STABILIZING WOOD:
An Alchemist's Guide

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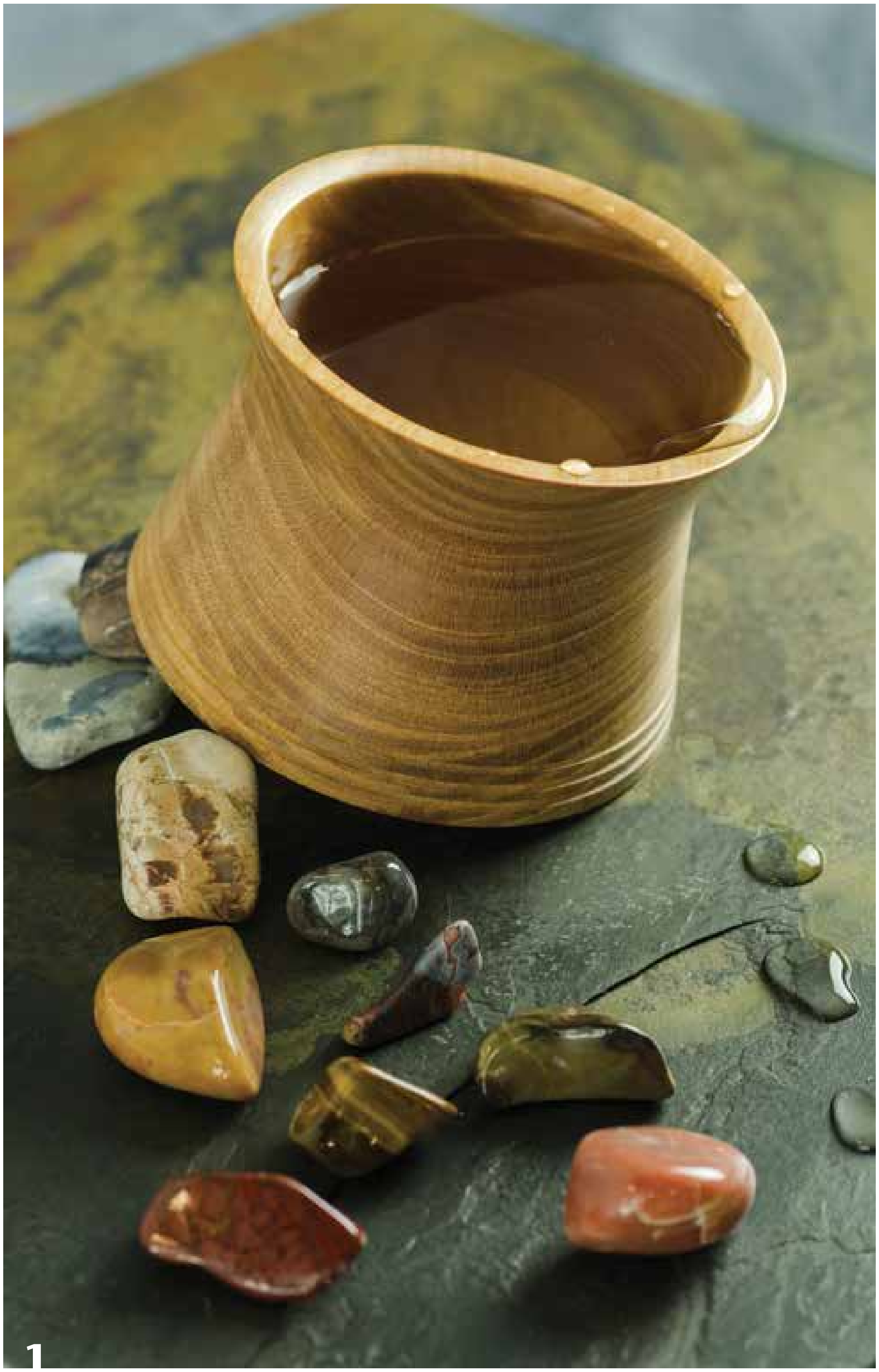

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Wooden service items exposed to cycles of wetting and drying present a chronic challenge. Weighed before and after holding water for 14 hours, this cherry vessel, stabilized before finishing with cyanoacrylate, gained 1 gram and showed no sign of distortion or staining.

