

Unit 8: Common Fumigants

Learning Objectives

For each fumigant discussed in this unit, the reader will be able to:

- Describe basic application and aeration techniques.
- Understand its mode of action.
- Use it safely and effectively.
- Know which detection equipment best measures its concentration.
- Dispose of its residues and empty containers in a safe and legal manner.

This unit discusses some of the most common fumigants used to fumigate food and stored commodities. By reading it, you will understand how each of these fumigants works and how to use them effectively. This unit will explain basic application and aeration procedures. You will learn the risks of each chemical. You will discover how to protect yourself and others from exposure. Selection and use of detection equipment are discussed. This unit will also outline how to properly dispose of leftover fumigant and associated residues.

Terms to Know

Bonnet – The cap that covers the valve and safety cap on a fumigant cylinder. The bonnet protects the valving system from damage and prevents accidental release of the fumigant.

Corrosive – Able to weaken or destroy something gradually.

Deactivate – To make something ineffective. For example, by deactivating fumigant residue, you would be neutralizing its toxic effects.

Formulation – The form in which a pesticide is offered for sale to the user (tablets, pellets,

Prepacs, etc.). A formulation contains both the active ingredient and inert materials.

Inert Gas – A gas that does not have toxic effects.

Prepac – Metal phosphide fumigant tablets that are packed in a gas-permeable material.

Residue – Traces of fumigant that remain after treatment.

Threshold Limit Value-Time Weighted Average (TLV-TWA) – The average concentration of fumigant for a normal 8-hour workday and a 40-hour workweek to which workers may be repeatedly exposed without adverse effect. The TLV-TWA is expressed in parts per million (ppm). It is used to monitor long-term exposure.

There are a limited number of fumigants on the market. Each has its own advantages, disadvantages, uses, and limitations. This unit does not intend to indicate a preference toward any one fumigant. You must make your own choice based on the pest, the commodity, or structure that is infested, and the label information.

Disclaimer

Just because a fumigant appears in this manual does not mean that it is legal to apply. Laws and regulations governing pesticides change often. Fumigants described here may no longer be legal. Always check current laws and regulations before using any fumigant for any purpose. For example, at the time of this writing, methyl bromide has been labeled an ozone-depleter. As a result, this widely used fumigant may soon be banned. Keep up-to-date on the state and federal laws and regulations that apply to you.

Methyl Bromide

Methyl bromide is a colorless gas. At normal concentrations, it is odorless, tasteless, and has no irritating qualities to indicate its presence. However, at concentrations higher than those normally used in fumigation, methyl bromide

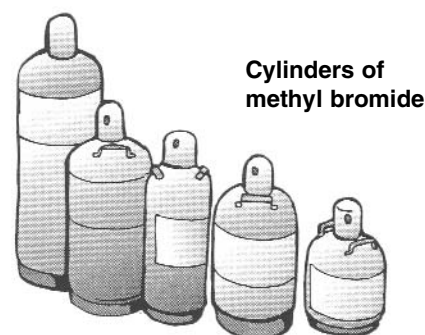
gives off a sickly sweet odor. Methyl bromide is toxic to all stages of insect life. The gas is 3.3 times heavier than air and tends to stratify, settling out in low places. Fans are needed to ensure thorough mixing of the gas with air. With fans, methyl bromide penetrates most commodities very well.

