

BY LISA LUPO

TREATING WITH A SIMPLE PRINCIPLE — A COMPLEX APPLICATION

HEAT

When exposed to temperatures of just less than 100° F, an insect's growth will slow. At temperatures of 100° F to 120° F, it will die in a day. Above 120° F, an insect will die in minutes.

That's a simple enough concept, and, in fact, the simple principle behind the pest management method of thermal remediation. However, as Seattle-based Sprague Pest Solutions Technical Director Jeff Weier noted: "The principle is simple. Making it work is a little more complex."

FUMIGATION ALTERNATIVE. Thermal remediation, or more simply heat treatment, is the process of gradually heating a structure or equipment to temperatures high enough to kill insects or other pests living or breeding within. It can provide a viable alternative to fumigation for empty structures, eliminating infestations or carry-over insect populations of previous years, which can infest newly stored product. Heat has, in fact, been used to control insects in structures since the early 1900s, with major food and grain companies successfully using heat for insect management over the last 50 years. With the Montreal Protocol ordering the phase-out of methyl bromide in recent years, interest in — and the availability of — heat as a fumigation alternative has grown.

The complexity of the technique has to do with effective distribution of the heat, the mobility of insects, the sensitivity of products and some equipment to high temperatures, and the insulating nature of commodities and debris. However, there are significant advantages to using heat for pest management, including the facts that high temperatures kill all life stages of the insect; it is non-pesticidal, so it can be used in organic-production plants; and unlike fumigation, specific areas can be treated without shutting down operations throughout the entire facility.

HOW IT WORKS. In a heat treatment, the air within the area being treated is gradually heated to temperatures between 120° F-140° F. This can be achieved by placing a unit inside the building that heats the air inside and then re-circulates it, or through a forced-air system in which the unit pulls air from outside through a heating

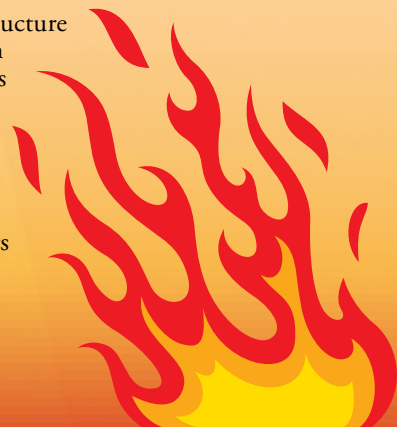
unit. As explained by Raj Hulasare, senior scientist of thermal remediation for Temp-Air in Burnsville, Minn., the advantages of a forced-air system are that positive pressure is created, which improves air distribution for a more uniform air temperature and vastly reduces cold spots. "Using outside air to pressurize the building ensures heat gets into the cracks and crevices," he said.

One of the most critical aspects of the process, Hulasare said, is the gradual increasing of the air temperature. Heating the air too quickly could result in thermal shock to the structure, including the expansion of structural components and joints. To guard against that, the temperature is brought up to the 120° F-140° F range over a period of hours, dispersed through the area with flexible ducting and high-temperature fans, then held at these temperatures for 24 hours. "It's all a function of airflow," he said, "and how you manage that airflow to get a uniform temperature."

During the hold time, the area is monitored for temperature consistency with a remote, wireless system and inspections can be made for insect activity. "That's the main beauty of heat, that with heat you can identify the zones and cracks and crevices and take corrective action during the process," Hulasare said. In fact, he has worked jobs where inspection during treatment revealed hundreds of insects pouring out of a crack — trying to escape the heat. Companies also will place insect-vial bioassays in strategic locations, checking them regularly for 100 percent mortality.

At the end of the 24-hour period, a final inspection is conducted, the area cooled, the process documented and a wrap-up report issued.

It also is important that the structure is inspected prior to treatment. In this case, though, inspection revolves around structural components and materials, determining the proper BTUs, and ensuring that the structures will in fact hold the heat, as some materials can continually absorb the heated air, which hinders efforts to sufficiently heat the space.



