IMPRESSION MATERIALS

IMPORTANT TERMS

- **Hydrophilic:** Strong affinity for water.
- **Hydrophobic:** Aversion to water.
- **Setting time:** The time from the start of mixing until the material is firm enough to resist permanent deformation.
- **Working time:** The time from the start of mixing until the impression is fully seated without any distortion.

IMPORTANT TERMS

Water is loosely packed in the network of gel fibrils in hydrocolloid gels.

Under 100% humidity, hydrocolloid impression will loose water.

- **Syneresis:** Contraction through loss of water.
- **Imbibition:** Expansion through water intake.

IMPORTANT TERMS

- **Sol state:** Molecules or aggregates of molecules dispersed in a liquid medium.
- **Gel state:** Formation of jelly like mass when the suspended particles combine with a liquid vehicle.

$$\text{SOL STATE} \underset{\text{Liquifaction Temperature}}{\overset{\text{Gelation Temperature}}{\rightleftharpoons}} \text{GEL STATE}$$

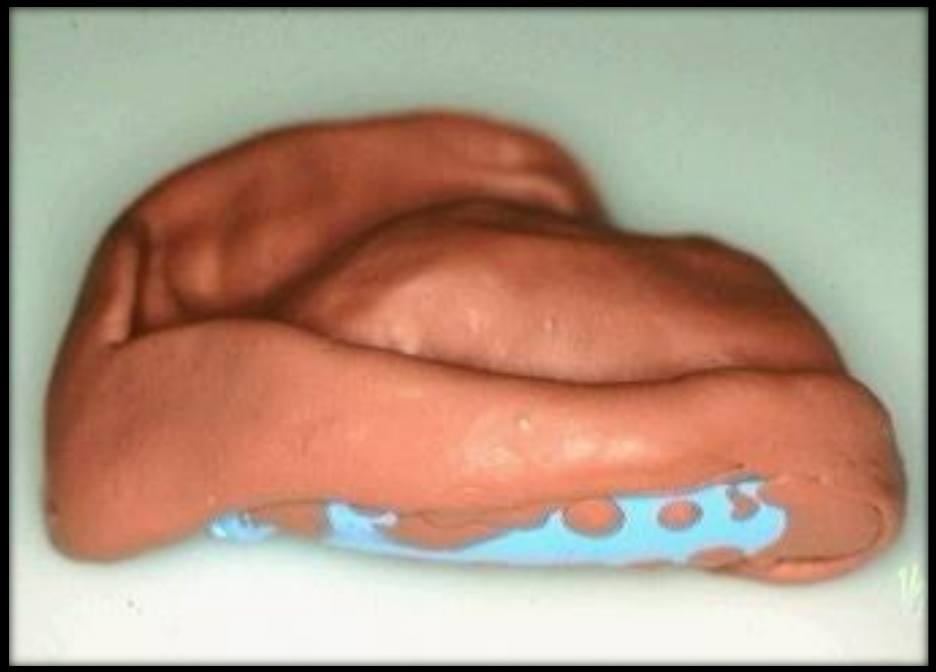
IMPORTANT TERMS

- **Addition reaction:** A polymerization reaction in which each polymer chain grows to a maximum length in sequence and no reaction by-product is formed.
- **Condensation reaction:** A polymerization process in which a polymer chains grow simultaneously and a reaction by-product is formed.

INTRODUCTION

- **Impression** is the negative replica / reproduction of the oro-dental structures.
- The materials used to obtain the impression of the tooth structure and/or the surrounding oral tissues are called as **impression materials** (AUXILIARY DENTAL MATERIALS)
- The impression materials can be used to produce replicas of both intra-oral and extra-oral tissues.

DENTAL IMPRESSION



DENTATE UPPER JAW IMPRESSION

EDENTULOUS UPPER JAW IMPRESSION

IDEAL PROPERTIES OF IMPRESSION MATERIALS

- Biological properties.
- Chemical properties.
- Physical and Mechanical properties.
- Other properties

IDEAL PROPERTIES OF IMPRESSION MATERIALS

- **BIOLOGICAL PROPERTIES:**

1. No adverse effect on the health of the operator or patient.
2. Non toxic.
3. Non irritant.

IDEAL PROPERTIES OF IMPRESSION MATERIALS

- **CHEMICAL PROPERTIES:**

1. Should not react with other materials. e.g. model and die.
2. Should not react with other materials during setting process.
3. Should form bond with impression tray.
4. Capable of being disinfected.
5. Should not produce any by-product.

IDEAL PROPERTIES OF IMPRESSION MATERIALS

- **PHYSICAL AND MECHANICAL PROPERTIES:**

1. Thixotrophic behavior.
2. Should have enough time for mixing, loading of tray and setting in patient 's mouth.
3. Elastic enough to be withdrawn from the undercut areas without deterioration.

