Power Notes:

Radiant Heaters Speed Manufacturing Process

One of the newest technologies being used today that increases speed in the manufacturing process is the use of radiant heaters. In order to use these heaters properly, it is important to understand the process of radiant heat and what takes place during the process. Take, for example, a simple convection process that heats a plastic sheet or a thin film in an oven. A plastic sheet placed in an oven at 400iF for one hour will gradually heat up to that temperature simply because it is soaking in an atmosphere for one hour. The air is heated in the oven, and it impinges on the plastic sheet surface, excites the molecules on the surface of the plastic and causes the heat to transfer to the next molecules. Within one hour the entire thickness of the sheet is heated to 400 degrees. Radiant heaters, operated at the proper wavelength, can bring the temperature of the same plastic sheet up to the same temperature of 400iF within minutes and, therefore, eliminate the tremendous time-dwell created by a convection oven. This process can save significant amounts of money for the manufacturer in energy costs, process time and labor to maintain the process. There are three things that one must understand regarding the product to be heated before applying the proper radiant heaters to do the job.

Emisivity

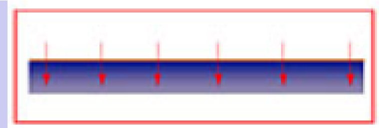
The first thing one must know is the emisivity of the product. Emisivity is defined as the ability of a product to emit or receive radiant rays. Most non-metallic solids can emit or receive radiant rays and, therefore, have a high emisivity. Emisivity values range from 1.0-0.0, with 1.0 being the highest and 0.0 being the lowest. Therefore, plastics, brick, paint, dirt, rocks and other non-metallic solids have a 0.9, or a high emisivity. It is important to remember that not only can these products receive radiant rays, but they can re-emit them back.

Wavelength

The second thing to know is the wavelength in which the highest amount of absorption takes place. In most plastics that wavelength is 3.5 microns and 7.0 microns. In water it is 2.5 microns and 3.5 microns. By knowing the wavelength that is most efficiently absorbed by the product you can decide what temperature your radiant source needs to be in order to emit that particular wavelength. For instance, based on Planks Curve a 900iF-1,000iF source will emit a 3.0-3.5 wavelength, which will be absorbed by most plastics and paints efficiently.

Thermal Conductivity

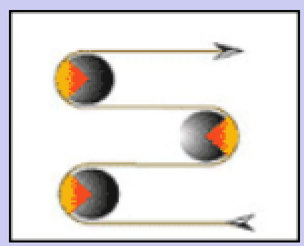
Third, one must know the coefficient of the thermal conductivity of the product being heated. This is so the product can be heated evenly throughout, and not just the surface. Heating of plastic and rubber, because the coefficient is low, can become a problem because once the surface is heated with radiant heat, if it cannot conduct the heat through the thickness then the surface will continue to heat up and possibly overheat or burn. This problem can be resolved simply by allowing a dwell time for lower conductivity products to heat internally or by adding conductive receptors like metal or carbon to the plastic or rubber (Figure 1). A highly conductive product like aluminum cannot receive radiant rays very well because its emisivity is too low (0.2) (Figure 2), but by adding a high-emisivity coating to the surface, it can be heated very quickly and efficiently. A black plastic-ceramic type of coating is put on the surface, radiant heat is absorbed efficiently by the surface coating and is then immediately conducted away by the high conductivity of the aluminum.



If you're looking to improve your process by making it better, faster or less costly, consider emisivity, wavelength and conductivity of the product and how you can use one or all of them to improve your process.

Example: Wallpaper

The manufacturing of wallpaper is simply a procedure of printing on a preprocessed stock paper. This processed paper could be a woven linen type, a vinyl-coated type, or it could be slightly embossed. In either case the paper has to go through a printing process in which an offset printing machine is used, often printing four different colors one after the other. As each color is printed, it has to be dried before the next color is applied so that no smearing occurs. This drying is done by passing the paper over heated rollers, which heat the paper and the ink.



This process of heating the ink to dry it can be achieved more efficiently by the use of radiant heat (Figure 3). This method heats the ink directly rather than heating the paper and then relying on the paper to transfer the heat to the ink. The heated roll method only partially dries the ink on the paper so that other colors can be printed. After the printing is complete the paper needs to be made washable so that it can be cleaned periodically by the consumer. The ink substrate (particles within the ink) has to be heated to 250iF to give the ink a final cure so that light rubbing with a cleaning solution would not smear or take off the ink. This final cure is accomplished by passing the printed paper (printed side towards heaters) past radiant heat for three seconds. The ink, because of its emisivity, is able to absorb the heating rays very fast, thereby elevating the temperature to a final cure without affecting the paper.

This new process has solved a multitude of problems for wallpaper manufacturers because it quickly heat-sets the ink without heating the paper, thereby reducing smearing or taking off the color by washing.