EPA Alert

At the time of this printing, methyl bromide is believed to contribute to the depletion of the earth's ozone layer. For this reason, the EPA has initiated action under the Clean Air Act to phase out the production and use of this fumigant. A 70-percent reduction in production was mandated by January 1, 2003. The complete phaseout of production was scheduled for January 1, 2005. The Environmental Protection Agency (EPA) is amending the regulations governing the phaseout of methyl bromide (MeBr) to allow for exempted production and import beyond the phaseout date of January 1, 2005, for critical uses and to address sales of pre-January 1, 2005 stocks of methyl bromide for critical uses. This rule makes approximately 8,942 metric tons of methyl bromide available for critical uses in 2005, which is 35 percent of the U.S. methyl bromide 1991 consumption baseline. The 1991 consumption baseline was established in the 1993 rulemaking, to cap and phase out methyl bromide production and import. An additional 2.5 percent of baseline was recently authorized for 2005 critical uses by the Parties to the Montreal Protocol at their meeting on November 26, 2004. EPA is beginning the notice-and-comment rulemaking process on the supplemental amounts to make them available for critical uses as quickly as possible. It is your responsibility to keep up-to-date on any changes that affect the legal use of products you intend to use.

Formulations

Methyl bromide is available as a compressed liquid in 1 1/2-pound cans or in cylinders containing up to 200 lbs. It is also formulated with chloropicrin. **Do not use chloropicrin on food or stored commodities.**



Cylinders of methyl bromide

Uses

Use methyl bromide to control pests in processed food or feed. There are established tolerances for methyl bromide residues on many commodities. Pure methyl bromide is not labeled for use in empty structures. It is strictly for the treatment of raw or processed commodities and some nonfood products. When mixed with chloropicrin, do not use methyl bromide on processed foods; in dairy, cheese, or meat plants; or where there are living plants. You can use the methyl bromide/chloropicrin combination to treat empty grain bins and warehouses.

There are several materials that should not be exposed to methyl bromide. Some react with the gas and create long-lasting odor problems. Others may be damaged by the gas. Do not use methyl bromide to treat the following items:

- Iodized salt
- Full fat soya flour

- Items that may contain reactive sulfur compounds such as some soap powders, some baking sodas, and some salt blocks used for cattle licks
- Sponge rubber
- Foam rubber as in rug padding, cushions, and mattresses
- Reclaimed rubber such as rubber stamps
- Furs
- Horsehair
- Pillows (especially feather pillows)
- Leather goods (particularly white kid or any other leather goods tanned with sulfur processes)
- Woolens
- Viscose rayons (rayons produced or manufactured by a process that uses carbon bisulfide)
- Paper (especially silver polishing paper and writing paper cured by the sulfide process)
- Photographic materials used in dark rooms, and
- Cinder blocks

It is also important to remove all charcoal products before fumigating with methyl bromide. Charcoal can absorb methyl bromide reducing its effectiveness.

Application

Small cans of methyl bromide are ideal for small jobs. A special apparatus is required. The apparatus punctures the can, and polyethylene tubing transfers the gas from the can into the fumigation enclosure. It is usually not necessary to heat the fumigant.

For larger jobs, use cylinders. First, attach 1/4-inch copper tubing to the cylinder using a gastight fitting. Then, form the tubing into a 25-foot coil and immerse it in water heated to 150°F. The tubing from the heater to the fumigation chamber should be either copper or polyethylene. Use as few fittings as possible. It is difficult to keep fittings from leaking. Because methyl bromide is heavier than air, be certain that you place the outlet of the introduction tube high within the fumigation enclosure.

When methyl bromide changes from liquid to gas, it becomes very cold. Even when heated, there is a chance that the low temperature created will change a part of the gas back to a liquid. To protect the commodity from any dripping methyl bromide, place a pan beneath the outlet end of the tubing.

Methyl bromide works quickly. Exposure times of 24 hours or less are normal. If the cylinders are outdoors, it is not necessary to wear a respirator during the introduction of the fumigant. However, you must have a SCBA ready and available.

Methyl bromide liquid vaporizes into gas at temperatures above 39°F. For this reason, do not use methyl bromide when the temperature in the fumigation area is below 40°F.

Precautions

If the concentration of methyl bromide is unknown or exceeds 5 ppm, each person in the exposed area must wear a SCBA. You may supplement the SCBA with a hose that provides air from an outside source as a backup. Regardless of the fumigant concentration, appropriate respiratory protection must be available at the fumigation site in case it is needed.

