impression and pouring the wet stone.
8. It has low flexibility and harder than polysulphide, extra spacing 3mm should be provided in impression tray. Care also should be taken while removing the stone cast from the impression to avoid any breakage.
9. Shelf life ranges from 1-2 years.
10. More expensive.

## ***Polyether:***

It has good mechanical properties and dimensional stability. Its disadvantage is that it is very stiff material, short working time and expensive.

♠ **Supplied as:** base and accelerator in collapsible tubes. The accelerator tube is usually smaller. Earlier it was supplied in single viscosity. A third tube containing thinner was provided. Now it is available in three viscosities: light bodied, medium bodied & heavy bodied.

## ♠ Composition:

**Base:** Polyether polymer.
Colloidal silica (filler).
Glycolether or phthalate (plasticizer).

**Accelerator:** Aromatic suffonate (cross-linking agent).
Colloidal silica (filler).
Glycolether or phthalate (plasticizer).

## ♠ Setting reaction:

Polyether + Sulphonic ester ⟶ Cross-linked rubber

## ♠ Properties:

1. Pleasant odor and taste.
2. The sulphonic ester may cause skin reaction… direct skin contact should be avoided.
3. Setting time is around 8.3 minutes, the material is clean to handle.
4. Good dimensional stability under relatively low humidity; because the material is hydrophilic so humidity will cause swelling and distortion of the material when the humidity is high. Curing shrinkage is low 0.24%, permanent deformation is low. The material should not be stored in water or in humid climates.
5. It is extremely stiff. Its hardness is higher than polysulphides and increase with time. Removing it from undercuts is difficult, so extra spacing 4mm should be given. Care also should be taken while removing the cast from the impression to avoid any breakage.
6. Good tear strength, excellent reproduction of surface details and expensive**.**

7. It is hydrophilic, so moisture in impression field is not so critical. It has the best compatibility with stone.
8. Excellent shelf life more than 2 years.

## *** Technical considerations for rubber impression materials:

1. Impressions are usually made in special tray. Perforated stock trays are used only for making impressions in putty viscosity.
2. The spacing given is between 2-4mm.
3. Elastomers do not adhere well to the tray. An adhesive should be applied onto the tray and allowed to dry before making impression.
4. The bulk of the impression should be made with heavier consistency to reduce shrinkage. Light bodied should only be used in a thin layer as a wash impression.

## *** Methods of making impression:

1. **Single mix technique:**
   **Tray used:** resin custom tray with 2-4mm spacing.
   **Viscosity used:** regular only.
2. **Multi mix technique:**
   **Tray used:** resin custom tray with 2-4mm spacing.
   **Viscosity used:** light bodied & heavy bodied.
3. **Two stage putty wash technique:**
   **Tray used:** perforated stock tray.
   **Viscosity used:** light bodied & putty.

# Polysulphide

First elastomeric to be introduced

Uses :
crown and bridge and dentures work .

Supplied as two pastes
Base and accelerator


Light body (syringe type)

Heavy body (tray type)

Medium body (regular type)

Very heavy (putty type)

## Polysulfide Manipulation

- Adhesive to tray
- Uniform layer
  - custom tray
- Equal lengths of paste
- Mix thoroughly
  - within one minute
- Setting time 8 – 12 minutes
- Pour within 1 hour


## Condensation Silicone Manipulation

- Mix thoroughly
  - paste - paste
  - paste - liquid
- Putty-wash technique
  - reduces effect of polymerization shrinkage
  - stock tray
    - putty placed
    - thin plastic sheet spacer
    - preliminary impression
      - intraoral custom tray
    - inject wash material

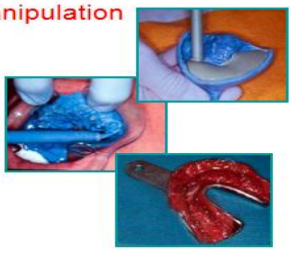
## Addition Silicones

- Vinyl polysiloxane
- Indications
  - crown and bridge
  - denture
  - bite registration

Supplied as:
Paste tube
Equal size jars

## Addition Silicones Manipulation

- Adhesive to tray
- Double mix
  - custom tray
    - heavy-body
  - light-body
- Putty-wash
  - stock tray



# Polyether

- Indications
  - crown and bridge
  - bite registration

supplied as:
tow pastes system

## Polyether Manipulation

- Adhesive to tray
  - stock or custom tray
    - very stiff
- Paste-paste mix
- Auto-mixing
  - hand-held
    - low viscosity
  - mechanical dispenser
    - high viscosity