Dental Material

Gypsum Material

Lecturer :
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The Science of Dental Material: Is that part of the physical sciences that request to explain the properties and performance of materials by examining their internal structure.

Biomaterials: Are man-made materials used to replace tissues or functions in intimate contact with living tissues.

Dental Materials : Are biomaterials used in or around the oral cavity.

The object is to understand why materials behave the way they do and what the clinician can do to maximize the performance of these materials.

Classification of dental materials:

1. Restorative materials: Used to replace lost oral tissues. These include filling and crowns, dentures, and maxillofacial prosthesis.

2. Impression Casts and Models: Used to produce replica for oral tissues.

3. Cements: Include -**Luting agent**: Used to paste crowns and bridges. -**Bases and Liners:** isolating layer under the restoration.

4. Temporary Materials: Used for a limited period of time like temporary crowns and temporary restorations

Introduction

5. Preventive Materials: Used to prevent decay or trauma like pit and fissure drop-out, mouth guards, fluoride trays.

6. Polishing Materials: Used to remove a thin layer of the restoration surface or remove plaque from natural teeth.

7. Implants: Specialized materials used to replace the root portion of lost teeth

8. Specialty Materials: Are unique to sure field of dentistry like sutures in oral surgery and rubber bands in orthodontics.

Gypsum Material

- Products of gypsum are used extensively in dentistry.
- Gypsum was found in mines around the city of Paris, so it is also called plaster of Paris. This is a misnomer as gypsum is found in most countries.
- The mineral gypsum $CaSO_4.2H_2O$
- is usually white to yellowish white in color and is found as a compact mass.

Composition

Gypsum → Gypsum product + water

$$2CASO_4 \cdot 2H_2O \rightarrow (CaSO_4)_2 \cdot H_2O + 3H_2O$$

Calcium sulphate dihydrate

Calcium sulphate hemihydrate

Gypsum Material

CLASSIFICATION

- Type 1 — Dental plaster, impression
- Type 2 — Dental plaster, model
- Type 3 — Dental stone, model
- Type 4 — Dental stone, die, high strength, low expansion
- Type 5 — Dental stone, die, high strength, high expansion

- Figures 2. A to E: The 5 types of gypsum products in dentistry. (A) Type 1—Impression plaster, (B) Type 2—Dental plaster, (C) Type 3—Dental stone, (D) Type 4—Die stone, High strength low expansion, (E) Type 5—Die stone, high strength, high expansion.

TYPE 1 OR DENTAL PLASTER, IMPRESSION

- Impression plaster was one of the earliest impression materials in dentistry. Because of its rigidity (not elastic), it often had to be fractured to remove it from undercut areas in the mouth.

- USES

1. For making impressions in complete denture and maxillofacial prosthetics (not used currently for this purpose).

2. Bite registration material.

Impression plaster

COMPOSITION

Dental plaster + K_2SO_4 + Borax + Coloring and flavoring agents.

TYPE 1 OR DENTAL PLASTER, IMPRESSION

IDEAL-PROPERTIES

- 1. The setting time should be under accurate control. The setting time desirable is 3 to 5 minutes.

- 2. For better accuracy the setting expansion should be low. Both setting time and expansion are controlled by modifiers (accelerators and retarders) added by the manufacturers.

- 3. The plaster should have enough strength to fracture cleanly without crumbling to facilitate removal from undercuts.

TYPE 2 OR DENTAL PLASTER, MODEL

COMPOSITION

Contains beta hemihydrate and modifiers.

USES

1. For making study casts (laboratory) and models.
2. To make molds for curing dentures.
3. . For mounting casts on articulator.

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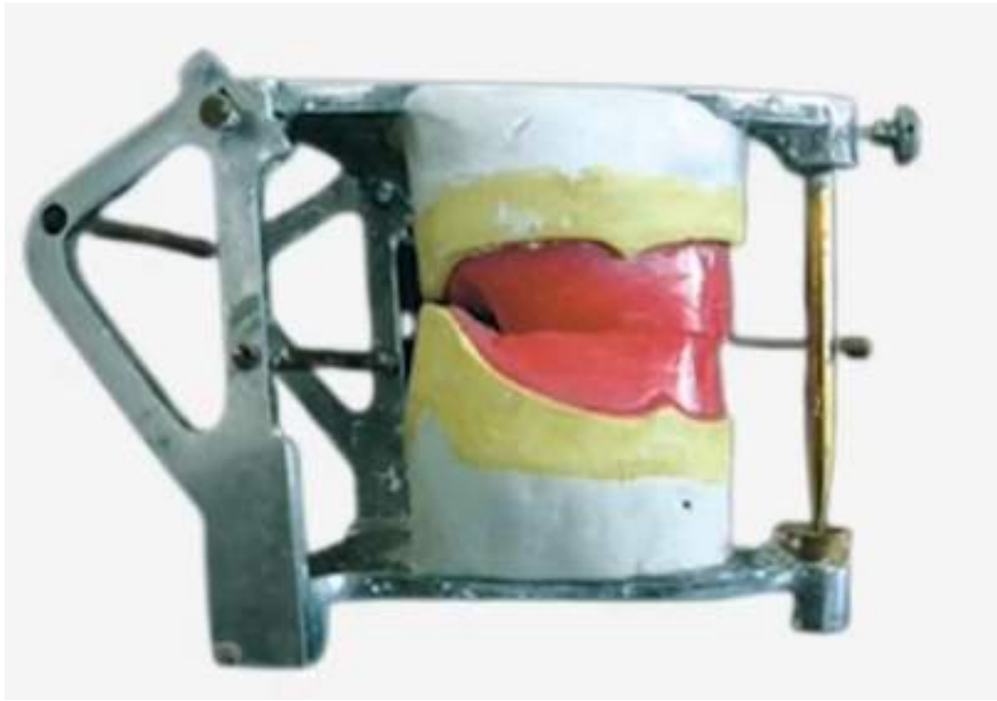

TYPE 2 OR DENTAL PLASTER, MODEL

- REQUIREMENTS OF AN IDEAL CAST

1. It should set rapidly but give adequate time for manipulation.
2. It should set to a very hard and strong mass.
3. It should flow into all parts of the impression and reproduce all the minute details.

4. It should not contract or expand while setting.
5. After setting it should not warp or change shape.
6. It should not lose its strength when subjected to moulding and curing procedures

TYPE 3 OR DENTAL STONE, MODEL

- **USES**

For preparing master casts and to make molds.

- COMPOSITION
- Alphahemihydrate
- 2 to 3% coloring matter • K2SO4—Accelerator
- Borax—Retarder
- Some commercial dental stones contain a small amount of beta hemihydrate to provide a mix of smoother consistency.

Synonym: Class I stone or Hydrocal

TYPE 4 OR DENTAL STONE, DIE, HIGH STRENGTH, LOW EXPANSION

Synonyms: Class II stone, die stone, densite, improved stone.

USES

1. Die stone is the strongest and hardest variety of gypsum product

2. It is used when high strength and surface hardness is required, e.g., dies used for inlay, crown and bridge wax patterns.

TYPE 5 OR DENTAL STONE, DIE, HIGH STRENGTH, HIGH EXPANSION

It is the most recent gypsum product having a higher compressive strength than Type 4 stone.

USES

- To prepare dies with increased expansion.

Thank you 🦋

Dental Material

Gypsum Material

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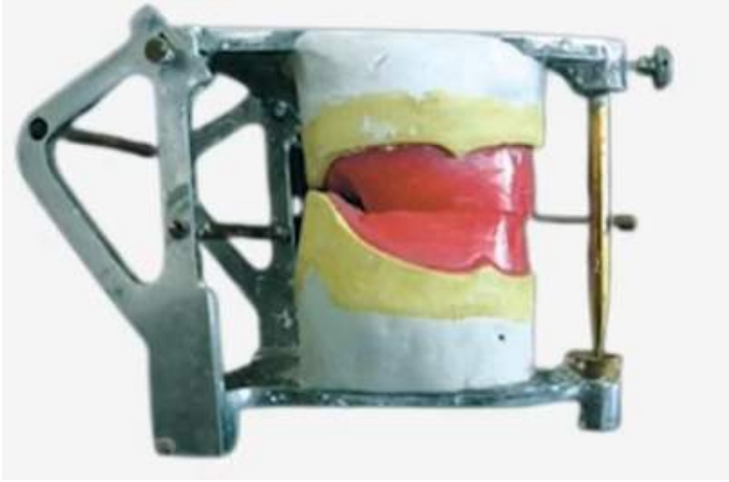
Application of gypsum in dentistry:

1- Impression plaster.

2- Mounting the casts to the articulation.



3- Form casts and dies.

4- Used as a binder for silica.

5- Used as a mold for processing dental polymers.

6- Used for bite registration (record centric jaw relation).

Manufacture of gypsum products :-

Gypsum products are produced by partial dehydration of mineral gypsum, which is calcium sulfate di-hydrate ($CaSO_4.2H_2O$). They are supplied as powder when mixed with water they form slurry or paste, which set to form a rigid mass.

1- Plasters are produced when the gypsum mineral is heated in an open kettle at a temperature of about 110° to 120°C (dry calcination). The hemihydrate produced is called Beta-calcium sulfate hemihydrate. Such a powder is known to have a somewhat irregular shape and is porous in nature. These plasters are used in formulating model and lab plasters.

2- Chemically stone is the same as plaster that is $CaSO_4.½H_2O$ but it is made by heating gypsum in wet condition under super heat steam to 125°C (wet calcination). the crystals are dense and regular and have prismatic shape, they are called Alpha - calcium sulfate hemihydrate.

SETTING REACTION

When mixing any type of gypsum product (plaster, stone or die stone) with water, they are converted back to gypsum and set to a hard mass. The probable sequence is as following:

A- plaster, stone or die stone ($CaSO_4.\frac{1}{2}H_2O$) dissolve in water.

B-it is react with the water to form gypsum ($CaSO_4.2H_2O$).

C- gypsum is less soluble in water and the solution becomes super- saturated (unstable).

D- gypsum crystallizes, allowing more particle to dissolve and to form gypsum. This will continue until all particles have been converted to gypsum($CaSO_4.2H_2O$).

During this process part of the gypsum form a gel, which act as a cementing medium between the crystals. Then the rigid mass is formed by the interlocking network formed by the long needle- like gypsum crystals.

SETTING TIME

Is the time from the beginning of mixing the powder with water until the material hardens.

The time may be measured by GILMOR DEEDLE APPARATUS or by VICAT APPARATUS in which needle of different weight and thickness is used, penetration of these needles being measured at various times during setting.

FACTORS AFFECTING THE SETTING TIME:

1-W/P ratio :- The more water is used for mixing, the fewer the nuclei there will be per unit volume, and consequently the setting time will be prolonged.

2-FINESS:- The finer the particle size of the hemihydrate, the faster the mix will harden. The rate of the solution of the hemihydrate will be increased.

3- MIXING:- The longer and more rapidly the plaster is mixed, the shorter is the setting time. When powder is drought into contact with the water some gypsum crystals will be formed. As mixing begins, more particles will be exposed to water and thus form more crystals at the same time the crystals are broken up by mixing and they are distributed thought the mixture and result in the formation of more nuclei for crystallization thus the setting time is decreased.

4-TEMRATUR:- There is little change in the setting time between 0 – 50 °C but if the temperature exceeds 50 °C the setting time will be retarded. As the temperature approaches 100°C no setting will take place.

5-IMPURITIES:- If the manufacture adds gypsum, the setting time will be shortened because of the increase in the potential nuclei for crystallization.

6-RETRADERS & ACCELERAROTS:- The addition of retarders and accelerators are the most effective and practical way to control the setting time. Retarder is the chemical material added to the gypsum product to increase the setting time. It will reduce the dissolution of the hemihydrates and might deposit on the nuclei of crystallization and effectively reduce the rate of crystallization and so retard setting time. Accelerator is the chemical material added to the gypsum product to decrease the setting time.


Mixing Plaster
Mixing Gypsum
Pouring Models
Mixing Gypsum

1.Physical Properties

1)**Density:** lightness is nearly always an advantage in restorative materials in order to control its mobility.

2)**Hardness:** Hardness is the resistance of a material to localized plastic deformation.

3)**Solubility:** is the ability of a substance, the solute, to form a solution with another substance, the solvent.

4)**Color:** the dental restorative materials should be translucent in order to look like a natural teeth.

5)**Dimentional stability:** many material change shapes when they set or harden (should not change dimensions when set).

6) Abrasion Resisitance: ability to withstand the wear and tear of friction caused by mechanical parts and instances of repetitive scraping or rubbing. Restorations must be hard enough to resist abrasion, but not so hard to wear away the opposing teeth.

7**) Adhesion:** The force of attraction between the molecules/atoms of two different surfaces as they are brought into contact.

2. **Biological Properties**

1)Non toxic
2)Non irritant
3)Not produce allergic reactions.

3. Thermal Properties

a)Thermal coefficient of thermal expansion: the changes measured by the linear coefficient of thermal expansion and contraction which is the change in length per unit length for 1°C temperature change.

b)Thermal conductivity: is the physical property that deals with heat transfer through a material by conductive flow.

c)Boiling & melting points: Any material has its certain and specific boiling and melting points. Some materials do not boil or melt, but decompose if heated sufficiently, like wood.

4. Mechanical Properties:

One of the most important properties of dental material is the ability to withstand the various mechanical forces placed on them.

a)Strength: is the measure of the resistance of the material to the externally applied forces.

b)Stress: is the force per unit area induced in a body in response to some externally applied force. It is force / area measured in Kg/ cm^2 or Pound/ $inch^2$ or Pascal.

c)Strain: is the change in dimension per unit dimension caused by externally applied forces. It is a unit less quantity.

Strain = final length - original length / original length x Percentage of elongation

strain x 100%

Thank you 🦋

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DENTAL MATERIALS

METAL ALLOYS USED FOR FABRICATION METAL CERAMIC RESTORATION

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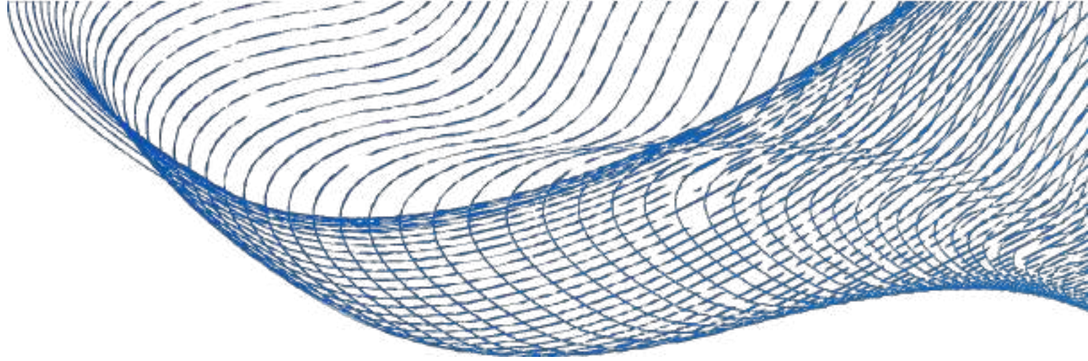
METAL ALLOYS



Alloy : Is a mixture of two or more metallic element .

Alloy must not contain any elements likely to discolor the ceramic during firing ,

The hardness and strength of the metal must be high to form a strong , rigid support for the ceramic .

CLASSIFICATION

There are three common classification systems used to classify metal alloys for fabricating metal ceramic restorations

,They are based on either :

1.Noble metal content (Noble metal ,high noble metal ,base metal).

2. Cost

3. Physical properties (density ,hardness and color)

NOBLE METAL ALLOYS :

1- Palladium - silver Alloy:

These alloys contain(53% palladium , 28% silver) and lower percentage of base metals for hardening

The main problem with their use is a green discoloration of ceramic by silver contamination .

2- palladium - copper :

These alloys contain between 74% pd , 15% Cu .
Palladium - copper alloys offer two differences to the Palladium silver alloys :

1- Do not produce greening , which is caused by silver .

2.They tend to sag more at ceramic firing temperatures , therefore they are not recommended for long span bridge work

3. Palladium - Gallium.Silver Alloys :

These alloys are the most recent of the noble metals , they are

. thermally compatible with lower expansion ceramic

High NOBLE METAL ALLOYS :

1- Gold - Platinum Palladium Alloys

Advantage :

1.These alloys are thermally compatible with most ceramic.

2.excellent adherence to ceramic .

Disadvantage :

1- Poor sag resistance at ceramic firing temperatures , makes them suited for single units only .

