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Methyl Bromide Recapture Technology

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Abstract: Methyl Bromide recapture technology has been commercialised to address the environmental and health and safety problems which arise from the unfettered use of this gas. Regulations requiring recapture are spreading across a number of regions, driven by local air quality, worker and community health concerns as well as international obligations under the Montreal Protocol.

Key words: methyl bromide, recapture technology

Introduction

Global Methyl Bromide use has been reduced dramatically and is a credit to the success of the Montreal Protocol on Substances that Deplete the Ozone Layer. This has largely been achieved by substitutions in many applications in both post – harvest and stored product treatments [1].

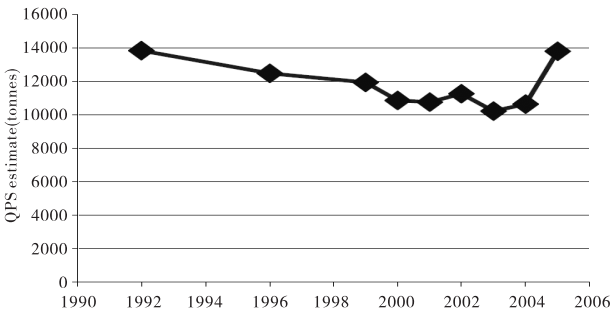

Fig. 1 Worldwide Production of Methyl Bromide for QPS Use (MBTOC and UNEP Data)

The main usage of Methyl Bromide in developed countries is now for Quarantine and Pre-Shipment applications, and there are signs that its usage has increased in certain areas [2]. It may be many years until an effective substitute is proven for all quarantine requirements, which are essential for biosecurity and international trade. For these applications the merits of applying recapture technologies is self-evident.

Benefits of Recapture

Methyl Bromide is a serious Ozone Depleting Substance and its impact is reported to be up to 50 times as destructive of the stratospheric ozone layer as chlorine from Chlorofluorocarbons [3]. The chemistry of ozone depletion is shown in Fig. 2 below:

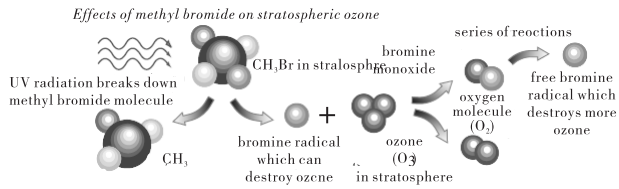

Fig. 2 Effects of Methyl Bromide on Stratospheric Ozone [4]

Local air quality can be compromised by emissions of this gas, which disperses in response to weather conditions, temperature, wind direction and other factors. An example of the spread of emissions is shown in Fig. 2. As the gas is odourless and colourless at unsafe concentrations, the impact on local workers and communities is obvious.

The contours on this graph (Fig. 3) were created after readings were taken from live fumigations at the Port depots, and results incorporated into computer models showing gas dispersions. Present fumigation methods result in risks categorised as ranging up to Moderate and Extreme, risks which can exceed current and proposed regulatory criteria [5]. Nordiko's systems reduce these risks by recapturing the highly toxic gases that are used in fumigation.

Technologies are under development for the recycling and reuse of Methyl Bromide after recapture. For larger volume applications, this can provide an economic benefit. However, this is hindered by the relatively low cost of this gas today.

Technologies Available

There are a number of technologies available which can be used for recapture purposes. These include recapture on filters such as activated carbon or zeolite, wet scrubbing in solu-

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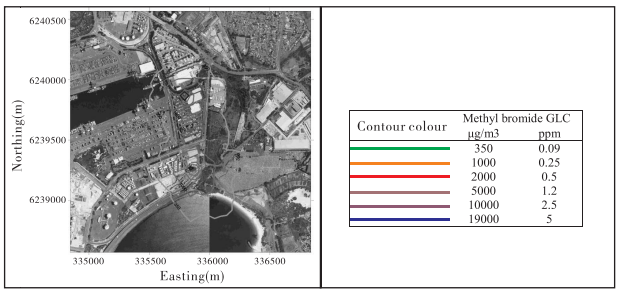

Fig. 3 Concentrations of Methyl Bromide afte Releaser from Operations in a Major Australian Port [6]

tions such as sodium thiosulphate or ammonium thiosulphate, condensation from fumigation atmospheres or even recycling from one fumigation enclosure to another.

