Case Study No. 11 Waterborne and UV-Cured Coatings
Geiger Brickel
Atlanta, GA

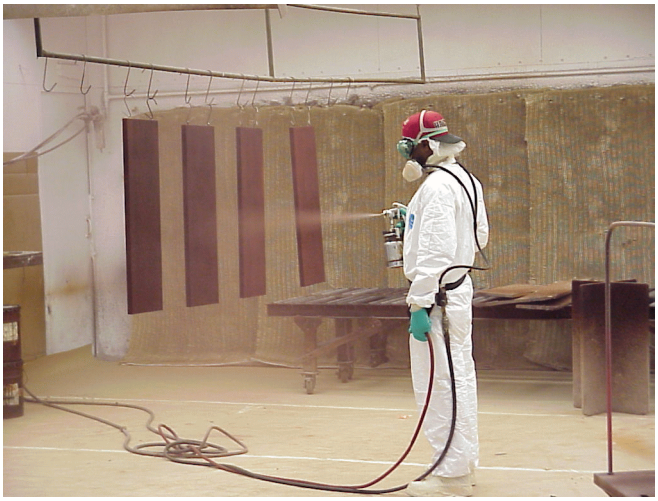
Background

Geiger Brickel began producing high-end wood office furniture in Toronto, Ontario, in 1964. The company has two manufacturing facilities in Atlanta, referred to as the Fulton facility and the Assembly to Order (ATO) facility. The Fulton facility began operation in 1978, has about 290 employees, and produces about $40 million per year. The ATO facility was completed in May 1999. Geiger anticipates the ATO facility will have approximately 78 employees and produce about $40 million per year at full production. Most of the finishing operations in the Fulton facility are manual, while only automated spray and roll coating equipment are used at the ATO facility.

The switch to low-VOC coatings at Geiger was prompted by a desire for a high-quality, more environmentally friendly coating and to stay "ahead" of EPA requirements. Geiger Brickel applied for and received a grant from EPA to investigate a waterborne urethane topcoat. They began using the new waterborne urethane in 1996. They installed a roll coating line at the Fulton facility in 1998 to apply UV-curable topcoat to certain types of flat components.

Manufacturing and Coating Processes

All raw materials are received in bulk at the Fulton facility, including particleboard, veneers, and solid wood. Both domestic and imported wood species are used, including maple, ash, cherry, oak, walnut, beech, sycamore, anigre, and sapele. After the materials are sorted, veneers are spliced together, and the particleboard and solid wood are milled into components. Veneer is applied to the particleboard using a waterborne glue and a hot press. Some components receive a wood veneer on one side and a paper backing on the other side if only one side will be visible on the finished product. Any edge banding or solid wood edging then is applied.



Shading spray booth

Casegood components receive any necessary holes or grooves and are sanded and assembled prior to finishing. Desk and table tops are sanded before finishing and are finished separately from other components.

Fulton Facility Coating Process

There are five coating lines or stations at the Fulton facility: a stain wiping station; a shade/sealer spray booth; a waterborne urethane spray booth; a solvent-borne urethane spray booth; and a flat line used to apply UV-curable

topcoat. All stains at the Fulton facility are hand wiped to achieve the desired depth and clarity. An oil-based stain currently is used, but the facility plans to move to waterborne stains in the future. After stained products air dry, they move to a spray booth, where they are sprayed with additional stain to match a color control sample. This step is referred to as shading. Both natural and stained products receive a coat of sealer in this booth. All spray guns are HVLP. The product is then racked and left to dry.

After the product has dried (usually 24 hours), a topcoat is applied. One of three topcoats is used: waterborne topcoat, solvent-borne topcoat, or UV-curable topcoat. Table and desk tops (horizontal surfaces) receive one coat of solvent-borne urethane topcoat. Most casegood frames receive two coats of waterborne urethane topcoat. The first coat is sprayed, the components are transferred to a flashoff area to stand for 20 minutes, and then enter a gas-fired oven. After cooling, the components are sanded, receive a second coat, and pass through the flashoff area and oven a second time. About 80 percent of the volume of products coated in the Fulton facility receive the waterborne topcoat.


