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Supporting quarantine and health & safety monitoring of fumigants and industrial chemicals in offshore transport containers with Gasmet Multicomponent FTIR gas detection technology

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Abstract

Cargo containers and wooden packing materials are fumigated to control the spread of pests and micro-organisms. However, fumigant gases are toxic and present a danger to human health even at low concentrations. Additionally, products shipped in containers may release VOCs from the solvents, coatings and glues used in manufacturing processes, and the concentrations of these vapors may be significant in the confined space of the container. Gas measurements are required in order to protect the health of any workers involved in opening these containers.

As potentially hazardous gases originate from a variety of different sources, the amount of gases that need to be monitored, in order to ensure a safe working environment, is very large. The Fourier Transform Infra-Red (FTIR) measurement principle allows simultaneous measurement of a large amount of inorganic and organic substances, regardless of their molecular weight. The portable Gasmet™ DX4040 Multicomponent FTIR Gas Analyzer records infrared spectra at 10 scans/second and is capable of sub-ppm detection. When used with a laptop computer and the pro version of Calcmet™ software, the DX4040 is capable of analyzing up to 50 components simultaneously with compensation for cross-interference effects.

A standard application has been developed for container measurements. The application consists of a gas library of 50 gases that has been configured to include all of the most important fumigants and other hazardous gases found in containers, along with a number of other commonly found gases for correction of cross-interference effects. A built-in QA/QC routine ensures reliable results and alerts the user of the possibility of unknown gases in the sample.

If the presence of unknown gases in the sample is suspected, these can be identified using the library search function available in the CalcmetTM software. Identification is undertaken by automatically finding matching spectra in the library of hundreds of different reference spectra measured by Gasmet for different compounds. Once the unknown compound has been identified, it can be added to the analysis for quantification. The measured sample spectra are not altered by the analysis and are saved so they can be re-analyzed at a later time if needed.

The Gasmet™ DX4040 is battery powered, backpack sized designed for use in field conditions. The analyzer is portable, so there is no need for separate sampling and the sample can be collected and analyzed directly on site. Quick and easy sampling, coupled with fast, simultaneous analysis of all compounds makes for an

exceptionally quick measurement procedure per container. The DX4040 requires no span gas calibrations and uses no consumables for sampling or analysis. Only a short zero calibration with nitrogen is required once per day. This means that containers can be measured quickly and with a negligible cost per measurement.

The Gasmet DX4040 provides a powerful and cost effective solution to the challenge of measuring gases inside cargo containers. The use of FTIR technology enables the simultaneous measurement of an unparalleled amount of gases for a portable device, which leads to improved safety of workers. The DX4040 is also durable, requires no calibration gases (other than N2 for zero measurement) and requires no consumables for sampling. This means that the cost of ownership for this solution is also exceptionally low.

Efficiency of phosphine and modified atmospheres against five different stored products insects

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Abstract

There has been a notorious resistance to phosphine over the last decade, and a wide variety of factors can be associated with this rise to tolerance in stored products in the northwest of México, which can be due to bad exposition times and application of phosphine, and others causes; investigations were conducted in a warehouse place comparing the efficacy of phosphine with the use of mixtures gases in order to create the modified atmosphere against five diferrent adults: *Cryptolestes ferrugineus* (Stephens), *Tribolium castaneum* (Hbst.), *Rhyzopertha dominica* (Fabricius.), *Oryzaephilus surinamensis* (L.), and *Prostephanus truncatus* (Horn.). An application of 1.4 ± .21 gr/m^3 of phosphine for 72 ± 1 h exposure time could achieve 100% mortality to four species just like: of *Tribolium castaneum*, *Rhyzopertha dominica*, *Oryzaephilus surinamensis*, and *Prostephanus truncatus*. While for *C. ferrugineus* the 100% mortality could be achieved after 4.2 ± 63 gr/m^3 of phosphine for 120h exposure time.

Modeling the distribution of phosphine in cylindrical grain silos with CFD methods for precision fumigation

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Abstract

In the present study, the distribution of phosphine gas in a cylindrical silo was modeled and compared with available sensor data. The cylindrical silo was filled with wheat and a recirculation system was used to enhance the diffusion of phosphine throughout the grain volume. A Computational Fluid Dynamics (CFD) model was developed with OpenFoam software, which accounted for gas transport in porous media and sorption effects of phosphine into the grain. A time-dependent source was used to model the phosphine release from Aluminum Phosphide bags. Furthermore, simulation results were obtained for insect mortality as a function of their exposure to phosphine gas. The phosphine concentration measurements were available from calibrated wireless sensors provided by Centaur Analytics, placed near the silo walls at various heights. As the agreement of phosphine measured data with the simulation results was satisfying, it led to considering that the proposed CFD model (equations, boundary conditions, grain properties, recirculation system approach, etc.) was accurate. Utilizing the capabilities of fumigation modeling, the phosphine concentration could then be determined for every location inside the storage volume and at any given time, thus a prediction method for fumigation