A NEW FORMULATION OF ALUMINIUM PHOSPHIDE PROVIDING CONTROLLED RELEASE OF PHOSPHINE.

C.J. Waterford*,. Stored Grain Research Laboratory, CSIRO Entomology,
GPO Box 1700 Canberra, ACT 2601, Australia
P.P. Asher. United Phosphorus Ltd, 11, GIDC, Vapi 396 195, Gujarat, India.

A new formulation of aluminium phosphide was developed in Australia in the early 1990s (Waterford *et al*. 1994). In air, it is stable and inherently less reactive than other currently available aluminium phosphide preparations because it is based on paraffin wax. In water, however, the new formulation reacts steadily only at its surface, a property that makes it suitable for use in generators. Commercial development of this potential application is being undertaken by United Phosphorus Ltd. (India) in collaboration with the Australian grains industry.

The need for a controllable source of on-site phosphine has long been recognised by the Australian grain industry. Controlled delivery of phosphine to a fumigation gives many advantages. This ability, currently provided in Australia by phosphine in cylinders, has allowed the development of active application methods, which enhance rapid gas distribution. However, phosphine supplied from cylinders, though convenient, has some drawbacks.

Generators using metal phosphide as a source for phosphine already exist. Several models using currently available phosphine generating formulations (tablets, pellets), have been used in China (Li Sen *et al*. 1998, Wu Zengqiang, Yuan Chongqiang 1998 and Liu Tanjin 1998). Generally, these generators are designed to deliver phosphine to a grain store in a relatively short time. None function to provide for slow release of phosphine over many days. In practice, because of the reactive nature of currently available aluminium phosphide formulations (tablets or pellets), controlled generation over long periods is complex and difficult, and rapid generation can present significant hazards. These difficulties are the result of the need to transfer tablets or pellets from a dry storage hopper into a wet reactor. This is the main reason why such generators have not been adopted in Australia.

By contrast, generators using the new formulation overcome many of the technical difficulties and complexities when using tablets or pellets. Generator design based on the new formulation is aimed at providing:

- an effective supply of phosphine
- for a range of production rates,
- for extended fumigation exposure periods
- for a number of different fumigation applications.

The First priority for a generator in Australia was to ensure for controlled release of phosphine over extended periods to service active fumigation systems such as SIROFLO®. The prototypes of this generator have undergone extensive development trials in the laboratory and in the field using the new formulation. The results of these trials provided a clear understanding of the limits, within which the new formulation can be used safely.

The generator includes many aspects aimed at

- providing margins of safety required by the Australian industry,
- ease of use for the operator, and
- reliability during use,

so that efficacy and OH&S requirements are met. These will be constantly monitored and upgraded as required.

The second priority for a generator in Australia is for rapid release of phosphine. A prototype version that meets this requirement has also been tested. In this case it is possible to react all the phosphine from the new formulation and deliver it into a fumigation enclosure within five hours.

By combining the controllers used in these two generators it is possible to:

- rapidly establish a fumigation dose,
- top up to compensate for gas loss,
- maintain a constant target concentration.

This technology is being developed by one the world's major manufacturers of aluminium phosphide for use in the Australian grain handling industry. It will provide effective methods for supplying phosphine to a range of fumigation applications for that industry. While development of the technology has initially focussed on the requirements of a bulk grain storage and handling system, there are application opportunities outside of this system, where phosphine generators using the new formulation could provide added flexibility. These include disinfestation of flour mills and food preparation plants, bag stacks and ship fumigation.

References

Li Sen, Shen Fuchang, and Zhou Jainchang 1999. A trial of outside-storehouse phosphine generator in stored grain fumigation. In: Jin Zuxun, Liang Quan, Liang Yongsheng, Tan Xianchang, and Guan Lianghua ed., Stored Product Protection. Proceedings of the 7th International Working Conference on Stored Product Protection, Beijing, Peoples Republic of China, 14-19 October 1998, Sichuan Publishing House of Science and Technology, Chengdu, Sichuan, PRC. 1, 503-5051. ISBN 7-5364-4098-7/TD.15

Waterford, C.J., Whittle, C.P., Winks, R.G. 1994. New aluminium phosphide formulations for the controlled release of phosphine. In: E.J. Highley, E.J. Wright,

H.J. Banks and B.R. Champ, ed., Stored Product Protection. Proceedings of the 6th International Working Conference on Stored Product Protection, 17-23 April 1994, Canberra, Australia. CAB International, Wallingford, UK. 1, 226-235. ISBN 0 85198 932 2.

Wu Zengqiang 1998. An outside-silo rubber bag phosphine generator for stored grain fumigation. In: Jin Zuxun, Liang Quan, Liang Yongsheng, Tan Xianchang, and Guan Lianghua ed., Stored Product Protection. Proceedings of the 7th International Working Conference on Stored Product Protection, Beijing, Peoples Republic of China, 14-19 October 1998, Sichuan Publishing House of Science and Technology, Chengdu, Sichuan, PRC. 1, 503-505. ISBN 7-5364-4098-7/TD.15

Yaun Chonqiang and Liu Tanjin 1998. A trial of a phosphine generator for use in grain fumigation. In: Jin Zuxun, Liang Quan, Liang Yongsheng, Tan Xianchang, and Guan Lianghua ed., Stored Product Protection. Proceedings of the 7th International Working Conference on Stored Product Protection, Beijing, Peoples Republic of China, 14-19 October 1998, Sichuan Publishing House of Science and Technology, Chengdu, Sichuan, PRC. 1, 503-505. ISBN 7-5364-4098-7/TD.15