IR Curing ShopTalk

Infrared Equipment Division of IHEA

This column is provided to you by members of the Infrared Equipment Division (IRED) of the Industrial Heating Equipment Association (IHEA). The group includes infrared (IR) curing equipment suppliers from throughout North America. We publish the column three times a year to give you the latest information about IR curing techniques and equipment. Contact information is at the end of the column. Most IR manufacturers offer testing for free or for a fee. Any IRED member can assist you in finding solutions to curing problems and best practices for finishing of coatings. This issue's column was submitted by IRED member Judith A. Lietzke, Carlisle Fluid Technologies, Scottsdale, Ariz.

Powder coating MDF materials

With the countless advancements in wood-based products, and with medium density fiberboard (MDF) in particular, many manufacturers have been scrambling to find the right formula for applying paint and surface curing. Powder coating heat-sensitive materials like wood products has never been easy. Manufacturers are aware that the key to achieving smoothly coated, durable products is finding the right formula of application and cure.

"Wood-based product designers now have a huge range of creative flexibility. To optimize that flexibility, they need a powder system that promotes coverage of contours, slots or bores, complex edges, and even very sharp edges with no picture frame effect," says Judith Lietzke, senior product manager at Carlisle Fluid Technologies. "Designers like the fact that they can put their imaginations to work and know that, chances are, whatever they conjure up on paper can be quality coated to meet their vision."

Prepping, coating, and curing the MDF parts

A quality finish requires multiple steps and good surface preparation. The surface preparation could be something as simple as blowing off the parts to remove surface debris or it could be much more complex. Once the part is cleaned, the first step in powder coating MDF is to preheat the surface prior to coating. The powder is coated electrostatically, and a good quality electrostatic finish requires a good grounded work piece. Preheating the surface will induce moisture in the wood, which is needed to make the surface conductive and more accepting of the powder coating. The recommended moisture range is a uniform 6 to 7 percent. The moisture generated in the wood by preheating provides a good ground to draw the charged coating to the part while reducing wasted material. In addition, the preheating process can help the small powder particles adhere better to the surface. Preheating will also release gases in the MDF material that could hinder a quality finish.

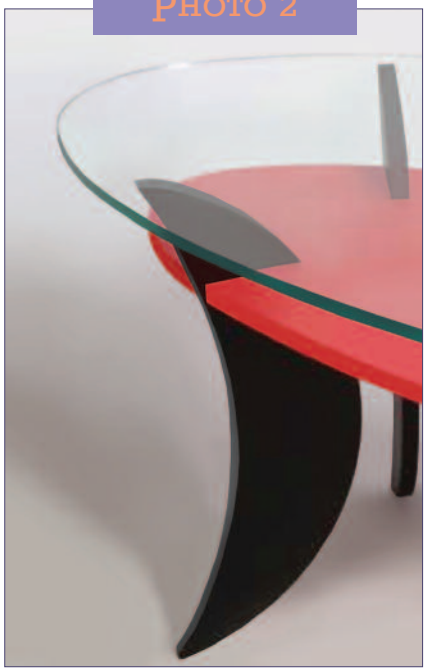
Many manufacturers offer ovens in various sizes and types that use minimal floor space to help preheat the product surface. Booster ovens are one type that will help heat the product surface to release the gases and provide a uniform internal moisture content. Oven options such as zoning the heat source creates an even surface temperature for geometrically complex shapes and sizes. The type and size of oven is dependent upon the application and floor space available, but choosing the correct oven for your needs is necessary to achieve a solid, smooth, and durable finish.

The next step is applying the first coating, or base coat, which supports the substrate. MDF materials have a natural inclination to swell and shrink, so the base coat is critical. The next layer, or covering coat, is what delivers the visible properties such as color, depth, protectiveness, brightness, and hardness. The application of these coatings can be applied manually or, most typically, in an automated system. Many new powder coatings can eliminate the need for two coatings, and just one coat will suffice for a good application. However, it is always best to work with your coatings provider when looking at new materials, processes, or applications.

In an automated system, the parts can be moved through the pretreatment area to ensure proper moisture content all the way through to the final cure. Some manufacturers specialize in MDF product powder coating systems. A typical such system incorporates special back electrodes to avoid build up on product edges and to control the lamination strength on the product's edges.

