Reversible agar agar hydrocolloid
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Reversible agar agar hydrocolloid remains an excellent, cost-effective impression material. A review of the history of the development of the material and a sound technique for its use are presented. (Quintessence Int 1990;21:225-229.)

Introduction
In recent years, many new elastomeric materials for making dental impressions have been introduced. While each demonstrates specific properties that address problems presented to the dentist, I find that an old standby still ranks as the standard. This material, reversible agar agar hydrocolloid, with little change, has met the test of time and remains a cost-effective, excellent impression material.

Agar agar hydrocolloids were first used in industry in 1925. The first “tooth impressions” (in the mouth) were made in 1937. Until that time, the chemicals used to strengthen the hydrocolloid material were harmful to human tissue.

In 1938, Rose, the Dean of the University of Tennessee College of Dentistry, assigned to me (then a first-year dental student) the task of making complete-arch impressions of the dental students currently enrolled in the dental college. Rose was a periodontist and was concerned with occlusion of the teeth as a causative factor of periodontal disturbances.

My assignment was to make the impression, pour the stone casts, and make interocclusal records. Rose and others mounted the casts in Hanau articulators, studied the occlusion, and adjusted the occlusion to their satisfaction. Usually the result was monoplane occlusion, but there were no interferences left when they were finished.

The two impression materials available at that time were plaster of paris and compound. These two materials were carried to the mouth in smooth metal trays. The materials were allowed to “set” or harden to the appropriate time, the tray was removed from the mouth, and, after proper cuts, the impressions were removed in sections from the mouth. The above description is an oversimplification of a difficult, tedious exercise.

The plaster sections were then allowed to dry, repositioned in the tray, and luted together with sticky wax. The compound sections did not need to dry. A separating solution was applied to the plaster impression (none was needed for the compound), and the impression was poured in cast, or similar, stone.

To circumvent the hard work and to prevent intra-oral lacerations caused by these impression procedures, Rose suggested that I investigate the possibility of using agar agar hydrocolloid.

Agar agar chips or flakes were purchased from the local pharmacy in large quantities. It was the same material that bacteriologists had been using for years in their petri dishes. Remember this should you be tempted to reuse the material, especially in another patient’s mouth. The material is too inexpensive to reuse.

These flakes were mixed into a pot of boiling water, and various ingredients were added to the pot in a “helter skelter” fashion. We added long cotton filaments, flakes of glue, antibacterial chemicals, antifungal chemicals, asbestos fibers, and a substance called “Fuller’s Earth” to give the material body. This was boiled until it was the proper consistency, then allowed to cool until it reached a temperature of approximately 150 to 160 °F. Water-cooled trays were not available, or at least we did not have access to them. We used smooth trays and made undercuts with sticky wax or compound stops. The post dams and tray extensions were made in compound. The tray was filled with the
hydrocolloid and placed in a basin of water at approximately 120 to 125 °F and left a few minutes. It was then inserted into the student's mouth and held as still as possible. An assistant (usually another student) filled a water bulb syringe with cold water and squirted this cold water into the student's mouth. After a time, the impression was removed and inspected, and if acceptable at all, was poured in some cast stone material.

The above technique was worked out after many trial and error procedures. The intraoral tissues of many students were scorched, and we almost drowned a few trying to cool the material.

Later, a large metal mixing syringe was purchased. The material was processed as stated previously and was allowed to cool until it gelled. The material was then cut into a cylindrical shape to fit the syringe, placed in the mixing syringe and placed into boiling water. When the material reached the sol state, an internal plunger was pushed up and down, and the material was mixed. The syringe was placed in 150- to 155°F water and cooled as it was mixed. Then the trays were loaded from the mixing syringe, placed in tempering water at about 120°F for a few minutes, and removed. Any remaining surface moisture was removed before the trays were inserted into the mouth. The cooling process was the same until the water-cooled trays came on the market, mainly through the efforts of Thompson and others. The Thompson conditioner was a great advancement over the equipment we used from 1938 to 1942.

