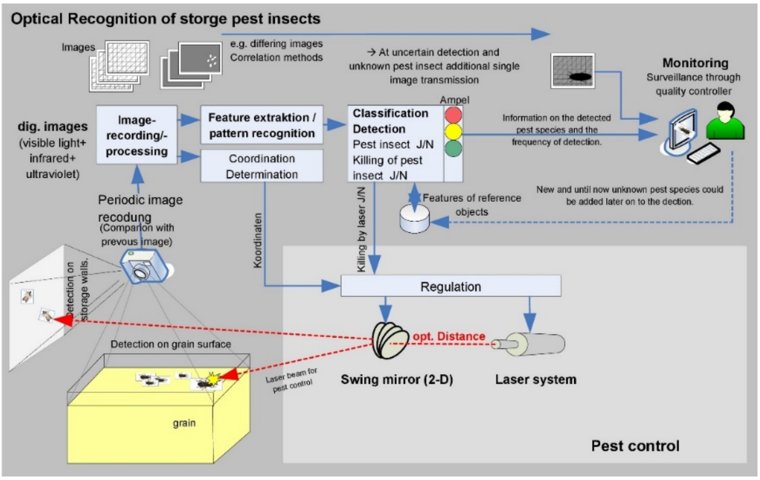

Fig. 9 Scheme of the complete system with detection and pest control

3. Outlook

This study will evaluate the probability of the early detection and pest control and will be a foundation to develop a prototype system. The detection of pest insects facilitates the installation of a model database under diverse environmental conditions and camera angles. The database will be improved if the information of different capture systems (storages) with diverse conditions and will be saved here altogether. With this detection unit a centralized monitoring can be established to lower the personnel costs for inspections and to facilitate a prompt action. Industry partners are integrated early on, starting in the development stage, to guarantee the incorporation of commercial demands. With the results of this study, an industry partners can develop a suitable scanner (light source & camera) in the evaluated spectral region. Preprocessing of video data could be implemented in the camera hardware, hence the transmission of big data amounts (video data) could be minimized drastically.

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Web-Based Phosphine Fumigation Monitoring with Active Sensor Validation Confirms Lethality in Stored Grains

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Abstract

The predominant measurement technologies for fumigation gases over the past 60 years include colorimetric tubes, photoionization detectors, and electrochemical sensors. Their limitations and inaccuracies are well documented. Spectros Instruments has shown non-dispersive infrared monitoring (NDIR) to be a superior analytical tool for the practical measurement of fumigation gases as shown in Table 1. Any compliant fumigation monitor must be accurate, reliable and affordable. Stored Product Protection has additional requirements in remote regions such as Central China and Western Australia. In these cases, the value of real time access via the internet to fumigation data collected with NDIR Technology from a remote location adds heretofore unknown benefits. Allocation of manpower and materials resources are optimized by access to information about fumigant gas levels in grain storages via the internet. Data is automatically transferred to a central database that can be accessed in real-time from any location with internet access. Intelligent monitors with built-in diagnostics tracking barometric pressure, temperature, sample flows and detector voltages are described. This data collection, data warehousing and reporting platform maintains measurement traceability to certified compliance with secure, encrypted electronic notebook format. Knowing REAL phosphine concentrations allows informed decisions to be made to achieve required CxT and avoid situations leading to target pest phosphine resistance.

Key words: NDIR, phosphine resistance, fumigation monitors, phosphine, internet, remote sensing

Introduction

Stored Product Protection requires a compliant fumigant to be applied as a gas and achieve penetration within the grain mass. Control of insect populations necessitates precise phosphine fumigation control and accurate gas concentration measurements. Phosphine has achieved premier status as the fumigant most used worldwide. It is inexpensive, offers good results when used correctly and leaves no residues but also has unique requirements for accurate measurement.

Currently, stored grain is heavily reliant on phosphine to eradicate infestations. The warmer climates have increased likelihood of more widespread insect occurrence in stored grains. Countries such as Australia have used phosphine since the 1950s. As the need for low chemical residues on grains was mandated on international markets through the 1980s; phosphine became the viable solution and its use increased significantly through the 1990s. World-wide, some estimate that phosphine is used over 80% of the time in grain storage/pest control applications.