Do not wear jewelry, gloves, goggles, tight clothing, a chemical protective suit, or rubber boots when using methyl bromide. The gas can become trapped inside clothing and cause skin damage.

Methyl bromide is not a fire hazard at normal application rates. In fact, it used to be an ingredient in fire extinguishers. Still, you must extinguish all open flames and pilot lights before using methyl bromide. It produces corrosive acid when it reacts with moisture near a heat source. In addition, while methyl bromide does not corrode most metals, it can react with aluminum or magnesium in the absence of oxygen to form an explosive mixture. Therefore, aluminum or magnesium tubing should never be connected to

a methyl bromide cylinder. Be sure neither metal is present during vacuum fumigation with methyl bromide.

Aeration

During fumigation with methyl bromide, commodities absorb inorganic bromide residues. Aeration does not remove these compounds. After repeated treatments (as may occur with flour), these residues may exceed legal tolerances. The Food and Drug Administration (FDA) may seize the product. If this occurs, the last fumigator may be held responsible. Always check residue levels before fumigating any product. Be sure your treatment will not increase residue levels past legal limits.

Detection

You can measure methyl bromide concentrations with halide gas detectors, color diffusion detector tubes, and thermal conductivity analyzers (TCAs) such as the Fumiscope®. Always consider the sensitivity of the detection device when making your selection. For example, the halide gas detector and Fumiscope® only provide an indication of methyl bromide presence. They do not indicate concentration. Use these devices to detect leaks. Halide detectors and TCAs do not read low enough to detect gas levels for reentry purposes. To check fumigant levels before reentry, use color diffusion detector tubes.

Disposal

Dispose of methyl bromide containers according to label directions. Return cylinders, empty or partially used, to the manufacturer. Cans are not usually returnable. Instead, keep empty cans in a well-ventilated, secure location for 12 hours before disposal. If local authorities allow, you may be able to recycle the cans. Otherwise, dispose of them according to local regulations.

Phosphine

Aluminum phosphide and magnesium phosphide at a glance: (also called hydrogen phosphide and PH₃)

Required clothing:

- Dry cotton gloves if you contact the pellets, tablets, or dust.

Respiratory protection:

- Respiratory protection is required if exposure is likely to exceed the 8-hour TWA of 0.3 ppm during application, or is above 0.3 ppm at any time after application is complete.
- Concentrations less than 0.3 ppm: no respiratory protection required.
- Concentrations 0.3 to 15 ppm: NIOSH-approved full-face gas mask and hydrogen phosphide canister.
- Concentrations 15.1 to 1,500 ppm: NIOSH-approved full-face gas mask and hydrogen phosphide canister for escape only.
- Concentrations greater than 15 ppm or when concentrations are unknown: NIOSH-approved SCBA or supplied-air respirator.

Uses:

- What: Raw agricultural commodities such as grains, nuts, seeds, cotton, wool, and tobacco. Animal feeds and feed ingredients, processed foods, and nonfood items.
- Where: Boxcars, containers, ships, and other transport vehicles, bins, silos, barges, under tarpaulins, in small sealable structures and enclosures, mills, food processing plants, and warehouses.

There are two main types of phosphine fumigants: aluminum phosphide and magnesium phosphide. These “metal phosphides” are formulated as solids that react with moisture in the air to produce “hydrogen phosphide” (phosphine gas). Phosphine also comes as a bottled product (phosphine dissolved in liquid carbon dioxide).

Phosphine gas is colorless and highly toxic to all stages of insect and animal life. It has a distinct garlic or carbide odor that is readily detectable at levels below worker protection limits (0.3 ppm). The odor is due to an impurity rather than the phosphine gas itself. However, odor is not a reliable indicator of the presence or absence of phosphine. This is especially true when phosphine has been in contact with a commodity for a considerable length of time.

