Methyl Bromide Alternatives: The Role for Irradiation

Joseph Borsa, Ph.D., Nordion International Inc., 447 March Road, Kanata, Ontario, Canada K2K 1X8

Abstract

Irradiation has potential for replacing methyl bromide for insect disinfestation to meet quarantine requirements for various internationally traded agricultural commodities. There are a number of pre-requisites which must be satisfied before irradiation can be implemented. In this presentation, the individual requirements are examined, and a feasibility checklist is provided as an aid in evaluating the overall suitability of irradiation for a particular application.

Background

Historically, methyl bromide has served to satisfy a variety of needs in the agri-food sector. These include its use as a fumigant to control parasites and disease organisms in soil, insects in flour and feed mills and other structures, and to provide quarantine security for both perishable and non-perishable commodities (1). The latter application is critical for facilitating international trade in agricultural products. Loss of methyl bromide will have severe impacts in each of these areas of use. Irradiation has the potential to replace methyl bromide in a limited sub-set of these applications.

The Technical Niche for Irradiation

Irradiation is an excellent treatment to effect disinfestation of various products for purposes of quarantine security. This includes essentially all non-perishable (grains, flours, fibers) and a variety of perishable (papayas, bananas, mangos, dried fruits, cherries, etc) commodities (2). Practical considerations preclude the use of irradiation for disinfestion of buildings, or for eliminating parasites and disease organisms from soil in the field, although treatment of packaged soil for use in greenhouses, flower pots, and the like, could be done.

Process Description

Conceptually, irradiation is very simple. The heart of the process is the irradiation chamber, in which a suitable source, most commonly cobalt-60, provides a constant field of ionizing energy (radiation). Concrete shielding around the irradiation chamber confines the ionizing energy and prevents unwanted exposure of surrounding objects to the radiation field. For processing, the product to be treated is conveyed into the irradiation chamber and exposed to the field of ionizing energy for an appropriate length of time to deliver the desired dose of radiation. This process does not make the product radioactive. Treatment times range from a few minutes to a small number of hours, depending on the source strength, and on the required dose. Normal variations in ambient temperature and humidity only negligibly affect the process, unlike the case with fumigation. Practical irradiators can handle pallet loads, or equivalent packages, of materials. Treatment can be done with the product in the final packaging, since ionizing energy readily penetrates packaging materials. Treated product can be utilized immediately after completion of the process, without need of a post-treatment time equivalent to the aeration period required after fumigation. Temperature rise resulting from irradiation is negligible, generally being less than one degree C at the doses required for disinfestation. Irradiated product is essentially unchanged from untreated product in terms of its sensory properties.

Critical Requirements for the Irradiation Option

Technical

The principal requirement is for an irradiation facility, which consists of a shielded irradiation chamber, a suitable source of radiation (generally cobalt-60), a product conveying apparatus, and a control system, plus the usual warehouse and storage areas. In addition, a suitable treatment protocol is required, to ensure that the treatment effects the desired benefits, while avoiding any unacceptable deleterious changes.

Infrastructure

Required infrastructure includes all the transport and other connections needed to integrate irradiator operation into the normal commercial handling of the product.

Regulatory

Regulatory clearance for irradiation of each product must be in place before treatment can proceed. Such clearances are granted by the appropriate authorities in each country, in response to petitions submitted by proponents. International shipment of treated products is greatly facilitated if there is harmonization of regulations between the countries of origin and destination, otherwise the treatment must comply with the regulations of the importing country.

Business

Business arrangements are required to procure, treat, distribute and market treated product. The irradiation business must be integrated into normal commercial practice.

Societal

Society at large, and consumers in particular, must accept the irradiation option and support it as part of the process of providing safe and wholesome food to meet the needs of the people.

Feasibility Checklist

A comprehensive feasibility evaluation must be carried out, to ensure that the necessary pre-requisites for a successful radiation processing application are satisfied. These include the following areas: (i) there is a driving need or problem to be remedied; (ii) irradiation is a technically feasible approach to meeting this need, or solving this problem; (iii) irradiation is economically feasible under commercial conditions; (iv) logistics for radiation processing of the products are manageable; (v) regulatory clearances are in place; (vi) the required business arrangements can be put in place with suppliers, irradiation facility operators, distributors and marketers; and (vii) consumers are willing to accept the treated product.

In the presentation, feasibility assessments for some of the most probable applications will be examined.

References

(i) UNEP 1994 Report of the Methyl Bromide Technical Options Committee, for the 1995 Assessment of the Montreal Protocol on Substances that Deplete the Ozone Layer. ISBN 92-807-1448-1; pp28.

(ii) IONIZING ENERGY in Food Processing and Pest Control: II. Applications. Task Force Report No. 115, June, 1989. Council for Agricultural Science and Technology (CAST), 137 Lynn Avenue, Ames, Iowa 50010-7120