B/ Nonelastic Impression Materials (Inelastic Impression Materials):

Inelastic impression materials are brittle materials that exhibit an insignificant amount of elastic deformation before fracture. They include

1. Impression plaster
2. Impression compound
3. ZOE impression paste

Impression plaster:

- Its fluidity makes it suitable for making impressions of soft tissues in the uncompressed state (a mucostatic impression material).
- a custom tray is needed
- It can be used as a wash impression material (a thin lining material placed over a stiffer base material or tray) for edentulous impressions.
- The main component of impression plaster is
  - i. β-calcium sulfate hemihydrate, which reacts with water to form calcium sulfate dihydrate.
  - ii. Additives to adjust the setting time and setting expansion.
- The water/powder (W/P) ratio should be measured out carefully.
- Impression plaster is rigid and will break rather than bend.
- The plaster must be stored in an airtight container, because it will absorb water from the air which may adversely affect its setting time.
- The clinician broke the plaster impression to facilitate removal of the impression and reassembled the fragments to form a completed impression ready for pouring the cast. A separate medium was applied on the impression to keep the cast from merging with the impression plaster. The impression would be fractured again to retrieve the cast.

Impression Compound (modeling plastic): (types I and II)

- Dental compound cannot be used to record undercuts because it is not elastic.
- Impression compound is available in either cakes or sticks in various colors.

- Uses:
  1. it can be used for full-crown impression (type I)
  2. impressions of partially or completely edentulous jaws (type I)
  3. impression trays in which a final impression is taken with another material (type II)

- Composition:
  1. Natural resins (40%) to give the compound its thermoplastic character. Shellac is often used.
  2. Waxes (about 7%) also have thermoplastic properties
  3. Stearic acid (about 3%) acts as a lubricant and plasticizer.
  4. Fillers (eg, diatomaceous earth, soapstone, and talc)
  5. Inorganic pigments account for the remaining 50% of the formulation.

- Thermal and mechanical properties:
  1. The setting mechanism is a reversible physical process rather than a chemical reaction. Dental compound's thermoplastic property allows it to be used warm (45°C) and then cooled to oral temperature (37°C), at which it is fairly rigid.
  2. Dental compound is limited by its thermal properties. Type I materials have a flow of at least 85% at 45°C and less than 6% at 37°C. Type II materials flow about 70% at 45°C but less than 2% at 37°C. Both types become quite plastic with only an 8°C rise in temperature.
  3. The thermal conductivity of dental impression compounds is very low. These materials require heat soaking to attain a uniform temperature throughout the mass. When heated or cooled, they soften or harden quickly on the outside, but time is needed for the temperature to become uniform throughout the entire mass. If the impression is removed from the mouth before it has cooled completely, severe distortion may occur.
  4. Since these materials contain resins and waxes, they have high thermal expansion and contraction coefficients. Contraction from oral temperature to room temperature may be as high as 0.3%. Therefore, the dimensions of the resulting impression could be significantly different from those of the mouth.
  5. Since the compound has such a high viscosity, it is difficult to record details.
  6.

- Manipulation:
  - Impression compound is softened by heating over a flame or in a water bath. Care must be taken to prevent volatilizing ingredients over a direct flame.
  - A room-temperature water spray is used to cool the impression in the mouth.
  - Care must also be taken to prevent overheating and burning of the tissues being replicated. Also, cooling water should not be too cold, to prevent thermal shock.
  - To ease separation of the die stone, the impression should first be softened by immersion in warm water.

- Advantages:
  1. Dental impression compound is compatible with die and cast materials
  2. easily electroplated to form accurate and abrasionresistant dies.

- Disadvantages:
    1. The handling of dental impression compound is very technique sensitive. If it is not prepared properly, volatiles can be lost on heating or low-molecular-weight ingredients can be lost during immersion in a water bath. Also, excessive wet kneading can incorporate water into the mix and change the flow properties of the compound.
    2. Due to a high coefficient of thermal expansion, the dimensions of the impression are not likely to be the same as the dimensions in the mouth.
    3. These materials are nonelastic and may distort on removal from the mouth.
    4. The casts should be poured within 1 hour.

Zinc oxide–eugenol:

- Uses:

1. for dentures on edentulous ridges with minor or no undercuts.
2. as a wash impression over the compound in a tray or in a custom acrylic tray.
3. as a bite registration material.

- Composition:

This material is available in:
*a powder and liquid form and as *two pastes.
One paste, called the base or catalyst paste, contains:

1. zinc oxide (ZnO),
2. oil acts as a plasticizer and aids in offsetting the action of the eugenol as an irritant
3. hydrogenated rosin to facilitate the speed of the reaction and yields a smoother, more homogeneous product

The second paste, the accelerator, contains:

1. about 12% to 15% eugenol,
2. oils,
3. rosin,
4. a filler such as talc or Kaolin.

These two pastes have contrasting colors so it can be determined when the pastes are thoroughly mixed.
Mixing of the two pastes is accomplished on an oil-impervious paper or glass mixing slab.
Equal lengths of the two pastes, or properly proportioned amounts of the powder and liquid, are mixed with a stiff spatula on a special oilresistant paper pad or a glass slab.
The mixed material is placed in a preliminary impression made from tray compound or tray acrylic.
The setting time is shortened by increases in temperature and/or humidity. The set material does not adhere to set dental plaster or stone.
Zinc oxide, in the presence of moisture, reacts with eugenol to form zinc eugenolate, which acts as a matrix holding together the unreacted zinc oxide: The setting reaction is accelerated by the presence of water, high humidity, or heat.
A dimensional change of only about 0.1% shrinkage (a negligible shrinkage) accompanies the setting.
These impression materials are classified as hard-and soft-set.
The hard-set material sets faster (in about 10 minutes, compared with 15 minutes for the soft-set material), although the hard- and soft-set materials both begin to set in about 5 minutes. The hard-set material is more fluid before setting than the soft-set material; after setting, it is harder and more brittle.

Noneugenol pastes containing carboxylic acids (eg, lauric or orthoethoxybenzoic acid) in place of eugenol are available to avoid the stinging and burning sensation experienced by some patients.

- Mechanical properties :

The hardness of zinc oxide–eugenol impression materials is determined using a Krebs penetrometer with a load of 100 g for 10 seconds. The hardness for type I (hard-set) materials should be no greater than 0.5 mm, and the hardness for type II (soft-set) materials should be between 0.8 and 1.5 mm.

The cast should only be made from gypsum-type plaster or stone. After the stone has set, the impression is immersed in warm water (60°C) to ease its removal from the cast. The spatula may be cleaned by warming or by wiping with available solvents.

- Advantages:
    1. gives high accuracy of soft tissue impressions due to its low viscosity.
    2. The material is stable after setting
    3. has good surface detail reproduction
    4. inexpensive.
    5. It also adheres well to dental impression compound.

- Disadvantages:
    1. This material is messy
    2. has a variable setting time due to temperature and humidity.
    3. Eugenol is irritating to soft tissues.
    4. This material is nonelastic and may fracture if undercuts are present.