

Beekeeping Basics

Using Wax to Preserve Woodenware

by MEGHAN MILBRATH



Ever notice that the word “pain” is in “painting”? While I love bees and beekeeping, I hate painting boxes. My sideline operation in Michigan is limited by both space and time, and paint needs both to dry. Since I operate out of a small shared building, and Michigan weather is not always reliable for drying paint outside, a few years ago I looked into alternatives to painting boxes as a method of woodenware preservation. I tried paraffin wax preservation, and I have never looked back. The process is quick, it does not require space for drying, and the boxes last much longer than those done with paint or stain. Even better, a hot wax system can sterilize equipment — including American foulbrood (AFB) spores, and I love reducing disease risk any way that I can. In this article I have tried to outline my experience so you can see if this is something that might work for you and your operation.

The whole process occurs by dipping woodenware in a tank of hot wax. The tank is basically a large stainless steel rectangle with a removable lid. Mine is big enough to dip six deep boxes at a time (two stacks of two side-by-side with one in the middle of each stack), though I’ve seen others that are much smaller. The nice thing about having such a large tank is that it ultimately saves a lot of time — between loading, unloading, and a 10-minute dip, each batch takes about 15 minutes. If you double the size of the batch, you halve the time it takes to get through your woodenware. Of course, this is only useful if you plan on doing a lot of boxes. The downside to a large tank is that I had to purchase a LOT of wax to fill the tank — about 700 pounds.

I have always been able to find the wax, though it is not cheap because it is an in-between size order for most companies — more than used for

crafts, but less than used in industrial applications. Often, the cost of shipping is about the same cost as the wax, so if you have the vehicle and time to pick it up it is likely worth your while. I’m lucky because there are two other beekeepers in the area that I can order with to share costs. It is also important to know what size pieces the wax will arrive in if you have to hand-unload like I do. While I can accept a freight shipment at the farm, I have to hand-move it around the garage, so I get 60-pound boxes that I can easily lift. I use a mixture of **2:1 ratio of paraffin and microcrystalline wax**. I use this ratio because it is what most beekeepers use who dip their equipment (and write about it on the internet or answer my phone calls). I have not been able to find a lot of data or reasoning behind wax mixtures, but the current mix works fine, so I have not been motivated to mix it up. I do always talk to a dealer to check the specs, because it is really important to pay attention to the flash point and the melting point. You want a wax with a higher melting point, so that it will not get tacky and sticky in hot sun in the bee yard (this is why beeswax does not work). More importantly, you want to have a high flash point so that you don’t create a driveway disaster.

In order to sterilize boxes for AFB spores, you want wax that can be heated to 160° C (320° F). The wax also has to be hot because the process needs to be above the boiling temperature of water. Rather than coating the outside of the wood, the wax dip process boils the moisture out of the wood, and the wax is sucked inside. The hotter the wax, the faster this process occurs.

Because you are boiling water out of wood, the moisture of the wood is



Note the foam caused by the new boxes. We try to leave at least 12” between the top of the wax and the top of the tank, but that is sometimes not enough if the wood is wet or you pack it full with lots of small pieces. Photo by Kirk Mason

a very important consideration. When the woodenware is brand new, and often very wet, there will be a lot of moisture. Because we do it outside, we also have to watch the weather so the boxes are dry and we don't get rain/moisture into the tank. Moisture will cause the wax to foam, and it can overflow. We learned this the hard way, and now also have an accidentally (and expensive) paraffin-sealed cement pad in our driveway. Now, we never fill the tank more than $\frac{2}{3}$ with wax, to allow for the space of the wood and the wax, and our tank has a 2" baffle that drains into an overflow bucket. If I were to make a new tank, I would make a much larger overflow pipe to a bigger bucket, because when overflows happen, they are fast and dramatic.

Besides overflows, there is a lot of potential for fire. We minimize risk by keeping a fire extinguisher close by, keeping a clear space around the tank, and having a steel lid always accessible — it hooks to the side during use. Our bottom is flat, but in the beta version, I would have a lip that drops down to shield the burner from drips. Our tank is on casters, so it can be rolled out of the garage to an outdoor, open cement pad for dipping. If you had a forklift, I would just leave pallet jack openings rather than the casters in the design. If you do get casters, I would make sure they are metal — speaking from experience, if you have composite casters, and it is a cold windy day so you insulate around the bottom of the tank too well, you will melt your casters to the

cement pad, and have a real fun afternoon trying to move an 800-pound tank that is melted to your driveway.