Formulations

Both aluminum phosphide and magnesium phosphide fumigants are available in a number of formulations. These include pellets, tablets, Prepacs, bags, and plates. Since metal phosphide fumigants react readily with moisture, they must be packaged in gastight containers. Phosphine can also be applied from cylinders containing phosphine in liquid carbon dioxide.

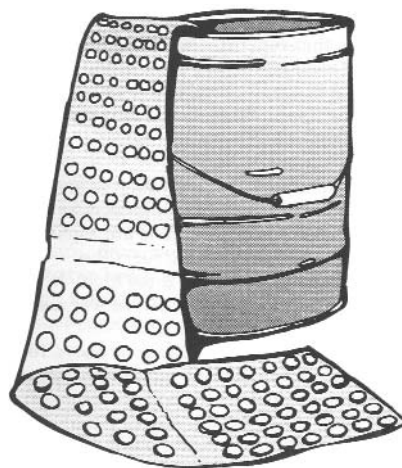
Most aluminum phosphide formulations yield about 1/3 of their weight in phosphine. Aluminum phosphide is available in 0.6 gram pellets and 1.0 gram tablets.

Magnesium phosphide comes as Prepacs for spot fumigation, and in polyethylene plates and strips for space and commodity treatments.

Pellets: Pellets weigh 0.6 grams. They yield 1/3 (0.2 grams) of their weight in phosphine. They are available in resealable flasks.

Tablets: Each tablet weighs 3 grams and releases 1 gram of phosphine. Tablets are available in resealable flasks. Tablets are also used in Prepacs and Prepac Ropes.

Packaged Fumigants: Packaged fumigants are available in several forms. These include bags, Prepacs, and plates. In all cases, the metal phosphide is encased in a gas-permeable material, which is then overpacked in gastight



Aluminum phosphide Prepac rope

containers. Bags containing powdered aluminum phosphide formulation are available. Each bag will release 11 grams of phosphine. Many of these packaged fumigants are not resealable. Once opened, you must use the entire contents.

Uses

You can use metal phosphides to treat spaces and commodities and to control certain burrowing pests. Commodities treated with phosphine include processed foods, nonfood items, animal feed, and feed ingredients.

Aluminum phosphide is the main form used to treat agricultural commodities. Magnesium phosphide is more reactive than aluminum phosphide. It is preferred when rapid release is desired and when treatment is performed at lower temperatures and humidities.

Application

One advantage of aluminum and magnesium phosphide products is that they are easy to use. Start by calculating the cubic volume of space you intend to treat. (See Appendix B for information on calculating volume.) Then, count out the required number of pellets, tablets, plates, Prepacs, or bags. Always wear gloves when handling phosphide tablets or pellets. Packaged metal phosphides such as bags and Prepacs do not require gloves. Place the pellets, tablets, or bags onto a tray or sheet of cardboard. Slip the tray under the fumigation tarp or inside the fumigation chamber or structure. The moisture in the air will liberate phosphine in about one day, depending on the

temperature and humidity. When treatment is complete, usually in two or more days, aerate the commodity or area. Aeration is rapid.

Fumigation with phosphine takes time. Buildup of the fumigant is slow. It may take 12 to 48 hours to reach the desired concentration of gas. If the atmosphere or commodity is very dry, the process may take even longer. In areas where the relative humidity is low, you can increase the speed of gas liberation by placing a pan of water under the fumigation tarp. You can also spray water onto the floor or dirt. Be very careful. Do not allow any water to contact the phosphine. An explosive mixture may result. Normal exposure periods can take three to five days. If gas concentrations are lower than required after 72 hours, extend the fumigation period.

Magnesium phosphide releases phosphine faster than does aluminum phosphide. Therefore, you are more likely to need respiratory protection when applying magnesium phosphide.

