Technology Advances Expand Powder Coating Market Potential

John Binder, Powder Coating Systems, Nordson Corporation

Powder coating continues to be the fastest growing of all the finishing technologies… and for good reason. Powder coatings are solvent free, 100 percent solid coatings that provide durable and attractive finishes. Until now, the benefits of powder coatings were generally available to manufacturers of metal products such as cars, appliances, office furniture, and lawn and garden equipment. Today, a variety of ultraviolet (UV) curable, and convection (thermoset) curable materials are bringing the environmental and performance benefits of powder coating to the medium density fiberboard (MDF) and natural wood products industries.

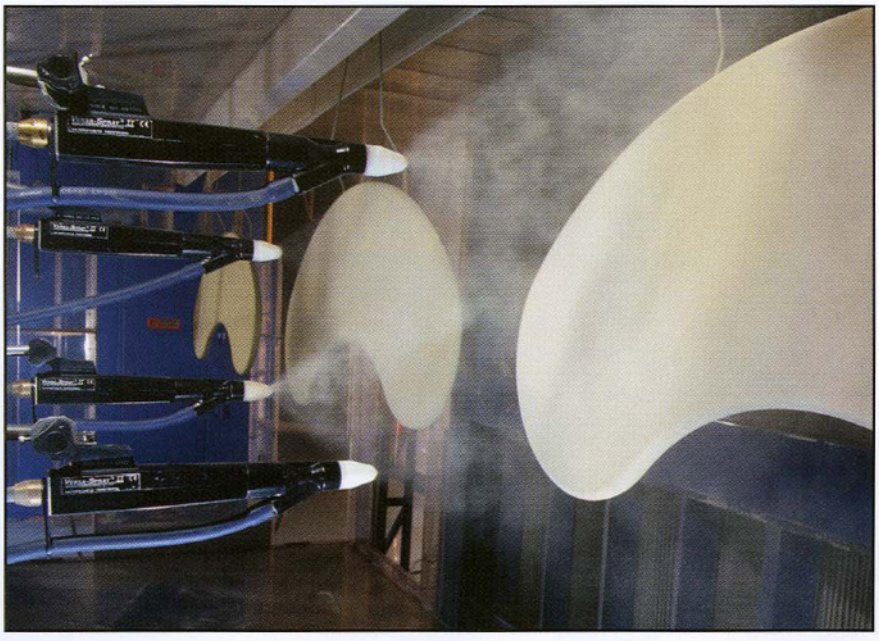
Market Potential

Over the past few years, major powder and resin suppliers have made significant progress in developing powder materials that can be applied to substrates other than conventional metals. MDF, wood, glass and plastics comprise the majority of these alternative substrates, often categorized as "heat-sensitive." The primary goal of the powder development effort has been to provide a powder coating process that does not compromise end-user expectations for hardness, durability, moisture resistance, color and luster. Aggressive development of both thermoset and UV curable powders reflects an understanding of the commercial potential. Within recent years, UV powders with curing temperatures as low as 250 degrees F, in addition to those that cure at conventional temperatures (375 to 400 degrees F) have emerged that are commercially suitable for heat sensitive substrates. These include both non-metallic and metallic substrates with heat sensitive components, that fall into three general categories

- Natural woods such as hardwoods and pine, and engineered wood products, specifically particleboard (PB) and MDF
- Plastics such as polycarbonate and polypropylene
- Pre-assembled parts, such as electric motors

Of the above categories, the majority of interest at this time is primarily from engineered wood products manufacturers of kitchen cabinets, ready-to-assembly furniture and high-end office furniture. In comparison with natural grain woods, powder coating for the engineered woods market at this point appears to have the most potential for growth. Engineered wood materials like PB and MDF are homogeneous in structure and do not have the natural grain, resin-rich structure that, if not treated properly, can lead to severe out-gassing during the cure process.

