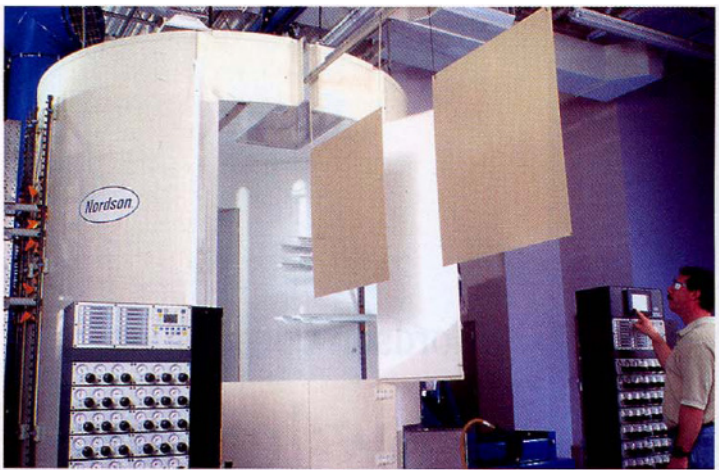
Powder on MDF – a market and process analysis

According to ECNext, a web-based market intelligence resource firm, powder coating material sales in the United States has been forecasted to rise approximately 8 percent per year until 2005, when demand will reach roughly 500 million pounds. This increase in demand will continue to be driven by environmental benefits over non-compliant solvent-based coatings, excellent adhesion, high resistance to both impact and scratching, and other favorable performance characteristics.



Engineered woods like MDF are an attractive growth market for powder coatings due to their uniformity and low potential for outgassing.

While powder coatings have become a $1 billion dollar industry in the United States, and a $3.5 billion dollar industry globally, this still represents only 5 percent of the total worldwide industrial coatings market. In an effort to provide continued growth for powder coating materials, both new and existing material suppliers are rapidly expanding the functional range of powders beyond traditional metal product finishing, into non-metallic substrates such as wood and plastics.

Of these potential substrates, engineered woods such as MDF are fast becoming an attractive market for powder coatings due to the uniform density of the substrate, smooth surface and low potential for outgassing relative to natural woods. Specific MDF user markets that have been penetrated successfully to date are office and institutional furniture, store fixtures and displays and kitchen cabinets.

Many of the manufacturers in the aforementioned industries have been, and still are, heavy users of laminates or thermofoil. Replacement of this particular process (in addition to replacing liquid coatings on wood) represents the greatest potential for the use of powder coatings. At this point there are no powder coatings that can replace simulated woodgrain foil, however, much work has and continues to be done in the area of textured powders, speckled powders, and of course numerous colors with various levels of gloss.

UV vs. thermoset

There are two basic types of powder coatings: thermoset, which are cured with heat, and UV, which are cured by ultraviolet radiation. Both are proven technologies currently being used in the production and finishing of MDF, and the author does not endorse one type over the other.

The UV process for powder coating MDF has garnered more publicity to date, due to its shorter cycle times and reduced floor space requirements. The cycle times and equipment (gas convection ovens) utilized in the thermoset powder coating process mirror those of the powder on metal process. Because of the shorter cycle time and reduced floor space requirement for the cure oven for UV powder, the overall process requires less floor space than thermoset powders.

Typically in a UV operation, the boards to be coated are first hung on an automatic overhead conveyor and then pre-heated in a hybrid electric IR/gas convection oven. The boards are then powder coated at a line speed that is pre-determined by the amount of pre-heat and cure time required.

The boards enter a hybrid electric IR/gas convection/UV oven to cure. First, the coating melts or “flows out” for approximately 1.5 minutes. The board then continues to the UV curing stage for final curing and hardening of the powder. After the UV curing stage is complete, the parts cool naturally as they travel onto the unload station.

With the thermoset process for powder coating MDF, boards must be preheated to about 50 degrees warmer than they do in the UV process. They are then powder coated and advance into a gas convection oven for the cure stage. Finally, the boards travel through a cooling tunnel and are unloaded.

See the table for specific times and temperatures needed for both processes.

Comparison of cycle times and heat levels needed for UV and thermoset powder coatings on MDF

	UV-CURED	THERMAL-CURED
Cycle Time	90 second pre-heat 90 second cure	15 minute pre-heat 5 minute cure
Board Temperature		
After preheat	225F	275F
At spray guns	150F	200F
At melt and flow oven	250F	not required
At cure oven exit	200F	300F

Note: All times and temperatures are averages for a ¾-in. board. Process specifics vary depending on substrate and coating material.

