United States Department of Agriculture
Natural Resources Conservation Service

Air Quality Enhancement Activity – Ozone Precursors

Ozone Precursors

Ozone is a gas composed of three oxygen atoms that is the primary component of smog. Although ozone in the upper atmosphere forms a layer that provides protection from ultraviolet radiation, ozone in the lower atmosphere and at ground level can be harmful. Ozone is not typically emitted directly from agricultural operations; rather, it is formed in the atmosphere through chemical reactions of nitrogen oxides (NOx) and volatile organic compounds (VOCs) in the presence of sunlight. NOx and VOCs are known as ozone precursors because they are the pollutants that form ozone in the lower atmosphere.

Ground-level ozone is an environmental issue as it can cause health problems related to the respiratory system, and safety and aesthetic issues by reducing visibility. These precursors react in the presence of sunlight to form ozone. In addition to respiratory and visibility issues, high atmospheric concentrations of ozone can cause considerable damage to agricultural crops, significantly reducing a grower's yield and profitability.

Benefits

These activities will reduce emissions of ozone precursors (including volatile organic compounds [VOCs] and nitrogen oxides [NOx]), which lead to the formation of ozone.

Criteria for Ozone Precursors Enhancement Activity

This enhancement requires a participant to implement and/or maintain two or more of the following activities that relate to their operation/enterprise.

Activities applicable primarily to animal feeding enterprises:

- Implement a and/or maintain biofilters system on enclosed structures to treat exhausts
- Implement and/or maintain a wet or dry scrubber or bioscrubber system on enclosed structures to treat exhausts
- Use additives in animal housing and/or manure storage structures and areas

Reference:

Applicable to all Animal Feeding Operations:
ODOR MITIGATION FOR CONCENTRATED ANIMAL FEEDING OPERATIONS: WHITE PAPER AND RECOMMENDATION, Published by the American Society of Agricultural and Biological Engineers, St. Joseph, Michigan www.asabe.org. Citation: Pp. 721-758 in Animal Agriculture and the Environment: National Center for Manure and Animal Waste Management White Papers. J. M. Rice, D. F. Caldwell, F. J. Humenik, eds. 2006. St. Joseph, Michigan: ASABE. Authors: John M. Sweeten, Larry D. Jacobson, Albert J. Heber, David R. Schmidt, Jeffery C. Lorimor, Philip W. Westerman, J. Ronald Miner, Ruihong H. Zhang, C. Mike Williams, Brent W. Auvermann

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Biofilters, Wet Scrubber/Bioscrubber:
THE POTENTIAL OF COUPLING BIOLOGICAL AND CHEMICAL/PHYSICAL SYSTEMS FOR AIR POLLUTION CONTROL: A CASE STUDY IN THE RENDERING INDUSTRY Published by the American Society of Agricultural and Biological Engineers, St. Joseph, Michigan www.asabe.org. Citation: Pp. 073-105 in Air Pollution from Agricultural Operations III, Proceedings of the 12-15 October 2003 Conference (Research Triangle Park, North Carolina USA), Publication Date 12 October 2003. 701P1403. Authors: J. R. Kastner and K. C. Das

ENHANCED BIOFILTRATION OF HYDROGEN SULFIDE IN THE PRESENCE OF METHANOL AND RESULTANT BACTERIAL DIVERSITY, Published by the American Society of Agricultural and Biological Engineers, St. Joseph, Michigan www.asabe.org. Citation: Transactions of the ASABE. 49(6): 2051-2059. @2006. Authors: Y. Ding, K. C. Das, W. B. Whitman, J. R. Kastner

KINETICS AND MODELING OF ODOR OXIDATION USING CHLORINE DIOXIDE FOR EMISSION CONTROL UTILIZING WET SCRUBBERS, Published by the American Society of Agricultural and Biological Engineers, St. Joseph, Michigan www.asabe.org. Citation: Pp. 215-241 in Air Pollution from Agricultural Operations III, Proceedings of the 12-15 October 2003 Conference (Research Triangle Park, North Carolina USA), Publication Date 12 October 2003. 701P1403. Authors: J. R. Kastner, C. Hu, K..C. Das, and R. McClendon

