IR Curing ShopTalk

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 Michael J. Chapman, Vulcan Catalytic Systems, Portsmouth, R.I.

Wheel refurbisher rolls along with a powder coating triple play

Snider Fleet Solutions, Greensboro, N.C., is a private company founded in 1976 that supplies new tires, retreads, and vehicle services to the transportation industry. The company operates a growing auto and truck rim and wheel refurbishing business in Bluffton, Ind. The Bluffton plant's process utilizes a dedicated powder coating line to clean, shot blast, prime, and coat the rims and wheels. Until 3 years ago, the company used an overhead conveyor system and single convection oven to powder coat its parts. This limited production to 3,000 wheels per month working three shifts, 24 hours per day.

With excellent service and high-quality work driving the business, the company realized it needed much more capacity to continue meeting demand. This was mainly because a growing percentage of parts were now requiring a two-step coating process of epoxy primer and polyester topcoat, causing an additional strain on production. During the two-part process, the primer was applied and the parts would pass into the convection oven to cure. After curing, the parts then circled back in production to cool, get powder coated, and then pass through the oven a second time. The company knew there had to be a better and more efficient way to ramp up production.

Supplier search and evaluation

Dave Double, plant manager at Snider Fleet Solutions, realized the company had to come up with a more efficient and smoother flow routing of parts. The extra handling of the heavy parts in the production setup was also cumbersome and wasteful. Manufacturing bottlenecks were created in different places each day due to the variations in cooling time, lot sizes, and colors of each lot of parts. Waiting for parts to cool at different stages added to this logistics challenge. Therefore, flexibility was a major requirement for more efficient operation.

Double did some research and concluded that Vulcan Catalytic Systems was the best choice for revamping the powder coating line. Vulcan, Portsmouth, R.I., is an IHEA/IRED member company that manufactures heaters and ovens and supplies specialized overhead conveyor systems to provide an overall systems solution through its subsidiary company, NikoTrack. As a manufacturer of catalytic infrared equipment, Vulcan was well-versed in the application of powder coatings and had extensive experience in supplying ovens for powder coating lines.

Flexibility and logistics efficiency

Vulcan provides testing to help evaluate new powder coating applications, so Snider Fleet Solutions asked for a thorough engineering evaluation, including part testing. Based on the evaluation results, the company elected to revamp its entire manufacturing process cell.

Figure 1

Company background

Facility: Approximately 4,000-square-foot area manufacturing cell that includes: • Three shot blasting stations • Primer booth • Primer catalytic IR oven • Powder booth • Catalytic IR cure oven
Parts for coating • All steel wheels and rims, including 10 percent of the business in antique wheels (ie: for the Ford Model-A)
Production flow • Product demands multiple runs of very small batch sizes throughout each day
Overhead conveyor system • Three staging areas • Operating range of 2 to 4 feet per minute
Colors • Polyester powder in six standard colors • Majority of products are first primed with an epoxy primer, including certain truck wheels

The logistics solution was to supply a new overhead conveyor system that is a hybrid manual and power driven system with three staging areas. Parts are loaded two each to pull flight bars on the manual track system. This track system is external to the power driven line. A combination of lines, staging areas, and track transfer switches allow the operators to easily move and batch lots together where they are needed.

The power track line utilizes two synchronized power drives for a continuous loop that runs from staging area 1 through the primer booth, catalytic IR primer gel oven, powder booth, catalytic IR cure oven, and ends at the cool down and unload staging area. (See Figure 2.)

Parts can be transferred on and off the power line depending on the process requirements. The staging areas quickly eliminate bottlenecks in production and provide the flexibility to shift parts immediately where they are needed. For example, parts that do not need primer are sent via the bypass line directly to staging area 2 prior to the powder booth.

"The staging areas have been life savers," says Double. "When one operation gets ahead of the pace of the next operation, we can hold them in the staging area so they are ready to roll when needed. Production stays current and productivity stays high. We are able to put up to forty wheels in each staging area. It helps us stay right on track."

