



Fig. 6: A conveyor carries the product to be browned under the IR burners at high speed. Pyramid Food Processing Equipment Manufacturing, Tewksbury, Mass.

## Infrared Burners

IR ovens, perhaps more appropriately called "toasters", create IR radiation by the simple expedient of heating a solid wall until it glows. In the food industry this is most economically achieved with clean burning natural gas fuel. Fig. 2 shows that when a surface glows red, most of the energy it radiates actually goes into invisible IR emission.

Fig. 3 shows how a typical IR heating element (burner) functions. Burners operate with a pre-mix of air and gas entering through a pipe manifold. Air from a blower and gas come together in a proportional mixer. The flammable gas/air mixture enters an enclosed burner chamber, then passes through a porous metal wall.

The actual flame burns at the wall's outer surface, heating the side facing the food. The flame cannot flash back into the burner because the close contact between the metal and mixture flowing through the pores cools the gas below its ignition temperature.

"Generally we like to run these burners slightly lean for good combustion and to keep the burners' internal parts cool," says Tom Bannos, President of burner-manufacturer Red-Ray Manufacturing Company in Cliffside Park, N.J. "The air/gas mixture comes out of the surface and there's typically a ribbon burner or another means of lighting it. Once the burners are lit, they just go 24 hours a day. It's very common for these to run a week at a time without shutting them down."

## All Stainless Burners

"With our new all-metal burner, the body is all stainless steel," Bannos reports. "The connectors are all stainless steel as well, and the face is a sintered stainless steel fiber mat. The air/gas mixture passes through pores in the mat and

combustion occurs along its outer surface. The fine filaments glow in the IR from the heat of combustion along the surface."

Fig. 4 shows the burner's glowing outside surface. The intimate contact between the burning gas and metal surface heats the latter to about 1,700°F, where it glows red-orange and puts out copious infrared energy.

"Burners operate very well down to 1,200°F," says Bannos, "With our new all-metal burner, 1,700°F is a typical safe temperature."

The burners are modular. Individual burners can be as small as seven inches by three inches or as large as twelve inches by five inches. All of them mount on a pipe manifold with connectors. If there's a problem with one burner the user can rapidly remove and replace it.

Fig. 5 shows a set of seven burners mounted on a single manifold. "That burner is about 40 inches wide, which is good for a 39-inch-wide conveyor belt common in tortilla chip ovens. Generally there are a number of rows. "Three rows is the smallest I've ever seen," says Bannos. "Typically, there are five rows, and there can be as many as ten rows of burners."

The raw product enters the oven on a large conveyor, as shown in Fig. 6, moving through the oven at 180-300 feet per minute. The conveyor is made of stainless-steel links, which interlock to form a rack. Generally, the product passes under a set of burners for toasting on one side, then flips over onto a second conveyor to toast on the other.

Pyramid has taken a different approach to creating an even IR radiation field with their Radiant Wall Oven technology. As Fig. 7 shows, their oven consists of an elliptical stainless steel tube heated by gas flames impinging on the outside wall. The tube's cross section is fashioned so that the IR intensity is essentially constant all across the conveyor width.

The product is surrounded 360 degrees by a wall of infrared radiation. In other words, there's this stainless alloy elliptical tube running inside an enclosed box. The box is gas fired, which heats the tube up to 1,200 degrees, where it actually starts to glow red. And as the product moves through this environment, the browning occurs.

The radiant-wall oven's footprint is approximately seven foot six inches wide, by 19 feet long. This provides an effective infrared zone seven and a half feet long and wide enough for a 40-inch wide conveyor belt.

## Gas vs. Electric

"Basically you've got the two options,"

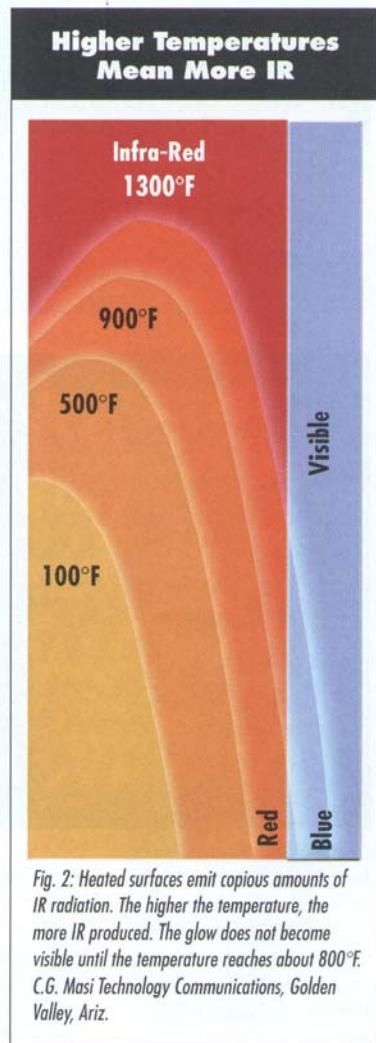


Fig. 2: Heated surfaces emit copious amounts of IR radiation. The higher the temperature, the more IR produced. The glow does not become visible until the temperature reaches about 800°F. C.G. Masi Technology Communications, Golden Valley, Ariz.