

THE LINDE GROUP

*Linde*

Protection matters.

Linde crop science in action.



“Sustainability is a big priority for us and we feel that VAPORMATE® is a more environmentally sound way to meet our fumigation duties. It aligns better with our corporate responsibility policy.”

Raj Kesha, Export Manager,  
Fresh Food Exports

# Proven fumigation results for a more sustainable future





Growing concerns with the atmosphere and the ever increasing population poses a threat to global food supplies. Farmers are increasingly under pressure to increase the quantity, quality and sustainability of agricultural production. This includes the need to protect valuable crops against pests and diseases both before and after they have been harvested.

For centuries, people have struggled with the need to eliminate pests in pre- and post-harvested food without compromising human health or the environment. Up until recently, for instance, methyl bromide was the fumigation gas of choice. Now, under the Montreal Protocol, methyl bromide is being phased out globally due to concerns over its toxic effects and ozone-depletion potential. This is raising demand for viable alternatives.





## Fresh approach

Linde can help meet today's fumigation challenges. As a leading global supplier of speciality gases, we have over 100 years' experience in developing and delivering gas-enabled innovations for the food industry. Building on our strong heritage in product stewardship and environmental care, we invest around €100 million in scientific research and development every year. Much of this spend is channelled into environmental and clean technologies. This work is inspired by a hands-on, in-depth understanding of our customers' individual needs, production challenges, safety concerns and environmental responsibilities. Innovations supporting more sustainable food chains include:

- Oxygen and carbon dioxide solutions to reduce the environmental impact of food packaging production
- Green sources of energy for food production
- Second-generation biofuels (made from biomass) for food production
- Carbon and harmful emissions management solutions for food processing plants
- Innovative modified atmospheres to preserve shelf-life without compromising quality
- Natural refrigerants to chill food with zero or negligible contribution to global warming
- Eco-friendly cryogenic cleaning solutions for food processing equipment, eliminating the need for harsh cleaning agents
- Fish farming oxygenation solutions to secure farmed supplies while protecting wild livestock
- Sustainable oxygenation solutions for water treatment

Complementing the above process technologies, we have developed a range of environmentally sound, non-residual fumigation solutions at controlling damaging pests with no known global warming potential. Not only are these products extremely effective, they are also better at protecting the quality of perishable fruit and vegetables.

## One-stop service

We combine our innovative fumigants with professional consulting, services and reliable safety support to maximise the return on your investment and ensure optimum outcomes. Our service experts will accompany you every step of the way from advice on the products best suited to your application to dosing equipment customisation. We can even help with field trials, registration support, safety audits and safety training.



“Linde’s crop science technology also improves quality during storage and distribution of imported fruit by delaying the Maillard reaction relative to methyl bromide.”

Kim Nam-Kook,  
Director of Dole Korea

“VAPORMATE offers faster venting times. So we are able to treat and clear more fruit for export more quickly, thus maximising each shipment.”

Raj Keshu, Export Manager,  
Fresh Food Exports

## Protecting a growing world

According to experts, the global population will pass the 9 billion mark by the year 2050, and feeding the world sustainably will become one of the biggest challenges facing society.

Already today, the Food and Agriculture Organisation of the United Nations estimates that 1.02 billion people are undernourished worldwide. Much of this could be avoided by preventing food loss and wastage. It is estimated\* that roughly one-third of food produced for human consumption is lost or wasted globally, which amounts to about 1.3 billion tonnes per year. This wastage occurs throughout the entire food chain, from initial agricultural production down to final household consumption.

Reducing this waste calls for a variety of measures, including advances not only in crop production and harvesting, but also in the protection of harvested crops. This means controlling the insects and diseases that can threaten a harvested crop or felled wood while preserving quality through faster shipment times.

## A better way

At Linde, we have developed innovative fumigants to limit the impact of pests and disease on timber and in agriculture. Our crop science solutions reflect years of research and underscore our commitment to providing environmentally friendly alternatives to conventional fumigants with strong ozone depletion and global warming potential. Our fumigation solutions are designed to protect a growing world – the natural way.

