Aurobindo College of Dentistry

Indore, Madhya Pradesh

INDIA

Module plan

- Topic : IMPRESSION MATERIALS AND TECHNIQUES
- Subject: ENDODONTICS
- Target Group: Undergraduate Dentistry
- Mode: Powerpoint – Webinar
- Platform: Institutional LMS
- Presenter: DR.SANKET HANS PANDEY

CONTENTS

Introduction

Impression materials are used to register or reproduce the form and relationship of the teeth and oral tissues.

Hydrocolloids and synthetic elastomeric polymers are among the materials most commonly used to make impressions of dentulous arches.

Construction of a model or cast is an important step in numerous dental procedures.

The cast must be accurate representation of oral structure, which requires an accurate impression.

Impression: An imprint or negative likeness of the teeth and adjacent structures for use in dentistry (GPT8).

Impression material is a dental material whose function is to accurately record the dimensions of oral tissues and their spatial relationship.

History

Table 23.1 Chronological history of some impression materials.

Year/Decade	Event
1730s	Sealing wax and plaster casts were introduced
1820	Impression tray was made
1844	Plaster impressions were developed
1857	Modeling compound was developed
1883	E.C.C. Stanford, a British pharmacist, discovered algin, the precursor for alginate
1925	Reversible hydrocolloid introduced by Alphons Poller, an Austrian who patented it as "Nogacoll"
1929	Commercial production of alginate by a company named "Kelco" in California
1931	Hydrocolloid "Denticole" was first marketed
1935	A.W. Sears promoted the use of agar as an impression material for fixed partial dentures
1953	Polysulfide impression material was introduced
1960s	Polyether impression material was introduced
1970s	Condensation silicone was introduced
1980s	Addition silicone material was introduced

CLASSIFICATION

I. ACCORDING TO ELASTICITY

Impression Materials

- Rigid
  - Plaster
  - Impression Compound
  - ZnO - Eugenol
- Elastic
  - Aqueous Hydrocolloids
    - Agar (reversible)
    - Alginate (irreversible)
  - Elastomers
    - Polysulfide
    - Silicones
      - Condensation
      - Addition
    - Polyether

O'Brien, Dental Materials & their Selection.

TABLE 8-1 Classification of Dental Impression Materials

	MECHANICAL CHARACTERISTICS	
Setting Mechanism	**Inelastic**	**Elastic**
Chemical reaction (irreversible)	Plaster of Paris Zinc oxide–eugenol	Alginate Polysulfide Polyether Condensation silicone Addition silicone
Thermally induced physical reaction (reversible)	Impression compound	Agar

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ACCORDING TO THE PRESSURE EXERTED ON ORAL TISSUES

1. **Mucostatic impression materials**

These do not compress the tissue during seating of the impression.

E.g.,: Plaster of Paris, light body elastomeric impression materials, agar hydrocolloid.

2. **Muco-compressive impression materials**

These compress the tissue during seating of the impression.

Desirable qualities

1. A pleasant odor, taste, and acceptable color

2. Absence of toxic or irritant constituents

3. Adequate shelf life for requirements of storage and distribution

4. Economically commensurate with the results obtained

5. Easy to use with the minimum of equipment

6. Setting characteristics that meet clinical requirements

7. Satisfactory consistency and texture

8. Readily wets oral tissues

9. Elastic properties that allow easy removal of the set material from the mouth and good elastic recovery.

10. Adequate strength to avoid breaking or tearing upon removal from the mouth

11. Dimensional stability over temperature and humidity ranges normally found in clinical and laboratory procedures for a period long enough to permit the production of a cast or die.

12. Compatibility with cast and die materials

13. Accuracy in clinical use

14. Readily disinfected without loss of accuracy

15. No release of gas or other byproducts during the setting of the impression or cast and die materials

RIGID / INELASTIC IMPRESSION MATERIALS

IMPRESSION PLASTER

- Impression plaster is a β-calcium sulfate hemihydrate.
- It has a characteristic of mucostatic impression material.
- Mostly used for making preliminary impressions or splinting transfer coping utilized to produce long-span implant-supported prostheses.

COMPOSITION

- β-calcium sulfate hemihydrate
- Potassium sulfate
- Borax
- alizarin red

water/powder ratio of approximately 0.5 to 0.6.

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IMPRESSION COMPOUND

- Rigid, Reversible impression material

which sets by physical change.

- It is mainly used for making impressions of

edentulous ridges.

- A somewhat more viscous compound,

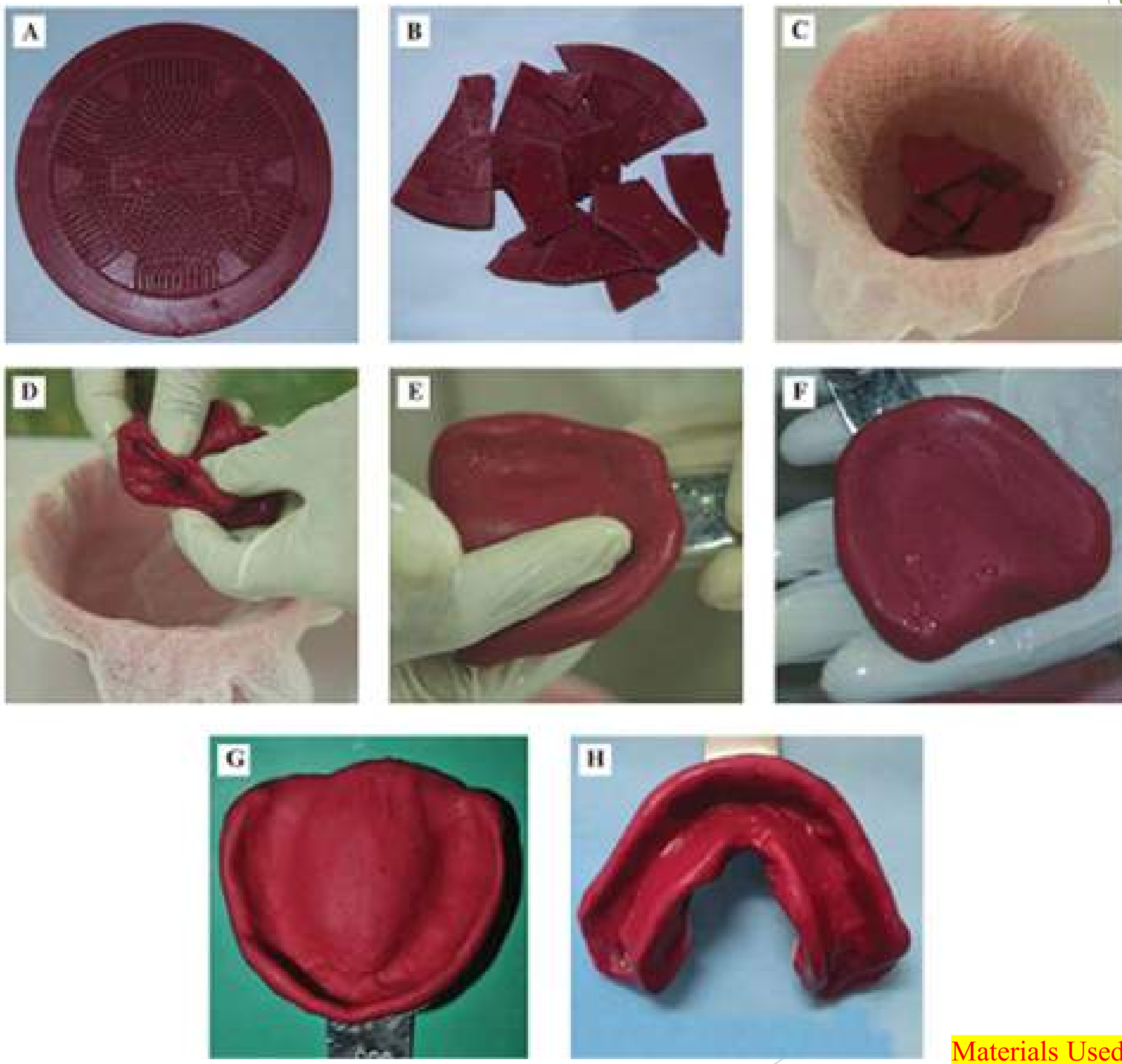
called Tray Compound can be used to form a tray for construction of dentures.

- Supplied as : Sheets, Sticks, Cakes in variety of colours.

COMPOSITION

- Mixture of waxes
- Thermoplastic resins
- Filler : Diatomaceous earth, soap stone, French chalk.
- Plasticizers :Shellac, Stearic acid, Gutta percha.
- Colouring agent

MANIPULATION



Materials Used in Dentistry S Mahalaxmi,

PROPERTIES

- **FUSION TEMPERATURE** : Temperature at which the material looses its hardness on heating or forms a rigid mass upon cooling. Above 43.5 degree C, the material continues to soften and flow to a plastic mass.
- **THERMAL CONDUCTIVITY** : poor conductors of heat.
- **COEEFICIENT OF THERMAL EXPANSION** : High due to presence of resins and waxes.
- **DIMENSIONAL STABILITY**: Relaxation of compound can lead to distortion.
- **DETAIL REPRODUCTION** : Comparatively less because of its high viscosity and low flow.
- **DISINFECTION**
- The recommended disinfectant is 2% glutaraldehyde.

ZINC OXIDE EUGENOL

Applications

- Imp material for edentulous mouths
- Surgical dressing
- Bite registration paste
- Temporary filling material
- Cementing medium
- Temporary relining material for dentures

Classification

- Type I hard paste (setting time- 10 mins)
- Type II soft paste (setting time- 15min)

COMPOSITION

Components	Function	Percent
Tube no 1 (Base)		
Zinc oxide	Main ingredient	87
Vegetable/ mineral oil	Plasticizer	13
Tube no 2(Accelerator)		
Oil of cloves/eugenol		12
Gum/polymerized rosin	Accelerator/smooth homogenous product	50
Filler (silica type)	Viscosity increases	20
Lanolin		3
Resinous balsam	Incease flow, improve mixing	10
Accelerator solution ($CaCl_2$) and colour		5

SETTING REACTION

- Typical Acid-Base reaction to form a Chelate.