IDEAL PROPERTIES OF IMPRESSION MATERIALS

- **PHYSICAL AND MECHANICAL PROPERTIES:**

4. Should not shrink.(0.1% to 0.27%)
5. Should have acceptable discrepancy. (20 – 50 μm)
6. Should not deform permanently.
7. Tear resistance.
8. Neutral odour and taste.
9. Acceptable colour.

IDEAL PROPERTIES OF IMPRESSION MATERIALS

- **OTHER PROPERTIES:**

1. Radiopaque.
2. Ease of handling.
3. Require minimum equipment.
4. Cost effective.

(15ml of impression material required for a quadrant costs)

Polyether	£ 1.75.
Addition silicone	85p–£1.40.
Condensation silicone	40p.
Alginate	20p.

Dental update,2004.

IMPRESSION TRAYS

Impression trays are of three types,

1. STOCK TRAYS.
2. DISPOSABLE TRAYS.
3. SPECIAL TRAYS.

IMPRESSION TRAYS

- **STOCK TRAYS:**

1. Standard sizes.
2. Can be smooth or perforated.
3. Reusable.
4. Made up either of plastic or metal.

Upper impression tray

Lower impression tray

IMPRESSION TRAYS

DISPOSABLE TRAYS:

1. For single use only.
2. Mostly perforated.
3. Made up of polymeric materials. e.g. Nylon.

IMPRESSION TRAYS

- **SPECIAL TRAYS:**

1. Also called as custom trays.
2. Disposable.
3. Fabricated by the lab technician.
4. For recording secondary impression in edentulous patients.
5. Made from Self cure acrylic.

DIFFERENCE IN UPPER AND LOWER IMPRESSION TRAYS

UPPER IMPRESSION TRAY

LOWER IMPRESSION TRAY

IMPRESSION TECHNIQUES

1. **MUCOSTATIC IMPRESSION TECHMIQUE:**
   The technique in which the impression material is fluid enough to flow and does not displace the oral tissues.

- MUCOSTATIC IMPRESSION MATERIALS:

1) Impression plaster.
2) Agar Agar impression material.
3) Zinc Oxide Eugenol impression pastes.
4) Light body Elastomers.