## Protecting your investment

We understand that farming can be an unpredictable, harsh business. By the time you have got to the point of harvesting your crop, you have probably already battled with unpredictable weather, fluctuating water supplies and various insects, diseases, weeds and other pests. And that is only the start of it. Once you have harvested your crop, you need to protect your investment by controlling the impact of pests and diseases.



## Results you can count on

We can help you secure your valuable produce with innovative fumigants to pre-treat soil against insects, diseases, nematodes and weeds. You can also rely on our fumigants to treat harvested fruit and vegetables or stored products prior to shipment or export. Benefits include high penetration characteristics and shorter treatment times compared with conventional approaches. Our non-ozone depleting, non GWP, cost-effective fumigants will boost your profitability and protect your investment – both before and after harvesting.

## Protecting the delicate balance of nature

Although many countries continue to use methyl bromide – especially for critical-use exceptions – pressure for complete phase-out is increasing. This challenges the agricultural industry in a growing number of countries to find solutions that match the effectiveness of methyl bromide but improve the environmental performance of fumigation activities.


## Balancing today's needs with tomorrow's imperatives

At Linde, we pride ourselves on our ability to balance these needs. Our fast-acting, non-residual solutions are attractive alternatives to methyl bromide for pre- and post-harvest control of food pests in food processing, packaging and storage facilities. Underpinned by our strong sense of product stewardship, our fumigants promise effective results while protecting the delicate balance of nature for future generations.

**“Ethanedinitrile is a fumigant with the potential to replace methyl bromide for control of insects, nematodes and wood pathogens.”**



Source: Ren, Y., Lee, B. and Padovan, B. (2011) Penetration of methyl bromide, sulfuryl fluoride, ethanedinitrile and phosphine into timber blocks and the sorption rate of the fumigants. *Journal of Stored Products Research*, 47 (2). pp. 63-68.



“Essentially, we saw better results with less fumigant when we switched over to Linde.”

Raj Kesha, Export Manager,  
Fresh Food Exports

“In general, ethanedinitrile showed high toxicity to all immature and adult stages tested and in this respect is more toxic than methyl bromide.”

## Customer snapshots

### QTC

Based in Auckland, New Zealand, QTC Ltd is a Quarantine Treatment Centre. It is one of the leading treatment providers in New Zealand for both imported and exported goods. Approved by the Ministry of Primary Industries, the company delivers a wide range of biosecurity services to help exporters meet their statutory pest and disease control needs. In January 2013, QTC switched from methyl bromide to VAPORMATE® for several of its blueberry exporters.



### Fresh Food Exports

Founded in 1991, Fresh Food Exports Ltd. has expanded its initial persimmon and blueberry orchard to include strawberries and a variety of melons. The company is highly successful, now supplying strawberries to the biggest supermarket chains in the South Pacific and exporting them internationally. The company also exports an extensive range of fresh New Zealand produce. Following successful trials, Fresh Food Exports switched from methyl bromide to VAPORMATE to treat specific strawberry pests.

### Dole Korea

Every year, Dole Korea, established in 1991, supplies around 83,000 tonnes of imported fruit to supermarkets and hypermarkets as well as to retail, discount and department stores. This accounts for 30% of total Korean banana imports and a significant share of lemon, orange, pineapple and other fruit imports. Keen to comply with the Montreal Protocol on Substances that Deplete the Ozone Layer, Dole Korea discovered that Linde's innovative VAPORMATE solution offered a number of benefits over methyl bromide.



## Getting ahead through innovation

With its innovative concepts, Linde is playing a pioneering role in the global market. As a technology leader, it is our task to constantly raise the bar. Traditionally driven by entrepreneurship, we are working steadily on new high-quality products and innovative processes.

Linde offers more. We create added value, clearly discernible competitive advantages, and greater profitability. Each concept is tailored specifically to meet our customers' requirements – offering standardised as well as customised solutions. This applies to all industries and all companies regardless of their size.

If you want to keep pace with tomorrow's competition, you need a partner by your side for whom top quality, process optimisation, and enhanced productivity are part of daily business. However, we define partnership not merely as being there for you but being with you. After all, joint activities form the core of commercial success.

**Linde – ideas become solutions.**



For more information, please contact your local Linde supplier or visit <http://cropscience.linde-gas.com/en/index.htm>

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