

PHOSPHINE FUMIGATION

By Johan Stephens

The past two years the pest control industry had to adapt to a fumigation industry without methyl bromide. For decades we had a "quick fix" to infestation problems in the food industry. It would only take a few kilograms of CH₃Br and only a 24-hour exposure to get rid of the problem relatively cheaply. It can be foreseen that other fumigation gases will be introduced (or reintroduced) to the South African market, but one can expect that the volume charge could be expensive as the handling and transporting toxic gases in cylinders is an expensive and complex exercise.

The pest control industry and their customers will have to adapt to the use of PH₃ gas, as in most cases it is currently the only gas available. We need to use the gas responsibly to prevent further insect resistance. In my addition of the *"Manual of Fumigation for Insect Control"*, printed in 1989, the following chemicals were listed as fumigants: methyl bromide, phosphine, hydrogen cyanide, ethylene dibromide, ethylene oxide, ethylene dichloride, carbon disulphide, carbon tetrachloride, chloropicrin, dichlorvos, sulphuryl fluoride, acrylonitrile, dichloronitroethane, acetaldehyde, azobenzene, dichloronitroethane, ethylene chlorobromide, methyl allyl chloride, methylene chloride, nicotine, propylene dichloride, sulphur dioxide, methyl chloroform and carbon dioxide. Of all these gases we are only left with PH₃, as dichlorvos does not kill the egg and pupae stages effectively. Sulphuryl fluoride is expected to be available in the near future.

In order to use phosphine gas effective and safely, one needs to understand the following about the physical properties of the gas:

- PH₃ gas has no specific gravity of only 1.214% and therefore it is a very light gas, which will diffuse in a diluted concentration in all directions, horizontal and vertical.
- In bulk grain commodities it does not move more than 1 to 1.5 meters in any direction.
- It is a slow working gas and in the low metabolism stages of some stored product insects it only starts killing the egg and pupae stages after 72 hours, therefore a minimum exposure of 5 to 14 days will be needed.
- The lowest explosion point is 1.79%, therefore at a concentration of 1790 ppm the gas can explode spontaneous without an ignition source.
- The gas is flammable
- PH₃ gas reacts with copper and precious metals will destroy any electronic equipment and do damage to standard electricity wiring.
- The threshold limit for a 40 hour work week is only 0.1 ppm.
- The maximum concentration to which workers should be exposed for a period up to 15 minutes is 1 ppm, with the stipulation that at least 60 minutes should elapse between such exposures.

- **A respirator with an activated carbon canister for inorganic vapours will only give protection up to 0.5 % PH₃ gas by volume of air. (5000 ppm)**
- **The exposure time should be increased at lower temperatures and fumigation under an average day temperature under 15 degrees C is not recommended.**

The tobacco fumigation trade has been regulated for more than 20 years by CORESTA and the standards specified by them is a good guideline for all PH₃ fumigations. A dosage of only 1.5 g PH₃ gas per cube meter is allowed by the tobacco industry and in order to achieve gas concentrations of over 600 ppm for more than 5 days is a challenge. (1 g PH₃ gas = 718 ppm)

In order to do a successful fumigation attend to the following;

- **The most common mistake made by fumigators is a too short exposure period; a minimum of 5 days is needed in summer and seven days in winter. This is relevant for both magnesium and aluminium phosphide preparations! A very high gas concentration cannot compensate for a cut in exposure time!**



– The do's and don'ts

- Make sure that the volume calculations are correct. For most grain products use a dosage of three to four grams of PH3 gas per cubic meter. For tobacco a dosage of 1.5 g per cub.m. is used.
- A minimum gas concentration of 600 ppm is needed after three to five days and preferably a maximum gas concentration of above 1000 ppm.
- Gas samples need to be taken from the centre of the commodity, not the open air space in-between.
- Where 1 ton bulk bags are fumigated, the minimum exposure time needs to be extended to 7 days and if the bags have an inner lining of more than 30 micron, the exposure time needs to be extended up to 14 days. Use double tarpaulins if needed to force the gas through the bulk bag.

- Make use of proper tarpaulins. The minimum requirement is 180 microns but a minimum thickness of 250 micron is recommended.
- Seal the tarpaulins properly against the floor by taping the tarpaulin to the floor or use sand snakes. The joining of tarpaulins should be avoided where possible, but if joins need to be done, insure that the two tarpaulins are folded over three times and taped on both sides of the joint.



- Ensure that the tarpaulin does not make channels at the corners which allow the gas to escape to the outside.
- Make use of an electronic gas analysing meter to ensure that the necessary gas concentrate has reached in the centre of the product. Make use of a steel probe to sample the gas with at least six 2 mm holes drilled from the sides of the first 60mm of the probe (see attached photo).



Let us all use phosphine gas responsibly and professionally to ensure that the gas will still be effective when used by future generation fumigators.