Our tank is not insulated, so on very cold days it is hard to keep the wax up to temperature. One very cold and very windy day we were using a ton of propane, and would have to take breaks between rounds to bring the wax back up to temp. Our solution was to insulate with rockwool and cement board. Those are both safe to use, and non-flammable. However, what we missed was that if there was an overflow, the insulation would keep the wax right next to the tank. It dripped down the side of the tank and onto the casters, causing them to burn. We chose to learn through experience, but you could use foresight if you like — either insulate the tank more safely, only dip on hot days, or assume that everything nearby is fair game for starting on fire, and purchase metal casters accordingly.

Our tank is heated underneath with a black pipe burner (from a meat smoker/grill company) with an adjustable regulator hooked to a 100-pound propane tank. I have seen photos of some people who heat their tank with an open fire. I believe this to be dangerous because the wax is so flammable and the flame cannot be "turned off" if there is an emergency and there is no way to control the temperature of the wax. Originally we used multiple 20-pound propane tanks. We have a gas station nearby with propane refill, and we would switch them out as needed during the day. That was

a pain (there is only one employee at the station for both counter work and propane refills, so sometimes we would have to wait at the station for a long time). The 20-pound tanks also got maxed out a lot. They would freeze up and required a lot of maintenance to unthaw valves or to tip to get more pressure. We now use a 100-pound tank, and keep the small tanks to use while the large tank is getting refilled. I usually use a full 100-pound tank each weekend that I dip.

I get up around 5 a.m. and start the burners to melt the hardened block of wax. The time it takes to get the wax to temperature depends on the outside weather, but usually it is about 4 hours if the tank is uninsulated and it is cold, or about 2 hours if it is insulated and warm out. Usually by 9 or 10 in the morning we are busy dipping boxes. If the boxes are dry, we can keep the process going without stop. If they are wet, we often have to pause to let the excess water boil off and the wax get back up to temperature. We use an infrared thermometer to easily check the surface temperature of the wax so we aren't wasting our time trying to dip when it is too cold. When the wax is not hot, it takes much longer for the water to boil out, and the process does not seem as effective. I usually try to do at least two days in a row, because if it is warm enough (and I get up early enough) the wax will not completely solidify at night, and I won't have to wait for it to completely melt again.

The dipping can easily be done with one person, but it is better with two. The person working the tank protects themselves from the wax drips with a heavy duty apron and heavily insulated gloves. The other person moves boxes — we keep a pallet for woodenware that needs dipping on one side of the tank, and pallets of finished boxes on the other. The person working the tank adds the boxes slowly — preventing splashing, and watching the levels of foam/moisture. At 160 C (320 F) the boxes have to sit submerged for 10 minutes. The boxes will want to float, so you'll need something to hold them down. I have seen designs for bars with a spring and catch, but we just use some scrap metal (see the rebar and angle iron 'ladder' in the photo) that is held down by a concrete block. We had to add a similar rack to the bottom of the tank so we were not pressing the boxes against the hot bottom where they can burn.



In this photo you can see bubbles as the hot wax is sucked into the corners of the wood. I have only had the dipping tank since 2015, so I cannot personally speak that well to the longevity of the boxes, but I have yet to see any signs of rotting corners from the dipped boxes. Photo by Kirk Mason

The rack also keeps the boxes cleaner, as dirt and flotsam such as cocoons, propolis, etc. from re-dipped boxes will sink to the bottom. We have a metal mesh skimmer (home-made with hardware cloth) to get bees and cocoons that float, but it is almost impossible to clean the dirt from the bottom of the tank, so we are careful about what goes in. I use a wire brush on used boxes to remove spider webs and dirt, and we keep the lid on the tank when it is in storage. Over time, the wax is no longer totally pristine, but it kind of adds to the natural look, and we don't really care, so I have not put more effort into keeping the wax perfectly clean.