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DISADVANTAGES. One of the most restrictive aspects of heat treatments is that they cannot be used on product itself; the process is limited to empty structures or areas. And, that treatable area must be thoroughly cleaned before work can begin.

“You have to have it empty. You really can’t disinfest flour,” said Mark Sheperdigian, vice president of technical services for Rose Pest Solutions in Troy, Mich. “It doesn’t take a very big pile of flour to protect a pest.” Such products act as their own insulators so that heat can affect an outer layer, but does not penetrate even small residues of such commodities. Product itself cannot be left in an area undergoing heat treatment because the heat can alter the properties or quality of the product — even literally cooking the food, he said.

Sheperdigian, Weier and Jim Sargent, corporate entomologist for Copesan, wrote “Heat Treatment: Capabilities and Limitations” in 1999. Still applicable to the industry today, the paper discusses heat tests conducted in a flour facility.

As described in the paper, “small test vials were placed in 12 high locations, 12 low (floor) locations, and 12 mid-level locations in a large processing/packaging area. Each vial contained a tiny amount of flour with five adult confused flour beetles or five late instar larvae or approximately five eggs. All test specimens died during the 24-hour heat treatment where the maximum temperatures in the 36 locations ranged from 117° to 152° F. However, some resident insects in low spots (e.g. drains), in building corners, under objects on the concrete slab ground floor and inside small piles of flour inside milling or filling equipment or on the floor survived the treatment. It is interesting to note how adept the pests were at finding and exploiting insulated microenvironments within the treatment area.

POINTS TO CONSIDER. It is for this reason that, just as with any Integrated Pest Management method, sanitation is critical for

success in a heat treatment program.

Other areas of consideration include:

- *Heat effects.* The high temperatures of thermal remediation can affect certain equipment and other product in the building, which, Sheperdigian said, “could be more heat sensitive than the insects they are trying to kill.”

The best way to ensure the heat is safe for the facility and equipment is to check with equipment manufacturers for heat tolerances and involve plant engineers in the process. “If the plant engineer is satisfied with bringing temperatures in the plant to the required temperature (of 140° F), it works very well,” Weier said.

Another option, he said, is to design or modify the facility with heat treatment in mind, setting up the facility with less sensitive equipment and materials or ensuring that heat-sensitive items are easily removed.

This is particularly viable if a plant expects to use the technique on an ongoing basis.

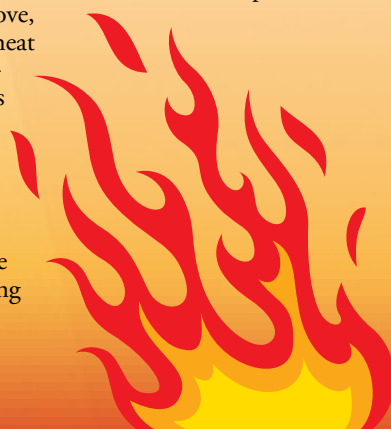
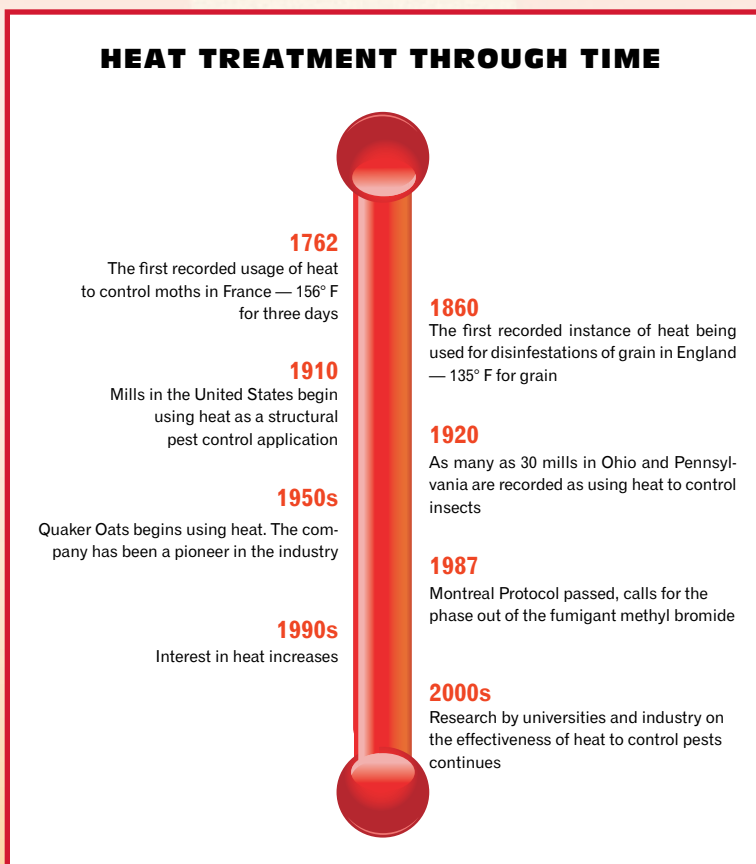
Because the temperatures can set off fire suppression systems, Weier said, older plants may have to modify these or temporarily remove or shut off components.