Understanding the substrate

Much as been learned to date about MDF and the process parameters required for optimum "paintability" relative to powder coatings. What has been gleaned thus far from both scientific study and "trial and error" indicates that absolute consistency must be achieved in conductivity, moisture content and board density in order to achieve a hard, durable and uniform finish that is consistent in both gloss and color.

Adequate grounding is essential. This is achieved and maintained by hanging the board with clean metal hangers on a conveyor that is tied to an earth ground. Once the board is grounded, preheating the board drives moisture content to the outer surface, achieving optimum conductivity. Studies have shown that optimum controlled moisture content prior to pre-heating is 6 percent to 9 percent.

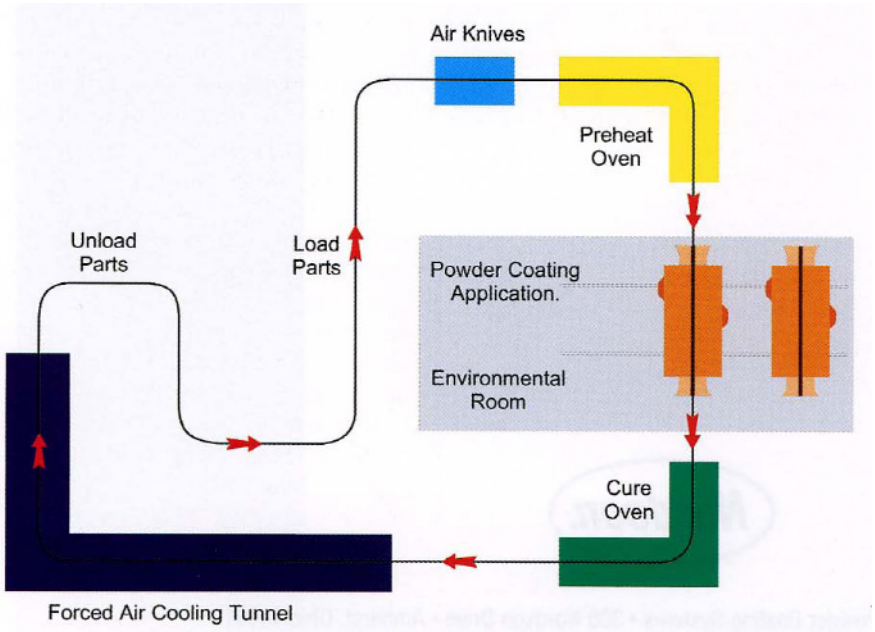
In order for the board to be uniformly pre-heated, and therefore uniformly conductive, the board must possess uniform density of the fibers and resins that it is constructed from. One method of illustrating this is to pre-heat and powder coat a kitchen cabinet door that is designed with a decorative routing on the face of the door. The dimensional differences in the thickness will only serve to magnify the differences in density and moisture content between the routed (thin) area of the door and the rest (thicker section) of the door. The thinner area tends to lose its moisture content quicker than the thicker area. This can be overcome, however, through precision control of the powder gun's electrostatic charge and powder flow rate.

Process benefits

There are three critical market drivers behind the favorable economics of powder coating on MDF:

Operational cost reductions: A well-known economic benefit of powder coating is the ability to reclaim and re-use powder to achieve overall system efficiencies over 97 percent. Waste disposal costs are further reduced because waste powder requires no special handling for disposal and can be landfilled.

New design opportunities: High-end office furniture manufacturers are moving away from the "classic" shapes (squares and rectangles) for office furniture. While less complex shapes are amenable to the edge-banding process to hide the exposed edges of laminated workpieces, new configurations require: curved edges, including interior circles and ellipses for computer cord drop-through; seamless desktop coatings; and a



This diagram shows the process for application and curing of thermoset powder on MDF. UV-cured powder does not require the long cooling tunnel and the parts cure in an IR/UV combination oven.

broad variety of unconventional colors and effects. All are strengths of the powder coating process.

Streamlined manufacturing: Reduced labor and material handling costs provide two key manufacturing benefits. Throughput is increased because powder coating is a continuous coating process, and because powder is a single-coat process that does not require a long time to dry. Powder coating also reduces the amount of sanding and handling of parts needed, and eliminates edge-banding costs.

Summary

Finally, to ensure that the powder coating on MDF process meets your specific product performance requirements, it is necessary to:

- Open lines of communication with major powder material and powder equipment suppliers relative to finishing MDF;
- Test a variety of engineered woods from a variety of suppliers; and
- Develop a better understanding of the different processes, their capabilities, and their associated costs (or cost savings).

Proven technology and process development have helped to make the overall powder on MDF process a viable one for those finishers that are interested in achieving greater throughput, reduced process time, and an attractive, durable finish.