Resin Stabilization of Wood

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Background and Introduction

Wood stabilization is the process of impregnating wood with a resin which is then polymerized. This stabilizes the wood making it firmer, more durable, and workable. Craftspeople have been using stabilized wood for several years. Knife makers have used it to create more durable and attractive handles. Turners have used it with beautifully patterned spalted or punky woods that would otherwise be too damaged to turn. Additionally, they have used it to add stability to burls that are too crumbly to use in their natural state. Stabilized woods have been combined with other resins to create patterns, colors, and textures that do not exist in nature. More recently ornamental turners have used stabilization to add hardness to more readily available woods so the woods can take the detail necessary for ornamental turning. This has expanded the species of wood available for ornamental turning and reduced the need for some of the expensive and hard to obtain exotic woods that have typically been used. Jewelry makers and other craftspeople have incorporated stabilized wood into their work because of its increased stability and durability. During the stabilization process dyes can be added to the wood creating attractive colors and allowing all of these craftspeople to create new and different items. Since these dyes penetrate through the wood and do not just sit on the surface there is no danger of losing the effect as the item is being created, and the piece does not require additional coloring time since the dying is done during stabilization.

There is extra cost to stabilized wood, but when a piece of stabilized wood has been completed it can be sanded to a high finish and then polished without adding any additional finish. This saves the craftsperson time and expense which offsets at least some of the cost. Additionally, should the item lose its level of initial finish with use, it can be restored by rebuffing the piece.

Since stabilized wood is commercially available, why go to the expense, time and effort to stabilize our own woods? There are several reasons. The first being that some woods and sizes of wood that the artist would like to use are not commercially available. Until recently if the artist had a special piece of wood that he would like stabilized he had to find a commercial stabilization service that accepted custom work. The second is cost. A good percentage of the cost of commercially stabilized wood is the cost of the time and the overhead of the stabilization service. If the artist can stabilize his own wood, then these problems and costs can be overcome and the artist has more control of the creative process. The third is that it is now easy to stabilize wood in a home shop. Initially, the directions for stabilizing wood may seem complicated so it can seem to be a daunting procedure. In truth this is not the case. Now with available equipment designed for the craftsperson, it is a simple procedure. Most of the process can be done unattended so that other work can be done while your wood is stabilizing.

For these reasons and being a turner who does both plain and ornamental woodturning, I have been interested in wood stabilization since the process became available to the home turner several years ago. I began studying the process and the available materials. This led me to realize that there are several requirements for a system that would work well for me. The first requirement was that the chemicals and equipment used had to be safe for home shop use. The second requirement was that the equipment had to be durable, well made, and long lasting. Third, the equipment needed to be complete without requiring me to go to other suppliers for additional items the main supplier did not offer. Fourth, the equipment had to be designed to make the process easy or I probably wouldn't continue using it for the long term. My fifth and final requirement was that once my other requirements were met that the equipment was priced well. To stabilize wood you need the stabilizing resin, a vacuum source, a vacuum chamber, and with most resins an oven to cure the resin. I have found materials and procedures that work well for my needs and I'll share them in this article. You may find

that you need to make changes for the work you do, but this article can serve as a guide while you develop your own resources for stabilizing wood.

You may want to add dyes to your resin so that the resulting wood will be dyed. In my work I have not needed to do this so I can only give a few general comments and suggestions, and this procedure does not include dying steps. First, make sure the dye you choose is compatible with the resin you use. Some dyes will not dissolve in some resins. Some dyes will look good dissolved in the resin, but the resulting wood will not have the desired color. It is not worth skimping on cheap dyes when you consider all the other costs and time involved in the process. Second, when using a new dye or using a new wood species, it is always a good idea to do a test run to ensure that the wood will achieve the desired effect. You can do this by mixing the dye in a small container which can be placed into your vacuum chamber. Thus you do not use a large amount of resin when testing a dye. Once you have gotten the desired result you can scale up the recipe for a full run. This brings me to my third point, it is important to measure dyes accurately and keep good records so you can repeat a color once you have the desired result. Fourth, and finally, store each dyed, unpolymerized resin in an appropriate, labeled container for reuse.