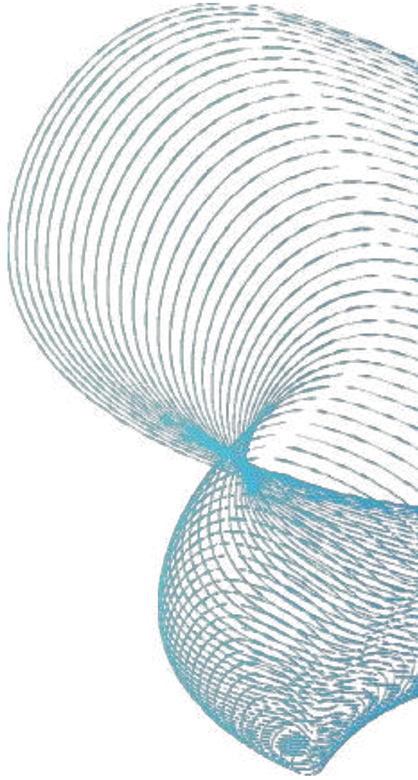
2- High cost .

2-Gold - palladium - silver Alloy (High silver content)

These alloys are white in colored

Because of the addition of higher palladium concentration ,

the melting ranges are rised , thus improved resistance to deformation at elevated temperatures



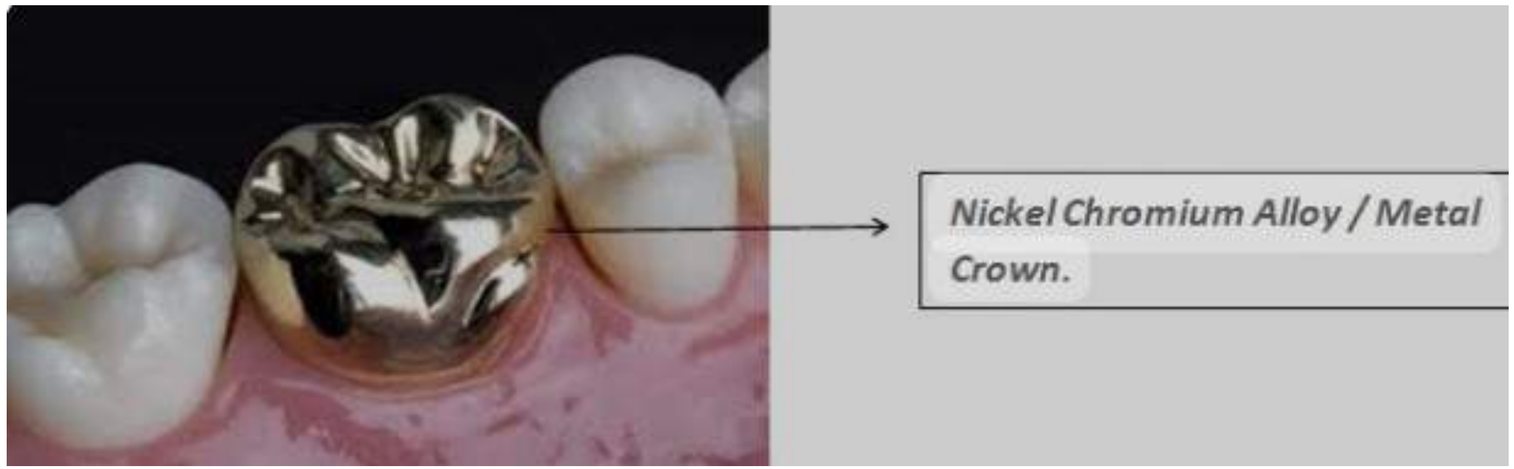
BASE METAL ALLOYS :

1- Nickel chromium Alloys (Ni-Cr) :

Typically containing 70-80% Nickel , 10-25% Chromium with small quantities of other metals .

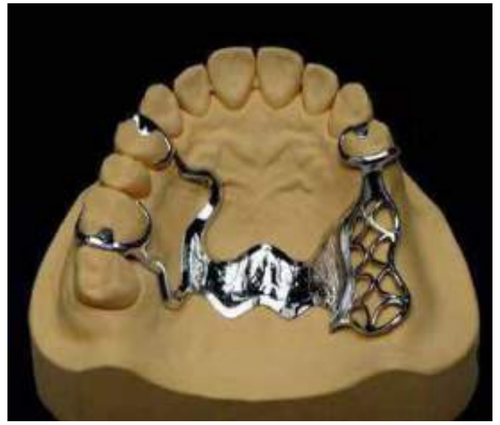
These alloy have the advantage of a very high melting temperature

Their disadvantage are a high casting shrinkage.



2- cobalt- Chromium Alloys :

the chromium content is generally about 25% by weight and perhaps as a result, these alloys have been found to have better corrosion resistance than Ni-based alloys. The main difference between cobalt alloys used for fabricating partial denture prostheses and those used for ceramic metal restoration is their carbon content.



3- **Titanium Alloys** : Titanium is used in a variety of fields because of its excellent properties, which include physical or mechanical characteristic such as, a high strength, high heat resistance and chemical properties such as corrosion resistance.

Used in fixed prosthodontics

Thank you 🦋

Dental Material

Wax Dental Materials

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Wax

- Waxes are thermoplastic materials which are normally solid at room temperature but melt without decomposition when heated to form liquid material.

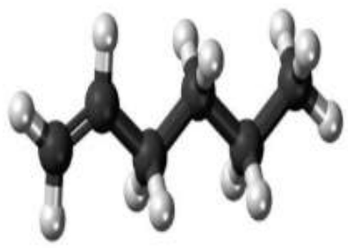
- Waxes are, essentially, soft substances with poor mechanical properties.

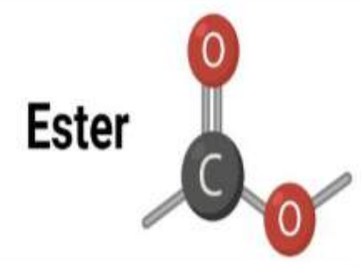
- Wax are used to fabricate the artificial parts of soft and hard tissues of the oral cavity

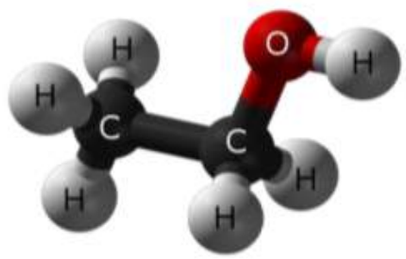
Composition of Wax

- Waxes are composed of long-chain hydrocarbons, which are molecules made up of carbon and hydrogen atoms. In addition to hydrocarbons, waxes can contain various functional groups, such as esters, alcohols, and acids. These functional groups provide specific properties to different types of wax.

- The waxes that used in dentistry normally consist of two or more components which may be natural or synthetic waxes, resins, oils, fats and pigments.







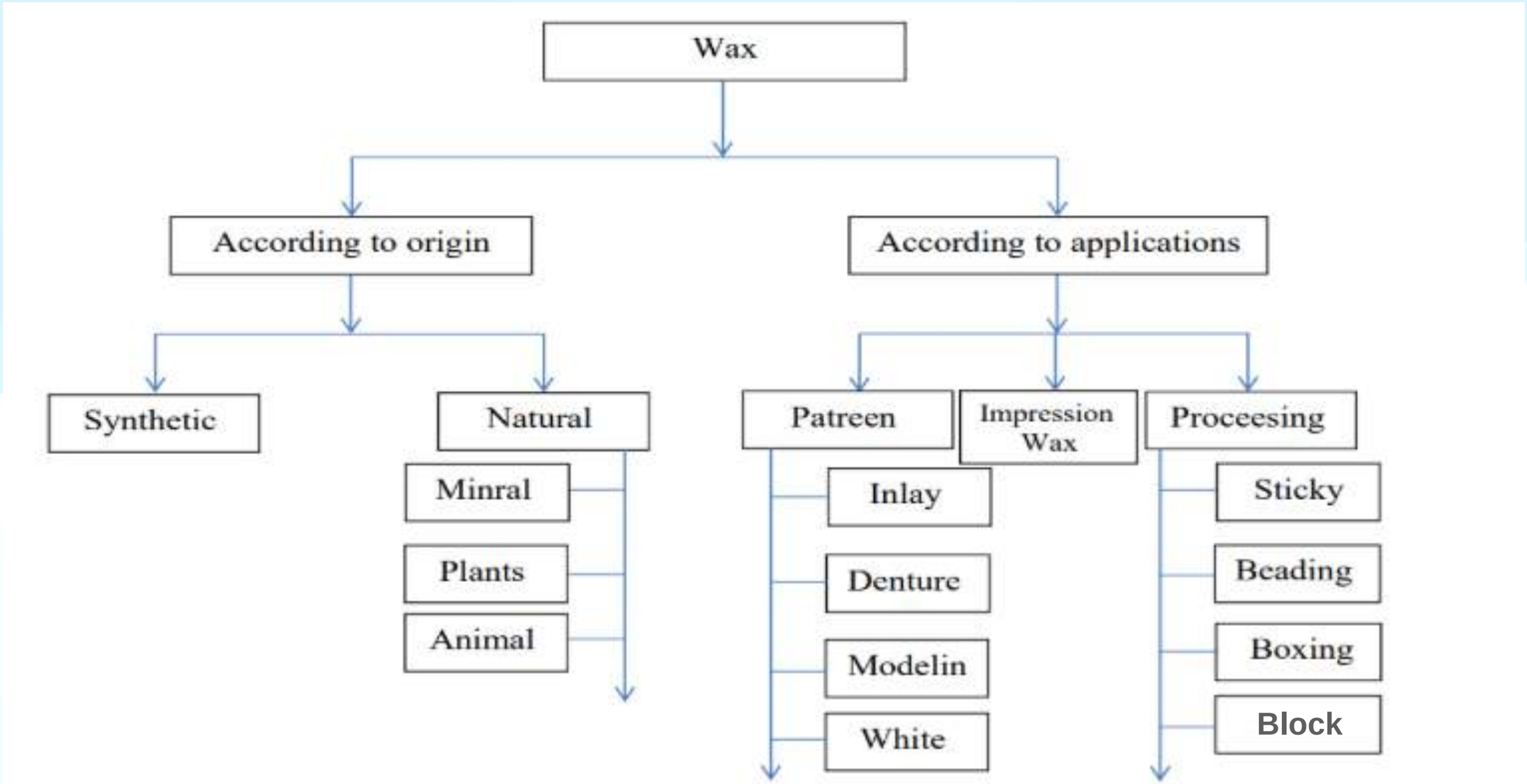
Properties of dental waxes

1. Should have enough flow when melted to produce the fine details.
2. No dimensional change should takes place once it's formed.
3. Wax should burnout completely without any residue.
4. Easily carved and smooth surface can be produce.
5. Wax should show less distortion.
6. They are thermoplastic materials.
7. High coefficient of thermal expansion and contraction it is the highest of dental materials. Shrinkage of wax from liquid to solid at room temperature is 0.4%

Properties of dental waxes

8. Poor thermal conductivity after softening of the wax it is allowed to cool, which is accompanied by contraction.
9. Flow: should have high flow when softened but should have little or no flow at room temperature or mouth temperature in order not to distort.
10. Brittleness: inlay wax should be brittle in order to fracture rather than distort when removed from undercut of the cavity.

Classification of Wax Materials



Classification of Wax Materials

According to their origin: (Synthetic , Natural)

1. Synthetic wax is a man-made wax synthesized from appropriate monomers. For example, polyethylene waxes. The synthetic waxes have specific melting points and are blended with natural waxes.

Classification of Wax Materials

2. Natural Wax (Minral , Plants , Animal)

-Mineral

1- Paraffin wax refined from crude oil, has relatively low melting point (50-70°C) and relatively brittle.

2- Ceresin wax refined from petroleum, has medium melting range (60°C). Less brittle than paraffin wax and less volumetric change.

Classification of Wax Materials

-Plants

1- Carnauba wax Obtained from carnauba palm trees, it is hard, tough, and has high melting point (80-85°C).

2- Candelilla wax It is hard, tough, and melting temperature: 68–75°C . Added to harden paraffin waxes

-ANIMAL

1- Stearin wax Obtained from animal fat, has low melting point 50°C.

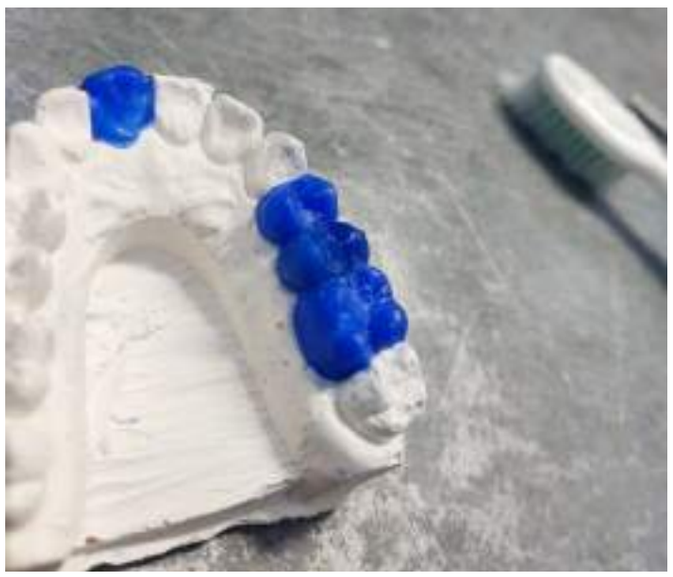
2- Bees wax Obtained from honey-comb, consist of partially crystalline natural polyester. It is brittle, has medium melting temperature (60-70°C).

Classification of Wax Materials

2- Classification of waxes according to the their Application in Dentistry

1. **Pattern wax divided into: (Inlay ,Denture , Modelin ,White)**

- **Inlay wax:** Should be hard and brittle in order to fracture rather than to distort when removed from undercut areas. The wax is mostly blue in color. They are used to make inlays crowns and pointic replicas. They are mostly paraffin with carnauba wax.



Classification of Wax Materials

-**Denture casting wax:** used to produce the metal components of cobalt – chromium partial denture. It is based on paraffin wax with bees wax to give softness necessary for molding and stickiness necessary to ensure adhering to an investment material. It is mostly green sheet.

Classification of Wax Materials

- Modelling waxes (Denture base plate wax, sheet wax) It is used to form the base of the denture. Modeling waxes consist mainly of mixtures of paraffin wax and bees wax and have melting points in the range 49–58ºC. They are generally supplied in pink sheet form. Modeling waxes are tough enough to resist fracture when withdrawn from shallow undercuts.

-White wax use to make pattern similar to veneer facing in crowns.

Classification of Wax Materials

1-**Processing wax** used during processing of the appliance like (Beading ,Boxing, Sticky, Block)

Block wax Used to block – out undercut areas on cast during processing of Co/Cr metal frame work.

Classification of Wax Materials

Beading wax used to make beading around the impression before pouring gypsum to protect the margins

Boxing wax used to make box around the impression to make pouring gypsum into the impression easier and more perfect.

Classification of Wax Materials

Sticky wax used for joining two components of an appliance and join the broken pieces of the denture before repair.

Classification of Wax Materials

Impression wax: They are used to make impression but distort when removed from undercut, they have high flow.

1- Impression wax used to make the impression.
2- Corrective wax used to record selected areas of soft tissues in edentulous arches

Wax Distortion

Wax Distortion is one of the most serious problems faced when forming the pattern and removing it from the mouth or die.

Reasons for wax Distortion

1. **Thermal changes**: using of the wax at not uniform temperature makes some parts of the wax thermally contract more than others when stresses are introduced.
2. **Releasing of internal stresses**: The stresses are induced from the natural tendency of the wax to contract on cooling, from occluded gas bubbles, change of shape during moulding and due to carving, etc.
3. **Distortion** may also take place due to flow of wax under its own weight particularly at a higher temperature during cooling.

The Future
depends on
What you do today 🦋

Dental Material

Polymer Materials

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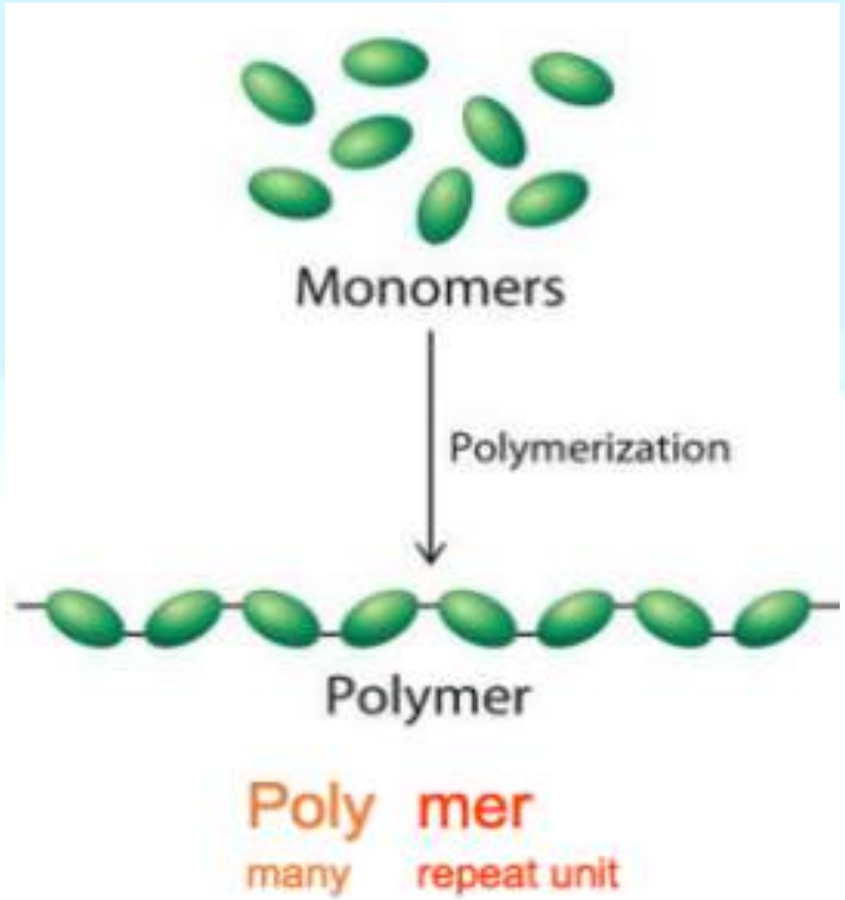
Polymer

Polymer: is a chemical compound consists of a **large organic molecule** formed by the union of many smaller repeating units (mers).