Medieval alchemists must have enjoyed great job security. They spent their days looking for a way to turn base metals into gold or on the alternate career track, in pursuit of a universal elixir. Plenty of woodworkers might argue that using chemicals to change wood's inherent properties can be dismissed as modern alchemy. But the wood products industry has invested decades of research in pursuit of ways to change—marketers would say enhance—the properties of wood, and turners can benefit from their efforts.

Heat (an idea that is thousands of years old), pressure, various waxes, epoxy and plastic resins, and a laundry list of chemicals and bulking agents have all been unleashed on wood with varying degrees of success to make it harder, stronger, more stable, resistant to decay or insect attack, resistant to chemicals or abrasion…the list goes on. For turners, the list of possibilities is somewhat shortened as concerns like insect attack or bending load limits rarely cross our minds.

One treatment most of us are familiar with is polyethylene glycol (PEG), which has long been available as a means for treating green wood and preventing loss during the drying process (*AW* vol 15, no 1). Epoxy resin, another trick in the alchemist's bag, is most often used as a surface treatment or void filler, but can also be used to impregnate a turned piece for durability or to enhance light transmission (*AW* vol 27, no 6). Stabilizing wood by impregnating it with liquid acrylic is an idea that has also been around for at least two decades, but the technology lay primarily in the purview of

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A pair of shaving brushes turned from stabilized spalted maple.

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This piece of holly had great promise but was so soft from spalting it was a challenge to get an acceptable surface finish. Stabilizing bulked the wood to the point where it would even accept threads.

4
The threaded spalted holly finial adds visual interest to this small Indian rosewood urn. There is no finish on the finial, just a sanded and buffed surface.

companies with the space and capital to conduct the process. For a number of reasons, the process can now be scaled down for the home shop, opening some creative opportunities for the turner.

Straightforward process

The process of stabilizing wood is straightforward, although it is a little finicky and demands attention to detail. Because the physical changes from impregnation occur at microscopic and molecular scales, understanding what stabilizing accomplishes may help you attain better and more consistent results.

Wood as a substance has two basic components, cell walls and the space within the cell walls known as the lumen. While a tree is alive, the lumen provides space for the movement of water. After the tree dies, moisture escapes from the drying wood, leaving behind the now-empty space in the lumens. The stabilizing process takes advantage of the lumens, filling the space with a liquid compound, which is then hardened through heating or chemical conversion. To be effective, the compound used to impregnate the wood needs to have a sufficiently low viscosity to be drawn into the voids. Here comes the modern alchemy part.

The most commonly used ingredient in wood stabilizing products is methyl methacrylate (MMA). MMA is a monomer—a small molecule that will fit in microscopic spaces while anxiously hoping to link up with other molecules of its MMA kin. MMA is mixed with a catalyst before it is placed in a vacuum chamber and drawn into the wood. The catalyzed MMA remains fluid and workable until it is exposed to heat, at which time the catalyst initiates the reaction that converts the monomer MMA into ▸

As with any chemical in the workshop, you should read and adhere to the manufacturer's handling instructions. Methyl methacrylate is flammable in some formulations—keep it away from any source of ignition. It is irritating to the respiratory system and skin and may cause dermatitis on skin contact. Use it with good ventilation, and avoid getting it in your eyes, or on your skin or clothing. If you do get it on skin or clothes or in eyes wash it off with large quantities of water. It permeates all types of disposable gloves.

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In theory, you can stabilize anything that has space to absorb the MMA, including a shelf fungus. Not all experiments bear repeating, even if the result is poor man's African blackwood.

Building and Using a Vacuum Chamber

Stabilized wood is widely available from a number of commercial sources, and some companies provide stabilization services for wood that you supply. But the equipment and materials for doing the job yourself are readily available, giving you complete control over the process. Hold Fast markets a complete outfit that uses an air compressor to generate a vacuum. This system, and stabilizing resin, can be purchased through Packard Woodworks, and likely an increasing number of other outlets. A quick search of eBay will turn up additional options. In addition to Packard, stabilizing solution is available through Curtis Seeback (TurnTex.com).

Making a chamber is also easy, and any turner with a vacuum chuck has already incurred the largest expense—a vacuum pump. To make a chamber, you will need the items depicted in *Photo 6*.