Safety

The first requirement for any shop procedure is to consider safety. You will be working with chemicals, vacuum, and heat. While the MSDS for the resin I recommend indicates that this material is reasonably safe in its liquid and polymerized form, I always prefer to error on the side of caution. I wear Nitrile gloves which are more chemically resistant than latex or poly gloves. The resin in its liquid and polymerized state has no odor, but there is a mild odor when it is heated to cure. While the MSDS does not require it I wear a chemical mask with replaceable cartridges during this stage. During the entire procedure I wear safety glasses or a safety shield. The wood will be hot after polymerization so I wear oven gloves for protection.

Other than the appropriate personal protective equipment (PPE), it is important to know that your equipment is in good working order and will function as expected and desired. Always visually inspect your equipment before each use. After each use clean it as recommended and store it properly between uses. Improper vacuum chambers can implode so I do not recommend homemade chambers. I recommend using a toaster oven for polymerization. You should never use your home oven which is also used for food preparation. Heating the resin to the proper polymerization temperature is important and the thermostats on toaster ovens are notoriously unreliable so it is important to use an oven thermometer to set and monitor the toaster oven temperature. The wood will be hot when removed from the oven and it is important to remove the aluminum foil wrapping while the wood is hot. Therefore, you need a pair of oven gloves that allow you enough sensitivity to work while protecting your hands from the heat.

Always dispose of any chemicals in a safe manner.

Materials and equipment

1. Personal protection equipment mentioned above and any additional equipment you feel you need.
2. Vacuum chamber.
3. Vacuum source.
4. Resin.
5. Toaster oven capable of controlling the temperature at 200ºF.
6. Oven Thermometer.
7. Heavy duty aluminum foil.
8. Wood to be stabilized. Must have a moisture content of 10% or less. Less is best! I'll discuss this in the detailed instructions.
9. Funnel, disposable filter, and anti-rust spray.

There are several suppliers of both resins and equipment designed for home shop use. I looked at several suppliers over a few years before I found a system that works well for me. I came to the conclusion that the best resin is Cactus Juice and the best equipment is available from Conestoga Works. There are several reasons why I chose these products which are beyond the scope of this article, but basically I find these are the best quality and safest products available for me. If you are interested in more information about Cactus Juice you can find it at https://www.turntex.com/. Additional information about Conestoga Works can be found at http://conestogaworks.com/. Cactus Juice is also available from Conestoga Works. If you would like to learn more about my reasons for choosing Conestoga Works products you can read my product review in the August 2016 issue of More Woodturning at https://www.morewoodturningmagazine.com/.

Outline of Procedure:

1. Ensure your wood is dry.
2. Wear your PPE and do a Safety Check.
3. Load wood into the chamber carrier and place carrier into the chamber.
4. Add Cactus Juice to the chamber.
5. Apply vacuum.
6. Allow the Cactus Juice to penetrate the wood.
7. Polymerize the Cactus Juice.
8. Remove the aluminum foil (if used).
9. Cleanup.

Detailed Procedure:

The procedure I describe is for the products I use. If you chose a different resin or different equipment it may come with different instructions, and you may need to modify this procedure to fit your equipment.

1. Ensure your wood is dry.

Your wood must be lower than 10% moisture or the moisture in the wood will interfere with infiltration and polymerization of the resin. The best way to check this is to use a moisture meter. I have found that inexpensive meters available from most hardware stores are accurate for this purpose. I have not had trouble using wood with a moisture content of 6-10% moisture. Curtis Seebeck, the originator of Cactus Juice, who has much more experience and understanding of this resin; strongly recommends a moisture content of less than 6% because remaining water will prevent the resin from completely infiltrating the wood resulting in less stabilization. The lower the wood's moisture content, the greater the amount of resin the wood will absorb increasing the percentage of stabilization.

Additionally, the moisture remaining in the wood can move into the resin in the chamber. When the resin is reused additional moisture is added with each use. This build up of moisture could affect the life of the Cactus Juice.

