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 Baskar Vairamohan, Electric Power Research Institute, Palo Alto, Calif.*

# Case study: Powder curing with electric infrared

Howse Implement Co. Inc., Laurel, Miss., is one of the major rotary cutter manufacturers in the world. The company makes several farm and garden implement products, such as rotary cutters, blade and rakes, tillage, lifting devices, and many other types of equipment. Howse products can be found all over the US and in more than 30 foreign countries.

In 2008, Howse modernized its existing factory to improve productivity and eliminate inefficient operational procedures. A new building was constructed for the sole purpose of providing a standalone finishing system separate from the fabrication operations of the plant. Products from the existing fabrication buildings would be conveyed into the finishing building.

This case study highlights some of the improvements achieved because of the implementation of electrotechnology-based process heating. The following innovative combinations of electric equipment installed in the facility will be discussed:

- Shot blast cleaning as a replacement of traditional pretreatment cleaning and preparation
- Electric (medium-wave) infrared booster oven
- Electric convection paint curing oven
- Electric infrared (short-wave) comfort heating
- Desiccant dehumidification system and high-efficiency heat pump for sensible cooling

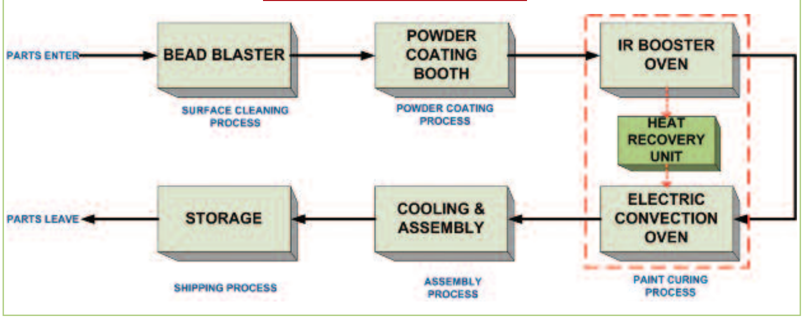
## Process description

Although there are many steps along the path to powder coating a product at the company's facility, the following section briefly describes the continuous process involved when a product goes through the company's finishing line. Figure 1 illustrates these various process steps.

**Step 1: Pretreatment.** A part enters the surface preparation process (pretreatment) where all parts are exposed to shot blast material. The shot blast material uses mechanical energy and particle impingement to provide the necessary cleaning of rust and manufacturing oils to ensure an adequately clean substrate for the powder paint to adhere. All removed rust and dirt particles are filtered from the air, and the shot blast materials are captured and reused. The pretreated parts are continuously conveyed through the shot blast chamber. The shot blast uses 100 to 140 kW of power while operating.

**Step 2: Powder coating.** In this step, the part goes through a powder coating booth where different color powders are sprayed on the surface of the part. Each part hangs on a hook that's electrically grounded, and the powder particles are ionized with a positive charge. During the powder application, the positively charged powder is immediately attracted toward the parts (because they are electrically grounded) and evenly coats the parts. Howse uses three different paint booths to paint six different colors. One paint booth paints red, the second booth paints black, and the third booth paints the other four colors. The paint booths are equipped with wheels, making it relatively easy to switch from one color to another. The company can make color changes in just 15 minutes or less. The paint booths use about 20 kW of power during operation. Any unused powder can be reclaimed and reused.

FIGURE 1

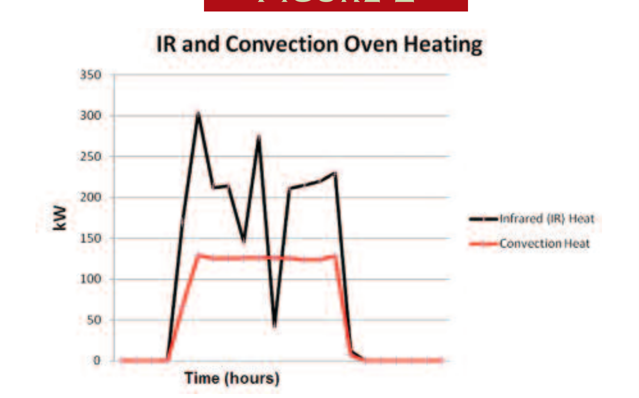


**Step 3: Powder curing.** The powder curing process involves two stages: an IR booster oven and an electric convection oven, which is a 90-foot-long cure oven. The cure oven was designed by Thermal Innovations and built by Rapid Engineering. The entrance and exit vestibules are 8-feet long. The IR oven is a 20-foot section and houses 18 medium-wavelength electric IR elements (22kW each), which are primarily used for preheating and gelling the powder coated parts. The waste heat from this section is captured and used in the convection oven. The IR oven has different zones and uses zone control to reduce power for the various shapes and sizes of the parts. The variation in power use in the IR oven, as shown in Figure 2, is because of zone control for thinner and thicker parts.