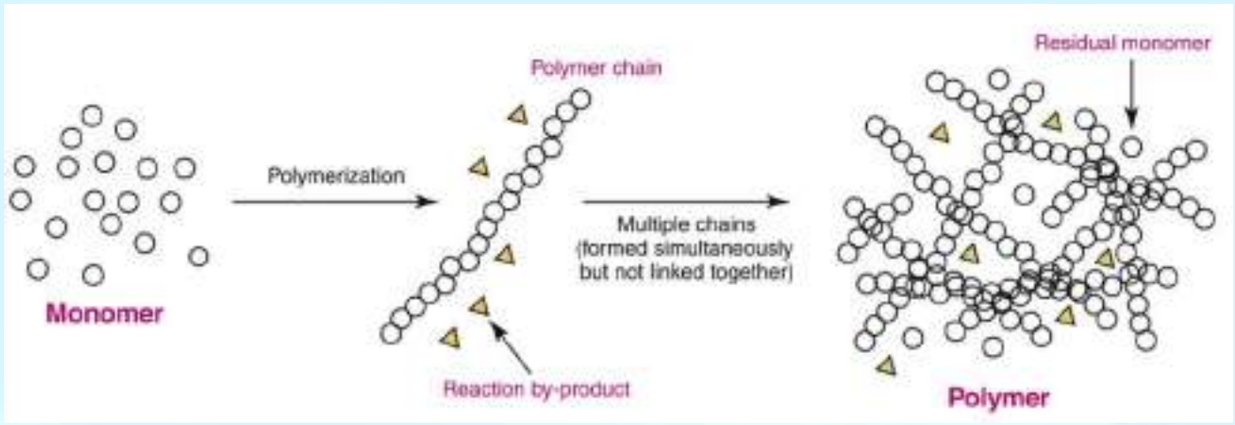


- **Monomer**: it is a **single molecule** from which the polymer is constructed. It is a chemical compound that is capable of reacting to form a polymer.

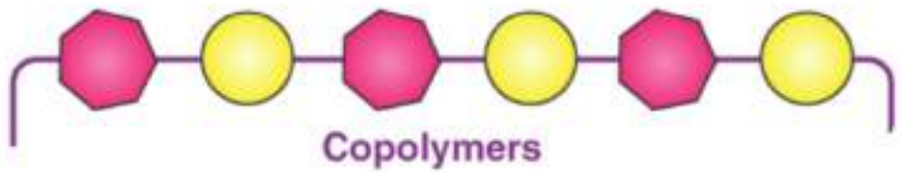
Mer: the repeating units in a polymer chain

Polymer

Polymerization: Chemical reaction in which monomers of a low molecular weight are converted into chains of polymers with a high molecular weight. The polymerization is exothermic reaction.



Copolymers: Polymer made of **two or more** monomer species. **Copolymerization** is used to improve the physical properties of resin.



Polymer

Degree of polymerization (D.P): is defined by the total number of repeated units in the chain of the polymer. The **higher** the degree of polymerization, the **better** will be the physical properties

Glass transition temperature (Tg): It is the temperature when the polymers leave the rigid phase and turn into rubber phase.

Polymer

Factor control polymer properties:

1- Chemical composition of the polymer

2. Topology of polymer chain

3. Monomer distribution in the polymer chain

4- Polymer molecular weight (MW)

5. Supra molecular structure (molecular organization).

Factor control polymer properties

1- **Chemical composition of the polymer:** This depends on types of monomers and its structure. e.g.

CH2—CH---R vinyl polymer

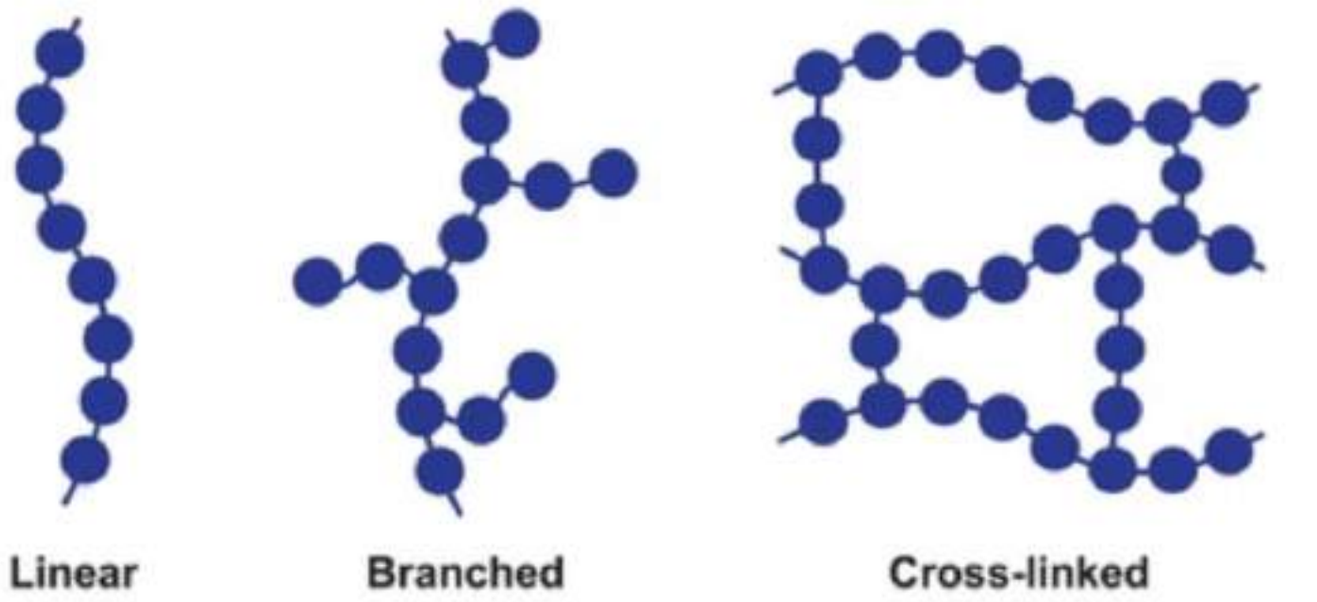
when R=H (polyethylene), the repeating unit is CH2 group. The polymer is **hydrophobic**.

But when R=OH (polyvinyl alcohol), the polymer is **hydrophilic**.

Factor control polymer properties

2. **Topology of polymer chain:**

- Linear polymer.
- Non-linear (branched) polymer.
- crosslinked polymer (polymer network): the crosslinking restricts the motion of the chains and improve rigidity of polymer.



Factor control polymer properties

3. **Monomer distribution in the polymer chain:**

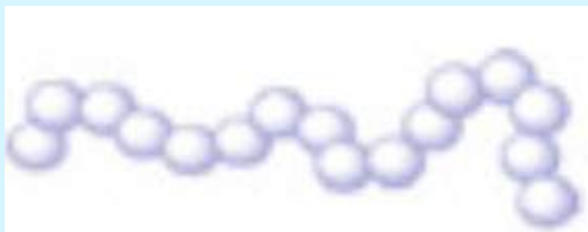
A.Homopolymers: one type of monomer (linear or branched).
B.Copolymers: 2 or 3 types of monomers. it is ether:

.**Random copolymer**: No sequential order exists among the two or more mer units along the polymer chain.

- **Block copolymer**: Identical monomer units occur in long sequences (blocks) along the main polymer chain.

- **Alternating copolymer**

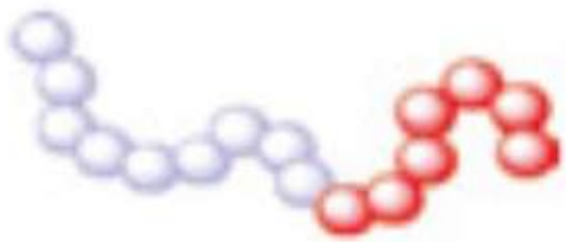
- **Grafted or branched copolymer:** sequences of one type of mer unit grafted onto a backbone chain of mer unit to form branched configiration.



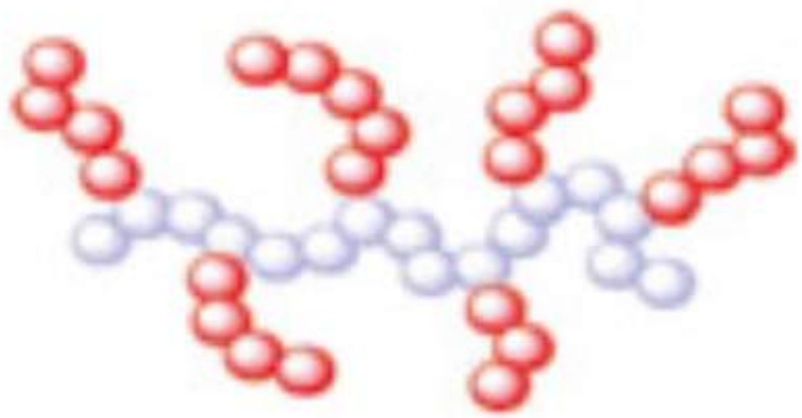
Homopolymer

Random/statistical copolymer

Alternating/periodic copolymer



Block copolymer



Graft copolymer

Factor control polymer properties

4-Polymer molecular weight (MW)

Mw of polymer molecules = the Mw of the mers x number of mers
Mw may range from thousand to millions of molecular weight units depending on preparation conditions.

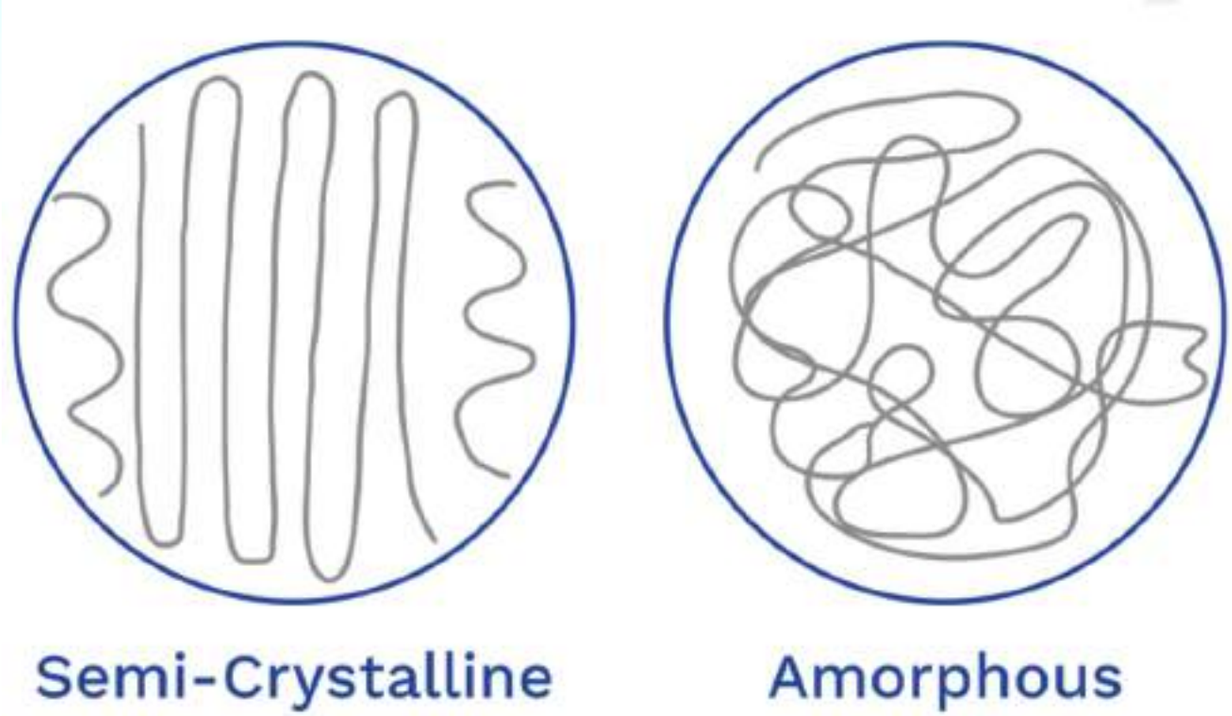
Mw of polymers plays an important role in determining its physical Properties:

1.The higher the Mw the higher the softening and melting point and the stiffer the plastic.
2. The higher the Mw of polymer made from a single monomer, the higher the degree of polymerization.
3.The strength of the resin increases with the increasing of the degree of polymerization.

Factor control polymer properties

5-Supra molecular structure (molecular organization).

1. Amorphous polymers (coiled irregular) random Shape of polymer chains.
2. Semi crystalline polymer: regular (crystalline) structure acting as special type of cross-links.



Application of polymers in dentistry:

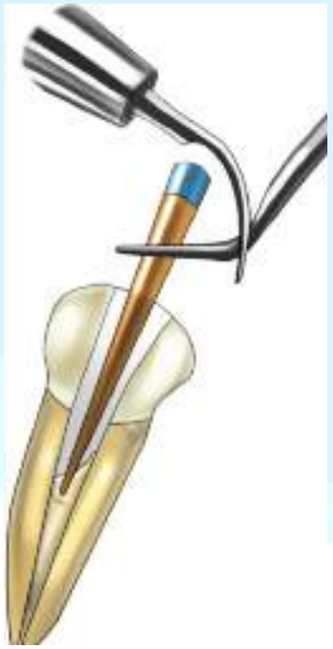
1. **Prosthodontics**: denture bases, denture teeth, soft liners, custom trays, impression materials, cementing materials, maxillofacial prostheses.

2. **Operative Dentistry**: dentin bonding agents, cavity fillings, resin and glass-ionomer cements, veneers.

3. **Orthodontics**: brackets, bracket bonding resins, cements, and spacers.

Application of polymers in dentistry:

4-**Endodontics**: gutta-percha points, root canal sealants, and rubber dams.



5. **Equipment**: mixing bowls, mouth guards, protective eyewear

Types of polymerization reaction

Condensation polymerization: The condensation reaction progress by the same mechanism as chemical reaction between two or more simple molecules. The reaction produces byproducts such as water, halogen acids and ammonia or alcohol.

Addition polymerization: most dental resins are polymerized by additional polymerization which involves the joining of monomer molecules to form polymers chain. In this type of reaction, **no byproduct** is obtained. It's formed from smaller units or monomers without change in composition, the monomer must have an unsaturated group in its structural formula for covalent bond with another molecule.

The additional reaction take place in 3 stages:

1.Induction stage
2.Propagation stage
3.Termination stage

Induction stage: Two processes control the induction stage (activation and initiation). For an addition polymerization process to begin, a source of free radicals (R•) is required. Free radicals can be generated by the activation of radical-producing molecules like **heat**, **visible light** and **chemical agents**.

Free radicals: are very reactive chemical species that have unpaired electron. The free radicals are produced by reactive agents called initiators. The free radical reacts with a monomer and initiates the polymerization process.

Initiators: are molecules which contain one relatively weak bond which is able to undergo decomposition to form two reactive species (free radicals). The decomposition of bond of initiator needs source of energy (activator) such as heat, light and chemical activator. Initiator which is used in dental polymers is Benzoyl peroxide.

The initiation reaction is an addition reaction producing another active radical species which is capable of further reaction (addition of free radical on the double bond of monomer).

The initiation period depends on **the purity of the monomer and the temperature of the reaction**. Any impurities present that are able to react with activated groups can increase the length of the induction period.

The higher temperature, the more rapid formation of free radicals and the shorter the induction period.

2. Propagation stage: The initiation stage is followed by the rapid addition of other monomer molecules to the free radical and shifting of free electron to the end of growing chain, this called propagation stage.