Photo 1

Photo 2



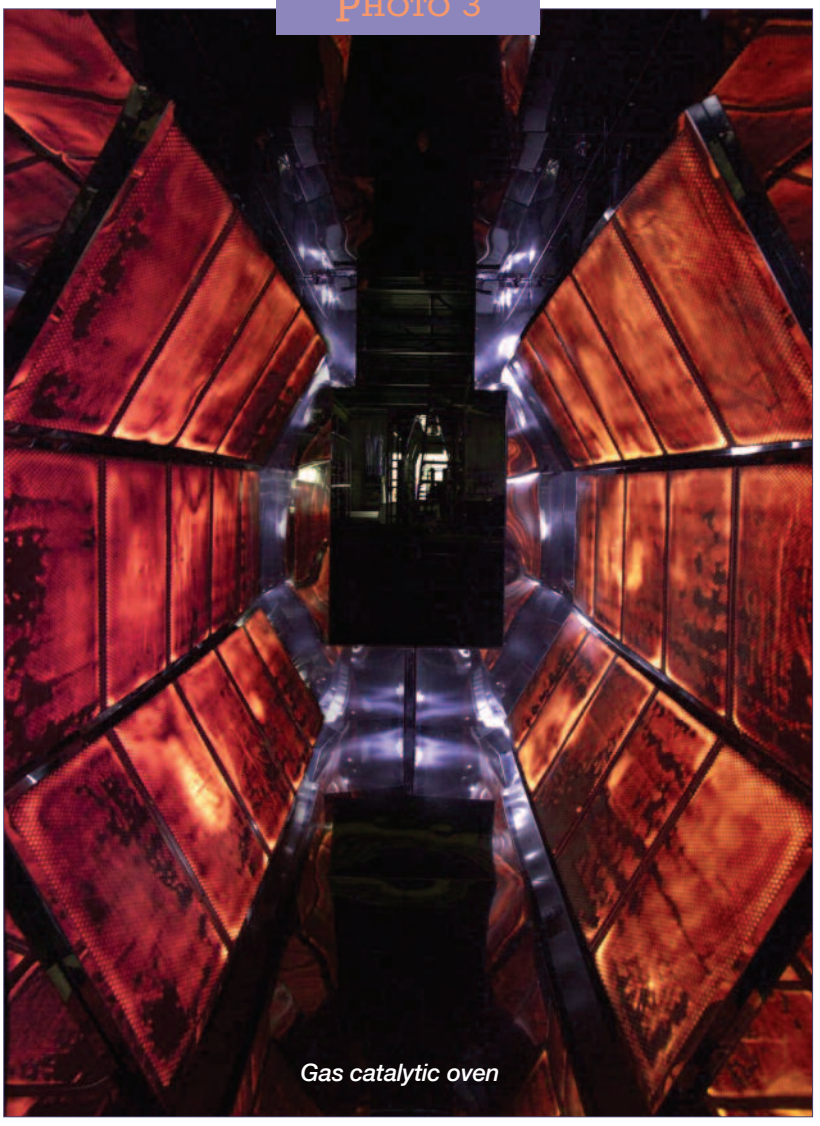
Once the two coatings are applied, they are merged together on the MDF part during the curing phase. The infrared (IR) heat that's applied melts the layers together and hardens them to the substrate for a smooth, tough finish. Curing ovens can range from standard IR to gas catalytic. The key is to ensure that the coating material is cured properly for a consistent quality finish.

When coating with powder, the powder is fused or cured into a continuous film by heat or radiant energy provided by the oven. This is achieved by main cure attributes such as temperature, which refers to the coated product's surface temperature; dwell time, which refers to the amount of time the coated part is held at cure temperature; and cure time, which is defined as the oven cycle time. The effects of over or under curing diminish the physical properties such as gloss, color, adhesion, and chemical resistance. For this reason, choosing the right oven is important.

Comparing the available curing methods

Understanding the different types of curing technologies and the benefits of each is the first step in determining the right type of curing technology for the application. There are a few basic types of powder curing systems, including gas fired convection, gas catalytic, and electric IR technology.

Photo 3



Gas catalytic oven

A gas fired convection oven transfers heat to the powder coated part by circulating air around the part. Of this technology, there is direct and indirect fired. With a direct system, the burner flame directly heats the circulated air. With an indirect system, the flame is exposed to an air stream inside a heat exchanger. An advantage to gas convection is the low cost of gas and low capital initial investment cost. Disadvantages are that it's a slower process, larger floor space is required, and there are cleanliness issues due to airflow. Another big disadvantage is that the heat is not transferred directly to the part being cured, but instead it's circulated around the part.

Gas catalytic ovens, as shown in Photo 3, are natural gas or propane fired catalytic IR heaters that emit heat through flameless technology, which produces a

Photo 4

Electric short-wave infrared oven

uniform low intensity heat. The heat emitted is in the form of medium or long wavelength energy. Electricity is used for a short time to preheat the catalyst in the heater panels. A combination of fuel, oxygen, and preheated catalyst facilitates the catalytic reaction. Once the catalytic reaction is established, electricity is no longer needed and then the oven will operate until the gas is shut off. Advantages include lower operating costs, lower airflow than a gas convection oven that requires airflow to circulate the heat, and the fact that it can be used on heat-sensitive substrates. Disadvantages include a slow reaction to temperature adjustment, minimal control requirements, and a large footprint.

