CYLINDERIZED PHOSPHINE AS A REPLACEMENT FOR METHYL BROMIDE

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Cytec Industries have been manufacturing and marketing cylinderized phosphine fumigant for post harvest applications since 2000. Two product formulations are currently registered in the US, $ECO_2FUME^{®}$ fumigant gas and VAPORPH3OS® phosphine fumigant. $ECO_2FUME^{®}$ fumigant gas is a blend of 2% phosphine and 98% carbon dioxide. VAPORPH3OS® phosphine fumigant is 100% phosphine gas. Both products are packaged in high pressure steel cylinders.

$ECO_2FUME^{®}$ has successfully replaced methyl bromide and traditional phosphide fumigants in a number of applications. This success lies in the many advantages of $ECO_2FUME^{®}$ fumigant gas. $ECO_2FUME^{®}$ is a non-ozone depleting fumigant and produces no waste by-products or residue issues. It is easy to apply and control targeted concentrations during fumigation and does not require the use of heat or fans to achieved distribution. $ECO_2FUME^{®}$ penetrates commodities quickly and aerates with similar ease. $ECO_2FUME^{®}$ fumigant gas can be applied on a wide variety of commodities and on storages of all sizes.

VAPORPH3OS® phosphine fumigant is the newest addition to Cytec's fumigant product line. It is designed to be used for on-site blending with carbon dioxide or dilution with the surrounding air. This blending or dilution is achieved through the use of specialized equipment that has been approved by Cytec. Cytec offers equipment for the on-site blending of VAPORPH3OS®and carbon dioxide. This equipment can be customized to meet individual needs. Its basic design allows for the generation of a 2% mixture of phosphine in carbon dioxide, making it essentially the same as $ECO_2FUME^{®}$.

Fosfoquim de Chile is the manufacturer of the Horn Diluphos System (HDS) required for the dilution of VAPORPH3OS® with air for fumigation. Two models have been designed, field trialed and are commercially available. The HDS80 model is capable of dispensing up to 19g of phosphine per min. and the HDS200 model is capable of dispensing up to 50g/min.

VAPORPH3OS® phosphine fumigant shares the same advantages as $ECO_2FUME^{®}$ fumigant gas. It also has the added advantage of reducing cylinder handling issues. One cylinder of VAPORPH3OS® is the equivalent to 23 cylinders of $ECO_2FUME^{®}$ fumigant gas. This translates into significant cost savings associated with the transportation, storage and handling issues associated with fumigations.

Brief overviews of some successful Methyl Bromide replacement work using cylinderized phosphine are listed below in case study format.

Case 1: Rice (Rough and Finished Stages)

- **Storage Type:** Concrete Silos, Metal Bins
- **Recirculation:** Yes
- **Dispensing Technique:** Made use of existing Methyl Bromide vaporizer on concrete silos. Direct addition to metal bins.
- **Results:** Easy conversion of storage. Easy to dispense and control concentration. No waste or residue issues. Successful control of target insects.

Case 2: Cocoa Beans

- **Storage Type:** Stacked material under tarp, containers
- **Recirculation:** No
- **Dispensing Technique:** Direct addition under tarp at one location. Direct addition to container.
- **Results:** Easy to dispense and control target concentration. Penetration of fumigant fast and thorough. No change to current fumigation practices with respect to site preparation or aeration. No waste or residue issues. Successful control of target insects.

Case 3: Mill

- **Storage Type:** Structural
- **Recirculation:** No
- **Dispensing Technique:** Direct addition to each floor of building from ground level. No heaters or fans required for gas introduction or distribution. Fumigant used in conjunction with heat (85-90^{o}F) and additional carbon dioxide (5-10%). Phosphine dosage maintained at low concentrations (<100ppm) to control corrosion.
- **Results:** Easy to dispense and control target concentration. Quick and thorough distribution of fumigant. No waste or residue issues. Successful control of target insects in 24-36 hours of exposure. Over 70 mills have been fumigated successfully to date using this method.

Case 4: Fresh Fruit

- **Storage Type:** Cold Storage of tropical fruits, apples, grapes and kiwi
- **Results:** A source of pure phosphine without ammonia in cylinders has opened the possibility for fumigation of fruits, living plants and flowers without phytotoxicity, or environment concern. Early testing looks very promising. Large scale study underway in Chile by the Fruit Development Association (FDA). This group is working in close contact with the Chilean authorities, SAG, and also with contacts to USDA.