Moisture meters do not measure accurately at 6% or less. If you choose to dry your wood to this level you need to weigh the wood and measure the weight loss during drying. You can start with air dried wood which you weigh before further drying. The air dried wood is heated to about 220°F (above the boiling point of water) for several hours and weighed periodically. When the weights are stable the wood is immediately placed in a zipper plastic bag and allowed to cool to room temperature. The bag prevents the wood from regaining moisture prior to starting the stabilization process. Placing hot wood into the resin can cause premature polymerization of the resin on the wood's surface thus stopping additional resin from penetrating the wood. The dried wood is stored in the sealed bag until you are ready to continue with stabilization.

2. Wear your PPE and do a Safety Check

Check the vacuum chamber and the lid seal to ensure they are clean, undamaged, and free of moisture. Connect the vacuum source to the vacuum chamber and apply a vacuum to the chamber. Once satisfied that everything is working correctly, open the relief valve and turn off the vacuum source. If using a vacuum pump, do not turn the pump off while under a vacuum if you are using an electric rotary vane pump. Also, do not allow an electric pump that uses oil to run for an extended period of time while not pulling a vacuum.

The upper photo shows nitrile gloves and safety glasses which should be worn throughout the procedure. I prefer to wear a full face shield. The lower photo shows oven gloves and a chemical respirator which I use during the oven polymerization phase of the procedure.

3. Load Wood into the Chamber Carrier

The Conestoga Works vacuum chambers are provided with a steel carrier which consists of a bottom plate and an arm which supports an adjustable top plate. The arm is bent at the top to serve as a handle to make it easy to move the carrier into and out of the vacuum chamber. Some suppliers do not include this helpful feature in their chambers. These chambers are transparent which makes it much easier to monitor the release of air bubbles during the vacuum step.

3 Sizes of Chambers from Cones-

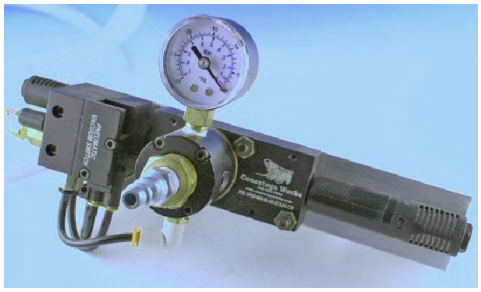
The wood to be stabilized is placed on the base plate of the carrier and the top plate is adjusted to hold the wood in place. If multiple pieces of small wood are being used it may be helpful to bundle them with cotton string to orientate them on the carrier. The carrier can now be placed into the vacuum chamber.

4. Add Cactus Juice to the Chamber

The Cactus Juice can now be added to the chamber. It is important that you have previously followed the directions with the Cactus Juice to catalyze the resin prior to use. The resin will not harden if this step is not done.

Add enough Cactus Juice to the chamber to cover the wood by several inches. During the infiltration step the level of Cactus Juice will drop as it enters the wood. For typical woods I fill the chamber to 1-2" above the top of the upper plate of the carrier. If the top of the wood becomes exposed then that wood will not be stabilized. Remaining Cactus Juice can be filtered and reused after each run so it is important not to skimp on the amount of resin added to the chamber. Also, there must be enough head space in the chamber to allow for the bubbling that occurs during the vacuum step. If enough space is not allowed, resin can be drawn into the vacuum source which can cause damage. Therefore, the size of the chamber determines the amount of wood that can be stabilized per run.

5. Apply Vacuum



I choose to use an Air Saver Venturi vacuum source available from Conestoga Works. A venturi works by creating vacuum from a compressed air source. In addition to the venturi itself this unit comes with a vacuum check valve, air piloted air valve and pneumatic vacuum switch so the unit is ready to use as received. The vacuum switch allows me to set the desired amount of vacuum and once this level is reached the flow of compressed air is shut off until the vacuum level drops. Thus this venturi uses much less compressed air than a unit without a switch. This also means less shop noise and it is certainly quieter than an electric vacuum pump which must run continuously during the vacuum cycle. I also use this venturi for vacuum chucking on my lathe and it works well for vacuum hold down fixtures. As with all vacuum systems the maximum amount of vacuum that can be generated depends upon your elevation above sea level. I find that in my area I can generate 27-28 inches of mercury. The unit requires only 0.8 SCFM of air at 60 PSI.

