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Treatment Manual

Certifying Facilities

Certifying Atmospheric Fumigation Chambers

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Construction and Performance Standards

The primary purpose of a program fumigation is to obtain quarantine control of the pests in all stages of development in or on the product being fumigated. A properly constructed fumigation chamber will provide an enclosure into which the product can be loaded and where the fumigant will be maintained at the prescribed concentration for the required exposure period.

When constructing an atmospheric fumigation chamber, the primary consideration is making it as gastight as possible. In addition, install circulation equipment to properly distribute the fumigant throughout the chamber. The chamber must retain these qualities of tightness and fumigant circulation during every fumigation.

Although chamber sizes are not restricted to specific dimensions, size chambers according to the volume of material to be fumigated. Experience has shown that two moderately sized chambers is preferable to one large chamber.

Select the construction material according to the type of product to be fumigated and the method of operation involved. Wood frame construction with light metal sheathing could be used if the products to be fumigated are lightweight and are to be hand loaded. Heavy products, often loaded by machinery or handtrucks, require heavy-gauge sheet metal, masonry, or metal plate construction. It is advisable to construct the chamber in the most durable manner consistent with its intended use.

Auxiliary equipment is required to measure, vaporize, circulate, and exhaust the fumigant. Size such equipment according to the volume of the chamber. When a relatively small amount of methyl bromide is used, it is often measured by volume in graduated dispensers. When larger amounts are used, the fumigant is most often measured by weight.

Equip chambers with heating or refrigeration units depending on the climatic environment and the products to be fumigated. Product injury or an ineffective fumigation can occur within certain temperature ranges. Although provisions for temperature control are not generally mandatory, in certain fumigation operations, temperature control is necessary and therefore must be considered in the design and construction of fumigation chambers.

While complete construction details for an atmospheric fumigation chamber are not contained in the following narrative, sufficient information is available to develop specifications for a proposed structure. Firms considering chambers for approval by the U.S. Department of Agriculture (USDA) should submit drawings to:

USDA-APHIS-PPQ-CPHST
1730 Varsity Drive, Suite 400
Raleigh, NC 27606

Basic Elements for Design and Construction of Chambers

- Equipped with removable, slatted floors unless all material placed in the chamber is on pallets or carts
- Gastight and remains so during every use
- Provides an efficient system for circulating and exhausting the fumigant
- Provides an efficient system of dispensing the fumigant
- Provides heating or refrigeration units when required for fumigation efficiency or to prevent product injury
- Provides a recording thermometer when product temperatures are critical or treatments are of such duration that temperature variations could affect the efficiency of the fumigation
- Provides suitable fittings to facilitate a pressure-leakage test and gas concentration sampling

The criteria listed above deal primarily with the efficiency of the fumigation chamber itself. In determining the ultimate design and construction, it is essential to give consideration to the safe and practical operation of the facility.

Gastight Construction

Interior surfaces must be impervious to the fumigant. Seal joints with proper compound, solders, or welds. Provide all doors and vents with proper gaskets. Make all openings for wiring, thermometer, tubing, and ports for pressure-leakage tests, etc. gastight.

Paint interior surfaces—whether metal (except for stainless steel), cement, concrete block, tile, or plywood—with epoxy resin, vinyl plastic, or asphalt base paints. Such paint coverings make the surfaces less sorptive, an important factor in maintaining gas concentrations.

Important

Aluminum base paints are **not** acceptable because of the corrosive effect caused by a reaction between such paints and the fumigant.

When wood or wood and sheet metal are used in construction, it is critical to seal all joints and seams with a nonhardening material. This makes a gastight seal and allows for expansion and contraction without leakage. In masonry construction, joint the mortar between all courses of cement blocks to produce a smooth, compact surface. Poured concrete structures should also have smooth, compact surfaces.

The construction and fastening of chamber doors is most critical. Hinge the doors from the top or side. A chamber door hinged at the top is less apt to sag. If the door is hinged at the side, use refrigerator hinges. Install a high-quality gasket around the entire perimeter of the chamber opening. To obtain maximum tightness, uniformly fasten the doors against the gaskets.

Circulation and Exhaust Systems

Fans or blowers delivering the prescribed minimum air movement are essential to proper fumigant distribution.

