Progressive Powder Coating: New Infrared Curing Oven at Metal Finishing Plant Increases Production by 50%

Benefits

- Saves $54,000 annually
- Increases production by 50%
- Improves product quality
- Reduces natural gas consumption by 25% annually
- Achieves a 2.5-year simple payback

Application

Traditional convection ovens can be very energy intensive and can result in slow production cycles. Adding an infrared curing oven to a process heating plant can reduce energy costs and accelerate the production cycle. Such ovens can be used in various process heating systems throughout industry.

Summary

Like most metal finishing plants, Progressive Powder Coating in Mentor, Ohio, uses a convection oven in its manufacturing process. Progressive Powder was experiencing bottlenecks in its production process because of the time required to cure thicker pieces of metal in the convection oven. Curing thicker metal pieces forced the plant to slow the conveyor line speed, which reduced productivity. In an effort to save energy and improve production, Progressive Powder installed an infrared (IR) oven in between the powder coating booth and the convection oven on its production line. The IR oven allowed the plant to increase its conveyor line speed and increase production by 50%. In addition, the plant was able to reduce its natural gas consumption, yielding annual energy savings of approximately $54,000. With a total project cost of $136,000, the simple payback is 2.5 years.

Company Background

Progressive Powder Coating is a subsidiary of Buyers Products Company, a manufacturer of products for the mobile equipment industry, including truck and trailer components. Buyers Products is a vertically integrated company whose manufacturing capabilities include forging, stamping, laser cutting, computer numerically controlled machining, robotic welding, powder coating, assembly, and retail-oriented packaging. Progressive Powder performs most of the powdered metal coating for Buyers Products in its 25,000-square-foot facility. In addition to the convection oven, Progressive Powder's plant contains a five-stage product washing unit, a dedicated cleaning stage, an iron phosphate stage, and an anti-corrosion sealer stage.

Before the IR booster oven was installed, Progressive Powder depended on a traditional convection oven to cure the powder coats. This curing oven is approximately 128 feet long, with two 60-foot zones and an 8-foot wrap-around section. This length is typical for a facility such as Progressive's plant and is necessary so that the plant's products will have sufficient time to absorb heat at the proper curing temperature.

Project Background

Progressive Powder Coating worked with Dominion Power[1] to evaluate the convection oven to determine how to eliminate the production delays. Despite the convection oven's length, it was unable to fully cure the thickest pieces at normal conveyor line speeds. The conveyor line speed had to be slowed down to 4 feet per minute (fpm) for the powder coating on

[1] Dominion Power has an employee who is a qualified specialist on the BestPractices Process Heating Assessment and Survey Tool (PHAST).

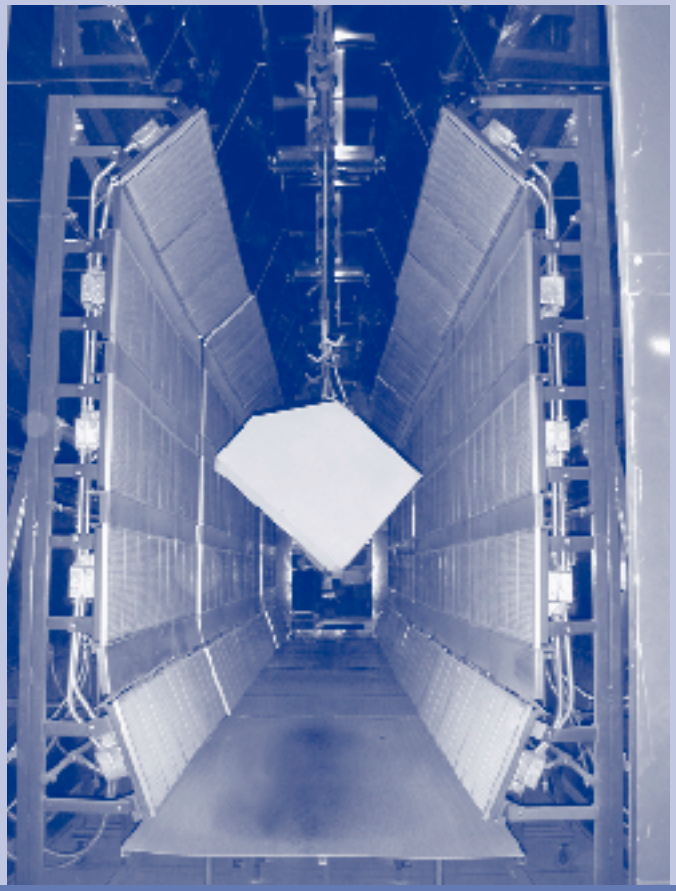
thick pieces to become fully cured, which lowered the plant's productivity, causing production bottlenecks and scheduling problems. Because the plant's gas usage was consistently between 1.8 to 2.4 million cubic feet per hour of operation, regardless of the mix of products that were cured, the thinner pieces were more costly to treat on a per-unit basis than thicker ones.