  1) Zno + H2O ⟹ Zn (OH)2

  2) Zn(OH)2 + 2HE ⟹ ZnE2 + 2H2O

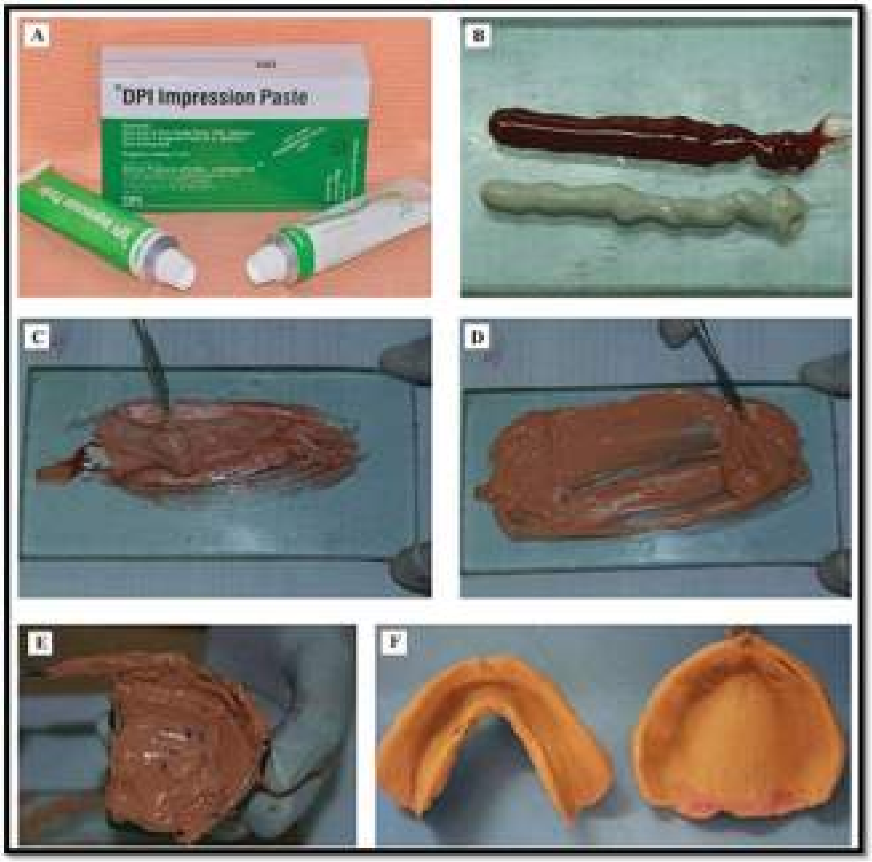
  (Base) (Acid Eugenol) (Zinc Eugenolate) (Water)

- **Microstructure :**

The chelate forms a matrix surrounding a core of zinc oxide particles.

The chelate is thought to form as an amorphous gel that tends to crystallize giving strength to the set mass.

MANIPULATION



Decrease setting time-
Add small amount of zinc acetate
Drop of water
Extend mixing time

Increase setting time-
Cool spatula and mixing slab
Adding retarders as oil or wax

Materials Used in Dentistry S Mahalaxmi,

PROPERTIES

- Consistency and Flow : very good flow.
- Detail reproduction : registers surface details quite accurately due to the good flow.
- Dimensional Stability : quite satisfactory.
- Biological Considerations : some patients experience a burning sensation in the mouth due to eugenol. Can also cause tissue irritation

Non eugenol pastes can be substituted.

NON EUGENOL PASTES

Disadvantage of eugenol is stinging or burning sensation on contact with soft tissues- Orthoethoxybenzoic acid (EBA) substitute for eugenol.

- **Surgical pastes:**

After gingivectomy, to aid in retention of medicament and promote healing. Softer pastes and slower in setting, forms rope to pack into gingiva.

- **Bite registration pastes:**

Recording JR in complete and fixed or removable partial denture

No resistance to closure of mandible, so high accuracy and stability.

Wax pattern

- Wax pattern is nothing but the prosthesis pattern which is to be fabricated.
- Fabrication of wax pattern is most important step in cast fabrication as any minute error can cause failure of casting.

Composition of inlay wax

Paraffin wax -40-60%
Carnauba wax -25-30%
Dammer resin -5%
Colouring agents **(Phillips 11th edition)**

Types of inlay wax
Type 1- medium wax for direct technique
Type 2- soft wax for indirect technique

Armamentarium for waxing technique

Instruments for waxing technique were introduced by Dr. Peter K Thomas hence known as PKT instruments.

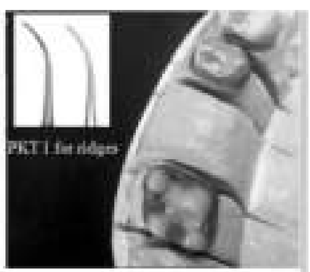
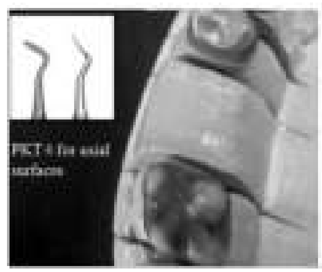
PKT No. 1 -positioning cusps , marginal ridges and triangular ridges.

PKT No. 2- eliminating voids remaining on the occlusal surface.

PKT No. 3- smoothening developmental and supplemental grooves.

PKT No. 4- Smoothening of axial surfaces

PKT No. 5- refine the ridges


Ref- Waxing Techniques to Develop Proper Occlusal Morphology in Different Occlusal Schemes (The journal of Indian prosthodontic society Dec 2011)

Methods of wax pattern fabrication

1. By carving
2. Incremental built up
3. Direct built up
4. Anatomic core built up

A) Formulation of wax pattern by carving

1. Die is lubricated and all the details are overfilled such that it should not contain voids.

2. Occlusal, facial, lingual and proximal limits of the pattern are marked and established.

3. Facial and lingual axial anatomy and contours are established

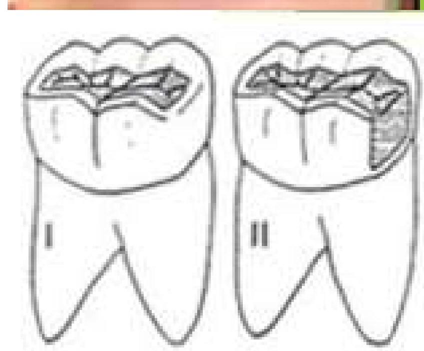
4. Occlusal anatomy is created, checked & corrected.

5. Proximal contour and anatomy is carved.

6.All surface anatomic components are blended together.

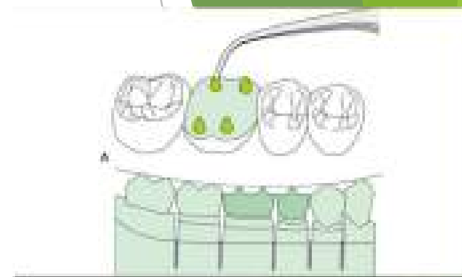
7. Pattern is polished using silk cloth and brush.

8. Occlusal component are checked in functional and static relation.



B) Incremental build up of the wax pattern

1. Cusps with their tips are build in exact same location & checked in static and dynamic occlusal relation.



2. Triangular ridges of cusps are added & checked for any deficiencies or interference.

3.Marginal ridges are built up &checked.

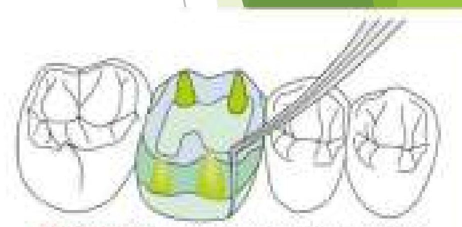


FIGURE 40.38 Placement of buccal and lingual cusp ridges and marginal ridges.

4. Facial, lingual & proximal contour & anatomy is established and checked.

5.Fossae & grooves are completed & checked.

6. Pattern is marginated & surface is polished.

FIGURE 40.39 Placement of triangular ridge.

C) Direct wax pattern

1. Matrix is applied(no wedges are applied). Separating medium is applied on cavity& matrix.
2. inlay wax stick is softened at tip and gently kneaded & inserted in matrixed cavity & kept under pressure till it gets hardened.
3. Gross excesses is cut &occlusal anatomy is carved.

4. Matrix band is released from retainer & removed.

5. Pattern is replaced after lubricating it for second time and deficient contouring can be adjusted.

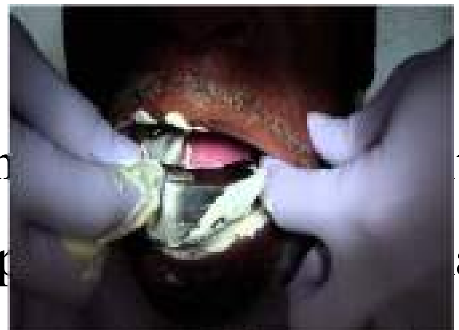
6. Pattern should be marginated occlusally, facially, lingually using hot tine.

7. While holding the pattern with apical pressure using a small burnisher & is polished using silk cloth.

8. Floss should be passed through proximal area to eliminate proximal discrepancies.

D) Anatomic core wax pattern

eparing teeth for cast, desired shape of future r with hard wax, all mandibular movements are made and wax is adapted accordingly.



2. Pick up in ... th im ... ove height of contour, resulting im ... atomi

3. Teeth preparation , impression & die preparation is carried out, anatomic core is verified on working model.

4. One die is filled at a time with molten wax & lubricated anatomic core is pressed down under pressure to determined position until wax solidifies.

5. Anatomic core is removed & fine adjustments are done. Other patterns are fabricated in same manner.

ELASTIC IMPRESSION MATERIALS

Hydrocolloid Impression materials

Agar (reversible hydrocolloids)

➢Agar hydrocolloid was the first successful elastic impression material to be used in dentistry.

