STORAGE

FUMIGATION

ALUMINUM PHOSPHIDE

Fumigation using aluminum phosphide

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maintaining grain quality from grain-infesting insects is a never-ending challenge. To help, Milling & Grain asked two industry professionals from Douglas Products to share their experience using aluminum phosphide fumigant to protect stored grain.

Why is fumigation important?

Baker: We all want — and food regulations require — safe and nutritious food. Grain-infesting insects are a leading threat to grain quality. Fumigation is an important and proven means to eliminate target pests in grain and other commodities as well as pest harbours in the storage facility.

Fumigation is a word I hear mistakenly used to refer to fogging treatments. It’s true that both are used to control pests in a space, but what fogging does is use application equipment to generate insecticide particles into the air as a smoke, fog or mist. With a fogging treatment, insecticide is suspended into the air, but the insecticide only penetrates grain or insect harbours to a limited degree in the structure and targets adult and immature stages.

Depending upon airflow, equipment used, and applicator skill, the insecticide may not even reach all the intended treatment areas. In contrast, with fumigation the gas molecules will diffuse throughout the enclosed space and penetrate to reach pests in grain and harbours. Fumigation is lethal to all life stages of pests present in the grain and harbours. Fumigation is lethal to all life stages of pests when the proper concentration of the gas is held over the range of dosages for various storage structures.

How long has aluminum phosphide been used?

Bigler: It is not clear when aluminum phosphide was invented, but we know it was used as a fumigant in Germany as early as in the 1930s, and then used during World War II to treat German stores of grain. After the war, there were patent disputes between two manufacturers, one in East Germany and one in West Germany.

Those lawsuits were eventually thrown out, and in the later 1970s, companies in other countries began to manufacture and market phosphide products. Aluminum phosphide has been used in the US since at least the early 1960s. Douglas Products started marketing aluminum phosphide products in the early 1980s and later purchased the aluminum phosphide labels from Drexel in 2008. Today, we are a registrant and we market our phosphide in PH3 branded tablet and pellet formulations.

What is the difference in the two formulations?

Baker: Both products perform similarly. Tablets weigh three grams and release one gram of hydrogen phosphide gas. Tablets are packed in aluminum flasks containing 500 tablets each. Pellets weigh 0.6 grams each and release 0.2 grams of hydrogen phosphide gas. Pellets are packed in aluminum flasks containing either 1,660 or 2,500 pellets. Both are solid formulations that contain 60 percent active ingredient with 21 kilograms of material per case.

One tablet of five pellets produces a concentration of 25 ppm of hydrogen phosphide gas in a volume of 1,000 cu. ft. The pelleted formulation tends to react and release a little faster, about a 24-hour faster difference, and tends to be used more often in northern climates where it is cooler. Tablets tend to be used more often in southern states where the climate is warmer.

What happens chemically with phosphine?

Bigler: When exposed to the air, aluminum phosphide pellets or tablets react with moisture in the air to produce hydrogen phosphide gas, often commonly referred to as simply “phosphine.” The chemical properties of hydrogen phosphide are what make it a great fumigant.

The combination of its low boiling point, specific gravity and vapour pressure causes it to penetrate grain and fill the space without the need for mechanical ventilation. When the fumigation is completed, the gas desorbs rapidly from the commodity and treated space.

The residue, for the most part, is aluminum hydroxide. The residue can be disposed of without hazard and is not an issue for food, unless the grain is intended for use by a company that has a no-residue policy. If so, the aluminum phosphide tablets or pellets can be placed inside commercially available permeable gas bags during the application to allow the residue to be confined within the bags.

Are there important use precautions or restrictions?

Bigler: No phosphide results, you need to look at air movement in that bin. Hydrogen phosphide gas is light and active and tends to rise instead of moving down, so look at recirculating the air if there are fans. In a column of grain or in flat storage you can pulse the air by running fans for an hour or two and then shut them off for some time to allow the gas to equalise in the space.

Steel tanks and ships tend to be tighter and hold the gas better than concrete, and new facilities are generally tighter than older ones. With any container it’s important to inspect and seal openings and vents.

What can be done to help ensure results?

Bigler: In stored grain you need a kill and what determines that is the concentration of fumigant active ingredient over the time of exposure. That is C x T. In fumigation talk, C being concentration and T time. You can achieve the same results with less fumigant over more time versus much more fumigant over a shorter period.

The important point is the fumigation needs to be extended out long enough. A lethal CT can be ensured by taking readings of concentrations using concentration lines to draw air samples at three or four levels within the grain column.

Baker: Management needs to work with fumigators, whether they are in-house or contracted. The role of fumigation is to prevent insect damage or stop it when necessary. But fumigation is only one part of an integrated pest management program.

The condition of the facility, day-to-day operations, empty bin treatments, how new grain is brought in and more play a role in maintaining grain quality. It’s the job of the fumigator to make sure management understands what fumigation can and cannot do. It’s the job of management to listen to their expert advice.

Any other advice?

Baker: No two grain facilities are the same, so if your results are not as good as desired, we’re available to take your questions and offer suggestions. We are experienced former fumigators and are available to help with any type of fumigation. As a leader in fumigation, Douglas Products has a long track record of use of fumigants by offering training on the use of safety equipment, site signage and product stewardship training.

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