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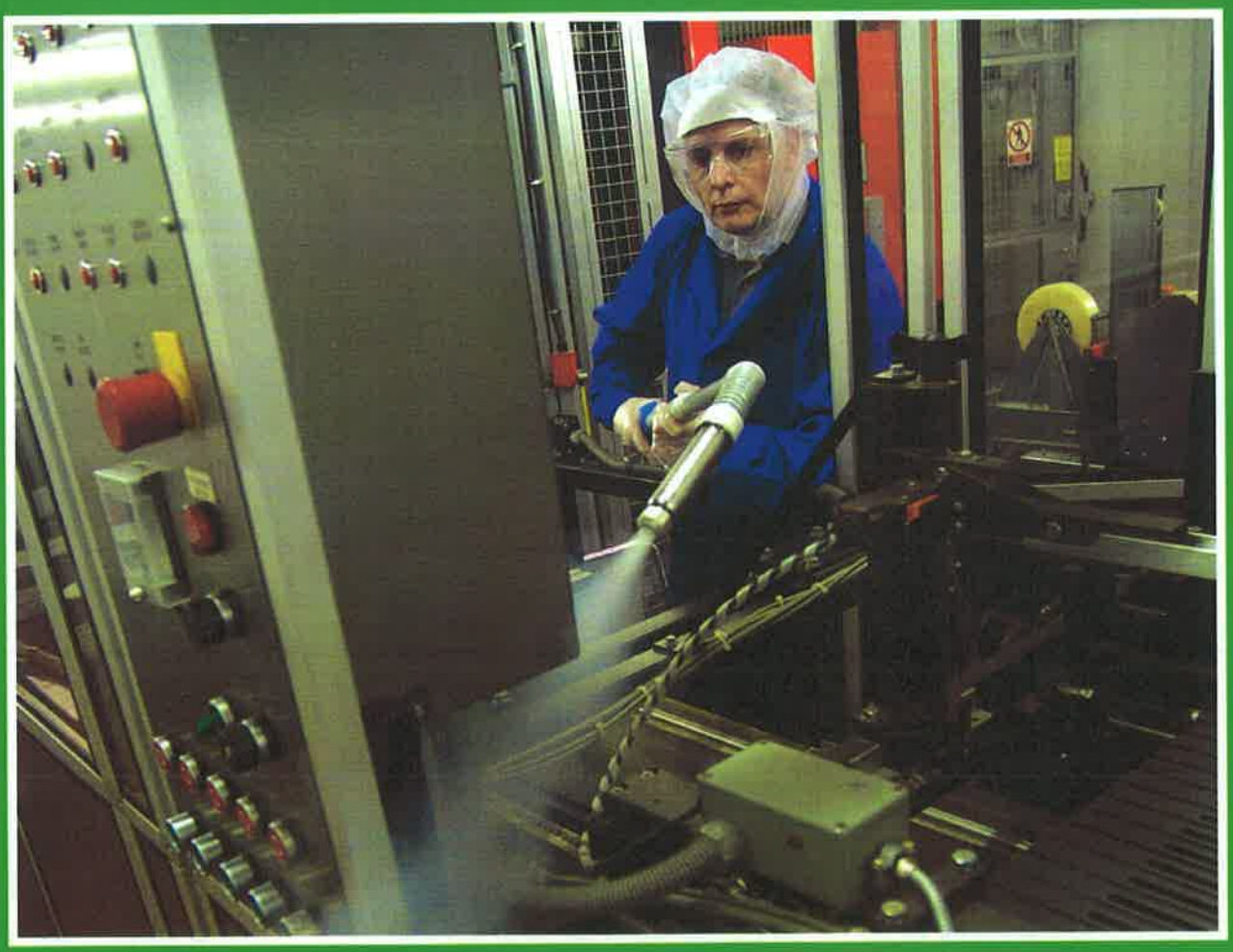

- IVCC seeks practical vector control
- Termite research grant announcement
- Resistance and control of mosquitoes
- Monitoring and control of bed bugs
- Fluid application for plant nutrition
- Progress on the CEN Standard
- Toxicity of PBO and mothballs
- New soil fumigation schedule
- Global threat of herbicide resistance

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BED BUG FOUNDATION

FAOPMA

Field study testing the efficacy of Cryonite® against bed bugs *Cimex lectularius*

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Bed bugs remain an important public health pest in many global communities. Often the environments in which they appear are sensitive, which precludes the use of pesticides or where pesticide use can limit the continued use of the contaminated space. One of the solutions to treating such environments is the Cryonite® system from Sivandersson, Sweden.

