

DENTAL METARIALS

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Hydrocolloid impression materials the colloids are often classed as the fourth state of matter known as colloidal state, they can exist in the form of viscous liquid known as a sol, or a jelly like elastic semi-solid described as a gel.

If the particles are suspended in water, the suspension is called hydrocolloid.

Hydrocolloid impression materials are based on the colloidal suspension of polysaccharide in water.

- **In sol form:** there is random arrangement of polysaccharide chain.
- **In gel form:** the long polysaccharide chains become aligned and material becomes viscous and develops elastic properties.

Gelation: it is conversion of sol to gel.

Type 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 makes them reusable.
- 2- Irreversible hydrocolloids set by a chemical reaction. Once set it is usually permanent e.g. alginate.



Agar

agar hydrocolloid was the first successful elastic impression material to be used in dentistry. It is an organic hydropinghlic colloid extracted from certain types of seaweed. Although it is an excellent impression material and yields accurate impressions presently it has been largely replaced by alginate hydrocolloid and rubber impression materials.

Uses

- 1- for cast duplication (during fabrication of cast metal removable partial denture).
- 2- for full mouth impressions without deep undercuts.
- 3- for crown and bridge impressions before elastomers came to the market.
- 4- as tissue conditioner.

Supplied as

- 1- gel in collapsible tubes (for impressions with water cooled tray).
- 2- A number of cylinders in a glass jar (syringe material).
- 3- in bulk containers (for duplication).

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Component	purpose
Agar (12%)	Colloid
□ Potassium sulfate (1 -2 %)	It acts as dispersion medium. To improve the strength of gel. To ensure proper setting of gypsum cast against agar (accelerator for cast material) Preservative. Thixotropic material (it acts as plasticizer).

□ Coloring and flavoring agents (traces)

Manipulation



Agar hydrocolloid requires special equipment:

- 1- hydrocolloid conditioner.
- 2- Water cooled rim lock tray.

Agar is normally conditioned prior to use by specially designed conditioning bath (temperature controlled water bath). The conditioning bath consist of three compartments each hold at

different temperature.

1- Boiling section or liquefaction section

- the tube of the gel converted to viscous liquid after 10 minutes in boiling water (100°C).
- The sol should be homogenous and free of lumps.
- Every time the material is reliquefied, 3 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 reheated more than 4 times.

2- Storage section

- 65-68°C temperature is ideal when agar can be stored in the sol condition till needed.

3- Tempering section

- 46°C for about 2 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.

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°C to 21°C through the tray until gelation occur, rapid cooling (ice cold water) is not recommended as it can induce distortion.

Conditioning unit

Liquefying	Store	Tempering
100° C	65° C	46° C



Alginate alginate was developed as a substitute for agar when it became scarce due to World War II (Japan was a prime source of agar).

Currently, alginate is more popular than agar for dental impression, because it has many advantages.

Types

- 1- fast setting.
- 2- Normal setting.

Supplied as a powder that is packed in bulk container (sachets), a plastic scoop is supplied for dispensing the bulk powder, and a plastic cylinder, is supplied for measuring the water.

Application

- 1- it is used for impression making.
 - When there are undercuts.
 - In mouth with excessive flow of saliva.
 - For partial dentures with clasps.
- 2- for making preliminary impression for complete denture.
- 3- for impression to make study models and working casts.
- 4- for duplicating models

Composition

Setting reaction sodium alginate powder (soluble) dissolves in water to form a sol, that reacts with calcium sulfate (reactor) to form calcium alginate (insoluble gel) this reaction is too fast, there is not enough working time, so the reaction is delayed by addition of a retarder (sodium phosphate).

Properties (according to ADA specification no. 18 for alginate hydrocolloids)

- 1- alginate has a pleasant taste and small.
- 2- Its flexibility is about 14 % at a stress of 1000 gm/cm²
lower w/p ratio (thick mixes) results in lower flexibility.
- 3- Alginate is highly elastic, but less than agar. 4- The elastic recovery is 97.3 %, permanent deformation is less if the set impression is removed from the mouth quickly.
- 5- Detail reproduction is also lower when compared to agar.
- 6- Compressive strength is 5000-8000 gm/cm².
- 7- Tear strength is 350-700 mg/cm².