The most widely used approach is recapture onto activated carbon filters. The gas can then be destroyed by chemical reaction, desorbed and incinerated at high temperature, carbon with gas degraded as landfill or (with appropriate equipment) be released from the filter and reused.

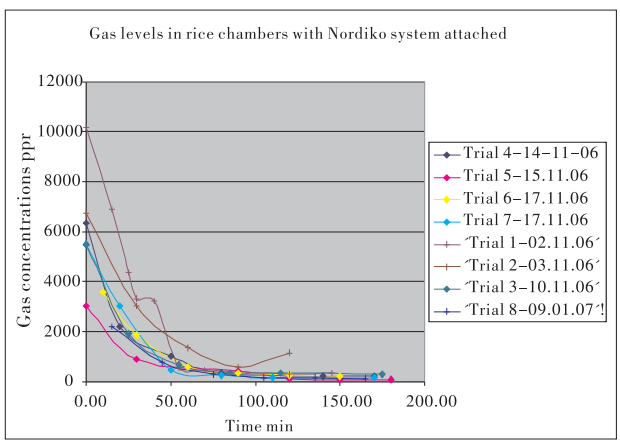

Fig. 4 Gas Levels in Rice Chambers with Nordiko System Attached [7]

Fig. 5 Large Scale Recapture Systems

One of the most important steps in the recapture process is the means by which the fumigant is evacuated from the fumigation enclosure and trapped on the filter medium. This has been the subject of considerable research and for the most widely used fumigation enclosure the shipping container is the subject of a number of patents.

Nordiko Systems

Nordiko is arguably the most commercially advanced company involved in fumigation, recapture and ventilation technology. It is an Australian based company that has developed and patented a number of systems.

These systems are now in use around the world in a range of locations and industries:

Australia, New Zealand, Malaysia, Belgium, USA, Mexico, Chile, India, Italy, Poland and the UK. Industries served include: ISPM 15 Timber, Fresh Produce, Container Depots, Airports, Warehouses, Grains and Customs etc.

Fig. 6 Nordiko Methyl Bromide recapture Systems in Antwerp Port, Belgium

Nordiko wants to develop the market in China for this type of technology in collaboration with government, institutions and private industry.

Safe Levels

The safe level of exposure to Methyl Bromide, or any fumigant, varies by country. Table 2 sets out TLV levels for a selection of countries:

Table 2. Comparative Maximum Exposure Standards to Residual Gases [8]

	Methyl Bromide	Ethylene Dibromide	Ethylene Oxide	Formal – dehyde	Hydrogen Cyanide	Phosphine	Sulphuryl Fluoride	Chloropicrin
Australia	5ppm	0.5ppm	1ppm	1ppm	10ppm	0.3ppm	5ppm	0.1ppm
New Zealand	5ppm	0.5ppm	1ppm	1ppm	10ppm	0.3ppm	5ppm	0.1ppm
USA	1ppm	1ppm	---	0.3ppm	4.7ppm	0.3ppm	5ppm	0.1ppm
India	5ppm	---	---	---	---	---	---	---
EU	0.5ppm			0.1ppm	10ppm	0.01ppm		0.1ppm

The safe level has also declined over time, as more experience has been gained of the deleterious effects of this gas on human beings and the natural environment.

Health effects of exposure to Methyl Bromide may include: headaches, throat and eye irritation, shortness of breath, chest pain, nausea, fatigue, dizziness, numbness, central nervous system and respiratory system failure, amongst other symptoms [9].

A recent example of community concerns over the risk of exposure to Methyl Bromide arose in Nelson, New Zealand an important log and timber exporting centre. An Environmental Court decision was recently reached which set strict controls on the nature and extent of fumigations and required recapture systems to be used in future[10].

