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.

Infrared webinar boosts interest in finishing industry

In March, the Industrial Heating Equipment Association's Infrared Division (IRED) conducted an Infrared Webinar that sparked a lot of interest throughout the finishing industry. More than 130 people attended and offered positive feedback as well as additional questions for the infrared experts. This article lists just a few of the questions and answers from the webinar.

Q: When IR is used as a booster for a convection oven, would the high temperatures inside the convection oven shorten the life of the heater or the electrical connections to power the heater?

A: When mounting an IR booster inside of a convection oven to help initiate the curing process, special considerations to the type of wire and lamp end seal cooling must be observed. The junction boxes for the wiring also need to be addressed; their mounting location will need to be modified. Typically, these are mounted outside of the oven, away from the heat generated in the oven.

Another consideration is keeping the lamp ends cool enough so as to extend its useful life. Keeping the ends cooled below the temperature threshold specified by the manufacturer is critical to increased lamp life. In most convection ovens, the operation range is typically a maximum of around 450°F to 500°F. This is usually below the lamp manufacturers end seal temperature range. In a high bake convection oven for curing of PTFE coatings, which typically operates around 750°F to 800°F, the introduction of cooling lamp end seals needs to be addressed.

The advantage of having the IR heater inside the hot air convection oven is the ability to accelerate the part temperature to help begin the curing process. An additional advantage is that energy not absorbed by the product goes directly into the air in the convection oven and will typically help reduce the amount of energy needed to keep the convection oven at operating temperature.

Q: Are there any problems with IR scorching or burning the surfaces of coatings?

A: When applied incorrectly, infrared can burn or scorch coatings. However, when applied correctly, infrared is an excellent heat source for drying and curing applications. Some factors to consider when examining an infrared application for a particular product are the wavelength of the infrared (short, medium, or long), specific heat, emissivity, and thermal conductivity.

Specific heat is the measure of the heat energy required to increase the temperature of a unit quantity of a substance by a certain temperature interval. *Emissivity* is a measure of the efficiency in which a surface emits thermal energy. It is defined as the fraction of energy being emitted relative to that emitted by a thermally black surface (a black body). A black body is a material that is a perfect emitter of heat energy and has an emissivity value of 1. A material with an emissivity value of 0 would be considered a perfect thermal mirror. *Thermal conductivity* is the property of a material that indicates its ability to conduct heat.

The product's specific heat, emissivity, and thermal conductivity along with the desired temperature profile for the product will play a role in determining which infrared wavelength will work best. Your infrared vendor can assist you in matching the required infrared wavelength for your particular application.

Q: Explain the advantage(s) of IR curing compared to microwave curing in regards to rubber products.

A: For the curing of rubber, infrared and microwave technologies have different advantages. It is very difficult to highlight the advantages of IR technology over microwave because they both have unique applications as far as heat treating rubber is concerned. A better question is, perhaps, what are the advantages of IR and microwave curing compared to traditional methods in regards to rubber products.

Rubber must be heat cured to obtain final strength and resiliency and to reduce stickiness. Rubber conducts heat poorly, so any process that requires heat penetration, such as steam curing, is slow. An advantage with IR curing is that it can rapidly cure unusual shapes within a minute, before they have time to slump and distort.

IR and microwaves can both cure diverse shapes at a uniform rate, so a greater variety of rubber products can be cured. With zoning control and the use of short-wave IR, heating rubber products of various sizes and shapes can be accomplished in a matter of few seconds.

Rubber must be heated under pressure with additives (e.g. sulphur) to increase strength and resiliency and to reduce stickiness and odor. The entire thickness must be heated to the required process temperature as quickly as possible. This process is called *vulcanization* of rubber. It should be noted that this is an irreversible process that eliminates the drawbacks of natural rubber, like deforming under heat and brittleness.

Both IR and microwave is used for the vulcanization process. In IR vulcanization, high intensity short-wave IR lamps are fitted in the equipment. The short-wave IR penetrates deeper into rubber/silicone, thereby resulting in quicker vulcanization. IR offers uniform heating, so the temperature distribution over the profile is uniform and the end product is dimensionally very stable.

Some of the advantages of IR over traditional methods (e.g. steam autoclaves) for rubber curing are:

- Quick heating — Heating occurs throughout the material's mass and is 2 to 20 times quicker than conventional methods. Production rates increase, sometimes more than 100 percent. Heating rates are limited by the material's ability to heat rapidly without being damaged.
- Uniform heating — For a homogeneous material, heating is more uniform throughout the cross section, ensuring more uniform material properties.
- Improved product quality — Heat-sensitive materials are not exposed to high temperatures for long times, improving product strength and quality.
- Combination with conventional methods — IR booster ovens can be added before, after, or inside existing equipment to speed the process.
- Space savings — IR heating equipment requires only 20 to 35 percent of the floor space of conventional heating units.
- Increased flexibility — The equipment features instant on/off, so no warm-up and cool-down time is needed. Electronic controls accurately and instantly change product temperature.
- High energy efficiency — The energy efficiency, defined as the energy put into the material divided by the power supplied to the equipment, is 20 to 30 percent higher than conventional rubber curing methods.

Q: Can I listen to the rest of the webinar to learn more from the infrared experts?

A: Absolutely. You can access the full recorded webinar through the IHEA website by going to https://ihea.siteym.com/?page=IRED and scrolling down to the IR Webinar link. **PC**

An off-road vehicle frame is shown inside a combination oven. Photo courtesy of BGK Finishing Systems, Infrared Curing Solutions.

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