The seaweed, or kelp, plant is the tallest plant, even taller than the giant redwood tree. Some of the best seaweed (kelp) plants grow in a reef off the coast of lower California. The height of the seaweed is controlled by the depth of the reef’s floor.1 Before World War II, Japanese came to this reef and harvested the plants, loaded them on ships and took them to Japan, where the seaweed was cleansed, boiled in water, and allowed to gel. The gel was transported back to California, where it was converted into agar agar hydrocolloid for the dental profession.

With the advent of World War II, Japanese ships were denied the use of the sea lanes to California, and the production of agar agar hydrocolloid closed. This brought about the “discovery” of the “alginites,” or irreversible hydrocolloids.

According to Johnston et al.2 “The accuracy and ease of handling of agar agar hydrocolloid has made possible actual duplication of cavity or abutment preparations and their relationships, with less effort and time expended by both the patient and the dentist. . . . success depends upon a good working knowledge and careful control of all variables,” namely good working equipment and efficient office routines (paying strict attention to all steps). If these things are observed, authentic reproduction of the areas involved can be expected.

“The technique is unexcelled for the indirect construction of restorations for individual teeth and partially edentulous mouths.”2 The material is unexcelled for making impressions of the hard structures of the mouth.

When the agar agar hydrocolloid is heated it forms a gel; when it is cooled (to approximately 102°F) it forms a solid. The process is reversible, hence, the term reversible agar agar hydrocolloid.

One product on the market consists of 15% agar agar, 80% water, and 5% thermoplastics (inert materials: chemicals, antiseptic, antifungal).

Method and materials

Equipment

There are many good conditioners on the market today. The temperatures are controlled with either bimetal or solid-state thermostats. As a general rule, the bimetal controls are less expensive, but are not as accurate and will not last as long as the solid-state controls, and repair is more involved.

In my opinion, the conditioners should have removable stainless steel pots. Cleanliness is one important factor in this system, and the removable stainless pot can be kept clean with minimal effort, if it is done routinely. Clean equipment and an accurate thermometer are mandatory. The mercury-glass thermometer is the one of choice. It is less expensive and more accurate than the dial type. The electric thermometers will not be accurate if they are dropped or even bumped hard, and they are expensive.

Syringes for injecting agar agar material around and into the gingival crevice may be constructed from one of the dentist’s older novocaine anesthetic syringes (without the harpoon). The opening for the disposable needle is slightly enlarged with a dental bur.

A good syringe on the market is made of plastic, in which you place the glass carpule of syringe material. The plastic keeps the material warm and plastic will not burn or damage the patient’s lips as will metal. The carpule syringe system is an advantage over the one in which “sticks” of syringe material are loaded
into a syringe and the syringe and contents are “boiled” in the first bath.

Solid water-cooled trays are manufactured in several sizes by various companies. Some are made for partially edentulous arches, others for fully dentulous arches. There are complete-arch trays (mandibular and maxillary), half-arch trays, quadrant trays, and a quadrant tray that is supposed to be good for making the maxillary and mandibular quadrants at the same time. However, there is a serious disadvantage to this last technique. The occlusal surfaces of the teeth will be in occlusion, with only a piece of material (tin foil or filter paper) separating them, and the occlusal surfaces will not be accurate when the casts are poured.

Complete-arch impressions are recommended, because the casts from the impression can be accurately mounted in the articulator. However, if the complete-arch impression is not used, the half-arch impression is preferable to the quadrant impression. The half-arch impressions encompass the anterior teeth and the resulting casts can be more accurately articulated than can the cast made from a quadrant impression.

Impression materials

There are many good brands of agar agar hydrocolloids on the market today. They are all basically the same (80% water, 15% agar agar, and 5% inert materials). You may purchase either regular- or heavy-bodied consistency in poly tubes or flex skins for complete-arch impressions, or quad skins for quadrant or half-arch impressions.

The syringe material comes in light- or heavy-bodied consistency and is packaged in glass cartridges or sticks.

Gingival displacement material

A wide assortment of chemicals are used in conjunction with cord, yarn, thread, rings, and other materials to relax and displace the gingival tissue and to control hemorrhaging. Some in use today are epinephrine, alum, aluminum potassium sulfate, aluminum chloride, and hemogent — zinc chloride should not be used.