Waterborne urethane spray booth

Casegood components referred to as “storage 3,” such as shelves and drawer fronts, are sanded and receive two coats of UV-curable topcoat on a roll coater. Component edges also are finished on an edge coating machine using a UV-curable coating.

Finished parts then are sent to the assembly area. After products are fully assembled, they are blanket-wrapped and shipped.

ATO Facility Coating Process

Components to be coated come into this facility already veneered and edge banded. There are four coating lines at this facility: a reciprocating spray stain line; a roll coating line for flat components; an edge coating line; and a robotic spray line for table and desk tops.

Parts to receive stain are placed on the stain line and travel through a sander and a dust removing device. Stain is applied on the edges of the parts by hand. The parts then pass over a sensor that determines the shape of the part and the appropriate spray pattern. A waterborne stain is applied by the reciprocating sprayer and any overspray is recycled. A transfer efficiency of up to 80 percent can be achieved with this equipment. Upon exiting the spray booth, the parts are wiped by hand and then pass through a drying tunnel.

Flat parts then pass through the roll coating line twice to receive both a UV-curable sealer and topcoat (although the same material is used for both coats). These parts then go to the edge coating line to receive two coats of UV-curable topcoat for the edges.

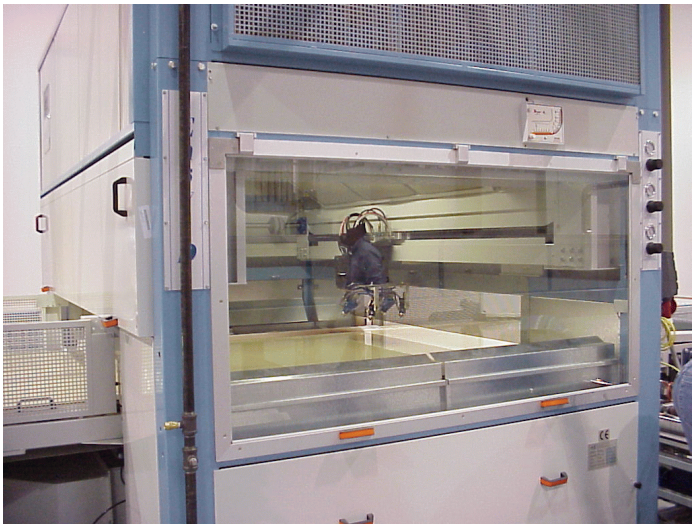

Reciprocating sprayer

Table and desk tops receive a UV-curable sealer and topcoat on a robotic spray line. The tops pass through a sander and receive a coat of sealer in the robotic spray booth (overspray is recycled here, also), followed by a drying oven to flash off the solvent in the coating and UV lamps to cure the coating. The tops pass through the line a second time to receive the topcoat. The sealer and topcoat are different materials on this line.

After all coating steps are complete, components pass to the sub-assembly and assembly areas. After assembly, the furniture is blanket-wrapped and shipped.

Conversion to Waterborne and UV-Curable Coatings

Geiger Brickel worked with their coating supplier for 2½ years to develop the waterborne urethane topcoat used at the Fulton facility. Facility personnel stated that changing over to the waterborne topcoat was easy, because all the performance issues were resolved in the research and development phase. They worked very closely with their coating supplier to develop a waterborne coating that met their performance expectations. The waterborne urethane topcoat actually is harder than the solvent-borne urethane topcoat. Geiger has received no negative feedback from their customers or salespeople since implementing the waterborne topcoat.

One issue that Geiger overcame was an increase in drying time with the waterborne coating. In order to accommodate the desired production rate, a drying oven was necessary. Geiger did not have to purchase a new drying oven because they had one that had been in use for an old product line. Another issue was the appearance of the coating if too much was applied at one time. Geiger switched from applying one coat of topcoat to two light coats because the waterborne topcoat appears cloudy if too much is applied at once. Running on the vertical surfaces also was a concern if too much of the coating was applied.