Phosphine is not effective at temperatures below 40°F. Be sure to keep aluminum phosphide and magnesium phosphide products dry during storage. Since magnesium phosphide is more reactive than aluminum phosphide, it is usually recommended for fumigation in cool and/or dry conditions.

Pure phosphine is about 17 percent heavier than air. However, since it is given off slowly, it does not tend to stratify. Fans are not needed to ensure even distribution except when treating bulk commodities. Because of its low sorption and good penetration capacity, phosphine tends to leak from bins that are not gastight. Phosphine will go where the airflow goes.

Precautions

Phosphine does not accumulate within body tissues as do other fumigants. Any phosphine gas entering the body will be completely eliminated within 48 hours. Even so, phosphine is very toxic to humans. The threshold limit value-time weighted average (TLV-TWA) is only 0.3 ppm. This means the gas is about 60 times as toxic as methyl bromide. However, because of the way phosphine is liberated and because of its distinct odor, it is far safer to handle than other fumigants.

Applicators and other workers must wear approved respiratory protection if the concentration of phosphine in the work area is likely to exceed an 8-hour time-weighted average (TWA) of 0.3 ppm. A gas mask/canister combination may be used at concentrations up to 15 ppm. Above this level, or when the concentration is unknown, a SCBA must be worn.

After the application, workers must wear respirators whenever the concentration of phosphine is unknown or exceeds 0.3 ppm. The TWA applies only during application. "Application" is the period covering the opening of the first container, applying the appropriate dosage of the fumigant, and closing the site to be fumigated. At all other times, anyone exposed to fumigant concentrations exceeding 0.3 ppm must wear respiratory protection.

Always wear gloves when handling aluminum phosphide pellets, tablets, and the residue that remains after fumigation. Aerate used gloves and other contaminated clothing in a well-ventilated area before washing them. Wash your hands thoroughly after handling phosphide materials.

Phosphine is extremely flammable. Never open metal phosphide containers near an open flame or in a flammable atmosphere. Fire or an explosion can occur if the phosphine concentration is too high. It is better to open containers outdoors or near a fan. Phosphine may also ignite spontaneously at concentrations above 18,000 ppm. If you conduct the fumigation properly, however, concentrations will not approach this level. Phosphine is also explosive under vacuum conditions. Never use it for vacuum fumigation. Finally, do not stack or pile phosphine pellets or tablets as this can create a fire hazard.

To reduce the risk of flammability, some phosphine products contain ammonium carbamate in their formulation. This helps to produce a gaseous mixture that will not burn or explode at normal application rates.

Both aluminum phosphide and magnesium phosphide can react violently if they contact water.

Never allow aluminum or magnesium phosphide or their residues to directly contact

any processed food. To prevent the residue from contacting a commodity, place the aluminum phosphide pellets or tablets on a tray instead of adding them directly to the commodity. Aerate foods and feeds that have been treated with phosphine for 48 hours before giving them to the consumer. Dispose of any residue according to the label instructions. (See “Disposal” later in this section.)

Phosphine gas, especially at high temperatures and humidities, will corrode silver, copper, and copper alloys. Copper-containing equipment, such as computers, telephones, and other electrical devices, may be severely damaged. Protect or remove items that contain these metals during treatment. Exercise care.

Aeration

Areas treated with phosphine aerate rapidly. To be safe, open all doors and windows first to assure good ventilation. Then, while wearing respiratory protection, open the fumigated space or remove seals from the edges of a tarp. Some aerations will be complete in one to two hours. Others will require much longer aeration periods. Take gas readings to be sure concentrations are below 0.3 ppm.

Detection

Several reliable gas detectors are available to measure phosphine gas. Glass detector tubes are the most common. Two types of glass tubes are available. The first measures low levels of gas (0.1 to 40 ppm). Use this type of detector to determine worker exposure levels and to locate leaks. The second type of detector measures high levels of gas (50 to 2,000 ppm). Use it to determine if phosphine levels during treatment are high enough to kill the target pest.