Although the line speed could be increased for thinner pieces and slowed when thicker pieces entered the oven, plant personnel determined that this was not optimal because the convection oven needs time for any new temperature to stabilize before it can be used effectively. If thinner pieces are in the oven and there is a change to thicker products, spaces must be left on the conveyor belt to allow for the temperature in the oven to rise and the thinner products to exit the oven. If not for the space, the thinner pieces would be over cured or burnt and the first few thicker pieces under cured.

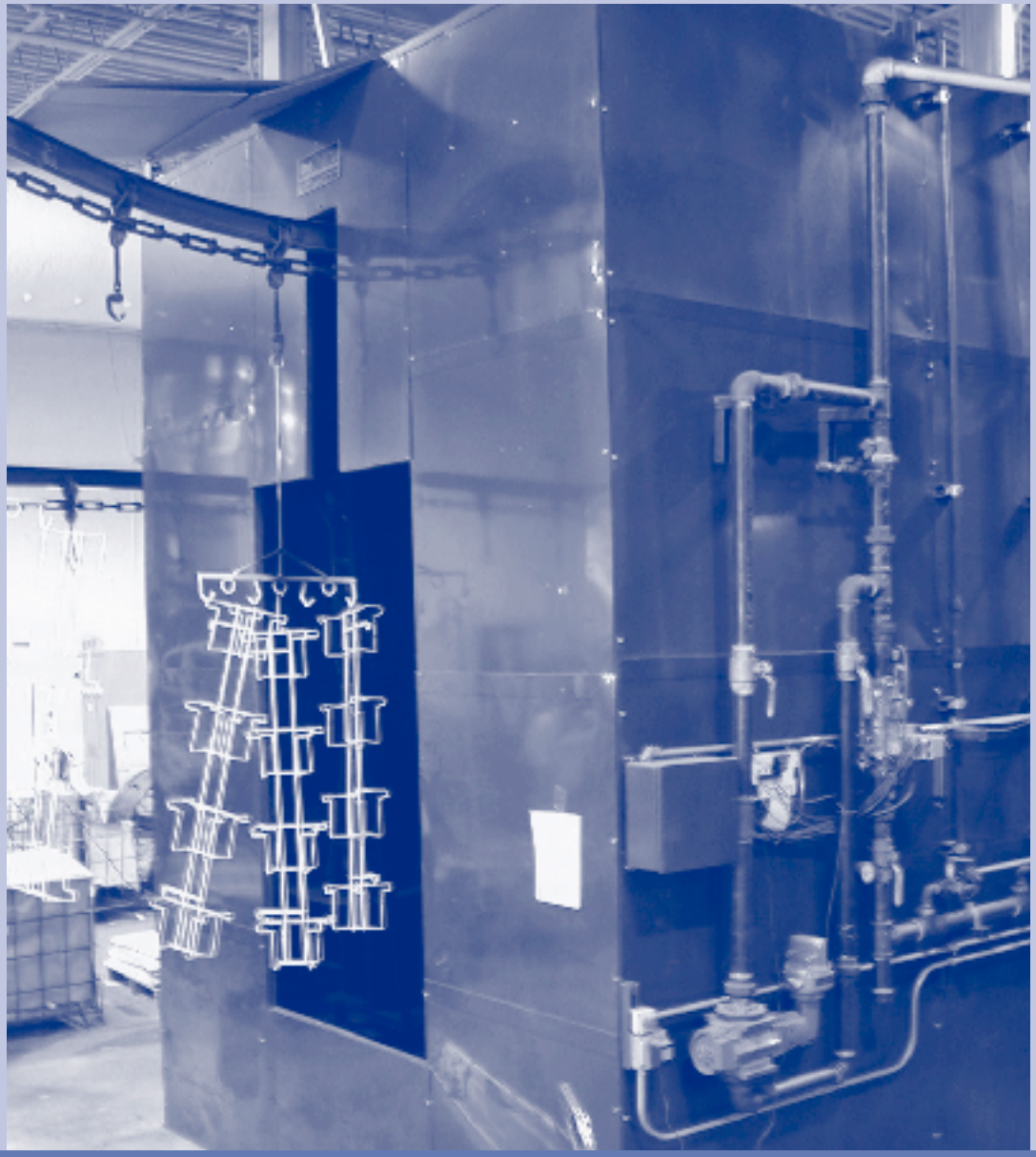
In addition, the entrance to the convection oven was more than 100 feet away from the end of the powder-coating booth. This caused powder loss because of the conveyor belt vibrations and convection oven turbulence, and reduced product quality.