➢It is an organic hydrophillic colloid (polysaccharide)extracted from a type of seaweed (gelidium,gracilaria etc).

➢Agar is a sulfuric ester of a linear polymer of galactose.

Classification

- Based on viscocity of reversible hydrocolloid:
- Type I- high consistency (for use as tray material)
- Type II-medium consistency (for use as tray or syringe material)
- Type III:-low consistency(for syringe use only)

Composition

COMPONENT	FUNCTION	%
AGAR	BASIC CONSTITUENT	13-17
BORATE	STRENGTH	0.2-0.5
SULFATE	GYPSUM HARDENER	1-2
WAX(HARD)	FILLER	1-2
THIXOTROPHIC MATERIAL	THICKENER	0.3-0.5
WATER	REACTION MEDIUM	

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Properties

TABLE 12.2 Typical properties of heavy bodied agar hydrocolloid impression material

	Working Time (min)	Setting Time (min)	Gelation (°C)	Recovery* (%)	Flexibility† (%)	Compressive Strength‡ (MPa)	Tear Strength§ (kN/m)
Agar	—	—	37-45	99.0	4-15	0.78	0.8-0.9

*At 10% compression for 30 seconds; †At a stress of 1000 g/cm^2; ‡at a loading rate of 10 kg/min; §ASTM Tear Die C at 25 cm/min.

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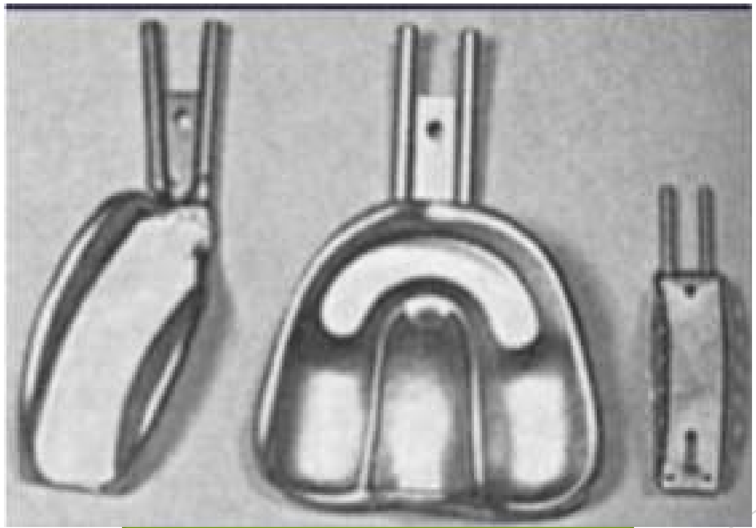
Manipulation

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

- Hydrocolloid conditioner
- Water cooled rim lock trays
- Impression syringes
- Connecting water hose
- Agar tray material in tubes
- Agar syringe material

3) MAKING AGAR IMPRESSION:

- Before tempering process completed, syringe material taken directly from the storage compartment and applied to prepared teeth.
- First applied to base of preparation, then remainder of prepared tooth.
- Point of syringe held close to tooth.
- Tray held in place with a very light force.



A water cooled tray

Alginate (Irreversible hydrocolloids)

The alginic acid is extracted from certain brown seaweed.
It is a linear copolymer of β-D-mannuronic acid and α-L-guluronic acid

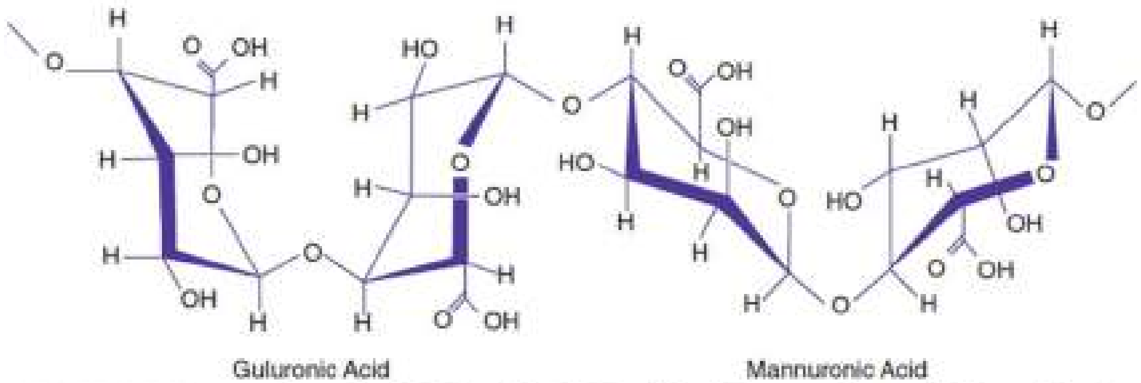


FIGURE 8-17 Structural formula of alginic acid. Alginic acid is a linear copolymer with homopolymeric blocks of β-D-mannuronic acid and its epimer α-L-guluronic acid covalently link together in different sequences or blocks.

Classification

- Type I (fast set): 1.5–3 min.
- Type II (normal set): 3–4.5 min

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Composition

TABLE 12.1 Ingredients in an Alginate Impression Powder and Their Functions

Ingredient	Weight (%)	Function
Potassium alginate	18	To dissolve in water and react with calcium ions
Calcium sulfate dihydrate	14	To react with potassium alginate to form an insoluble calcium alginate gel
Potassium sulfate, potassium zinc	10	To counteract the inhibiting effect of the hydrocolloid on the fluoride, silicates, or borates setting of gypsum, giving a high-quality surface to the die
Sodium phosphate	2	To react preferentially with calcium ions to provide working time before gelation
Diatomaceous earth or silicate	56	To control the consistency of the mixed alginate and the powder flexibility of the set impression
Organic glycols	Small	To make the powder dustless
Wintergreen, peppermint, anise	Trace	To produce a pleasant taste
Pigments	Trace	To provide color
Disinfectants (e.g., quaternary ammonium salts and chlorhexidine)	1-2	To help in the disinfection of viable organisms

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Setting reaction

$$CaSO_4 - 2H_2O(s) \longrightarrow Ca^{2+}(aq) + SO_4^{2-}(aq)$$

$$Na - Alginate(s) \longrightarrow Na^{+}(aq) + Alginate^{-}(aq)$$

$$Na_4P_2O_7(s)\ (retarder) \longrightarrow 4Na^{+}(aq) + P_2O_7^{4-}(aq)$$

$$2Ca^{2+}(aq) + P_2O_7^{4-}(aq) \longrightarrow Ca_2P_2O_7(s)$$

$$Ca^{2+}(aq) + Alginate^{-}(aq) \longrightarrow Ca - Alginate^{+}$$

$$\downarrow$$

gel
network

Factors Controlling Setting Time

- W/P ratio.
- Mixing time.
- Amount of retarder added.
- The temperature of the mixing water
- levels of metallic ions (Ca, Mg)

Properties

TABLE 12.2 Typical properties of Alginate

	Working Time (min)	Setting Time (min)	Gelation (°C)	Recovery* (%)	Flexibility† (%)	Compressive Strength‡ (MPa)	Tear Strength§ (kN/m)
Alginate	1.25-4.5	1.5-5.0	—	98.2	8-15	0.49-0.88	0.4-0.7

*At 10% compression for 30 seconds; †At a stress of 1000 g/cm²; ‡at a loading rate of 10 kg/min; §ASTM Tear Die C at 25 cm/min.

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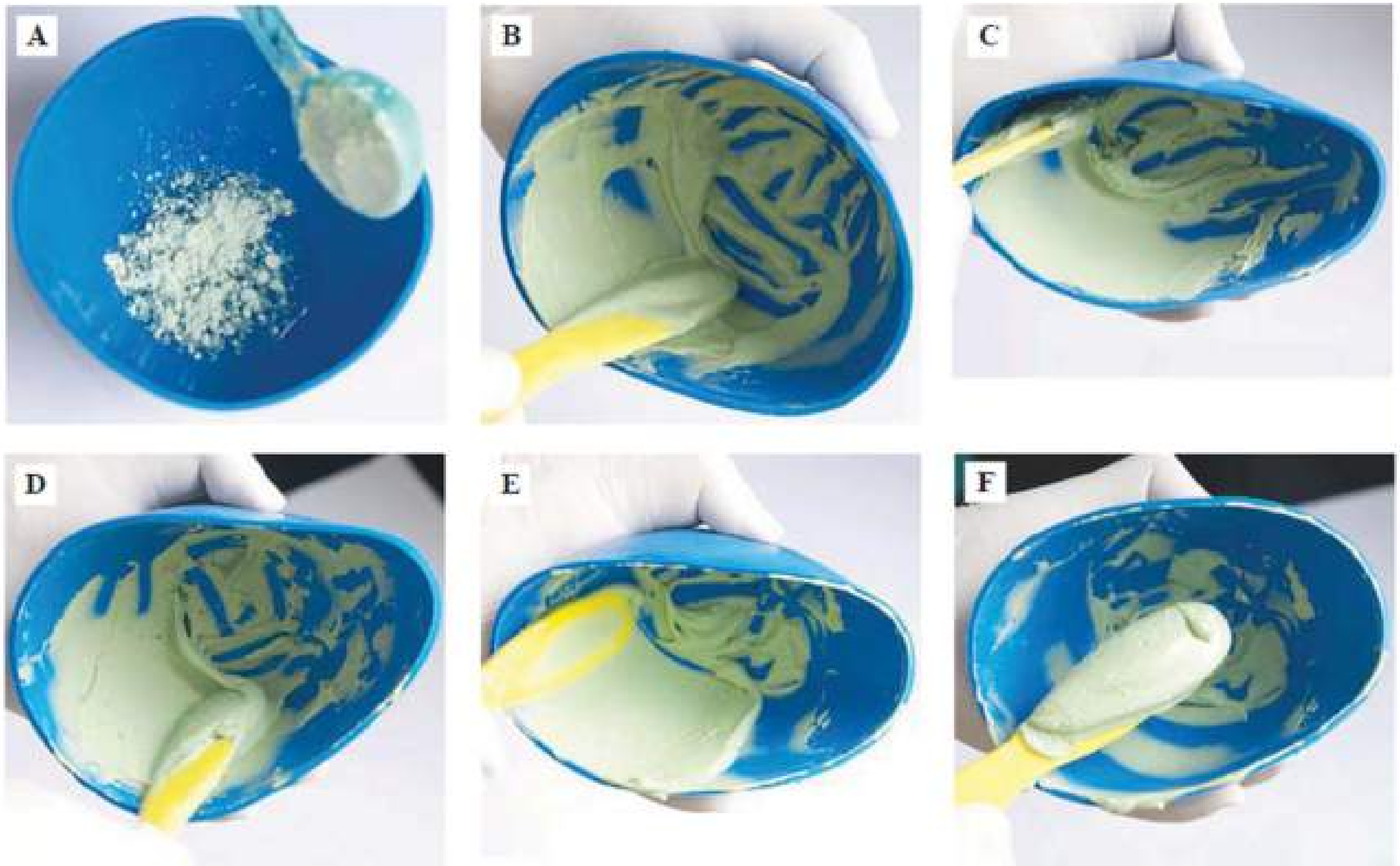
MANIPULATION



Materials Used in Dentistry S Mahalaxmi,

Manipulation of chromatic alginates.

