Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

AIR FILTRATION AND SCRUBBING

CODE 371

(no)

DEFINITION

A device or system for reducing emissions of air contaminants from an agricultural structure.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Reduce direct emissions of particulate matter
- Reduce emissions of volatile organic compounds (VOCs)
- Reduce emissions of ammonia
- Reduce emissions of odorous sulfur compounds
- Reduce emissions of methane by cleaning biogas for beneficial uses

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to any agricultural operation that includes a naturally or mechanically ventilated structure from which the air contaminants identified in the “Purpose” section above may be emitted.

CRITERIA

General Criteria Applicable to All Purposes

Design

Design the device or system to remove targeted air contaminants from a structure by one or more technologies. Meet the minimum design and operational requirements for the type of device or system specified.

Design devices or systems based on demonstrated performance for agricultural production or similar applications. Support the design with independently verifiable data for demonstrating device or system performance, which may include universities; Federal, State, or local agencies; other independent research organizations; a manufacturer’s guarantee based on manufacturer literature and research results; generally-accepted good engineering practices; and/or actual operating experience.

Meet the requirements of the National Electrical Code (NEC) based on the location and type of installation for all electrical components, including wiring, boxes, connectors, etc. Local electrical requirements may exceed those set by NEC.

Design devices or systems to reduce the risk of a dust explosion or fire.

Ventilation
Apply the device or system only to those concentrated airflows that are identified for treatment to accomplish the intended goals of the device or system. For mechanically ventilated structures, treatment is not necessarily required for all concentrated airflows.

Size the device or system to treat the maximum ventilation rate of the concentrated airflows to be treated.

Base ventilation rates on industry standards for ventilated structure design or good engineering design principles. Maintain the minimum required ventilation rates for the structure after the addition of the device or system.

Fans
Evaluate and select fans based on their—

- Ability to provide the required ventilation rate for the sum of the maximum expected pressure drop through the ventilated structure and the control device.
- Ability to meet the range of ventilation rates needed.

Provide the required ventilation rate based on fan performance characteristics developed by a recognized independent testing laboratory or a manufacturer's guarantee.

Select fans based on the anticipated characteristics and composition of the concentrated airflow. Use fans made of materials that will resist corrosion.

Utilize shutters on all fans in multiple fan systems to minimize the potential for backflow.

Ductwork
Design and size ductwork to minimize pressure drop so that the ductwork system is not the limiting factor on ventilation rate.

Byproducts
Handle, store, and dispose of any byproducts of the device or system in accordance with all legal requirements and to prevent nuisances to the public.

Criteria for Inertial Collectors
Utilize inertial collectors for removing particles in a concentrated airflow exhausted from a mechanically ventilated structure. Inertial collection is not effective for removing gaseous compounds from a concentrated airflow.

Design inertial collectors based on—

- Characteristics of the concentrated airflow, such as velocity, temperature, moisture content, and chemical composition.
- Concentration of particulate matter in the concentrated airflow.
- Particle size distribution of particulate matter in the concentrated airflow.
- Particle size range to be collected.
- Collection and disposal system for particulate matter removed by the inertial collector.

Criteria for Fabric Filters
Utilize fabric filters for removing particles in a concentrated airflow exhausted from a mechanically ventilated structure. Fabric filters are not effective for removing gaseous compounds from a concentrated airflow.

Design fabric filters based on—

- Characteristics of the concentrated airflow, such as velocity, temperature, moisture content, and chemical composition.
- Concentration of particulate matter in the concentrated airflow.
- Particle size distribution of particulate matter in the concentrated airflow.
- Particle size range to be collected.
- Airflow-to-cloth ratio of the filter material.
- Collection and disposal system for particles removed by the fabric filter.
- Methodology for cleaning the fabric material.

Criteria for Electrostatic Collectors

Utilize electrostatic collectors for removing particles from either the inside of a structure or in a concentrated airflow exhausted from a mechanically ventilated structure. Electrostatic collection is not effective for removing gaseous compounds.

Design electrostatic collectors based on—

- Characteristics of the concentrated airflow or air inside the structure, such as velocity, temperature, and moisture content.
- Concentration of particulate matter in the concentrated airflow or air inside the structure.
- Particle size distribution of particulate matter in the concentrated airflow or air inside the structure.
- Particle size range to be collected.
- Collection and disposal system for particles removed by the electrostatic collector.
- Methodology for cleaning the collector plates.

Criteria for Wet Scrubbers, Bioscrubbers, and Liquid Spray Systems

Utilize wet scrubbers, bioscrubbers, or liquid spray systems for removing particles or gaseous compounds from either the inside of a structure or in a concentrated airflow exhausted from a mechanically ventilated structure.