- a selection of ¼" pneumatic fittings (dry vacuum gauge to measure up to 30", ¼" NPTM hose barb, NPTF cross, 2 NPTM hex nipples, ball valve). I added a quick disconnect coupler to the vacuum hose on my system so I can easily switch between my vacuum chuck and the chamber. Also consider whether you need to buy any ¼" vacuum hose—I had a piece left over from setting up my chuck.
- Teflon (plumber's) tape.
- You will need the chamber itself, which can be a pot salvaged from a thrift store. I recommend stainless steel, and make sure the rim is flat so that it will seal against the lid. Remember that the larger the pot, the more MMA you will have to buy to cover your treated items. Get something close to the size you need, or better yet, collect a few different sizes, as one lid with its pneumatic fittings should work on all of them.
- You need to be able to see the contents of the vacuum chamber to monitor treatment progress, so I recommend a sheet of clear acrylic for a lid. The lid needs to be thick enough to withstand the vacuum (½" should be fine, I used ¾"), and large enough to extend beyond the rim of your largest pot.
- A gasket to fit between the lid and the chamber. A medium-to-thick piece of closed-cell packing foam works well.
- A ¼" 18 NPT drill bit and thread tap.
- A hold-down weight to keep your wood under the surface of the MMA during treatment. I made a weight from hardware cloth and drill rod attached with electrical ties.

Steps

1. Using the tap and bit set, drill a hole in the approximate center of your lid, then use the tap to cut the female threads into the hole. Use one of your male ¼" fittings to check for fit and assure that the female threads are clean.
2. Assemble the pneumatic fittings, wrapping male threads with a layer of Teflon tape before assembly to reduce air leaks. Thread the assembled pneumatic fittings into the hole in the lid *(Photo 7)*.
3. Cut your gasket material to overlap the chamber's lid and create an opening to allow a view into the chamber.
4. Place the gasket on the top of the chamber, then set the lid with its pneumatic fittings on the gasket, and hook up the chamber to your vacuum. Turn on the vacuum pump and close the ball valve to check the performance. Depending on your elevation and the strength of your pump, you should show a vacuum in the range of 23–26". The stronger the vacuum, the more effective the system will be.

Basic process

Detailed instructions for stabilization should be included with your stabilizing solution. The basic process is as follows.

1. I rough turn some pieces to minimize the amount of wood I will need to remove after treatment (and therefore the amount of MMA left on the shop floor with shavings). Wood to be stabilized should be as dry as possible—at a maximum 10 percent moisture content. You may want to place your wood in a low temperature (~180˚F) oven for 8 hours prior to stabilizing to force out the last bit of moisture. Be sure to allow the wood to return to room temperature before proceeding with treatment.
2. Place wood to be stabilized into the chamber.
3. Cover wood with hold-down weight and add enough MMA to cover the wood by a ½" to 1". Place the gasket and lid on the chamber.
4. Make sure the ball valve on top of the lid is open and turn on the vacuum pump. Slowly close the ball valve. The wood will bubble and the MMA will foam and you want to control this process so that it proceeds slowly and you don't draw MMA into your vacuum pump.
5. Once the foaming has subsided, completely close the valve and leave the wood to soak under vacuum until bubbling stops. This typically takes 1 to 3 hours.
6. Slowly release the vacuum using the ball valve, and then turn off the vacuum pump. The MMA level will go down as the solution is drawn into the wood. Leave the wood to soak—overnight is fine if you are using a stainless chamber.
7. Remove the wood from the chamber, let it drain, and remove excess liquid from the outside (an old credit card makes a good squeegee for dimensioned lumber).
8. Wrap each piece of wood in foil and place it in a 200˚F oven for 90 minutes (thick stock may require additional time).
9. Unwrap and cool the wood *(Photo 8)*. Excess hardened acrylic on the outside of the wood can be scraped, sanded, or trimmed with a saw. Or, just turn off the excess acrylic as you excavate your way down to reveal the hidden treasure in your chunk of wood.

(6) The vacuum chamber with lid and vacuum fittings, closed cell foam gasket, weight, and a selection of wood ready for treatment.

(7) A close-up shows the vacuum connection threaded into the chamber's lid. The center is the NPTF cross, the ball valve on the left, gauge on top, hose barb on the right. Hex nipples connect the ball valve to the vacuum unit, and the unit to the chamber lid.