Energy and process heating efficiency

According to Double, the company's gas bill was "through the roof!" The statement has a literal meaning also as convection heats a product by first heating air and then the hot air must transfer the heat to the parts. The hot air is exhausted and literally most of the heat is lost up the stack and through the roof. Infrared heating, on the other hand, transfers the heat energy through infrared radiation to directly heat the parts. Process heating using gas catalytic infrared heaters is much more efficient than convection heating for powder gelling and curing.

After accounting for the materials to be coated, the line speed, part loading time, and part sizes, Vulcan's engineering staff designed the infrared ovens so that the IR heaters surrounded the parts for optimal heat transfer. The overall heat load was determined by the number and weight of the parts to be coated per hour along with the rate at which they are to be cured. The material to be coated is also critical to calculate the heat required, as the capacity to absorb heat varies greatly for different materials. The target temperature and dwell time is a function of the powder curing schedule.

The layout of the oven was then determined by using a part window analysis. The infrared heaters are positioned around the part window in this analysis to ensure complete coverage of the largest part. The oven is then designed around the placement of the heaters using the reflective properties of medium- to long-wave infrared to effectively gel the part throughout from top to bottom. (See Figure 3.)

Once the testing was complete and the oven design established, the powder pre-gel ovens using the gas catalytic infrared heaters were quoted. The cure oven has four sections and is 30 feet long with a total of twelve zones of independently controlled catalytic heaters. The primer gel oven is a two-section unit that is 16 feet long and has eight zones of control. Both ovens are designed to create heating profiles that are adjustable from

FIGURE 2

System diagram shows the power driven conveyor, manual conveyors, track transfer switches, staging areas, and processing units. Note the optional paths and direction of product flow in the system.

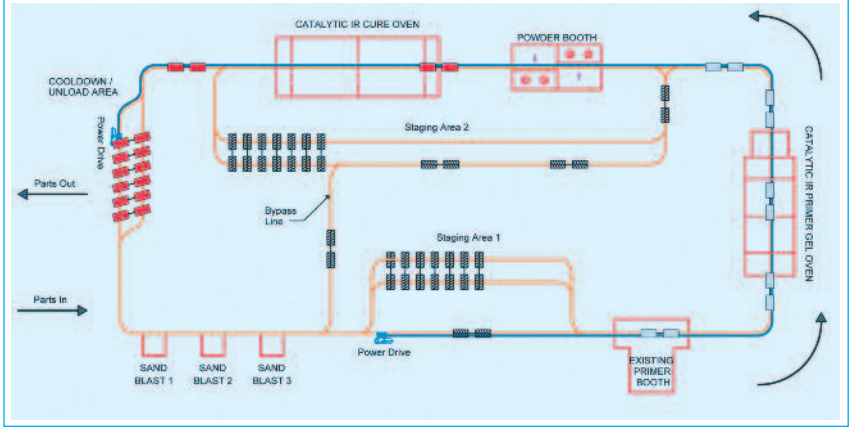
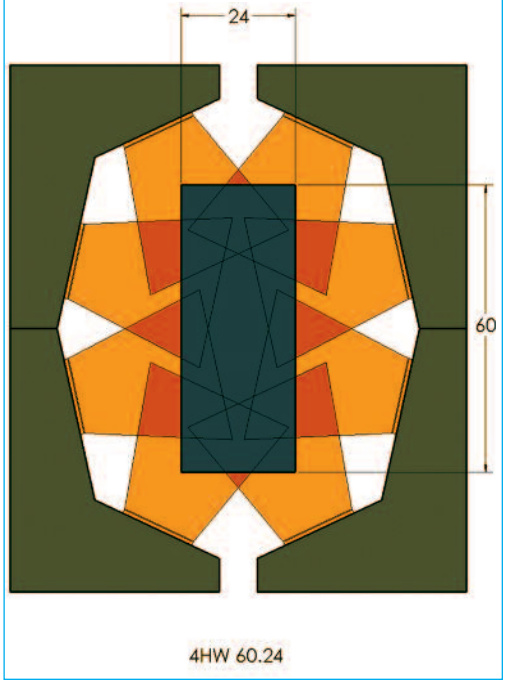


FIGURE 3

Part window analysis is used to design the oven along with the number, position, and angle of catalytic IR heaters to optimize the infrared process heating capabilities.

