HEAT TREATMENT TO CONTROL INSECT INFESTATIONS IN THE MILLING INDUSTRY

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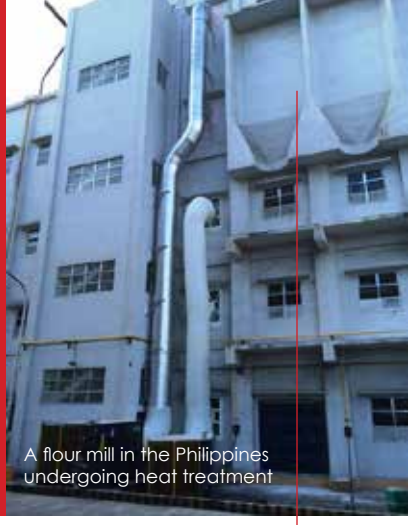

A flour mill in the Philippines undergoing heat treatment

Heat treatment is an effective environmentally benign pest management tactic to kill all life stages of stored product insects by attaining and maintaining elevated temperatures in the range of 50° to 60°C.

Heat treatment is performed in a scientific manner to manage stored-product insects, without any damage to structure, machinery or storage structure. Heat treatment is highly effective Integrated Pest Management (IPM) tool to control insect infestations in food-feed processing plants, warehouses and storage structures.

History and renewed interest in heat treatments

Heat treatment of mills dates back to the 1900s. Over a century ago (1910s), heat treatment in more than 20 mills in Kansas proved that no stage of insect, even in the most inaccessible places, could withstand heat.

Several mills in mid-west US and southern Canada corroborated the practicability and efficiency of heat to control insects. Heat treatment has been performed successfully by major food and grain-processing companies for the past 60 years.

The three main drivers for renewed interest in heat treatments are:

- Consumer preference for pesticide-free products
- Heightened interest in environmentally-friendly technologies or using the "Go Green" approach
- Increased tolerance/resistance of insects to chemicals.

A safe, effective, and viable alternative to chemicals

Heat is an effective, nonchemical, nontoxic, nonresidual, and noncorrosive alternative to chemical fumigation. It is an effective and viable eco-friendly approach to control stored product insects without the chemical-associated environmental or health risks to people, animals, or surroundings.

With the 1987 Montreal Protocol and the 1998 amended US Clean Air Act, mandates were established to start phasing out the production of methyl bromide due to its connection with depletion of the ozone layer. Except for critical use exemptions, methyl bromide is being phased out of structural fumigations and has been subjected to more restrictions.

The resistance of insects to phosphine and, to a lesser extent, methyl bromide (MB) is also now an acute problem worldwide. Phosphine, the most widely used fumigant, has been shown to corrode electrical circuitry and the components of processing plants.

The high tolerance and resistance of insects to chemicals requires alternatives to control insect populations effectively and economically. These factors spurred the use of heat treatment to control insects.

Research on efficacy of heat

The company Temp Air has expertise in the effects of high temperatures on various stored-product insects and their life stages (eggs to adult). Our sponsored research at the Department of Grain Science and Industry at Kansas State University (KSU) in 1999 yielded valuable insight into the Time-Temperature relationship for control (mortality) of various stored product insects.

Research findings show that most insects die in less than an hour at 50°C (or 122° F), and all life stages are killed when exposed for more than five hours.

Temp Air offers integrated solutions to heat-treat food-feed processing plants, metal and concrete silos of all sizes, using a wide array of heaters, real-time wireless temperature monitoring systems, and on-site training for do-it-yourself subsequent heat treatments.

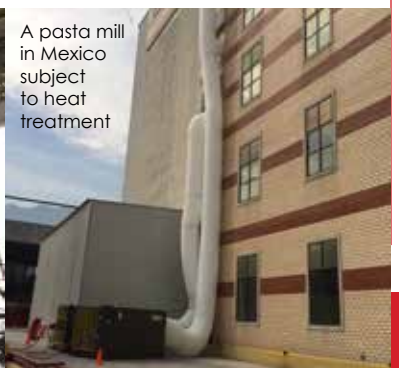
A collaborative effort

Temp Air has collaborated actively with pest control companies, universities (eg, Purdue University, KSU, and the University of Minnesota), and autonomous institutes (eg, the Propane Education Research Council (PERC)) to develop products and protocols for various heat applications.

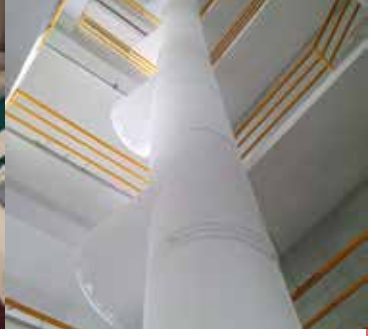
With partial funding from PERC, Temp Air collaborated with KSU's Department of Grain Science and Industry on US Department of Agriculture and Environmental Protection Agency projects. For example, as a part of the US Department of Agriculture grant, Temp Air collaborated with Kansas State University to heat treat the Hal Ross pilot mill three-times during 2009-10 to compare and evaluate the efficacy with fumigation using MB and Sulfuryl Fluoride (SF).