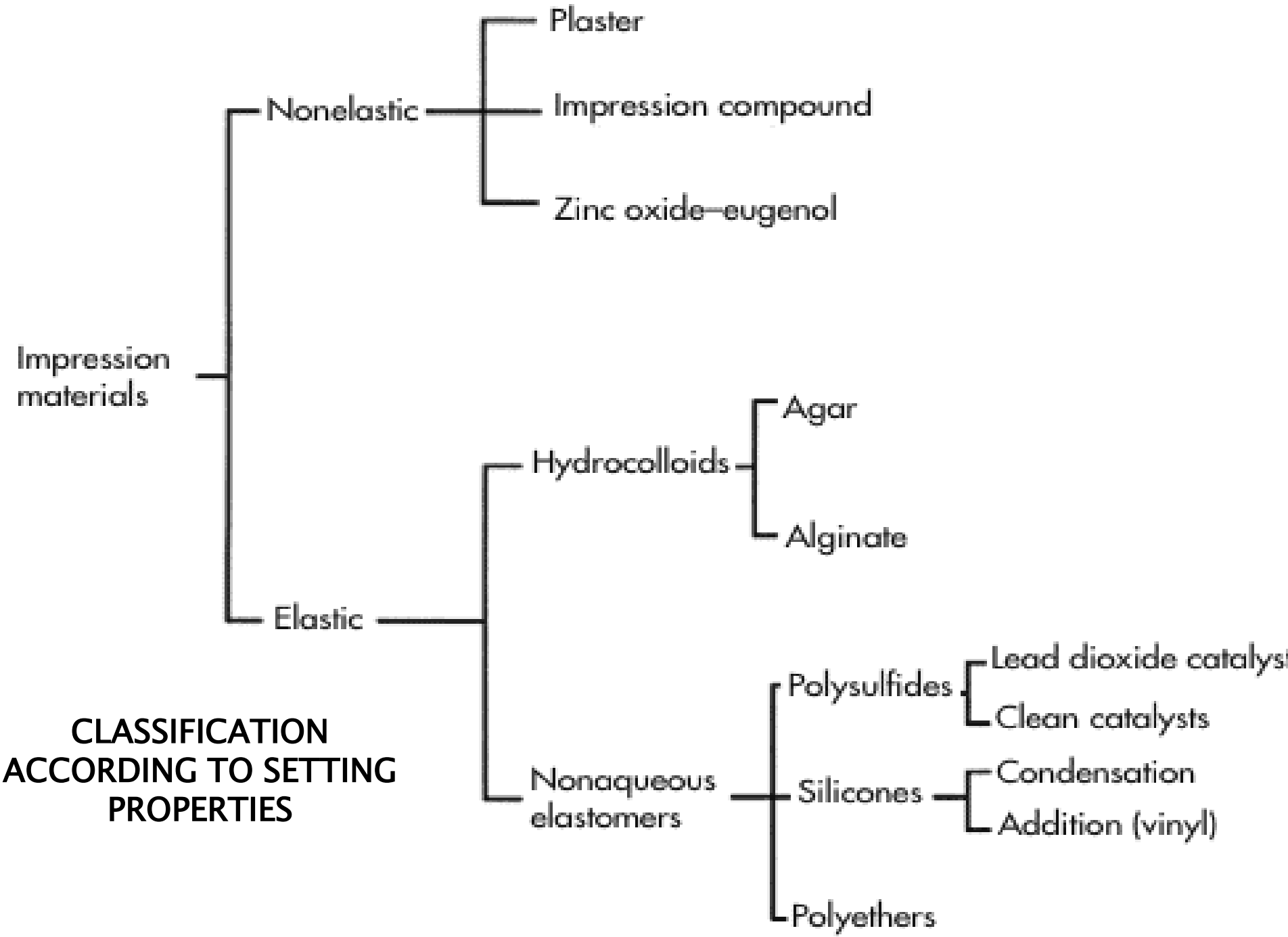
IMPRESSION TECHNIQUES

2. **MUCOCOMPRESSIVE IMPRESSION TECHNIQUE:**
   The technique in which the impression material is viscous and is able to compress the oral tissues on insertion in the patient ‘s mouth.

- MUCOCOMPRESSIVE IMPRESSION MATERIALS:

1) Impression compound.
2) Viscous alginate.
3) R,H,P consistencies of elastomers.

CLASSIFICATION OF IMPRESSION MATERIALS



CLASSIFICATION ACCORDING TO SETTING PROPERTIES

NON ELASTIC IMPRESSION MATERIALS

Impression Plaster

Impression Compound

Zinc Oxide Eugenol Impression Pastes

IMPRESSION PLASTERS

5 types of gypsum products according to ISO standard.

Type 1	Dental plaster, Impression.
Type 2	Dental plaster, model.
Type 3	Dental stone, die and model.
Type 4	Dental stone, die, high strength, low expansion.
Type 5	Dental stone, die, high strength, high expansion

IMPRESSION PLASTERS

- Powder form.
- Chemically

  Calcined β-calcium sulphate hemihydrate.

  On reaction with water forms calcium sulphate dihydrate.
- Mixing with water or anti-expansion solution.

IMPRESSION PLASTERS
COMPOSITION

Calcium sulphate hemihydrate*	Main ingredient
Potassium sulphate*	Accelerator
Borax*	Retarder
Alizarin red	Colouring agent
Gum tragacanth	Improves cohesiveness
Starch	Soluble plaster

* Agents in anti-expansion solution

IMPRESSION PLASTERS

- **MANIPULATION:**

1. Mucostatic impression technique.
2. Mix powder in water or anti-expansion solution.
3. Powder to water ratio (50-60ml/100g).
4. Avoid air bubbles during mixing.
5. Normally used as wash impression.

IMPRESSION PLASTERS

- **ADVANTAGES**

1. Initial fluid state capable of recording soft tissues in uncompressed state.
2. Absorbs water from the tissue surface.
3. Useful in recording impressions of excessive mobile teeth and flabby ridges.

- **DISADVANTAGES**

1. Dry sensation to patient due to absorption of water from tissue surface.
2. No elasticity after setting

IMPRESSION COMPOUND

Impression compound is a muco-compressive, thermoplastic, non elastic impression material used to record the primary impressions of edentulous arches

- Simply called as **"COMPO"**
- **OTHER NAMES:**

1) **Dental compound.**
2) **Model compound.**
3) **Modeling compound.**

Available in the form of sheets, cakes, discs and sticks.

IMPRESSION COMPOUND

- According to ISO impression compounds are classified as

1. TYPE I: Low fusing→ green stick compound (also called as tracing stick/tracing compound/border moulding compound)
2. TYPE II: High fusing→ tray compound.

IMPRESSION COMPOUND

COMPOSITION

COMPONENTS	FUNCTION
Thermoplastic materials (Resins and waxes) **{47%}**	Plasticity. Workability. Forms “matrix”
Fillers **{50%}**	Effect viscosity. ↓ thermal conductivity.
Lubricants **{2%}**	Flowability.
Colouring agents **{traces}**	Colouring contrast.

IMPRESSION COMPOUND

MANIPULATION:

1. Softening of impression compound.
2. Hot water bath method.
   - Temperature range : 55 – 60 ºC.
   - Kneading is performed.
     - Dry kneading.
     - Wet kneading.
   - Kneading improves plasticity.
   - Prolonged immersion or over heating not recommended.
   - Constituents may leach out.
   - Do not boil or ignite the material.