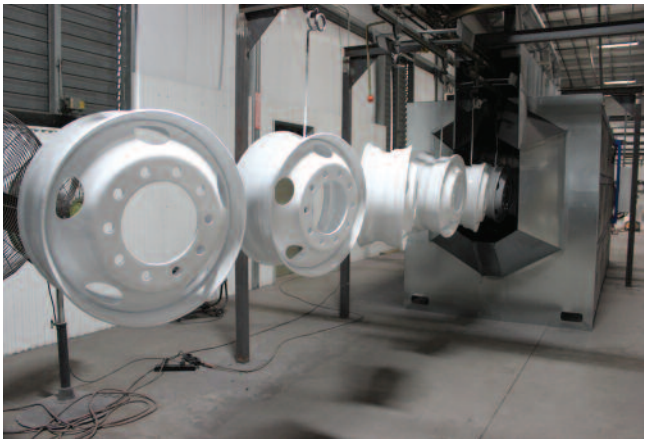


entrance to exit and top to bottom. Once the profiles are created, recipes are saved in the PLC for future recall. After the decision was made to proceed with the conversion to the gas catalytic infrared ovens, the complete specifications were established.

Installation

The oven's lightweight modular sections allowed for easy shipping and handling during installation. The prewired and plumbed modular sections were each easily moved into place with pallet jacks. The oven was assembled by setting the right and left sections in place for final gas and electrical connections around the newly installed conveyor line.

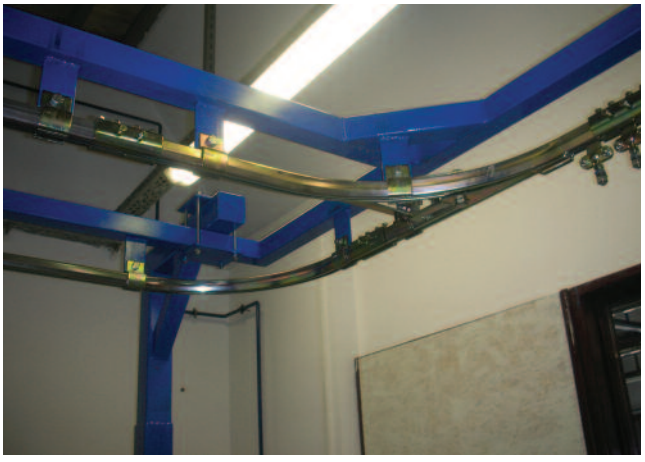
The initial installation included only the catalytic IR cure oven and the existing convection oven was used as the primer gel oven. This was quickly abandoned, as the high temperature caused some logistical issues with the



Parts after exiting the primer booth and before entering the catalytic IR primer gel oven.

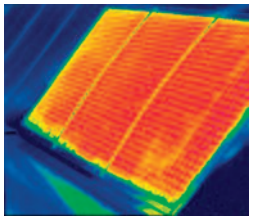
Parts hanging in pairs on the flight bars in the staging area await their turn in the next production step.

Parts entering the curing oven.



Automatic tongue switch changes tracks of the flight bar trailing trolleys to send parts to dual tracks in parallel to save space.

Parts exiting the curing oven.



The catalytic IR heaters are not visibly hot, although they are radiating medium- and long-wave IR. This is apparent in the thermo imaging of the heater, as shown with a face temperature of 900°F.

Triple tongue switch used to transfer flight bars.

Primer application booth is shown with one of the staging areas seen in the background.

Powder coated refurbished wheels await final packing for shipment.

track system and the inefficiencies of convection heating. In 2011, a smaller gas catalytic primer gel oven was installed to replace the single convection oven.

Success

The successful conversion has allowed Snider Fleet Solutions to stay ahead of the growing demand for its refurbishing business. It greatly improved plant logistics and utilized a much more efficient process heating method, which has helped more than triple production. The line is currently operating around the clock and powder coating approximately 9,500 wheels per month with the capacity to exceed 10,000 wheels per month. "The biggest advantage of the new system is our ability to continually move parts through our process," says Double. "It works very well now. The benefits of using efficient catalytic IR ovens have also saved us a ton of gas already, since our big open convection oven was very inefficient. The gas savings alone since the conversion have completely paid for the new ovens within one-and-a-half years of installation." **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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