Notwithstanding, the engineered portion of the wood coating market easily has the potential to be as large as today's metal coating market. Optimist industry estimates place the potential market for wood to be approximately $1.1. billion dollars in



Following the preheat process, powder coating material is applied to parts that are conveyed to an oven to gel and cure the powder.

annual powder material sales. A more conservative estimate might put the convertible portion of this market more on the order of $250 million in annual sales. This conservative estimate reflects particular confidence in the conversion of the MDF segment only. MDF is perceived to be more attractive for powder coating because of the high quality finishes that have been achieved both in practice and production, again, due to the benefit of a homogeneous substrate structure.

Powder on MDF Processes

UV/IR

The UV/IP process for powder coating MDF (Figure 1) is quickly becoming the more popular method, as opposed to the thermoset powder coating process, wherein the cycle times and equipment (gas convection ovens) mirror those for the powder on metal process. Because of the shorter cycle time and reduced floor space requirement for UV/IR ovens, this translates into far less floor space for the overall process. The boards are first pre-heated in a hybrid electric IR/gas convection oven for less than two minutes to achieve a board substrate coating temperature of anywhere from 140 to 180 degrees F. The parts (boards) are then powder coated at a line speed (average 10 fpm) that is predetermined by the amount of pre-heat and cure time required. To cure the powder, the boards then enter a hybrid oven (electric IR/gas convection/UV) where the coating melts or "flows out" for approximately 1.5 to 3 minutes. During this melt stage, the board's substrate peak temperature can range anywhere from 250 to 300 degrees F. After the melt stage is complete, the board will then continue on 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 (or in a cooling tunnel) and are then unloaded.

Thermoset

With the Thermoset process for powder coating MDF (Figure 2), the board needs to be at a temperature (depending on board thickness) of 175 to 230 degrees F. To accomplish this, boards will need to be preheated in a gas convection oven for 10 to 20 minutes at approximately 375 to 400 degrees F. The boards are conveyed through the entire process either hung on an overhead conveyor or laid flat on a flat belt conveyor. After the pre-heat station, the boards are powder coated at a line speed that is pre-determined by the amount of pre-heat and cure time required. After being powder

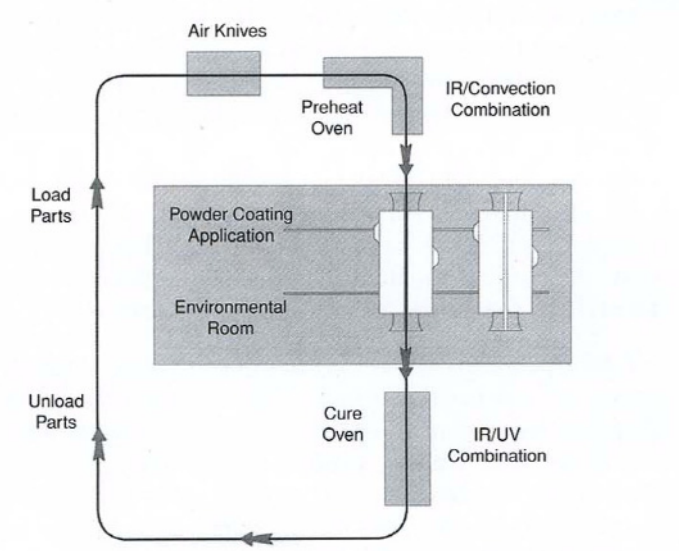
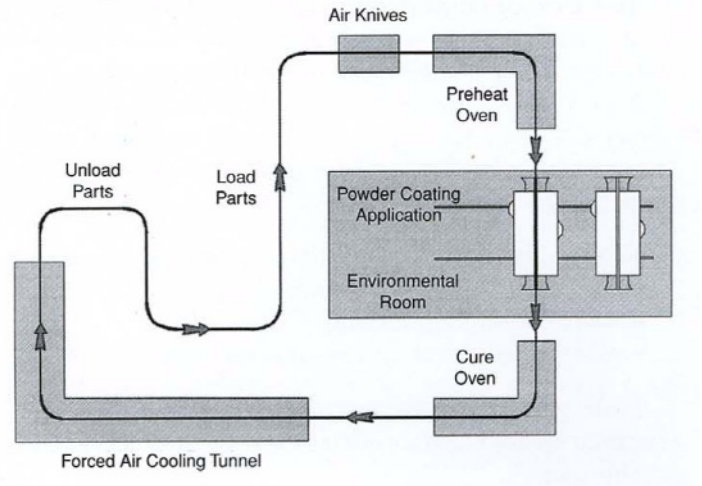