LAMINATE TECHNIQUE

(Alginate – Agar Method)

- Chilled alginate on tray and agar syringe material (in contact with teeth). Alginate gels by chemical reaction, agar gels by contact with cool alginate.
- Advantage- Cost effective, maximum detail
- Disadvantage- agar-alginate bond not sound

2. WET FIELD TECHNIQUE:

The area to be recorded is damped with warm water and agar syringe material is applied over the surface

↓

Following which the tray loaded with high viscosity hydrocolloid is placed over it immediately before the material sets

↓

Hydraulic pressure of the viscous tray material makes the first-placed material to flow and record the finer details

Materials used in dentistry. S Mahalaxmi,

3. WINDOW TECHNIQUE:

- Uses two impression materials.
- An alginate or putty impression is used to record the complete arch.
- Region involving flabby tissues or relief areas which need to be recorded undisturbed is cut off from his first impression, creating a window like opening in the initial impression.
- Low viscosity light body or impression plaster is syringed onto these areas and when a set plaster scaffold is created over this to support the low viscosity material while pouring the cast.

ELASTOMETIC IMPRESSION MATERIAL

An **elastomer** can be defined as a three dimensional polymer network which has good elasticity.

Chemically, there are three elastomers based on the backbone of polymer chains: polysulfide, silicone (condensation and addition), and polyether.

Classification

I. **According to chemical reaction**

A. Polysulfide

B. Polyether

C. Condensation polymerizing silicone

D. Addition polymerizing silicone

II. **According to viscosity**

A. Light body

B. Medium body (regular)

C. Heavy body

D. Very heavy body (putty)

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III. **According to ADA specification**

	Max. permanent Deformation	Max. Flow in Compression	Max. Dimensional change in 24 hrs.
Type I	2.5	0.5	- 0.5
Type II	2.5	0.5	-1.0
Type III	5.5	2.0	- 0.5

Materials Used in Dentistry S Mahalaxmi,

Definitions

Gel—A network of fibrils forming a weak, slightly elastic brush-heap structure of hydrocolloid; also the solid network structure of a cross-linked polymer.

Gelation—The process of transforming a hydrocolloid from a sol to a gel.

Hydrocolloids: Hydrocolloids are polysaccharide materials such as agar and alginate that form cross-link networks by hydrogen bonding.

Imbibition—The displacement of one fluid by another immiscible fluid in a hydrocolloid. In the context of impression materials, it is the uptake by agar or alginate when immersed in water.

Syneresis—The expression of fluid onto the surface of gel structures.

Polysulfides

Polysulfides usually refer to a class of polymers with alternating chains of several sulfur atoms and hydrocarbons.

❑ MODE OF SUPPLY:

Available as 2 systems :
Base and accelerator
✓3 viscosities :Light
Medium
Heavy bodied

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COMPOSITION:

BASE PASTE:	FUNCTION	PERCENTAGE
Polysulfide polymer With terminal and pendant mercaptan group (-SH)		80-85%
Filler (Eg : Lithopone, Titanium dioxide, Zinc sulphate)	Provides required strength	44%
Plasticizer (Dibutyl or Dioctyl Phthalate)	Confers appropriate viscosity to paste	5%
Sulphur	Accelerator	0.5%

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CATALYST PASTE	FUNCTION	PASTE
Lead Oxide	Active catalyst	60-68%
Dibutyl Phthalate	Plasticizers	30-35%
Sulfur		3%
Other substances such as magnesium stearate and deodorants (retarders)		

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CHEMISTRY AND SETTING REACTION OF POLYSULFIDE:

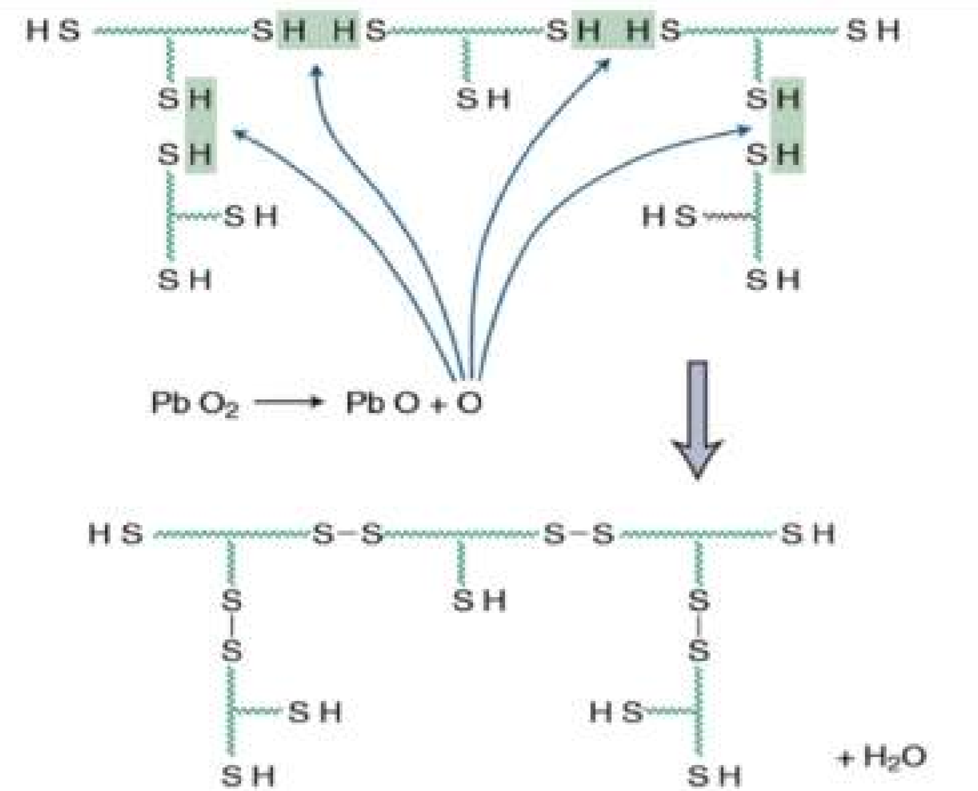

FIGURE 8-3 Polymerization of polysulfide impression material. SH groups interact with oxygen released from lead dioxide (*left*). Completion of the condensation reaction results in water as a by-product (*right*). Pendant –SH is for cross-linking and terminal –SH is for chain lengthening of the polymer.

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PROPERTIES

1. Unpleasant odor and color - stains linen & messy to work with

2. Extremely viscous and sticky - mixing is difficult

3. Mixing time is 45 seconds

4. Long setting time of 12.5 mins (at 37^0C) - Patient discomfort

5. Excellent reproduction of surface detail

6. Dimensional stability:
   - Curing shrinkage is high 0.45%.
   - It has the highest permanent deformation (3 to 5%) among the elastomers

7. It is hydrophobic

8. It has good flexibility and low hardness

9. It can be electroplated (with silver than copper)

10. The shelf life is good (2 years)

ADVANTAGES

Long working time

High tear resistance

Margins easily seen

DISADVANTAGES

Requires custom trays

Stretching leads to distortion

Stains clothing

Obnoxious odor

Pour within 30 min

CONDENSATION SILICONE

The materials are supplied as a base paste and a low-viscosity liquid catalyst (or paste catalyst), a two-paste system, or a two-putty system.