IMPRESSION COMPOUND

MANIPULATION:

3. Impression must be thoroughly cooled before withdrawal from the oral cavity.
4. Cool water must be sprayed till the material becomes hard.
5. Softening of the compound in warm water recommended for removal from the cast.

IMPRESSION COMPOUND

PROPERTIES:

- Undercut recording poor.
- dimensional stability not good.
  1.5% by volume shrinkage on cooling.
- Impression may relax with an increase in room temperature.

IMPRESSION COMPOUND

- Compatible with model or die material.
- Mucocompressive.
- Biocompatible.
- Thermal conductivity is low.
- Adequate shelf life.
  - Long term storage not recommended.

ZINC OXIDE EUGENOL IMPRESSION PASTE

- Non elastic.
- Sets by chemical reaction.
- **Zinc oxide (ZnO):**
  - Fine odorless white or yellowish powder.
- **Eugenol:**
  - A colourless liquid extracted from cloves.
  - Pungent spicy taste.
  - Antiseptic and analgesic properties.

ZINC OXIDE EUGENOL IMPRESSION PASTE

- A 2 paste system. (paste-paste formulation)
- **PASTE 1:**
  Base paste.
  White in colour.
- **PASTE 2:**
  Accelerator paste
  Blue in colour.

ZINC OXIDE EUGENOL IMPRESSION PASTE

COMPOSITION (BASE PASTE)

Zinc oxide **(87 %)**	▪Main reactive agent
Vegetable oil or mineral oil (**13%)**	▪Inert component. ▪Plasticizer. ▪Counteracts irritant action of eugenol.
Zinc acetate.	▪Accelerator.
Water	▪Accelerator. ▪If absent, setting retards till contact with saliva.

ZINC OXIDE EUGENOL IMPRESSION PASTE

COMPOSITION (ACCELERATOR PASTE)

Eugenol / Clove oil (12%)	■Main reactive agent. ■Less burning sensation from clove oil as compared to eugenol.
Fillers {Wax / Kaolin / Talc} (20%)	■Inert like. ■Gives body to the set material.
Canada Balsam / Peru Balsam. (10%)	■Increases flow. ■Improves mixing properties.
Gum or polymerized rosin (50%)	■Accelerator. ■Provides a smooth mix.
Accelerator soln and colour. (5%)	■Facilitate reaction. ■For Colouring demarcation.

ZINC OXIDE EUGENOL IMPRESSION PASTE

MANIPULATION:

1. An oil impervious paper pad or glass slab.
2. A flexible stainless steel spatula.
3. Equal lengths of both the pastes extruded onto the mixing pad.
4. Both pastes mixed together rapidly.
5. Mixing completes when a homogenous colour is attained.
6. Mixing time approx 1 min.

ZINC OXIDE EUGENOL IMPRESSION PASTE

PROPERTIES:

- Dimensional stability satisfactory. Shrinkage less than 0.1%
- Irritability due to Eugenol.
- Adequate shelf life.

EUGENOL FREE ZnO PASTE

- Zinc oxide reacts with carboxylic acid to form ZOE like material.
- Orthoethoxybenzoaic acid (E.B.A)
  - Substitute of Eugenol.
  - Reaction not effected by temperature or humidity.
  - Bactericidals and other medicaments can be added.

ELASTIC IMPRESSION MATERIALS

AQUEOUS HYDROCOLLOIDS

Agar (reversible)

Alginate (irreversible)

NON AQUEOUS ELASTOMERS

Poly sulphides

Silicones (Addition & Condensation)

Polyethers

AGAR IMPRESSION MATERIAL

- Also called as Agar-Agar.
- Agar is a galactose sulphate which forms a colloid with water.
- When heated, hydrogen bonds are broken, helix is uncoiled and a viscous fluid is formed.
- The process is reversible.

  GEL $\xrightarrow{\text{Heating}}$ SOL $\xrightarrow{\text{Cooling}}$ GEL
- Thermoplastic material.
- Can be used repeatedly.

AGAR IMPRESSION MATERIAL

- Usually supplied in 2 forms

  Syringe material.

  Tray material.
- Requires careful control and expansive equipment.
- Dimensionally unstable, model should be poured soon.

AGAR IMPRESSION MATERIAL

COMPOSITION

COMPONENTS	FUNCTION	WEIGHT %
Agar	Gelling agent	13%-17%
Borate	Strength	0.2%-0.5%
Sulfate	Gypsum hardener	1.0%-2.0%
Wax	Filler	0.5%-1.0%
Thermoplastic material	Thickener	0.3%-0.5%
Water	Reaction medium	Balance

AGAR IMPRESSION MATERIAL

- **DISPENSING OF AGAR:**
  3 chamber conditioning unit.

100°C for 10 min	65 °C till use	46 °C for 3 min
Liquefying chamber	Storage chamber	Tempering chamber

AGAR IMPRESSION MATERIAL

ADVANTAGES

- No mixing required.
- Good surface details.
- Inexpensive
  - After initial equipment.