3-**Termination stage:** The growing chain is stopped.

Termination occurs when monomer units are used up or free radical is finished by reaction. Chain reaction can be terminated either by reaction of two growing chains to form one dead chain or by reaction of growing chains with molecules of initiation, dead polymer, impurity or solvent if present.

Inhibitor: it is chemical material added to prevent or delay polymerization during storage and to provide enough working time and decrease sensitivity to ambient light like hydroquinone.

The following factors inhibit the polymerization:

1. Any impurity in the monomer that can react with free radicals or with any activated growing chain.
2. The addition of hydroquinone to the monomer.
3. Oxygen also causes retardation of polymerization reaction because the oxygen reacts with free radicals.

Plasticizer: these are substance added to the polymers to:

1- Decrease the brittleness of the polymer.
2.Increase the solubility of the polymer.
3.It decreases strength, hardness and softening point so it is used to prepare flexible polymer.

Success is a decision 🦋

Dental Material

Denture Base Materials

Lecturer :
Dr. Huda Ayad
B.D.S.

Denture base material

The denture base is that part of the denture that rests on the soft tissues and holds the artificial teeth.

Many materials were used for denture base construction.

1.Cellulose products
2.Phenol-formaldehyde
3.Vinyl resins
4.Vulcanite

Nowadays, acrylic resin ((polymethyl methacrylate) (PMMA)) is the mostly used material universally.

The Ideal requirements of denture base material :

1. It should be **insoluble** and **non-absorbent** in the oral cavity.
2. It should be **non-toxic** and **non-irritant**.
3. It should have good properties(coefficient of thermal expansion, density, thermal conductivity, esthetics)
4. It should have sufficient mechanical properties.
5. It should be **dimensionally stable** during construction and during patient use.
6. It should provide **good retention** with artificial teeth.
7. It should be **inexpensive** and **easily constructed**.
8. It should accept teeth addition and repaired easily.
9. It should be **radio-opaque** for easily detected by radiograph if accidentally inhaled or ingested.
10. Resistance to bacterial growth

Classification of denture base materials

1.**According to the Type of Materials**
• metallic e.g. Cr/Co denture base
• nonmetallic e.g. poly (methyl methacrylate)

2.**According to the Method of Polymerization**
• Addition polymers, e.g. poly (methyl methacrylate)
• Condensation polymers, e.g. nylon.

3.**According to their Thermal Response**
• Thermoplastic, e.g. polyvinyl acrylics and polystyrene.
• Thermosetting, e.g. poly (methyl methacrylate).

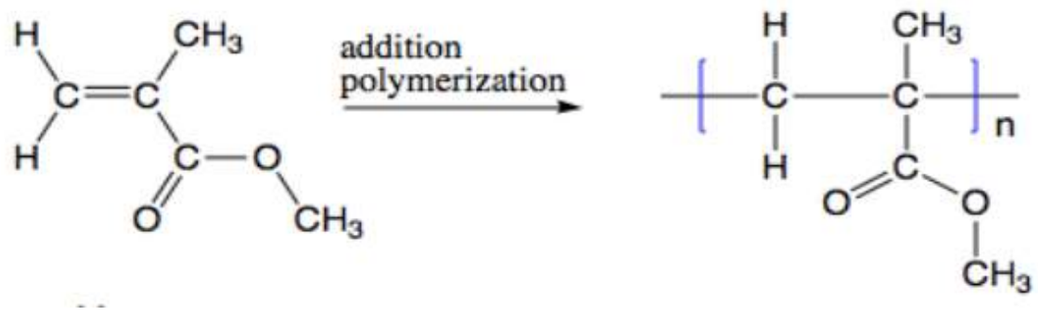
4-According to the Method of Activation
• Thermal
• Microwave
• Catalyst
• Visible light activated

5.**According to the Dispensing System**
• Powder and liquid system, e.g. heat-cure and self-cure acrylic resins.
• Sheets and ropes (Single component), e.g. light activated denture base resins.
• Gel type, e.g. vinyl acrylics

Acrylic Resin

- It is widely used for fabrication of denture bases, special trays, denture liners, provisional restorations and maxilla-facial prosthesis.
- It is poly-methyl methacrylate polymer that is polymerized by an addition polymerization reaction.

- It is activated either by heat or chemical reaction.
- Pure poly-methyl methacrylate is transparent and it is pigmented with different colors to obtain tissue-like shades.



Types of Denture Base Resin

1.Heat cure acrylic denture base resin

2.Cold cure acrylic denture base resin

3.Light cure acrylic denture base resin

4.Microwave acrylic denture base resin

Heat Cure Acrylic

The heat cure acrylic resin supplied as powder and liquid

1. Proportioning of powder and liquid:

- P/L is 3:1 by volume or 2.5:1 by weight.
- High P/L will cause incomplete wetting of the powder with liquid leading to granular mix.
- Low P/L will lead to increase shrinkage and porosity of the denture

Composition of heat cured acrylic materials

Liquid heat cured acrylic	Powder heat cured acrylic
Monomer: methyl methacrylate (MMA).	Beads or granules of poly-methyl methacrylate (pre-polymerized PMMA).
Inhibitor (hydroquinone): To inhibit pre mature polymerization reaction during storage.	Initiator (benzoyl peroxide): To initiate the polymerization reaction.
Cross-linking agent (glycol dimethacrylate): To improve mechanical properties.	Pigments: To give tissue-like shades.
	Radio-opacifiers: To give radio-opacity.
	Fibers (acrylic or nylon): to simulate blood vessels appearance.
	Plasticizers: to give resiliency and soft polymers.

2. Mixing:

• Mixing is done by a stainless steel spatula inside a glass jar.

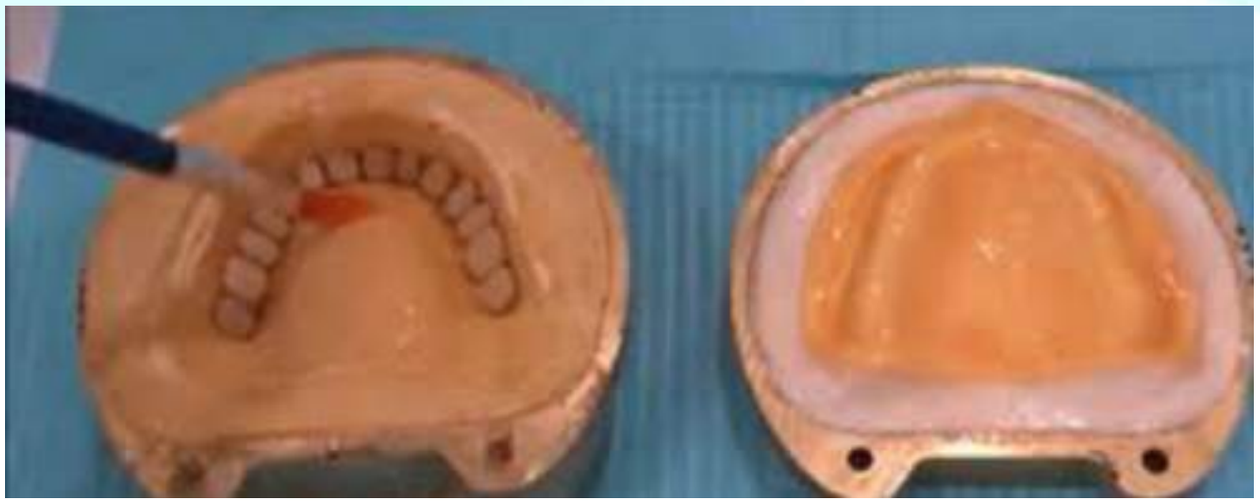
•The mix pass through the following physical stages:

1. Sandy stage.
2. Sticky (stringy) stage.
3. Dough stage.
4. Rubbery stage.
5. Stiff stage

- The mix is packed inside the mold at the dough stage.
- Until reaching the dough stage, the mix is left inside a sealed jar to avoid evaporation of the monomer

3. Separating medium application (sodium alginate):

- Before packing, the inner surface of the mold (except the fitting surface of the teeth) should be painted with a separating medium.



Role of separating medium:

1. Prevent passage of water from gypsum to resin to avoid resin crazing.
2. Prevent passage of monomer from resin to gypsum to prevent porosity.
3. Decrease surface porosity.
4. Facilitate separation of the two parts of the flask.

4. Packing:

- Packing is done at the dough stage.
- The mold should be overfilled with acrylic resin and sufficient pressure is applied on the flask to compensate polymerization shrinkage of the acrylic resin.

Early packing at sandy or sticky stages leads to:

a) Flow of the mix outside the flask due to their lower viscosity.

b) Denture porosity as a result of monomer evaporation.

Delayed packing at rubbery stage leads to:

a)The two parts of the flask will not contact due to high viscosity of the mix.

b) Movement or fracture of the artificial teeth.

Heat Cure Acrylic

Processing:

• To cure acrylic resin and reach the stiff stage, heat is applied in a water path.

•The time and temperature of heat application should be controlled.

•Decrease curing time (under curing) leads to high residual monomers.

•Increase curing temperature (over curing) will lead to increase the temperature inside the mold.

•This will lead to boiling and evaporation of monomer (at 100.3 °C) before its polymerization and result in gaseous porosity.

•The heat accumulated inside the mold arises from

•Applied heat

•Heat of polymerization reaction (exothermic reaction).

•This accumulated heat will not dissipate easily due to lower thermal conductivity of the gypsum.

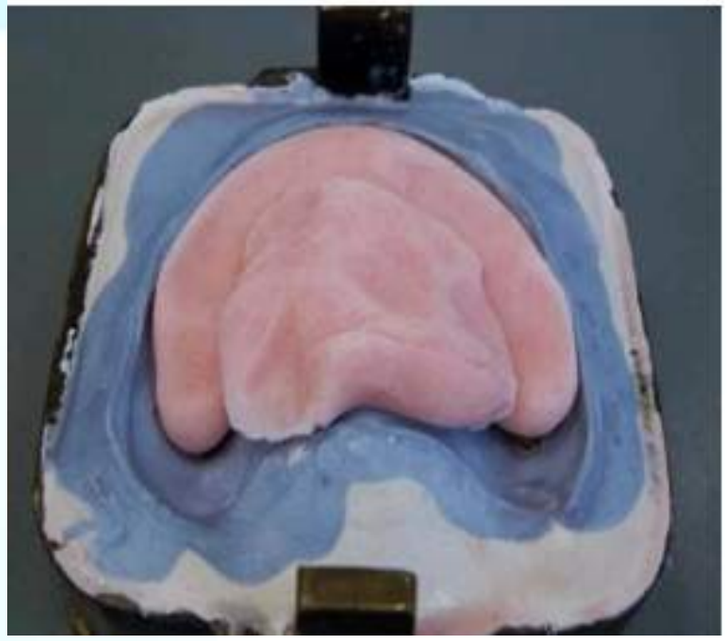
Heat Cure Acrylic

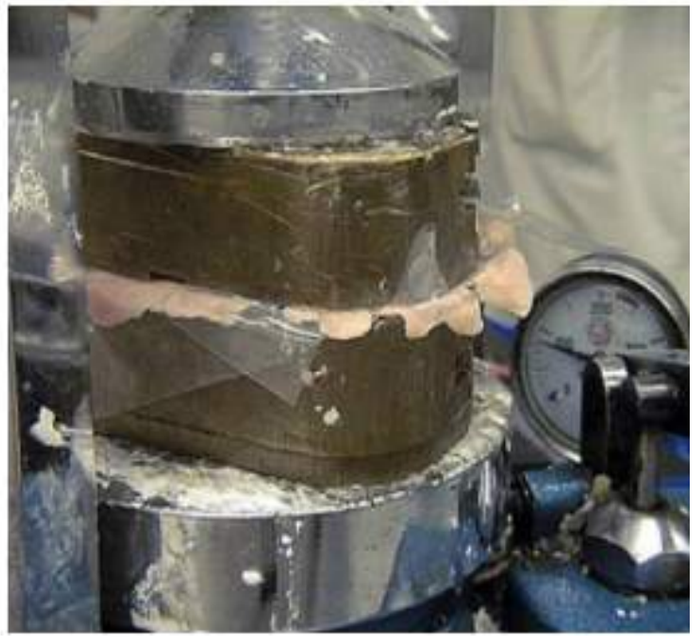
Curing cycles:

a)Long cycle: Constant temperature is applied at 74°C for 8 hours.

b) Short cycle:

- Heat is applied at 74°C for 2 hours then increase the temperature until water boiling (100°C) for addition 1 hour.





6. De-flasking and finishing:

- After completion of curing cycle, the flask is removed from the water bath and allowed to be cooled to room temperature then opened.
- Opening of the flask before cooling leads to denture warpage.
- Rapid cooling of the flask leads to generation of internal thermal stresses.
- After cooling, the denture is removed from the flask and cleaned from the gypsum debris then finished and polished.
- Denture should be stored in water until delivery.



Cold cure acrylic

2. Cold-cure acrylic

The chemistry of these resins is identical to that of the heat-cured resins, except that the cure is initiated by a tertiary amine (e.g. dimethyl-P-toluidine or sulphinic acid) rather than heat.

Cold cure compared to heat cure acrylic:

Cold-cure resins	Heat -cure resins
More residual monomer	Less residual monomer
Poor color stability	Color stability is good
Shorter working time	Longer working time
Less shrinkage	More shrinkage
Decrease strength	More strength
Low hardness	High hardness
lower modulus of elasticity	higher modulus of elasticity

Light cure acrylic denture base resin

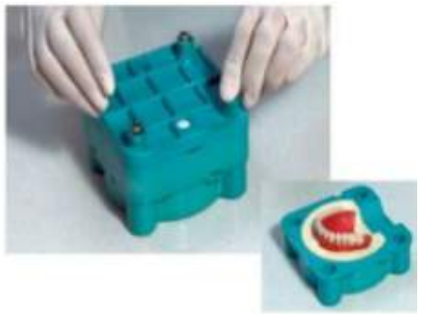
3.Light cure acrylic denture base resin (Light activated denture base resins

This material is a composite having a matrix of urethane dimethacrylate with an acrylic copolymer, micro fine silica fillers, inhibitors and light initiator for polymerization.

•It is supplied in sheets (Single component) and rope form in light proof pouches having clay like consistency. It is polymerized in a light chamber (curing unit) with visible blue light (400-500nm) is the activator in curing unit.

4. Microwave polymerized polymer Resins

Are the same as used with conventional heat cured material or using specially microwave acrylic resin and are processed in a microwave by using non-metallic flask. The properties and the accuracy of these materials have been shown to be as good as or better than those of the conventional heat cured material. The advantages of microwave curing are cleaner and faster curing than the water bath polymerization. Processing time is much shorter (4-5 min).



All the best

Ministry of Higher Education and Scientific Research
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DENTAL MATERIALS

FLEXIBLE DENTURES

Lecturer :
Dr. Huda Ayad
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THERMOPLASTIC POLYMER (FLEXIBLE DENTURES)

Is a plastic becomes moldable above a specific temperature and returns to a solid state upon cooling.

Types:

1. Thermoplastic acetal
2. Thermoplastic acrylic
3. Thermoplastic polycarbonate
4. Thermoplastic nylon

THERMOPLASTIC NYLON

The Thermoplastic nylon is used as a denture base in every case specially used in partial and complete denture when we have **undercut** , patient **allergy to acrylic** monomer, patient **allergic to nickel**, if there is **reduced mouth opening** and when we need **high esthetic demand.**

ADVANTAGE OF FLEXIBLE DENTURE

1. Excellent **flexibility** and **ductility**.
2. It is semi translucent and provides **excellent esthetic**. No metal clasp appearance on the tooth surface
3. **Biocompatible** (frees of monomer and metal which are the principle cause of allergic reaction).
4.. High strength, High fracture resistance
5. Lower water sorption than PMMA resin.
6. Light weight.

DISADVANTAGE OF FLEXIBLE DENTURE

1.**Minimal bonding strength** to artificial teeth and torelining material
2.Difficult to **adjust**, **polish** and **repair**
3.Good resistance to most chemical but they can affect by **strong acids** and **alcohols**
4.After short period of time the flexible dentures **deteriorate**, **stain** and **develop a rough surface**

PROSSESING ERRORS

1. Porosity

Presence of **bubbles** in/on the surface of resin lead to:

1.. Unsightly appearance of the denture base

2.Improper cleaning of the denture => denture and oral hygiene are suffered

3.Weaken the denture

2. Crazing:

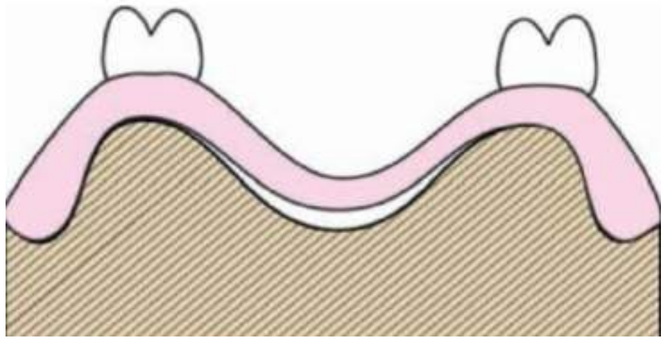
Crazing is formation of surface **cracks** on denture base resin and has a weaking effect on the resin and reduces the esthetic qualities. The cracks formed can cause fracture.

