QUICKPHLO-RÔ TECHNOLOGY DELIVERS PHOSPHINE FAST

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A new aluminium phosphide formulation and generator developed by the CSIRO Stored Grain Research Laboratory in conjunction with United Phosphorus Limited, India, provides rapid on-site production of phosphine suitable for the fumigation of sealed structures in the least time possible.

Phosphine, a cheap, effective fumigant of insect control is under threat from insect resistance. However, when properly applied, phosphine still controls the most resistant strains. With the phase out of methyl bromide fumigators are looking to see if phosphine can fill the gap. The main constraint on this is time. Methyl bromide fumigations can be completed in a matter of hours and the commodity shipped once the gas is vented to safe levels. Phosphine fumigations using standard phosphine generating formulations, such as aluminium phosphide, can take from 5 to 10 days because the formulations react slowly with ambient moisture and it often takes 1 or 2 days for effective concentrations to be generated. Rapid generation and application allows for the minimum time of an effective phosphine fumigation.

QuickPHlo-R™ is a quick release phosphine generator that delivers phosphine from the added formulation in 90 minutes to rapidly establish an effective concentration in sealed storage. This formulation, designed to react with water to release phosphine, is simple and safe. Extensive laboratory trials of the formulation focused on selecting the best and safest method for commercial generation technology. Models to deliver up to 25 kg of phosphine are planned. QuickPHlo-R™ technology is a combination of a granular formulation of aluminium phosphide (approximately 75 - 80 % active) and generation equipment including a stainless steel reaction vessel, control panel to manage the generation reaction, a supply of water sufficient to complete the reaction of the formulation and a blower to stir the water and formulation and displace generated phosphine from the reaction vessel. A commercial model designed to fumigate containers and small storages of around fifty tonnes is available. Generated phosphine is passed into recirculated air of the sealed storage by a blower for effective distribution of the gas in about 90 minutes.

Water, matched to the quantity of formulation being digested, is first added to a container above the reaction vessel. A sachet containing specialised formulation is opened and the contents added directly into the reaction vessel, the vessel is sealed and a generation cycle of 90 minutes commenced from the control panel. The water-formulation mix is continuously stirred by air from a blower to ensure an even reaction, maintains the phosphine concentration below the flammability level in the generator (Figure 1), and control the temperature within the water formulation mix (Figure 2). At the end of the 90 minute cycle the residue is washed with a further quantity of water into a second chamber below the reaction vessel where the deactivation of residues is completed. Residual phosphine generated here is removed by a small phosphine scrubber until deactivation is complete. At this stage the generator is ready for a further cycle of generation. Up to eight cycles can be

completed before it is necessary to recover and dispose of the deactivated residues collected in the lower chamber.

A shipping container of 33.1 m^3 (945 cft) capacity using the QuickPHlo-R™ technology at a dose of 1.5 gm^{-3} requires about 50 g of phosphine or a sachet of formulation of 125 g. After the addition of 600 ml of water, the concentration in the container is established in less than 90 minutes.

QuickPHlo-R™ technology is patented and is an efficient and safe approach to rapidly complete the application of phosphine out of the generator and into the storage. When the output is matched to recirculation, even distribution of the gas through the commodity being fumigated is achieved in a minimum time. An effective concentration is established in a few hours rather than days, allowing the fumigator to either shorten the fumigation period by a day or gain an extra day of phosphine exposure within a conventional fumigation period. The former brings phosphine fumigation closer to the short time in which a methyl bromide fumigation can be done in and the latter is becoming increasingly important as longer exposure times are being advocated to offset increased tolerance of insects to phosphine.

Production of phosphine from conventional forms of aluminium phosphide has some limitations including:

- decomposition that takes from 3 - 7 days depending on moisture;
- peak concentrations achieved after 1 - 2 days;
- gas distribution that is not uniform without recirculation;
- no capacity to compensate for leakages from structures;
- safety in handling of formulations;
- no fumigation at low temperatures;
- laborious to apply formulation and recover spent residues;
- residues remain in commodity if not withdrawn;
- can present a fire hazard when improperly applied; and
- some inferior quality products available can lead to fires during fumigation

The QuickPHlo-R™ rapid generator technology over-comes many of these difficulties and provides several occupational health and safety advantages including:

- application and retrieval at ground level removes any requirement for carrying formulation to the top of the store, entering a confined space and then re-entering that space to retrieve spent material after ventilation;
- portability, easing the task of installation and removal;
- deactivated residue collected below the reaction vessel, in a controlled way ready for disposal; and
- reduced hazards associated with storage, handling and transport because the new formulation is much less reactive in air.

With the phase out of methyl bromide and increased time required for phosphine, this ability to rapidly establish fumigation concentrations will become an increasingly valuable choice for fumigators.

