January 2010

Swine Facility Emission & Odor Monitoring

Paul Kivlin, UW Extension / NPM / Discovery Farms
Kevan Klingberg, Dennis Frame and
Amber Radatz UW Extension / Discovery Farms

Introduction

Air quality and odor control are pressing environmental issues facing animal agriculture across Wisconsin and the United States. In the near future, producers will be faced with increasing pressure to comply with newly developed air quality standards. For the past several years, pork producers have been at the forefront of these issues and they understand the importance of odor and emission control. As leaders in their industry, Lynn and Patricia Harrison (E & L Harrison Enterprises, Inc.) participated in an emission/odor monitoring project with the Discovery Farms Program and Baumgartner Environics. This study evaluated their hog finishing facilities against current Wisconsin Ambient Air Quality Standards.

Ammonia, hydrogen sulfide and odor from livestock facilities can all have an adverse impact on air quality, which may affect the health and wellbeing of the people and livestock living and working in these areas. The Wisconsin livestock industry has limited quantitative data to document actual on-farm emissions associated with livestock facilities and feedlots. To improve the amount of information available, industry representatives requested that monitoring be conducted to identify the baseline levels of loss for ammonia, hydrogen sulfide and odor generated from a variety of livestock facilities.

Ammonia (a nitrogen gas) is emitted from housing facilities, manure storage areas, and from applications of manure / nitrogen fertilizer to fields. Field applications of manure that contain ammonium can have losses that remain in the air as particulate haze or re-deposited to the land. Concerns about ammonia emissions include:

1) atmospheric particulates that cause haze and stimulate human respiratory health issues; and

2) additions of "extra" nitrogen to the ecosystem resulting in soil acidification, changes in plant speciation and water quality concerns (hypoxia).

Hydrogen sulfide is a product of the anaerobic decomposition of manure (or other organic matter). Exposure to hydrogen sulfide at 50 parts per million (ppm) can cause dizziness, headache and nausea; while exposure at levels of 1,000 ppm or more can cause death from respiratory paralysis. Occasionally workers who are in areas with extremely high concentrations of hydrogen sulfide (manure pits, transfer stations, poorly ventilated buildings, etc.) can become ill and/or die.

Odors from livestock facilities arise from a wide variety of gases and compounds, many of which exist at very low concentrations. The actual odor can be from any combination of manure, dust, decaying feed and other organic material. Odors evoke a wide range of physical and emotional reactions, both positive and negative – depending on the person.

University of Wisconsin – Extension
DISCOVERY FARMS
University of Wisconsin – Madison

Project Methods

This project was conducted by Baumgartner Environics and Discovery Farms staff at five swine finishing barns located northwest of Eau Claire, Wisconsin. Animal management within these barns is "all in – all out", where feeder pigs are brought in at 50 lbs. and finished to 250 lbs. within a 16 week period. On the day that the air quality monitoring was conducted, each feedlot/barn had the following hog populations:

Table 1. Population at each study site

Location	Hog Numbers	Hog Weights (lbs)	Animal Units (1 unit/1000 lbs of hog)
Feedlot 1 East Barn	320 and 300	220 and 120	105
Feedlot 1 West Barn	600	120	72
Feedlot 2	800	230	184
Feedlot 3 North Barn	1000	80	80
Feedlot 3 South Barn	1000	50	50

Figure 1. Using colorimetric tube to measure ammonia from barn fan

The emission rates for ammonia, hydrogen sulfide and odor were determined for each barn. Ammonia was measured directly from barn exhaust fans, as well as manure pit exhaust fans using gas detection colorimetric tubes (Figure 1). Hydrogen sulfide was measured at the exhaust fans and the property lines using a Jerome 631-X Hydrogen Sulfide Analyzer (Figure 2). Odor was measured using two methods. First, by collecting a bag of air from barn exhaust fans for lab analysis by dynamic olfactometry (Figure 3). Odor was also measured on-site using a Nasal Ranger Field Olfactometer (Figure 4). Baumgartner Environics used the U.S. Environmental Protections Agency's CALPUFF air quality model to estimate odorous gas concentrations present at property lines and nearest neighbor residences.

Figure 2. Using Jerome Meter to measure hydrogen sulfide

Figure 3. Bag of air collected and delivered for lab analysis by dynamic olfactometry

Figure 4. Using Nasal Ranger Olfactometer to measure odors

Project Results

Emissions of ammonia, hydrogen sulfide, and odor are measured as the amount of gas emitted per square meter of barn floor per time unit. These measurements are referred to as 'gas flux rates', and are provided for this study in Figures 5-7. For the purpose of comparison, each figure also shows the average emission flux rate from a number of Minnesota swine finishing barns, (Wood, S. L. et al. 2001. Odor and Gas Emissions From Animal Production Systems. 2001 ASAE Annual Meeting Paper No. 01-4043. St. Joseph, MI.).