Figure 1 (UV Powder on MDF Process)

coated, the boards advance onto a gas convection oven for a cure stage. Again, the cure stage can take anywhere from 5 to 10 minutes (sometimes as much as 20 minutes depending on the powder and/or powder formulation) at approximately 375 to 400 degrees F. Finally, the boards advance through a cooling tunnel where they are unloaded.

Figure 2 (Thermoset Powder on MDF Process)



Powder Process Benefits

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

- Operational cost reductions
- New design opportunities
- Streamlined manufacturing

Operation Cost Reductions

In comparing spray-to-waste liquid systems, a well known economic benefit of powder coating is the ability to reclaim and re-use powder to achieve overall system efficiencies of over 97 percent. When combined with reduced waste disposal costs, the operation of a wood powder coating line is potentially less expensive than a wet line. Manufacturers of kitchen cabinets are the most likely to experience reduced operational costs that should provide an attractive return-on-investment (ROI) for the capital cost of a typically project.

Total operational costs can also be reduced through improved process throughput. Replacement of a batch thermoforming vinyl film process with a continuous (or batch) powder coating process cannot only improve throughput, but also allows for specialty colors and effects, decreased production labor, and reduced scrap due to “edge-tear” quality problems. In comparison, a single-sand, single-coat powder coating process would only be as much as one-half the cost of a typical laminate operation.

Lamination and/or thermofoil processes typically require employees to sand many parts to prevent marks from showing through the vinyl covering, a step not always required with powder coating. A typical process run with powder can be achieved in one-fifth the time that it would take to process the same number of parts with thermofoil. Furthermore, another advantage of powder over thermofoil is its environmental friendliness. Since powder overspray can be reclaimed and resprayed, the powder coating process requires no solvents and releases no VOCs into the atmosphere. Unlike vinyl, powder can be disposed of in a sanitary landfill.

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 more amenable to an edge-banding process to hide the exposed edges of laminated workpieces, new “designer” configurations are more demanding and require:

- Curved edges including interior circles and ellipses for computer cord drop-through
- Seamless desktop coatings
- A broad variety of unconventional colors and effects

Traditional lamination technologies relying on edge-banding methods cannot effectively compete with powder in this area.

Streamlined Manufacturing

Reduced labor and material handling costs provide two key manufacturing benefits:

Increased Throughput

As a continuous coating process, production throughput is increased by the elimination of vinyl laminate membrane presses that can only process units in lots of a fixed size. Even if comparing a powder coating “batch” process to a spray-to-waste liquid coating batch process, the potential to save both time and money is greater because powder is a single coat process that does not require additional coats or a long time to dry.

Seamless Desktop Coatings

The two most important elements of this area are (a) reduced sanding and handling of parts, and (b) elimination of edge-banding costs. Liquid painting and traditional lamination also require numerous repetitive steps that add to processing time and costs.

Powder Performance Benefits

Tests applied to wood coated samples vary in performance, but several standard measures are used to quantify coating performance. Typical standards are design for coatings on metal substrates, so results that are acceptable for wood may vary slightly. A good example is performance relative to humidity. It appears that water absorption issues occurring over time affect the substrate – much more than the coating itself. In other words, the coating’s permeability will be a factor in the possibility of coating de-lamination or cracking.

Finally, to ensure that the powder coating on wood/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 wood/MDF
- Test a variety of engineered woods from a variety of suppliers
- Develop a better understanding of the difference processes, their capabilities and their associated costs (or cost savings)

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