Technical Reports

Low-oxygen storage of dried foods

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Insects, humidity, and high temperatures cause enormous wastage to most agricultural produce. This article reports on a process that does not rely on chemicals to prevent infestation and spoilage of food but instead uses a low-oxygen atmosphere to kill insects and a vacuum to prevent further spoilage.

The most common cause of losses of agricultural produce in many producing countries is infrastructural hurdles in the supply chain, notably lack of suitable storage facilities. Insects, humidity and high temperatures are a serious and continuous threat during storage. Increasing volumes of chemicals are applied to fumigate crops, largely ignoring growing pesticide resistance of insects and human or environmental hazards. Also fumigation does not prevent re-infestation or spoilage due to high humidity and high temperatures.

In Holland, a company named b-Cat has developed a new system to treat dry food commodities. From its origin, b-Cat has specialized in low-oxygen applications, and the new system brings the oxygen level in hermetically sealed rooms down to almost 0 per cent and keeps it at this level for between 3 to 10 days. The oxygen is removed from normal, ambient air by separating it from nitrogen using permanent, active carbon-based filters (see Figure 1). The result: no oxygen, no life and 100 per cent mortality of all insects. Larvae are the most difficult to kill since they have the most oxygen reserves, but eggs and adult insects die relatively quickly. The system, named 'ZerOx', has so far been used mainly to treat dry organic foods, but there is increasing interest in also treating non-organic commodities, such as nuts, grains, spices, cocoa, and rice. The low-oxygen system is said by the company to have become increasingly competitive with chemical fumigation and is the most environmentally friendly way to kill insects, especially if 'green' electricity is used. Producers who are used to paying per fumigation treatment may see the main limitation of the ZerOx system as the investment required in gastight rooms

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and filtering equipment. The company believes that the cost per treatment, taking into account electricity consumption, maintenance and depreciation, is competitive with chemical fumigation, provided producers can make the initial investment.

Although the ZerOx system has proved effective as an alternative to fumigation for cleaning products of insects, it does not keep products clean by preventing re-infestation, high humidity and high temperatures during storage. The company therefore looked for ways to address this and developed a vacuum storage system. This hermetically seals the commodity and preserves its aroma and quality. The challenge was to find a way to store bulk quantities of crop: traditional vacuum packaging machines only handle small quantities, up to 25 kg per bag, whereas producers needed to vacuum-pack at least 1 or 2 metric tonnes per bag. The solution was to create a vacuum directly in the bag and not using a vacuum chamber as in traditional vacuum-packing machines. To achieve this, a special valve was developed, through which any remaining air inside a bag can be removed. The main advantage is that it is possible to create a vacuum in any sized container, provided it has a gastight liner. The new system is named 'vQm

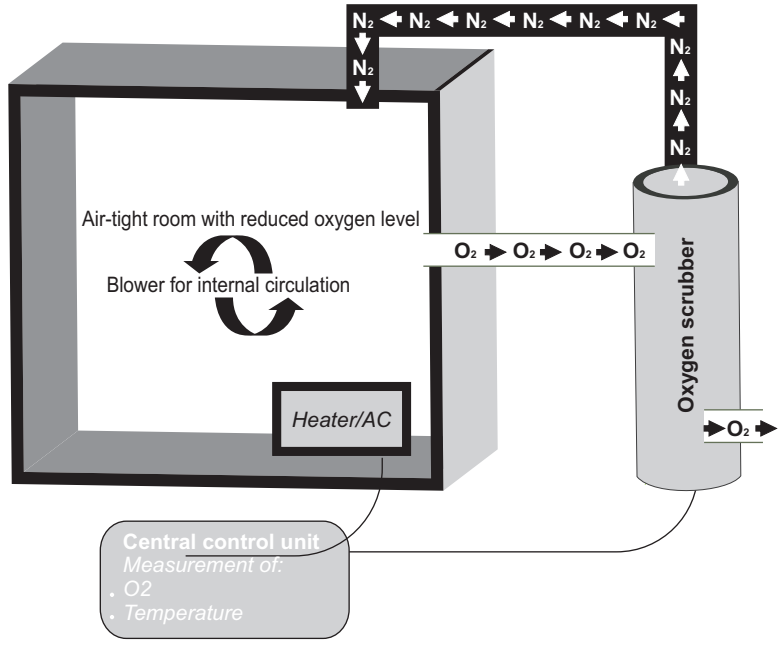

Figure 1. How the ZerOx method works

Packaging'. The technology required to create the vacuum comprises a normal air compressor, which is available in most countries – even in rural areas – and a small vacuum unit that uses compressed air to create a vacuum and suck remaining air out of the container. It is also possible to flush the bag with an inert gas such as nitrogen to better preserve commodities such as spices and nuts. The vQm system can also package powders under vacuum. Normal vacuum-packing systems cannot handle powders because they diffuse into the vacuum chamber and make it impossible to properly seal the bag. In the vQm system, the bags are first sealed and then put under vacuum; and a special filter on the vQm valve allows powders to be vacuum-packed as easily as any other product.

The combined ZerOx and vQm systems have the potential to safeguard any dry food commodity throughout the full chain from farmer to consumer. Products are protected from insects; they are not subject to humidity changes; they are protected from temperature fluctutions, and they are preserved in an oxygen-free environment to minimize oxidation. Transport and storage cost may also be reduced.

The company reports that ZerOx and vQm systems are used in producing countries on every continent, ranging from India, Kenya, Argentina, Dominican Republic, Turkey, Oman, USA, and throughout Europe. The company estimates that an initial investment of approximately € 13,000 is sufficient to start vacuum packaging. The main recurring cost is the 1-2 tonne bags made from a 7-layer foil, 180µ thick with the valves inside, which can only be manufactured by a few companies worldwide. The cost of a 1000-litre liner is currently about € 20 but increasing production volumes may reduce the cost in future. Environmentally, vQmbags are an oil-based product but they can be recycled. Theoretically, the liner bags can also be re-used, but this is not widely practised. A future challenge is to produce a strong, gastight liner that is also fully bio-degradable. Further information is available at www.b-cat.nl/