

Opaque UV Curable Coatings for Wood Meets Manufacturer's Challenges

The Challenge: Reduce Emissions and Improve Quality of Wood Moldings

E&J Industries of Woodridge, NY, manufactures a wide assortment of wood moldings, including brush blocks (the portion of a brush to which the bristles are attached) and tool grips, such as mop and broom handles. The company processes several million feet of oak, ash, pine, and fir every year, much of which requires some type of protective or decorative finish. The stains, paints, and lacquers traditionally used to finish these products contain significant amounts of solvents (VOCs) and, frequently, hazardous air pollutants (HAPs). VOCs and HAPs are monitored by federal and state agencies and, in most cases, must be drastically reduced or totally eliminated in order for a company to be in compliance with the Clean Air Act.

Ed Kossar, President and CEO of E&J, stated "We had previously converted to UV curable clear coatings and had excellent results. We reduced emissions, improved quality, and lowered our operating costs. Based on that experience, we decided to convert our opaque lacquer-based paints to UV curable coatings. Our goals were to totally eliminate the emission of VOCs and HAPs from our plant, provide a safer workplace for our employees, and improve the quality of our products."

The Conventional Way

E&J utilized a gasket dipping method to apply various colors of lacquers to dowel stock used for broom and mop handles. A spray application was used for other molded products. All coatings were air-dried at ambient plant temperatures.

The gasket dipping method was a semi-automatic process by which products were loaded into a feed hopper that fed them to a conveyor. The conveyor transported the dowels to the coating chamber

where the paint was applied, and then through a squeegee-like gasket that removed the excess coating. The products continued on the conveyor for air-drying. Depending on the temperature and humidity, the total time for the process was 10 to 20 minutes.

The spray application method was entirely manual. Products had to be placed on racks to be painted, allowed to air-dry, then manually turned over to allow coating to be applied to the other side. Once both sides were painted, the products were removed from the racks and stacked for bundling. Total time for this process was 1 to 3 hours.

E&J had looked at several alternatives for replacing their opaque coatings, including waterborne paints and powder coatings, but found that none provided all the properties necessary to significantly decrease or totally eliminate emissions, reduce finishing time, and improve quality.

The New Way

The clear coatings that E&J uses are easily cured with ultraviolet light because they do not contain pigments that can block transmission of the UV energy and result in curing only the surface of the coating. However, the conversion to colors required an extensive R&D effort in order to develop opaque coatings that would attain full cure when exposed to the UV lamps. The company worked closely with paint manufacturers and UV lamp suppliers to determine the correct chemistries and UV wavelengths necessary to achieve complete cure of the opaque coatings.

E&J now uses two types of coating systems—a vacuum coating system to apply a variety of opaque colors to dowel stock, and totally enclosed automatic spray application equipment for coating



Coatings are applied by the foreground unit and then fed into the UV curing unit (far left) which cures in 10 seconds or less.

other shapes. All over-sprayed material is automatically recycled back to the coating reservoirs in each system and reused. Both lines are equipped with UV lamps for curing the coatings. Each system is conveyorized and consists of the coating application and recovery equipment, followed by a curing chamber that contains high-pressure mercury vapor UV lamps. The lines run at 20 feet per minute when opaque colors are used and 60 feet per minute for clear coatings.

Products are placed in hoppers and automatically fed to conveyors that move them to the coating chambers. After the coatings are applied, the parts immediately enter the curing chambers where they are exposed to ultraviolet light to cure the coatings. Curing occurs within a few seconds. Upon exiting the curing chambers, the parts are conveyed to hoppers at the end of each system where they are bundled and readied for shipment.

The Results: E&J Meets Its Goals

UV curable coatings have enabled E&J to totally eliminate VOC emissions and HAPs, improve the environment of the workplace, and increase the quality of its products.

Reduced Emissions

The UV coatings used by E&J contain no solvents and consist of 100% solids. Viscosity of the coating is controlled through the use of monomers, which crosslink with the oligomers and polymers in the coating to form a solid cured film. Heating the coating in a reservoir also controls viscosity of the applied coating.

Due to the absence of solvents, E&J was able to reduce its emissions by 99% and, because there are no solvents used, become totally compliant with both federal and local air quality regulations. In addition, any over-sprayed or vacuum-removed coating is returned to the supply reservoirs, making solid waste almost non-existent. Additionally, any materials that must be disposed of, such as purged material and cleaning rags, are simply exposed to UV light and cured. This eliminates the need for special disposal sites for liquid materials.

A Safer and Cleaner Workplace

Due to the hazardous nature of the solvents used in nitrocellulose lacquers, their application requires the use of special storage conditions and explosion-proof equipment. Substantial ventilation is also needed to exhaust solvents from the workplace in order to prevent a hazardous build-up and to protect workers' health. Humidity must also be controlled when applying lacquers, to ensure adequate drying and prevent blushing of the coating.

Use of UV curable coatings has eliminated the need to ventilate the workplace since the coaters are self-contained and no solvents are emitted into the work environment. The air required for both systems is drawn from the plant, filtered, and exhausted to the atmosphere.

Improved Product Quality

Lacquers are not generally resistant to a wide variety of common chemicals. In addition, they are brittle, which causes them to chip and abrade easily. Fluctuations in plant temperature and humidity can cause the appearance of a lacquer finish to vary considerably from day to day. And, because the coating is air-dried, surface defects from airborne contaminants can result in rejected parts that must be sanded and re-coated. UV curable coatings, on the other hand, are thermoset materials that exhibit good chemical resistance and result in very flexible coatings that minimize chipping and damage from shipping and handling.

Since humidity is not a significant variable in the enclosed application systems, appearance quality is more consistent. The rapid curing prevents airborne contamination of the coating, which results in fewer rejects. These features, along with a more consistent film thickness due to the automated process, resulted in an overall increase in the quality of the products E&J manufactures.

What Did It Cost?

The new systems allow almost all of the coating to be used and, because the UV coatings are virtually 100% solids, there is negligible loss due to evaporation. E&J reports that their material costs for opaque coatings did not increase after converting to UV curable coatings. The total equipment costs for both lines was about \$200,000. The energy savings realized from reduced exhausts, along with the labor savings and fewer rejects, will provide rapid payback of the investment.

The Bottom Line

The use of UV curable coatings has allowed E&J to reduce emissions, increase



Ed Kossar (right), president and CEO of E&J Industries, and Steve Blabac, New York State Electric and Gas, work together to meet NYSEG's goals.

quality, improve the environment of the workplace, and reduce overall costs. The elimination of VOCs and HAPs has improved air quality for both the community and the plant. The increase in quality will allow E&J to pursue new business, and the reduction in operating costs will improve overall profitability of the company.

Assistance from Local Utility

With the assistance of Steve Blabac of New York State Electric and Gas (NYSEG), E&J was able to identify a coating and curing process that would enable them to meet all their goals. Steve worked with the EPRI Center for Materials Fabrication to locate equipment and for technical support.

Other Applications for UV Coatings

UV coating technology produces a tough, durable finish on a wide variety of coated and printed products, including wood furniture, electronic components, electric motors, tubing, plastic cups, and printed labels and tags. UV curable coatings, in both liquid and powder form, are available for application to wood, plastic, metal, paper, glass, and ceramic substrates.

Photographs courtesy of E&J Industries

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