Impression materials II
Impression materials are used to record the shape of the teeth and alveolar ridges. There are a wide variety of impression materials available each with their own properties, advantages and disadvantages.

Materials in common use can be classified as **elastic or rigid** (non-elastic) according to the ability of the set material to be withdrawn over undercuts.
**Alginate-Mixing**

Powder : Water = 1 : 3 in a flexible bowl with a curved, rigid spatula

- Container of powder should be shaken before use to get an even distribution of constituents. Powder and water should be measured to manufacture's instructions. Water at room temperature should be used, this gives a reasonable working time of a couple of minutes.
- On mixing the powder with water, a sol is formed, a chemical reaction takes place, and a gel is formed.
- Dimensionally unstable
  - Syneresis (H2O loss from the surface)
  - Shrinkage → impression should be cast in 15 minutes, or stored in hygrofor
- Do not adhere to the impression tray – adhesives, or perforated trays
- pH changes during setting - chromatic alginates
Study impressions of upper and lower jaw alginate
Study casts of upper and lower jaw
Rigid materials

**Elastic**
These materials can be stretched and bent to a fairly large degree without suffering any deformation. These are used for recording the patient's mouth where undercuts are present. Usually used for partial dentures, overdentures, implants and crown and bridge work.

**Rigid**
These materials are rigid and therefore exhibit little or no elasticity. Any significant deformation produces a permanent deformation. They are used where there are no undercuts and are mainly used for edentulous patient cases.

- Non-elastic impression materials are generally not used for obtaining impressions of crown preparations because of their inability to accurately record undercuts.
Impression materials after setting

Elastic

- Hydrocolloid:
  - Alginate
- Synthetic elastomers:
  - Polysulphide
  - Polyether
  - Silicone

Rigid

- Non undercut areas
  - Impression Plaster
  - Compound
  - Zinc-oxide eugenol paste
  - Wax
The synthetic elastomers

- First introduced in the late 1950s, synthetic elastomeric impression materials quickly became popular as dental materials because they significantly reduced the two main problems associated with the hydrocolloids, namely poor dimensional stability and inadequate tear resistance. These are used where a high degree of accuracy is needed, especially in crown and bridge work.

- They have two main advantages over the Hydrocolloids - good tear resistance and dimensional stability. They are mainly hydrophobic rubber based materials. All of these materials come in different viscosity's ranging from low to high viscosity. The light bodied material maybe used as a wash impression over a medium or heavy-bodied material.
Silicone elastomers

- Polymers of silicone and oxygen atoms → polysiloxane
  Elastic properties can be obtained by cross linking and addition of the long chains
- Viscosity types: high viscosity - heavy bodied, putty
  regular viscosity - intermediate flow
  low viscosity - light bodied
  very low viscosity - light bodied

Polydimethyilsilandiol
Condensation cured silicones

polysiloxane chains are terminated with silanol, dibutyltin dilaurate catalyst present during setting, condensation reaction occurs and the byproduct is alcohol

Supplied as a paste and liquid or two pastes, in light, medium, heavy or very heavy bodied (putty).

do not adhere to impression tray-adhesive solutions!
**PROPERTIES**
- Hydrophobic
- Hydrogen gas evolution on setting
- Moderate shelf life
- Moderate tear strength
- Good surface detail
- Shrinking of impression over time
- Non toxic and non irritant
- Very elastic (near ideal)

**ADVANTAGES**
- Accurate
- Ease of use
- Can be used on severe undercuts

**DISADVANTAGES**
- Hydrogen evolution
- Liquid component of paste/liquid system may cause irritation
Addition cured silicones

during setting, addition reaction occurs
Platinic compound catalyst present
no byproduct
no polymerization contraction

- Supplied in 2 pastes or in a gun and cartridge form as light, medium, heavy and very heavy bodied.
- On mixing, in equal proportions, crosslinking occurs to form a silicone rubber. Setting occurs in about 6-8 minutes.

do not adhere to impression tray-adhesive solutions!
expensive
**PROPERTIES**
- Good shelf life
- Dimensionally stable
- Moderate tear strength
- Excellent surface detail
- No gas evolution
- Non toxic and non irritant

**ADVANTAGES**
- Accurate
- Ease of use
- Fast setting
- Wide range of viscosity's

**DISADVANTAGES**
- Hard to mix
- Sometimes difficult to remove the impression from the mouth
- Too accurate in some circumstances (cast produced is not sufficiently oversized)
Polyether elastomers

**Composition:**

supplied as two pastes

- base paste:
  - liquid polyether
  - fillers
  - inert oils

- activator paste:
  - sulphonic acid ester in hydrocarbons
  - fillers

During setting reaction cross linking reaction occurs with the aziridino groups of the base and the end product is a rubber-like polymer.
A popular polyether impression material, Impregum (Espe GmbH, Germany), was the first elastomer to be developed specifically for use in dentistry and introduced in the late 1970s.
- **Impregum™ Penta™ Soft Heavy Body/Light Body Impression Material**
  Polyether precision impression material that is accurate and hydrophilic, resulting in outstanding detail even in a moist environment.