Disposal

Metal phosphide fumigants leave a white powdery residue. This residue contains a small amount of unreacted phosphide that may or may not need to be deactivated. The deactivation process differs somewhat for aluminum phosphide and magnesium phosphide.

NOTE: If the fumigant residue is grayish green, the metal phosphide is only partially spent. Extend the fumigation period until the residue turns white, or use extreme care during the deactivation process.

Always deactivate metal phosphide fumigants outdoors. Respiratory protection may be required.

To deactivate residue from aluminum phosphide pellets or tablets, prepare a deactivating solution. Fill a small to large container with water. Fifty-five gallon drums work well for large amounts of aluminum phosphide. Add enough nonsudsing detergent to create a 2-percent solution. Fill the container to within a few inches of the top with the deactivating solution. Then, stir in the aluminum phosphide. Do not add more than about 45 to 50 pounds of aluminum phosphide to 15 gallons of water-detergent mixture.

To deactivate magnesium phosphide pellets or tablets, no detergent is needed. Instead, fill a container to within a few inches of the top with water ONLY. Add the phosphide residues until they are saturated and sink to the bottom. Because unreacted or partially reacted magnesium phosphide reacts vigorously with water, be sure to add the residues slowly.

To deactivate residue from bag formulations, first cut or tear open the bag(s). Then stir the contents into a bucket containing a mixture of water and nonsudsing detergent (2 percent by volume). This deactivation procedure must take place outdoors. Wear the appropriate respiratory equipment. Never place residue in enclosed containers. It could cause a fire hazard. After deactivating the residues, dispose of the rinsate in a storm sewer, sanitary landfill, or by other approved methods. The solid may be buried or spread out on the ground. These actions will not harm the environment. However, check with local authorities for disposal regulations.

Sulfuryl Fluoride

Sulfuryl fluoride at a glance:

Required clothing:

- Use splash-resistant goggles or full-face shields when handling the liquid, such as opening the cylinder to introduce gas into a structure. Liquid sulfuryl fluoride can freeze the eye tissue.
- Wear a loose-fitting or well-ventilated long-sleeve shirt, long pants, shoes, and socks.
- Do not wear gloves.
- Do not wear rubber boots.

Respiratory protection:

- For ProFume use in commodities, concentrations of 1 ppm or less require no respiratory protection. Concentrations above 1 ppm require NIOSH/MSHA approved SCBA or combination air-supplied respirator/SCBA, such as those manufactured by Ranger, Survivair, Scott, or MSA.
- If (emergency) reentry into a structure under fumigation, prior to complete aeration, with sulfuryl fluoride is required, the proper respiratory protection (SCBA) must be used.

- What – For control of insects pests for the commodities listed on label, such as confused flour beetle, red flour beetle, sawtoothed grain beetle, warehouse beetle, Indianmeal moth, Mediterranean flour moth, codling moth, navel orangeworm, granary weevil, rice weevil, and other moths and beetles as well as rodents. Area around fumigation must be monitored using a detection device such as INTERSCAN gas analyzer or MIRAN vapor analyzer to ensure that workers without respiratory protection are not exposed to concentrations of sulfuryl fluoride exceeding **1 ppm**.
- Where – Non-residential structures (for the food commodities listed on the label) such as mills, warehouses, stationary transportation vehicles (railcars, trucks, etc., excluding aircraft and passenger railcars), temporary and permanent fumigation chambers, and storage structures. For use in food processing establishments containing only those commodities listed on the label. Not for use in other food-handling establishments.

Sulfuryl fluoride (ProFume®) is a colorless, odorless, and tasteless toxic gas. It is heavier than air and tends to initially settle in low areas. It is nonflammable; however, heaters, pilot lights, and open flames must be extinguished as temperatures above 752°F will cause decomposition products to be formed which can be corrosive and can etch glass and metal. Refer to ProFume fumigation manuals and labels before usage and for any changes in use that may have occurred from the registration process. Sulfuryl fluoride is toxic to most living organisms including humans. In case of over exposure, get medical attention immediately.