DISADVANTAGES

- Initial expanse.
- Technique sensitive.
- Poor tear strength.
- Dimensionally unstable.

ALGINATE IMPRESSION MATERIAL

- First presented in 1940s by Amalgamated Dental Company.
- Viscoelastic impression material.
- Mucostatic material.

ALGINATE IMPRESSION MATERIAL

COMPOSITION

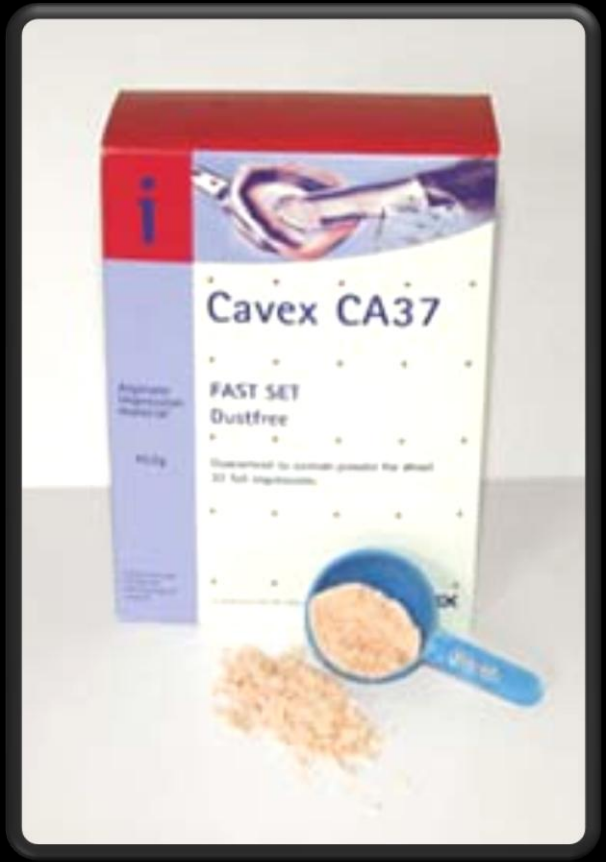
Components	Function	Weight %
Potassium Alginate	Soluble Alginate	15
Calcium sulphate	Reactor	16
Zinc oxide	Filler particles	4
Potassium titanium floride	Accelerator	3
Diatomaceous earth	Filler particles	60
Sodium sulphate	Retarder	2

ALGINATE IMPRESSION MATERIAL

MANIPULATION:

1. Powder / water ratio as suggested by the manufacturer. (normally equal parts are taken)
2. Powder is added to water in a clean rubber bowl..

- If powder added first greater mixing time is required.



ALGINATE IMPRESSION MATERIAL

MANIPULATION:

3. Avoid incorporation of air into the mix.
4. Vigorous figure-8 motion of Spatulation is best for thorough mixing.
5. A smooth creamy mix is formed.
6. Should not drip when spatula is raised from the bowl.
7. Mixing time → 45 sec – 1 min.
8. Setting time,
   - Fast setting 1.5 to 3 min.
   - Regular setting 3 to 4.5 min

ALGINATE IMPRESSION MATERIAL

PROPERTIES:

1. Easy to manipulate.
2. Comfortable to the patient.
3. Relatively inexpensive.
4. Requires inexpensive instruments for manipulation.

RANGE OF ALGINATE IMPRESSION MATERIAL

1. Fast setting alginate with colour change indicators. (CHROMOCLONE)
2. Dust free alginate. (Triethanolamine alginate, a salt of alginic acid)
3. Fluoride containing alginate. (0.44%–1.87% floride is added)
   - Produce firmer more definite set.
   - Surface condition of stone cast is improved.

NON AQUEOUS ELASTOMERS

- Also referred as **ELASTOMERIC IMPRESSION MATERIALS** or simply **ELASTOMERS.**
- Four types of synthetic elastomeric impression materials are available.

1. Polysulfides. (first of all synthetic elastomers, available in 1950)
2. Condensation silicones. (available in 1955)
3. Addition silicones. (available in 1975)
4. Polyethers. (available in 1965)

NON AQUEOUS ELASTOMERS

(COMPOSITION)

- **POLYSULPHIDE:**

BASE PASTE:

Polysulphide

Inert filler (titanium dioxide)

CATALYST PASTE:

Lead dioxide.

Sulphur.

Dibutyl or dioctyl phthalate.

NON AQUEOUS ELASTOMERS

POLYSULPHIDE

ADVANTAGES

- Viscoelastic.
- Lower cost.
- Long working time.
- Long shelf life.
- Good detail production.
- High tear strength.
- High flexibility.
  - elongation to break 500%.

