COMPARISON OF HEAT TREATMENT METHODS IN STRUCTURES

Raj Hulasare, Ph.D., P.Eng.
TEMP-AIR

Bruce Lindsay, P.E.
TEMP-AIR

Heat treatment has been suggested as a safe, effective and environmentally friendly alternative to fumigating structures with methyl bromide, but it has only seen limited adoption in the food processing industry. Heating a building to 120^{o}F has been shown to kill 100% of all insect lifestages. Pioneers have complained about the length of downtime, damage to structures and process equipment, insect survival, and cost. Unfortunately, they are describing failures of just one type of heat treatment process that uses the existing steam plant and heat distribution system. There is another heat treatment method that has overcome these problems by using temporary equipment and a patented process and it has been available to and used by the food industry for seven years. This process, Thermal Remediation, is a technically and economically feasible alternative to methyl bromide. Despite the success of this alternative, regulators are continuing to grant Critical Use Exemptions on the basis that heat treatment is NOT technically and economically feasible. Clearly there is a misunderstanding between the different heating process and this paper will compare the two alternatives.

Conventional Heat Treatment Using the Permanent System

Most food processing plants have a central steam plant and a heat distribution system for use in the winter months. If the plant wants to heat treat during the summer to control insects, it is understandable that they would want to use the system that is in place. They reason that if the plant can maintain an interior temperature of 70^{o}F when the outside temperature is 0^{o}F, it should be able to maintain the interior temperature at 140^{o}F when the outside temperature is 70^{o}F. Many plants do use their permanent system for heat treatment. However, it has taken many years to "work out the bugs". There are many reasons for the limited success.

1. Heat is only effective at killing insects if they can be exposed to 120^{o}F for 60 minutes. If they can escape to a cooler spot, they may survive. Since heat moves up, the floor is usually the most difficult spot to heat. Steam radiators mounted high on along the walls, will have a difficult time pushing the heat to the floor. Auxilliary fans will improve heat distribution.
2. As the heat moves up, the ceiling will be exposed to very high temperatures. This may damage roofing material. Equipment placed near the steam radiators will also see higher temperatures and may be damaged. The thermal stratification will induce infiltration of cold air, normally at door openings at the floor or in cracks and crevices, providing an escape for insects.
3. The heating system may "maintain" the desired temperature, but it was not designed to rapidly bring the facility up to temperature. It may not have adequate

capacity. It could take 8, 12, or 24 hours to reach the critical temperature, delaying production. Temperatures may not be uniform throughout the structure. Adjusting and balancing the steam system is very difficult if an area is overheating. There is no effective way to modify the system once the heat up begins. Additionally, what happens if the weather during the shutdown is colder than anticipated or there is a failure in a component.

4. The permanent heating system is free to use. However, most steam boilers are rated at 80% combustion efficiency. The system efficiency is much lower, especially if it is operating out of its design conditions. Fuel costs will be very high. Extending steam lines and adding radiators and controls is very capital intensive.

Thermal Remediation

The Thermal Remediation process is based on over 40 years of construction heating. TEMP-AIR has been providing temporary heat to the largest buildings under construction in the northern US. They have developed a line of direct-fired make-up air heaters specifically for hostile environments and they excel at setting up and tearing down the equipment in the worst conditions. These heaters use high static pressure fans that enable the use of long lengths of ductwork.

The basic process is very different from conventional heating. They heat outside air and introduce it into the building using fabric ductwork to pressurize the building. They plan to achieve 3 to 5 air changes per hours. This provides several advantages:

1. The ductwork puts the heat directly on the floor.'
2. The ductwork can be laid out to put heat directly where it is needed. Once in operation, it can be moved, extended, cut or slit to change the heating pattern.
3. Pressurizing the building provides more uniform temperature distribution and reduces cold air infiltration. If insects attempt to escape in cracks and crevices, the hot air will be following them.
4. The direct-fired make-up air heaters have full fuel modulation, allowing critical temperature control. They have a combustion efficiency of 100% and are the most fuel efficient alternative with a 25% advantage.
5. There is practically no limit on the heating capacity of the heaters. Ship as many as needed including spares.
6. The high air change permits the building to be brought to temperature very rapidly. Typical heat up time is 4-8 hours. Additionally, the relative humidity is lowered to 20-25%, which accelerates the killing of insects by desiccation.
7. There is practically no capital investment required. Extending power and fuel connections is common. Everything else is rented.

TEMP-AIR has developed refinements to improve the heat treatment process. They are utilizing remote wireless temperature sensors to monitor the heat up and rapidly respond to control the process. They have developed proprietary software to size the equipment and estimate costs. More importantly, they have experience on over 80 large projects on diverse buildings