Infrared:

How Does It Work?

Basic introductions to infrared process heating. The author details the relationship between wavelength and temperature, and where infrared can be used effectively

by Hugo Cahnman

Everyone knows infrared energy is heat that can be applied to many things for manufacturing, finishing, drying and heat processing. But, do we really know and understand the characteristics of infrared energy or do we use it simply as another source of heat?

To find out what infrared really does, what it can do, and where it can and cannot be used to its full advantage, here is a short guide.

We are all confronted with energy conservation. Can infrared help avoid wasting energy? It can, provided we know how to use it efficiently.

Essentially, infrared is an electromagnetic phenomenon, which is measured in wavelengths (microns). Electromagnetic energy particles attack the surface of materials to be processed after which conduction takes over.

To use infrared successfully, we have to understand this reaction. Materials can act as a good heat conductor. In many cases, however, the conductivity is less than desired resulting in absorbing and retarding the penetration of heat. Some of the materials may work as an insulator. In this case, the infrared energy must be applied from two sides, especially if a web is involved.

One major advantage is the fact that heating tunnels or structures having infrared heat do not require heavy insulation as is necessary in convection ovens. However, shields on the sides may be needed to prevent drafts.

Choosing I-R systems: Basic mistakes in choosing the wrong radiant heater can render such an installation to be inefficient, costly to operate and maintain.

Therfore, it is necessary to find out how infrared actually works. It has already been mentioned that infrared radiation is fundamentally electromagnetic energy. This measurable energy can be divided into roughly three types of density: 1. Short-wave or very high density radiation beginning with 1.2 microns of usable energy and ending around 1.3 microns; 2. medium-wave around 2.5 microns to medium density to around 3.8 microns; and 3. low-density long wave or far-infrared around 3.8 to 6.0. Beyond long wave, infrared should not be used because of inefficient radiation resulting in low temperatures.

Before we go into this further, we must repeat the fact that infrared energy is surface phenomenon. For example, processing foam is a poor radiant energy conductor. Even thin foam should not be radiated from only one side because one surface will be rapidly heated while air or agents trapped in the material slows down heat penetration considerably, acting as an insulator. Consequently foam must be radiated from both sides.

Also, if the surface is shiny, such as aluminum, the surface may reflect the infrared and bounce it back and forth. Result: delay of the heating action.

Objects or material that readily absorb energy usually give satisfactory results. But this type of application is only a part of where we can apply infrared emission. We can also achieve satisfactory results by combining radiant emission and air-flow. In some cases, it is necessary to avoid surface hardening, which causes bubbles underneath the dried coat. By combining radiant heat and air, the problem will be satisfactorily solved. However, the air must be applied without cooling the radiant heater; otherwise, energy consumption will increase considerably.

Wavelength and temperature: The higher the temperature the shorter the wavelength. Which temperature/micron level is required to process product economically? That depends on what is being processed and at what speed it is being processed. Basically, any product has its own inherent reaction to infrared. This is called "heat absorption factor." Each type of material can be categorized in a certain wavelength. Naturally, that can be translated into degrees of temperature. As a result we are able to obtain the fastest possible reaction from materials if exposed to an infrared radiation peak corresponding to its absorption factor.

Its always advisable to consult a specialist working inside the field of infrared radiation applications who will be helpful in finding the proper way to apply infrared.

The peak of absorption you will have will be flattened, in may cases, because the material to be heat treated will have not only one basic type, but additives which contribute to shift the peak to the shorter or longer absorption factor.

In all cases, infrared is a hotter energy source than convection heat. Infrared heat is always applied directly to materials. The exposure to this direct heat source has to be timed in order to not overheat and destroy the material.

Replacement: Can such a heating system be replaced by one which uses radiant infrared energy, and under which circumstances can it be done? If the material lends itself to be processed by infrared radiation economically, which means a drastic reduction of energy and higher speed of production, we must consider this alternative now. This excludes heavy bulk of any type, and materials, which by nature, have to be transformed into the required state by slow heat processing.

Again, applying infrared heat at random, just because it is heat, can be wasteful and even detrimental to the purpose of reducing energy and overall costs unless it is understood and properly applied.

When a heat radiator glows at any color, dark red to white hot, it means the radiation has already reached at least 1185 degrees F and may go up to high temperatures, according to the color of the element.

We cannot make use of this heat just by exposing materials to it even if it has the proper emission value, we have to time the exposure accurately. The result will always be a considerably faster method of heat processing with a relatively low energy requirement, provided we use the right system that emits the proper wavelength, by using transmitters having a high transforming ratio; input energy versus usable radiant output.

For more information, circle 172