This consists of a unique, patented lance, which connects to a standard carbon dioxide cylinder with a flexible hose. The carbon dioxide is converted to dry ice or snow, which the Cryonite unit emits from the specially designed and patented nozzle. Key to efficacy is speed. The freezing process is extremely fast and reaches a very low temperature (-60C). The speed of freezing is unique, as well as essential for effectiveness. Because freezing is so quick, there is limited opportunity for the insects to escape. Cryonite is a dry treatment with no residual effect. The lance is extendable to permit good accessibility and ensure outstanding results even in difficult to reach areas.

The engineered design makes Cryonite easy to use and requires minimal personal protection. It is effective against most crawling insect pests, where direct contact is possible, including stored product pests. Cryonite acts through contact and kills all stages of insect life-cycle, adults, larvae, pupae and eggs and can be used alone or in combination with other treatments to provide a full IPM solution.

The absence of pesticides or residues means that treatment can take place without stopping production or evacuating staff. Cryonite is by its very nature environmentally friendly and hygienic. As the carbon dioxide used is a byproduct of industrial processes, Cryonite adds no carbon dioxide to the atmosphere. Frozen carbon dioxide is also referred to as "DRY ICE", as it sublimates, that is, it goes from ice/snow directly to gas with no liquid phase in between. This enables Cryonite to be used as a pest treatment in areas like electrical cabinets, sockets and motors.

The Cryonite snow penetrates into cracks and crevices, complicated machinery and reaches into pipes. It can also be used on surfaces in direct contact with food. Using Cryonite in homes enables tenants to return immediately after treatment and in hotels the room can be let immediately afterwards.

Treating floor drains using the lance

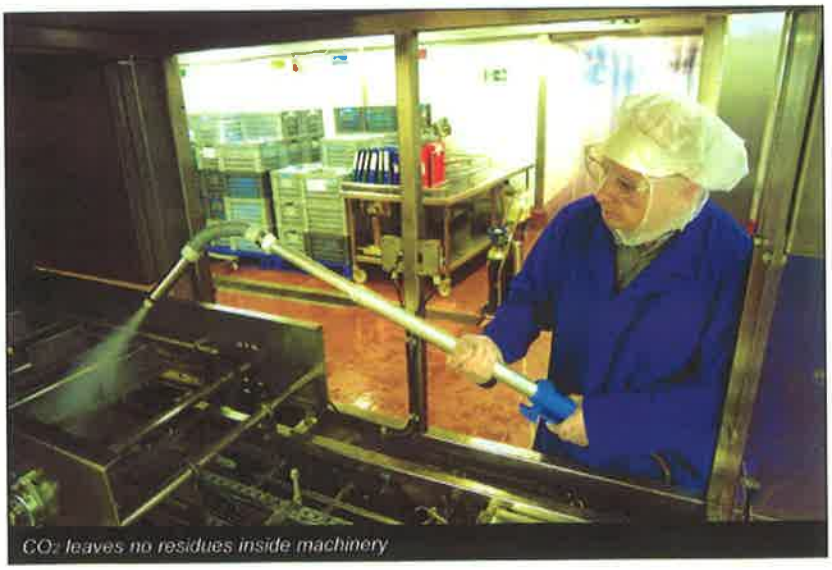
Objectives of the study

To test the efficacy of the Cryonite Cryogenic system against populations of bed bugs. Sites were selected using the criteria as follows:

1. *Cimex lectularius* population
2. Availability of site(s) for pre and post sampling
3. Ability to do post treatment sampling over extended periods of time
4. Relative distance from researchers locations
5. Cooperation from owners and tenants

Methodology

As with any pest management application, equipment, products and materials, it is of critical importance that the operator has a thorough understanding of the equipment to be used, to assure that proper use and optimal application results are obtained under field conditions. Prior to use the appropriate training video and written instruction documents accompanying the Cryonite System were reviewed by the researchers as well as the accompanying materials.