Causes:

- Mechanical stresses .
- Attack by solvent (alcohol)
- Incorporation of water during processing.

3.Denture warpage

is the **deformation** of denture or **change in shape** that affect the fit of the denture.



Causes:

1.Release of stresses in denture during processing , rapid cooling, packing of acrylic in rubber stage or improper deflasking.

2.Rise in temperature while polishing

3.Recuring of denture after addition of relining material

4.Repeated wetting and drying of denture

CARE OF ACRYLIC DENTURE

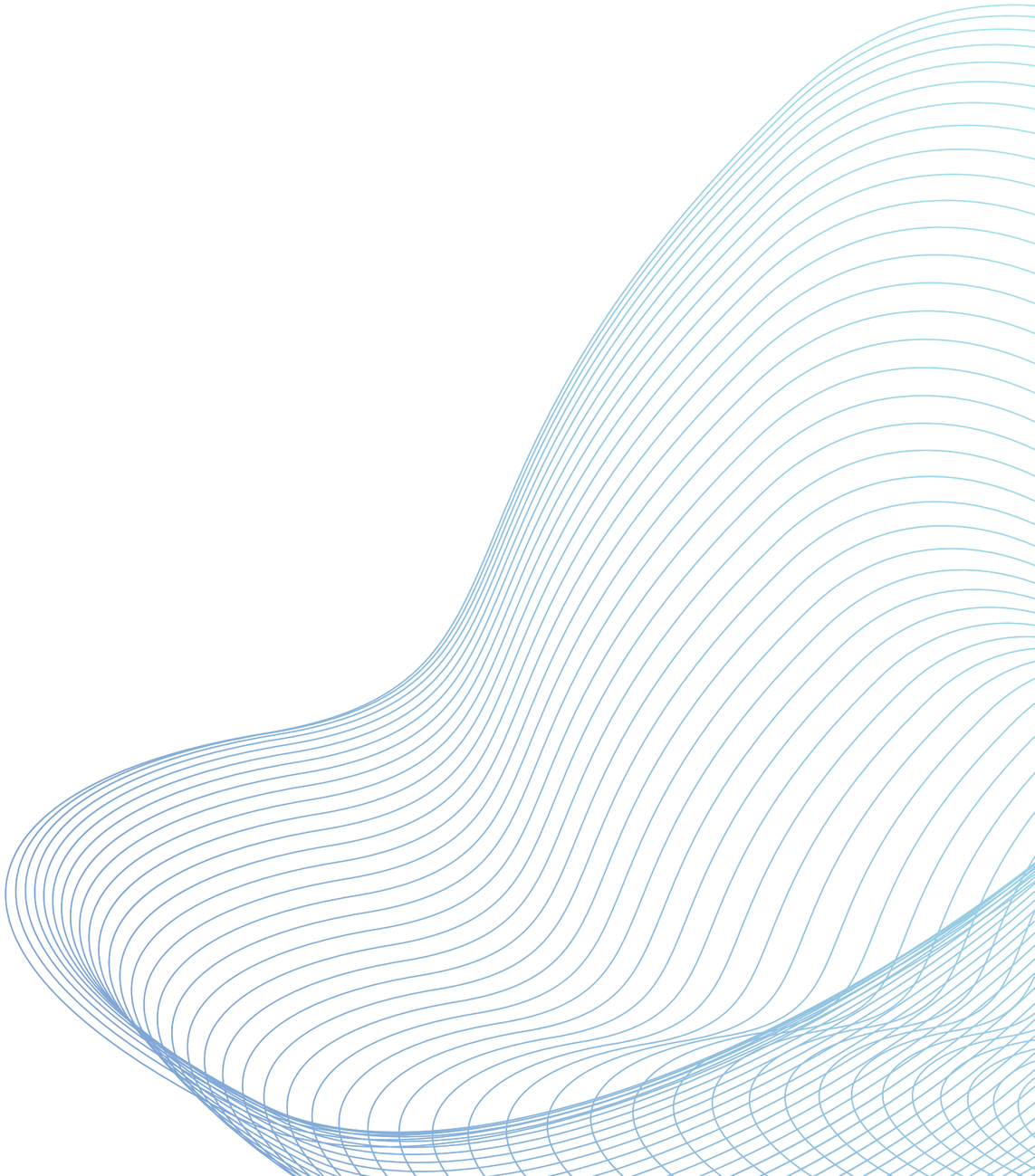
1. stored in water when not used

2. brushed carefully with soft brush

3. no hot water used

4. no abrasive toothpaste or household cleansers used

Thank you 🦋



Ministry of Higher Education and Scientific Research Al-Furat Al-Awsat Technical University
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DENTAL MATERIALS

INVESTMENT

Lecturer :
Dr. Huda Ayad
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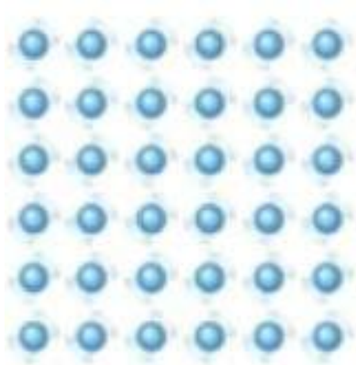
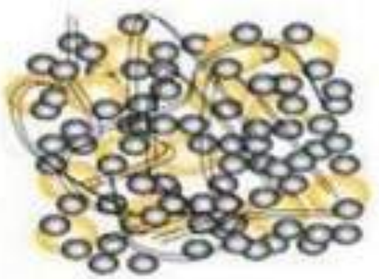
INVESTMENT

Is a material poured around the wax pattern whilst still in a fluid state , when the investment sets, the wax and sprue former are removed by softening or burning out leaving a mould which can filled with an alloy or ceramic using a casting technique .

Compositions



1-**Refractory materials** : This material is a form of silicon dioxide such as quartz, crystobalite, or a mixture of them.



2.Binder materials :are used to form a coherent solid mass with refractory material. Most commonly used binders in dental investments are α-calcium sulfate hemihydrate, phosphate, and ethyl silicate.

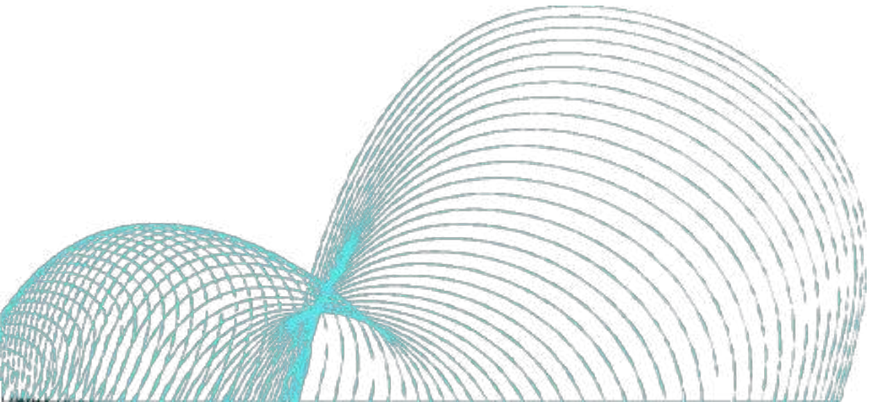
3.Modifires : These materials may be added in small quantities to modify various physical properties as sodium chloride and Boric acid to enhance thermal expansion.

REQUIREMENTS OF AN INVESTMENT

1. Easly manipulated
2. Have sufficient strength
3. Not decomposed when being heated.
4. Have enough expansion to compensate for shrinkage of the wax pattern and the metal that take place during the casting
5. Should be porous enough to permit the gases in the mould cavity to escape easily during the casting
6. Must have a smooth surface and fine details and margins on the casting.
7- After the casting is completed, the investment should break away readily from the surface of the metal and not reacted chemically with it.

The predominate Compositions used for the casting of high temperature alloys and for creating veneering dies, are based on the use of

1. phosphate binder.
2. Silicate-binder.
3. gypsum binder.



Phosphate-Bonded Investments

Applications:

1- Casting of alloys

There are two types of casting investments

Type 1, has been employed for the casting of inlays, crowns, and other restorations, especially for alloys based on gold, platinum, palladium. cobalt- chromium, and nickel-chromium, to which porcelain is fused in the construction of esthetic fixed restorations.

Type 2; is used for the casting of removable partial dentures.

Phosphate-Bonded Investments

2- Soldering and porcelain veneering; Another use of phosphate-bonded investments is to make "soldering" fixtures that hold prosthetic components in alignment while they are being joined with solders, brazing alloys, or welding alloys

Advantages :

1. They have both high **green strength** and **fired strength.**
2.They can also provide **setting and thermal expansions** high enough to compensate for the thermal contraction of cast-metal prostheses or porcelain veneers during cooling .
3. They have the ability to **withstand the burnout process** with temperature that reach 900 c.°

Phosphate-Bonded Investments

Disadvantage

1-When used with higher-melting alloys, those with casting temperatures higher than about 1,375℃. These temperatures result in **mold breakdown and rougher surfaces on castings.**

2.The high strength of these investments, can make **divesting** (removal of the casting from the investment) .

3.When the powder is supplied in bulk form-rather than in sealed. premeasured packages-is **that it can react over time with moisture in the air and result in either a lower expansion during setting or a loss of the ability to set to a strong mass**

Ethyle Silicate-Bonded Investment

Ethyl silicate-bonded investments comprise the second type of investment used in dentistry.

These investments have been used since the early 1930s to;

1. Make molds for the casting of removable partial dentures of cobalt chromium alloys.
2. Used for the casting of nickel-based alloys.

Advantages

1Ethyl silicate-bonded investments offer the ability to cast high temperature cobalt- chromium and nickel-chromium alloys.

2. Attain good surface finishes, low distortion, and high thermal expansion (good fit).

3. They are less dense (more permeable) than the phosphate-bonded investments.

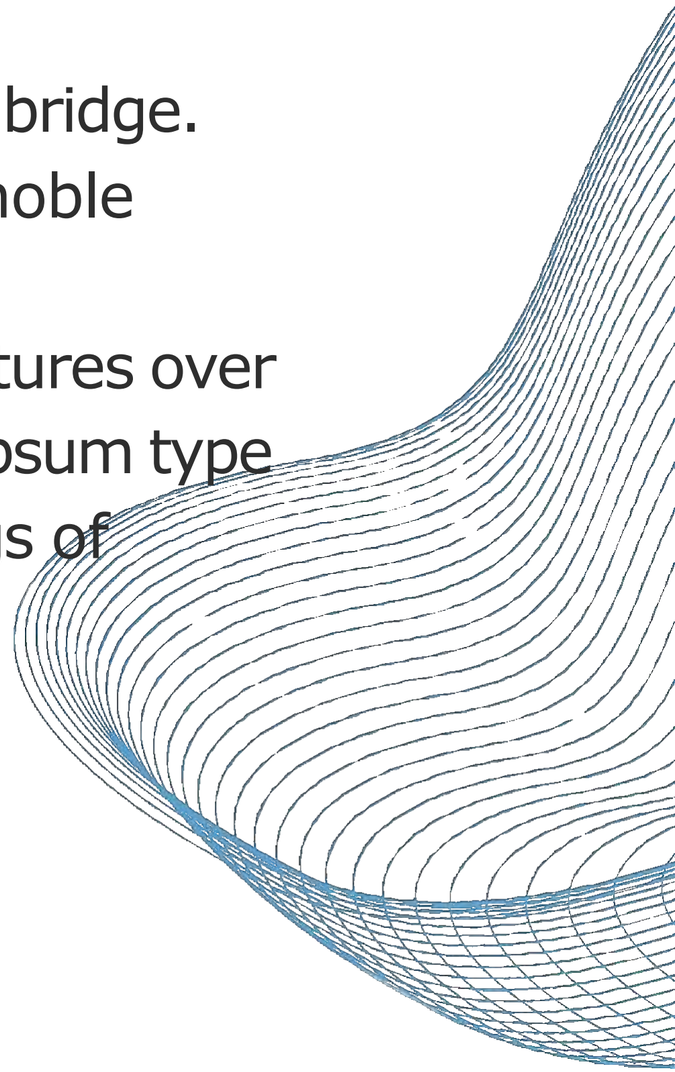
Disadvantages:

1.The extra precaution needed in handling the low-strength fired molds.

2-The low strength and high thermal expansion require a more precise burnout process and firing schedule to avoid cracking and, hence, destruction of a mold.

Gypsum-bonded investments

The investments suitable for **casting gold alloys** for crown and bridge.
The gypsum -bonded investment is usually limited to gold or noble metals castings, and is not heated **above 700°c.**
The gypsum portion of the investment decomposes at temperatures over 700°c, tending to embrittle the casting metal. Therefore, the gypsum type of binder is usually not used in investments for making castings of palladium or base metal alloys.



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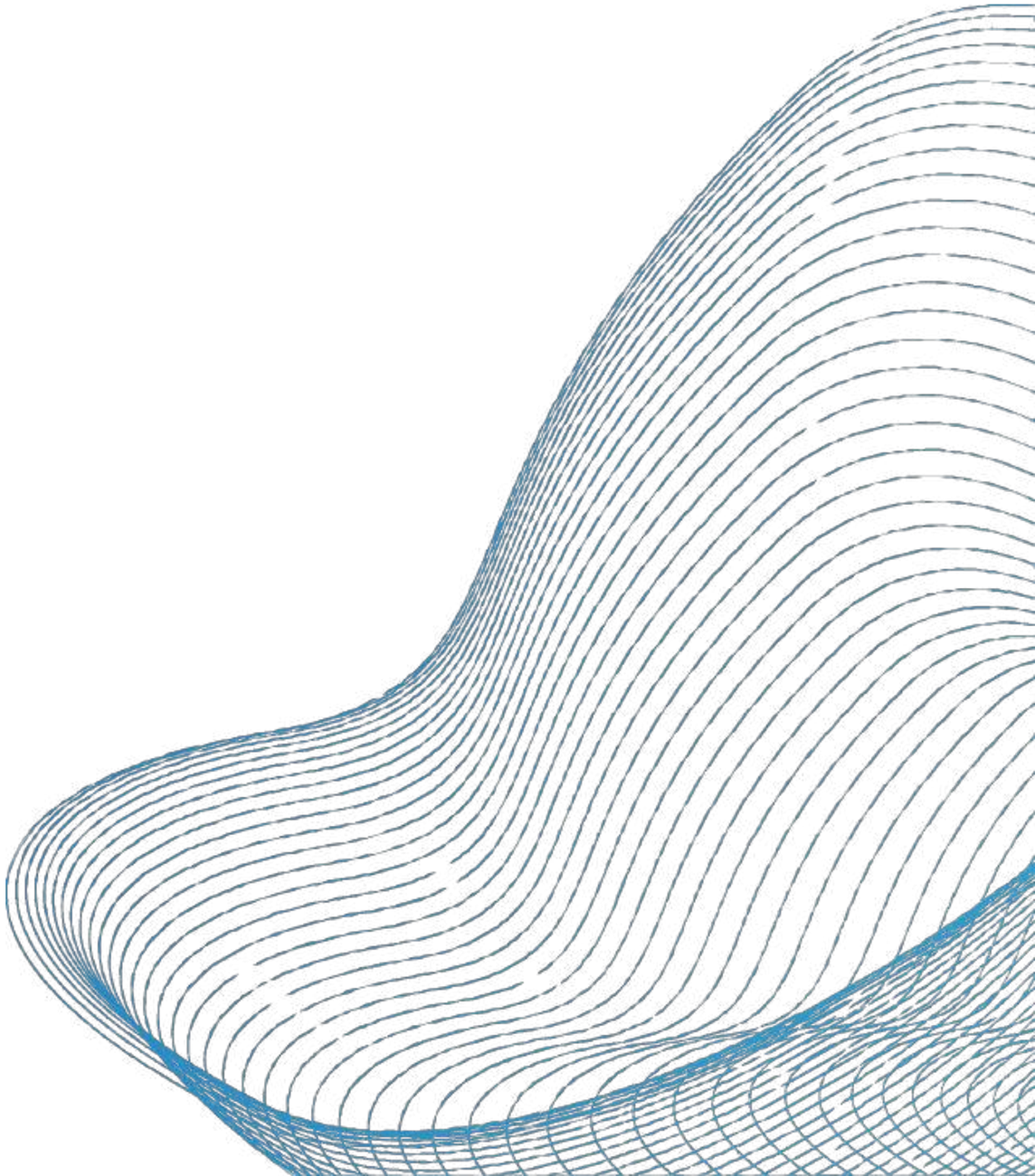

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DENTAL MATERIALS

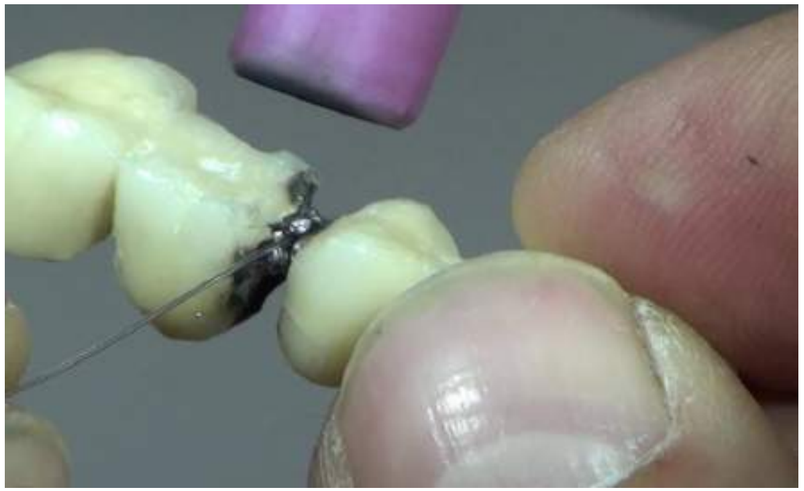
SOLDERING

Lecturerr:
Dr.Huda Ayad

SOLDERING

Soldering :is a method of joining two or more cast or wrought pieces using another alloy called solder .