Phosphine Resistance

Along with the increased use of phosphine there has been a well-documented increase in the frequency of global resistances of major target pests. This resistance to phosphine is a major challenge to the worldwide grain market. Insect resistance to phosphine occurs because of improper application of the product usually applied as aluminum phosphide tablets under various trade names. In grain storages these react with moisture in the air to release phosphine gas. The gas moves around by diffusion and in air currents inside the silo. Phosphine leaks in non-gas tight silos are quite common.

The widespread use of phosphine gas fumigation in unsealed silos in farm, merchant, and bulk handling facilities has significantly contributed to insect resistance to phosphine fumigations. Frequent exposure of insect populations to sub-lethal dosages allows some insects with a new resistance gene to survive treatment and continue breeding, passing on their resistance. Repeat fumigations favour the insects that carry the resistance gene by allowing them survival, but killing normal, susceptible insects.

When strongly resistant insects are present, phosphine fumigation in an unsealed silo will have virtually no effect on the insects. One key to success is the ability of a silo to pass a pressure test. Compliant Silos that can be sealed well enough will hold the required concentration of phosphine for long enough to kill all stages of the insects, including resistant insects.

Monitoring Phosphine Fumigation Gas Concentrations

Accurate measurements of phosphine gas concentrations will increase the likelihood of successful fumigations. A precise, measured concentration level is desired. Dosage IS NOT concentration! Monitoring done correctly helps avoid situations where either too little or too much gas is used. Real-time web-based diagnostics of measured physical parameters confirms proper monitor performance and in turn defends traceability to compliance in matters of concentration documentation. (Figure 1.)

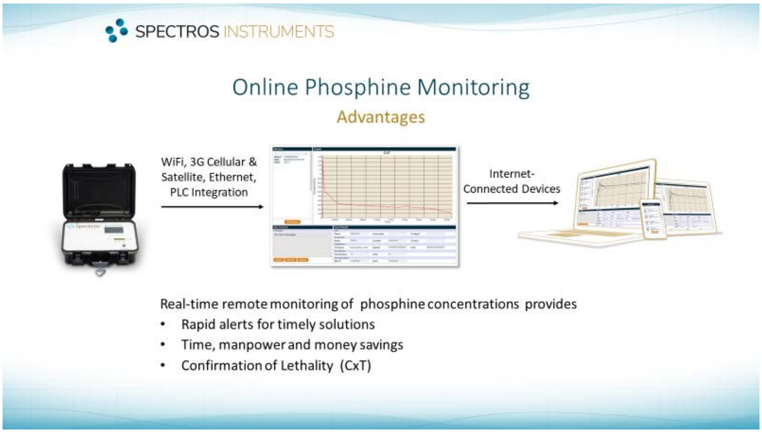

Figure 1: Spectros Instruments Phosphine Monitors Onboard Active, Real-Time Diagnostics assures correct monitor performance and validates phosphine fumigation data

Infrared Spectroscopy measures absolute physical constants and compensates for changes in temperature; barometric pressure; relative humidity as well as other interfering gases. The Spectros Instruments Phosphine Web Based Monitors provide communication protocols (3G cellular, WiFi, ethernet, Modbus RTU) for remote collection, organization, and reporting of fumigation data that the phosphine monitor collects as well as any alerts generated. Goals of increased efficiency, secured electronic records, compliance proof (traceability) and financial savings have been realized. Confidence in target CxT is achieved. (Figure 2.)

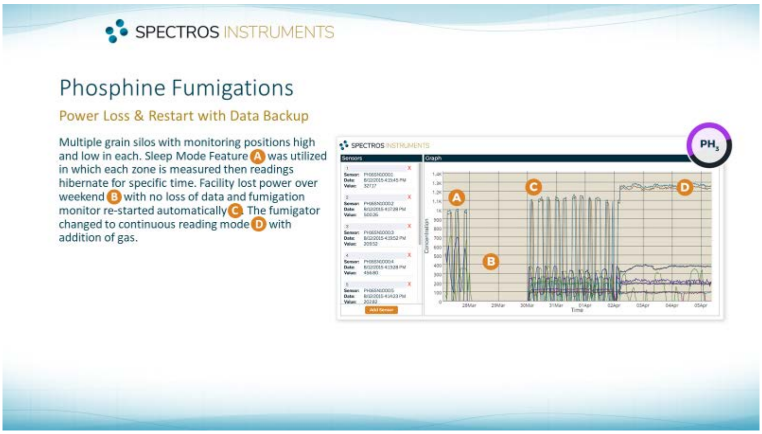

Figure 2: Spectros Instruments Architecture for secure web portal communication, warehousing & analytics of phosphine fumigation data

