APPLICATION

UV Coatings on Wood Shelving

EPRI Center for Materials Fabrication

Industrial and Agricultural Technologies and Services

The Challenge: Maintain or Improve "Top Shelf" Quality While Reducing Emissions

Lundia Division of Mll, Inc. in Jacksonville, IL, manufactures shelving display units for use in stores and offices. Lundia processes about 8 million board feet of kiln-dried pine, fir, hemlock, birch, oak, and alder per year, plus laminated plywood and particleboard used for back and side panels. The stains, paints, and lacquers used in traditional wood finishing contain solvents that produce significant amounts of volatile organic compounds (VOCs) and hazardous air pollutants (HAPs). Both substances are closely monitored by state and federal agencies, particularly since the Clean Air Act Amendments of 1990.

"All our previous finishes were lacquer-based and contained MEK (methyl ethyl ketone) and toluene," Gary Frye, Lundia's General Manager explains. "We wanted to reduce VOCs and HAPs and to make our plant as safe as possible for our employees, the community, and the environment, as well as improving the quality and consistency of our finished products."

The Old Way

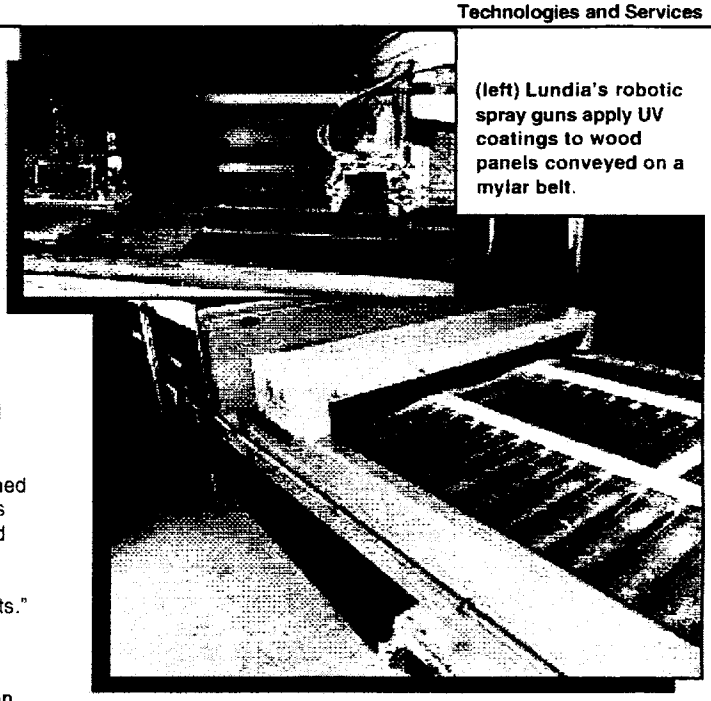
Lundia used curtain coaters to apply clear finish to flat panels. The products were dried using tunnel-type convection ovens at 120°F. Other products receiving clear finish went through spray booths. All pigmented products were sprayed in the booths. Sprayed items were placed on racks and air dried. The racks were emptied manually, the products turned over and coated on the other side. Several coats were applied in this manner. Air drying time ranged from two hours for some coats when humidity was low to 24 hours for pigmented coatings when humidity was high.

Lundia, aiming to reduce VOC and HAP emissions, tried replacing solvent-borne coatings with waterborne coatings, but found none suited their requirements for production throughput or surface finish quality and performance.

The New Way

Lundia ultimately chose ultraviolet (UV) coating technology, which achieved the company's environmental and safety goals, improved finish durability, and eliminated resin bleed-through in pine products. The company now uses a UV spray booth finishing system for virtually all products.

On the new line two independently-controlled sanders with powered dust collectors first prepare the product surface. Photo-optic sensors then read the shape and position of each piece and feed the information directly into the programmable logic control (PLC). The PLC governs the movement of four robotic spray guns on each of two automated reciprocating carriages, programming the guns to spray the new low-solvent UV coating mixture only when park are coming through the line.



(left) Lundia's robotic spray guns apply UV coatings to wood panels conveyed on a mylar belt.

UV light cures the white paint on shelving uprights near the end of the production line.

The PLC enables spray guns to apply accurate and consistent amounts of material, resulting in coatings of more uniform thickness. Spray tip size, atomization of paint or other coating material, and pressure in pumps and regulators can all be varied to produce exactly the desired finish characteristics. Lundia uses hot air to preheat the finish, thus preventing the coating's surface from curing before the base. After preheat, mercury vapor and gallium UV lamps almost instantaneously cure the coating to a hard, stackable finish. UV lamp intensities, temperatures, and internal pressures are critical and are chosen based upon the type of coating applied, its pigmentation, and its thickness.