DISADVANTAGES

- Poor dimensional stability.
  - Water by-product.
  - Pour within an hr.
  - Setting contraction 0.3%-0.4% in first 24 hrs.
- Custom trays.
- Lead allergy.
- Long setting time.
- Messy.
  - Paste-paste mix.
  - Bad colour.
  - May stain clothes.

NON AQUEOUS ELASTOMERS

(COMPOSITION)

- **CONDENSATION CURED SILICONE:**

BASE PASTE:

Silicone polymer with terminal OH group.

Inert fillers.

CATALYST PASTE:

Tetra-ethyl silicate (cross linking agent)

Stannous octoate (activator)

NON AQUEOUS ELASTOMERS

CONDENSATION SILICONES

ADVANTAGES

- Better dimensional stability than alginates.
- More elastic than polysulphides and Polyethers.
- Adequate tear strength.
- Adequate elongation to break.

DISADVANTAGES

- Poor dimensional stability.
  - 0.3% – 0.5 % shrinkage in 24 hrs.
- Hydrophobic.
- Limited shelf life.

NON AQUEOUS ELASTOMERS

(COMPOSITION)

POLYETHERS:

BASE PASTE:

- Polyether polymer.
- Fillers (silicates).
- Plasticizers (a glycol either high or low viscosity)
- Pigments.
- Flavorings.

CATALYST PASTE:

- Alkyl aromatic sulphonate.
- Fillers.
- Plasticizers.
- Pigments.

NON AQUEOUS ELASTOMERS

POLYETHERS

ADVANTAGES

- Reliable material.
- Good dimensional stability.
- Clean to handle.
- Odorless.

DISADVANTAGES

- Very stiff material.
- Due to high stiffness tearing on withdrawal.
- On prolonged contact with water, dimensional stability not good.
  - Immersion in disinfectants for 4 hrs should be avoided.

NON AQUEOUS ELASTOMERS

CALLAPSABLE

TUBES

CARTRIDRE

FORM

NON AQUEOUS ELASTOMERS

(Properties)

- SETTING PROPERTIES:

  In order to use the materials to their best advantage attention must be made to the proper mixing and insertion times.

NON AQUEOUS ELASTOMERS

(Properties)

- **VOSCOSITY:**
  - Viscosity increases with time.
  - Shearing force effects the viscosity in case of polyether and addition silicone impression materials. (shear thinning or pseudoplasticity)
  - With discontinuation of influence, the viscosity increases.
  - Pseudoplasticity is very important for monophase impression materials.

NON AQUEOUS ELASTOMERS

(Properties)

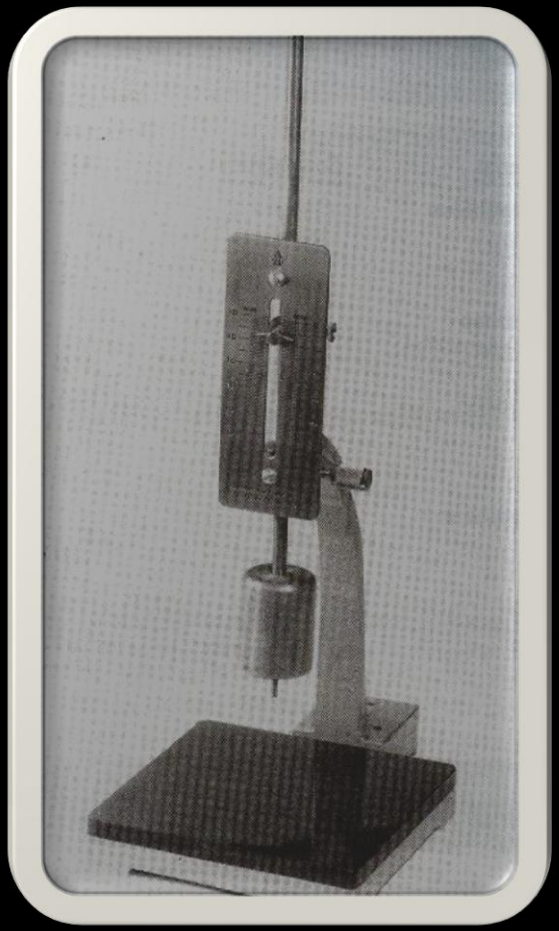
- **WORKING and SETTING TIMES:**
  - Working and setting time decrease as the viscosity increases.
  - The behavior of an elastomeric impression material to a clearly defined working time with a sharp transition into the setting phase is called ***Snap set*** (Polyethers)
  - Increase in temperature and humidity shorten the working and setting times.
  - Working and setting times can be accurately determined by PENETOMETER.

NON AQUEOUS ELASTOMERS

(Properties)

Vical penetometer

Used to determine the setting time of impression and other restorative materials.