Electric IR technology uses radiant energy, usually measured in wavelengths, to cure the part in "line of sight." There are three types of wavelengths available. Short-wave IR, as shown in Photo 4, provides instant on/off, which eliminates heat up time, reduces energy consumption, and requires the shortest cure time in the smallest footprint. Other benefits include closed-loop temperature and zoning control. The disadvantage to short-wave IR is the fast evaporation of solvent and the cost of electricity in some areas. The other two types of IR include medium and long wave technology. As you would expect, long and medium wave offers many of the same benefits of short wave, but requires a longer cure time and does not offer instant on/off. Long wave technology may take up to 5 minutes to get to temperature, consuming more energy in the curing process.

One of the biggest advantages of IR heating over convection heating is that IR technology can deliver heat in exact amounts to specific areas of the part being cured. IR technology can be more directional and zoned to meet specific part cure requirements. Zoning type technology allows heating only the part, as needed, as it goes through the oven. No energy is wasted to heat the entire oven at all times, providing significant energy savings. Zone type IR technology is a benefit for complex shapes and configurations where the part requires different cure times in different areas due to the part's intricate design or physical stature.

Photo 5

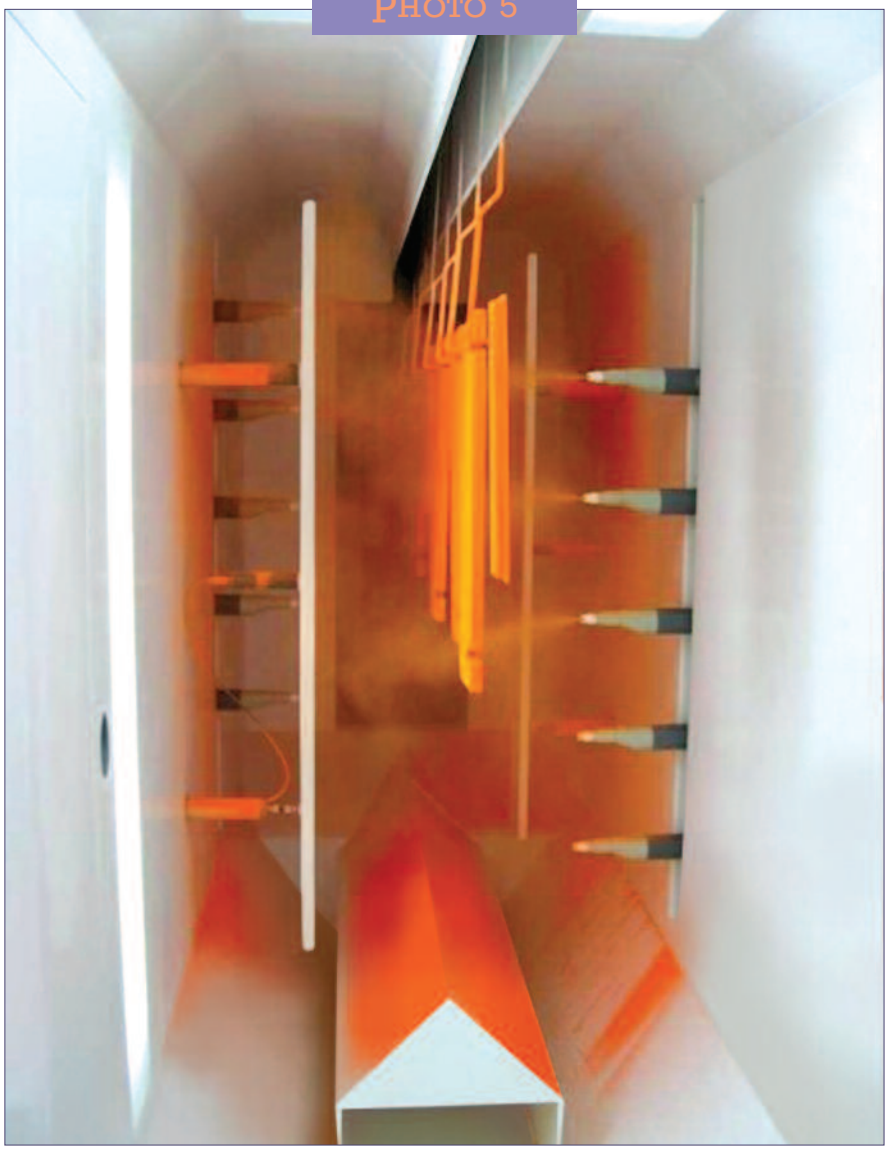


Photo 6

PHOTO 7

In summary

To properly coat MDF materials, an automated system is required. From the conveyor that moves the parts to suitably preheating the parts to applying the coating material and through to the final process of curing, all phases need proper integration and operation to ensure a quality finish.

"Even though MDF has many advantages for designers, it also offers challenges for the typical manufacturer if they don't have the right tools," concludes Lietzke. "With the desire for unique designs and numerous color palettes, I don't see this changing any time soon." **PC**

For more information or to submit a question, contact Anne Goyer, executive director of IRED, at 859/356-1575; anne@goyermgt.com; http://www.ihea.org/?page=IRED.

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