High pressure UV lamps also emit some infrared (IR) radiation, which can cause wood panels to get so hot that resins leach into the coating before it cures, producing an inferior finish. To achieve the desired finish, Lundia uses a system of inclined mirrors to reflect only the cool UV energy onto the product.

UV has given Lundia much more flexibility in meeting customer demands. In the past, most customers requested clear finishes, but today many prefer pigmented ones, particularly white. Conventional white paint was slow to dry and limited production throughput. Now all UV finishes cure so rapidly that pigmented coatings are no longer a concern.

The Results: A Cleaner Environment and Increased Production

Reduced Emissions. Solvents in the UV coating facilitate degassing, flow, leveling, and spray application. These solvents, such as ethyl acetate and butyl acetate, are not on the US EPA's list of HAPs. And because UV-curable coatings contain liquid monomers and oligomers that crosslink to form a solid cured film upon exposure to UV, only a minimum amount of solvent is required. This small amount of solvent (VOC) is released during the drying step prior to UV curing. By using UV coatings, Lundia has simultaneously improved plant air quality and reduced concern about environmental compliance.

Increased Production. Lundia has increased productivity, primarily because drying time and material handling have been greatly reduced. For example, a shelf that previously required up to two days to paint and dry during periods of high humidity can now be finished in one hour. Only two people, a loader and an unloader, are typically required to operate the UV line, enabling Lundia to transfer finish department employees into other departments within the plant. Labor expense per unit has decreased because plant throughput has increased, but no employees have been displaced as a result of the new equipment.

Cost Savings Through Material Recovery. In the old system, overspray was collected in filters that had to be frequently replaced. The new automated system sprays coating material directly onto each part, thus greatly reducing the amount of overspray. And a mylar belt catches almost all the overspray, which is later removed by a counter-rotating roller. Most recovered material is either directly recycled or reconstituted and used for base coating.

A Superior Product. UV coatings have proven to be much more uniform in color and thickness, more durable, and more chip-resistant than lacquer finishes. Color and thickness uniformities are particularly important for Lundia's interchangeable parts. Faster drying and curing times have virtually eliminated handling-caused smears and the accumulation of dust that previously degraded finishes,

What Did It All Cost?

The new UV flat-line finishing system was developed by Cefla, an Italian manufacturer of UV equipment, and purchased on a turn-key basis from Stiles Machinery of Grand Rapids, MI. The system included a sanding module, optic sensors and paint gun controllers, a paint booth with overspray collection system, stain wiper module, convection oven for solvent flash off, fluorescent light section, and two UV lamp modules. Capital cost was approximately $750,000. In a mere ten days time the system was assembled, installed, debugged, and was producing high quality coatings, The new line increased power demand by 102 kW and energy usage by 660,000 kWh annually.

The Bottom Line: UV Coatings Provided Multiple Benefits

The use of UV coatings enables Lundia to dramatically increase production and to simultaneously reduce direct labor costs. By decreasing VOCs and eliminating HAPs, the company has improved air quality for both the plant and the environment.

Other Applications of UV Coatings

UV coating technology produces tough, glossy finishes on a wide variety of coated and printed products in addition to wood furniture. UV coated products include electronic components, plastic cups and tubes, and printed labels and tags. For more information on UV curing, see CMF *TechApplication* Vol. 1, No. 17, "UV Curing in the Label Industry," and CMF TechCommentary Vol. 4, No. 4, "Ultraviolet Curing Technology."

Role of Electric Utility

Illinois Power supplies power to Lundia Corp. and works with them in evaluating current manufacturing practices and in exploring new technologies. Lundia representatives obtained information about new UV coating technologies through an Industrial Product Finishing Seminar conducted as part of Illinois Power's Environmental Solutions Program. Illinois Power also helped Lundia with the EPA permitting process.

Company Profile

Lundia Division of Mil, Inc., Jacksonville, IL

President - William H. Hunt

Lundia is privately owned and has been in operation since 1959. The Lundia plant covers 155,000 square feet and employs approximately 140 people. Lundia produces wood shelving and storage systems, display racks, and mobile filing and storage systems for multiple applications in retail stores and offices.

Marty Behrens (left) of Illinois Power, and Beverly Dambacher, Lundia's Plant Manager, cooperate in implementing UV curing technology.

Beverly Dambacher and Gary Frye of Lundia Division, Tom Sheehan of Stiles Machinery, Marty Behrens of Illinois Power, and Dick Nelson, CMF, made valuable contributions to this issue.

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