NON AQUEOUS ELASTOMERS

(Properties)

- **DIMENSIONAL CHANGES DURING SETTING:**
  - Impression materials undergo dimensional change on setting.
  - Major factor for contraction is cross linking & rearrangement of bonds.
  - Impression materials can expand by water sorption.
  - All types undergo shrinkage due to polymerization.
  - Those with reaction by-products cause additional shrinkage.
  - Polysulphides and condensation silicones show largest dimensional change (0.4% – 0.6%).
  - Addition silicones have lowest change (0.15%) followed by polyethers (0.2%).

NON AQUEOUS ELASTOMERS

(Properties)

MECHANICAL PROPERTIES:

- **ELASTIC RECOVERY:**
  - Addition silicones have best elastic recovery.
  - Followed by condensation silicones.
  - Polyethers follow condensation silicones.
  - Polysulphides have least elastic recovery among all types of dental elastomers.

NON AQUEOUS ELASTOMERS

(Properties)

- **STRAIN IN COMPRESSION:**
  - In general low consistency materials are more flexible than high consistency elastomeric materials.
  - Polyethers are generally the stiffest.
  - Followed by addition silicones, condensation silicones and polysulphides.

NON AQUEOUS ELASTOMERS

(Properties)

- **FLOW:**
  - Flow is measured on a cylindrical specimen 1 hr old and a percent flow is determined 15 minutes after a load of 1N is applied.
  - Silicones and polyethers have lowest values of flow .
  - Followed by polysulphides.

NON AQUEOUS ELASTOMERS

(Properties)

- **HARDNESS:**
  - Hardness increases from low to high consistency.
  - Low, medium and high viscosity addition silicones and polysulphides do not change hardness significantly with time.
  - Hardness of condensation silicones, addition silicones putties and polyethers does increase with time.
  - Hardness and strain in compression affect the force required to remove the impression from the mouth.

NON AQUEOUS ELASTOMERS

(Properties)

- **CREEP COMPLIANCE:**
  - Elastomers are viscoelastic.
  - Mechanical properties are time dependent.
  - Higher the rate of deformation higher the tear strength.
  - Higher the permanent deformation, longer the impression materials are deformed.
  - Additional silicones have lowest viscoelastic quality and requires less time to recover viscoelastic deformation.
  - Followed by polyether, condensation silicone and polysulphide.

COMPARISON OF PROPERTIES

- **WORKING TIME:**
  - Longest to shortest.
    - Agar > Polysulphide > Silicones > Alginate > Polyether.
- **SETTING TIME:**
  - Shortest to longest.
    - Alginate < Polyether < Agar < Silicones < Polysulphide.
- **STIFFNESS:**
  - Most to least.
    - Polyethers > Addition silicone > Condensation silicone > Polysulphide > Hydrocolloids.
- **TEAR STRENGTH:**
  - Greatest to least.
    - Polysulphide > Addition silicone > Polyether > Condensation silicone > Hydrocolloids.

COMPARISON OF PROPERTIES

- **DIMENSIONAL STABILITY:**
  - Best to worst.
    - Addition silicone > Polyether > Polysulphide > Condensation silicone > Hydrocolloids.
- **COST:**
  - Lowest to highest.
    - Alginate < Agar < Polysulphide < Condensation silicone < Addition silicone < Polyether.
- **WETTABILITY:**
  - Best to worst.
    - Hydrocolloids > Polyether > Hydrophobic addition silicone > Polysulphide > Hydrophobic condensation silicone.

CROSS INFECTION CONTROL

- Important to disinfect the impression before sending it to Laboratory for making models / prosthesis or appliances.
- Important for the protection of Laboratory staff from the transmission of infection from the patient.
- Properties of impression materials need to be considered before disinfecting.