Figures 5-7 show 1-day emission and odor values for the five Harrison farm barns in this study, compared to a number of Minnesota swine finishing barns. The Harrison farm measurements show a high correlation to the number of animal units present in each barn (an animal unit is equal to 1000 pounds of animal). Table 1 shows that on the day of this study, Harrison farm-Site 2 was the most densely populated barn on the farm with 800 market weight hogs (184 AU). Similarly, Figures 5-7 show that same barn had the highest emission and odor values measured at the exhaust fans, compared to the other barns with fewer animal units in each. Emission rates of ammonia and hydrogen sulfide from all the buildings on the project farm were below the Minnesota average. The levels of odor were slightly above the Minnesota odor average. On the Harrison farm, the detectable gas concentrations and odor intensities were mostly limited to the immediate vicinity of the feedlot barns.

In summary, the sampling and modeling of air quality indicate that E & L Harrison Enterprises, Inc. hog finishing facilities are not a significant public health concern with regard to ammonia and hydrogen sulfide emissions. Odor is primarily confined to the immediate vicinity of the barns but could be detected (at non-annoying levels) at the property lines for some locations. A full report for this project, "Air Quality Impacts at Three Hog Feedlots", was prepared by Baumgartner Environics and is available on the University of Wisconsin - Discovery Farms Program website: (http://www.uwdiscoveryfarms.org/pdf/pubsnewsres/other/harrisonBErpt.pdf).

