

POWDER COATING WOOD FURNITURE

Description

Powder coating offers environmental and performance benefits over other coating and laminating systems. Past uses for powder coating have been mostly in metal coating. Technology and powders have only recently been commercialized for heat-sensitive substrates, such as wood products, plastic, and pre-assembled parts. Furniture, shelving, and cabinetry components made from medium density fiberboard (MDF) are being successfully powder coated. Powder coating other wood products, such as natural wood, particle board and other engineered wood products (EWP) remains in experimental development as of mid-2002.

Challenges to powder coating wood are related to moisture and sap content, low conductivity, variation in properties of different MDF and EWPs, and high heat sensitivity. Exposure to high temperatures causes off-gassing, raising of grain or fibers, distortion, and charring.

Two newer, fast-cure powders, ultraviolet (UV) and thermosets, help address these challenges. Powder coating of natural wood remains experimental, but it is likely that UV powders for natural wood, especially harder varieties, will be commercially available in 2003.

In general, powder coating applies charged powder particles to a grounded, preheated substrate, then heats the substrate and powder. Thermosets are heated to the powder's melting temperature until coating particles fuse into a continuous coating. UV powders are heated in a melt flow oven, then cured for a few seconds under UV lamps. Process steps for wood applications follow:

Preconditioning: The substrate is evenly heated in infra red (IR) and/or convection ovens to achieve required conductivity, and release gasses. Typically, the substrate surface temperature is equalized at 200-220° F before entering the spray booth, although some have had success at lower temperatures. Wood moisture must remain equalized across the surface at about 4 to 6% or higher to maintain conductivity for powder adherence. Since heat evaporates moisture, careful controls on preheating are necessary.

Application: After preheating, powder is typically applied electrostatically, in a booth. Corona or tribo spray systems are recommended.

Powder Recovery: Recovery systems utilize cyclones or filtration to recover 95 to 99.9% of overspray, which can then be reused as is.

Cure: Thermosets are cured by IR and/or convection. UV powders are initially melt flowed by IR/convection, then cured with UV light. Time, temperature, and IR or UV settings and wavelength vary with film and substrate thickness, powder, and substrate size and shape.

Cooling: After curing, parts cool in open air, or thermosets may cure in a forced air tunnel.

Highlights

<u>Product:</u>	Powder coatings: Ultraviolet (UV) and thermoset powders
<u>Technologies:</u>	Electrostatic spray curing, thermal and UV
<u>Applications:</u>	Medium density fiberboard (MDF)
<u>Environmental Benefits:</u>	High transfer efficiency Low to no VOC or HAP emissions Overspray recovery Short drying time, no drying ovens No effluent

Advantages

Several furniture and cabinetry manufacturers have had success with powder coating MDF. Pigmented powder applications to MDF have been developed and used more extensively than coating of natural wood, or clear coating of MDF or other EWPs. Establishing a new system may require significant research and production trials to achieve desired process efficiency and final product quality.

- Powder coating has a high transfer efficiency, reduced (or no) emissions, one-step, one-coat process, elimination of edge banding, significant reduction of exhaust and oven ventilation air, minimal drying time (eliminating the drying oven and associated energy use and floor space), reduced labor via increased automation, and high durability and chemical resistance.
- Most shapes and profiles can be successfully powder coated with adjustments to the powder formulation, flow, gun and/or lamp placement (for UV curing).
- Although energy output from UV lamps is high, elimination of thermal oven drying equates to much lower energy consumption with UV over thermal.
- The powders cost more per unit quantity than other coatings, however a cost analysis on the total cost per applied square foot is typically significantly lower over liquid coating and laminating systems.

Limitations

- Preheating is necessary, but also contributes to rising of grain or fibers, and reduced moisture. Moisture must be high enough for conductivity, usually a minimum of 4 to 6%. Sealers or primers can prevent blisters in the coating caused by moisture and sap off-gassing, but add an extra step.
- MDF properties (e.g., density, moisture, basic content) vary amongst manufacturers. Some MDF may not accept powder well, or may require sanding to avoid coating surface defects and cracking.
- UV cannot reach shadow areas (beyond line of sight).
- If preconditioning temperatures are too high, edges lose moisture faster than the center areas, creating a challenge for good powder adherence.
- Routed and rough areas may require sanding, extra powder, or other special attention.