Table 1 History of Fumigation Gases Monitored by Spectros Instruments

Year	Fumigation Gas	Development Partners
1996	Ethylene Oxide	Johnson & Johnson
1998	Phosphine	Lorillard; RJR
2004	Sulfuryl Fluoride	Dow Chemical
2005	Methyl Bromide	USDA APPROVED
2009	Ethanedinitrile	Linde

Conclusions

Accurate, traceable to compliance and accessible phosphine concentration web monitoring provides immediate actionable data (**Figure 3)** to deliver safeguards that address potential insect resistance. If implemented, these demonstrable advantages allow an expanding global market to reasonably rely on a higher quality, uninterrupted supply chain for stored grain stuffs. Data accuracy, warehousing and easy access of data is key for informed decisions.

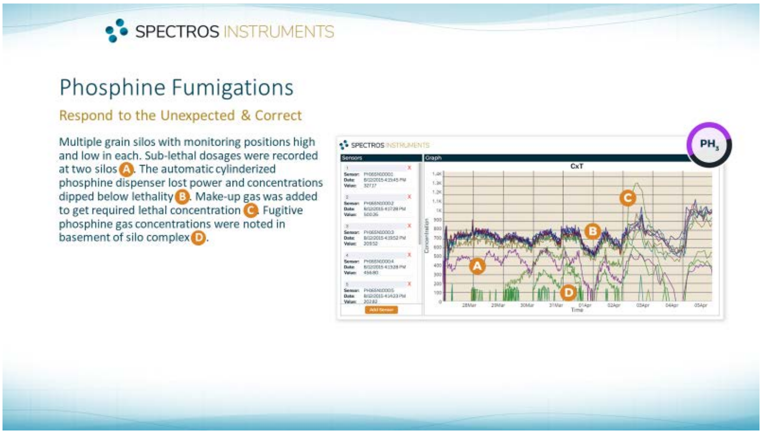

Figure 3: Sixteen-position web-based phosphine fumigation at a grain processing facility. Each line (trace) represents one sampling point of gas concentration vs. time and details proactive corrections avoiding a fumigation failure.

Qualitative Discussion about Reducing Grain Postharvest loss with Mobile storage in Ghana, West Africa

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Abstract

Farming sustainably and protecting gross harvest production correctly provides growers with “health care, school fees and peace-of-mind” (net benefits). Reducing Postharvest and input loss sustains the components of agriculture’s triple-bottom-line which are “accessible nutrition, reduced green-house emissions, and foreign exchange reserves”. Lacking storage that stops grain PHL, agriculture suffers critical problems like the Aspergillus fungi that leaves grain contaminated with invisible aflatoxin that growers cannot consume or market. The objective of the Ghana pilot study was to understand why new ideas/findings like, applying biologicals to the soil before harvest, gross production inputs, virtual markets and especially the spread of stationary grain warehouses have failed to improve the net benefits of farming or agricultures’ triple-bottom-line in sub-Saharan Africa. Qualitative comparison methods were used to identify roadblocks to improvement as scientific monitoring and storage eliminate grain Postharvest loss on the drylands in many parts of the world. Observations suggest net benefits are being ignored as reviews and assessments of primitive or council storage exchange scientific rigor for Stationary Warehouse Prejudice. Scientific rigor illuminates how the qualitative cost of aflatoxin, and quantitative expense of pests, recycling plastic, and empty stationary warehouses impact end-user-cost per unit stored per month. We conclude that Postharvest loss is expensive, and that relatively inexpensive mobile metal storage assets would improve net benefits and the triple-bottom-line.

Key words: grain, aflatoxin, storage, postharvest loss, triple-bottom-line.

1. Introduction

Staple, pulse, and legume (grain) farming means harvesting sustainably as much as possible from