



# Odor and Nutrient Management

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## Tools to Address Air Quality Concerns

by Wendy Powers, Michigan State University; Angela Rieck-Hinz, Department of Agronomy and Jay Harmon, Department of Agricultural and Biosystems Engineering, Iowa State University

Emissions from livestock operations come from three main sources: animal housing, manure storage and land application. In some cases, feed storage may also contribute to overall emissions, depending on the type of feed and the storage method. The relative contribution of each source is site-specific and highly dependent on the species and the type of housing, manure storage and land application methods. Variations exist within a species, too.

For example, a pull-plug swine nursery barn will have different odor and gas emissions than a deep-pit swine finishing barn because of the way the building and manure within the building are managed. The two facilities will also have very different relative contributions from the manure storage area, largely because the finishing barn may not have additional storage. Similarly, a tie-stall dairy barn with only winter manure storage facilities may have vastly different mitigation strategies from that of a freestall dairy facility that has manure storage under the free-stall area and in a concrete tank. And the turkey or broiler chicken grower who raises multiple flocks on the same litter has still another completely different set of considerations.

### Assessing Where to Invest

With limited resources to devote to reducing air emissions, producers are faced with the daunting task of deciding where to invest. To make a wise investment, you need to establish objectives. What do you want to control—odor or a specific gas, such as ammonia or hydrogen sulfide? Or do you want to reduce emissions of particulates (dust) or a group of gases, such as volatile organic compounds (VOCs).

Once the objective is established, you need to know how much control is necessary. In some cases, established guidelines, rules or regulations may set the benchmark. But in many cases, there are no established benchmarks—you need to make your own decision on how much emission control you want to have.



With emission control benchmarks set, you need to decide which mitigation strategy to employ. To realize the biggest return for your investment, use assessment tools to identify problem areas that should receive priority attention. If most odor concerns arise when you're cleaning out the concrete manure storage area, for example, do not start with a strategy that would be used in the barn. If complaints arise from neighbors nearest the fields where manure is applied, then invest in your land application method, not in a manure storage cover.

After the high priority area or areas have been identified, it is time to select a mitigation strategy. This can be a hard and costly decision. Take care to ensure that the strategy is compatible with current management and will result in meeting the reduction targets. A tool available through Iowa State University, the Air Management Practices Assessment Tool (AMPAT), found at <http://www.extension.iastate.edu/airquality/practices/homepage.html>, provides assistance in making this decision.



(Air quality concerns continued from front page)

AMPAT asks a series of questions designed to help narrow the available strategy options based on the current management system. The remaining options all have corresponding reduction for odor, ammonia, hydrogen sulfide or dust, and a relative cost associated with their implementation. AMPAT also provides a list of additional resources for more information about any particular strategy.



AMPAT helps narrow mitigation strategy options, but it does not help identify priority areas for implementation. To fill this gap, in September 2007, the USDA Natural Resources Conservation Service awarded a grant to 12 universities to develop a national air quality self assessment or third party assessment tool (AQSAT) that will enable livestock producers to best decide how to reduce air quality concerns. The result of the two-year project will allow a producer to walk through his or her site and determine where a mitigation practice can have the greatest impact on air quality. Producers will be able to select a gas of interest or odor as their primary reduction objective and from there decide where to implement a mitigation strategy as well as estimate the benefit of any strategy considered. Following development, this multispecies tool will be on-line and available to all producers considering a new operation or an expansion, or those wanting to reduce emissions from their existing operations.

States involved in the project are California, Colorado, Georgia, Indiana, Iowa, Maryland, Michigan, Minnesota, Nebraska, Oregon, Pennsylvania and Texas. In many states, Extension has partnered with state livestock associations to develop and field test the tool. The geographical distribu-

tion of project partners will allow for a tool to be developed that meets the needs of dairy, beef, swine, turkey, laying hen and broiler chicken growers across the country.