- **Impregum™ Penta™ Soft Medium Body Impression Material**
  Polyether precision impression material medium viscosity and is intended for use in the monophase technique.
Polyether impression materials tend to have a fast setting time of less than 5 minutes.

In contrast to polysulphides, they undergo an addition cured polymerisation reaction on setting which has no reaction by-product resulting in a material with very good dimensional stability.

The set material may however swell and distort because of the absorption of water on storage in conditions of high humidity. Impressions should therefore be stored dry.

Do not adhere to impression tray-special adhesives!
**PROPERTIES**
- Hydrophillic (ie absorbs water)
- Good shelf life of up to 2 years
- Good elastic recovery
- Non toxic
- Low setting contraction
- Low tear strength
- Excellent surface detail
- Good dimensional stability

**ADVANTAGES**
- Accuracy
- Good on undercuts
- Ease of use

**DISADVANTAGES**
- May cause allergic reaction due to the sulphonic acid ester
- Poor tear strength
- Rapid setting time (ie short working time)
- Stiff set material (sometimes hard to remove from mouth)
Polysulphide elastomers

• **Composition:**

  supplied as two pastes
  base paste: liquid polysulphide 55%
  fillers (ZnSO4, TiO2) 44%
  perfume 1%
  activator paste: lead-dioxide 10%
    colloidal sulfur 1%
    oleic and stearic acid 2%
    fillers (ZnSO4, TiO2) 50%
    inert oil 37%

  causes polymerization
  stabilizes setting
  characteristics

Mixing should continue until a streak-free mass is obtained
During setting reaction terminal hydrogen atoms of the liquid polisulfide are oxidized by the lead dioxide with a resultant increase in the degree of polymerization.

$$3\text{HS}-(R-S-S)_x-R-SH+\text{PbO}_2+S\rightarrow$$
$$\text{HS}-(R-S-S)_x-R-S-S-(R-S-S)_x-R-S-S-(R-S-S)_x-R-SH+2\text{H}_2\text{O}+\text{PbS}$$

- do not adhere to impression tray
- adhesives: rubber solution in acetone
- lead dioxide may have toxic effect
- alternative oxidizing systems
- types: heavy bodied
  - regular
  - light bodied
relatively unpopular materials, setting reaction of polysulphides tends to be long with setting times often in excess of 10 minutes (acceleration is possible by adding a small drop of water to the mix)

- messy to handle
- objectionable odour

Dies wider and shorter than the tooth preparation. This distortion, which worsens the longer the delay in pouring up, is the result of impression shrinkage which is directed towards the impression tray - hence the wider die. Shrinkage occurs firstly as a result of a continued setting reaction after the apparent setting time, and secondly through the evaporation of water produced as a by-product of the setting reaction.

- A special tray, providing a 4 mm uniform space, is needed to reduce distortion from the shrinkage of a large bulk of material. The recommended maximum storage time of the set impression is about 48 hours
**PROPERTIES**

- Dimensional stability
- Excellent surface detail (is only used in special trays)
- Viscosity depends on the brand used
- Very small setting contraction (0.3-0.4% over the first 24 hrs)
- Contraction on cooling from mouth to room temperature
- Very good tear resistance
- Good shelf life
- Viscoelastic

**ADVANTAGES**

- Dimensional stability
- Accuracy
- Comes in a number of different viscosity's
- Long working time (although this may be a disadvantage in some clinical situations)
- Long shelf life

**DISADVANTAGES**

- Lead oxide in base paste may have toxic effects
- Staining of clothes due to the Lead oxide
- Messy to work with - unpleasant rubbery smell
- Can only be used in a special tray
Impression materials after setting

**Rigid**
Non undercut areas
- Impression Plaster
- Compound
- Zinc-oxide eugenol paste
- Wax

**Elastic**
Undercut areas allowed
- Alginate
- Polysulphide
- Polyether
- Silicone
Impression Plaster

Composition – CaSO₄ . ½ H₂O

- Potassium-SO₄ or salts of strong acids (2,5%)
  → accelerators
  → reduce of the setting expansion

- Salts of weak acids or borax (0,25%)
  → retarders

- Coloring agent
Manufacturing

$$\text{CaSO}_4 \cdot 2\ H_2O \quad \leftrightarrow \quad \text{CaSO}_4 \cdot \frac{1}{2}\ H_2O + 1 \frac{1}{2}\ H_2O$$

Mineral gypsum: CaSO$_4$ · 2 H$_2$O - heating 110-130 °C
- dry $\rightarrow$ β-hemihydrate - irregular particles
  plaster of Paris, model stone
- autoclave $\rightarrow$ α-hemihydrate - more perfect crystals
  model stone, die stone
β-hemihydrate