It is used for joining metal components ,it is used also to overcome distortions that may occur during cooling for metal frameworks for long-span bridge work .These casting defect can be corrected with soldering .



IDEAL PROPERTIES OF A DENTAL SOLDER

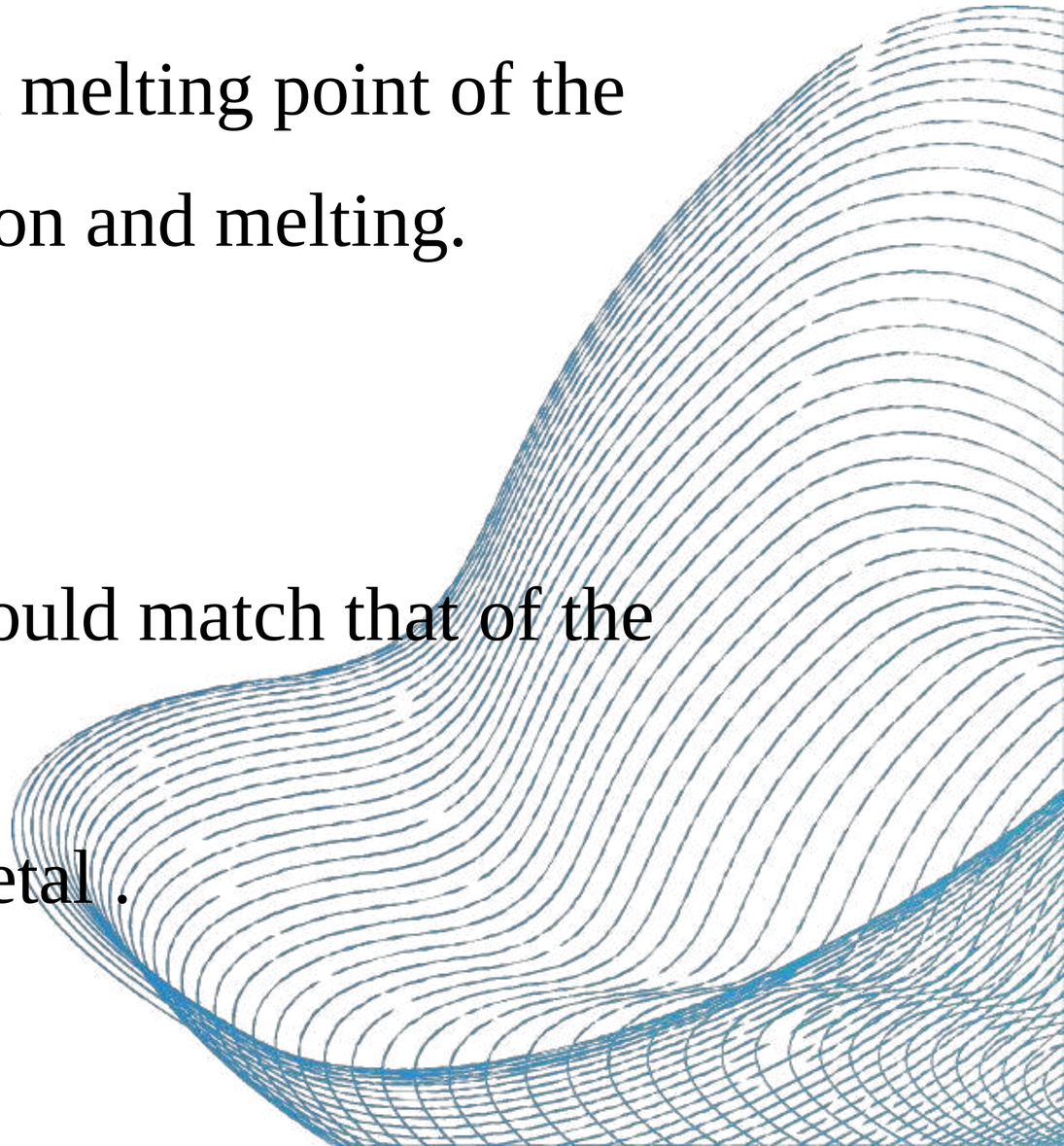
1- Lower fusing : 50 C-100°C lower than melting point of the components , so as to prevent the distortion and melting.

2- Strong

3- Corrosion resistance .

4- Same color : the color of the solder should match that of the alloy .

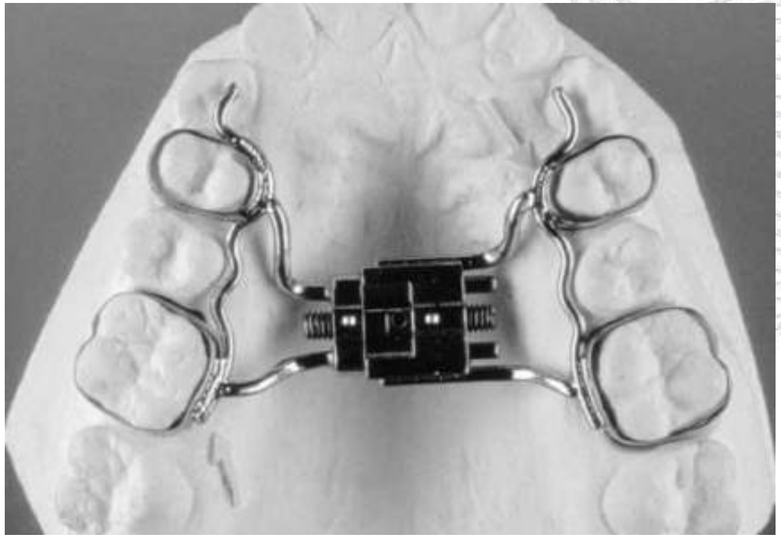
5- Solder must be compatible with the metal .



SOLDERING TECHNIQUES

A) **Free Hand**

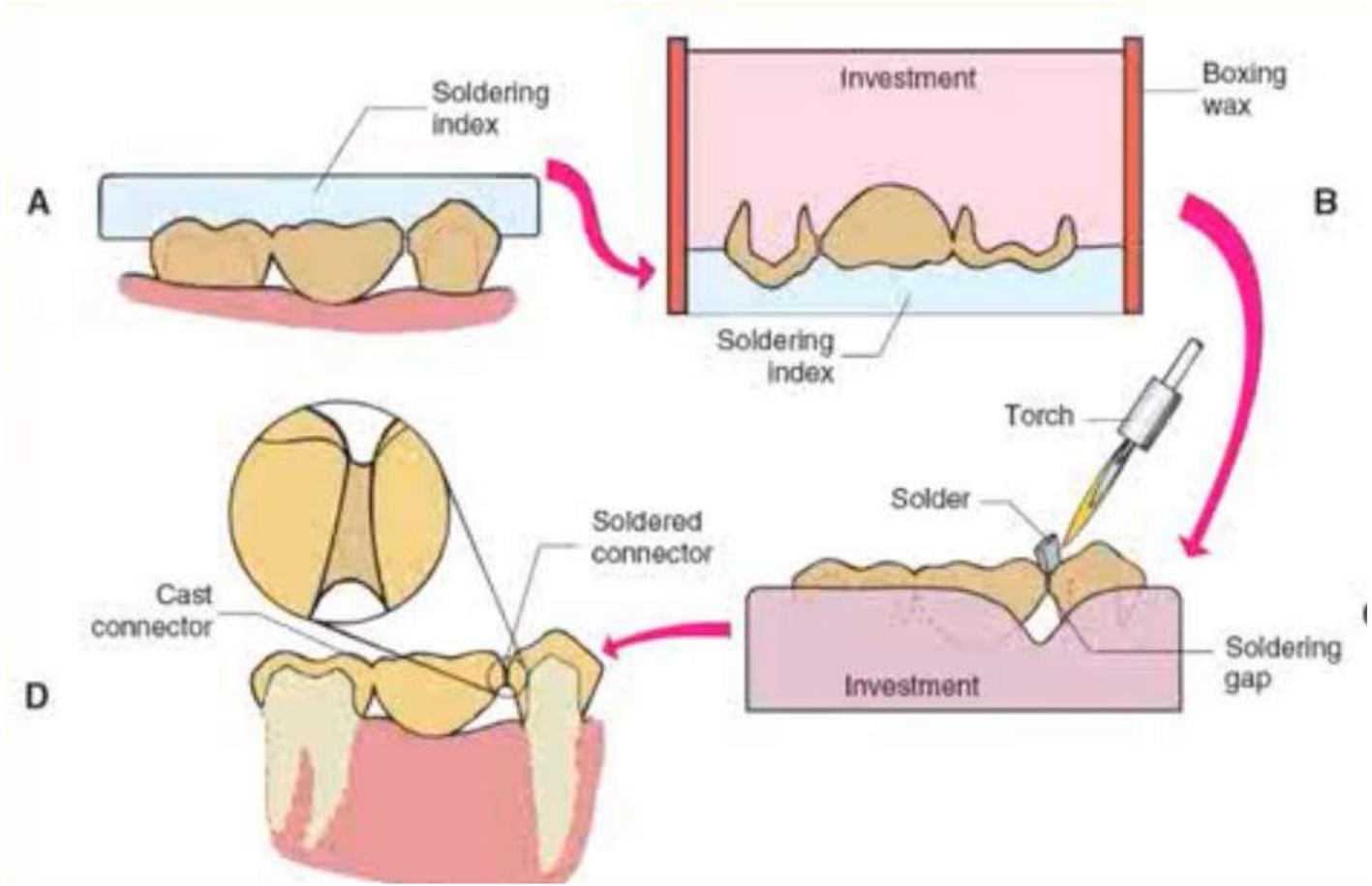
1. Addiding proximal contact
2. Used for soldering orthodontic appliances



B) Investment soldering

1- Repair broken joints

2- Joining the bridge



LASER WELDING

Welding: Two pieces of metal are joined together without adding another metal, the metal pieces are heated to a high enough temperature so they attach to each other

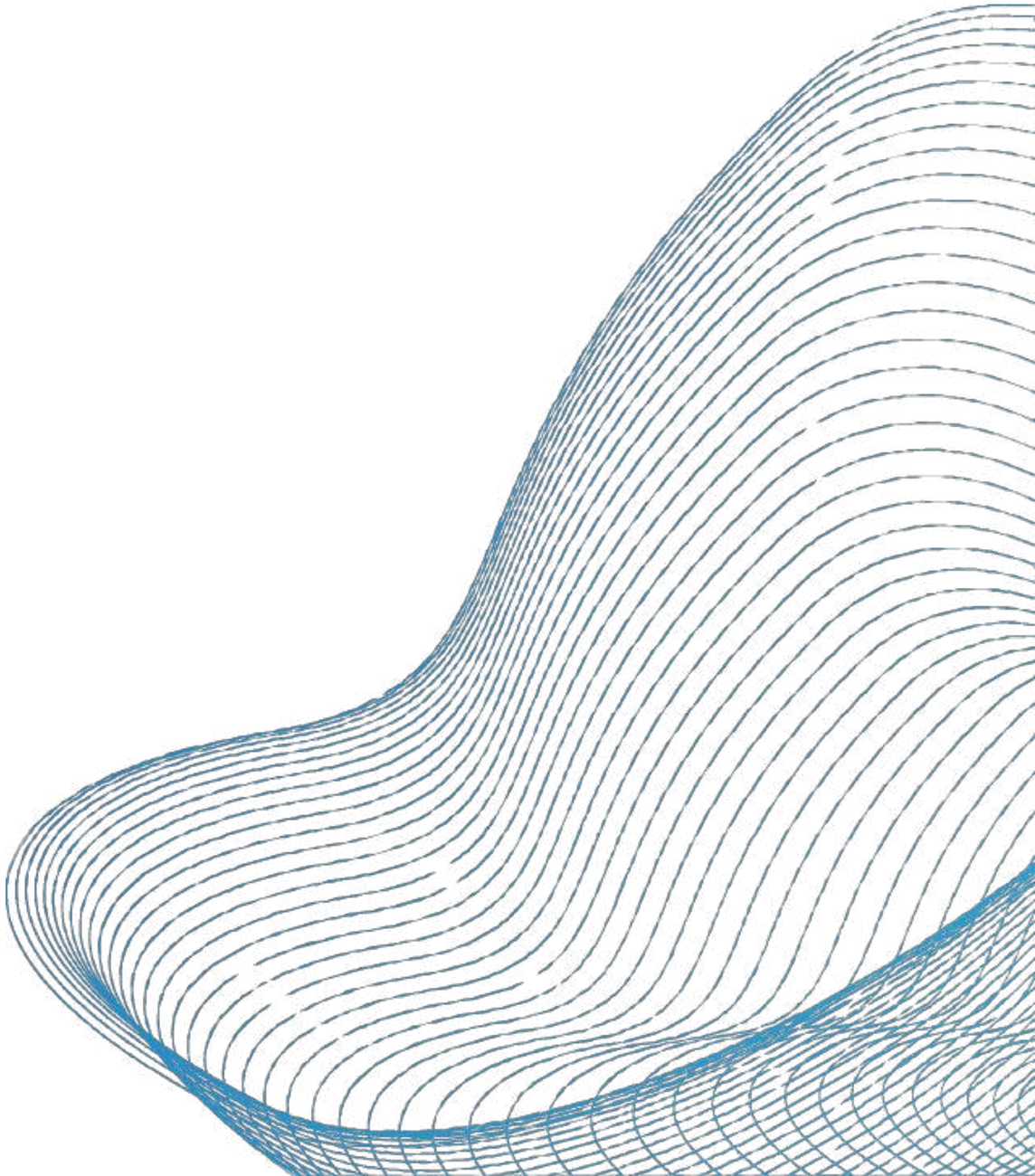
ADVANTAGE

1-Heat area is small so don't affect the alloy properties

2-Less distortion occurs.

3-Less working steps.

THANK YOU



Dental Material

Impression Materials

Lecturer :
Dr. Huda Ayad
B.D.S.

Impression

- **Impression** is a negative production of the teeth and surrounding oral structures.
- **Impression materials** It is the material that used for making impression. It is inserted into the mouth in a **plastic form** then **set**.
- **Cast (Model)** It is the positive reproduction of the teeth and surrounding oral structure.

Ideal Requirements Impression Material

1. It should be **accurate** to produce fine details.
2. It should be **biocompatible** with oral environment. It should be not toxic or irritant to the oral tissues.
3. It should be **easily manipulated** without complicated equipment.
4. It should have **suitable working time**.
5. It should have **suitable setting time**.
6. It should have **acceptable taste** and **odor** to the patient.
7. It should **accept addition** and **correction**.
8. It should be easily **disinfected** without loss of its accuracy.
9. It should have **good shelf life**.

Factors Affecting Accuracy of Impression Material

1. Flow: The material should have sufficient flow to record all fine details. It should have sufficient viscosity to be contained in the tray.
2. Hydrophilicity: The material should be hydrophilic to wet the oral tissues easily.
3. Dimensional accuracy: The material should not show any dimensional changes during setting (neither expansion nor contraction).

Classification of Impression Materials:

1.According to setting mechanism:

a)Reversible: They soften by heat and harden by cooling (physical reaction). e.g.: impression compound and agar.

b) Irreversible: They set by a chemical reaction. e.g.: plaster impression material, zinc oxide-eugenol, alginate and elastomers.

