

Manure Gas Hazards
...page 1

Livestock Odors 101 - How Odors are Measured and Evaluated
...page 2

Design Tools Update
...page 3

SOC Update
...page 4

Manure Gas Hazards

Cheryl Skjollas - Director of UW Center for Ag. Safety and Health

It has been one of those days for a farmer or hired hand. At every corner, something seems to go wrong, and now there's a problem with the pump in the manure reception pit. Tired, frustrated and thinking of everything else that needs to be done, a lone worker enters this deadly trap that takes his or her life. Today, for a variety of factors, the air quality in this confined space is oxygen deficient and filled with dangerous gases. One, maybe two breaths will be all that it takes for this individual to be overcome in this toxic environment. Others in the area attempt a rescue. Tomorrow, the news media will broadcast information on this sad and tragic loss of lives as several others are overcome as they entered the pit to help the victim.

to manure gases and confined space entry. Manure gases are not a new hazard but a natural part of decomposing animal wastes just like septic gases are to human waste. What is changing in our agricultural landscape are the types of manure handling systems and the amount of manure in storage. Instead of daily trips with a manure spreader filled with waste and straw which has accumulated in a shallow gutter, we're now looking at millions of gallons of manure being removed from buildings via tanks, channels and pipes and then stored in large lagoons and fabricated structures. Each discussion on manure handling systems surfaces a variety of hazards. To begin a safety discussion, we'll start with the manure gases.

This scene is composed from facts common to fatalities related

Hazards of Gases

There are four main gases produced with the anaerobic decomposition of manure. These gases are methane, carbon dioxide, ammonia and hydrogen sulfide. Each gas has unique characteristics that are important to know. The primary hazards of these gases are: toxic or poisonous reactions in people and animals, asphyxiation, a result of oxygen depletion, and



Hazardous Gas Air Monitor

Produced Jointly By:
Wisconsin Department of
Agriculture, Trade and
Consumer Protection
and
USDA
Natural Resources
Conservation Service

Livestock Odors 101 - How Odors are Measured and Evaluated

Steve Struss - DATCP

Note: This is the second in a three-part series of articles on livestock odors. In the first article we looked at what stinks and why, and in the third, odor BMPs will be discussed.

Getting a “handle” on odors can be quite challenging. People’s sensitivity to odors varies, as does their perception of what smells good or bad. And people can grow accustomed to odors over time (like when living near a paper mill) and lose the ability to detect them. One of my college roommates seriously thought that hog farms smelled good “like money” since he grew up on one! That being said, a sampling of “normal” observers (my roommate not included) will generally agree on how intense an odor is and whether it is offensive or not.

Measuring odors is as much an art as it is a science. We have yet to come up with an instrument as sensitive as the human olfactory for measuring odor. Individual components,



Hand-held Olfactometer

such as hydrogen sulfide, can be quantified, however any given odor is a complex mix of many components, making it nearly impossible to measure. For example, there are up to 200 different gasses being emitted from a typical manure pit that all contribute to its odor! You can imagine the difficulty with accurately measuring that many compounds at once.

There are two basic methods for measuring odors. One involves the quantification of an “indicator” gas, and the other uses the human nose. With simple odors, knowing the concentration of one of its major components will indicate the intensity of the odor. This is not possible with complex odors, however, therefore the methods used rely on the human nose. This is done in one of two ways; either by taking a bag sample and sending it to a lab for analysis, or by using a field olfactometer.

When a lab analysis is used, a panel of average subjects (usually 5 to 8) are blindfolded and then allowed to sniff “zero” air with ever increasing amounts of the odor sample mixed in. The dilution level at which the odor is first detected by each panel member is then recorded and averaged. This is what is known as the “dilution to threshold” or D/T level of the odor, and is a measure of its relative intensity. In some

cases the panel participants are also asked to characterize the odor, using descriptors such as floral, pungent, rancid, etc.

In the field, a hand held olfactometer is used (see photo). This device works similar to a lab unit by filtering ambient air through an activated carbon filter. Once the operator’s nose is zeroed out by breathing 100% filtered air, unfiltered air is introduced in ever increasing amounts. This is accomplished by rotating a dial with varying sized orifices drilled in it. Again, the dilution level where the operator first detects the odor indicates its relative intensity (D/T). Although this method is still somewhat subjective, the yes-no nature of the testing, like a hearing test, minimizes that subjectivity and generally produces repeatable results.

Evaluating odors is more subjective than measuring them, since it requires testers to apply their own set of criteria to the odor they observe. Based on our past experiences, some odors may conger up pleasant memories, or ones we would rather forget. A certain perfume may remind us of a favorite aunt or our strict third grade teacher. Some of these reactions may be conscious while others may illicit feelings we are not even aware of. In an attempt to bring science to

(Continued on next page)

the art of odor evaluation, odor wheels have been introduced. Odor wheels are charts of common odors, arranged by category and example in pie-chart form. Different observers evaluating the same odor can come to a common understanding by comparing the odor to the standard set of odors listed on the wheel. This forces observers to make concrete decisions rather than basing their evaluation on their own set of likes and dislikes. Descriptors like floral or fishy are more useful than sweet or sickening.

