

# Clear UV Spray Finishes for Wood

By Don Hart

**A**s with any new technology, there is a learning curve. UV finishes are no exception.

Spraying UV finishes has been a challenge since UV was first invented. For the first three decades that UV finishes existed, there was very little happening in UV-spray technology due to the difficulty in getting the liquid finely atomized enough to spray. The reason that UV was so difficult to spray had to do with the fact that the first generation of UV finishes were high in viscosity. Some in the industry have said that they were 'thick as mud.' It was nearly impossible to atomize these original UV finishes without

on cabinet doors and frames. The industry had originally focused on adding solvent to the UV clear coating or using water-based UV to give a "lacquer look." Unfortunately, both the solvent-based UV and the water-based UV have the downside of having to dry (flash-off) the solvent or water.

The solvent-based UV has the additional downside of being flammable and may require permitting, depending upon the type of solvent used and the area in which the facility is located. First-generation UV finishes with VOCs as high as 5 lbs/gallon were sold to customers who were looking for improved performance properties, but not necessarily an environmental advantage. These finishes were sold through the 1990s until customers started to demand "greener" finishes.

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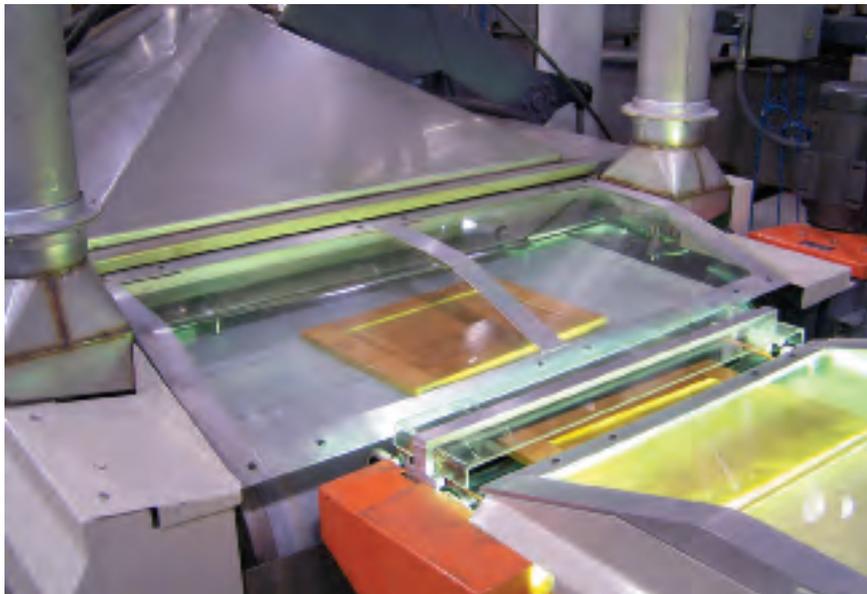
using special airless spray equipment. Even when these finishes were sprayed with the most advanced spray equipment, there was an "orange peel" texture and it could not be substituted for conventional conversion varnish or lacquer.

The original UV finishes' viscosity was so high that some manufacturers decided to reduce the coatings with solvent (usually butyl acetate, ketone or alcohol solvents). This made the finish easier to spray, but this solvent-based UV finish had lost its environmental appeal. The cabinet industry (the leader in spray UV) had long desired a zero VOC clear finish that would give an "open grain look"

## **State-of-the-Art in Spray UV Wood Finishes**

Many types of UV finishes are sold for spraying onto wood components. The main types of spray UV wood finishes include 100% solids UV, water-based UV and solvent-based UV.

About 15 years ago, raw materials could not be found to formulate a coating with low enough viscosity and that could be sprayed without adding solvent. Advances in UV-raw materials have made it common to formulate low-viscosity 100% solids UV finishes that can be sprayed at viscosities of 20 seconds on a #2 Zahn. Many large coatings manufacturers have failed to bring this technology to the market because solvent-based UV products are currently selling and working



Mist Coater

Photo courtesy of Dubois Equipment.

reasonably well and are very profitable to the finish manufacturer.

Water-based UV finishes have become very popular recently and are gaining ground in the wood components markets. They offer low solids and low viscosity that make them easy to spray.