ADDITIVES IN ANIMAL HOUSING AND/OR MANURE STORAGE STRUCTURES: EVALUATION OF TREATMENT AGENTS AND DIET MANIPULATION FOR MITIGATING AMMONIA AND ODOR EMISSIONS FROM LAYING HEN MANURE, Published by the American Society of Agricultural and Biological Engineers, St. Joseph, Michigan www.asabe.org. Citation: Paper number 054160, 2005 ASAE Annual Meeting. @2005. Authors: Yi Liang, Hongwei Xin, Hong Li, Jacek A Koziel, Lingshuang Cai

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1. Implement and/or maintain a biofilters system on enclosed structures to treat exhausts (Ozone-01)

A biofilter is a layer of organic material (woodchips, straw, compost, or other organic material) through which exhaust air from an animal building is passed. Microbes in the organic material convert volatile organic compounds (VOCs) to carbon dioxide and water. For a complete description of biofilter function, design, and operation criteria, see *Schmidt, Janni, and Nicolai, 2004, Biofilter Design Information, Biosystems and Agricultural Engineering Update 18, University of Minnesota Extension Service (http://www.manure.umn.edu/assets/baeu18.pdf).*

Required Elements:

- Attach design criteria and specifications, and operational specifications, for the biofilter specific to your operation. Include photographs of functioning biofilters on buildings at your operation
- Briefly describe your animal operation (including number of animals, type of facility, and biofilter placement) and your evaluation of the effectiveness of the biofilters to reduce VOCs coming off your operation

2. Implement and/or maintain a wet or dry scrubber or bioscrubber system on enclosed structures to treat exhausts (Ozone-02)

A scrubber is an add-on control device designed to remove air pollutants from an exhaust stream via adsorption of the pollutants to a fixed media filter, a scrubbing liquid, or a combination of the two. A bioscrubber utilizes microbes in the scrubber to consume some or all of the pollutant compounds that are adsorbed. Wet scrubbers and bioscrubbers are effective at reducing VOCs from the air stream by making the VOCs soluble in the scrubbing liquid.

There are a variety of scrubber types that can be used to remove VOCs from exhaust air streams. In most cases, a producer should contact an air pollutant control technology design firm to assist in designing an exhaust gas scrubber system that meets the particular requirements (i.e., pollutants to control, size and operational limitations, etc.) for the farm site. The U.S. EPA has also developed fact sheets for many of the most common types of air pollution control technologies (including many types of scrubbers), which can be found at: *http://www.epa.gov/ttn/catc/products.html*.

Required Elements:

- Attach design criteria and specifications, and operational specifications, for the scrubber specific to your operation. Include photographs of functioning scrubbers or bioscrubbers on buildings at your operation
- Briefly describe your animal operation (including number of animals, type of facility, and dry scrubber placement) and your evaluation of the effectiveness of the scrubber to reduce VOCs coming off your operation

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3. Use additives in animal housing and/or manure storage structures and areas (Ozone-03)
Additives are combined with manure to reduce production of volatile compounds (VOCs) from the manure. Many additives are an enzyme- or bacteria-based treatment which enhances bacterial populations in the animal manure for VOC consumption. Some additives counteract chemical compounds, while others absorb or adsorb chemical compounds. Some land grant universities have developed guidance, evaluation, and/or recommendations for specific applications of additives, and this information may be helpful in developing the manure additive plan. Any producer using this enhancement activity shall adhere to the relevant design criteria put forth in Conservation Practice Standard 591, Amendments for the Treatment of Agricultural Waste.

Required Elements:

- Provide a copy of your manure additive plan which utilizes additives to reduce VOC emissions from manure
- Attach receipts showing purchase of manure additives for use in the manure additive plan
- Briefly describe your animal operation, including number of animals, manure storage facilities, type and quantity of additives you use, and your evaluation of the effectiveness of additives to reduce VOC emissions from your operation