CO_2 leaves no residues inside machinery

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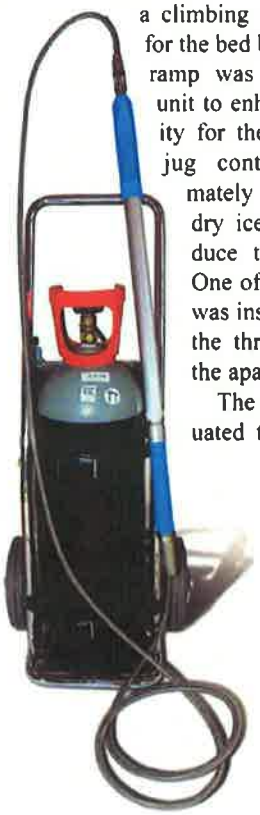
Three sites were identified based on the site selection criteria:

Site SE SILV 01 was an apartment in Florida within a complex that has a history of bed bug problems and recorded bed bug infestations. The unit chosen was a 1,214 ft^2, two storey townhouse with heavy infestation in the bedrooms. The unit was vacated by the tenants and all furniture and possessions removed to avoid re-infestation after treatment. Verification of bed bug activity was carried out using adhesive traps designed for monitoring bed bugs. As preparation for treatment, all wall socket and switch covers were removed and all cupboard spaces opened to allow access. As an additional monitoring precaution, a number of traps were placed throughout the apartment. These traps were checked and maintained every few days throughout the process from 05 May 2011 through to the final use of the CO_2 traps on 03 June 2011. CO_2 traps were installed on 11th May 2011. CO_2 traps were constructed using inverted dog food bowls for the base and one gallon cooler jug for each containment vessel. The exterior of the bowl was covered with masking tape to create a climbing textured surface for the bed bugs and a paper ramp was added to each unit to enhance accessibility for the insects. Each jug contained approximately four pounds of dry ice pellets to produce the CO_2 plume. One of these CO_2 traps was installed in each of the three bedrooms in the apartment.



The traps were evaluated the next day on 12th May 2011. Pre-sampling using CO_2 traps was conducted in order to allow an estimate of the population of *Cimex lectularius* to be made. Treatment with the cold induced Cryonite system was carried out and then repeated within twenty-four hours post first treatment. Treatment was made throughout the premises. All carpeting was pulled back around the wall perimeter junctions. The treated areas include all floor to wall junctions, sockets and switch cavities, pipe chase openings, cabinet areas, ducting systems, central systems, installed fixtures i.e. shelving units, blinds and curtains, refrigerators, stoves, built in microwaves etc.

Site SE SILV 03 was a single family house in Atlanta, Georgia, consisting of 3 bedrooms. The house was vacated and unfurnished and had a moderate infestation. The Cryonite system was used to treat the home on two successive days and follow up inspections were then conducted. All cracks and crevices, floor wall junctions, window sills, air conditioning registers, door jams, etc., were treated with the high pressure nozzle and then the second treatment was completed with the low pressure nozzle. The garage was treated in the same manner as the house, in as many areas that could be accessed. CO_2 traps utilizing dry ice were used to monitor for bed bugs for the 24 hour post application periods as well as one week post application.

Applying CO_2 to mattress

Site SE SILV 04 was a shelter for the homeless in Atlanta, Georgia, consisting of 51 bedrooms that were 80% vacant at the time of treatment. There was a heavy infestation. The Cryonite treatments conducted at this location included treatments on successive days to heavily infested mattresses, furniture and sleeping rooms. Follow up inspections were conducted as well as post treatment CO_2 trapping.

No pesticides were applied during the assessment or testing periods in any

It is important to treat all areas, but sometimes this can be awkward

Using Cryonite to treat high level equipment

of the three sites described. The only interventions used during the studies were the CO_2 traps for assessment and the Cryonite unit for the treatment of the sites.

Results

Site SE SILV01

A total of sixty nine (69) bed bugs were caught in the CO_2 traps and of these fifty nine (59) bed bugs were released and allowed back into the areas where they were originally captured.