The base paste consists of α-ω-hydroxyl-terminated polydimethyl siloxane

COMPOSITION:

BASE	CATALYST	FILLERS
Polydimethyl Siloxane (α-ω-hydroxyl-terminated)	• Tin organic ester suspension • Stannous octoate	• Silica

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SETTING REACTION OF CONDENSATION SILICONE:

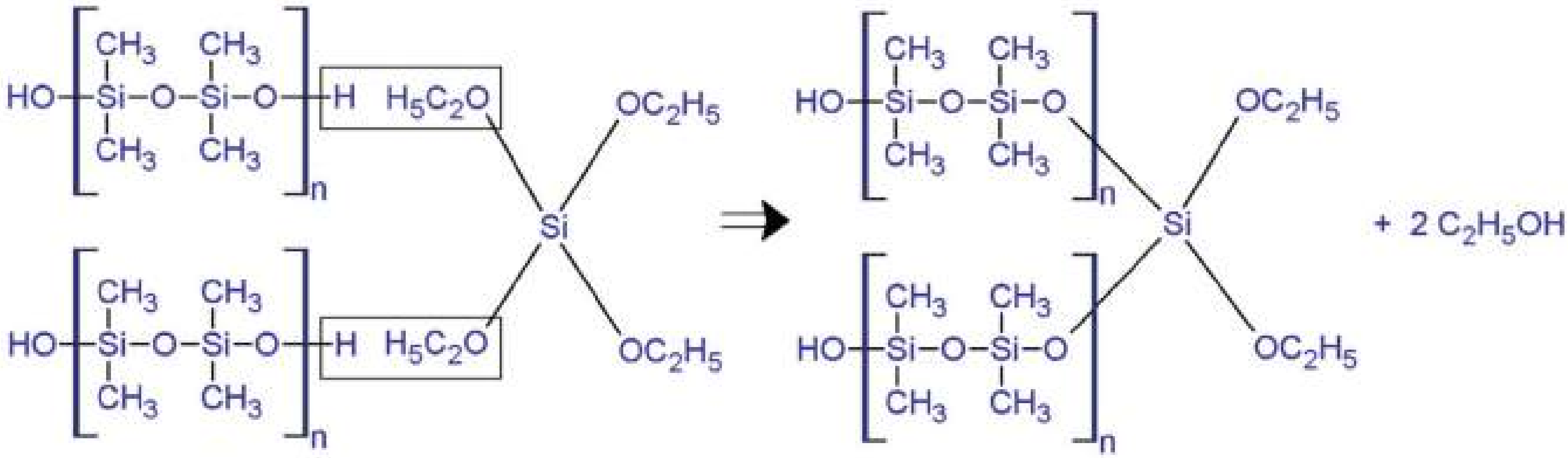

FIGURE 8-4 Condensation polymerization of α-ω-hydroxy-terminated poly (dimethyl siloxane) with tetraethyl orthosilicate in the presence of stannous octoate (catalyst). The reaction results in the release of ethanol molecules.

PROPERTIES

- Pleasant odor and color.
- Mixing time of 45sec & setting time of 6-8mins.
- Excellent reproduction of surface details and highly elastic.
- Lesser dimensional stability
  - high curing shrinkage (0.38 - 0.6%)
  - shrinkage due to evaporation of ethyl alcohol & permanent deformation is also high (1-3%).

- Hydrophobic.
- Tear strength is lower than polysulfide. Stiffer and harder than polysulfide
- Electroplatable (silver / copper) but silver is preferred
- Biologically inert.
- shelf life is less than polysulfides due to unstable nature of orthoethyl silicates.

ADVANTAGES

Clean and pleasant

Good working time

Easily seen margins

DISADVANTAGES

High polymerization shrinkage

Volatile by-product

Low tear strength

Hydrophobic

Pour immediately

ADDITION SILICONE

This material is often called a polyvinyl siloxane (PVS) or vinyl polysiloxane (VPS) impression material.

the addition silicone is based on addition **polymerization** between divinylpolysiloxane and polymethylhydrosiloxane with a platinum salt as the catalyst.

COMPOSITION:

BASE	CATALYST
Polymethyl hydrogen siloxane	Divinyl Polysiloxane
Other siloxane prepolymers	Platinum salt (catalyst)
Filler (colloidal silica, metal oxide)	Palladium(H_2 absorber)
	Platinum
	Retarder
	Fillers

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CHEMISTRY AND SETTING REACTION:

Vinyl Siloxane + Silane Siloxane ⟶ Silicone Rubber
(Platinum salt)

No byproduct → If no impurities present and there is correct proportion.
If out of proportion or impurities → *H_2 gas is produced* →Pinpoint voids in stone cast.
Latex gloves→ Contains sulphur → Inhibits polymerization

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PROPERTIES

Pleasant odor and color

Excellent reproduction of surface details

Mixing time of 45 secs ,setting time of 5-9 mins.

Best dimensional stability - low curing shrinkage (0.17 %)

- lowest permanent deformation (0.05 – 0.3 %)

Stone pouring delayed by 1-2 hours

Can be electroplated with silver and copper

Good shelf life of 1-2 yrs

Good tear strength (1500-4300 N/m)

ADVANTAGES

Automix dispense

Clean and pleasant

Easily seen margins

Ideally elastic

Pour repeatedly

DISADVANTAGES

Hydrophobic

No flow if sulcus is moist

Low tear strength

Difficult to pour cast

High cost

POLYETHER

- There are two types of polyether impression materials.
- The first is based on the ring-opening polymerization of aziridine rings, which are at the end of branched polyether molecules.
- The second type is based on an acid-catalyzed condensation polymerization of polyether prepolymer with alkoxysilane terminal groups.

COMPOSITION:

BASE	CATALYST
▪Polyether polymer ▪Glycolether or Phthalate (plasticizer) ▪Filler (colloida silica)	▪Aeromated sulfonate ester (cross linking agent) ▪Colloidal silica ▪Glycolether or Phthalate (plasticizer)

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CHEMISTRY AND SETTING REACTION:

Polyether + Sulfonic ester ⟶ Crossed linked rubber

- ✓Reaction is brought about by Aziridine rings (present at the end of branched polyether molecule).
- ✓Main chain is copolymer of ETHYLENE OXIDE and TETRAHYDROFURAN

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PROPERTIES

Pleasant odor and taste

Sulfonic ester can cause skin reactions. Direct skin contact should be avoided.

Mixing time is 30 secs, setting time of 6 mins

Dimensional stability is very good.

Curing shrinkage is low (0.19-0.24%)

The permanent deformation is also low (0.8-1.6%).

Very stiff (flexibility of 3%)

Tear strength is good (1800-4800 N/m)

Hydrophilic (moisture control not critical)

Electroplatable with silver & copper

Shelf life extends upto 2 years

ADVANTAGES

Clean

Accurate and fine details

Compatible with cast & die materials

Delay pour

Easily seen margins

Good stability

Good wettability (hydrophilic)

DISADVANTAGES

Stiff, high modulus, Needs to block undercuts

Bitter taste

Absorbs water

Leaches components

High cost

SPECIALIZED MATERIALS

VISIBLE LIGHT CURED POLYETHER URETHANE DIMETHACRYLATE

Introduced in early 1988 by GENESIS and L D CAULK.

Two viscosities: Light and heavy.

COMPOSITION

-Polyether urethane dimethacrylate
-Photo initiators
-Photo accelerator
-Silicon dioxide (Filler) 40-60%

PROPERTIES

Long working time and short setting time.

Blue light is used for curing with transparent impression trays.

Tear strength – 6000 to 7500 gm/cm^2 (Highest among elastomers)

Other properties are similar to addition silicone

MANIPULATION

Both light body and heavy body are cured with visible light having larger diameter probe.

Curing time approx 3 min.

Adv: - Controlled working time
- Excellent properties

Disadv: - Special transparent trays
- Difficult to cure in remote area

PROPERTIES OF ELASTOMETIC IMPRESSION MATERIAL

TABLE 8-6 Comparative Properties of Elastomeric Impression Materials

Property	Polysulfide	Condensation Silicone	Addition Silicone	Polyether
Working time (min)	4–7	2.5–4	2–4	3
Setting time (min)	7–10	6–8	4–6.5	6
Tear strength (N/m)	2500–7000	2300–2600	1500–4300	1800–4800
Percent contraction (at 24 h)	0.40–0.45	0.38–0.60	0.14–0.17	0.19–0.24
Contact angle between set material and water (°)	82	98	98/53*	49
Hydrogen gas evolution (Y/N)**	N	N	Y[†]	N
Automatic mixing (Y/N)**	N	N	Y	Y
Custom tray (Y/N)**	Y	N	N	N
Unpleasant odor (Y/N)**	Y	N	N	N
Multiple casts (Y/N)**	N	N	Y	Y
Stiffness (value of 1 indicates greatest stiffness)[‡]	3	2 (1)	2 (1)	1 (2)
Distortion on removal (value of 1 indicates the greatest and 4 the least potential distortion)	1	2	4	3

*The lower contact angle resulted from testing of a hydrophilized PVS.

**(Y/N) stands for yes or no.

[†]A hydrogen absorber is often included to eliminate hydrogen gas evolution.

[‡]The numbers in the parentheses reflect the ranking when soft formulation of polyether impression material is considered.

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Disinfection Methods for Impressions

TABLE 8-4 Guide for the Selection of Appropriate Disinfection Methods for Impressions Transported to a Dental Laboratory

Material	Method	Recommended Disinfectant	Comments
Alginate	Immersion with caution Use only disinfectant for a short-term exposure time (<10 min for alginate)	Chlorine compounds or iodophors	Short-term glutaraldehyde has been shown to be acceptable, but time is inadequate for disinfection.
Agar			Do not immerse in alkaline glutaraldehyde!
Polysulfide and silicone	Immersion	Glutaraldehydes, chlorine compounds, iodophors, phenolics	Disinfectants requiring more than 30-min exposure times are not recommended.
Polyether	Immerse with caution Use disinfectant only for a short exposure time (<10 min)	Chlorine compounds or iodophors	ADA recommends any of the disinfectant classes; however, short-term exposures are essential to avoid distortion.
ZOE impression paste	Immersion preferred; spraying can be used for bite registrations	Glutaraldehydes or iodophors	Not compatible with chlorine compounds! Phenolic spray can be used.
Impression compound		Iodophors or chlorine compounds	Phenolic spray can be used.

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Sawyer *et al* studied the accuracy of casts produced from three classes of elastomeric impression materials. They concluded that polyether was the only material, where a second accurate cast in the same impression or a delayed pour after a week, produced essentially the same accuracy, compared to that of the cast poured immediately. The delayed excessive shrinkage of silicones did affect the second and delayed pours.

Sawyer HF, Dilts WE, Aubrey ME, Neiman R. Accuracy of casts produced from the three classes of elastomeric impression materials. J Am Dent Assoc 1974;89:644-8.

Eames *et al* in a study evaluated the accuracy and dimensional stability of elastomeric impression materials. They concluded that the new addition silicones exhibited the least change dimensionally. They were found to be statistically equivalent to polyether. They recommended that in situations, which preclude the immediate pouring of impressions only the stable materials should be selected.

Eames WB, Wallace SW, Suway NB, Roger LB. Accuracy and dimensional stability of elastomeric impression materials. J Prosthet Dent 1979;42:159-62.