- *Pest mobility.* The more mobile the target pest, the less effective heat treatment can be. To offset this factor, it is critical that potential escape routes be sealed and the heat be completely and equally distributed throughout the area, so that insects cannot find a cool spot in which to hide out. Consider the physical aspects of the structure, Sheperdigian advised. “Will you be able to adequately heat all areas?” This includes cracks, crevices and voids, which should be sealed or monitored to obstruct insect harborage.

- *Cost.* It is because of these challenges that heat treatments require professional applicators, who are experienced in the technique, have the pest management experience to know where the pests are likely to be and want to move, understand how to disperse the heat to all areas, and are able to monitor and measure temperatures for consistency and efficacy.

And it is these challenges that make heat treatments “still fairly pricey compared to fumigation,” Weier said.

On the other hand, he added, the ability to maintain operations during



treatment of adjoining areas can more than offset the cost difference. "You may pay more for treatment, but you don't have to shut down the plant and stop production."

ADVANTAGES. "The biggest advantage is being able to heat part of the building and keep the rest of the building in operation," Weier said. "You can even go into the treatment area if needed."

In addition:

- Thermal remediation is generally considered a "green," eco-friendly process because it does not involve chemicals. In addition to the fact that "people want products that don't have chemical residue," Hulasare said, the technique can help to prevent insect resistance which can develop through the reuse of certain of chemical applications.

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their environmental impact," Weier added. Although the treatment does require energy, it does not expose the environment, facility or product to pesticides, making it a viable alternative for organic plants.

While there are certain risks of over-exposure to heat, these are significantly less than those of exposure to fumigants. Thus heat treatments are considered to be a safer for the applicator — although thorough training is essential for any application.

- Less labor generally is required for heat treatments than for standard fumigation because only areas such as dock doors and other entryways need to be sealed. In fact, some ventilation is necessary for proper distribution, Hulasare said. "We want the building to breathe."
- Because the high temperatures dehydrate the insects, the technique kills all life stages from egg to adult, Hulasare explained. Above 120° F, the insect's cell membranes "melt," its enzymes are destroyed, its salt balance is changed and its proteins coagulate.


CONCLUSION. When a plant is treated with heat, a concurrent periphery treatment often will be made. Dusting or spraying the outside of the building can ensure that any insects that do escape are still eliminated.

"It's good to have multiple strategies, because something always hits it," Hulasare said. "I don't say heat is 100 percent effective because I know nothing is 100 percent. But I know when we tear down, there won't be any live insects." **QA**

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Read the full text of "Heat Treatment: Capabilities and Limitations" by Mark Sheperdigian, Jeff Weier and Jim Sargent at www.qualityassurancemag.com. The paper discusses tests conducted in a flour facility on the effectiveness of heat treatments.


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