Because odors are something humans react to, consciously and subconsciously, they are inherently subjective in nature. However, tools such as olfactometers and odor wheels help to minimize that subjectivity and bring science to the art of measuring and evaluating odors.

Design Tools Update

Due to space limits in this issue, a full Design Tools Update could not be included. The Design Tools Committee has recently revised a number of engineering spreadsheets. Please go to the NRCS Website: http://www.wi.nrcs.usda.gov/technical/eng_spreads.html to get the most up-to-date version of any spreadsheet.

explosion when oxygen is added to the mix.

Methane (CH₄) is a non-toxic gas. CH₄ is odorless, colorless and lighter than air. However, it is highly flammable. A spark from equipment, poor wiring, or welding could provide an ignition source for an explosion or fire. At Manure Tech 2007, a custom hauler shared that as he started to weld in a pit within the barn, the methane ignited and the flash went all the way up to the rafters. Methane is an asphyxiant and will cause rapid breathing, dizziness and fatigue.

Carbon Dioxide (CO₂) is heavier than air and will displace oxygen. CO₂ may result in headaches and dizziness. Death by asphyxiation is possible at high concentrations of CO₂.

Ammonia (NH₃) has a sharp pungent odor and is lighter than air. Ammonia causes irritation of the eyes and respiratory tract, and may cause permanent lung damage.

Hydrogen sulfide (H₂S) levels may increase a thousand-fold during agitation. This extremely toxic gas is the most dangerous part of the manure gas as it is colorless, heavier than air, and may cause death in seconds at high concentrations. While H₂S

is commonly known for its rotten egg odor, it isn't detectable by the human sense of smell at higher concentrations. It affects eyes, as well as the respiratory and central nervous systems. While manure pit related deaths are often reported as being caused by methane, hydrogen sulfide is the more frequent cause of death. The July, 2007 fatalities in Virginia were first reported as due to methane and a couple weeks later, the cause of death was revised to hydrogen sulfide. The most serious problems with gases occur when manure is agitated or when ventilation systems fail. However, gases are constantly being produced and there is never a "safe" time to enter a pit or other confined spaces within a manure handling system.

Monitoring for Gases

Your nose is not an effective monitor for these gases. A four-gas monitor is your best investment. While these monitors cost around \$2,000, consider the cost compared to a workplace fatality or other health complications to workers. Most safety supply companies carry four-gas monitors. You'll want to assess the instruments for ease of use and your intended application. An important part of monitoring is to monitor every time you enter the confined space. Otherwise, the one day you are in a hurry and take a chance on entering a potentially deadly space may be your last day on earth.

SOC Standards Update
Kevin Hogan - SOC Coordinator

Standards in Development:

Feed Storage Leachate and Runoff Control — The draft Standard was completed and work on a separate companion document will likely be scheduled in the future.

Proprietary Stormwater Sediment Control Devices — The draft standard was in the broad review comment period through Oct. 17, 2007. Additional team meetings will be scheduled to evaluate and respond to comments.

Wet Detention Basin — The existing DNR technical standard (1001) is undergoing revision and the work team so far has focused on methods to size basins without modeling, the water quality control criteria, the role of liners, and O&M requirements. In September 2007, the work team completed responses to comments received in the broad review comment period. The next version of the draft standard will incorporate changes from the broad review process, and the team will then complete the draft standard.

Infiltration Trench — A new work team has just been formed to develop a post-construction infiltration trench technical standard for the state Department of Commerce, although the scope of the standard will not be limited to urban applications. The new standard will conform to existing stormwater infiltration laws and regulations, including NR 151.12 and Comm. 82.365. It will address plumbing, as well as non-plumbing trenches, and will attempt to minimize differences between the two types of trenches.

Milking Center Waste — The draft Standard has been completed, and the team is finishing the companion document, which will soon be published.

New Work Teams Being Formed:

Fence — A new work team is being put together to revise the existing NRCS fence standard (382). The current standard is fairly old and addresses primarily livestock containment. The revised standard will be broader in scope to also address safety design criteria for perma-

nent (and possibly temporary) fencing situations (e.g., safety issues around manure pits, to exclude both livestock and children). Also, information on incorporating newly available fencing materials into projects could be the subject of a Technical Note. There is already a draft standard for this, so this team would not be a huge time commitment. If you are interested in being on this team, please contact Kevin Hogan at kevin@wlwca.org.

SOC is in the early planning stages for a new DNR slope stabilization technical standard that will apply to operations above the shoreline in both agricultural and urban areas. Although DOT has in place some erosion control practices, there is little that's relevant to structural issues. The new standard will likely require an evaluation of slope, practices to stabilize the slope, a soils investigation and an evaluation of bedrock and water influences.

Contact Kevin Hogan, SOC Coordinator at kevin@wlwca.org if you have any questions.

Editors: Pete Wurzer - DATCP 715-832-6547 (x102) peter.wurzer@datcp.state.wi.us
Beth Peterson - NRCS 608-637-8321 (x242) beth.peterson@wi.usda.gov



**Department of Agriculture,
Trade and Consumer Protection**

2811 Agriculture Drive
PO Box 8911
Madison WI 53708-8911



U.S. Department of Agriculture
Natural Resources Conservation Service
USDA is an equal opportunity provider and employer

8030 Excelsior Drive
Suite 200
Madison WI 53717-2906