2. According to behavior after setting:

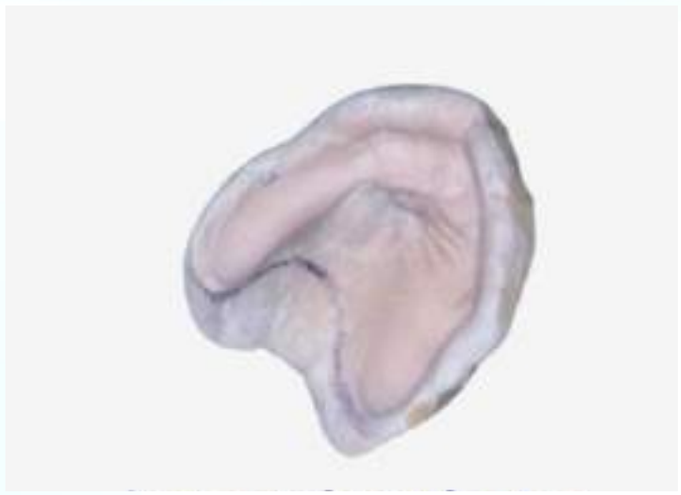
a) Elastic impression materials: They recovered after removal from undercut. They used for both dentulous and edentulous patients.

b) Non elastic (rigid) impression materials: When removed from undercut they fracture or deform. They used for completely edentulous patients.

Non-elastic Impression Materials

1.Plaster Impression Materials
2. Impression Compound and Sticks
3.Zinc Oxide - Eugenol

Zinc Oxide - Eugenol



.Plaster Impression Materials

Impression Compound

	Plaster impression	Impression compound	Zinc oxide and Eugenol
Setting Reaction	Chemical Reaction	Physical Reaction Heat—soft Cool—Hard	Chemical Reaction Two pastes of different colors
Flow	High flow	Low flow	Good flow
Dimensional accuracy	Good It has little expansion during setting due to presence of anti-expansion additives.	Bad The material has high coefficient of thermal expansion, so it shows high contraction during cooling from softening temperature to mouth temperature	Good It has very little shrinkage (0.1%) during setting

	Plaster Impression	Impression Compound	Zinc oxide and Eugenol
Elacticity	Rigid. It fractured if removed from undercut.	Rigid. It deformed if removed from undercut	Rigid. It deformed if removed from undercut
Adhere to the tray	Good	Good	Good
Compatiblity with gypsum products	Not compatible It requires a separating medium which reduces the accuracy of the final cast	Compatible	Compatible after setting of cast, it is placed in a hot water path for easy separation of the impression

	Plaster Impression	Impression Compound	Zinc oxide and Eugenol
Mode of supply	Powder + water	•Sheets and cakes. •Sticks (green stick compound	Two pastes of different colors

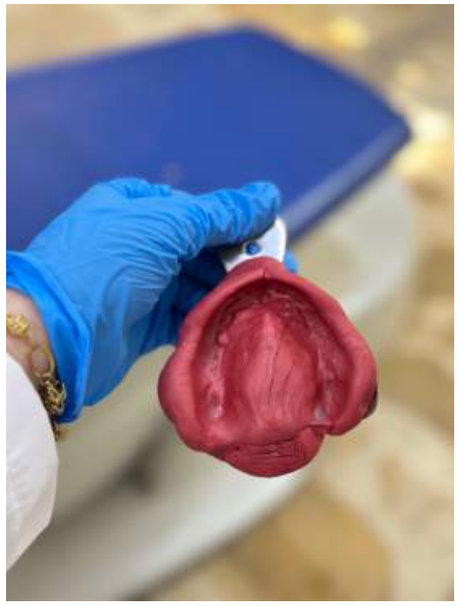
Manipulation

1-Manipulation of Plaster impression: Like Gypsum products

2. Manipulation of Impression compound (cakes and sheets)

Heated in a water path (55 – 60 °C). Due to its lower thermal conductivity it should be immersed for sufficient time and kneaded. The material is kneaded outside the water to avoid water incorporation which acts as a plasticizer and increase the flow.



Manipulation

Manipulation of The sticks:

They heated over a direct flame. Avoid overheating as it will cause volatilization of some ingredients which will affect its properties.

Manipulation

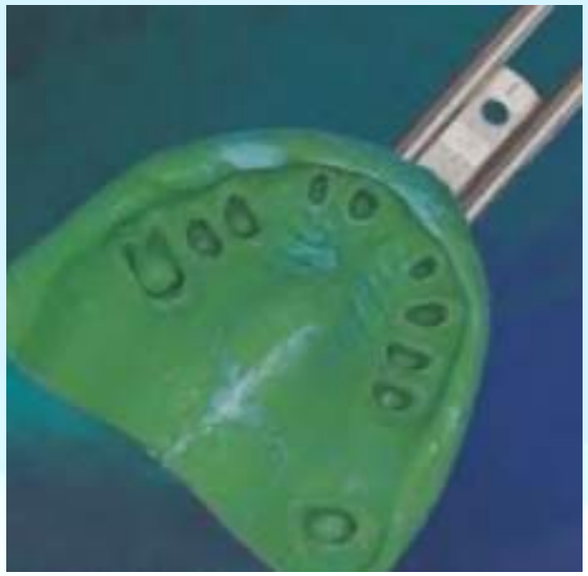
3. Manipulation of Zinc oxide and eugenol:

Dispense equal lengths form both tubes on a glass slab or oil resistance pad. Mix using stainless steel spatula until homogenous color is obtained.

Elastic Impression Materials

1) Hydrocolloids (Agar impression material , Alginate impression material)

Alginate



Agar impression

2) Elastomers (Polyether, Addition silicon (PVS) , Condensation silicon, Polysulfide (Mercaptan)

Addition silicon

Condensation silicon

HYDROCOLLOIDS

Alginate impression material	Agar impression material	
Powder + Water	Gel suppled in tubes and syringes.	Mode of supply
• Soluble salt of alginic acid: (sodium or potassium alginate) 12%. • Calcium sulfate: 12% • Tri-sodium phosphate retarder. • Fillers: 70%. • Fluoride: to improve surface hardness of gypsum cast. • Flavoring agent: to give good taste to the patient. • Chemical indicators: to indicate working and setting time.	• Agar: 12.5%: as dispersed phase. • Borax: strengthening agent and increase viscosity. It retards setting reaction of gypsum. • Potassium sulfate: accelerate gypsum setting • Water: 85% as dispersion medium. • Fillers: control strength and viscosity	Composition

Alginate impression material	Agar impression material	
• Chemical reaction (irreversible reaction) • Because of the setting reaction is too fast; retarder (tri-sodium phosphate) is added to increase working time.	Physical reaction (reversible reaction)	Setting Reaction
Good flow but less than agar.	Good Flow	Flow
• Bad dimensional accuracy. • The setting starts from tissue to tray (as the tissues is hotter than tray and setting reaction is chemical reaction accelerated by heat). • So, any changes occur during setting will affect the accuracy of the impression. • The tray should not move during setting to minimize distortion.	• Good dimensional accuracy. • The setting starts from tray to tissues (as the tray is cooler). • So, the impression contacting the tissue stays liquid for longest time and can flow to compensate any changes occurs during setting.	Dimensional accuracy
Viscoelastic material Elastic recovery 97.3%	Viscoelastic material Elastic recovery 98.8%	Elasticity

Alginate impression material	Agar impression material	
The most flexible impression material	High flexibility	Flexibility
Do not adhere to the tray. Some manufacture provides adhesives.	Do not adhere to the tray. Some manufacture provides adhesives.	Adhere to the tray
Not compatible	Not compatible	Compatibility with gypsum products
Cheap	Requires expensive equipment	Cost

Manipulation

Manipulation of Agar impression material

It requires:

1.**Hydrocolloid conditioner** It has three compartments:

b)**Liquefaction**: at 100°C. The tubes and syringes are heated for 10 minutes (gel sol).

c)**Storage**: the sol agar can be stored for several hours at 65°C.

d)**Tempering**: The sol agar is loaded at the tray and tempered at 46 °C for 2 minutes just before inserting into patient's mouth

Manipulation

2. Water-cooled tray it is a specially designed tray. It has channels for circulation of cold water.

3. Running water supply It supplies the tray with cold water. The water temperature should not be less than 13 °C to avoid developing of thermal stresses.

Manipulation

Manipulation of Alginate impression material

The tray should provide 4mm thickness for alginate.

•Shake the alginate powder container before use.

•Use rubber bowl and wide rigid spatula.

•The water is added in the bowl then the powder.

- Mixing starts with a stirring mixing to wet the powder followed by a rapid and vigorous mixing with squeezing the mix against the sides of the bowl until a creamy mix is obtained.

•The tray is loaded with alginate mix using the tip of the spatula. The mix should be pressed against the tray to release any trapped air.

Manipulation

.The tray is inserted into patient’s mouth.

•The impression is removed from the patient’s mouth 2-3 minutes.

•The impression is rinsed and disinfected.

•The impression should be poured with gypsum as soon as possible but if not, it should be stored in 100% relative humidity.

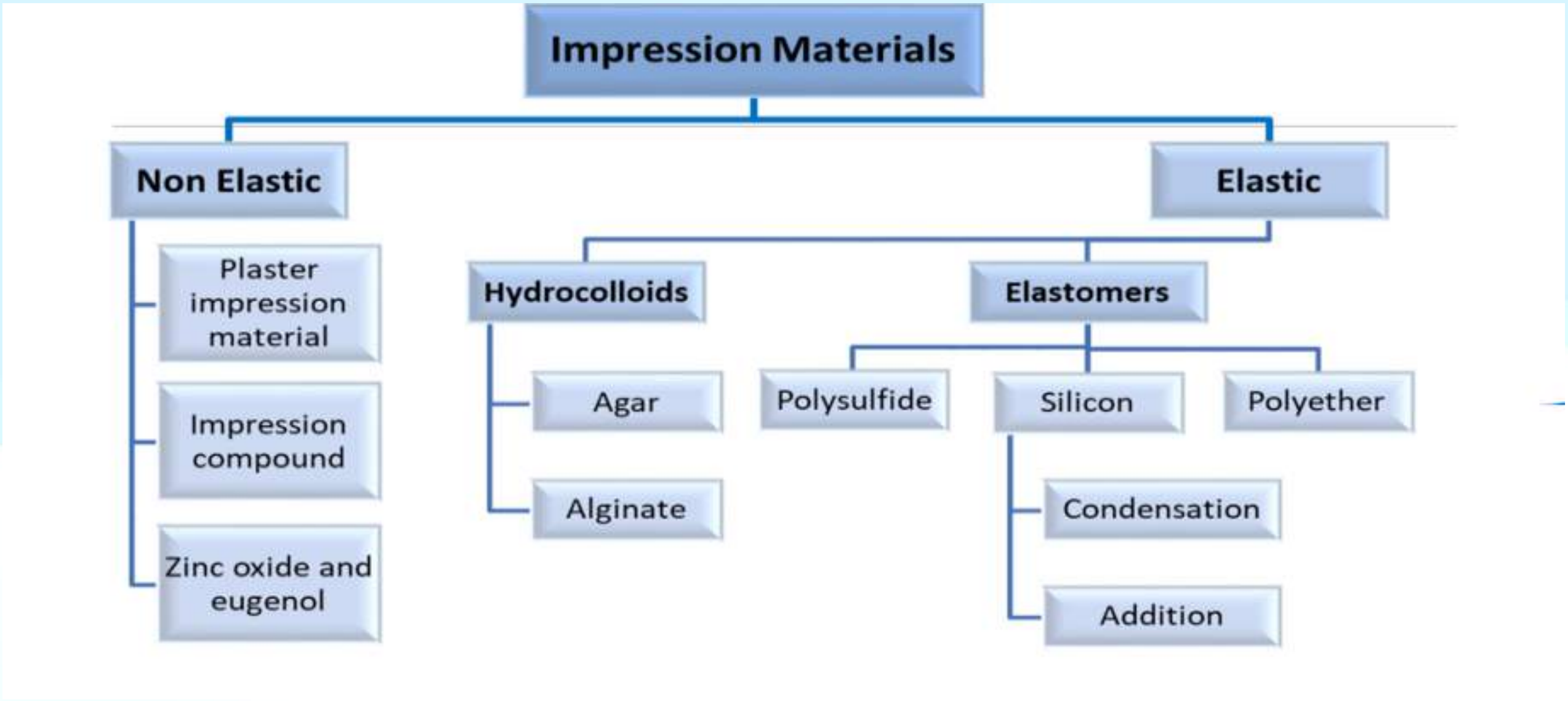
•The impression should be removed from the cast after 30-60 minutes.

Elastomeric impression materials

Polyether	Addition silicon (PVS)	Condensation silicon	Polysulfide (Mercaptan)	
• Fillers. • Aromatic sulfonic acid ester.	• Fillers. • Chloroplatinic acid (catalyst).	• Fillers. • Tetra-ethyl orthosilicate • Tin octoate (catalyst). • Diluent.	• Fillers. • Plasticizers. • Sulfur (accelerator). • Lead dioxide (to start reaction)	Composition
• 0.3% shrinkage	• 0.05% shrinkage	• 0.6% shrinkage	• 0.25% shrinkage	Dimensional accuracy

Elastomeric impression materials

Polyether	Addition silicon (PVS)	Condensation silicon	Polysulfide (Mercaptan)	
Addition polymerization reaction	Addition polymerization reaction	Condensation polymerization reaction	Condensation polymerization reaction	Setting reaction
Needs adhesive	Needs adhesive	Needs adhesive	Needs adhesive	Adher to tray
Compatible	Incompatible	Incompatible	Incompatible	Compatibility with gypsum products


Impression Materials
Non Elastic
Elastic
Plaster impression material
Impression compound
Zinc oxide and eugenol
Hydrocolloids
Elastomers
Agar
Alginate
Polysulfide
Silicon
Polyether
Condensation
Addition

Thank you

Ministry of Higher Education and Scientific Research Al-Furat Al-Awsat Technical University
Al-Najaf Technical Institute

DENTAL MATERIALS

CERAMICS
ABRASION AND POLISHING

Lecturer:
Dr.Huda Ayad
B.D.S

CERAMICS

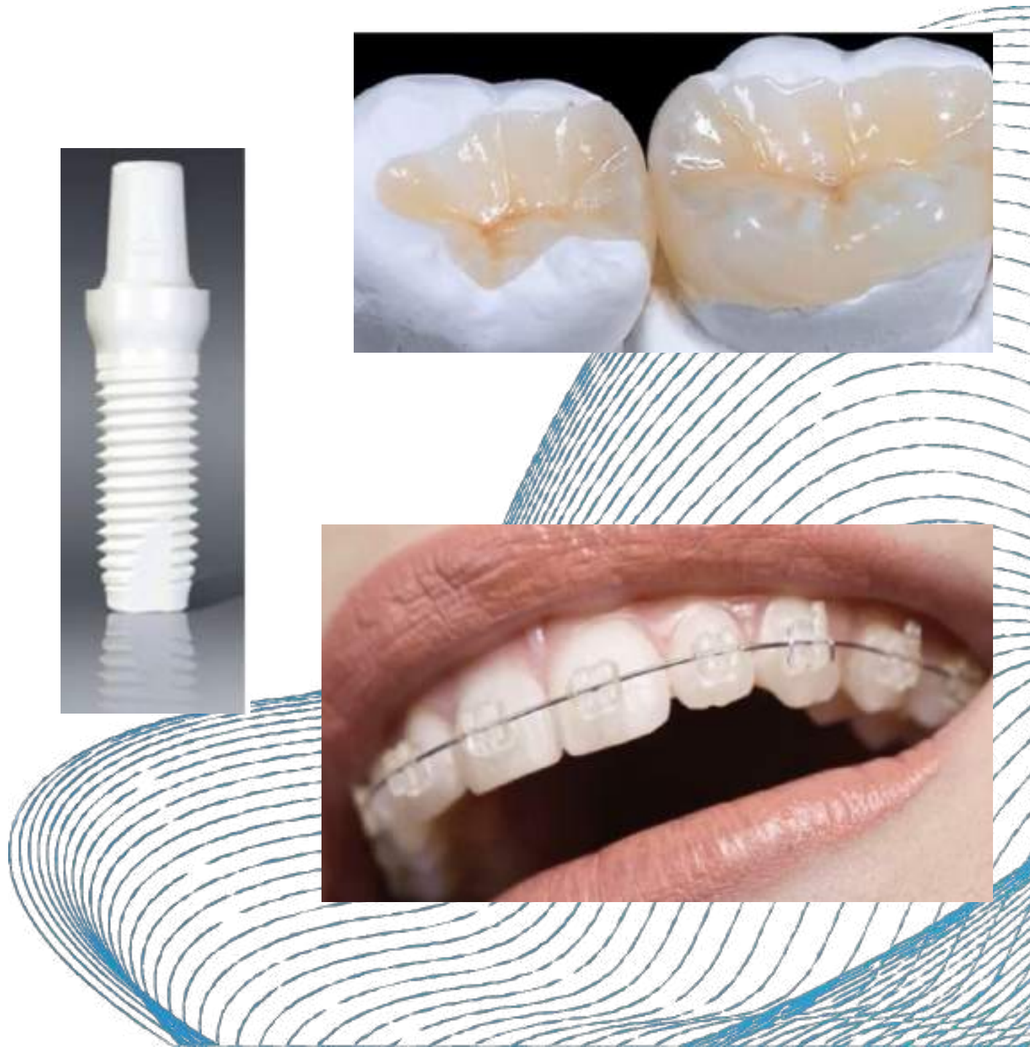
Ceramics: It refers to any material composed of nonmetallic inorganic material produced by firing at high temperature (Pyro-chemical reaction).