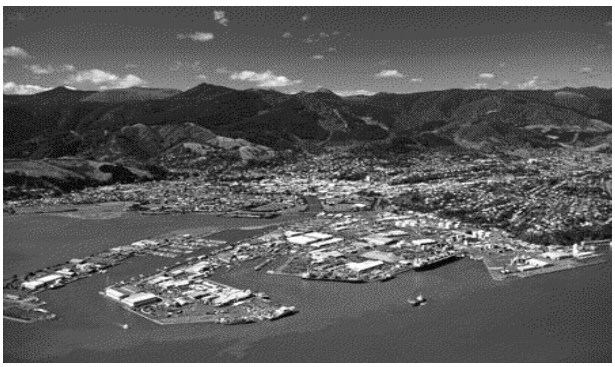

Fig. 7 Aerial Photo of Nelson Port [11]

Mandated Regions

A growing number of regions around the world are recognising that Methyl Bromide will not be replaced in the short term for many important quarantine and pre-shipment applications, and have taken the iniative to mandate recapture.

Nelson in New Zealand has been mentioned before and is a township that depends to a significant degree upon its log and timber trade as part of its export income. The first recapture systems are being installed in July 2008 for container fumigations, with bulk timber recapture system planned for the end of the year.

The Government of **Belgium** established a rigorous protocol which had to be met by accredited recapture systems and independently audited. A target has initially been set to recapture 80% of the gas available at the conclusion of the fumigation, with the expectation to increase this target over time. Recapture commenced on July 1, 2007 and has operated successfully for over a year by now.

In **Germany** the largest port where virtually all methyl bromide fumigations are performed is Hamburg. The port has adopted the protocol as established in Belgium, and has set September 1 2008 as the date from which adoption of an accredited recapture system must be made. It is noteworthy that the recapture directive, has been set more broadly, to encompass other toxic gases such as phosphine and sulfuryl fluoride as technically feasible.

The island state of **Tasmania** has some of the most stringent quarantine regulations in Australia and introduced a requirement to use "latest technology" during methyl bromide fumigations as early as 2006. This was interpreted at the time to mean adoption of recapture technology for methyl bromide, and it is now the state in Australia with the largest number of recapture systems installed.

Airports often have quarantine treatment facilities located in their environs, and at least two airports have required that recapture systems are used for Methyl Bromide fumigations. In Dallas-Fort Worth in the USA there is a large scale recapture plant, and at Perth International Airport in Australia fresh produce and timber fumigations must be performed using recapture systems.

The **USA** is going through the process of reregistering Methyl Bromide as a fumigant, and it is understood that consideration is being given to reduce the "**buffer zone**" surrounding fumigations, when recapture systems are in use. This is a sensible application of an economic and health and safety interpretation of the risks which arise during fumigations.

Inside the **European Union** Methyl Bromide was not put onto the list of approved chemicals and therefore may not be used for any applications from 2009/10, unless reregistered. It may be the case that the gas is reregistered for QPS usage only, and only on the basis that it is used with **accredited fumigation recapture technology**.

Residual Gas

Methyl Bromide is probably the most commonly encountered residual gas determined inside shipping containers. This poses a threat to those people unpacking the containers and in associated warehouse facilities.

Ventilation and recapture systems have been developed to effectively address the risks created by this phenomenon, allowing fast and safe turnaround of containers.

Residual gas can arise from other sources in addition to Methyl Bromide for example

Formaldehyde can arise from wood glues and products. It has recently been listed as a carcinogen in Europe.

Fig. 8 **Nordiko Residual Gas Extraction Unit Filter Model**

There are many other gases which have been found to arise inside shipping containers, these include: Dichloroethane, Phosphine, Sulfuryl Fluoride, Ethylene DiBromide, Hydrogen Cyanide etc. International experience is that between 1 in 3 and 1 in 5 containers can contain an unsafe level of gas.

Other Fumigants

Recapture technology is adaptable to other fumigants and gases beyond just Methyl Bromide. Many gases give rise to health and safety risks, therefore the benefits of ventilation and if applicable recapture of residual gases from inside shipping containers and other enclosures are very real.

Conclusion

Methyl Bromide recapture and ventilation technology has developed into an international business which is technically and commercially available and increasingly beneficial in many countries and regions.

Nordiko is one of a number of suppliers of equipment which can allow the benefits of recapture to be applied for the sake of the local and global environment and the health and safety of our workers and the general population.

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