### AQSAT in Iowa

The Air Quality Self Assessment Tool has been under development by a team of national scientists for the past year. The Iowa delegation to this team consists of two Iowa State University campus based specialists and five ISU extension field specialists. Currently, the Iowa team is field-testing the tool on swine, beef, turkey and layer farms in Iowa. It is anticipated the field testing will be complete in fall 2008. Upon completion of field testing, the tool will be finalized and developed into a Web based program accessible to those interested in using the program to determine where air emission control practices can be implemented on their farms. The final assessment tool is expected to be complete in fall 2009.

Funding support for the Iowa team and development of the AQSAT tool in Iowa has been provided by the: Iowa Pork Producers Association, the Iowa Turkey Federation, Iowa State University College of Agriculture and Life Sciences and the Iowa Pork Industry Center.

### Biofilters Now Eligible EQIP Practice

by Jason Johnson, Iowa USDA-Natural Resources Conservation Service

Iowa livestock producers with confinement operations can now apply to receive financial assistance to install biofilters, odor-reducing structures fit to the outlet of confinement exhaust fans, through the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS).

Through the USDA's Environmental Quality Incentives Program (EQIP), eligible producers can receive \$2.50 per animal unit for three years, with a cap of 1,500 animal units, to install and maintain biofilters. EQIP is a voluntary conservation program through NRCS that promotes environmental quality in agricultural production. EQIP is available to help agricultural producers protect air quality and reduce the need for regulatory programs.

A biofilter is a device or structure containing an organic material that filters out particulates. Active bacteria attached to the organic material breaks down odorous compounds as they pass through the filter. It is a living ecosystem of microorganisms that continually feed on odorous gases.



Jasper County hog producer Kevin Van Manen took proactive measures last fall when he installed open-bed biofilters on two hog confinements, totaling 3,200-head. He says he can tell a big difference in the reduced odor from his confinements, located adjacent to his home.

Van Manen learned about biofilters from Iowa State University (ISU) Professor Jay Harmon, at an ISU meeting on air quality control. From there, he worked with the Colin Johnson, Iowa Pork Industry Center, to design and implement his system. Van Manen admits making mistakes installing his first biofilter, but says he learned a lot.

### Research Shows Biofilters Work

According to Steven Hoff, ISU Department of Agricultural and Biosystems Engineering professor, biofilters are very effective in reducing odor when designed correctly. Hoff has researched biofilters at Greg Carlson's hog farm in Boone County for four years. His research indicates a reduction in odorous gases after emission from a biofilter compared to an unfiltered exhaust fan.

Hoff says the key to an effective biofilter is the right amount of throat opening from the confinement exhaust fan to the biofilter. If airflow is restricted due to the biofilters, it becomes cost-prohibitive to run fans.

Much of Hoff's research is now focused on limiting the time a biofilter is in use to cut electrical costs. Hoff is looking at "impact-based control" where he tracks weather patterns and monitors potential downwind neighbor events. By doing so, air is forced through the biofilters only when needed.

Hoff says biofilters will be more cost-prohibitive if used to ventilate all air from a confinement. Hoff is researching a way for air to bypass the biofilter, only filtering when it's egregious to neighbors, such as hot summer evenings or when winds are blowing toward adjacent homes.

### Design, Construction and Maintenance

The most common type of biofilter, and one eligible for financial assistance through EQIP, is an open-bed biofilter. There are a number of ways to design an open-bed biofilter, but it must contain the following fundamental components to be eligible through EQIP:

- **Ventilation** – A biofilter needs to be sized to treat airflows during periods when odors are a concern.
- **Media** – 10 to 18 inches of woodchips with the proper amount of porosity, moisture holding capacity, nutrient content and a slow decomposition rate. The estimated woodchip life is 5-8 years, but can be less.

