

Materials & Methods FAQs

Qs and As are distilled from discussions on PREPLIST and elsewhere, and more will be added, so visit this page again in the future for more!

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Q1: What is the best way to get shellac off of a specimen?

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Q1: What is the best way to get shellac off of a specimen?

A1: Shellac was, for many years, thought to be the best material available for consolidating fossils. It was used extensively for this purpose from the 1850s through the last decade, and is still used by some people today.

Shellac is at the top of the "not good" list of materials and should be avoided. However, before you decide how to remove it from all your fossils, you should first decide *if* you should remove it. It would be impractical and dangerous (to fossils and preparators) to try to remove the shellac from your entire collection. Attempting to remove any consolidant or coating from a fossil may do more damage than leaving it in place, even if the consolidant is "really bad stuff."

Some characteristics of shellac:

1. It can cross-link to an insoluble solid over time.
2. It darkens over time.
3. It is usually more of a surface coating than a penetrating consolidant (especially on fossils collected during Prohibition!)
4. It attracts and incorporates dust at elevated room temperatures.

Some reasons to remove shellac (or any prior consolidant):

1. Noticeable deterioration. Peeling, shrinking, flaking, spalling.
2. To expose obscured features for research purposes.
3. To improve the aesthetic appearance of a displayed specimen.
4. To break the cycle of dust accumulation/incorporation on the surfaces of specimens exposed to “less than ideal” conditions (often displayed specimens).

Techniques used in removing shellac depend a great deal on the nature of the specimen. Small, fragile specimens and comminuted bone actually being held together by the shellac require considerable care. Larger, more robust material is somewhat easier to deal with safely. Remember, though, that you will only be able to remove surface coatings; shellac that has penetrated the interstices of the bone can not be removed.

Surface buildup of shellac can be removed from “sound” bone as follows:

Materials:

- * Ethanol/Acetone 50/50
- * Cheesecloth or gauze
- * Light-weight polyethylene sheeting
- * Small (< 1/2 inch blade) wood, polyethylene, Teflon, or steel tools

Method:

Apply an ethanol/acetone-moistened pad of cheesecloth to a small area of the fossil. Cover with a piece of polyethylene sheeting. Let this remain in place for about 5 minutes, then remove and examine the surface coating. The shellac should have softened enough to gently scrape (“coax” is a better word) some off. Quite often, the shellac surface will bubble up and slide off very nicely, especially on smooth, non-porous bone. Repeat the procedure as needed to soften and remove all the shellac on the surface. Residue can be wiped off with solvent- moistened cheesecloth. You may also try applying the ethanol/acetone mixture to the bone and covering directly with p/e sheeting (no cheesecloth). The idea is to keep the surface coating of shellac exposed to the solvent, but to avoid soaking the bone (risking collapse. Obviously, the more porous or textured the bone, the less successful you will be).

Cross-linked shellac is insoluble in ethanol and acetone, and can not be removed this way. It has been reported that pyridine may “disrupt” cross-linked films, but we have no experience using this material. We find that removing cross-linked shellac is nearly impossible without damaging the

fossil and is seldom worth the risk.

NOTE: Many of the materials used in the preparation and conservation of fossils pose serious health hazards. Always acquire and read the Material Safety Data Sheets for the materials you use. Do not use any hazardous materials if you lack the facilities or training required to use them safely.

Q2: Is there a proper way to mix plaster?

A2: The Simple Answer:

Slowly pour plaster into 1-2 inches of water until little islands of plaster form. Let sit as is for 1-2 minutes before mixing, mix to a creamy smooth consistency. After mixing is complete you're good to go.

A2: The Detailed Answer:

The use of plaster is almost universal within the paleontological community. In the controlled confines of a laboratory more care can be given to the mixing of plaster than might occur in the field. Whether one mixes plaster in the laboratory or in the field it is useful to remember that the goal in plaster mixing is complete and even dispersion of the plaster particles in water. Examples and reasons for the proper mixing of plaster in the laboratory and under field conditions are given below.

