THE POTENTIAL FOR PHOSPHINE TO REPLACE METHYL BROMIDE

Mr Bishu Chakrabarti, Specialist Pest Control Consultant,
46 Seacourt Road, Langley, Berks. SL3 8EW. UK

Pest control is a major tool towards the protection and conservation of commodities. Whilst it is accepted that non-chemical methods of control and agents with selective toxicity should increasingly be sought and employed, it remains likely that chemicals with a wide spectrum of toxicity will, sensibly used, continue to play a significant role in pest control.

With the phased reduction and in some countries, total withdrawal of methyl bromide, phosphine is the fumigant of choice for most durable commodities. Unlike methyl bromide, in addition to achieving the required concentration - time product, exposure times are equally important for phosphine (PH_3). Exposure time differs with the species of insect and temperature and is a key factor for the success of a PH_3 fumigation. Phosphine producing formulations of aluminium or magnesium phosphides are made and marketed in various countries. Phosphine generator from solid formulation is now available in some countries. An electronically controlled apparatus produces PH_3 on the spot by the reaction of metal phosphide with water. Apart from solid formulations, phosphine is also mixed with liquid carbon dioxide (CO_2) and put in pressure vessels for marketing .

The toxicity of PH_3 against insects is well researched and dosage schedules are available for pest control practitioners throughout the world. The effectiveness of PH_3 against mites are not very clear and work is in progress to determine the relationship amongst the dosages, level of gas concentrations and temperatures. The resistance or increased tolerances to phosphine which have arisen are in most cases, due to the improper use of the proprietary products. The resistance can at present be controlled by maintaining the effective gas concentration over a longer period, such as is already required by the most tolerant species of insects. In two major areas, soil and perishable commodities, methyl bromide (MeBr) is used extensively at present. Although it was shown experimentally that PH_3 was effective in controlling nematodes in water suspension, there is little possibility of PH_3 being used for soil-borne pests. Time constraint and phyto-toxicity are the two critical factors against using PH_3 for perishable products but it's use is being researched for some products.

For durable commodities and structures there are new developments which would contribute to more effective PH_3 fumigation.

i. Standard fumigation method for bulk and bagged commodities can be improved considerably by sealing the fumigation area and with the use of virtually impermeable sheetings. Monitoring gas concentrations during the treatment provides valuable information for future control measures in a similar situation.
ii. In addition to (i) , circulation of PH_3 during fumigation will improve the distribution of gas throughout the bulk. This has even the potential to reduce the treatment time by raising gas concentration above the lethal level all thorough the

bulk , quicker than the usual treatment method. On the negative side, leakage will be higher unless the sealing standard is truly high. Also to avoid forming an explosive mixture under reduced pressure, extreme care needs to be taken in designing the recirculation system. Dosing from a cylinder with a mixture of 2% PH_3 in liquid CO_2 would reduce the possibility of forming explosive mixture and also with a sensor - related dosing system, the concentration of PH_3 could be maintained to a required level and for any length of time, thus eliminating the major factors for causing resistance.

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lx. in use in Australia. This is particularly suitable for bulk cereals and legumes in silos. Because the system maintains a positive pressure throughout, there is no ingress of air in to the bulk and selection pressure for resistance is thus avoided.

lx. The success of an in-transit fumigation for containerised cargoes depends entirely on the standard of sealing. Various techniques are currently available for the treatment of cereal in bulk carriers which give variable results, such as broadcasting tablets or pellets on completion of loading in a ship's hold, simple probing in to the bulk, insertion of sleeves with pellets or tablets and recirculation with some of these distribution methods. However, the circulation enhances the gas distribution throughout the bulk and enables lower doses to be used more effectively.

ɔoring insects are not in question.

Phosphine is effective against bark and longhorn beetles, wood-wasp at a dose of $1.2g/m^3$. However, during fumigation against stored product insects in flour mills and food production areas, PH_3 can cause corrosion to electrical and electronic components present in the building, particularly in hot and humid conditions. The heat, PH_3 and CO_2 combination method needs further evaluation before wider acceptance of the technique is recommended.

In the current climate it may be necessary that some of the earlier fumigation practices with PH_3 to disinfest materials which has proved to be less then perfect, in respect of containment and penetration, should be discouraged or abandoned in favour of the greater efficacy. Better training, supervision and competence in handling application and monitoring equipment of greater complexity would be required along with the use of impermeable sheeting, proper sealing and with frequent monitoring for effective phosphine fumigation. Pre and post fumigation monitoring of pest in the problematic areas would also help to formulate a strategy for fumigation.