

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 Chris Chapman, on behalf of Heraeus Noblelight America USA, Buford, Ga.

Lean powder coating with a focus on curing technology



Lean manufacturing is here to stay. The concept has been around for more than 50 years, and many companies that have implemented lean have seen significant and often immediate results. When implemented correctly, lean can produce far-reaching changes that ensure future competitiveness in an ever changing, more competitive business landscape.

This article focuses on how lean manufacturing philosophy applies when considering powder curing technology, specifically gas catalytic infrared versus convection curing. It will be of interest to any company involved in powder coating ovens and intends to, or is already following, the lean path. This article applies directly to the curing and oven technology of powder coating.

What is lean manufacturing?

Lean manufacturing, often just referred to as “lean,” is a systematic methodology for the identification and elimination of waste within a manufacturing system. A successful lean implementation, together with an ongoing program of continuous improvement (CI), will result in shorter lead times, improved quality, greater capacity, and more employee involvement.

Identifying lean wastes

The main thrust of lean is the identification of waste. In a typical powder coating environment, this encompasses:

- A continuous flow, tunnel type of oven
- An overhead conveyor for part movement
- Either continuous flow of similar part type and large batch size
- Or, intermittent flow of variable part type and batch size

Lean wastes are broken down into seven areas. These apply to any manufacturing process, not just powder coating. Here is a review of the seven wastes identified by lean, plus what many now consider to be the eighth waste — energy. The main aim is to identify and reduce the following lean wastes within any manufacturing process:

- Transport — Moving products unnecessarily
- Inventory — Work-in-progress over and above what is actually needed to complete orders in hand
- Motion — People or equipment moving or walking more than is required
- Waiting — People or energy consuming processes waiting for parts or parts waiting for people or energy consuming processes
- Overproduction — Production ahead of demand
- Overprocessing — Doing more to the product than is required

- Defects — Effort and cost involved in inspecting and fixing defects or scrapping parts
- Energy — Unnecessary use of energy in the production process

Here is a quick challenge. Take a walk around your shop floor, look at your work-in-progress, and ask the following questions:

- How long has it been in its current position?
- Why is it there?
- Is it good or defective/scrap?
- Can it be allocated to a customer order?
- Is it in the way?

Implications for powder coating

When the 8 wastes identified above are applied to conventional gas fired convection curing ovens, several issues become obvious. These issues are described in Figure 1.

Lean powder coating curing oven solution

If convection oven curing is not the correct technology for companies serious about lean, then what is the correct technology?

High intensity radiant IR. Gas-fired premix IR in the form of impingement and surface burners have covered the medium wavelength spectrum for well

FIGURE 1

Issue	Lean Waste
Initial oven start up can take up to an hour.	Waiting, energy
Conventional ovens are not responsive to breaks in production and run at full load without any parts curing.	Waiting, energy
In order to reduce oven operating times, there is a tendency to produce ahead of demand by sizing batches according to internal economic measures, not customer demand. In lean terms, the ideal batch size should be 1.	Overproduction, inventory
Conventional ovens have high rates of airflow causing powder blow off and cross contamination. High air movement also causes dislodgement of dust from overhead conveyors and internal walls and baffles within an oven.	Defects
Convection ovens are inherently inefficient (5 to 7 percent of heat produced is used to cure powder).	Energy

over 70 years and 50 years, respectively, and provide high intensity IR. They have a well-deserved place in the powder coating industry.

Electric infrared. Electric IR ticks all the lean boxes in terms of waste reduction and undoubtedly has a place in the powder coating world. Where there is a need for very high intensity but controllable application of IR to a powder coated part, electric IR is the only option. This needs to be balanced against operating costs, given that electricity is around four times as expensive as gas, its application needs to be very carefully thought through. Second, critics of electric IR will point out that the emitted short wavelength is not as easily absorbed by organic materials such as powder. But this is a moot point, and in operation this will probably not be noticed and is therefore irrelevant. Apart from the caveat on energy, the following gas catalytic IR advantages can also be applied to electric IR.

