ProFume® Gas Fumigant…The First Decade

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ProFume® Gas Fumigant received its first registration in Switzerland for flour mill fumigations in 2003, followed by the US Registration in 2004 and California in 2005. This marks the tenth anniversary of the first commercial use registration for ProFume®. Post-Harvest research for Sulfuryl fluoride began in 1996 in the state of California, where many field fumigation trials were performed to evaluate and optimize applications of ProFume® in a commercial environment. Since then, millions of pounds of ProFume® have been successfully applied throughout the US, and has proven to be a viable alternative to methyl bromide under most fumigation applications.

The post-harvest fumigation culture has changed since the phase-out of methyl bromide began many years ago, when large amounts of "Critical Use Exemption" (CUE) methyl bromide was available. As the volume of CUE fumigant declined, the industry became more receptive to alternative technologies because they were limited in choice and became aware that adoption was imminent and they must make changes. This culture has finally changed, and the industry is now very receptive to adopting ProFume® and other alternatives in their daily operations.

One of the most critical steps in the adoption of ProFume® as a commodity fumigant was the CODEX MRL listing for sulfuryl fluoride in 2006. This has enabled various commodity groups to convert to ProFume® without concerns over residue tolerances. The California rice export market is an excellent example of this transition. Many sea containers were treated on a daily basis with methyl bromide, but this treatment has been replaced with ProFume®, specifically for requirements of short exposure periods due to a limited supply of containers, demurrage charges, and a dwindling supply of CUE methyl bromide fumigant. Phosphine is not a preferred fumigant under many circumstances because of the 48 hour minimum exposure period requirement. Grains, dried fruits, and other commodities are successfully being fumigated with ProFume® and exported throughout the world.

As the industry has incorporated ProFume® into their operations, many have found ways to utilize this fumigant in novel and innovative applications. Also, by understanding the physical properties of sulfuryl fluoride, we have found many advantages to using ProFume®:

- ProFume® has been considered for use in raisin stacks where electrical power is lacking for running fans for recirculation or aeration. We have found that recirculation fans are not necessary to obtain equilibrium within these large 83,000 ft^3 stacks, so electrical power is not necessary giving them the ability to fumigate at any location.
- In California, during the almond harvest, the hullers and shellers cannot keep up with the harvest schedule, so the nuts are stockpiled on the farm and fumigated mostly with metal phosphide fumigants. The Air Pollution Control District prefers that fumigants other than metal phosphides be used because of the generation of ammonia gas. ProFume® is a good alternative, and may eventually replace metal phosphides for this use. Initial trials have shown excellent results with good gas distribution.
- In Nebraska, a 1,000,000 ft^3 corn bunker was treated with ProFume® because high winds may cause expensive tarpaulins to tear during a typical phosphine fumigation with a long exposure period (up to

seven days or more). High powered fans are used to keep negative pressure on the tarps during storage to keep the tarps from billowing and tearing in the wind, but are turned off during a phosphine fumigation. By converting to ProFume®, a fumigation may be performed in 24 hours or less, thus reducing the risk of having winds tear the tarps during the exposure period.

- Tree nuts stored in upright silos, bins and warehouses can successfully be fumigated without the requirements of recirculation fans. When methyl bromide was once used for this purpose, expensive recirculation fans and ducts would have to be installed in order to obtain consistent gas distribution within the storage enclosure, but ProFume® has been found to penetrate and distribute evenly within these structures in less than two hours without forced recirculation.
- Long-term storage of commodities allows for accumulation of CT Product over a long exposure period, which drastically reduces the required pounds of ProFume®. For many applications in grains, nuts, beans or dried fruit in storage, the application costs of ProFume® are reduced to a point where it is economically competitive with other fumigants.
- ProFume's® low sorptive qualities make it an ideal fumigant to use in the tree nut industry, since both walnuts and almonds show very high sorption of methyl bromide and phosphine fumigants. Since sulfuryl fluoride shows insignificant sorption in these commodities, the re-addition of ProFume® after the initial application is usually not necessary. It has been shown that walnuts (Leesch, 2008) and almonds (Reddy et al, 2007) are highly sorptive to phosphine and the fumigant must be re-introduced in order to maintain efficacious concentrations.
- ProFume®'s high vapor pressure can prove to be beneficial when fumigating over an allotted period of time. Aeration times are considerably less than methyl bromide, which can give the option for more time to be added to the exposure period resulting in reduced initial ProFume® pounds required, and a significant cost savings.
- Confined space entry restrictions have also created opportunities for ProFume® since applications from outside the storage areas are sometimes mandated by operations or regulatory. Since ProFume® is applied from outside structures, entry into permit required confined spaces is usually not required.
- In CA, there are concerns with the Department of Toxic Substance Control's consideration of aluminum phosphide residue being classified as a "Hazardous Waste". This requires permits and significant fees as well as HAZWOPER Training and has many metal phosphide users concerned. The Department has not made any decisions yet, but may cost users thousands of dollars if implemented.

As we continue to use ProFume® Gas Fumigant, we will utilize this important methyl bromide alternative in ways that will be efficient, effective and sustainable. There are no other standalone fumigants in development that have both structural and commodity uses that are as practical and effective.

References Cited

Leesch, J. 2008. Phosphine Walnut Sorption. USDA-ARS Independent Research Study.

Reddy, Palvai Vanitha, Y. Rajashekar, K. Begum, B. Leelaja and S. Rajendran. 2007. The relation between phosphine sorption and terminal gas concentrations in successful fumigation of food commodities. Pest Management Science 63:96-103