Formulations

Sulfuryl fluoride comes in pressurized cylinders (containers). ProFume is a restricted use product. Cylinders are under pressure, 303 psi at 90°F, and must not be stored near heat or open flame. Exposure to temperatures above 158F will cause a fusible plug to melt, and the contents will be released. Always store and transport cylinders in a secure upright position. Cylinders of sulfuryl fluoride should be stored in a dry, cool, well-ventilated, secure and locked area. Post as pesticide storage area.

Uses

This fumigant is very effective against insect larvae and adults but requires higher doses for insect eggs. Do not use for insect control when temperature at the site is below 40°F.

ProFume Uses

- **What** – For control of insects pests for the commodities listed on label, such as confused flour beetle, red flour beetle, sawtoothed grain beetle, warehouse beetle, Indianmeal moth, Mediterranean flour moth, codling moth, navel orangeworm, granary weevil, rice weevil, and other moths and beetles as well as rodents. Area around fumigation must be monitored using a detection device such as INTERSCAN gas analyzer or MIRAN vapor analyzer to ensure that workers without respiratory protection are not exposed to concentrations of sulfuryl fluoride exceeding **1 ppm**.
- **Where** – Non-residential structures (for the food commodities listed on the label) such as mills, warehouses, stationary transportation vehicles (railcars, trucks, etc., excluding aircraft and passenger railcars), temporary and permanent fumigation chambers, and storage structures. For use in food processing establishments containing only those commodities listed on the label. Not for use in other food-handling establishments.
- Do not use ProFume without the Fumiguide Program for ProFume Gas Fumigant. The ProFume Fumiguide is part of labeling for ProFume and must be used to calculate the dosage. Never allow untrained individuals to apply ProFume gas fumigant.
- **Read product label for any usage changes and further definition of uses prior to fumigation.**

Application

Sulfuryl fluoride does not adversely react with other compounds. However, all flames,

including pilot lights, must be extinguished. All electrical heating elements must be turned off or unplugged. Temperatures above 752°F will cause decomposition products to be formed which can be corrosive and etch glass and metal.

Introduce sulfuryl fluoride from the outside through tubes. Use polyethylene, polypropylene, or strong nylon tubing with an internal diameter of 1/8 to 1/4 inch. The tubing should have a minimum burst pressure of 500 pounds per square inch (PSI). The rate of fumigant released through larger tubing would be too great for good gas distribution. Place fans throughout the fumigation area. Run the fans during introduction and for at least 60 minutes afterward. For ProFume, Dow recommends leaving the fans running for the duration of the fumigation. Fans aid in the introduction, distribution, and the aeration process for sulfuryl fluoride. Fans will circulate the gas ensuring good distribution. If desired, use a remote shutoff such as a timer to turn off the fans.

Do not use sulfuryl fluoride at temperatures below 40°F. To prevent damage, do not apply sulfuryl fluoride directly to any surface.

Precautions

If the concentration of sulfuryl fluoride is unknown or exceeds 1 ppm for ProFume, all persons in the exposed area must wear a self-contained breathing apparatus (SCBA) or a combination air-supplied/SCBA respirator.

Always wear (safety) splash-resistant goggles or a face shield while releasing sulfuryl fluoride. However, you **should not wear rubber boots or gloves** when introducing sulfuryl fluoride. These may trap the liquid against your skin and cause injury.

Because the gas can get into frost-free refrigerators and freezers, you must either bag the contents of these appliances or remove their contents from the fumigated space. Additionally, open or remove items that might slow fumigant aeration, such as waterproof mattress covers. Do not use sulfuryl fluoride on living plants.

In-transit fumigation, including aeration, of any vehicle is prohibited on public roads or waterways.