Place the lid on the chamber, open the chamber relief valve to the full open position and connect the venturi. Slowly partially close the relief valve while observing both the Cactus Juice and the chamber vacuum gauge.

As the vacuum forms the gauge reading will rise and the Cactus Juice will begin to foam from the air being released from the Cactus Juice, air surrounding the wood, and the free air within the wood. If the vacuum does not begin to form after a few seconds of use, you can help seat the lid seal by GENTLY pressing down on the lid for a few seconds until the vacuum gauge begins to rise. You may also find it useful to initially fully close the relief valve to help the chamber to seal. However, if you do so keep an eye on the amount of foaming so that you can quickly partially open the relief valve to control the amount of foam and prevent it being drawn into the vacuum system.

Slowly continue to close the relief valve while observing the Cactus Juice. As the vacuum increases the foam will also increase. You want to prevent the foam from rising into the gauges and tubing. If you are using a vacuum pump the resin could severely damage the pump. This is not an issue with the venturi pump as any

resin drawn into the pump can simply be washed out with soap and cool water. Note: Not all venturi pumps are created equal. Some contain plastic parts which may be damaged by the resin and the pump may not be designed to be disassembled.

As the initial excess air is removed the foaming will subside and the relief valve can be fully closed to allow the venturi to generate maximum vacuum. Once maximum vacuum is reached the chamber will no longer require attention.

The length of the vacuum step depends upon several factors such as the variety of wood, its size, number of pieces, and the level of vacuum maintained. I make note of the time at which the chamber reaches maximum vacuum and then periodically check the chamber. I continue the vacuum until only a few very small bubbles are seen escaping from the wood. This is probably a longer time than needed, but since the chamber does not need attention I just let it run while I complete other tasks. It is better to error on too long a time than on too short a time. I note the time when the wood reaches its endpoint so I know how long it was in the vacuum chamber.

At this point I disconnect the venturi and slowly open the chamber relief valve.

6. Allow the Cactus Juice to Penetrate the Wood

The vacuum step simply removes the air from the wood so that the resin can enter the wood. This occurs by allowing the wood to soak in the Cactus Juice for at least twice the length of time that the wood was under vacuum. Again, a longer time is better than too short a time so I usually allow the wood to soak overnight.

Another benefit of the Conestoga Works chamber is that the PVC is inert to the Cactus Juice so neither the resin nor the chamber will be damaged by longer soaking. In fact, it is possible to do several back to back runs without removing the resin from the chamber as long as the resin does not discolor from the tannins or other chemicals in the woods and significant debris from the wood does not accumulate in the resin.

7. Polymerize the Cactus Juice

Remove the lid from the chamber, remove the wood from the Cactus Juice and allow the excess to drain off the carrier and the wood. In my shop it is convenient for me to suspend the carrier by its handle above the level of the Cactus Juice to allow it to drain back into the chamber.

The next step is heating the wood to polymerize the resin. I usually process multiple pieces of wood in each run and fill the toaster oven I use to polymerize the resin. Therefore, I separately wrap each piece of wood in heavy duty aluminum foil. If the wood is stacked in the oven without wrapping it can stick together making the pieces very difficult to separate after polymerization.

Once the wood is wrapped it is ready to be cured. The wood does not need to be immediately cured and may be stored at room temperature for several days by placing the wrapped wood in zipper bags to contain any leakage of the Cactus Juice. Remove the wood from the bags before placing the wood in the oven for curing. The oven should be preheated to 200ºF using an oven thermometer, not the oven's thermostat, prior to use. The temperature must come to 200ºF for several minutes throughout the wood for complete polymerization to occur. The curing process must be completed once started, so leave the wood in the oven for a sufficient

period of time to ensure the internal wood temperature reaches 200ºF. This normally takes a couple of hours for pen blanks and longer for larger pieces of wood. You cannot restart the curing process if you determine that you have removed the wood too soon and the wood is only partially cured. The already polymerized resin will interfere with curing the remaining resin and the wood will be unusable. The wood may be left in the oven for extended periods of time without any ill effect so a longer curing time is much better than losing good wood because it wasn't completely cured.