Materials for laboratory procedures

Any good die stone material of choice may be used. Hardness and color of these materials vary. Solutions are available to harden these materials.

Use of good smooth metal dowel pins and a simple system described later are my choice for cast construction.

Preparation of hydrocolloid impression material

Cleanliness, maintenance, and care of the conditioner and strict adherence to time and temperature are mandatory in the agar agar hydrocolloid impression technique.

The water pots should be clean and free of any foreign material, eg, wax, calcium deposits, and “scum” from the boiling water. Conditioners stay clean. Failure to keep the pots clean will result in temperature variations. Clean, cool, distilled water is placed in the three pots. The conditioner is turned on. Thirty minutes should be allowed for the water to reach the desired temperatures before proceeding. The boiling pot temperature should be 150 to 155 °F. The storage pot should be 150 to 155 °F, and the tempering pot should be 110 to 115 °F.

The caps on the tubes of hydrocolloid are tightened. The tubes are placed in the conditioner, caps down. If the glass carpules of syringe material are being used, place the rubber plungers down. The water is brought to a boil, and boiling is continued for 10 minutes. Tubes that have to be reboiled should now have an extra 2 minutes added to the 10 minutes. Longer boiling harms the material. The tubes should be left in the boiling compartment about 15 minutes after the boiling stops. Then the tubes of hydrocolloid are transferred to the tempering pot. The syringe material is left in the boiling pot. If the metal or plastic syringe is used, the cap on the needle is removed, and the stick of syringe material is placed on the syringe plunger, and inserted into the syringe. The plunger is pressed on, the cap on the needle is screwed on, thus forming a vaccum in the syringe (if the O-ring is in good shape), and the needle is placed end down into the conditioner.

Tooth preparation

When the agar agar hydrocolloid impression technique is to be used, a few cavity preparation procedures must be observed. A more accurate impression can be made if all caries is removed and all undercutts are blocked out with cements, composite resins, or other materials. This is a good technique no matter which impression material is being used.

If pinholes are to be placed in the preparation, they
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should be larger than, and not placed as deeply into the tooth as, pinholes in a normal pin-retained preparation.

The cervical margins should be distinct. There should be no large undercuts apically to the margin. In this case, the tooth must be removed circumferentially; if not, varying degrees of distortion or actual tearing of the impression is inevitable.

Grooves in three-quarters or five-eighths preparations should be larger when the hydrocolloid impression material is used than are grooves in a "normal" preparation. Box preparations should be used instead of grooves in the posterior teeth when hydrocolloid material is used to make the impression.

Trays should be selected and tried in the patient's mouth before the impression material is placed in them. Black compound or Van R Tacky Stops (Van R Dent Products, Inc) should be placed to guide and stop the tray in the desired position. There should be 3 mm of impression material around the teeth occlusally and laterally. For best results, three stops should be used to give the tripod effect. If possible, the stops should rest on the incisal surfaces of the anterior teeth and occlusal surfaces of the right and left posterior teeth. If there are no teeth available, or if these teeth have been prepared, soft tissue stop areas may be selected.

Preimpression steps

The prepared area, abutments, and gingival tissues are examined. A spray of diluted, warm mouthwash of choice is an excellent means of washing and cleansing the area. Adequate cotton rolls are placed; cotton roll holders are mandatory in the mandibular areas. The cotton rolls must be placed and maintained apically to the gingival crest area. If they are allowed to exert pressure on this area, the gingival displacement procedure will be in vain.

Saliva ejectors are placed in the mouth, and the prepared area is dried cautiously to rid the surface of moisture. The gingival displacement material is placed around the prepared teeth to the exact circumference of the preparation. No loose ends should lap over the gingival tissue or hang out over the labial or lingual tissue. A small tip end may be left in the interproximal area to aid in removal.

The prepared area and the oral cavity should be kept free of excessive moisture from the time the displacement material is placed until the impression has been removed.

Impression making

The agar agar hydrocolloid that has been stored in the 150- to 155°F bath is now removed and placed in the selected tray. The material should be placed in the tray without lapping or trapping air. The palatal area of the maxillary tray need not be filled unless the patient has a deep vault in the palate or an impression is being made for a removable partial denture in which a palatal bar or strap major connector is to be used. The filled tray is placed in the tempering bath at 110 to 115°F for 5 to 10 minutes or to the individual dentist's desire. After a few impressions have been made, the dentist has a good idea of the time and temperature best suited to his or her technique.