- **Sizing** – Biofilters can be configured horizontally or vertically. A horizontal biofilter requires more space, but costs less to build. A vertically-designed biofilter requires less ground space, but costs more to build.
- **Fans** – Fans must be able to move air through the building and the biofilter. Fan selection is important because it must be able to handle a flow resistance through the building and filter.
- **Moisture Content** – Bed media moisture content should be kept between 40-60 percent for optimal treatment. A garden sprinkler or soaker hose and a timer can facilitate watering.
- **Construction** – Biofilters have ducts, usually made of plywood, and a plenum to support the woodchips. The plenum is the structure under the bed that allows for air distribution. Ductwork connects the pit and wall ventilation to the biofilter plenum. Plenums can be concrete blocks or wooden structures with a mesh or screen on top to prevent woodchips from falling through.
- **Maintenance** – Key practices include maintaining proper moisture levels, weed removal, rodent control, and monitoring media airflow resistance to prevent clogging.

For more information about EQIP opportunities and biofilters, please visit your local NRCS office.

### Online Resources Include:

University of Minnesota  
Biofilters for Odor Control  
<http://www.manure.umn.edu/assets/biofilters.pdf>

BAEU-18 Biofilter Design Information  
<http://www.manure.umn.edu/assets/baeu18.pdf>

South Dakota State University  
FS 925-C Biofilters  
[http://agbio.sdstate.edu/livestock\\_dev/](http://agbio.sdstate.edu/livestock_dev/)





## Planning Considerations for Livestock & Poultry Mortality Disposal: Part 2 – Incineration and Landfilling

by Tom Glanville, Department of Agricultural and Biosystems Engineering, Iowa State University

In the last issue of Odor and Nutrient Management Newsletter, we discussed the pros and cons of on-farm burial of poultry and livestock, with particular emphasis on nutrient loading and risks to shallow groundwater, and on selection of burial sites that help to minimize these risks. In this, the second article in the series, we will review incineration and landfilling.

Incineration uses fuel—typically diesel, propane, or natural gas—to support high temperature combustion that reduces carcasses to ash and gaseous emissions. The primary benefits of incineration are rapid and timely disposal, minimal operational labor, and ability to rapidly destroy bacteria, viruses, and even highly persistent pathogenic materials such as anthrax spores.

On farm incineration is typically done with specially engineered, enclosed, fixed-capacity units employing thermostatic controls. Thermostatic controls are burn chambers lined with refractive materials, and secondary burn chambers—called burners or scrubbers—that reduce emission of odors and particulates.

One of the limitations of engineered incinerators is their fixed capacity. Units typically have fixed batch capacities ranging from 100 – 1,500 lbs. Overloading can result in lower than desired combustion temperatures resulting in air pollution. As a result, incinerators are typically used for disposal of routine losses of small or mid-sized species. In the swine industry, for example, incinerators are typically used for losses occurring in the farrowing house or nursery. A 2001 survey conducted by the National Animal Health Monitoring Systems project indicated that nearly 15 percent of pre-weaning losses were handled with incineration, while it was used for only about 6 percent of post weaning losses.

Fuel usage is an important incinerator characteristic; a 2001 report by University of Nebraska Extension listed diesel fuel consumption ranging from 1 to 3 gallons per 100 pounds of mortality. Ash removal and disposal, and routine repairs, are additional factors to be considered.

Because of their fixed capacity, incinerators designed for on-farm disposal of routine mortalities are usually inadequate to handle surges caused by disease or other catastrophic events. Large capacity portable air-curtain incinerators, however, have been used successfully to handle emergency losses.

These units consist of large open-topped refractory-lined boxes, or a temporary trench excavated in the ground, that is fitted with a fan and air manifold system. The fan blows a high velocity air “curtain” over and into the combustion chamber. This results in elevated burn temperatures, and significantly improved retention and combustion of smoke, larger particulates, and odorous emissions.

Air curtain incineration is a fuel-intensive process requiring both liquid fuel and dry wood. Trained operators also are required. As a result, routine use on most farms is impractical, but air curtain incineration service can be obtained through companies specializing in disaster cleanup and recover.