CROSS INFECTION CONTROL

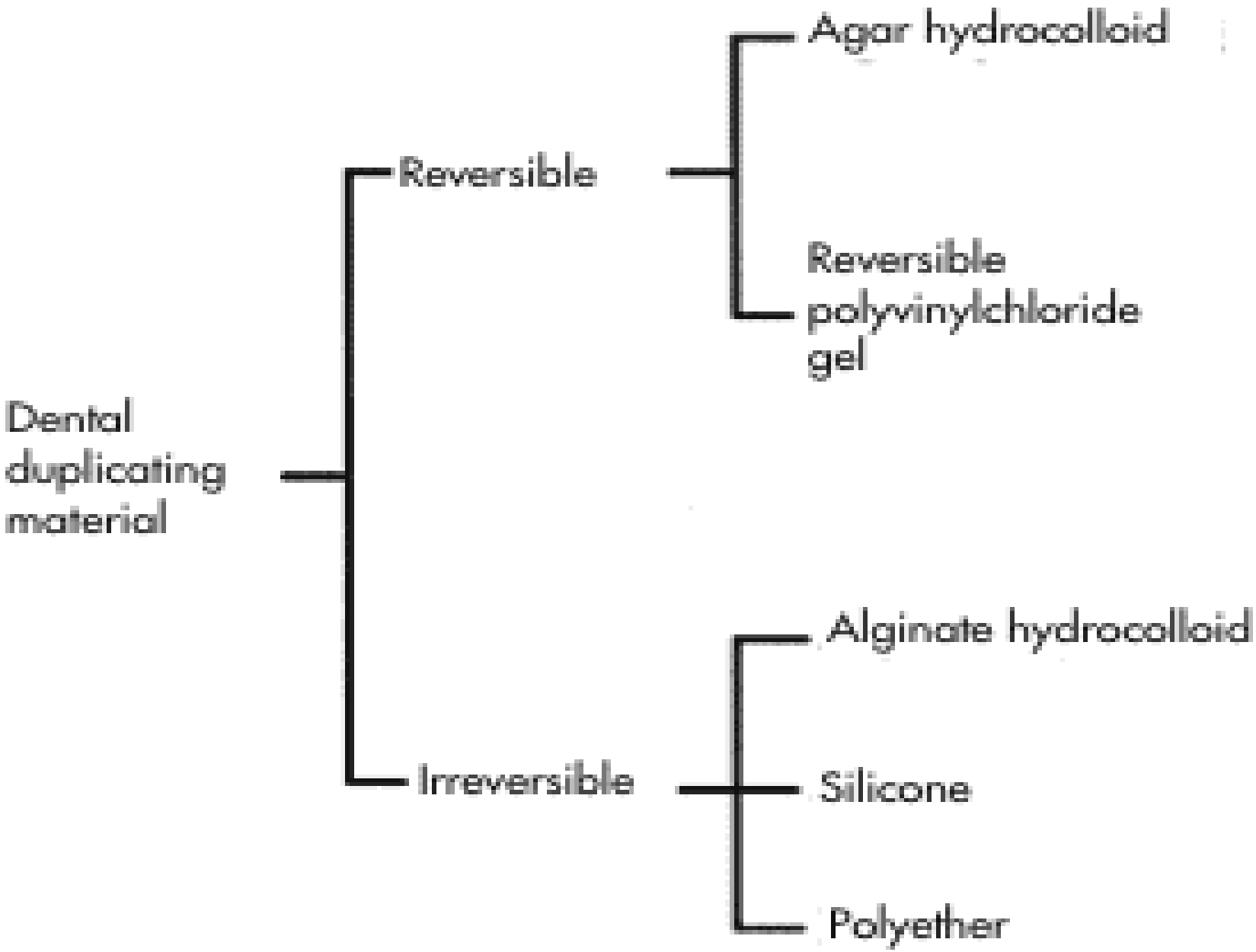
Materials	Methods	Disinfectant	Comments
Alginate	Immersion<10 min (short exposure time)	■Chlorine compounds. ■Iodophores.	Short term gluteraldehyde has been shown to be acceptable but the time is inadequate for disinfection.
Agar			Do not immerse in alkaline gluteraldehyde.
Polysulphide Silicones	Immersion	■Gluteraldehyde ■Chlorine compounds. ■Iodophores. ■Phenols.	Disinfectants requiring > 30 min are not recommended.

CROSS INFECTION CONTROL

Materials	Method	Disinfectant	Comment
Polyether	Immerse with caution, less than 10 min.	▪Chlorine compounds. ▪Iodophores.	ADA recommends any of disinfectant classes, however short term exposures are recommended to avoid distortion.
ZOE impression pastes	Immersion preferred but spraying can be used or bite registration.	▪Gluteraldehyde. ▪Iodophores.	Not compatible with chlorine compounds. Phenolic sprays can be used.
Impression compounds	Same as above.	▪Chlorine compounds. ▪Iodophores.	Phenolic sprays can be used.

LAMINATE TECHNIQUE (Alginate–Agar method)

- Recent modification.
- Combining alginate & agar technique.
- Hydrocolloid in tray is replaced by chilled alginate and agar is added through a syringe.
- Alginate gels by chemical reaction, whereas agar gels on contact with chilled alginate.
- Agar is in contact with prepared teeth.
- Disadvantage is that the bond is not sound between agar and alginate.


Dental duplicating material
Reversible
Agar hydrocolloid
Reversible polyvinylchloride gel
Irreversible
Alginate hydrocolloid
Silicone
Polyether

DUPLICATING MATERIALS

- Both types of hydrocolloids are used in dental lab to duplicate dental cast or models.
- Reversible hydrocolloids are more popular as it can be used many times and can be stored in liquid form for 1 or 2 weeks. Disadvantages are same as agar impression material.
- These duplicating materials have the same composition as impression materials but water content is high and agar and alginate contents are lower.
- Silicones and polyethers are examples of irreversible non aqueous types for duplicating materials. Their cost and techniques for taking an impression are the main disadvantages.

THANKYOU

QUESTIONS???