The term ceramics is derived from Greek word "Keramicos" which means "burnt stuff".

Classification OF DENTAL CERAMICS

1. **According to Application**:

Ceramics are used widely in dentistry as in ceramo-metallic fixed restorations, all ceramic crowns and bridges, inlay and onlays, dental implant fixtures and abutments, orthodontic brackets and ceramic denture teeth.



2. According to fabrication method:

a) Sintering:

The ceramics are supplied as a powder that is mixed by water to form the desired shape then sintered at high temperature to produce the compact form.

Metal substructure

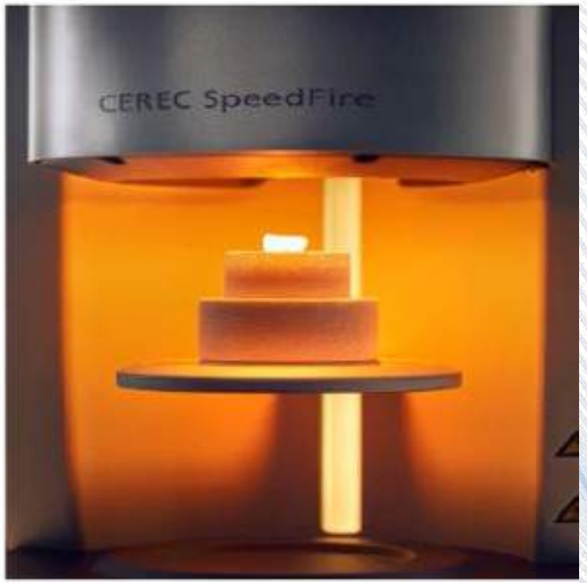
Body Porcelain

Mixing porcelain Powder

Applied Glaze

Opaque Porcelain

Final Restoration



Porcelain firing furnace

b) CAD/CAM (computer aided designing/ computer aided machining):

An optical impression is scanned then transferred to computer. The restoration is designed by computer aid then it is milled from ceramic block by the milling machine.

3-Accordind to fusion tepmerature in the dental laboratory :

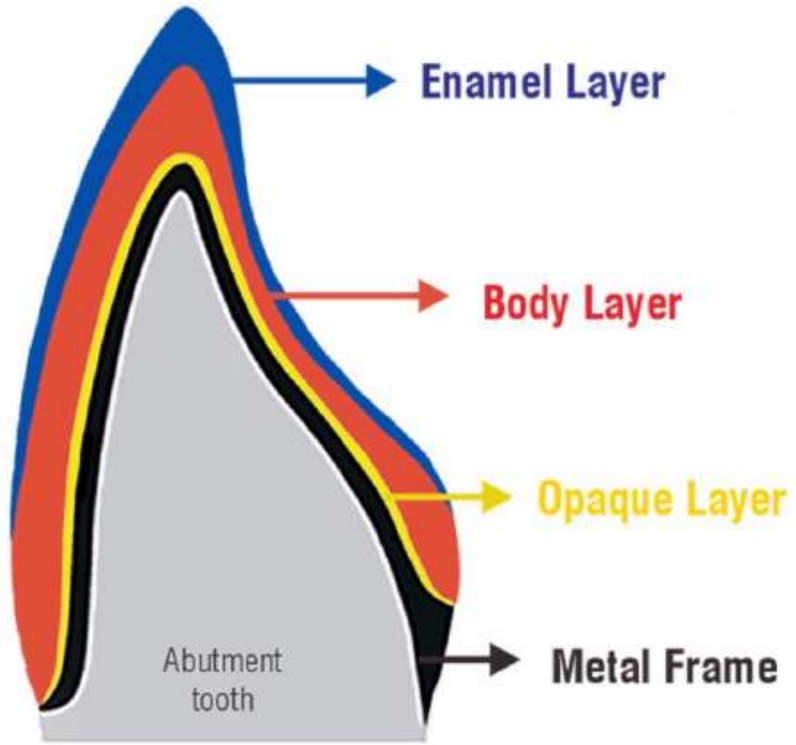
	Fusion temperature	Uses
a. High fusing	1300 °C	Denture teeth production
a. Medium fusing	1100 – 1300 °C	
a. Low fusing	850 – 1100 °C	Crown and bridge construction
a. Ultra-low fusing	Less than 850 °C	

4-According to translucency :

a) Opaque ceramic:

_it makes the color of the alloy and it is responsible for the metal ceramic bond.

_ The color of the opaque is very important to the development of the final shade of the teeth



B) Body ceramic:

Represent a veriety of ceramic that generally can be subdivided into three groups:

1. Dentine ceramics.
2. Enamel ceramics.
3. Modifiers.

They are relatively translucent and are always fused over opaque ceramic .

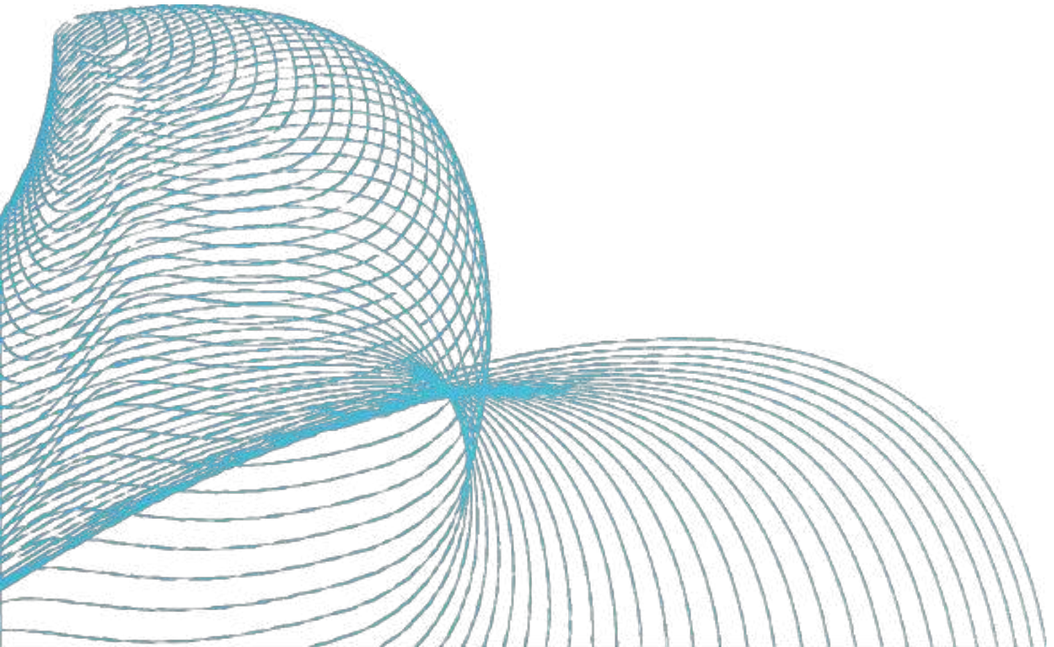
Body porcelain

Enamel porcelain

5- According to The method of Firing

a) At atmospheric pressure, air firing .

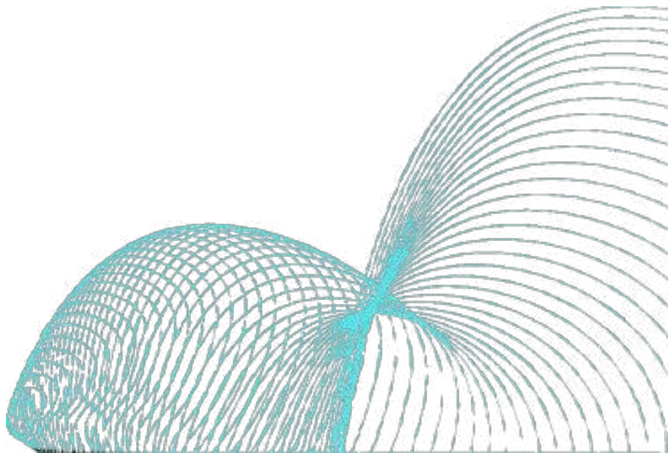
b) At reduced pressure , vacuum firing .



ABRASION AND POLISHING

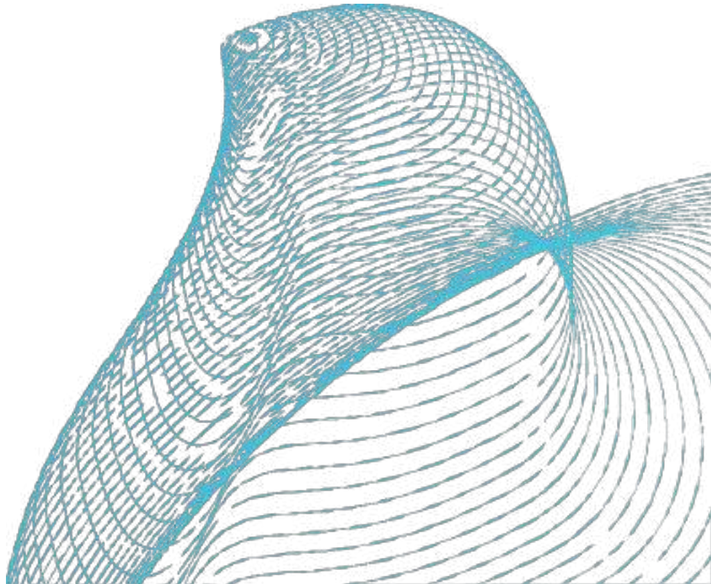
Abrasion: is the process in which a rough surface become smooth by moving abrasive hard sharp particles over the surface of material.

Abrasives are substances which wear away the surfaces of softer objects. In dentistry, they are used as powders, cemented to the surface of paper and cloth in the form of discs, and bonded with binders to form grinding stones of various shapes.



FACTORS INFLUNCING THE EFFICIENCY OF ABRASIVE :

1. The hardness of abrasive particles.
2. The sharpness of abrasive particles .
3. Particles size of abrasive materials.
4- The mechanical properties of abrasive particles.
5- The rate of movement of the abrasive particles.
6. The pressure applied to the abrasive surface.
7. The properties of the materials that being a braded.



MATERIALS OF ABRASION

1.Diamond Disk.

2. Aluminum Oxide (SiO2).

3.Silicon carbide (SiC) :-is the second hardest of the dental abrasives and usually is applied to paper or plastic disk.

4. Garnet.

5.Sand; is a form of quartz (SiO2) is available on plastic or paper disk.

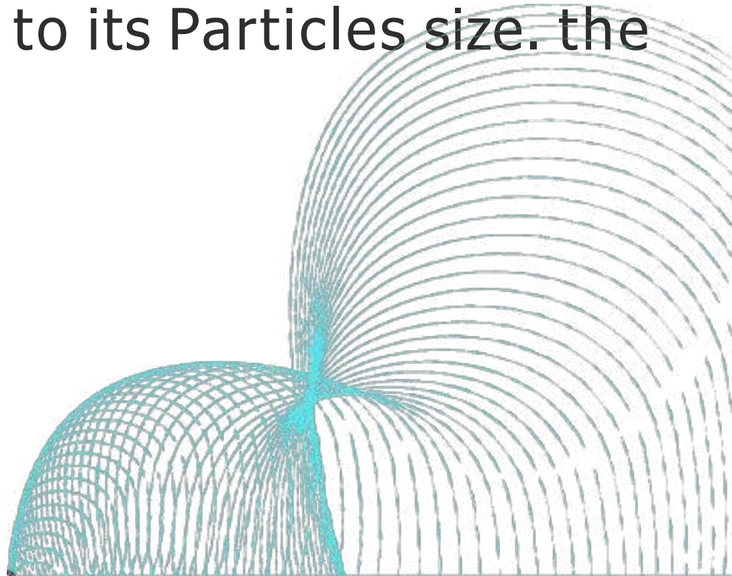
6, Tripoli:-is used as abrasive and polishing agent.

Pumice: it is used as abrasive and polishing agent according to its Particles size. the uses in dentistry is for:

a)smoothing of denture base.

b)Polishing of teeth in the mouth.

8/Emery.



Polishing

Polishing :is the process of reducing the irregularity of material surfaces .

MATERIALS OF POLISHING:-

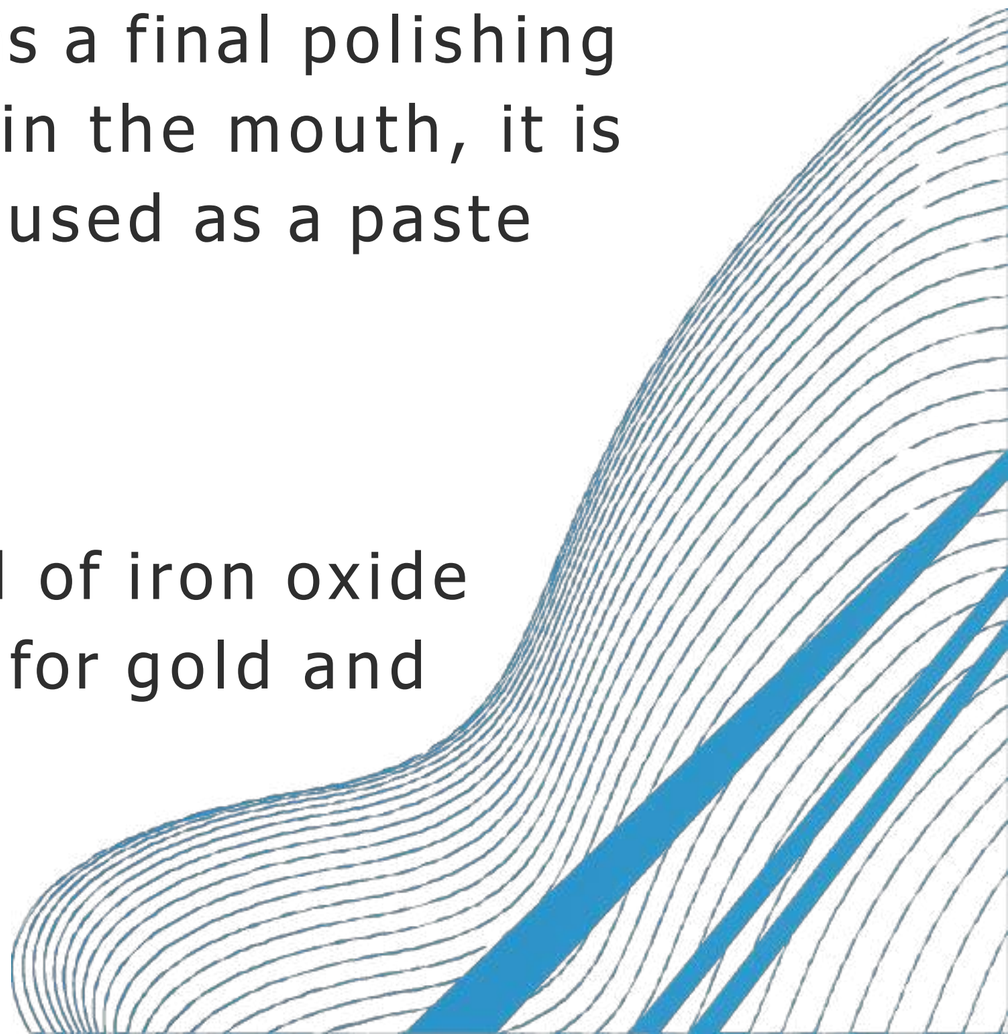
1. Tin oxide (SnOz):-
is a pure white powder used extensively as a final polishing agent for teeth and metallic restorations in the mouth, it is mixed with water alcohol or glycerin and used as a paste

2. Zirconium silicate (ZrSiO+):-

3. Pumice.

4. Tripoli.

5.Rouge:-it is a fine red powder composed of iron oxide (Fe2O3), It is an excellent polishing agent for gold and precious metal alloy.



GENERATION OF HEAT

There is heat generated during the process of abrasion so cooling often required for example:-

1)In cutting of tooth structure at high speed, water sprays required.

2)In abrading polymer materials, excessive heat should be avoided.

KEEP GOING ,
ALL THIS HARD
WORK WILL BE
WORTH IT
IN THE END . 🦋