1. Estimate how much plaster you'll need for the job at hand. Even after years of experience many of us still end up with too much or too little.
2. Pour the water into the container.
3. In the laboratory plaster is generally slowly sifted (not dumped) into the water until eventually absorption slows and dry islands will start to form. Field conditions often dictate that a similar but cruder approach be utilized. Instructions for mixing plaster in the field often go like this: grab a good handful of plaster with two hands and let it fall out between your fingers as you move your hands around the top of the mixing container (simulating sifting). The idea is to not drop in too much at a time, and to let it spread evenly around the bottom of the container. Don't be too fussy, but try not to drop in big blobs all at once. If you feel hard lumps in your plaster powder as you are hand sifting it, that means it has already reacted with moisture and you should discard the whole lot. Keep adding plaster until you start seeing "islands or archipelagos" appear at the surface — the islands/archipelagos mean you've got just about enough plaster in the mix.

Whether in the laboratory or in the field at this point in the mixing process it is wise to allow the plaster to soak 2-4 minutes (until all dry islands are saturated). Soaking removes the envelope of air surrounding

the plaster particles and prepares it for dispersion by mixing. Mix 2-5 minutes to obtain an even, creamy mix. Mixing disperses the saturated particles — longer mixing times result in more even dispersion and also maximum hardness when set (although mixing must stop before setting starts). Shorter mixing times result in softer plaster but also slows the setting time. Shorter mixing time can be useful in field jacketing when it may be desirable to have a longer working time for each batch. It is important to be aware that if you add additional water after the plaster has been stirred it will disrupt the crystallization and the plaster will set softer. In sculpture this is called “killing the plaster.” If the plaster has already started to set and you mix in additional water it will really kill it. This is the method used to create plaster for patching an existing plaster cast. The resulting patch remains softer than the sculpture and can be blended in better.

Extra: Some other tips for working with plaster

- *Water temperature affects setting time — hot water will speed setting, cold water will slow it.

- *Beware of anything which sucks water prematurely out of your plaster mixture, affecting set time and hardness. This can include any plaster from previous batches still stuck to your mixing basin, dry burlap strips (better to soak them first) or adding new plaster to old, dry plaster.

- *If you’re mixing plaster for casting replicas (not plaster jackets) take care not to blend water and plaster too vigorously so as to avoid unwanted bubbles.

- *The more you mix plaster the more you speed the reaction time. Except maybe with FGR 95 or other retarded plasters.

There is some very useful literature on plaster mixing available from US Gypsum Company (Industrial Gypsum Division Technical Assistance 1-800-487-4431). Bulletin No. IG503 has some recommendations for additives to accelerate and retard plaster.

Q3: I hear the word “hardener” a lot. Is there anything that actually “hardens” specimens?

A3: We wish there were such a thing. Sadly the term “hardener” is a common misnomer that people mistakenly use when they mean consolidant. Perhaps sometime in the future an actual hardener will be developed that will increase the strength and hardness of some of our softer fossils.

Q4: How do I temper my field chisels?

A4: Tempering chisels, and other tools, used to be an annual ritual for preparators as they readied equipment for their field season. Today carbide tipped chisels, albeit expensive, have largely replaced tempered high carbon steel chisels. Many preparation labs, in fact, have discarded the once ubiquitous forge.

Only high-carbon steels are temperable and can be hardened in the process called tempering. Low carbon steel will not take a temper but can be hardened by a process called case hardening, a process that finds little use in field applications. An easy test to determine if you have high carbon steel is place the steel against a power grinder and to examine the sparks produced. Generally a dull set of sparks means that you have mild steel, and a brilliant, sharply exploding spark is indicative of high carbon steel.

Once you have obtained suitable steel stock, procure the following; a heat source (propane torch or plumber's gasoline blowtorch for example) and a water filled container for quenching the hot steel. The easiest but least controlled tempering method is to hold the steel rod in tongs and heat about 1/2 an inch of the end to a cherry red. Quench it immediately in the water. This may produce a tempered edge but more likely it will result in an edge that buckles or cracks.

A more reliable, controlled method, is to polish the steel rod then heat about one and half inches of the rod end to a dull yellow. At this point quench about three-quarters of an inch of the end of the rod for about fifteen seconds or until the heat glow from the rest of the steel disappears. Transfer the still-hot rod to an anvil (or vise) and observe, in the polished section of the rod, the color changes caused by heat conductivity. Be alert, for when a dark yellow or bronze color reaches the cutting end the entire tool must be quenched. This is the right hardness for a chisel.

Q5: What is a "mother mold"?

A5: The Simple Answer:

A "mother mold" sometimes called a "shell mold," serves as the outer support for a mold, especially thin (skin) molds which do not have sufficient support themselves to maintain their overall shape.