Lacy *et al* investigated the time dependant accuracy of elastomeric impression materials and concluded that polyvinyl siloxanes were the most stable of elastomers. However, with putty wash system, they may reveal some loss of accuracy of dies produced by retrieval from multiple pours after 2-4 days.

Lacy AM, Fukui H, Bellman J, Jendersen MD. Time dependent accuracy of elastomer impression materials Part II: Polyether, polysulphide and polyvinyl siloxanes. J Prosthet Dent 1981;45:329-33.

Suresh et al evaluated the dimensional accuracy of elastomeric impression materials when treated with different disinfectants; autoclave, chemical, and microwave method. The impression materials used for the study were, dentsply aquasil (**addition silicone** polyvinylsiloxane syringe and putty), zetaplus (**condensation silicone** putty and light body), and impregum penta soft (**polyether**). They concluded that disinfection procedures produce minor dimensional changes of impression material. However, it was within American Dental Association specification. Hence, steam autoclaving and microwave method can be used as an alternative method to chemical sterilization as an effective method.

Comparative Evaluation of Dimensional Accuracy of Elastomeric Impression Materials when Treated with Autoclave, Microwave, and Chemical Disinfection
Suresh S Kamble, Rakshit Vijay Khandeparker, P Somasundaram, Shweta Raghav, Rashmi P Babaji, T Joju Varghese J Int Oral Health. 2015 Sep; 7(9): 22–24.

MAKING IMPRESSION WITH ELASTOMERIC MATERIAL

The use of elastomeric impression material to fabricate gypsum models, casts, and dies involves six major steps:

(1) preparing a tray.

(2) managing tissue.

(3) preparing the material.

(4) making an impression.

(5) removing the impression.

(6) preparing stone casts and dies.

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Preparing a tray.

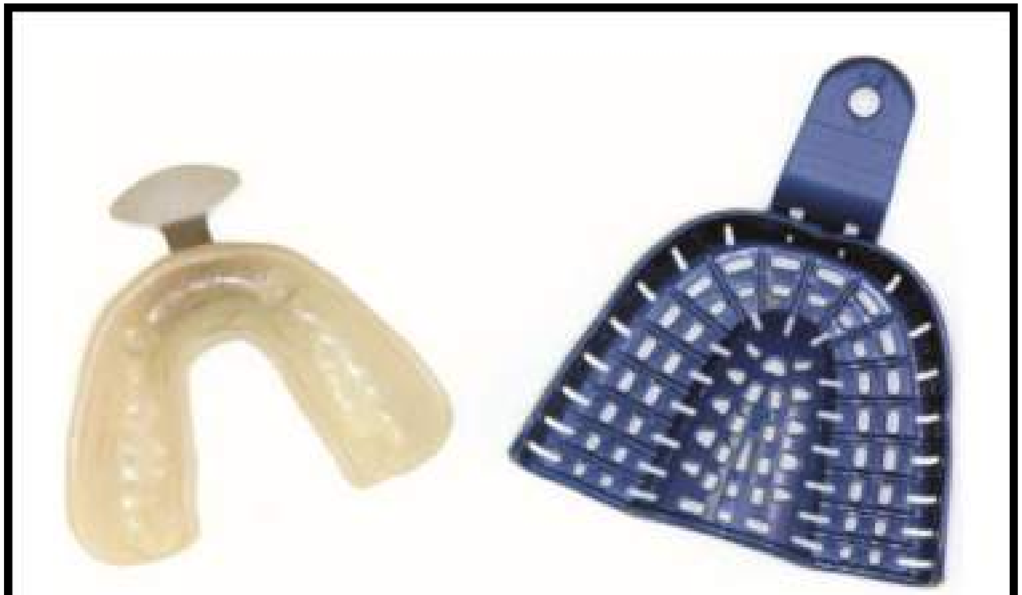


FIGURE 8-7 Impression trays. Custom tray (*left*) and stock tray (*right*).

Managing tissue.

Following methods are used:

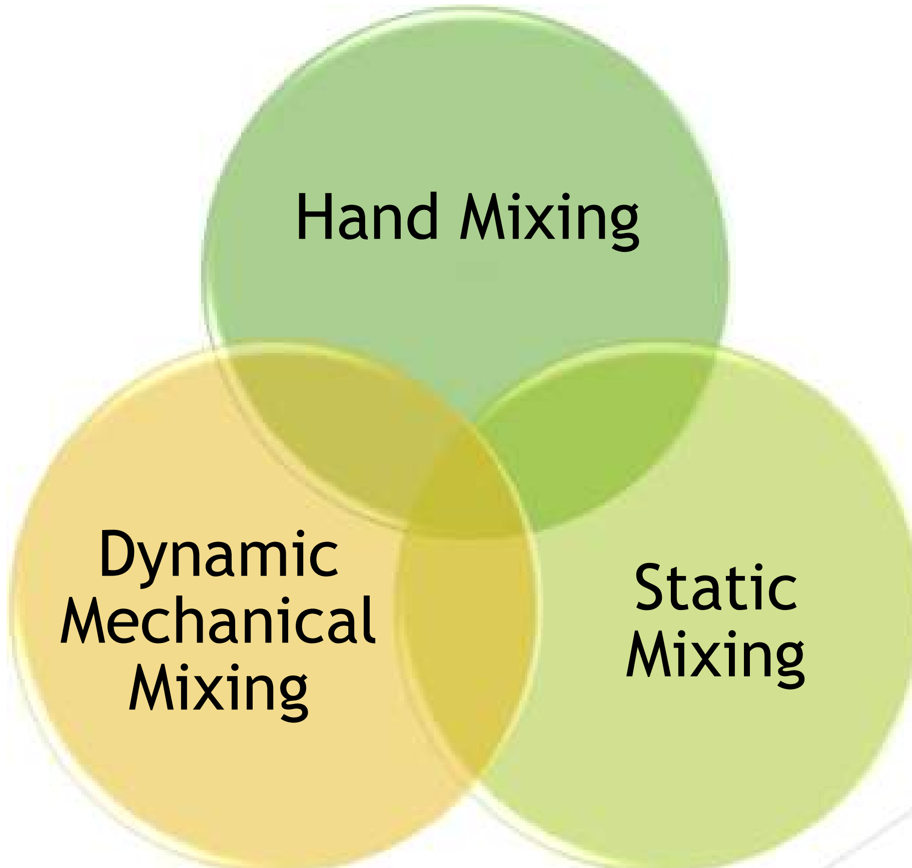
✓Gingival retraction cord

✓An electrosurgical unit

✓Soft tissue laser

Manipulation of impression materials:

Currently, elastomeric impression materials are supplied for three modes of mi



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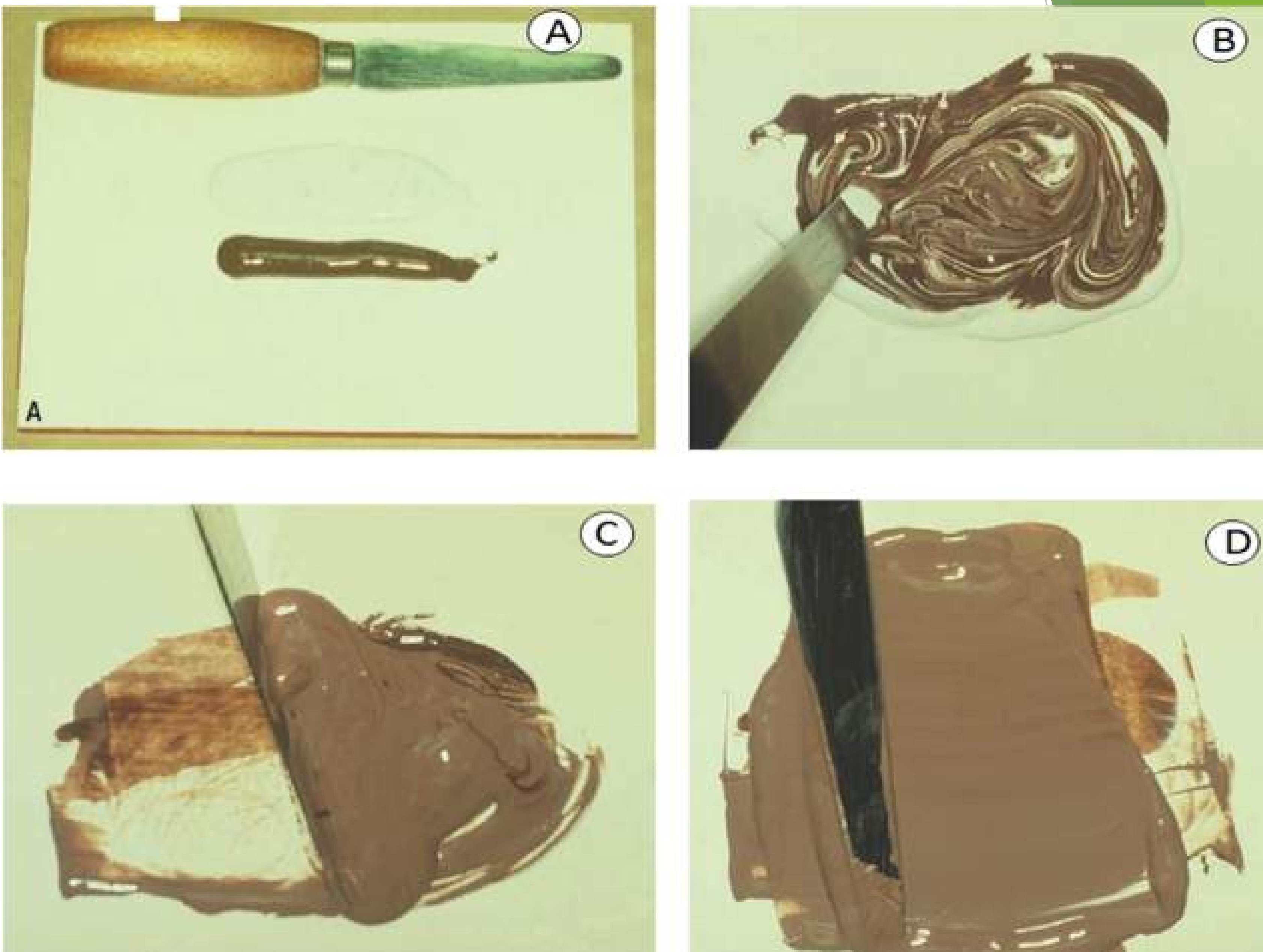
Hand Mixing



STATIC MIXING

Static mixing—A technique of transforming two fluid (or paste-like) materials into a homogeneous mixture without mechanical stirring; it requires a device that forces two streams of material into a mixer cylinder, such that as the streams move through the mixer, while the stationary elements in the mixer continuously blend the materials.