The syringe is removed from the bath, and some material is extruded from the needle to eliminate any contaminated syringe material. The displacement material is removed, the area is inspected quickly, and the syringe needle is placed in the free gingival sulcus. The material is injected carefully around the prepared abutment. Care must be taken not to trap any air during the procedure. The needle should not be lifted out and replaced in the material, as this will cause air pockets. Any excess syringe material may be quickly placed on the occlusal surfaces of the unprepared teeth to aid in the elimination of voids in the impression of these areas.

The prepared and filled tray is removed from the tempering bath before or during the insertion of the syringe material — a gauze square is placed on the surface to blot any excess water and the hoses are connected to the tray.

As soon as the syringe material has been placed on the abutments, the gauze is removed and the tray is inserted in the mouth. The gauze square should leave an imprint of the gauze on the hydrocolloid when it is removed. If the imprint is not visible, there is still excessive moisture on the surface of the hydrocolloid. The surface must be blotted again before proceeding. The use of mirror and a gentle rocking motion will aid in the placement of the tray. The stops will aid in guiding and seating of the tray.

The patient should be in an upright position, and the arch of prepared teeth should be parallel with the floor. The patient should be in a relaxed position, and the lips should be relaxed.

During and after insertion of the mandibular tray, the patient's tongue should be raised up and back into the palatal area and then relaxed into its normal position or left to rest on the upper part of the tray. The
The impression should be inspected, and, if it meets with the dentist's approval, it should be placed immediately into a glass or stainless steel covered dish in which a 2% potassium sulfate solution has been placed.

One teaspoon (5 mL) of potassium sulfate mixed with 1 pt (0.47 L) water will make a 2% solution. The impression should be left in the solution for 5 to 20 minutes.

The potassium sulfate solution gives a harder surface to the stone die material. Some, if not all, agar agar hydrocolloid contains borax as a filler. When the impression sets on the bracket table just for a few minutes, a thin film of water forms on the surface. The water film contains borax that has been leached from the hydrocolloid material. Borax retards the set of die stone, and the water film contaminates the surface of the die, resulting in a weak surface that will remain in the agar agar hydrocolloid material when the dies are removed.

The potassium sulfate acts as an accelerator for the stone, counteracting the retarding effect of the borax, thus producing a harder and sharper die. A hardening solution may be placed in the water used to mix the die stone, resulting in a harder die. Rudd has stated, "This will also result in a more brittle die." (Rudd KD: Personal communication).

The potassium sulfate should not be washed out of the impressions before the dies are poured. The impression must be blown carefully; the impression should not be dehydrated, but an excessive amount of water or moisture should not be left in the impression. The working cast should be poured immediately after the removal from the potassium sulfate bath. Excess water may be "blotted" using the end corner of a facial tissue. The occlusal depths are checked carefully for water droplets. The stone cast will have holes in areas in which the water has been left.

Transfer die method

Only the abutment impressions are poured with a good mixed die stone material. Gentle vibration of the impression tray will aid in getting the stone into the abutment impression area. As soon as the impressions of the abutments are filled, the impression is removed from the vibrator. Some die stone is picked up with a No. 7A spatula and the impression is held in one hand while the hand with the No. 7A spatula is placed on the vibrator and the root portion of the die is built up. A stiff, well-mixed die stone can be "stacked" as tall or high as the operator chooses. Care must be taken not to let the stone run over into the adjacent areas.

The impression with the "transfer" dies is placed into a humidor and set for 45 minutes to 1 hour. The impression is removed from the humidor, the transfer dies are removed carefully, and a solid cast is poured into the impression. The impression is again placed into the humidor and set for at least 1 hour. The solid cast can be mounted against the opposing cast in the articulator and used to wax the abutments and/or fixed partial dentures to the desired morphology and occlusion. The transfer dies are properly trimmed and the patterns are transferred to them for the final marginal adaption prior to spruing and investing.

References