Elastic Impression Materials

1.Hydrocolloid Impression Materials

The colloid can exist in the form of a viscous liquid known as a sol, or a solid described as a gel. If the particles are suspended in water, the suspension is called hydrocolloid.

Hydrocolloid impression materials are based on colloidal suspension of polysaccharide in water. In sol form means there is random arrangement of polysaccharide chain; while in gel form means the long polysaccharide chain becomes aligned and material becomes viscous and develop elastic properties. Gelation means the conversion of sol form to gel form.

♣ Types of hydrocolloid impression materials:

Based on the mode of gelation, they are classified as:

1. **Reversible hydrocolloids:** set by lowering the temperature, e.g. Agar; this make them reusable.
2. **Irreversible hydrocolloids:** set by chemical reaction, e.g. Alginate; once set it is usually permanent.

◘ Reversible hydrocolloids ~ Agar

It was the first successful elastic impression material to be used in dentistry. It has been largely replaced by alginate hydrocolloid and rubber impression materials.

- **Uses:**
  1. Cast duplication (during fabrication of cast metal removable partial denture).
  2. Full mouth impression without deep undercuts.
  3. Crown & bridge impression before elastomers came to the market.
  4. As tissue conditioner.

- **Supplied as:**
  1. Gel in collapsible tube for impression, used with water cooled impression tray.
  2. A number of cylinders in a glass jar (syringe material).
  3. In bulk containers.

- **Composition:**

  ***** Gel tray type:**

Component	**Amount**	**Purpose**
Agar	12%	colloid
Borax	0.2%	improve the strength of the gel
Potassium sulphate	1-2%	ensure proper setting of gypsum cast against agar (accelerator for model material)
Alkyl benzoate	0.1%	preservatives
Dyes of flavoring	trace	appearance & taste
Water	85%	acts as dispersion medium

  ***** Syringe applied material:** has the same component but a lower concentration of agar (6-8%).

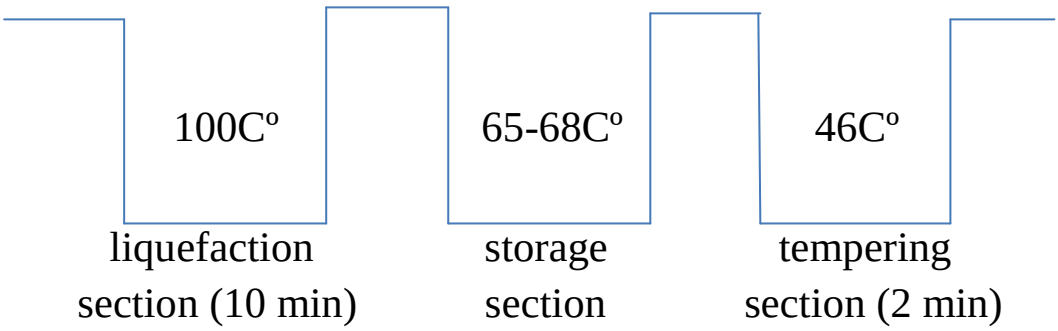
- **Manipulation:**

Agar hydrocolloid requires special equipment:

A. Hydrocolloid conditioner.

B. Water cooled rim lock trays.

****** A.** Agar is normally conditioned prior to use, using specially designed conditioning bath (Temperature controlled water bath), the conditioning bath consists of three compartments each hold at different temperature.



1. Boiling section or liquefaction section: tube of gel converted to viscous liquid after tem minutes in boiling water 100Cº. The sol should be homogeneous and free of lumps. Every material the material is re-liquefied, three minutes should be added; this because it is more difficult to break down the agar brush heap structure after a previous use. It should not be re-heated more than four times.

2. Storage section: 65-68Cº temperature is ideal when agar can be stored in the sol condition till needed.

3. Tempering section: 46Cº for about two minutes with material loaded in the tray. This is done to reduce the temperature so that it can be tolerated by the sensitive oral tissue. It also makes the material viscous.

******B.** The tray containing the tempered material is removed from the bath, the outer surface of the agar sol is scraped off, then the water supply is connected to the tray and the tray is positioned in the mouth. Water is

circulated at 18-21C^{o} through the tray until gelation occurs (rapid cooling; e.g. ice cold water, is not recommended as it can induce distortion.

- **Properties:**

1. It is hydrocolloid and mucostatic impression.

2. It provides very accurate reproduction of surface detail because in sol form agar is sufficiently fluid. In gel form agar is sufficiently flexible to be easily removed.