The quick reference table below shows powder coat properties based on several products and studies available for MDF powder coating. These are estimates and ranges, and vary with substrates and powder formulations.

Quick Reference Table: Properties of Powders Formulated for Wood Products		
Property or Characteristic	Thermoset	UV Curable
Chemical type	Polyester, epoxy, polyurethane, acrylic, hybrids	Polyester; acrylate, epoxy, and others in development
Storage stability (varies by powder formulation, pigment and photoinhibitor)	Dry, < 80°F, shelf life 3 months and up (varies by product)	Dry, <75°F, shelf life 3 months and up (varies by product)
Film surface properties	Textures at 5°-20° gloss, smooth at 15°-60° gloss, clear or pigmented; excellent color range	Gloss varies with texture; clear or pigmented; matte, smooth and yellow hues in development
Stain resistance	Medium to high	High
Impact resistance	40 to 60"	20 to 40"
Applied thickness	3 - 5 mils (textured) 4 - 6 mils (smooth)	2 - 6 mils clear 2 - 4.5 mils pigmented
Pencil hardness	>H to 3H (textured) 3 - 6H (smooth)	>3H to 6H
Adhesion (no primer)	Min 3B, or 95 to 100%	4B - 5B, or 100%
Preheat conditions (depends on substrate surface, powder formulation, oven type, etc.)	3 to 12 minutes at 280 - 300°F air temperature	1.5 to 3 minutes at about 250 °F
Cure conditions (depends on powder melting point and other variables. Longer cure uses lower temperature)	3 to 5 minutes at 300-375°F, up to 15 minutes at 200°F range oven air temperature	1.5 - 3 minutes at 200-300°F oven for melt flow, then 3 - 5 seconds in UV chamber

Who's in the Business?		
Equipment & Testing	Powder Formulators for MDF	Who's Powder Coating MDF?
<u>Application Equipment</u> : Nordson Corporation, ITW/Gema <u>Ovens & UV lamps</u> : Fusion UV Systems, Primarc UV Technology, Nordso, Nutro Corp., UV Systems <u>Integrated Systems</u> : George Koch Sons, LLC, Glenro Inc., Harris & Baum, Nordson Corp., PED Technologies, Vulcan Engineering Co. <u>Test Facilities</u> : Coatings Applications Research Laboratory, Nordson Corp., Nutro Corp., Protech, Morton Powders	Cardinal Paint, DuPont, Forrest Paint Co., Ferro, Govesan, H.B. Fuller, Interpon/Akzo Nobel, Morton Powders, Prism Powder, Protech, Tiger DryLac, and Valspar (See Powder Coating Institute supplier listing at http://www.powdercoating.org/membership_roster/)	Adept, City Cabinet Makers, Capital Components, Commercial Wood Products, Decorative Veneer, Fluid Concepts, H&G Powders, Herman Miller, Kenex Powder, Ltd., Knoll Group, The Marco Group, Plateau Corporation, Precise Wood Powder Coating, Riverstone, RadEX, and Teknion

Information Sources and Additional Resources

- "Finishing Medium Density Fiberboard with Powder Coatings" by Paul Horinka (<http://www.pcimag.com/CDA/ArticleInformation/coverstory/BNPCoverStoryItem/0,1848,71315,00.html>)
- Industrial Paint and Powder Bulletin Board (<http://www.ippmagazine.com/news/newswatch.asp>)
- Powder Coating MDF in Canada: Not Just for Metal Anymore (<http://www.wooddesign.bc.ca/news42.htm>)
- The Powder Coating Institute's Cost Analysis Tool (<http://www.powdercoating.org/software/index.cfm>)
- RadTech's UV Powder Coating Working Group (<http://www.radtech-europe.com/uvp.html>)
- "UV Powder Coating Application Guide", 2002. RadTech.
- "UV Powder on MDF" by Steven Kline, Jr. (<http://www.pfonline.com/articles/020201.html>)
- "UV Powder Reaching New Markets" by Susan Mitchell / Fusion UV (<http://pfonline.com/articles/120101.html>)

Prepared by the Pacific Northwest Pollution Prevention Resource Center (<http://www.pprc.org>). This fact sheet is intended for general reference only; it is not a complete statement of the technical capabilities of each product. Contact your vendor for additional information about this product, or others that may have similar pollution prevention benefits. Published December 2002.