The electric convection oven has two Watlow 63 kW electric duct heating elements to maintain operating temperature, which varies from 200°F to 375°F depending on the part size and the powder color. Because the oven is a straight-through, one-pass, continuous system, it eliminates a lot of conveyor mass to heat up and maintain. This helps to have a smaller footprint compared to a gas convection oven, according to Ben Howse, owner of the company.

**Step 4: Assembly and storage.** The parts exit the oven at a temperature of about 250°F and cool down on the conveyor for about 50 feet before final assembly. The parts are then stored and shipped to various distributors.

FIGURE 2





*This photo depicts Howse's facility along with some of its product line.*

## Process improvements

The finishing building contains several new manufacturing technologies, which are described in more detail below.

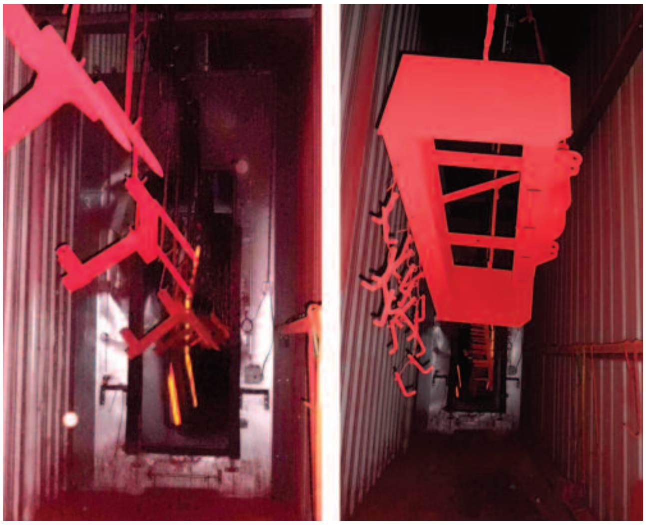
**Pretreatment process:**

*Old:* This process historically required considerable amounts of wash water and chemicals for pretreatment. It ensured the metal parts were clean and included a corrosion-preventive coating (phosphate). Costs involved water, chemicals, heat energy, process time, waste disposal, and regulatory filings. Operational problems included moderation of bacteria growth in the wash system and interaction with local waste treatment facility operators.

*New:* All water, chemicals, waste disposal, and regulatory filings were eliminated by replacing the old pretreatment process with a shot blaster. This device uses mechanical energy and particle impingement on the metal surfaces to provide the necessary cleaning.

**Coating:**

*Old:* The liquid coating had disposal and environmental regulations issues. The finish was not as high quality as desired. Durability was average to mediocre, and there were potential emission problems.



*Both small and large parts are shown entering the curing oven.*

*Finished parts are shown coming out of the oven.*

*New:* Powder coating replaced the liquid coating process. The powder coating process is environmentally friendly, doesn't pose disposal issues, is highly efficient with overspray recycling, and provides a high-quality finish. It has the ability to blow off powder and recoat if the first coating application is not correct. Powder coating provides a superior paint finish and higher perceived product quality. The new coating process does require a conditioned environment, typically around 75°F to 85°F, which was not required by the old coating line. The humidity of the space is maintained at 50 percent by a desiccant dehumidification system. According to Ben Howse, electric heating doesn't require exhaust because of the production of the combustion products.

**Curing (ovens):**
*Old:* There was an inefficient and uneven application of heat using the old infrared heaters.

*New:* The new combination infrared booster oven gels the powder paint as it enters an electrically heated convection oven. The oven is very efficient due to minimal exhaust requirements (no gas-fired combustion products requiring exhausting, and minimal volatile organic compounds [VOCs] from the powder paint). The infrared heating provides for rapid temperature rise of the parts. Because of the much smaller oven size and footprint, wall heating losses have been reduced.

## Productivity improvement and cost savings

After the installation of the IR booster and electric oven, the line speed increased for powder curing. The line speed now varies from 3.5 to 5 fpm, with thinner parts moving at 5 fpm and thicker parts moving at 3.5 fpm. The thicker parts typically stay in the convection oven for 15 minutes while it takes a shorter time for the thinner parts. At peak, the finishing system can process 18,000 pounds of parts per hour.

According to Ben Howse, the new line's waste reduction (waste water treatment) and energy reduction have saved the company about $100,000 per year. By switching to powder instead of liquid paint, the company also eliminated Title 5 requirements as well as the paperwork needed to be maintained for inspections. In addition, powder does not have suspended particles such as VOCs that need special disposal methods. **PC**

## Endnotes

1. Applicable NACIS codes for this article include: 337121, 337154, 337215, 337127, and 333111 (old SIC codes 34-39).

2. Contributors to this article include: Steve Armour and Mark Weldy, Mississippi Power Co.; Scott Bishop, Alabama Power Co.; Bill Pasley, Southern Co.; Ben Howse, Howse Implement Co. Inc.; and Baskar Vairamohan, Electric Power Research Institute.

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