Elastomers

Elastomeric impression materials are cross-linked polymers when set that can be stretched and yet rapidly recover to their original dimensions when stress is released.

Chemically, there are three elastomers:

1. Polysulfides.
2. Condensation silicones.
3. Addition silicones (polyvinylsiloxanes),
4. Polyethers.

Chemistry of Elastomeric Impression Materials:

Elastomeric impression materials are supplied in two components, a base and a catalyst (or accelerator), that are mixed before making impressions. The term catalyst or accelerator used here may be a misnomer with certain material systems. Reactor is a more appropriate term for the polysulfide and condensation silicone because they participate in the reaction. In the case of polyether, the catalyst contains initiators.

Mixing Systems:

Two types of systems are available to mix the catalyst and base thoroughly before taking the impression:

1) static auto-mixing in which the base and catalyst are in separate cylinders of the plastic cartridge.
2) Dynamic mechanical mixing in which the catalyst and base are supplied in large foil bags housed in a cartridge, which is inserted into the top of the mixing machine.

One variation in mixing is with the two-putty addition-silicone systems mixed by hand. Scoops are supplied by the manufacturer for dispensing, and the putties are most often kneaded with fingers until free from streaks. The putty materials that have a liquid catalyst are initially mixed with a spatula until the catalyst is reasonably incorporated, and mixing is completed by hand. It should be noted that latex gloves may interfere with setting of addition-silicone impression materials.

Mixing systems. **A**, Hand mixing. Two equal lengths of the material are dispensed on the mixing pad with the mixing spatula. B, Static mixing. When the trigger is pulled, the plunger is driven forward (to the left) so that the base and catalyst pastes are forced from the cartridge into the mixing tip (extreme left). The pastes pass through the bore and exit the nozzle as a uniform mixed paste. Four different sizes of mixing tips are shown; the more viscous the material, the larger is the mixing tip that should be used. Syringe tips can be fit to the nozzle to deliver the mixed paste directly to the prepared teeth. **C**, Static mixing syringe. These syringes fit the cartridge, such as the mixing tips shown in (**B**). The base and catalyst are first injected into the respective barrel. A plunger then forces the material through a smaller static mixing tip. It can deliver the light-body material directly onto the abutment(s). **D**, Dynamic mechanical mixing. The motor-driving mechanism forces the material into the mixing tip and makes the impeller (insert) inside the tip rotate. The function of the impeller is only to mix the material.

Impression Techniques:

1) **The simultaneous, dual-viscosity technique** is one in which low-consistency material is injected with a syringe into critical areas and the high-consistency material is mixed and placed in an impression tray. After injecting the low-viscosity material, the tray containing the higher-viscosity material is placed in the mouth. In this manner, the more viscous tray impression material forces

the lower-viscosity material to flow into fine aspects of the areas of interest. Because they are both mixed at nearly the same time, the materials join, bond, and set together. After the materials have set, the tray and the impression are removed.

An elastomeric addition-silicone impression.
Turquoise material is of a low or injection consistency, and maroon material of a high or tray consistency.

2) **Single-viscosity or mono phase technique:** impressions are often taken with a medium-viscosity impression material. Addition-silicone and polyether impression materials are well suited for this technique because both have a capacity for shear thinning. When the medium viscosity material is forced through an impression syringe, the viscosity is reduced (because it is pseudoplastic material) whereas the viscosity of the same material residing in the tray is unaffected. In this manner, such materials can be used for syringing and for trays, as previously described for the simultaneous, dual-viscosity technique.
3) **The putty-wash technique (wash technique):** is a two-step impression procedure whereby a preliminary impression is taken in high- or putty-consistency material before the cavity preparation is made. Space is provided for a lowconsistency material by a variety of techniques, and after cavity preparation, a low-consistency material is syringed into the area and the preliminary impression reinserted. The low- and high-consistency materials bond, and after the low-consistency material sets, the impression is removed. The putty-consistency material and this technique were developed for condensation silicones to minimize the effects of dimensional change during polymerization. Most of the shrinkage during polymerization takes place in the putty material when the preliminary impression is made, confining final shrinkage to the thin wash portion of the impression. Care must be taken so the wash material can freely escape via vents in the putty material when the wash impression is made.

❖ Polysulfides:

Composition and chemistry:

1) The base paste contains the polysulfide polymer, fillers (zinc oxide, titanium dioxide, zinc sulfide, and silica) to provide the consistency for mixing and the required strength when set , and plasticizers to confer the appropriate viscosity for workability of the paste, and a small quantity of sulfur (~0.5%) to accelerate the reaction.
2) The catalyst paste contains lead dioxide, filler, and plasticizer, as in the base paste, and oleic or stearic acid as a retarder to control the rate of the setting reaction. The balance of the catalyst paste is made up of inorganic fillers used to adjust the consistency and reactivity.

Each paste is supplied in a dispensing tube with appropriately sized bore diameters at the tip so that equal lengths of each paste are extruded from each tube to provide the correct ratio of base to crosslinking agent. They are available in low, medium, and high viscosities.
The condensation reaction causes the material to change from a paste to a rubber. The reaction is accelerated by increases in temperature and by the presence of moisture. The reaction yields water as a by-product. Loss of water from the set material has a significant effect on the dimensional stability of the impression.