Gas catalytic IR. Gas catalytic IR has been available for more than 20 years and offers significant advantages over conventional convection ovens. Gas catalytic IR can be used to eliminate a number of the wastes identified above:

- Less energy use.
 - Catalytic infrared is highly controllable and reduces overall energy consumption by up to 50 percent.

- During production breaks, the oven can be put into “lo fire” mode (20 percent of maximum output). Electric IR can be turned completely off.
- The oven can be split into individually controlled zones to suit different parts.
- Each zone is infinitely variable between 20 to 100 percent output.
- Gas catalytic infrared is about 85 percent efficient at converting energy into usable heat.
- Cure time is generally one third that of a convection oven.

- Less overproduction, less inventory
 - PLC controls allow for very fine tuning of oven temperature profiles, thus allowing smaller batch sizes more suited to actual customer demand rather than internal economic measures. This feature is a key component of lean; only produce to the demand of the customer.
- Less defects
 - Less air movement within the oven means less powder blow off that can cause cross contamination.
 - Less dislodged dust from associated equipment and therefore improved finish quality.
 - PLC controls give repeatable results and oven temperature profiles, providing consistent quality.

In summary

When applying lean techniques to powder coating, it is important to understand that the available technologies are not all the same. Some technologies, such as IR and gas catalytic IR in particular, are intrinsically more suited to reducing the identified lean wastes. In particular, the wastes that can be most reduced are: waiting, inventory, overproduction, defects, and energy.

It is clear that gas catalytic IR (and, to a certain extent, electric IR) technology

PHOTO 1



Lean powder coating oven

PHOTO 2

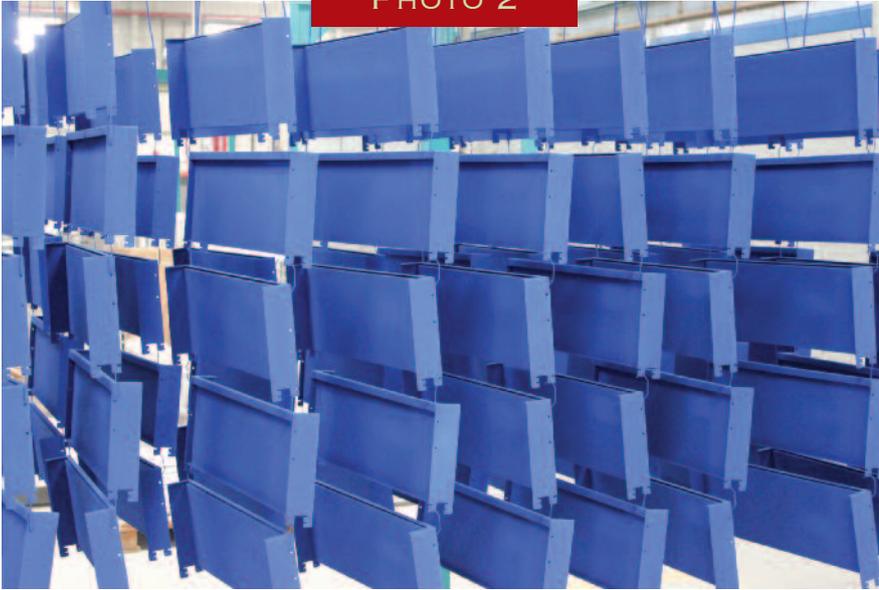
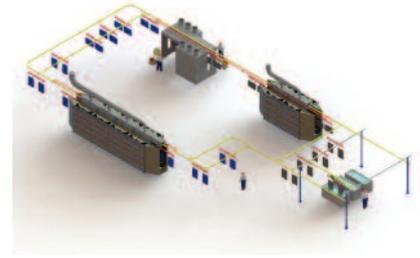


PHOTO 3



A well-planned gas catalytic IR line with pre-wash, dry-off, and cure ovens.

Batch sizes should be determined by customer demand, not internal economic measures.

addresses at least five of the lean waste issues that are raised by the use of a conventional convection oven. Companies involved in powder coating and wish to go lean should give serious consideration to a gas catalytic IR solution. **PC**

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

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