NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

AIR FILTRATION AND SCRUBBING

(No.)

CODE 371

DEFINITION

A device or system for reducing emissions of air contaminants from a structure via interception and/or collection.

PURPOSE

To control gaseous and particulate air emissions from ventilated structures by inertial collection, filtration, electrostatic collection, adsorption, scrubbing, and/or bioremoval. Specifically, this practice standard can be used to reduce emissions of the following air contaminants that contribute to air quality resource concerns:

- Direct emissions of particulate matter
- Volatile organic compounds (VOCs)
- Ammonia
- Odorous sulfur compounds
- Methane

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 air contaminants from a structure via inertial impaction, direct interception, electrostatic attraction, absorption, or adsorption and meet the minimum design and operational requirements for the type of device or system specified.

Base the design of devices or systems on demonstrated performance for agricultural production or similar applications. Sources of independent verifiable data for demonstrating device or system performance may include universities; local, state, or federal 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.

Follow the requirements of the National Electrical Code 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.

Ventilation. For mechanically ventilated structures, all concentrated airflows will not necessarily need to be treated. Apply the device or system only to those concentrated airflow(s) that are identified for treatment in order to accomplish the intended goal(s) of the device or system.

Size the device or system to treat the maximum ventilation rate of the concentrated airflow(s) to be treated.

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

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service State Office, or download it from the electronic Field Office Technical Guide for your state.

Fans. Base fan evaluation and/or selection on the ability to provide the required ventilation rate for the sum of the maximum expected pressure drop through the ventilated structure and the control device and on the ability to meet the range of ventilation rates needed. The ability to provide the required ventilation rate can be based on performance characteristics developed by a recognized independent testing laboratory or a manufacturer's guarantee

Base fan selection also on the anticipated characteristics and composition of the concentrated airflow. Preferentially select 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 achieve the maximum ventilation rate and minimize pressure drop.

Design and construct ductwork to enable all sections to be safely isolated and cleaned as part of routine maintenance.**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 particulate matter from a concentrated airflow exhausted from a mechanically ventilated structure. Inertial collection is not effective for removing gaseous compounds from a concentrated airflow.

Base inertial collector design on the following:

- 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 particulate matter from a concentrated airflow exhausted from a mechanically ventilated structure. Fabric filters are not effective for removing gaseous compounds from a concentrated airflow.

Base fabric filter design on the following:

- 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 particulate matter removed by the fabric filter

Criteria for Electrostatic Collectors

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

Base electrostatic collector design on the following:

- 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 particulate matter removed by the electrostatic collector
- Methodology for cleaning the collector plates

Criteria for Wet Scrubbers/Bioscrubbers

Utilize wet scrubbers/bioscrubbers for removing particulate matter or gaseous compounds from either the inside of a structure or a concentrated airflow exhausted from a mechanically ventilated structure.

Base wet scrubber/bioscrubber design on the following:

- Characteristics of the concentrated airflow or air inside the structure, such as velocity, temperature, and moisture content
- Type of air contaminant(s) to be removed from the concentrated airflow or air inside the structure
- Concentration of the targeted air contaminant(s) 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/recovery system for the scrubbing liquid and any removed air contaminants and other byproducts

Criteria for Adsorbers

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

Base adsorber design on the following:

- Characteristics of the concentrated airflow, such as velocity, temperature, and moisture content
- Type of air contaminant(s) to be removed from the concentrated airflow
- Concentration of the targeted air contaminant(s) in the concentrated airflow
- Potential for fouling of the adsorption media by particulate matter
- Recovery/regeneration system for the adsorption media
- Collection and disposal/recovery system for any removed air contaminants and other byproducts

Pre-clean a concentrated airflow containing high particulate 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 particulate matter, although there is a greater potential for fouling biofilter media if higher particulate matter concentrations are present in the concentrated airflow.

Base biofilter design on the following:

- Characteristics of the concentrated airflow, such as velocity, temperature, and moisture content
- Type of air contaminant(s) to be removed from the concentrated airflow
- Concentration of the targeted air contaminant(s) 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
- Collection and disposal/recovery system for the biofilter media and any removed air contaminants and other byproducts

For detailed design guidance refer to Iowa State University, University of Minnesota, and/or South Dakota State University Extension biofilter publications.

Pre-clean a concentrated airflow containing high particulate 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

Include the total cost (installation plus operation) of the device or system in comparison with the intended performance of the device or system. There is considerable variability in the installation cost of the options in this standard. Additionally, there is also considerable variability in the operating cost (including labor, maintenance, energy, etc.) of the various options.

Minimization of the overall system pressure drop to less than 0.3 inches of water column may allow for the use of standard agricultural production fans.

For particulate-laden concentration airflows, consider keeping the fan outside of the airflow stream or installing a device or system to remove the particulate matter from the airflow stream prior to contacting the fan to reduce the need or frequency for cleaning accumulated particulate matter from the fan blades.

If possible, recycle byproducts and/or filtration/scrubbing media and liquids instead of disposal.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for application of this practice for each site or planning unit according to the criteria of this standard. Specifications shall be recorded using specification sheets, job sheets, practice requirement sheets, narrative statements in conservation plans, or other acceptable documents.

Prepare a design documentation that includes a process diagram and specifies the following minimum information:

1. Type of device or system to be used
2. Identification of the air to be treated (i.e., concentrated airflow(s) from a mechanically ventilated structure or air inside a structure). Also identify any concentrated airflow(s) or air inside a structure that will not be treated by the device or system. Include a justification for treatment or non-treatment of the identified concentrated airflow(s) and/or air inside a structure.
3. Type and concentration/amount of air contaminant(s) to be targeted for removal
4. Characteristics of the concentrated airflow or air inside the structure, such as velocity, temperature, and moisture content
5. Design parameters for the device or system related to air contaminant removal
6. Process controls and monitoring
7. Expected performance (control efficiency) of the device or system
8. Collection and disposal/recovery system for any removed air contaminants and other byproducts

The following list of Construction Specifications is intended as a guide to selecting the appropriate specifications for a specific project. The list includes most but may not contain all of the specifications needed for a specific project:

IA-1 Site Preparation
IA-3 Structural Removal
IA-5 Pollution Control
IA-6 Seeding and Mulching for Protective Cover
IA-31 Concrete
IA-32 Concrete for Nonstructural Slabs
IA-45 Plastic (PVC, PE) Pipe
IA-81 Metal Fabrication and Installation
IA-82 Timber Fabrication and Installation

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 particulate-laden airflows, develop and implement a fan inspection and maintenance plan to prevent and/or remove dust accumulation.

For fabric filters, develop a methodology for cleaning the fabric material.

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