Uses:

1) They are widely used for fixed partial denture application.
2) These materials are useful for multiple impressions when extra time is needed.

Advantages:

1) high accuracy.
2) Relatively low cost.

Disadvantages

1) Polysulfides have an unpleasant odor.
2) Polysulfides have a tendency to run down the patient's throat due to lower viscosity.
3) stain clothing permanently.
4) Also, custom-made rather than stock trays are needed because of the greater chance of distortion.
5) Further, polysulfides must be poured within 1 hour and cannot be re-poured.

Disinfection

Polysulfide impressions can be disinfected by immersion in sodium hypochlorite, iodophors, complex phenolics, glutaraldehydes, or phenolic glutaraldehydes.

❖ Addition Silicone (polyvinyl siloxane (PVS) or vinyl polysiloxane (VPS)):

Composition:

- A base paste of this class of impression materials contains:
  a) polymethylhydrosiloxane
  b) siloxane prepolymers
  c) filler.
- The accelerator (catalyst) contains
  a) a divinylpolysiloxane
  b) a platinum salt (chloroplatinic acid) a catalyst which starts the addition polymerization reaction
  c) filler.
- Unlike the condensation type, the addition reaction does not normally produce a low-molecular-weight byproduct.
- A secondary reaction can occur with the production of hydrogen gas which can result in pinpoint voids in the gypsum casts poured soon after the removal of the impression from the mouth. . Epoxy dies should not be poured until the impression has stood overnight. Some products contain a hydrogen absorber (scavenger) such as palladium, and gypsum and epoxy die materials can be poured against them as soon as practical.
- Sulfur contamination from natural latex gloves inhibits the setting of addition silicone. The contamination is so pervasive that touching the tooth with latex gloves before seating the impression can inhibit the setting of the critical surface next to the tooth. Thorough washing of the gloves with detergent and water just before mixing sometimes minimizes this effect, and some brands of gloves interfere with the setting more than others. Vinyl and nitrile gloves do not have such an effect. Residual monomer in acrylic provisional restorations and resin composite cores has a similar inhibiting effect on the set of addition-silicone materials. The preparation and adjacent soft tissues can also be cleaned with 2% chlorhexidine to remove contaminants.

Consistency:

Addition silicones are available:

1. Extra-low.
2. Low (syringe or wash).
3. Medium (regular).
4. Monophase.
5. High (tray).
6. Putty (extra-high) consistencies

Advantages:

1) Ability to make multiple, accurate diagnostic casts from one impression.
2) Better detail reproduction.
3) Less variability in linear dimensional change than alginates.

Disadvantages:

1) The material is expensive
2) it is more rigid than condensation silicones and is difficult to remove around undercuts
3) it has a moderate tear strength, making removal from gingival retraction areas somewhat risky
4) it may release hydrogen gas on setting, producing bubbles on die surfaces if the material does not contain a hydrogen absorber.
5) Hydrophobic materials are difficult to electroplate and to pour in stone.
6) sulfur in latex gloves and rubber dam can inhibit polymerization.

❖ Condensation Silicone

The materials are supplied as a base paste and a liquid catalyst, a two-paste system, or a two-putty system. Condensation silicones are available in low, medium, high, and very high (putty) viscosities.

Composition:

- The base paste usually contains:
  a) Poly (dimethylsiloxane)
  b) orthoalkylsilicate
  c) inorganic filler 30% to 40% filler (A putty will contain 75% filler)
- The catalyst paste or liquid usually contains
  a) a metal organic ester, such as tin octoate or dibutyl tin dilaurate
  b) an oily diluent. A thickening agent is also used when making catalyst pastes.
  c) Sometimes a catalyst will contain both the orthoalkylsilicate and the metal organic ester.

Advantages

1. clean, favorable materials for the patient.
2. They are highly elastic
3. the setting time can be controlled with the amount of accelerator.
4. The use of a putty-wash method improves accuracy and eliminates the need for a custom tray.

Disadvantages

1. inaccurate due to shrinkage on standing and should be poured within 1 hour.
2. They are very hydrophobic, require a very dry field
3. difficult to pour in stone.

❖ Polyether rubber

The high stiffness and short working time of polyether rubbers restricts their use to impressions of a few teeth. They give accurate impressions without severe under-cuts.
Polyethers are available in low-, medium-, and high-viscosity materials.

Composition

These materials are supplied as two-paste systems:

- The base paste contains:
    a. polyether polymer
    b. fillers, such as colloidal silica
    c. plasticizer such as glycol ether or phthalate.
- The catalyst paste contains:
    a. an aromatic sulfonic acid ester
    b. a thickening agent
    c. fillers

Advantages

1. easy to handle and to mix.
2. These materials are more accurate than polysulfide or condensation silicone impression materials. They have good surface detail reproduction and are easily poured in stone.
3. If kept dry, they will be dimensionally stable for up to 1 week.

Disadvantages

1.The cost of these materials is high
2. working and setting times are short
3. High stiffness after setting, which limit their use.
4. Their bitter taste is objectionable to some patients.
5. Storage of polyether impressions is critical, as they will distort if stored in water or high humidity.
6. They cannot be left in disinfectant solutions for long periods.