A silo in India receiving heat treatment


Partial spot treatment


A pasta mill in Mexico subject to heat treatment





Heat treatment proved to be as effective as the chemical fumigants. Temp Air has also worked with the Canadian National Millers Association and Canada Agri-Food to document the efficacy and cost of heat treatment.

Advantages of heat treatment

- Heat kills all life stages of insects, from egg to adults, unlike chemicals, where higher dosages may be required for egg-kill
- Inspection of heated areas during heat treatment is possible, making it easy to observe areas of insect emergence and initiate cracks/crevices treatment after the heat treatment
- Heat is nontoxic, noncorrosive, and non-residual
- An entire facility or sections of the facility (spot or partial treatments) can be heat treated, while other areas remain operational
- No mandatory evacuation is necessary in adjacent untreated areas, such as a warehouse, shipping area, or office. These areas can function normally
- No extensive sealing is required, except for doorways and exit points.

Patented heat treatment process

Temp Air's patented heat treatment process uses 100 percent outside fresh air to create positive pressure within an enclosed structure to achieve temperatures lethal to all life stages of insects. The process has proven to be extremely effective to control stored product insects as it eliminates airtight sealing unlike chemical fumigants.

The process uses a combination of direct-fired (natural gas or propane) make-up heaters, industrial fans, high temperature tolerant flexible ductwork, and real-time wireless temperature system to attain and maintain lethal temperature profiles (50-60°C) throughout the treatment area. Airflow management is critical to eliminate hot or cold spots within the heated space.

A minimum lethal temperature of 50°C is attained and is held evenly throughout the treated space, for up to 24 hours or for the time required for the application. Due to temperature stratification (heat rises), the temperatures are maintained in the range of 50°C to 60°C throughout the heated space.

The positive pressure throughout the treated space pushes hot air into corners, cracks, and crevices making it virtually impossible for pests to hide anywhere.

Heat treatment of mills, processing plants

Temp Air has been performing heat treatments successfully for about 20 years in the food-feed industry. This includes flourmills, food processing plants, cereal plants, pet food plants, bakeries and warehouses.

Typically, initiating heat-treating of a processing facility involves four steps:

1. Site visit comprising a joint walk-through the facility with operational staff to assess the feasibility of a heat treatment. This includes discussions on equipment and a sprinkler system that can handle high temperatures.
2. Developing an engineering design covering energy and equipment requirements, duct sizing, heater size and fuel usage to estimate the cost of a heat treatment.
3. Mobilisation of equipment and personnel to the site for setup.
4. The actual heat treatment starting with pre-heat treatment and a joint inspection. This is followed by setup and starting heaters and other equipment. The temperature is ramped up gradually to avoid thermal shock to the structure, and the real-time temperature is monitored wirelessly with temperature sensors located around the heated space.

The temperature is attained and maintained (50°-60°C) for 24 hours. During this 24-hour period, frequent inspections are made to monitor insect activity and to identify any cold pockets that may need fixing.

Afterwards, the treatment area is cooled down, and the treatment is documented, in order to generate a final wrap-up report that can be discussed with the customer. The entire heat treatment of a structure is completed in less than 36 hours.

During the 24-hour treatment period, observing the insects' activity and movement from hotter areas to cooler areas and looking for any signs of re-emergence in the cooler areas, or from cracks and crevices, make it possible to identify the critical spots of infestation. A subsequent treatment of cracks and crevices can then be done after the main heat treatment.

Limitations of heat treatment

There are a few limitations to using heat to control insects. For example, Temp Air discourages heating warehouse or facilities full of products. Food and stored products are good insulators, and the heat may not penetrate the products well, and it also may alter the properties of the product(s). Heat also may damage packaging materials such as plastic.

Similarly, treating a bin or silo full of product is not advisable, as the quality parameters of the stored product or commodity may become altered and insects inside the product can survive. However, heat treating empty bins and silos is highly effective.

Heat treatment of bins and silos

Heat treatment of empty bins and silos is highly effective preventative tactic for disinfestation before storing fresh harvested grain on the farm and in processing plants. In flourmills and grain handling facilities, residual insect populations in bin hoppers and floors can become a major source of re-infestation, as grain gets warmer.

In some cases, chemical treatments may not penetrate well into a mass of grain, or the insecticide spray may drip through the clogged perforated floor of flat-bottom bins and may not reach the insects in the spoiled or broken grain underneath the perforated screen floor.

Presently, empty on-farm bins and silos are fumigated chemically or treated prior to harvest and loading fresh grain. The floors of bins and silos accumulate broken grain and fine matter that harbors insects and mold spores.

Also, blowing diatomaceous earth through the fan doesn't guarantee uniform application, and phosphine fumigation requires a licensed applicator. Using heat to treat bin floors and other grain holding areas, both metal and concrete, can overcome these obstacles effectively.

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