Various methods can be used to circulate the fumigant within the chamber. Equipment should be capable of circulating air at the rate of at least one-third the volume of the chamber per minute. Based on the volume of the empty chamber, the rate of airflow of the blower should give approximately one complete change of air per minute. For smaller chambers, a suitable circulating fan will usually provide the necessary air movement. For larger chambers, obtain effective gas distributions by using a circulating or squirrel cage fan that picks up the air/gas mixture from a duct reaching near the floor and blows it across the top of the load. A blower located outside the chamber can also be used, but this method considerably increases the possibilities of leakage.

Size exhaust blowers according to the volume of the chamber. Volume of enclosure (in cubic feet) divided by the sum of cubic feet per minute (cfm) of the exhaust fan(s) or exhaust blower equals the number of minutes required per complete gas volume exchange. Sixty minutes divided by the number of minutes per gas volume exchange equals the number of complete gas exchanges per hour. The result should be in the range of four to fifteen. The faster the rate of aeration, the better, particularly for perishable commodities. If the exhaust flow is connected to a MB recovery system, it must not impede the flow rate to less than four volumes per hour. Frequently, circulation and exhaust systems are designed to utilize the same blower. Extend the exhaust stack well above all nearby structures. Venting to the outside and complying with local safety ordinances are both essential.

Fumigant Dispensing System

The dispensing system needed will vary with the types of fumigants being used. The fumigant MB is usually introduced into the chamber through a tube extending from the volitizer. Within the chamber, provide this tube with properly spaced openings through which the fumigant is dispersed. Fumigants in small quantities are generally measured by volume using a graduated dispenser. Place the dispenser in the introduction line between the supply cylinder and the volatilizer. For larger quantities, place the supply cylinder on a platform scale and weigh the fumigant used. The measured amount of fumigant must pass through a volatilizer where it is converted from a liquid to a vapor. The volatilizer consists of a metal coil submerged in 150°F degree water. The water temperature must remain at or above 150°F throughout the entire gas introduction.

For the fumigant sulfuryl fluoride (SF), do not use a volatilizer or graduated dispenser. For the fumigant phosphine (PH), a chamber is generally not used because PH will corrode copper and brass (including tubing, fans, and electrical wiring).

Pressure-Leakage Test for NAP Fumigation Chambers

Before a chamber is used for fumigation, it must be checked for tightness using an open-arm manometer. *See Open-Arm Manometer* on **page- 8-1-25** for a detailed description of this type of manometer. (If a digital manometer is used, contact CPHST for accurate conversion factors.)

The procedure for conducting a pressure-leakage test is as follows:

1. Create an opening (usually one-inch diameter) in the chamber for the use of a blower or other means for the introduction of air to create a positive pressure in the chamber.
2. Create an additional opening, such as a gas sampling line opening, for the manometer.

3. Close chamber as for fumigation.
4. Attach one end of the manometer to the chamber opening.
5. Use vacuum cleaner blower or similar apparatus to create pressure of 25 mm as measured in **one** arm of an open arm manometer (50 mm total pressure.)
6. Discontinue blower and close its opening.
7. Observe time for pressure to recede.

For approval, the time lapse for the chamber pressure to recede (as measured by the difference between the two arms) from 50 mm to 5 mm (25 mm in one arm down to 2.5 mm in one arm) must be:

- 22 to 29 seconds: reinspect chambers every 6 months
- 30 seconds or longer: reinspect chambers annually


Important

Chambers used for fumigating cherries for export to **Japan** are required to meet a higher standard. For minimum approval, the time lapse for the chamber pressure (as measured by the difference between the two arms) to recede from 25 to 2.5 mm must be **60 or more seconds.**

The approving APHIS official must complete PPQ Form 480, Treatment Facility Construction, Operation and Test Data, and PPQ Form 482, Certificate of Approval. A copy of each of the forms should be given to the owner/operator of the chamber and also mailed to:

USDA-APHIS-PPQ-CPHST
1730 Varsity Drive, Suite 400
Raleigh, NC 27606

Other Auxiliary Equipment

According to the needs of the operation, other auxiliary equipment may be necessary. When heat is required, steam pipes or low-temperature electric strip heaters are generally recommended. Do not use open flame or exposed electric coils as they tend to break down the gas and form undesirable compounds. Size refrigeration units to the volume of the chamber and the type and amount of commodity involved. Temperature recording thermometers are usually attached to the outside of the chamber with a remote sensing unit attached to the inside wall or inserted into the product.