Engineered incinerators used on the farm do not require a permit from the Iowa DNR. But they are required to be equipped with afterburners or other approved devices that limit smoke emissions sufficiently to meet opacity limits set by the DNR. Open burning of carcasses, or use of home-made incinerators, is prohibited in Iowa.

Disposal of livestock mortalities in landfills is usually limited to emergency situations requiring careful management of large quantities of material. The benefit of using engineered landfills for disposal in these situations is that these facilities are carefully sited to avoid environmentally sensitive areas, and are constructed with leachate containment and/or treatment systems that substantially reduce the risks of soil and groundwater contamination.



Small county or municipal landfills often do not have sufficient excavating capacity, or stockpiles of cover soil, to handle large volumes of livestock during an emergency. Furthermore, animal remains are difficult to compact,



making proper construction of landfill cells difficult unless large quantities of more stable solid waste are available to bury with the carcasses.

Since most landfills are publically owned, public perceptions of environmental risk also can affect the willingness of landfill operators to accept carcasses. During the foot-and-mouth disease outbreak in Great Britain in 2001, opposition from the public limited the use of public and commercial landfills, forcing British authorities to construct special large emergency mass burial sites. With the above barriers in mind, livestock producers are well advised to contact the landfill managers well in advance of the disposal needs to determine if local facilities and services will be made available if needed.

### Reminder – Sign Up for Electronic Distribution of the ONM Newsletter

by Angela Rieck-Hinz, Department of Agronomy, Iowa State University

Many of you have told us the *Iowa Manure Matters-Odor and Nutrient Management Newsletter* (ONM) provides valuable information to you. Be sure to continue receiving this newsletter by signing up for our new delivery method, electronic distribution.

Starting with the December 2008 issue we will no longer print and mail the ONM newsletter. The newsletter will be available in **electronic format only**. To continue receiving the newsletter you need to sign up for an email notification that will tell you when the latest edition of the newsletter has been posted to the Web.

This email notification will also give you direct access the newsletter articles. To sign up for electronic notification please complete and submit the information form found at: <http://www.agronext.iastate.edu/immag/subscriptions.html>. Choose the button for “ONM Newsletter”.

It has been a pleasure to offer this newsletter in the print format for the past eleven years. We greatly acknowledge the financial contributions of the Iowa Natural Resources Conservation Service for their past funding support. As we transition to the new electronic format for delivery we hope you continue to find this newsletter to be a valuable source of information.

### Preparing for Fall Land Application

by Angela Rieck-Hinz, Department of Agronomy, Iowa State University

This newsletter arrives as your thoughts turn to harvest and subsequent land application of manure. Take a few minutes prior to the busy harvest season and land application to prepare for manure application. Some things to consider include the following:

#### Calibration of Equipment

Do you know how much manure you really apply? An easy way to determine your application rate is to calibrate your equipment. Iowa State University Extension has two publications that can assist you in calibrating equipment.

Calibrating Liquid Tank Manure Applicators - PM 1948 is available from the Extension online store at <http://www.extension.iastate.edu/Publications/PM1948.pdf> or you may order copies through your local extension office.

Calibration and Uniformity of Solid Manure Spreaders - PM 1941 is also available online at <http://www.extension.iastate.edu/Publications/PM1941.pdf> or through your county extension office.

#### Emergency Action Planning

Also, review your emergency action plan to prepare for any accidental manure spills or leaks. Review this plan with family members and employees. Make sure that everyone involved in the livestock operation knows where to find a copy of the plan, how to implement the plan, and how to report spills if needed. Some resources include:

Emergency Action Plans - PM 1859 is available at the Extension online store <http://www.extension.iastate.edu/Publications/PM1859.pdf> or can be ordered through your county extension office.

Iowa Pork Producers Association - Emergency Action Planning is available on the Web at: [http://www.iowapork.org/Portals/iowapork/IPPA\\_EmergencyForms\\_2008.pdf](http://www.iowapork.org/Portals/iowapork/IPPA_EmergencyForms_2008.pdf)

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