An alternative method of curing the treated wood is to use boiling water. I have not tried this method, but it is described in the instructions from Conestoga Works. The advantages to this method are you know the temperature of the boiling water is 212ºF unless you are working at higher elevations, and there is no odor with this method. An electric turkey fryer is an ideal appliance to use.

The wrapped wood must be placed in sealable bags that can withstand the boiling water such as bags designed for boiling or baking. Place the wrapped wood in the bag and use a food vacuum sealer to seal it. It is not necessary to pull a vacuum on the plastic bag; however, remove as much air as possible before sealing it. Place the bag in boiling water for a minimum of 30 minutes. Several smaller bags with a few blanks in each are better than one large bag with a lot of blanks in it. Remember, the internal temperature of the wood MUST reach 200°F for several minutes for the Cactus Juice to cure. Larger blanks will require additional time for the internal temperature to reach 200°F throughout the wood. Again, longer time in the boiling water is better than removing the bags before the wood has polymerized.

8. Remove the Aluminum Foil

Removing the aluminum foil is much easier while the wood is still hot. Wear gloves to protect your hands from the heat. When the foil is removed you will likely see a "crust" of polymerized resin that has drained from the wood and polymerized on the surface. A belt sander is a quick way to remove this material if you need to do so for marking or to see the finished appearance of the wood. I usually just turn it off when the wood is rounded on the lathe.

While I have not done this myself, the owner of Conestoga Works tells me that it is not necessary to wrap the pieces if they are cured in a single layer and are not touching during curing. An example he gives is a burl that's going to be cast in resin after stabilizing to form a blank containing both colored resin and wood. Some turners call these blanks "mutt blanks". In this case you do not want the crust that will be created on at least one surface when the wood is wrapped in foil. Without the foil the Cactus Juice will leak out of the perimeter of the burl, however, it is a very insignificant amount that does not affect the overall stabilization of the item. Just don't place the item in the oven where the Cactus Juice will tend to pool, and place a throw-away pan under the wood to catch any resin that does leak out.

9. Cleanup

The venturi requires no cleanup unless you allow resin to enter the unit. Since this unit has a brass interior and is designed for industrial use it can be disassembled and cleaned with mild dish soap and cool water. It should then be rinsed and dried thoroughly before being reassembled.

As mentioned previously if you plan to do another run that day or the next, the remaining Cactus Juice can just be left in the vacuum chamber. However, for longer term storage, the Cactus Juice should be filtered into

clean, dry, labeled plastic bottles. Bottles of this type can often be obtained at paint stores along with disposable filters which will fit common plastic funnels. The bottles are then capped and stored in a cool, dry, and preferable dark place until used again. Cactus Juice should have a one year shelf life if stored below 85°F and longer if it can be stored in a refrigerator. Remember that once the resin is catalyzed it will begin to very slowly polymerize at room temperature. I do not mix batches of resin that have been catalyzed on different dates since they have different shelf lives.

The vacuum chamber can be washed with mild dish soap and cool water. I allow it to dry thoroughly. The carrier is made from uncoated steel to ensure there is no reaction between any applied carrier coating and the Cactus Juice. Therefore, it will rust if left exposed to humidity. For short term storage Conestoga Works says it can be simply wiped down and stored in the chamber. However, I prefer to use the longer term storage method. I rinse the carrier at the same time I wash the chamber and make sure it is thoroughly dry. I then coat it with CRC 3-36 Multi-Purpose Lubricant and Corrosion Inhibitor which can be found online and at many auto part stores. I then wrap it in kraft type paper, place it in the clean chamber, and store the chamber with the carrier in its shipping box. The corrosion inhibitor is wiped off the carrier before the next use.