The mixing tip is made of helical mixer elements in a cylindrical housing .

The mixer elements are a series of alternating right- and left-turn 180° helixes positioned so that the leading edge of one element is perpendicular to the trailing edge of the next

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Dynamic Mechanical Mixing

The device , uses a motor to drive parallel plungers, forcing the materials into a mixing tip and out into an impression tray or syringe; meanwhile, the motor driven impeller, which is inside the mixing tip, mixes the materials as they are extruded through the tip

The function of the impeller is only to mix the materials as they are passing through; it does not propel the material

The materials are supplied in collapsible plastic bags housed in a cartridge

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The amount of material retained in the mixing tip is slightly greater than that used in static mixing.

In using this device, thorough mixing of higher-viscosity materials can be achieved with little effort.

Both polyether and addition silicone impression materials of various viscosities are available with this dispensing system

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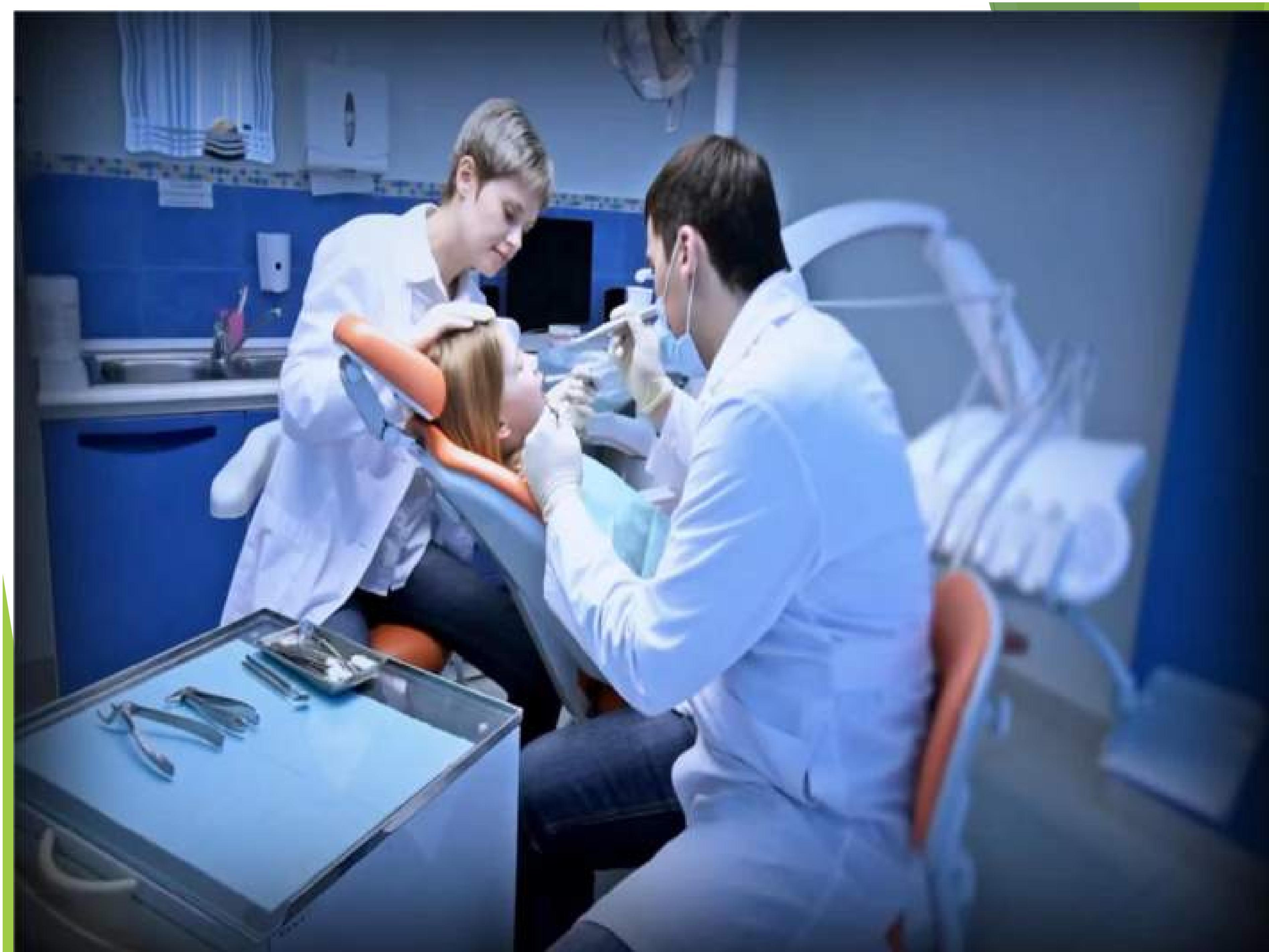
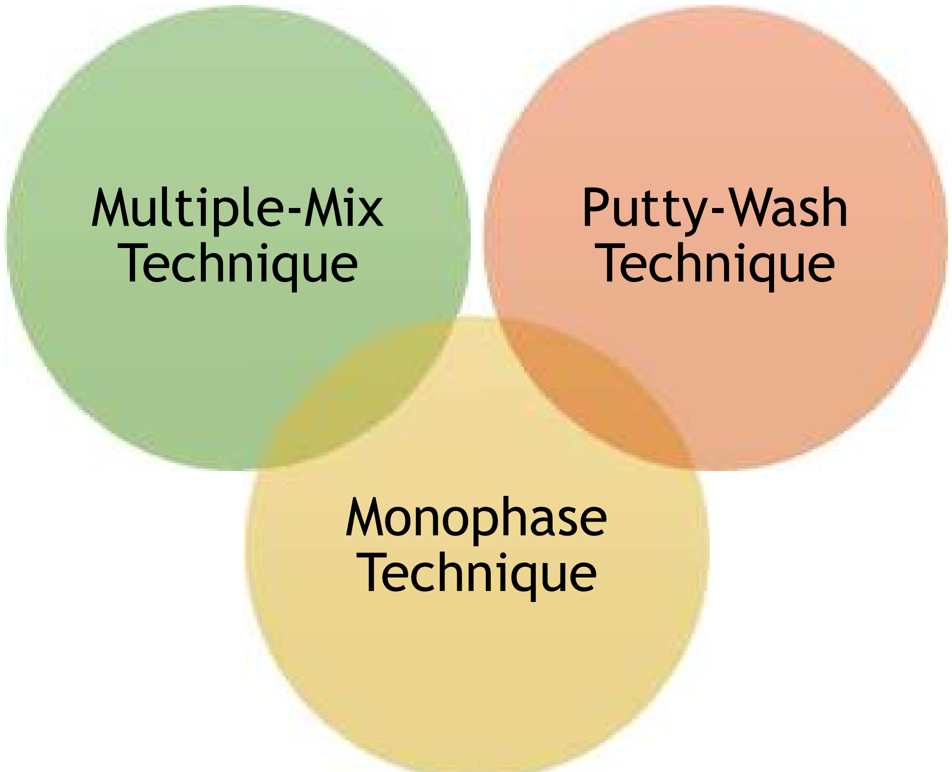


4. MAKING AN IMPRESSION:



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A) MULTIPLE-MIX TECHNIQUE

A syringe material (light body) and a tray material (heavy body) are used in this technique

↓

The two groups of materials are mixed simultaneously

↓

The lighter material is injected from the filled syringe or directly from a static mixing gun within and around the tooth preparation

↓

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The filled tray is then inserted in the mouth and seated over the syringe material, which has been extruded on hard and/or soft tissue

The tray material will force the syringe material to adapt to the prepared tissues

The two materials should bond together upon setting

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B) MONOPHASE TECHNIQUE

Medium-body polyether and addition silicone are often used for the monophase or single-viscosity technique

The procedure is similar to that of the multiple-mix technique except that only one mixture is made, and part of the material is placed in the tray, and another portion is placed in the syringe for injection in the cavity preparation, prepared teeth, or soft tissue

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The success of this technique depends on the pseudoplastic (shear thinning) properties of the materials

When a medium-viscosity material is forced through the syringe tip, the viscosity is reduced to allow the material to adapt well to the preparation

The material in the tray retains its medium viscosity, and, when seated, it can force the syringe material to flow past critical areas of the tooth preparation