Solvent-based UV finishes have been around for a long time, but are rapidly losing out to 100% solids and water-based UV due to their lack of environmental advantages and concerns about flammability.

### 100% Solids UV Finishes for Wood Components

100% solids UV finishes are actually liquid at room temperature, despite the name. The label “100% solids” normally refers to UV finishes that do not contain added solvent or water. When finishing people talk about “100% solids,” they are talking about a coating or finish that is liquid at room temperature but when it is applied to the substrate and cured, it will not emit solvent or water. It essentially reacts on the surface of the part to create a solid coating on the surface of the substrate with no loss of weight. There may be a slight inaccuracy in talking about this as

100% solids UV since there may be some volatile content in the coating from additives and impurities. These potentially volatile contents amount to about 1-2% of the total formula.

The first generation 100% solids UV coatings were not able to give the “lacquer look” because they would tend to bridge the soft grain of the oak, leaving what many wood finishers called the “plastic look.” This “plastic look” has long been the reason that 100% solids UV could not be used in high-end applications that required a thinner coating appearance.

Getting a conventional “lacquer look” is possible if you think outside the box. Sometimes it is best to use two different UV technologies to get the desired result. “The key to using 100% solids UV finishes is using the new ultra-low viscosity sanding sealers for wood components,” says Craig Martin, vice president of Mid-America Protective Coatings Inc. “These new ultra-low viscosity sanding sealers can still seal the wood in one coat, but do not leave the “orange peel” texture of old high-viscosity UV sanding sealers. The new ultra-low viscosity UV-sanding sealers need far less flash time than the solvent-based UV finishes that have

been used in the cabinet industry for years.”

Another advantage of 100% solids UV finish is that it allows for a smaller footprint on the finishing line along with the removal of most flammable solvents from the facility. Martin predicts, “In the near future, wood component finishing will be done with 100% UV-sanding sealers and water-based UV topcoats. The ultra-low viscosity 100% solids sanding sealers give good ‘hold-out,’ easy sanding, and immediate dry. The water-based UV topcoats give easy application, conventional finish ‘look,’ and allow immediate stacking capability without blocking right out of the drying and UV-curing unit. The final product has excellent hardness and flexibility.”

Bob Wade, senior scientist at Bayer MaterialScience, recommends that carefully controlling film thickness of 100% solids UV is the best way to get a “lacquer look” on wood components. “And, the best way to get a thinner film finish is by using 100% solids UV that is 100 centipoises (43 seconds #2 Zahn) or lower in viscosity.”

100% solids UV-spray finishes offer near zero VOC, no flammability hazard, and fast curing with almost no flash area. Most UV coatings have flash points above 205°F, compared to solvent-based coatings that may have flash points under 100°F.

They can be the solution to environmental, space and fire hazard problems in one package. Most 100% solids UV-spray finishes are also easily reclaimed and reused since they do not cure/dry until they are exposed to UV radiation.

### Water-Based UV Finishes for Wood

Water-based UV finishes are not the obvious answer for wood component finishers, but they have some real advantages. Water-based UV finishes



*Water-based UV finish on wood.*

must be dried out first through some type of oven (thermal convection, IR, microwave, etc.) This water-drying process is probably the main disadvantage for using water-based UV finishes. A UV-curing process follows the drying process. The water drying process tends to take up more space and energy than the UV curing process.

Water-based UV primers were first introduced in the 1990s to the pre-finished hardwood flooring industry in order to improve the adhesion of the UV sealers and topcoats to the wood. Water-based UV primers and sealers are used on many wood applications where adhesion and scratch resistance are of primary importance. Water-based UV topcoats are easy to spray due to their low solids and low viscosity. Water-based UV topcoats are more forgiving when it comes to application compared to other finishes because their viscosity can be lowered easily with water.

Bob Wade, of Bayer MaterialScience, suggests that water-based UV is the way to go for those who like a lacquer look. "Water-based UV has lower solids and so it naturally gives more of a

lacquer or varnish look than other UV finishes," he says.

Training spray machine operators is easier because the technology looks more like conventional solvent-based finishes. Water-based UV-spray finishes are easy to formulate to either high or low gloss. One disadvantage of water-based UV technology is that the water in the finish can raise the grain of the wood substrate when used as a primer or sealer. This may require an extra sanding or de-nibbing step in the coating process if the grain raise is severe enough.

