Case Study No. 24 UV-Cured Coatings
States Industries
Eugene, OR

Background

States Industries manufactures and coats plywood panels. The coated panels are used as interior paneling or as components in cabinets, drawers, and store fixtures. They have a large portion of the U.S. interior wall paneling business. States is a major source of HAP emissions due to their plywood pressing operations, and have been subject to the VOC emission limits (RACT) in the CTG for Factory Surface Coating of Flat Wood Paneling since 1977. The plant operates 6 days per week, 24 hours per day. The seventh day is set aside for maintenance activities. States began using UV-curable sealers and topcoats in 1993.

Manufacturing and Coating Operations

States Industries began manufacturing plywood at their Eugene facility in 1966. They dry 1/6-inch Douglas fir in the veneer dryer and use it as core material. A variety of wood species are used as the face veneers. A urea-formaldehyde glue then is applied to both sides of every other layer of the plywood using a roll coater. The layers are hand stacked and then loaded into a press. After pressing, the plywood is manually removed and stacked for later sizing. A portion of the plywood the facility manufactures is coated on-site, and the remainder is sold unfinished.


Plywood press

The majority of the surface coating is done on oak, maple, or birch plywood panels, but States also coats panels made of particleboard and particleboard with wood veneer. The panels coated range in thickness from 1/8 to 1½ inches, and are typically 4 feet wide and 6 to 8 feet long. The number of coating application steps in the coating line depends on the type of product being coated. All products receive a sealer and topcoat as the final steps in the coating process.

Five-gallon buckets are used at the line to supply the coatings to the application equipment and are replenished as needed during each shift. If a piece of equipment applying UV-curable coatings is not in use, the coating reservoir is covered so the leftover coating will not cure.

If the product being produced is interior paneling, the panel often has grooves cut lengthwise, and the grooves are painted. If oak panels are being coated, the panels are bleached, after the grooving step, to remove the tannic acid in the wood. Previously, the facility used bleach containing methanol, but is now using a formulation containing phosphoric acid. The panels are each flooded with the bleaching solution (the solution is sprayed then rolled) on both sides and stacked to dry for 24 hours. The panels are buffed after bleaching.


UV oven

At the beginning of the surface coating line, an operator feeds the panels one at a time onto a conveyor system. The panels are first presanded with sandpaper. The particulate emissions from all sanding or buffing steps are sent to the baghouse. The panels may then receive a UV-curable filler using a reverse roll coater with a chrome wiper roll. The panels are cured in a UV oven for approximately 2 seconds. The UV ovens on the coating line contain 300 watt-per-inch lamps. The panels then go through a second sanding step using sandpaper.

The panel then may be embossed, but this step is typically used only when particleboard panels are being coated. A stain then may be applied, using a direct roll coater. The stains used are waterborne and have low solids contents. An IR oven at 250°F is used to dry the panels after the stain coat. Excess heat also is used from a natural gas oven in another part of the line. A reverse roll coater may then be used to apply a color coat. The color coats (referred to as flood coats) are waterborne, but contain a small amount of VOCs (about 8 percent), primarily 2-butoxy ethanol. A natural gas-fired oven is used to cure the coating. The panels then are sanded.

A direct roll coater then may be used to apply either a waterborne sanding sealer or a basecoat. The basecoat is applied to hide the panel's natural wood grain. An IR oven is used to cure this coating, and the panel is sanded with 400 grit sandpaper. An offset printer may be used to produce a simulated oak or cherry wood grain. An oven using excess heat from another oven in the line is used to dry this coating. A differential roll coater may be used to apply a waterborne toner, which is the last color coat the panels can receive. A natural gas-fired oven is used to cure this coating. If the panel did not receive the waterborne sealer, it then receives a UV-curable sealer, is partially cured in a UV oven, receives a UV-curable topcoat, and is fully cured in the final UV oven.

The finished panels are inspected for defects and stacked on pallets. If the panel is to be finished on both sides, it goes through the coating line a second time. In the components division, coated panels used for components such as drawer sides and bottoms are cut, grooved, and sorted. They then are stacked on pallets for packaging and shipment. Any dust generated during cutting is exhausted to a baghouse.

There also is a small coating line in the lab for testing new colors on 16-inch by 24-inch panels. The coating line consists of a small roll coater and UV oven. The boards are sent through the line three times to receive one coat each of stain, sealer, and topcoat. Colors are matched by eye; no automated equipment is used for color matching or mixing.

Coatings are stored in drums or totes at ambient conditions in a small building near the laboratory. The acetone supplier takes their drums back and reuses them, but the facility has difficulty disposing of the other drums. Some coatings also are supplied in lined fiber barrels. The UV-curable sealer and topcoat are supplied in large stainless steel tote tanks that are returned to the coating supplier when empty and are reused.

Cleaning Operations

Acetone is used to clean the roll coaters (1997 acetone usage was 600 gallons). The facility experimented with lacquer thinner, glycol, and MEK, but found acetone works the best to clean the equipment and dries faster than MEK. No additional maintenance is required as a result of the switch to the UV-cured coatings.

States also used approximately 250,000 gallons of water for cleaning in 1997. All wastewater generated by the plant is treated on-site. A flocculator and filter press are used to remove the solids, which are disposed of as municipal waste. The remaining water then is treated, and much of it is recycled to the plywood manufacturing process for glue mixing and washing the glue application equipment.

Conversion to UV-Cured Coatings and Associated Emissions Reductions

In 1993, States switched to UV-curable sealers and topcoats. Product quality was the primary driving force, although the company also had made an environmental commitment and wanted to reduce their HAP emissions (e.g., methanol and formaldehyde). Prior to the switch, the facility was emitting 400 to 500 tons of methanol per year. States currently is using waterborne stains, sealers, and color coats, and UV-curable fillers, sealers, and topcoats.

According to facility personnel, the switch to UV-curable sealers and topcoats was fairly smooth. As part of the conversion, they bought new roll coaters and UV curing ovens. The coating supplier performed most of the testing on States' coating line, and it was about 6 months before the facility was fully satisfied with the new coating system. Facility personnel stated that the coating supplier was instrumental in providing advice

on what new equipment to purchase. The UV-curable coatings contain no HAPs, and a small amount of VOCs. They do have to watch for problems with blushing and streaking, but most quality problems are related to the condition of the machinery, the ambient conditions in the plant, or the quality of the sanding the piece receives prior to being coated.

The conversion to UV-curable coatings did not require additional finishing employees, but did require employee training. This training consisted of formal training provided by the coating supplier and more informal on-the-job training. Instruction was provided on the new equipment, proper handling of UV-curable coatings, and the safety issues with the new UV curing ovens. The UV-curable coatings have almost 100 percent solids and the waterborne coatings have 45 to 60 percent solids. Facility personnel indicated that the coating supplier is continually working to improve the UV technology, and that the price of the UV-curable coatings has decreased since States began using them.