(8) Stabilized spalted holly and spalted maple fresh out of the oven looks discouraging, but the magic begins as soon as the shavings start flying.

a single, complex chain polymer that is linked throughout the treated wood—all that liquid MMA becomes one big plastic molecule interwoven throughout the cell walls, thereby changing the properties of the treated wood.

As with any of the myriad ways we have contrived to alter wood, stabilization has its limits and is suited for select circumstances. I began investigating the technique in pursuit of shaving mugs for my clients that would hold up under the harsh treatment of repeated cycles of wetting and exposure to soap, followed by a drying cycle *(Photo 1)*. The tag line of my woodworking business is "creating family heirlooms"; if my pieces are ending up in the burn pile because they cannot hold up under use, I am not living up to my credo. Stabilizing does greatly improve water repellency (the rate of water uptake), but an extra step to seal open pores is still required to improve water resistance (that amount of water uptake).

I have discovered additional advantages and opportunities as a result of working with stabilized wood. One of the great benefits is that previously unusable wood can be pressed into service with gratifying results. Spalted, punky, and soft woods with poor working qualities readily take up the MMA solution and work like a dream after stabilizing *(Photo 2)*. After working with stabilized spalted woods, I realized that one of my other challenges in woodturning—hand-thread chasing—might be addressed. Relatively few species of woods have properties that lend themselves to threading, but filling the lumens with acrylic appears to improve the capacity of many species to accept threads. The options for timber for threaded finials, for example, are few and may not achieve the look I am striving for. Stabilizing can give some of our domestic hardwoods the properties they need to accept threads *(Photos 3, 4)*.

Materials not previously acceptable for any turning job may now become a source of inspiration and exploration *(Photo 5)*. The vacuum chamber that is integral to the stabilizing process can also be used to cast materials in acrylic or epoxy, a process that utilizes the vacuum to remove trapped air bubbles prior to the hardening of the casting material. Finally, MMA readily accepts dyes, so a piece of timber can be uniformly colored prior to working.

Insights, cautions, considerations

I have accumulated a few other insights while working with stabilized wood. Gluing, for example, is best done with adhesives compatible with plastics. Drilling of stabilized materials requires care and should proceed in small increments, as heat will cause the plastic to melt, bind the bit, make a mess, and potentially crack the wood.

Lung protection is always a worthy precaution, even more so with stabilized wood as working it sends tiny plastic particles into the air, especially during sanding. Like drilling, sanding should be done to avoid heat build-up—turn the lathe speed down, use a light touch and let the sandpaper do the work, and check the paper frequently for clogging. Sanding alone often produces an amazing finished surface, but if you want to gild the lily, a friction polish works well. Sealing with any topcoat will provide additional protection.

Although commercial enterprises have developed the equipment to stabilize items as large as slabs for use as countertops (imagine the effect!), in our home shops, the realities of space and expense constrain us. Fortunately, that pricey MMA that is not absorbed into the wood during the treatment process can be collected and saved for the next batch. But at about $100 per gallon, you will want to think carefully about how you can put the technique to best use. A large vacuum chamber can be built, but it will require a large volume of MMA to cover materials placed in it, and a large piece of treated wood will retain a lot of MMA, possibly increasing its cost beyond what the market will bear. Because of these factors, stabilization is likely to remain best suited for smaller projects like pen turning, finials, small threaded boxes, bottle stoppers, and utility handles.

As you experiment you will also find that some species of wood are more amenable to stabilization than others. Now that you know the fundamental theory behind the technique, you can readily understand that less dense species of wood with more inherent lumen space are more likely to take in more MMA, producing better results. Dense tropical hardwoods have little space for the MMA to fill, and the oil in some species interferes with curing. But don't give up hope without a trial run. Curtis Seebeck, a woodturner who markets Cactus Juice Stabilizing Resin, reports that one of his clients successfully stabilizes ebony. Experimenting with a scrap or cutoff before committing the best of your stock is always prudent. To understand how much MMA your wood absorbs, weigh your wood before and after treatment to track the weight gained through stabilizing.

Knowing how creative woodturners are, I am interested to see what other innovative ideas come out of access to a vacuum chamber and stabilized wood. Ever exploring for better ways to waterproof wood, my next alchemy will include using the vacuum chamber to impregnate wood with wax. Wish me luck. ■

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