Design scrubbers or spray systems based on—

- Characteristics of the concentrated airflow or air inside the structure, such as velocity, temperature, and moisture content.
- Type of air contaminants to be removed from the concentrated airflow or air inside the structure.
- Concentration of the targeted air contaminants in the concentrated airflow or air inside the structure.
- Particle size distribution of particulate matter in the concentrated airflow or air inside the structure, if particulate matter is the targeted air contaminant.
- Particle size range to be collected, if particulate matter is the targeted air contaminant.
- Collection and disposal or recovery system for the scrubbing liquid and any removed air contaminants and other byproducts.

Criteria for Adsorbers

Utilize adsorbers for removing gaseous compounds in a concentrated airflow exhausted from a mechanically ventilated structure. Adsorption may also remove particles, although there is a greater potential for fouling of the adsorption media if higher particle concentrations are present in the concentrated airflow.

Design adsorbers based on—

- Characteristics of the concentrated airflow, such as velocity, temperature, and moisture content.
- Type of air contaminants to be removed from the concentrated airflow.

- Concentration of the targeted air contaminants in the concentrated airflow.
- Potential for fouling of the adsorption media by particulate matter.
- Recovery or regeneration system for the adsorption media.
- Collection and disposal or recovery system for any removed air contaminants and other by-products.

Preclean a concentrated airflow containing high particle loading to minimize the potential for fouling of the adsorption media.

Criteria for Biofilters

Utilize biofilters for removing gaseous compounds from a concentrated airflow exhausted from a mechanically ventilated structure. Biofilters may also remove particles, although there is a greater potential for fouling biofilter media if higher particle concentrations are present in the concentrated airflow.

Design biofilters based on—

- Characteristics of the concentrated airflow, such as velocity, temperature, and moisture content.
- Type of air contaminants to be removed from the concentrated airflow.
- Concentration of the targeted air contaminants in the concentrated airflow.
- Potential for fouling of the biofilter media by particulate matter.
- Type of biofilter media to be used and anticipated lifespan of the media.
- Site conditions, including facility layout and meteorological conditions (e.g., temperature, precipitation, etc.).
- Collection and disposal or recovery system for the biofilter media and any removed air contaminants and other byproducts.

Preclean a concentrated airflow containing high particle loading to minimize the potential for fouling of the biofilter media.

Divert excess moisture (such as from precipitation) away from the biofilter.

Include an additional moisture delivery system in the biofilter design, if needed.

Implement a facility rodent control program that includes the biofilter.

Remove vegetation from the biofilter media periodically to maintain proper airflow.

CONSIDERATIONS

Compare the total cost (i.e., installation plus operation) of the device or system with the intended performance of the device or system. There is considerable variability in both the installation and operating (e.g., labor, maintenance, energy) costs of the technology options in this standard.

If possible, to allow for the use of standard agricultural production fans, minimize the overall system pressure drop to less than 0.3 inches of water column.

Move the fan outside of the airflow for particle-laden concentrated airflows. Install a device or system to remove the particles from the airflow prior to the fan to reduce the need for, or frequency of, cleaning accumulated particles from the fan blades.

Recycle byproducts and filtration or scrubbing media and liquids instead of disposal, where possible.

Use vertical biofilters to reduce the footprint of installation as compared to traditional horizontal biofilters. Vertical biofilters typically result in higher pressure drops and greater need for maintaining the biofilter medium than traditional horizontal biofilters.

Use closed-bed biofilters to reduce the potential for interference from precipitation, rodents, and vegetation. Closed-bed biofilters can also result in higher pressure drops than open-bed biofilters.

PLANS AND SPECIFICATIONS

Prepare plans and specifications that clearly describe the application of this practice for each site or planning unit according to the criteria of this standard. Record specifications using State-developed specification sheets, job sheets, practice requirement sheets, narrative statements in conservation plans, or other acceptable documents. At a minimum, include—

- Plan map or diagram showing where the system is to be installed inside or relative to the building.
- Pertinent elevations of features to be constructed.
- Detailed drawings of features to be constructed.
- Construction and material specifications.
- Specifications for all manufactured components.
- Electrical details of all components.
- Drainage and grading plan, if needed.
- Vegetative requirements, if needed.

OPERATION AND MAINTENANCE

Develop and implement an operation and maintenance plan that is consistent with the purposes of this practice, its intended life, safety requirements, and the criteria used for its design.

Operate and maintain the device or system in accordance with the manufacturer's recommendations, if applicable.

For fans used in particle-laden airflows, develop and implement a fan inspection and maintenance plan to prevent and remove dust accumulation.

Design and construct ductwork to enable all sections to be safely isolated and cleaned as part of routine maintenance.

Properly dispose of any byproducts from the device or system.

Inspect devices and/or system on a regular schedule. Repair as necessary.

Assess performance to determine when to replace media.

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