Product labels require that the structure be posted with specific warning signs on all entrances and all sides during the exposure and aeration period until the building is cleared for reentry by the fumigator.

Aeration

Aeration is rapid. Sulfuryl fluoride desorbs quickly. Follow the aeration procedures in the label information to determine your aeration time.

Detection

Use the Fumiscope® (a thermal conductivity analyzer) to monitor sulfuryl fluoride levels during application. The Fumiscope® can detect sulfuryl fluoride at levels greater than 240 ppm.

When measuring gas concentrations for reentry, however, you will need to use a different type of gas detector. Only approved detection

devices of sufficient sensitivity, such as specific types of gas analyzers or infrared detection systems (ambient air analyzers), can be used to confirm a concentration of sulfuryl fluoride of 1 ppm or less. At the time of this writing, the sulfuryl fluoride product label requires the use of an INTERSCAN or MIRAN analyzer or similar approved devices to measure gas concentrations for reentry.

Disposal

When a sulfuryl fluoride cylinder is empty, close the valve, screw the safety cap onto valve outlet, and replace the protection bonnet. Return the empty cylinder promptly to the distributor. Do not use the cylinder for any other purpose.

As with any Restricted Use Pesticide, carefully read and follow all label instructions. When using ProFume Gas Fumigant, the fumigator must also read and follow the ProFume Gas Fumigant Fumigation Manual as it is part of the label. All persons desiring to use sulfuryl fluoride, must comply with Dow AgroSciences product stewardship policies.

Test Your Knowledge

Q. Name a fumigant that should not be used to treat food products.

A. Chloropicrin

Q. Which fumigants do not have an odor at normal treatment concentrations?

A. Methyl bromide and sulfuryl fluoride

Q. Which of the fumigants discussed in this unit is most flammable?

A. Phosphine

Q. Name a fumigant that is corrosive to metal discussed in this manual.

A. Phosphine

Q. List four things you should not wear when working with methyl bromide.

A. Goggles, jewelry, gloves, contact lenses, sandals, or rubber boots

Q. Which of the fumigants discussed in this unit might be phased out in the future? Why? When might this occur?

A. At the time of this printing, methyl bromide is believed to contribute to the depletion of the earth's ozone layer. For this reason, the EPA has initiated action under the Clean Air Act to phase out the production and use of this fumigant. A 70-percent reduction in production was mandated by January 1, 2003. The complete phaseout of production was scheduled for January 1, 2005. The Environmental Protection Agency (EPA) is amending the regulations governing the phaseout of methyl bromide (MeBr) to allow for exempted production and import beyond the phaseout date of January 1, 2005, for critical uses and to address sales of pre-January 1, 2005 stocks of methyl bromide for critical uses.

Q. Describe the difference between aluminum phosphide and magnesium phosphide.

A. Aluminum phosphide is the main form of metal phosphide used to treat agricultural commodities. Magnesium phosphide is more reactive than aluminum phosphide. Magnesium phosphide is preferred when rapid release is desired and when treatment is performed at lower temperatures and humidities. In addition, when deactivating phosphide residues, nonsudsing detergent is required for aluminum phosphide, whereas you only need to use plain water to deactivate magnesium phosphide.

Q. What is responsible for liberating phosphine gas from its solid form?

A. Moisture in the air (humidity)

Q. What detection device is sensitive enough to check levels of methyl bromide before reentry into the treatment area?

A. Glass detector tubes

Q. What detection device is sensitive enough to check levels of sulfuryl fluoride before reentry into the treatment area?

A. Only approved detection devices of sufficient sensitivity, such as specific types of gas analyzers or infrared detection systems (ambient air analyzers), can be used to confirm a concentration of sulfuryl fluoride of 1 ppm or less. At the time of this writing, the sulfuryl fluoride product label requires the use of an INTERSCAN or MIRAN analyzer or similar approved device to measure gas concentrations for reentry.