
# TEMPERATURE CONTROL

## AN ALTERNATIVE TO TRADITIONAL INSECTICIDES AND FUMIGANTS IN FOOD HANDLING FACILITIES

### INTRODUCTION

The use of temperature control, that is the heating or cooling of an environment is not a new technology for the control of insects. For centuries, mankind has used heat to preserve food and other goods from bacterial and insect pests. Since around 1883, scientific literature has documented the use of heat to control insects in different situations. Around the 1920's, research turned toward determining the temperature ranges within which insects live. It was found that most insects have a relatively narrow range of temperature tolerance.

However, temperature control has never been found to be a practical alternative to currently available products and methods such as fumigation with various gaseous fumigants. The procedures involved were too costly to implement and damage to equipment and structures would sometimes result.

As research was being conducted with temperature extremes, the scientific community was able to produce organic and inorganic products which would safely and effectively control insect pests. With little or no down time to the facility or structure, these products have also been very cost effective to use. Products such as carbon tetrachloride (CCII), ethylene dibromide (EDB). phosphine gas (PH}) vapona (DDVP) and methyl bromide (MeBr) have gained widespread acceptance and use.

We can no longer use some of these products due to government action. The most recent action by the EPA to control production levels of methyl bromide by the year 2000 once again has the scientific community searching for alternative methods to control insects. This EP action is being initiated as part of the Clean Air Act because methyl bromide is suspected of being a contributor to the depletion of the earth's ozone layer.

### COOLING OR FREEZING AS AN ALTERNATIVE

One of the alternatives to methyl bromide that has been used with a limited degree of success is freezing (commonly called freeze outs). Worden (1987) has documented the use of freeze outs in Canadian flour mills for insect control, although it is practical as a tool only during the cooler months of winter. Stored product insects show a significant decrease in activity below 15°C. Since an insect's body fluids act like anti-freeze and it will only die below a specific temperature, the key is to not allow the insect to acclimate to the lower temperatures. The temperature reduction must be quick until the critical temperature where death occurs is reached. In crowded facilities where plenty of product is stored or in locations with large amounts of complicated equipment, this can be a very costly process. Product in the center of a pallet will take much longer to get to the critical temperatures because the outside layers of the product itself will act as layers of insulation. Some hospitals are good examples of lower temperatures being used for insect control. In these hospitals, patient food tray carts are stored in freezers overnight for German cockroach control.

A simple rule for control by freezing is to maintain a temperature at the site of the insect pest of -18°C for 7 days for 100 percent control of all stages of insect life.

Immediate Reduction in the Pests' Reproductive Potential. When PCO's remove the adult pests and immatures from their harborage, as well as removing their food and other materials that support their breeding situation, future generations of that pest may also be greatly reduced.

### POINTS TO CONSIDER

**Technicians' Training.** Time must be set aside to make sure that technicians know the biology and habits of target pests to maximize control effectiveness, and to ensure they are comfortable with the equipment and its efficient use.

**Requirement for the Use of an Electricity Source.** Due to the size and weight of vacuums, batteries as the main power source are not practical. Clients must be informed ahead of time that their electric sources will be used.

**Vacuums Make Noise.** Vacuums are noisy. They could present potential problems around persons who are ill. Some vacuums are designed to be comfortably quiet, but they still make noise. You should make clients aware of the potential noise and get their approval before vacuuming is started.

**Special Care May Be Needed.** Take care to avoid inadvertent, potentially damaging, suction of your client's property. Some vacuum devices may be powerful enough to pull and tear items such as curtains. Clothing, small furniture items, etc. Move slowly with the backpack in crowded quarters.

**Will not Eliminate All Pests by itself.** Deep voids may not be within reach of the suction appliance. As with any tool a vacuum device must be used to enhance your current IPM programs, not as a cure all. Other pesticide measures or chemicals will very likely still be needed to achieve and maintain desired levels of control of the target pest.

**Will Add to Service Time.** Vacuuming usually takes more time than applying pesticides alone.

**Filter Elements Could Release contaminants in to the Air.** Most basic filter material in commercial vacuum cleaners is inadequate to trap microscopic particles, which could be exhausted back into the air. Never vacuum rodent droppings due to potential spread of Hantavirus particles. High Efficiency Particulate Air (HEPA) filters are suggested for satisfactory filtration of most pests or their byproducts.

### CONCLUSION

Vacuuming is a tool that the PCO can use at a sensitive account or account which requests limited use of traditional pest control methods. Vacuuming can be a valuable part of integrated pest management programs.

To control the Indianmeal moth (Plodia interpunctella) research conducted in a Canadian seed packaging plant in 1993 showed that to control the most cold-hardiest stage required over 14 days at -10°C or 1 day at 15°C.

One device that can be used to treat pallets, or limited quantities of a product would be refrigerated truck trailers. Some of these trailers or "reefers" have the capacity to reach well below OF.

### HEAT FOR INSECT CONTROL

In the 1980's heat started gaining acceptance as a practical method to control some insects in structures. Extreme heat will kill insects by either dehydration, coagulating body fluids, destroying key enzymes or a combination thereof. With the application of heat, or "heated sterilization," targeted temperatures need to be between 43.33°C and 60°C depending on the insect species to be controlled and the type of structure. These heated sterilizations may last from a few hours to a few days.

In the late 1980s, Dr. Ebling and the late Dr. Forbes, using polyethylene or other heat impervious tarps and propane-fired forced air burners, found they could control dry wood termites, cockroaches and a few other wood infesting insects. Unfortunately they found it was not practical to control subterranean or Formosan termites using this method. Another disadvantage of this method, similar to fumigation, is that re-infestation can occur once the temperature drops below the lethal point.

Heated air is also used for insect control in stored products, raw commodities and some types of fruit. Research is presently ongoing to develop new hot air quarantine treatments. In literature, at least 10 different fruit types and 11 different pests have been treated using hot air. Some of the insects presently controlled are the thrips, fruit flies, scale insects and two--spotted mites. Heated sterilization is not suited for all commodities as damage to some fruits and vegetables can occur.

Cost normally plays a very important role in heated sterilization treatments. The equipment and energy needed to heat, monitor and maintain a structure at high enough temperatures can be cost prohibitive. Potential heat damage to the structure must also be investigated.

### COMBINATION METHODS FOR INSECT CONTROL

Fumigators and scientists are looking into the use of various products in conjunction with heat for insect control. Fumigations with inert gases combined with methyl bromide have been performed since 1929. Two of the products that are being used in various combinations are carbon dioxide (C02) and low levels of phosphine gas.

One interesting aspect of combining carbon dioxide with low levels of other fumigants is that of increased stress on the insects. Insect respiration can be increased 50% to 300% by increasing C02 levels from 3% to 5%.

Many challenges must still be overcome before combination fumigations will become practical and cost effective. Problems with corrosion of metals and damage to other structures must still be resolved. The cost to maintain proper concentrations and the equipment involved must also be addressed. Lastly, more research will be needed to determine proper concentrations and exposure times for the control of different insect species.

### CONCLUSION

The future use of fumigants like methyl bromide and others does not look too good. Our industries and the scientific community must develop commercially viable alternatives to keep our structures and our food supply insect free and affordable. Alternative products and methods such as freezing and heating will have to be continually researched until effective and cost efficient methods can be embraced by our industries. We know that we can control insects with heat or with freezing. The challenge is to make the methods practical and acceptable to customers.

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