### **Solvent-Based UV Finishes for Wood Components**

As previously discussed, solvent-based UV finishes were the first UV finishes available to spray. Some solvent-based UV finishes have VOCs as low as 2.3-3.0 lbs/gallon. Many coatings suppliers still tell their customers that they cannot spray 100% solids UV clear coatings because they are unwilling to reformulate coatings they are already selling. Many large coatings manufacturers have failed to bring this solvent-free

technology to the market because the solvent-based UV products they are currently selling are working reasonably well. They are easy to spray and give a fairly nice looking finish that approximates the look of conventional solvent-based lacquer or varnishes. In areas without much solvent emission regulations, they give a durable film that is solvent resistant, water resistant and chemical resistant without the need for new application equipment. "Solvent-based UV can provide an easy transition into UV technology because it is so easy to spray, but it is not the final solution for most wood components finishers trying to keep up with tightening environmental regulations," says Martin.

Unfortunately, solvent-based UV finishes are expensive (on \$/solids basis), flammable and not as easily recycled as other UV finishes because solvent usually has to be added back before they will spray well after reclamation.

### **Spray Technology**

Most spray UV finishes have traditionally been applied on flat-line units. Most of these units are now extremely efficient and can recycle most of the overspray. There are three types of spray systems currently in use—reciprocating, rotary and misting. The reciprocating and rotary flat line units use 2-8 air-assisted airless spray guns. In this system, the UV coating is sprayed down onto a plastic or metal conveyor belt. This belt can catch most of the overspray and allow it to be saved for future use. These types of spray units are up to 95% efficient. These spray units can use any UV-finish technology.

The misting type spray machine can also recycle the unused UV finish but it uses more traditional high volume/low pressure (HVLP) or conventional air-atomized spray

technology to “mist” the UV coating onto the part. The misting spray units capture the overspray on a plastic type conveyor belt and capture any overspray mist with a series of baffles in the exhaust system. This misting system is excellent for spraying low viscosity 90-100% solids UV finishes on wood substrates.

Jim Arvin, president of DuBois Equipment Company, thinks that (when spraying UV) it is important to get the same good pre-sand and sealer sand that you would get in conventional coatings. Arvin points out that UV finishes on wood still need good atomization and good sanding just like any conventional finish. Arvin claims, “The mist coater can be 98% efficient with UV finishes when reclaiming the overspray.” He also says that sanding the UV-wood sealers can be made easier by using a UV-curing unit that has variable power so that the topcoats can be fully cured, but the sanding sealer may only be 70% cured to facilitate ease of sanding and to improve intercoat adhesion.

Excellent results have been achieved in the laboratory using electrostatic rotary atomizing guns. This type of spray equipment has been used for breaking up the 100% solids UV coatings into a fine mist. This electrostatic technology has long been used in the automotive industry for getting great looking finishes and high transfer efficiency.

“Mixing a conductive prep solution into the wood stain allows for the use of electrostatic rotary atomizers for the finishing process,” says David Hagood, of Finishing Technology Solutions Inc. “The use of rotary atomizers has many benefits, including the ability to control atomized particle size much more consistently than other spray technologies. It also allows the finisher to use higher solids viscosity finishes when compared to some other spray technologies.”

Advancements in UV-finish chemistry and application equipment design have brought the use of 100% solids UV, water-based UV and even solvent-based UV spray finishes to the forefront of the wood components

industry. These systems cure faster, have lower viscosity and require much less energy to cure than first generation UV clear finishes or conventional varnishes. The upside is tremendous. Wood-component manufacturers will have the ability to finish cabinet doors faster, more efficiently, with less energy and in a more compact line. Easy-to-sand UV sealers are more available. Many of these systems can be sanded with automated sanding equipment on flat parts and most of the sanding can be automated for even-raised profile doors and mouldings. In addition, the UV-curing systems have been re-engineered to deliver more uniform UV energy with a lot less heat. The superior atomization of the air-assisted airless spray guns, newer air spray guns and rotary atomizing equipment help to lead 100% solids UV into markets that demand the “lacquer look.” The future looks bright for all types of sprayed UV finishes in the wood components industry. ▀

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