3. Agar impression is highly accurate at the time of removal from the mouth. Storage of agar impression is to be avoided; the cast should be poured immediately. Storage in air results in dehydration (shrinkage) and storage in water results in swelling of the impression; it absorbs water by process known as (imbibition), the gel may also loose water by exuding of fluid in a process known as (syneresis). During syneresis droplets of exudate are formed on the surface of hydrocolloid and the process occur irrespective of the humidity of surrounding atmosphere. If storage is unavoidable, it should be limited to one hour in 100% relative humidity (by wrapping it in a wet towel) which results in least dimensional changes.

4. Poor mechanical properties and low tear resistance but it is better than alginate.

5. The material is viscoelastic, so it is important that the tray is removed by a rapid snap action, this enhanced the elastic recovery and reduce the permanent deformation.

6. It is necessary to have reasonable thickness of impression material to limit the extent of deformation arising on removal from the undercut.

7. It is cheap and used in some laboratories for making duplicate models as it can be recycled up to four times.

- **Disadvantages:**

1. Need special equipment such as water cooled tray which is very bulky and temperature controlled bath and there is an initial cost in providing this equipment.
2. Great care must be exercised to ensure that the water baths do not get contamination.

◘ Irreversible hydrocolloids ~ Alginate

It is one of the most widely used dental impression material. It is supplied as powder mixed with water. A plastic scope is provided for dispending the bulk powder, a plastic cylinder is supplied for measurement of water. A wide blade, stiff spatula is used to mix powder and water. Used widely for taking impression of partial dentures and not recommended for crown and bridge work.

● Composition:

Ingredients and their function in alginate powder as follow:

	Ingredient	%	Function
1.	Sodium alginate	18	Hydrogel former (dissolve in water & reacts with calcium ions)
2.	Calcium sulphate dihydrate	14	Provides calcium ions of the cross linking reaction that converts sol to gel
3.	Sodium phosphate (Na3PO4)	2	Control working time, serve as retarder react with calcium sulphate
4.	Potassium sulphate (KSO4)	10	Counteract the inhibition effect of alginate on the setting of gypsum model material
5.	Filler (diatomaceous earth or silicate powder)	56	Control consistency of the mix

6.	Organic glycol	small amount	Coast the powder particles to minimize dust during dispending
7.	Pigments	trace	Provide color
8.	Quaternary ammonium	trace	Provide self-disinfection
9.	Reactive indicator (present in some product)		Give color change when setting is complete

❦ Chemical reaction:

when mixed powder and water, a chemical reaction occurs that cross links the polymer chain forming a three dimensional network structure.

chemical reaction

sol (powder+water) ⟶ gel

+water

sodium + calcium sulphate ⟶ sodium sulphate + calcium alginate gel

alginate dihydrate

The calcium alginate precipitates into fibrous network with water occupying the intervening capillary spaces.

❦ Mixing:

Powder should be mixed thoroughly before use, to eliminate the segregation of component that may occur during storage. When mixed powder with water a vigorous figure eight motion is the best with the mix being swiped against the side of the rubber bowel with intermitted rotation of spatula to press out air bubbles. The mix should be smooth, creamy with minimum of voids and does not drip off the spatula when it is raised from the rubber bowel.

● Properties:

1. It has a well controlled working time but does vary from product to product. There are regular setting (setting time 2-4.5 minutes) and fast setting (setting time 1-2 minutes) versions of this impression material. Lengthening of setting time is better accomplished by reducing the temperature of the water used with mix (18-24C^{o}). The clinical setting time can be detected by the loss of tackiness of the surface.

2. The material is mucostatic and also hydrophilic.

3. The material should be left in place for 2-3 minutes after tackiness has gone from the surface, since the tear strength and resistance to permanent deformation increase significantly during this period.

4. The surface production with alginate is not as good as that with agar or elastomers, they are not recommended for crown & bridge work, they are popular for partial denture work.

5. Alginate is susceptible to evaporation, syneresis and imbibition; giving poor dimensional stability, therefore the cast should be poured immediately, if storage is unavoidable; keeping in humid atmosphere of 100% relative humidity no more than one hour.

6. It is a highly viscoelastic material (like agar), a snap removal technique need to be employed in order to get an elastic response. The permanent deformation is somewhat higher than agar.

7. It has lower tear strength than agar and has poor mechanical properties.

8. Set gypsum model should not remain in contact with the alginate impression for a period of hours because contact of slightly soluble calcium sulphate dihydrate with alginate gel containing a great deal of water is detrimental to the surface quality of model.

9. Thin layers of alginate are weak. The thickness of alginate impression between the tray and tissue should be at least 3mm.

10. Retention means to hold the material to the tray is needed, therefore perforated tray or rim lock tray is needed.

11. They restrict the choice of model and die materials to those of gypsum type (cannot prepare metal dies).

12. Low cost. Alginate hydrocolloid is highly elastic but less when compare to agar.