Ten (10) bed bugs were held in a separate three gallon container and treated directly with the Cryonite system. There was immediate mortality after treatment of the bed bugs in the three gallon drink container. On site, post sampling with CO_2 traps continued for two weeks post second treatment and recorded. Post sampling with CO_2 traps two weeks caught no bed bugs after treatment. During the first treatment, the entire 20 pound cylinder was used up and the second cylinder was attached to complete the treatment. Total CO_2 usage on the first service was 22 pounds. The entire process was repeated on 19th May 2011 when 18 pounds of CO_2 was used.

No further bed bugs were captured after both the first and second treatments with Cryonite. A final observation of the CO_2 traps was completed on 3rd June 2011. Because no bed bugs were found in any traps and none were observed under visual inspection, the CO_2 traps were removed.

Site SE SILV 03

Pre-treatment, visible signs of bed bug activity were found in two of the three bedrooms of the house. Both bedrooms were unfurnished and had fitted wall to wall carpeted. Bed bug faecal stains and shed skins were found in both rooms along the base boards (skirting boards) near the carpet tack strips. Bed bug carcasses were also found on the floor, along the wall in the living room area. Faecal stains were also present in this area. No live bed bugs were found during post treatment visual inspections. No live bed bugs were found within the post treatment dry ice trap after the second treatment.

Site SE SILV 04

Residential floors (target areas) included individual resident rooms, common bath facilities and a central hall area. The central hall area included a television room, a stairway, an elevator and the large bathroom/shower area. All these areas were treated except the large bathroom/shower, elevator and stairway. Pre-treatment, the residential room locations were heavily infested with outward signs of obvious bed bug infestation present in the occupied rooms.

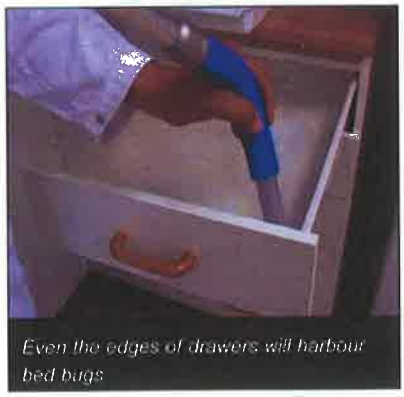
Direct applications of Cryonite to heavily infested mattresses and box springs resulted in immediate knock down of 100% of those bed bugs contacted. A small number of the bed bugs recovered, however a second Cryonite treatment provided 100% mortality. No live bed bugs were found during post treatment visual inspections. No live bed bugs were found with the post treatment dry ice trap after the second treatment.

Conclusions

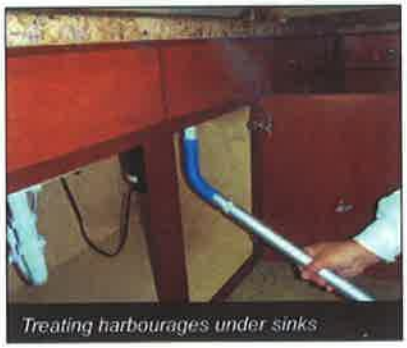
The Cryonite equipment is well designed, easy to use and effective. The introduction of the lethal temperature variant was immediate and did not promote or permit escape or the unintended spread of infestation that might otherwise be caused by peripheral temperature variations. This series of investigations were conducted to add to the existing laboratory, field data and anecdotal recommendations for the Cryonite technology from Pest Management Professionals.

In all 3 locations, two treatments with Cryonite alone were found to be effective in controlling bed bugs. Site inspection and appropriate monitoring were important in determining hot spots and essential areas for treatment. Removal of badly infested furniture and treatment of clothing and household possessions are important parts of the treatment programme.

® Cryonite is a registered trademark of Silvandersson, Sweden.



Even the edges of drawers will harbour bed bugs



Treating harbourages under sinks

Table of monitoring trap catch at Site SE SILV01

Room	Captured bed bugs	Details
NW bedroom	19	11 second or third instar nymphs
NE bedroom	12	12 second or third instar nymphs
Master bedroom	38	22 third instar nymphs, 16 adults