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Finishing in A Cold Shop

Fall marks the traditional onset of the "woodworking season". Unfortunately, it also brings the start of cold weather. With colder weather comes cooler shops and the potential for problems with finishes that are easy to apply when the temperature is above 65-Degrees. Water-borne acrylic finishes, including the host of Polyacrylic blends (so-called "water-based poly"), are the most problematic and my advice remains that they should not be used when your shop is cold, or for that matter when it is hot and humid. But my advice on oil-based varnish has changed as I am about to explain in this article.

In the past I have recommended that oil-based varnish not be applied in cold weather. The conventional wisdom has *always* been that cool temperatures negatively impact the ability of varnish to properly cure. But "conventional wisdom" and "myth" are frequently one-in-the-same. My rethink of this proposition comes as the result of an unintended *experiment*. I recently applied a coat of Waterlox Original Gloss varnish to a cherry sample for one of our customers. Soon after the finish was applied, we closed for the day and the freshly finished "sample" was disposed of in an unheated area of our warehouse. The next morning, I picked up the sample to toss in into the dumpster and noticed that it seemed quite "dry". I was further surprised to note that sanding the sample produced the fine white powder I was accustomed to seeing when sanding properly cured varnish between coats. Since these observations did not square with what I *knew* to be true; varnish does not properly cure at cold temperatures, I decided to repeat the process giving a bit more attention to controlling the conditions to be sure that what I observed is really what had actually happened. Sure enough, the second coat applied to the same sample and left in an unheated space overnight cured just as the first coat had.

Clearly, it was time to rethink my previous (and long held) position. Perhaps low temperatures *are not* the problem I thought they were. So, let's begin with what we know about oil-based varnish.

- Varnish is a reactive finish that is produced by "cooking" a drying oil with a resin.
- When the can is opened, and the varnish applied the molecules of varnish react with oxygen in the air to complete the polymerization process resulting in a cured coat of finish.
- The only element of "drying" that takes place is the evaporation of the thinner. Mineral spirits will evaporate whether the air temperature is 7-Degrees or 70-Degrees, so the evaporation of thinner can't be an issue in the curing of varnish.

Further, there is just as much oxygen in the air in January as there is in June, so the elements required for proper polymerization are present whether the environment is warm or cold. What was I missing and why do so many among us hold to the belief that varnish won't cure properly when it's cold? Clearly my samples cured in an area where the temperature was in the 40's, so it was time to dig a bit further.

My next step was to call my contact at Waterlox. After explaining in great detail what I had "discovered" I was treated to the humbling response; "*yes; and what did you expect...*" It was then explained to me that the only impact of cool temperatures on varnish is to retard flow-out and leveling (I'll return to that point in a moment). Heat, in the form of a "warm" finishing environment, acts only as a "catalyst"; it speeds the reaction of the varnish with oxygen in the air thus shortening the time to cure. But while a warm finishing environment is nice (especially for the finisher) even at very cold temperatures varnish will still cure properly; it just *may* take more time. My source went on to say that at temperatures much below 50-Degrees we should be prepared for a cure time of 36-hours as opposed to the eight to twelve hours that it takes when the temperature is 65-degrees and above. I was also told that the greatest inhibitor to rapid curing in cold conditions is not the low temperature. The problem is reduced air movement at low temperatures resulting in a reduction in available oxygen at the curing surface. Remember, reactive finishes must have oxygen available to cure. When the air temperature is warmer air easily circulates by simple convection (air movement brought about by the normal rising of warmer air and the drawing in of cooler air at the surface). As the air temperature cools convection slows to a crawl and air at the finished surface "stagnates" (oxygen available for the curing reaction is used up and curing slows). Since air movement ensures a fresh supply of oxygen in the micro-climate immediately adjacent to the finished surface the next best thing to increasing air temperature is to improve air flow across the surface. In other words, the availability of oxygen at the surface of the curing varnish is the key; if you can't have warm temperature then the replenishment of oxygen at the surface of the finish is the most important element

in the curing process. Therefore, when applying varnish in cool temperatures the cure rate can be significantly improved by turning on a fan to move air over the finished surface. To illustrate his point my Waterlox source told me about a floor they had finished in a new, unheated home in Cleveland the previous winter in which the air temperature was just 13-Degrees. They set-up fans to keep the air moving and the floor was sufficiently cured in 12-hours to allow for the application of a second coat.

Now, back to the point about flow-out and leveling; having not yet reached humiliation overload I decided to suggest that the best way to improve both when finishing in the cold would be to add thinner. Makes sense, right; by adding thinner, longer open-time and better flow-out and leveling. *Wrong*! The problem is not solved by adding more thinner, the problem is solved by changing the type of thinner added. Too much thinner just means that we will have to apply more coats to achieve proper film thickness. Given that curing may already be slowed by lower temperatures all we will do by adding thinner is make a slower process even slower. Never, I was told, use naphtha when the temperature is below 70-degrees; the stuff flashes off too quickly. Odorless mineral spirits should also be avoided for much the same reason. In cold weather use the less refined mineral spirits/paint thinner; or better still use pure gum turpentine. Turpentine flashes off slower than mineral spirits/paint thinner. This suggestion was most revealing since I have long used turpentine in very warm, dry weather for the same reason; to improve flow-out.

So, can you use varnish (including wipe-on varnish) in cold weather in your marginally heated (or unheated shop) and be confident that the finish will cure properly? Yes, you can; just understand that you must substitute air movement for heat to insure an adequate source of oxygen at the surface during the curing process. Further, since curing may take longer you should allow more time to finish your project. If you apply a second coat of finish before the first coat is sufficiently cured, you will permanently exclude oxygen from the uncured coat and your finish will be soft. (It is important to note that the same problem will arise if you recoat too soon in a warm finishing environment. "Seal" an under cured coat of varnish with a new coat and further curing is halted.) When finishing in less-than-ideal conditions, whether cold, or hot and dry, don't thin more than you normally would; change to a thinner that is more appropriate for the conditions. In my view there is never a good reason to thin with naphtha; there is no benefit to speed. Further, while odorless mineral spirits may be acceptable under ideal finishing conditions you will generally be better served by the less expensive and slower to evaporate mineral spirits/paint thinner

(they are the same thing). Finally, when it is cold, or when it is hot and dry use turpentine.

I am certainly not suggesting that we turn the heat off in our shops, or that we move to Cleveland and set up shop in an unheated space. But, contrary to my long-held misconception, finishing with varnish at less than optimal temperatures is a viable option.

Addendum to Original Article

Both lacquer and shellac are evaporative finishes; they don't *cure*, they *dry* by simple solvent evaporation. As long as the solvent, lacquer thinner and alcohol respectively, does not freeze it will evaporate as easily in cold weather as it does in warm weather (when alcohol freezes, we will all face problems far greater than getting a finish on our latest creation). So, while finishing in a cold shop may be *uncomfortable*, the finish won't know the difference.

Water-borne acrylic finishes remain a problem. These finishes, which include so-called "water-based poly", like neither cold nor hot; and the temperature range at which they will properly *coalesce* is quite narrow. Water-borne finishes are the only finish used by woodworkers that require close attention to the finishing room environment. (Unsolicited negative comment: Just one more reason to avoid water-borne acrylic finishes. Sorry, I couldn't help myself…)