Results of Heat, Phosphine and CO_2 Collaborative Project at Quaker Oats Facility

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Executive Summary

As a result of controls on the use of methyl bromide and the loss of other chemical controls for insect infestation, new approaches are required to ensure the Canadian food industry can maintain pest-free cereals and cereal-based products.

Rear view of Quaker Oats of Canada Ltd. oat mill showing the building that was fumigated and Praxair on-site trailer.

Collaboration by Agriculture and Agri-Food Canada, Environment Canada, Ontario Ministry of Environment and Energy, the pest-control industry and the Canadian food processing industry resulted in a commercial-scale testing of an alternative to methyl bromide for control of insect infestations. During the weekend starting 12 April 1996, a combined heat/carbon dioxide/phosphine fumigation was conducted at the Quaker Oats Company of Canada Limited, cereal milling and processing facility in Peterborough, Ontario. A nine-story building had its windows and doors sealed and the temperature raised to an average 37°C. Liquid carbon dioxide was gasified and piped in to provide a concentration of 4.3%. and magnesium phosphide Fumi-Strips® were distributed on several floors to provide 29.3 ppm phosphine. These values were the 4-36 hour treatment averages.

The efficacy of the treatment was determined by placing 10 vials containing 10 live confused flour beetle adults and 10 vials of 10 eggs on each of the nine floors for the duration of the fumigation, plus other test methods. Ten vials each of adults and eggs were kept as controls away from the treatment. Adults were examined within 2 days after the completion of the fumigation and showed 0% survival to the fumigation based on 900 insects; the unexposed controls had 99% survival based on 100 insects. Vials with eggs were incubated at optimal developmental conditions for one month to allow hatching and larval development. Only 1.7% of 900 treated eggs hatched into larvae after one month incubation compared to 51% of 100 control eggs.

Under traditional methyl bromide fumigations, a 95% kill rate is considered a successful fumigation. The combination fumigation method used in this experiment exceeded this rate — even under adverse conditions that included low ambient humidity and several leaks.

The additional costs of this treatment over a similar methyl bromide fumigation, was determined to be about $7,000, not including the capital investment for heaters, if required, and not including the energy costs of using the heaters. Using methyl bromide on this trial building would have cost approximately $15,000 and this combination method would have cost $22,000. This cost difference would be expected to decrease as building size increased and it should be noted that the cost of methyl bromide increased 30% last year. As a result of the experience gained from this experiment, it is expected that future fumigations could be completed at less cost.

The potential of this new technique as an adequate replacement for methyl bromide structural fumigation appears to be high.

BACKGROUND

Methyl bromide, a broad spectrum fumigant used in the Canadian agri-food industry to control pests and diseases in soil, facilities and commodities, has been listed as an ozone depleting substance under the Montreal Protocol. Concern about ozone depletion is one of the most important environmental concerns of the Canadian public; Canadian research shows that changes in atmospheric ozone results in increasing harmful UV radiation levels reaching the public. Although increased UV levels have been demonstrated in Canada to be a threat to fishing stocks, they are also considered to be a threat to agriculture production. As a result, the Canadian government has committed to zero use levels by 2001, except for the exemptions allowed under the Montreal Protocol. These exemptions are for narrowly defined quarantine and pre-shipment uses (the majority of which in Canada is used in cleaning dirty ship holds), and for some type of essential use process to exempt those uses for which there are no technically and economically feasible alternatives. This process will be refined through discussions at the meetings of the Montreal Protocol.

Within Canada, a large proportion of methyl bromide is used to control pest infestations in large facilities, such as food processing structures. Structural users of methyl bromide include a broad segment of flour and cereal primary processors, transporters and food producers, and the proposed controls places food processing users of methyl in a difficult position. Some of the members of this sector operate at very low profit margins with strong competition both from within Canada and from exports. Consumers of their products expect the products to be free of pests. At the same time they expect the companies they purchase from to be good corporate citizens, a rather fluid concept that includes an expectation of environmental improvements.

Food processing and pest control companies are run by people with families who hear about the results of ozone depletion with every weather broadcast. Unfortunately, in Canada they also often hear of business failures resulting in job loss and reduced productivity in the country they call home.

To their credit, the Canadian food processing and pest control industries approached the challenge of the loss of this important fumigant positively, with activities designed to understand the problem and find solutions. After some initial consternation most chose to spend their resources understanding the problem and assessing alternatives. Faced with the need to assist industry to adopt methyl bromide alternatives, the three government agencies involved in this issue - Agriculture and Agri-Food Canada, Environment Canada and Health Canada - worked to ensure good understanding, supported research and put mechanisms in place to quickly and effectively review alternative treatments.

The Canadian grain production, handling and transportation system has been designed to eliminate or greatly reduce pests. While Canadian grain has not been treated with methyl bromide for many years, storage spaces and processing facilities do occasionally use this fumigant. In order to avoid the expense of shutting down operations to conduct a fumigation, processors use several control options, including ensuring their incoming products are free from pests, their facility is clean and does not easily provide pest habitats, and that non-fumigant treatments reduce or eliminate pests when spotted. Stored product pests, are however, very resourceful and competitive foes. Many primary and food processors see a need for occasional structural fumigations, when an infestation is uncontrollable through the other controls.

Few chemical alternatives are approved for structural fumigation in Canada. Assessing chemical alternatives for this use is difficult, since it is commonly not only a structure that