How to Reattach Stalagmites

By Jonathan B. Beard

The Epoxy

Stalagmites broken by vandals can be reattached using a two-part epoxy mixture. The two parts of the epoxy are in a liquid state and consist of a base and an accelerator (hardener). When the two parts are mixed, they react and form a solid compound.

Epoxy Worklife

The "worklife" of the mixture is the time that, after they are mixed, they remain in the liquid state. During this worklife period, the mixture can be applied to surfaces to be bonded and "worked" into place. The worklife ends when the mixture is somewhat stiff and is not sticky to the touch. The total curing time usually extends for a considerable period after the worklife period has ended.

DP-110

The epoxy I use most often for repair of stalagmites in the Ozarks is DP-110, a two-part translucent liquid manufactured in Springfield, Missouri at the local 3M plant. It has an approximate 10-minute worklife, which is sufficient for mixing and applying to stalagmite surfaces. Its total curing time is a few hours. Allow yourself enough time to do it right. Don't rush it. Some stalagmites are easier than others, and the more experienced you are, the faster it will go.

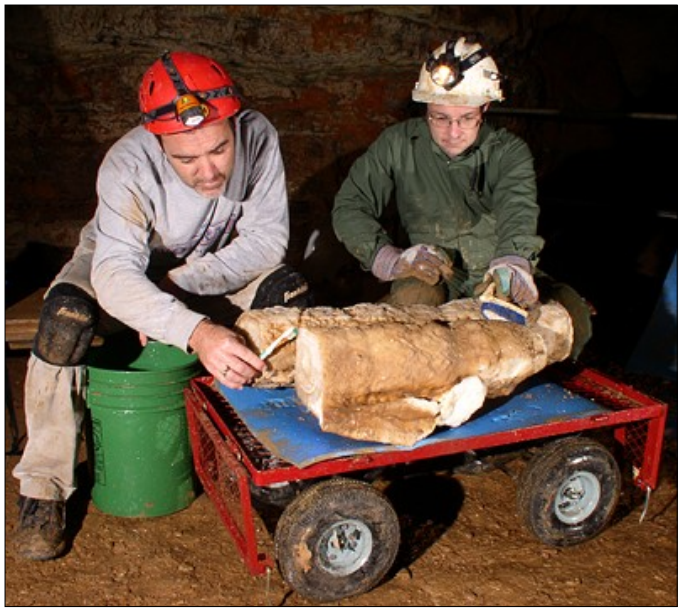
Right: The freshly reassembled "big boy" stalagmite in Fisher Cave, Meramec State Park.

The Gloves

When handling speleothems, it is recommended that you wear disposable nitrile or vinyl gloves—the kind a dentist, nurse or doctor uses. Latex disposable gloves are okay as long as you or anyone in your restoration crew isn't allergic to latex. Disposable gloves are useful in keeping the dirt and oils from the skin of your hands off of the speleothems. They also prevent epoxy from getting onto your hands.

Make Sure it Fits!

The piece might appear as if it belongs there , but until you "dry fit" it into place, you don't know it belongs there .Take the broken piece and align it where you think it belongs. If it's a great fit, then you can proceed to the next step. If it's not a good match, don't go any further. I have made the mistake of assuming the piece was a perfect match, cleaned the surfaces, applied the adhesive only to find it a "no go"! The next several minutes were spent emoving the adhesive from the surfaces while still soft enough to do so. From this experience, I have learned that adhesive is much easier to apply than it is to remove!



Matt Tenny and Jason Hardinger cleaning the main section of the stalagmite to be reattached.

Cleaning the Stalagmite

When I have found a match—that is, when I have found where the broken piece was broken from, the surfaces
to be bonded are to be totally cleaned and dried. This is important—there cannot be mud, dirt or water on the surfaces. These act as barriers that prevent the epoxy from coming into contact with the calcite surfaces—the epoxy simply won't "stick" to the calcite if there's something in the way. If there is only a little dirt, sometimes using a dry plastic brush is enough to clean the surfaces. However, if there's significant mud or water, then brushing and spraying with water may be needed to clean the surfaces.

An absorbent towel or cloth is then used to dry the surfaces. Only when I am confident the surfaces are clean and dry do I prepare the adhesve. I make a point of not over-cleaning the outside (visible) surfaces of the stalagmite—many have a "patina", that is, a natural coating from the settling of air particulates over a long span of time. Remove the excess mud, but don't remove the patina if possible.

Mixing the Epoxy

Apply the necessary quantities of both parts of the epoxy to the bottom of a small mixing tub following the manufacturer's recommended mixing ratio. I use small plastic butter cups or yogurt cups and wooden tongue depressors as my mixing tools. Use only what you think you will need for the repair. If you are using an epoxy with a relatively long worklife (one hour or more), you can mix enough epoxy for more than one repair. However, if your epoxy's worklife is short, such as 10 minutes, you will want to mix only enough epoxy for one repair. Mix the epoxy thoroughly so that it will cure throughout the application and cure when it is supposed to cure. Incompletely mixed epoxy may result in an inconsistent or incomplete cure.

Applying the Epoxy to the Stalagmite

I apply an adequate amount of the mixture to both surfaces to be bonded. Using the tongue depressor or a gloved finger, I spread the epoxy out and make sure it is sticking to the surfaces throughout each surface. There should only be a paper thin coating of epoxy on each surface. Any thicker than paper thin will result in an excessive amount of epoxy that will ooze out of the stalagmite.

Joining the Broken Piece to the Stalagmite Base

When the epoxy is spread completely, the two pieces are then joined. I slightly rock (jiggle) the piece to be bonded against its base to squeeze the epoxy enough to fill all voids within the surfaces being bonded and to squeeze out any excess epoxy. The tighter the fit, the stronger the bond. Toward the end of the worklife period, I use a tongue depressor or a gloved finger to wipe away any excess epoxy that has oozed out of the cracks. The excess epoxy is ready to be removed when it has the approximate consistency of "used" bubble gum.

Masking the Crack and Color Matching

Most of the time, there will be an obvious crack showing. This can be masked by either applying a mixture of calcite powder, dirt and water or epoxy until there is an approximate same color as the stalagmite and rubbed into the crack to fill the crack (again, using a tongue depressor or gloved finger). If the color match is good enough, the crack marking the original break will be somewhat difficult to see.

Calcite powder isn't always available. When drilling holes in stalactites to be rejoined (see How to Reattach Stalactites), I hold a cup under the stalactite to catch powder. This is saved for color matching. Dirt or mud in small quantities is mixed in with the calcite powder until it resembles the color of the stalagmite. When appropriate, a small amount of mixed epoxy is blended in, and then the mixture is applied to the crack. If a stalagmite is dry (dormant), it is possible to color match without epoxy. If the speleothem is active and growing, color matching may be unnecessary—new calcite growth will eventually cover the crack of the former break.

Chris Gertson (right) helps Jon rock the next piece as it settles into place.

Jon and Jenny Pratt disguise a reattachment crack.