

5 Misconceptions About Infrared Heating

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There are three means of transferring heat: conduction, convection and radiation. Conduction is the transfer of heat either by contact between the heat source and the object to be heated or within the object from one point to another. An example of conduction heating is a coffee pot on a warming plate. Convection is the transfer of heat from the heat source to the object being heated via a fluid medium -- commonly, air. An example of convection heating is a preheated oven used in front of an infrared tunnel on a thermoforming machine, or a convection oven used in a paint curing application. Radiation is the transfer of heat via electromagnetic radiation between the heat source and the object to be heated. This electromagnetic energy is emitted by all bodies above -273°C (0°K , or absolute zero).



Radiation is broken down into many subsets divided by different wavelengths. These wavelengths include ultraviolet, infrared, micro-wave and radio frequency. The wavelength spectrum ranges from 0.72 to 1,000 micron, and the infrared region is divided into three subsets:

- Short-wave (near): 0.72 to 2 micron ($7,000$ to $2,150^{\circ}\text{F}$).
- Medium-wave (middle): 2 to 4 micron ($2,150$ to 845°F).
- Long-wave (far): 4 to 1000 micron (845 to $<32^{\circ}\text{F}$).

The useful infrared region for industrial process heating ranges from 1.17 to 5.4 micron ($4,000$ to 500°F). The wavelength is inversely proportional to the temperature: As the temperature goes up, the wavelength goes down.



When infrared energy strikes an object, it causes the surface electrons to excite and oscillate. This oscillation creates heat. The electromagnetic energy travels in straight lines from the source, and it can be directed into specific patterns with the use of properly designed reflectors. It decreases in intensity as it travels outward from its source.

Why use infrared heating? Infrared heating in process applications provides several benefits. It

- Reduces floor space.
- Lowers energy consumption.
- Increases line speed.

- Reduces maintenance.
- Provides a clean operating environment.

For all of its process benefits, some processors are concerned about using infrared heating. They need not be. Most concerns about infrared are based on misconceptions; a properly designed system will provide years of effective heating. Let's take a closer look at the five most common misconceptions and the facts behind the buzz.

MISCONCEPTION NO. 1: Infrared radiation may be harmful to oven operators.

There is no immediate danger associated with the use of infrared radiation compared with ultraviolet radiation or microwave. However, as a precaution, one should avoid prolonged viewing of high intensity infrared emitters at close distances (less than 15'). Repeated, long-term, near exposure to high intensity infrared radiation may cause cataracts in some individuals.

MISCONCEPTION NO. 2: Infrared ovens are effective in heating only flat surfaces.

Flat surfaces are ideally suited to heating by infrared radiation. They can be heated rapidly and effectively in an infrared oven. However, more complex, three-dimensional shapes also can be heated in an infrared oven. Three-dimensional parts can be rotated so that all sides are evenly exposed to radiation as they pass through the oven. The heating rate also can be varied from zone to zone to allow sufficient soak times to heat internal regions of a part.

MISCONCEPTION NO. 3: Infrared radiation works better in a vacuum with little or no air moving.

Air is virtually transparent to infrared radiation; infrared is neither absorbed nor scattered by air. However, water vapor, carbon dioxide and other greenhouse gases do absorb infrared radiation. If the air between the emitter and the product contains water vapor or other absorbing gases, it could absorb a portion of the infrared radiation. For distances between the emitter and absorber of a few feet or less, the energy absorbed by the gases will be negligible.

MISCONCEPTION NO. 4: Short-wavelength infrared penetrates more than medium and long-wavelength infrared.

Although this statement is true in many cases, it is not universally true. For example, metals do not transmit infrared radiation of any wavelength. All the infrared radiation incident on a metal is absorbed or reflected at the surface. But, some nonmetals -- water, glass, quartz and some ceramic and polymer materials -- do transmit radiation. These same materials also may transmit longer wavelengths to some degree.

MISCONCEPTION NO. 5: Only one wavelength is best for a given application.

This statement is blatantly false. There are many factors that need to be considered. All wavelengths will most likely work for a given application. You need to consider not only the heating rate but also the available floor space, maintenance requirements, heater durability, response time, heater and system efficiency, initial oven cost, energy consumption cost, conveyor speed, part size variation, controllability and aggravation cost. All of these items need to be considered in order to pick the right solution.