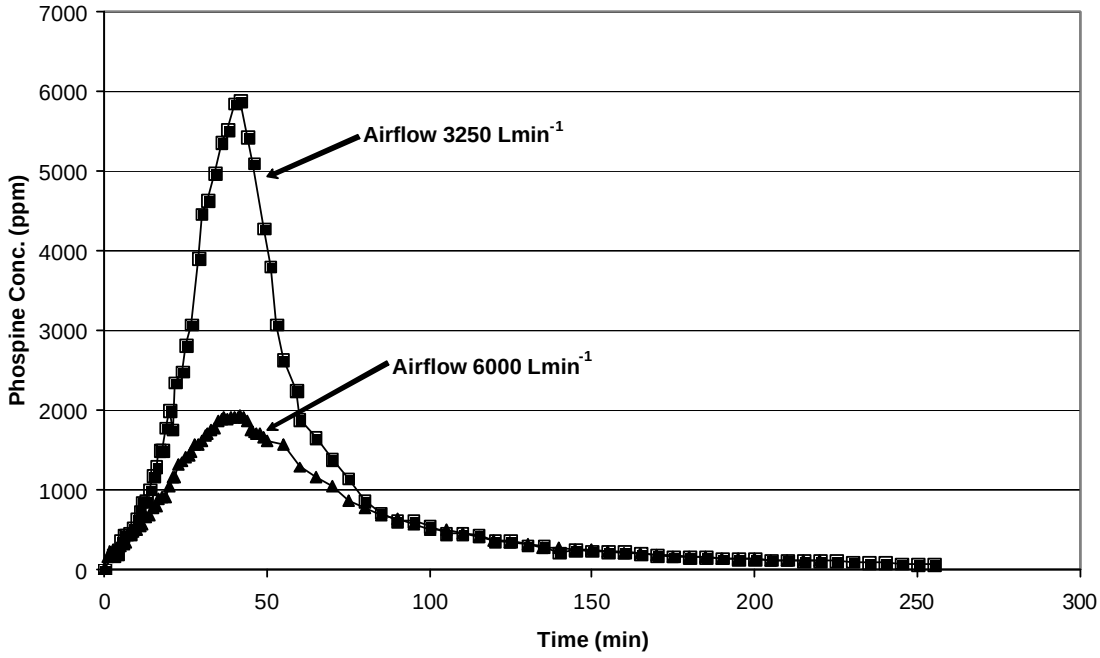

Figure 1 The effect of airflow on the headspace concentration in the reactor during generation of 1 kg of phosphine.

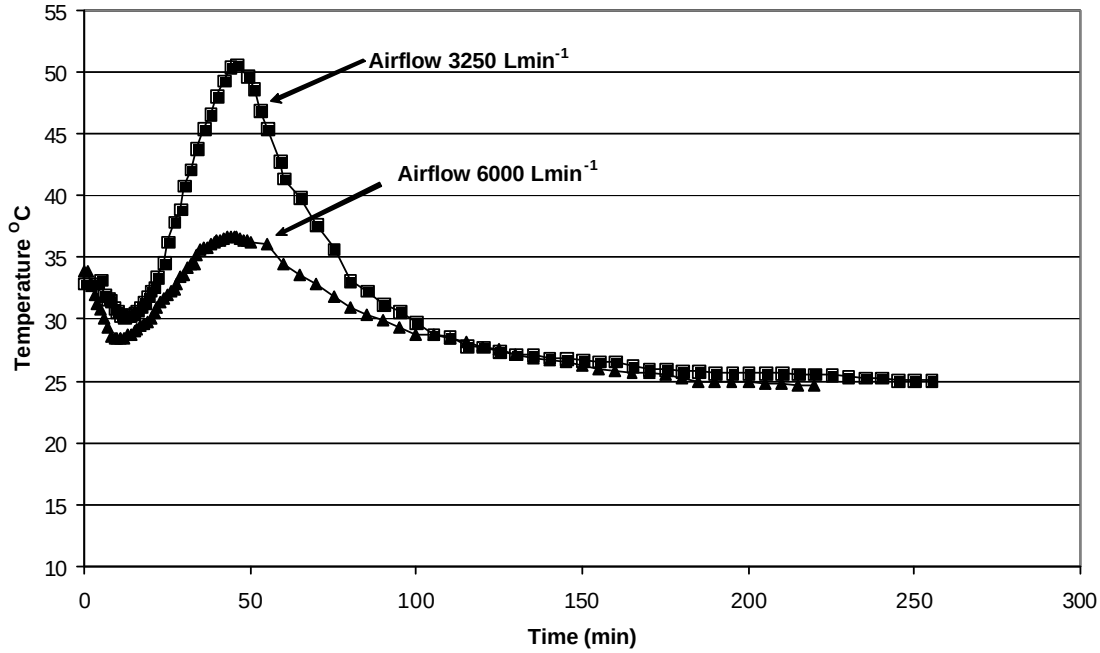

Figure 2 The effect of airflow on the headspace temperature in the reactor during generation of 1 kg of phosphine.