α-hemihydrate
Setting reaction

- hydration reaction
- quick, exothermic, setting expansion
- $\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O} + 1 \frac{1}{2} \text{H}_2\text{O}$ crystallization $\text{CaSO}_4 \cdot 2 \text{H}_2\text{O}$
- 100g powder + 60 ml water - mixed in a flexible bowl with a spatula

Visible signs:

1. Dissolution - light surface $\rightarrow$ fluid
2. Colloidal state - matt surface $\rightarrow$ paste
3. Crystal formation - solid $\rightarrow$ hardening
4. Breaks with a special sound

Influence on the setting time and expansion:

- water/powder ratio
- spatulation time
- Temperature
PROPERTIES
- Excellent at recording fine detail (because very fluid when inserted in mouth)
- Dimensionally stable if anti expansion solution used
- Fractures if undercuts present
- Mucostatic
- Needs to be treated with a separating medium (e.g. varnish or soap solution) before being cast in stone or plaster
- Exothermic setting reaction
- On storage dimensionally stable but a small amount of shrinkage may occur
- Non toxic but may be unpleasant due to dryness and heat evolved during setting

ADVANTAGES
- Good surface detail
- Excellent dimensional stability
- Rate of the setting reaction can be controlled by the clinician

DISADVANTAGES
- Cannot be used for mucocdisplacive impressions
- Cannot be added to
- Properties affected by operator handling technique
- Taste and roughness may cause the patient to vomit

"History": exothermic, breaks, non convenient...
Impression compound

**Composition:**
mixture of thermoplastic resins and waxes 47%
with fillers (talcum) and pigments 53%

becomes soft between 55 °C and 60 °C in water bath
at mouth temperature reverts to a solid state
(slow reaction because of poor heat conduction)
- **Dental application**
  - Type I: used for impression taking
  - sheet (black, brown, red) primary impressions for complete dentures
  - green stick border trimming material
**PROPERTIES**
- Poor surface detail
- High coefficient of thermal expansion (contraction of up to 0.3% when removed from mouth to room temperature)
- Distorts when removed over undercut areas
- Hardens in the mouth in suitable time
- Mucodisplacive
- Poor dimensional stability
- Can be modified by re-heating
- Tray borders can be progressively developed with greenstick
- During manipulation internal stresses can be set up
- Non toxic and non irritant
- Good shelf life

**ADVANTAGES**
1. Non irritant and non toxic
2. Reusable (but with re-use the constituents are leached out)
3. Can be reheated and readapted
4. Can support other materials for wash impressions
5. Mucocompressive

**DISADVANTAGES**
1. Poor dimensional stability
2. Poor surface detail
3. Expansion coefficient
4. Will distort if removed from undercuts
Zinc-oxide eugenol paste

**Composition:**

- supplied as two pastes
- base paste: white, ZnO, Hydrogenated resin, inert oil
- activator paste: brownish, transparent, eugenol, fillers: talc, diatomaceous earth
- MgCl as accelerator

Some pastes contain a substitute for eugenol e.g. a carboxylic acid.

The 2 pastes come in contrasting colours and mixed to give a paste of even colour.

- The material is mixed in a 1:1 paste ratio and used in thin sections only (2-3mm) as a wash impression.

**Dental application:**

- secondary impression for complete dentures
- temporary luting of fixed appliances
**PROPERTIES**
- Non toxic
- Adherence to tissues
- Mucostatic or mucocodisplacive (depending on brand used)
- Good surface detail in thin section
- Good dimensional stability (little or no dimensional change on setting, 0.1% dimensional change during setting)
- Can be added to with fresh zinc oxide eugenol
- Stable on storage and good shelf life

**ADVANTAGES**
1. Dimensional stability
2. Good surface detail
3. Can be added to
4. Mucostatic or mucocodisplacive

**DISADVANTAGES**
1. Cannot be used in very deep undercuts
2. Only sets quickly in thin section
3. Eugenol allergy in some patients
Waxes

- **Origin of waxes:**
  - mineral wax – obtained from petroleum distillation
  - paraffin wax – brittle at room temperature
    - melting temperature: 48-70 °C
    - microcrystalline wax - less brittle
      - melting temperature: 65-90 °C
  - animal wax (beeswax)
    - adding to paraffin wax → less brittle
  - vegetable wax
    - carnauba wax: derived from palm tree
    - candenilla wax: derived from plants
Dental application

- modeling wax (rose)
- inlay wax (blue, green)
- sticky wax (yellow)
- baseplate wax
- border trimming impression wax
- undercut wax

Properties:

- Waxes are thermoplastic materials, which flow at mouth temperature and are soft a room temperature. They do not set by chemical reaction. Normally used to correct small imperfection (e.g. airblows) in other impressions, especially zinc oxide impressions.
- A cast should be poured up immediately after taking the impression to avoid distortion which readily occurs in wax.

Because of easy deformation not widely used as impression material!
Thank You for Your Attention!

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