Project Overview

Working with Dominion Power consultants, Progressive Powder personnel analyzed the possibility that an IR booster oven could alleviate the plant's problems. After reviewing the plant's production needs and various types of IR ovens, Progressive Powder purchased and installed a 40-foot catalytic IR oven. The plant placed the new oven between the end of the powder coating booth and the



Interior of Infrared Oven



Pieces Entering Infrared Oven

convection oven. To minimize powder loss from the conveyor belt vibrations, Progressive placed the IR oven just 12 feet beyond the powder-coating booth. Because the IR oven can reach temperatures of up to 475°F, plant personnel realized that it could be used to pre-gel and cure powder coatings before the pieces enter the convection oven, thereby minimizing the amount of time they need to be in the convection oven.

Project Results

The installation of the IR oven has allowed Progressive Powder's plant to increase production and improve product quality, while decreasing energy consumption. The IR oven can pre-gel or partially cure thicker pieces before they enter the convection oven and can fully cure many thinner pieces. This allows the conveyor line speed to be maintained at 6 fpm instead of 4 fpm and has led to a

production increase of just over 50%. In addition, because the IR oven can pre-gel the powder coating before the piece enters the convection oven, less powder is shaken off by the conveyor or blown off by convection oven turbulence before gel temperature is reached. This has led to more consistent product quality and fewer products that have to be rejected or reworked. With the IR oven's curing ability and the improved product quality, Progressive Powder's plant now has more flexibility in its production scheduling.

Because some pieces can be fully cured in the IR oven, the convection oven uses less natural gas. The IR oven does not use blowers or fans, so the plant's electricity consumption is unchanged from before the IR oven's installation. However, natural gas usage is down 15.5% per piece and 6.8% per pound of product. Overall, the Mentor plant's natural gas consumption has declined by 25%, yielding annual energy savings of $54,000. Because the project's total cost was $136,000, the simple payback is just over 2.5 years.

Lessons Learned

IR heating ovens can improve energy efficiency and productivity in industrial plants that perform process heating. In the case of Progressive Powder, the IR heat generated by the IR oven was able to pre-gel and cure many types of products before they entered the convection oven. This allowed the plant to increase its production and reduce its energy consumption because pieces did not have to spend as much time in the convection oven to become fully cured. By experimenting on thinner products plant personnel have found they can boost line speeds to as high as 12 fpm, and they are exploring additional ways to fully utilize the IR oven. By optimizing the proportion of IR heating versus convection heating that will deliver the highest efficiency, Progressive Powder Coatings has improved the effectiveness of its production process.

Natural Gas Catalytic Infrared

Natural gas catalytic infrared (IR) is a flameless heating technology that produces a uniform, low intensity heat. A wide range of materials, including powder paints, readily and evenly absorbs its medium- to long-wavelength energy. The wavelength of the IR light determines the temperature the source will receive: The longer the wavelength, the lower the source temperature. Natural gas IR heating is adjusted by using different wavelengths of light in the IR spectrum band. The technology works by a diffusion process in which natural gas and air meet at a catalyst sandwiched between two layers, one of air and one of natural gas, in a counter diffusion mode. Because radiation rather than convection or conduction transfers heat, only the surface of the part and the powder must be heated rather than the whole part. The IR oven has no blowers or fans like a convection oven and thereby uses much less electricity and natural gas, depending on product mix, than convection ovens. The technology is also environmentally friendly and can help reduce emissions.

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BestPractices emphasizes plant systems, where significant efficiency improvements and savings can be achieved. Industry gains easy access to near-term and long-term solutions for improving the performance of motor, steam, compressed air, and process heating systems. In addition, the Industrial Assessment Centers provide comprehensive industrial energy evaluations to small- and medium-size manufacturers.

Project Partners

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