A5: The Detailed Answer:

A "mother mold," usually made of plaster, is a rigid support around a flexible mold that keeps it from ballooning or warping during casting. For extremely complex molds, ones that had multiple pieces, one might even

have a “grandmother mold” that served to keep all the pieces together and organized, and it is even possible to have “great-grandmother molds,” etc. in rare circumstances. This usage of “mother mold” is published in (e.g., p. 254): Goodwin, Mark B. & Chaney, Dan S. 1994. “Molding & casting: techniques and materials,” pp. 235–271 in: Leiggi, P. & May, P. (eds.), Vertebrate Paleontological Techniques, Volume 1, Cambridge University Press, New York.

Q6: Please explain the different units of measurement for air pressure (PSI, PSIG, and bar).

A6: PSI = pounds per square inch; to convert to kilograms per square meter (kg/sq. m.) multiply by 703.1; to convert to kilograms per square centimeter (kg/sq. cm) multiply by 0.07031.

PSIG = pounds per square inch on gauge, i.e., the PSI reading that you take directly from the gauge. Technically, since it’s resisted by normal air pressure, you need to add 14.7 PSI at sea level to correct it to what the PSI reading against a vacuum would be. Most times when people give you a PSI reading they mean PSIG. This is for the science nerds. To convert to kg/sq. m. or kg/sq. cm use the same multipliers given above.

Bar = an archaic measure based on how tall of a column (i.e., “bar”) of mercury air pressure would support against gravity in a vacuum. When defined, it wasn’t done at sea level so one bar is NOT one atmosphere, though it is close (multiply by 0.9869 to convert to atmospheres). To convert bars to PSI, multiply by 14.50; to convert bars to kg/sq. m, multiply by 1020; to convert bars to kg/sq. cm multiply by 1.020.

Q7: What is CFM?

A7: CFM = cubic feet per minute, a rate of flow. To convert to cubic centimeters per second multiply by 472.0; to convert to liters per second multiply by 0.4720.

Q8: A researcher in China is setting up a preparation lab and he wants to know how big a compressor he should install.

The following is a list of his tools and specifications:

- * Aero or Aero-type marking pen — 1.5 to 2 CFM, 90 PSI
- * Chicago Pneumatic or CP type air scribe— 2.5 CFM, 90 PSI
- * Dotco Pencil Grinder — 7 CFM, 90 PSI

- * 2 Paleotools Microjacks — less than 1 CFM, 100-110 PSI
- * He wants to be able to run two tools at once.

A8: All compressors should have, at a minimum, their CFM and PSI indicated in their specs. If they don't have this, then they should not be purchased. Though higher horsepower generally produces more CFM, the "horsepower" of the compressor is not really the determining factor in selecting a compressor; the actual CFM and PSI requirements of the tools used are. If a compressor just lists horsepower in its specs, and not CFM and PSI ... pass it by.

If he runs two tools at a time, the maximum air-flow needed would be about 9.5 CFM and the pressure >100 PSI. Note that compressors often have *maximum* PSI referenced in their specs. Be careful. Compressors with tanks have pressure switches that tell the compressor when to run to replenish the tank air reservoir. Typically for a 135 max PSI compressor, the compressor will turn on when the tank pressure reaches 90 PSI and turn off when the pressure reaches 135 PSI. This would be insufficient for a tool that requires 100+ PSI to run well (#3 microjack for example). Look for PSI *ranges* for the compressor, not just the max PSI.

In general, you'll find that tank sizes on compressors are related to CFM and PSI ratings. Higher CFM compressors will have larger tanks.

Duty cycle is also important. If you are working steadily at or near the maximum CFM and PSI capacity of the compressor, the compressor will have to run longer and more often. This will decrease the life of the compressor.

If you are working substantially below the maximum CFM at a given PSI, the compressor will run for shorter periods and less frequently, meaning longer compressor life.

For compressors of similar CFM and PSI ratings, larger tanks will reduce the duty cycle and prolong compressor life. (but remember, a large tank will NOT make up for a low CFM/PSI compressor)

Of the tools listed, the grinder requires high CFM, medium pressure; the microjacks require low CFM, high PSI. Therefore I'd suggest a compressor that produces at least 10 CFM at 90-100 PSI with an ON pressure switch not below 110 PSI (for example, pressure range between 110 and 145 PSI).