Geiger Brickel chose not to implement the new coating on desk and table tops because of the cost related to the purchase of an automated line with a drying system. They plan to make the switch to the waterborne urethane or the UV-curable topcoat used in the ATO facility on the desk and table tops in the near future. If they choose to switch

to the waterborne coating, they will have to install a drying oven on that coating line, and probably will install a robotic spray system, as well, to improve transfer efficiency and finish consistency.

Implementation of the roll coating line involved only a slight learning curve because, again, Geiger was able to resolve most issues during the research and development phase. They also began using the line in production slowly. The finish quality was acceptable in the beginning, but Geiger improved the quality to the level at which they currently operate in about 6 months and surpassed their previous quality level.

Geiger anticipates a total conversion to automatic spray and roll coating at the Fulton facility over the next few years. Use of urethane-based coatings requires that the spray booth operators wear supplied-air respirators. Although the waterborne urethane topcoat does have less VOCs and HAPs, the main safety issue becomes the detection of the coating, since there is no smell associated with it.

Cleaning Operations

Equipment used to apply waterborne coating is cleaned with a very dilute mixture (mostly water) purchased from the coating supplier. In order to reduce cleaning material usage and coating waste, Geiger purchased a new system that mixes the waterborne urethane and catalyst right before it is applied, instead of mixing a whole batch of coating and catalyst and discarding the unused coating at the end of the day. Equipment used to apply UV-curable coatings is cleaned with a mixture of chemicals Geiger purchases from their coating supplier.

Cleaning emissions consist mainly of acetone, butyl acetate, isopropyl alcohol, and mineral spirits. Implementation of the waterborne system greatly decreased the amount of organic solvent used for cleaning each month and the associated VOC emissions.

Costs

The waterborne urethane topcoat costs about 45 percent more per gallon than the solvent-borne topcoat. However, Geiger uses less of the waterborne topcoat per piece, so the coating cost per piece actually is lower. One significant cost of the conversion to the waterborne urethane was the purchase and installation of stainless steel lines and equipment. A new gun mechanism also was purchased and installed at the waterborne topcoat line to mix the catalyst and coating just prior to application (facility personnel estimated the cost to purchase and install that piece of equipment was $20,000 to $30,000). Other costs include the research and development costs, rework due to early test failures, and the additional energy required to run the drying oven.

The equipment required to apply UV-curable coatings is significantly more expensive than that required for the waterborne or solvent-borne coatings. Facility personnel estimated costs at about $200,000 for each edge coating machine, $500,000 for a robotic spray line, $200,000 for each sander, and about $200,000 for a roll coating line. The UV-curable coatings also are much more expensive per gallon than the solvent-

borne and waterborne topcoats, but the solids content is much higher and less of this coating is lost to overspray or waste because of the manner in which it is applied. There are cost savings associated with the reduced labor required to run the automatic spray and roll coating lines and with the reduced amount of coating waste.

Emissions

Since Atlanta is a VOC nonattainment area and the facility is subject to the wood furniture NESHAP, Geiger Brickel faces both VOC and HAP limits. Although Geiger still uses more gallons of solvent-borne topcoat than waterborne, facility personnel stated that the switch to waterborne urethane on vertical surfaces reduced mass emissions of VOCs by over 30 percent at a time when production simultaneously increased by about 40 percent. They also noted that the implementation of the UV-cured topcoats reduced emissions by another 14 percent at the Fulton facility. The table below compares the VOC and HAP contents of the solvent-borne urethane, waterborne urethane, and UV-curable topcoats, based on data provided by the facility. The VOC and HAP contents of the waterborne and UV-curable topcoats are considerably less than those of the solvent-borne topcoat.

Coating	Average VOC content, lb/gal (lb/lb solids)	Average HAP content, lb/gal (lb/lb solids)
Solvent-borne urethane topcoat	6.0 (3.4)	0.85 (0.62)
Waterborne urethane topcoat	0.31 (0.13)	0.01 (<0.01)
UV-curable topcoat	0.067	0.0090

The VOC emissions at the Fulton facility were about 70 tons in 1998. When Geiger begins using the waterborne urethane topcoat on horizontal surfaces at the Fulton facility (projected mid-year 2000), VOC and HAP emissions will be further reduced. Geiger estimates VOC emissions at the ATO facility will be about 15 tons per year at full production.