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Monitoring of post-harvest fumigation with Gasmet Multikomponent FTIR gas detection systems

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Fumigation business has changed dramatically after the Montreal protocol came into effect on January 1st 1989. Methyl Bromide had to be replaced in all its widespread application. A lot of fumigators having experience with Methyl Bromide are still mourning in regards of its outstanding fumigation performance. Today, almost 30 years after, we are having a big variety of different alternatives to Methyl bromide, developed by research institutes around the world.

Focusing on new gaseous alternatives to Methyl Bromide, FTIR technology is an extremely versatile detection principle, offering a widespread use in the fumigation industry.

Fourier transform infrared (FTIR) is a powerful gas measurement technology that offers true multicomponent capability. This technology that was originally used for challenging research applications has since proven to be very reliable and versatile and has become the industry standard in many challenging emissions monitoring applications.

Most gases absorb infrared light at some wavelengths in the infrared spectrum. The position and intensity of the absorptions are determined by the molecular structure of the gas and this means that each gas will have a unique absorption pattern. This unique pattern can be used like a fingerprint to identify and measure each gas in the sample.

An FTIR analyzer works by simultaneously scanning the entire infrared spectrum and then calculating the concentrations of each gas in the sample based on their characteristic absorptions. The fact that the entire infrared spectrum is scanned at once means that all the gases in the sample can be measured simultaneously. This allows for very quick multicomponent measurements and for compensation for any cross-interference.

As all gases are measured by scanning the same infrared spectrum, adding new compounds can be done easily in the software without requiring any changes to the hardware. The recorded spectra are also unaltered by the analysis performed on them and can therefore, always be re-analyzed at a later point. This allows for traceable data and facilitates for instance retrospectively checking the measurements for new gases.

All this makes FTIR the ideal solution for a variety of applications where multiple gases need to be measured quickly, accurately and reliably.

Working on approving, registering, developing or applying new fumigation procedures has become much more demanding than what experienced for Methyl Bromide. The need for an ideal gas detection device is enormous.

FTIR technology brings some outstanding advantages for the fumigation industry as listed below:

1. Detection of several different fumigants with the same instrument
2. No changes of sensors required for change in gases
3. Extremely easy and low cost calibration
4. Detection of complex gas mixtures

5. Due to the evidential detection of the target gas cross sensitivities are reduced to a minimum and can be evaluated and analysed even after the measurement.
6. Generating of ct-diagrams is a crucial part of the whole FTIR measurement.
7. Ready to measure new fumigants
8. High concentrations of fumigants during fumigations and low concentrations for clearance /entry permits can be measured with one instrument

A lot of gases can be detected, qualitative and quantitative

	Gas	Fumigation procedure	Clearance/ entry permit	LDL in N2
1.	Methyl Bromide	X		0,4 ppm
2.	Phosphine	X		0,2 ppm
3.	Sulfuryl Fluoride (Vikane®, Profume®)	X	X	0,03 ppm
4.	HCN	X	X	0,35 ppm
5.	EDN	X	X	0,9 ppm
6.	COS	X	X	0,004 ppm
7.	Ethyl Formate	X	X	0,1 ppm
8	Propylene Oxide	X	X	0,1 ppm
9.	Methyl Iodide	X	X	0,1 ppm
10.	Chloropricrin	X	X	0,08 ppm
11.	Formaldehyde	X		0,09 ppm
12.	Ethylene Oxide	X	X	0,2 ppm

A real big advantage is to detect several gases (up to 50) parallel. By using the entire spectrum between 850 and 4200 waves/cm.

Examples for parallel evaluations are:

1. HCN and CN2
2. SO2F2 and Chloropricrin

This options enables the user to check for interactions with the fumigated material, metabolisms and other tasks where more than one gas has to be evaluated.

Determination of safe storage moisture content of commercial maize (*Zea mays*) seeds during hermetic storage

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Abstract

Germination declines during storage and meeting official standards (90% limit) can be challenging for the seed industry. Hermetic storage, through the establishment of self-modified atmospheres has shown to preserve germination in high-moisture maize seeds, but in the range of the low-moisture contents (m.c.) used by the seed industry, the relationship between hermetic storage and seed quality has not been fully studied. The aim of this work was to determine the safe storage m.c. of commercial maize seeds during hermetic storage considering both germination and microbiological aspects. Maize seeds with 95% initial germination were conditioned to m.c.s. between 11.5 and 14.5% and stored hermetically at 25ºC for 6 months. Germination, % oxygen, % infected grains, and colony forming units (CFU) were evaluated. Germination declined with increasing m.c.s, dropping to 50% at 14.5% m.c. Microflora respiration started to be detected at 13.5% m.c. and an anaerobic self-modified atmosphere was reached at 14.5% m.c. Despite the higher relative humidity, % infected grains and CFU count at 14.5% m.c. were lower than at 13.5%, probably due to the suppressive effect of the anaerobic atmosphere. In conclusion, 11.5% was a safe storage m.c. as it preserved germination above marketing requirements without microbiological risk. Hermetic storage was useful to generate self-modified atmospheres for m.c.s above 13.5%, but these self-modified atmospheres were not effective to protect germination. Further research on the effects