After dipping, the boxes have to sit for only a few minutes to dry/cool. Once they are cool to the touch they are completely ready to go. It is good to have a drying rack that collects the dripping wax — there is a lot that drips off the boxes in the process, and since it is so expensive we have found that it is worth it to reclean it and put it back in (we just put the collected wax in the tank in a strainer as the tank is heating, and remove the strainer once the liquid wax has melted out). It is better to have a place sheltered from wind to dry the boxes.

We tried to dip boxes on a cold and windy day (probably the same day as we melted the casters), and the wax was drying so quickly it wasn't getting drawn into the boxes. We had to scrape the outsides of the boxes, and wondered how much actually went into the wood. You can paint the boxes immediately after the boxes come out of the tank, but not really after they are finished. (I have never tried, but I can't imagine it would work well.) We had a beekeeper want to decorate their boxes, so we set up a tarp painting station on the grass next to the driveway, and they were ready to immediately paint them. I have not done that much, but I like the option so I can still easily mark mating nucs to prevent drifting.

You can wax dip most equipment, used or new, as long as it is clean, not too wet, and not cheap plywood (the glues will delaminate). Metal covers and screened bottom boards are just fine — the wax drains off the metal, and a quick shake rids the screen of the liquid wax. I have had no problems with dipping painted boxes — only one color faded — but I don't think it absorbed well into the painted side. You can dip unassembled or assembled equipment. At first I thought



Here is a photo of the caster burning incident. The flames are all just melting plastic. It smelled horrible. Photo by Meghan Milbrath

there was a great benefit to dipping unassembled equipment, because you can fit so much more into the tank. However, I soon realized that they often stick together — so tightly that the wax does not penetrate in between. Prying them apart is difficult, so it does not save that much time. It could be solved by a slotted rack of some sort, however you also have to watch the foam and overflow risk. If you pack the tank with a lot of new wood, that means a lot of moisture, easily boiling over.

I only dip each box once, though I have seen that some people dip multiple times to make sure that the wood is fully preserved. I have re-dipped some boxes as the paint has worn off, or if they happened to be empty

and nearby while I was already dipping boxes, and I have noticed that it takes much less time on the second round — there is so much less foam — indicating that the wax is holding up at least for now. While I was trying to catch up on my back stock of woodenware I would usually fire up the wax dipper twice per year — in the spring and in the fall. I would stack up equipment to be dipped in the garage, and when I would have at least 60 boxes of my own equipment, I would send an email out to local bee clubs and let them know what weekend I would be dipping. I would do all of my boxes on a Saturday, and then dip other peoples' boxes on that Sunday. I leave pallets in the yard so people drop off their equipment all



A stack of woodenware sits ready to be dipped as a load of boxes sits submerged in the tank. The lid is hooked over the side for quick access. Photo by Kirk Mason



A mix of wax dipped and painted boxes in the field. I add the cleat at the same time that I dip the boxes so I can keep track of which boxes have been dipped. As I retire out old boxes I likely will not paint anymore except to add decorations to minimize drifting.

week (every single piece has to be labeled and they either have to leave a note or email me their contact info and the inventory of what they left). In non-pandemic years, people often stay to help, or use the other jigs in the woodshop, and it is a pretty fun and social event. Usually someone orders pizza, and we spend the day talking bees. In those two days, and keeping a social pace, I can usually dip upwards of 200 assembled boxes. I estimate it costs \$4-5 per box to cover the wax, propane, and initial materials. After each weekend of a few hundred boxes I have to refill the 100-pound propane tank and order a few hundred dollars' worth of wax to refill the tank. I only charge enough to cover my costs, because it isn't part of my business — it is more of a service I offer, but I do feel that the demand is high enough in my area that someone could make it part of their business model. I have not had any complaints from other beekeepers, and I've been quite happy with the way the boxes turn out. The real test of the economics of this system will be if the wax dipped boxes last without care as long as people tell me. I've read that a dipped box can last decades, while painted boxes rarely last a full decade. In my calculations, if I can prolong making new equipment by even a few years, the system will easily pay for itself. Only time will tell.

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