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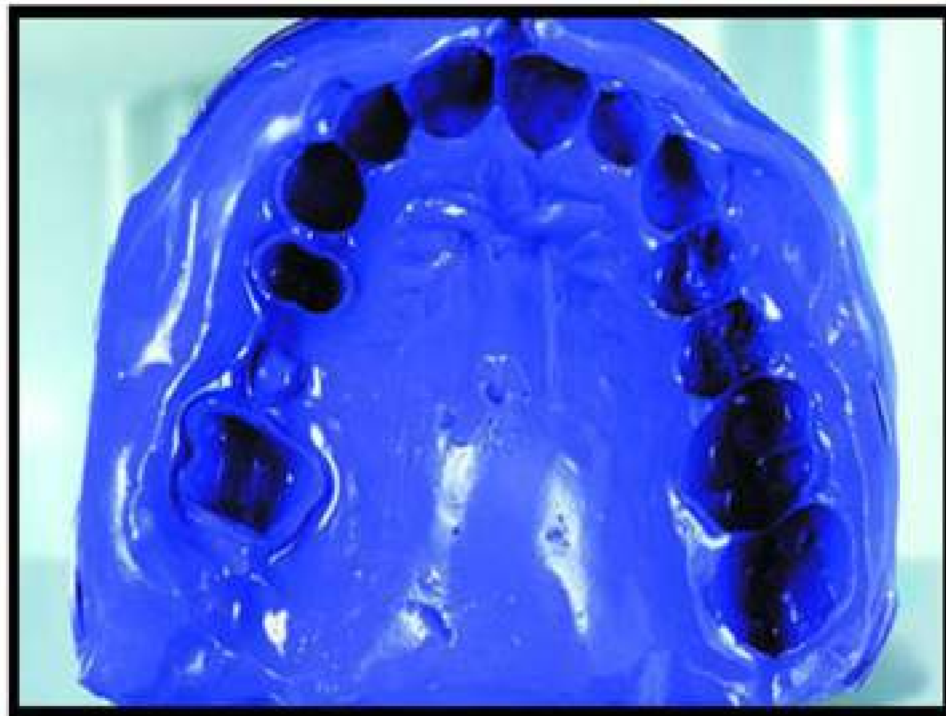

3. PUTTY WASH TECHNIQUE:

This method was originally developed for condensation silicone to minimize the effect of associated dimensional changes

↓

The thick putty material is placed in a stock tray and a preliminary impression is made

↓

This procedure results in what is essentially an intraoral custom-made tray formed by the putty

↓

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Space for the light-body “wash” material is provided either by cutting away some of the “tray” putty or by using a thin polyethylene sheet as a spacer between the putty and the prepared teeth during preliminary impression making

↓

A mixture of the thin-consistency wash material is placed into the putty impression and on the preparation; then the tray is reseated in the mouth to make the final impression

↓

An alternative approach is to inject the wash material around the preparation and then immediately seat the tray with freshly mixed putty over the wash material

↓

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This approach risks displacing too much wash material by the putty, so that a critical area of the preparation is reproduced in the putty without the required detail

Single step putty wash impression

Take equal quantities of FLEXCEED base & catalyst using the prescribed scoop.

Knead the FLEXCEED base & catalyst until a uniform blue color is achieved

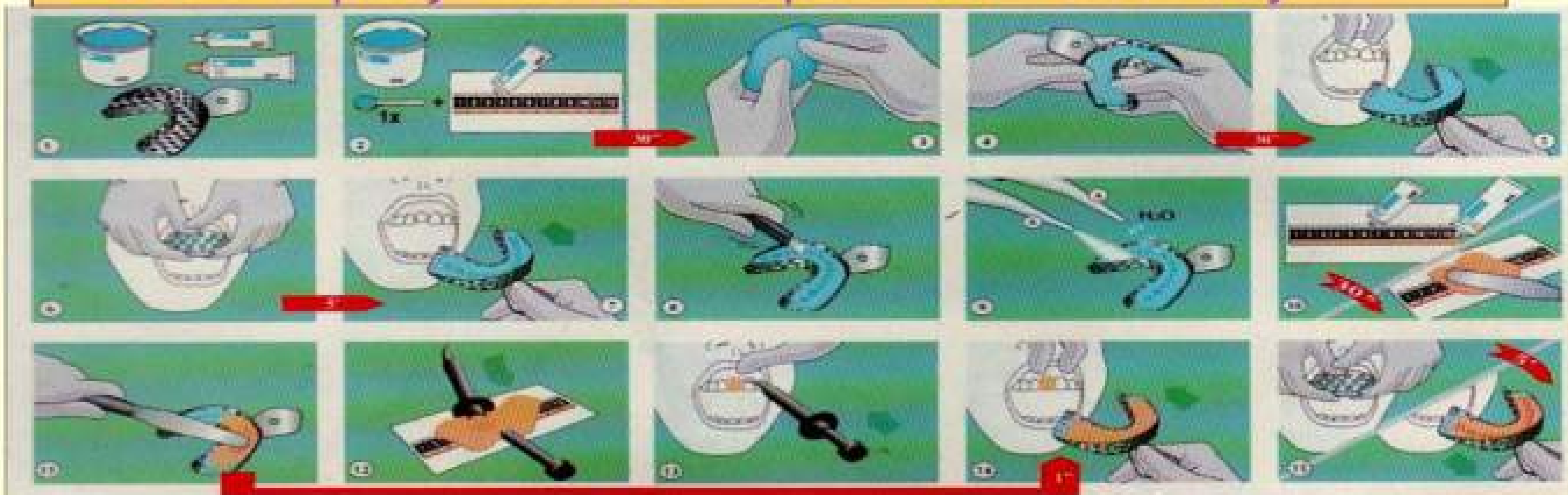
Load the FLEXCEED putty mix on the tray

Inject the FLEXCEED light body onto the putty mix making sure that the nozzle remains immersed to prevent air entrapment

Using the intra-oral tips, inject the FLEXCEED light body directly around the prepared tooth

Final impression is easy to read due to the contrasting colour of FLEXCEED

Double or putty wash technique – used stock tray



Relieving borders of heavy body impression material

Full arch impression with heavy and light body impression material by double technique

Maxillofacial prosthetic materials

RECENT ADVANCEMENTS IN IMPRESSION MATERIALS

- Alginates for maxillofacial prosthesis (J series)
- Elastomers
- Laser

FernandaPereiradeCaxias, International Journal of Dentistry Volume 2019, Article ID 8657619, 7 pages

J -603 Special formula alginate:

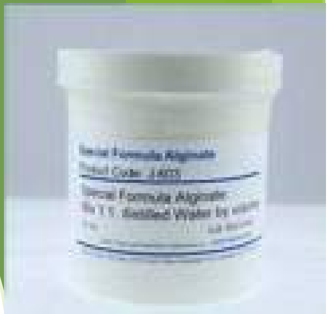
- Special formula for ophthalmic usage
- Neutral pH prevent irritation
- Fine grain particles – consistent, creamy, bubble free material.

J - 6380 alginate (6 minutes)

- Head and larger areas
- Smooth, strong, firm and flexible

J - 604 Fiber gel alginate

- Formulated for professional high – production, high end details
- 40 % stronger than conventional
- Adds tear strength, prevents run and drips
- Retains moisture, Reduces shrink rate
- Remains soft and flexible
- Delayed pouring without loss of details



Kaur G, Jain P, Uppal M, Sikka R. Alginate Impression Material: From Then Till Now... indicators.;18(19):20.

Advancement in impression materials

1. Alginate

- Extended pour alginate(5day)
- Chromic alginate
- Self disinfecting alginate
- High Viscosity Alginates:

2. Zinc oxide eugenol

- Luralite
- Cavex

3. Addition silicone

- Hydrophilic PVS

4. Polyether

- Polyvinyl ether siloxane (PVES)

Alaghari S, Velagala S, Alla RK, Ramaraju AV. Advances in alginate impression materials: a review. International Journal of Dental Materials. 2019 Nov 15;1(2):55-9.

DIGITAL IMPRESSION

- Digital technology has profoundly impacted the dental profession.
- Significant progress has already been made in computerized digital technologies, such as digital cast scanners, intraoral digital impression-capture devices, cone beam computed tomography, three-dimensional (3D) printers, laser sintering units, and milling machines
- It can be expected that in the not-too-distant future, the art of making conventional impressions will become nonessential

Punj, A., Bompolaki, D., & Garaicoa, J. (2017). Dental Impression Materials and Techniques. Dental Clinics of North America, 61(4), 779–796.

CEREC (Sirona, Dentsply)

- This system has been around for the longest time.
- The Omnicam unit is the latest version, and is available as a cart system that includes the camera and computer, all of which can be connected or simply transmit files to a milling system.
- The device works on the principle of triangulation but yields three-dimensional (3D) full-color video scans without the need for using imaging powder.
- This device is a closed system in that the software is only compatible with the company's milling unit and the image files cannot be exported and used with other milling systems

Planscan (Planmeca, USA)

- Similar to Sirona's CEREC, this system has an acquisition unit, design software, and milling device.
- This device is a powder-free system that obtains individual sequential images in color using blue laser technology.
- The scanner is available as a USB version that connects to a laptop.
- This device is an open system wherein .stl files can be exported to other systems for milling.
- This device is predominantly used for restorative dentistry

iTero Element (Align Technology, United States)

- This scanner is based on the principle of confocal laser scanning microscopy and uses no powder to capture images.
- A color display is now available and the unit comes as a cart or a USB version with touch screens.
- This device is an open system and can be used for orthodontics, restorative dentistry, and implantologyur.

Punj, A., Bompolaki, D., & Garaicoa, J. (2017). Dental Impression Materials and Techniques. Dental Clinics of North America, 61(4), 779–796.

CONCLUSION

Impression materials have improved to such an extent that they produce highly accurate impressions because they reproduce fine surface detail, and have excellent elastic recovery, adequate tear strengths, and exceptional dimensional stability, that the accuracy may be controlled more by technique than by the material itself. As a result, one would expect increased emphasis on the development of techniques for the taking of various types of impressions

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- Comparative Evaluation of Dimensional Accuracy of Elastomeric Impression Materials when Treated with Autoclave, Microwave, and Chemical Disinfection. Suresh S Kamble, Rakshit Vijay Khandeparker, P Somasundaram, Shweta Raghav, Rashmi P Babaji, T Joju Varghese J Int Oral Health. 2015 Sep; 7(9): 22–24.


Thank you!

Dimensional accuracy refers to the lack of dimensional change during curing and shortly after removal from the mouth.

Dimensional stability refers to the lack of dimensional changes over time.

Accuracy is the more important property when impressions are poured up immediately with a die material.

There are six major sources of dimensional change:

(1)polymerization shrinkage

(2) loss of a **condensation reaction** by-product (water or alcohol)

(3) thermal contraction from oral temperature to room temperature

(4) Absorption of water or disinfectant over a period of time

(5) Incomplete recovery of deformation because of viscoelastic behavior.

(6) incomplete recovery because of plastic deformation.