Factors affecting alginate gel strength

- w/p ratio, too much or too little water reduces strength.
- mixing time, over and under mixing both reduce strength.
- Time of removal of impression, strength increases if the time of removal is delayed for few minutes after setting.

8- Set alginate has poor dimensional stability due to evaporation, syneresis, and imbibition. The alginate impression should be poured immediately. If storage is unavoidable, keeping in a humid atmosphere of 100 % relative humidity (wrap with wet paper towel). Even under these conditions storage should not be done for more than 1 hour.

9- Alginate does not adhere well to the tray. Retention to the tray is achieved by mechanical locking in the tray (rim

Ingredients	%	Functions
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lock, perforated tray) or by adhesive.

10- The silica particles present in the dust of alginate powder are health hazard.

11- Shelf life and storage: alginate material deteriorates rapidly at elevated temperature and humid environment.

- * mixing time: 45-60 seconds.
- * Working time: 1-2 minutes.
- * setting time (gelation time): 2-4 minutes.

- **Control gelation time**

1- gelation is best controlled by adding retarders.

(**Manufacturer s hands**).

2- **The dentist** can best control the setting time by altering

	WT	
1- Sodium or potassium or triethanolamine alginate. 2- Calcium sulfate (reactor). 3- Zinc oxide. 4- Potassium titanium fluoride. 5- Diatomaceous earth. 6- Sodium phosphate (retarder). 7- Coloring and flavoring agents.	traces	Dissolves in water and reacts with calcium ions. Reacts with potassium alginate and forms insoluble calcium alginate. Acts as filler. Gypsum hardener. Acts as filler. Reacts preferentially with calcium sulfate. e.g. wintergreen, peppermint and anise, orange etc.

the temperature of the water colder the water, longer is the setting time, even the mixing bowl and spatula can be cooled.

- **Test for set** the alginate loses its tackiness and rebound fully when prodded with a blunt instrument some alginate are available with (color indicator), which on mixing is one color and on setting change to a different color.

Advantages

1- it is easy to mix and manipulate and need minimum equipment.

- 2- Flexibility of the set impression.
- 3- If properly handled, it gives accuracy and good surface details even in presence of saliva.
- 4- Low cost.
- 5- comfortable to the patient.
- 6- It is hygienic.

Disadvantages 1- it cannot be corrected.

- 2- Poor tear strength.
- 3- Distortion may occur without it being obvious if the material is not held steady while it is setting.
- 4- It cannot be stored for long time.
- 5- because of the above drawbacks and because of availability of better materials it is not recommended when high level of accuracy is required e.g. cobalt chromium
rpd, crown and bridge, etc.

Technical considerations of alginate

- 1. Impression should not be exposed to air because some dehydration will occur and result in shrinkage.
- 2. Impression should be protected from dehydration by placing it in a humid atmosphere or wrapping it in a damp paper towel until a cast can be poured. To prevent volume change, this should be done within 15 minutes after removal of the impression from the mouth.
- 3. Impression should not be immersed in water or disinfectants, because some imbibition will occur, and result in expansion.
- 4. Exudate from hydrocolloid has a retarding effect on the chemical reaction of gypsum products and results in a chalky cast surface. This can be prevented by pouring the cast immediately.
- 5. When alginate is used, place the measured amount of water (at 18-20°C) in a clean, dry, rubber mixing bowl. Add the correct measure of powder. Stir rapidly against the side

of the bowl with a short, stiff spatula. This should be accomplished in less than (1 minute). The patient should rinse his or her mouth with cool water to eliminate excess saliva while the impression material is being mixed and the tray is being loaded.

6- To prevent internal stresses in the finished impression, do not allow the tray to move during gelation (hold the tray immobile for 3 minutes). Do not remove the impression from the mouth until the impression material has completely set (releasing the surface tension).

* **cast construction** the stone cast should not be separated for at least 45 minutes the cast should not be left in the alginate

impression for too long a period **because:**

1- after setting the alginate can act as sponge, deprive stone from water result in a rough chalky surface.

Dried alginate becomes stiff, so removal of cast can break the teeth

المصادر:

1. PHILLIPS SCIENCE OF DENTAL MATERIALS-KENNETH J. ANUSAVICE, D.M.D, Ph.D.

2. RESTORATIVE DENTAL MATERIALS- ROBERT G. GRAIG, Ph.D.