Figure 5. Ammonia Emissions at 5 Swine Finishing Barns compared to MN study

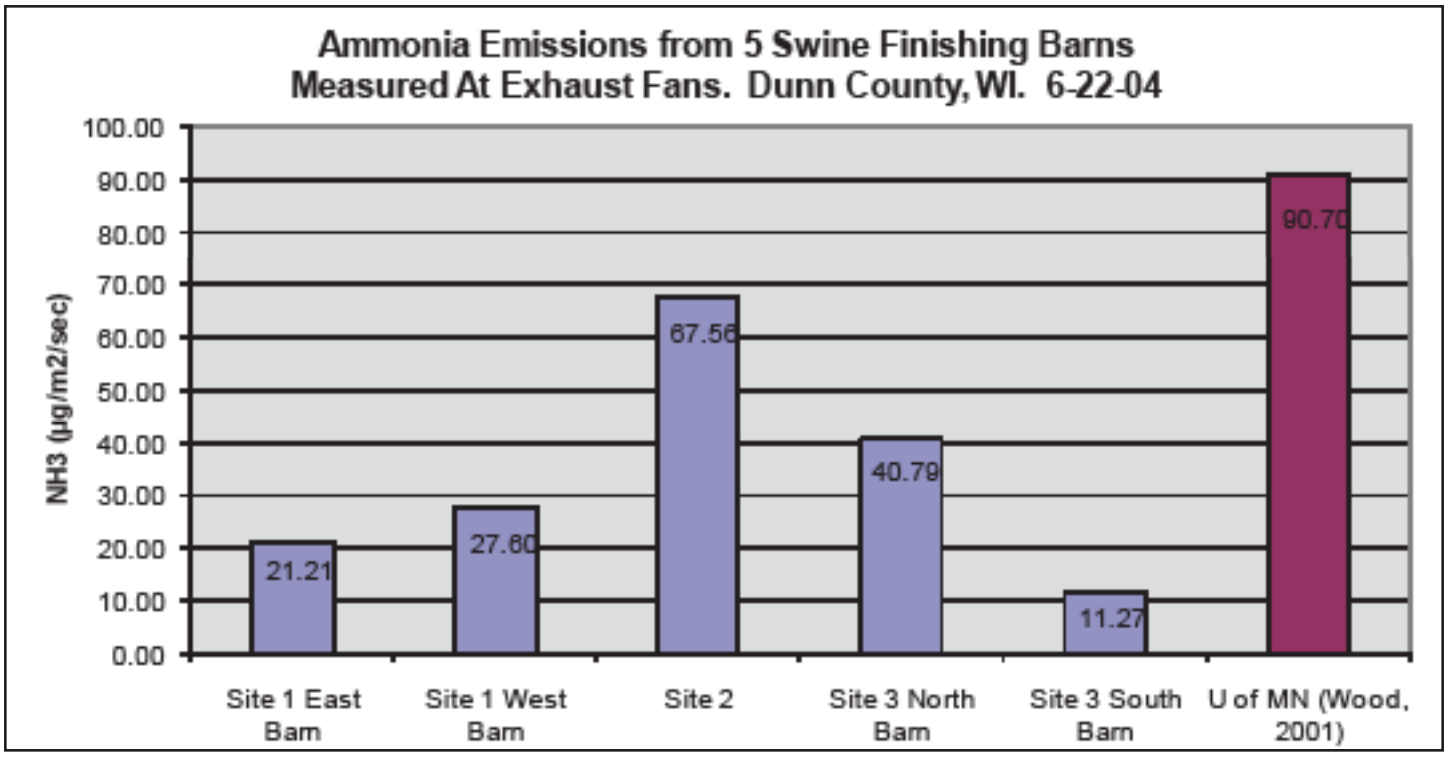


Figure 6. Hydrogen Sulfide Emissions at 5 Swine Finishing Barns compared to MN study

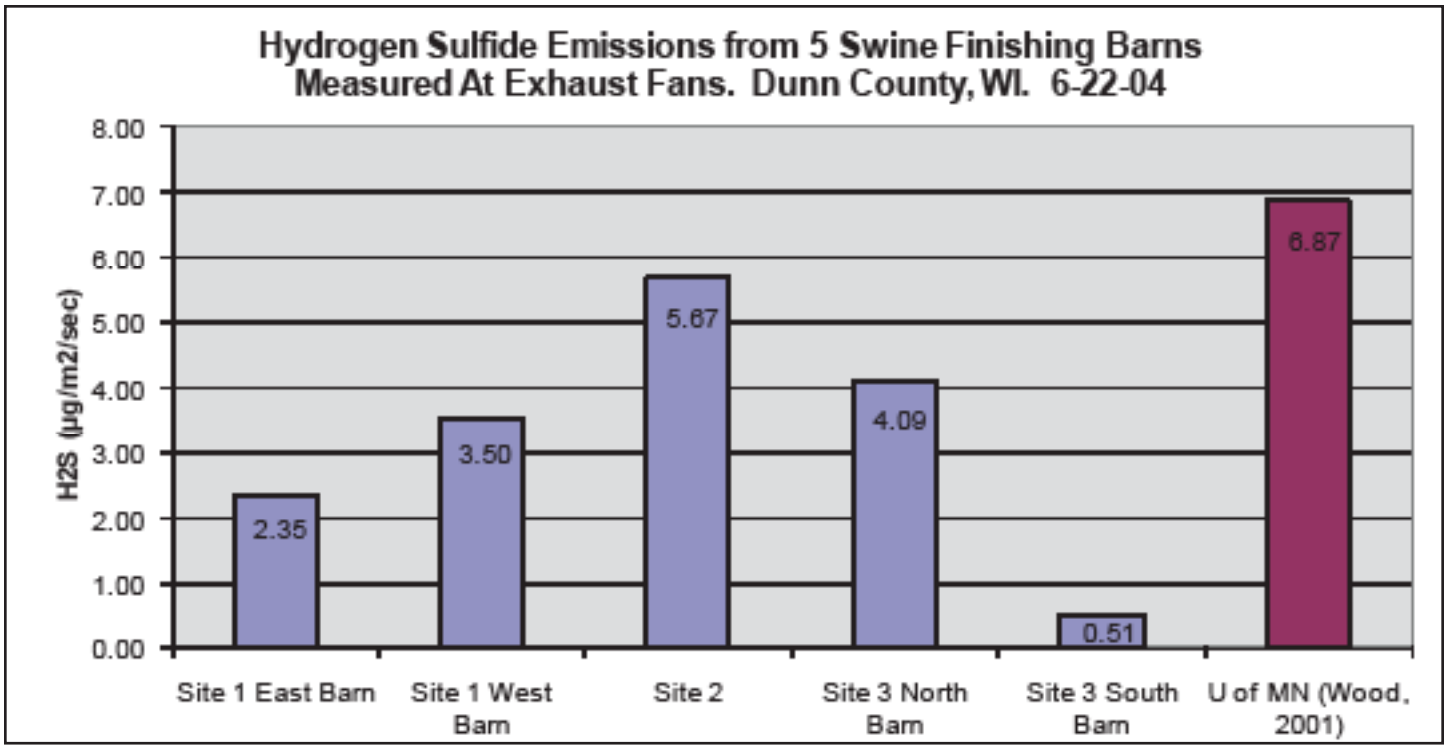
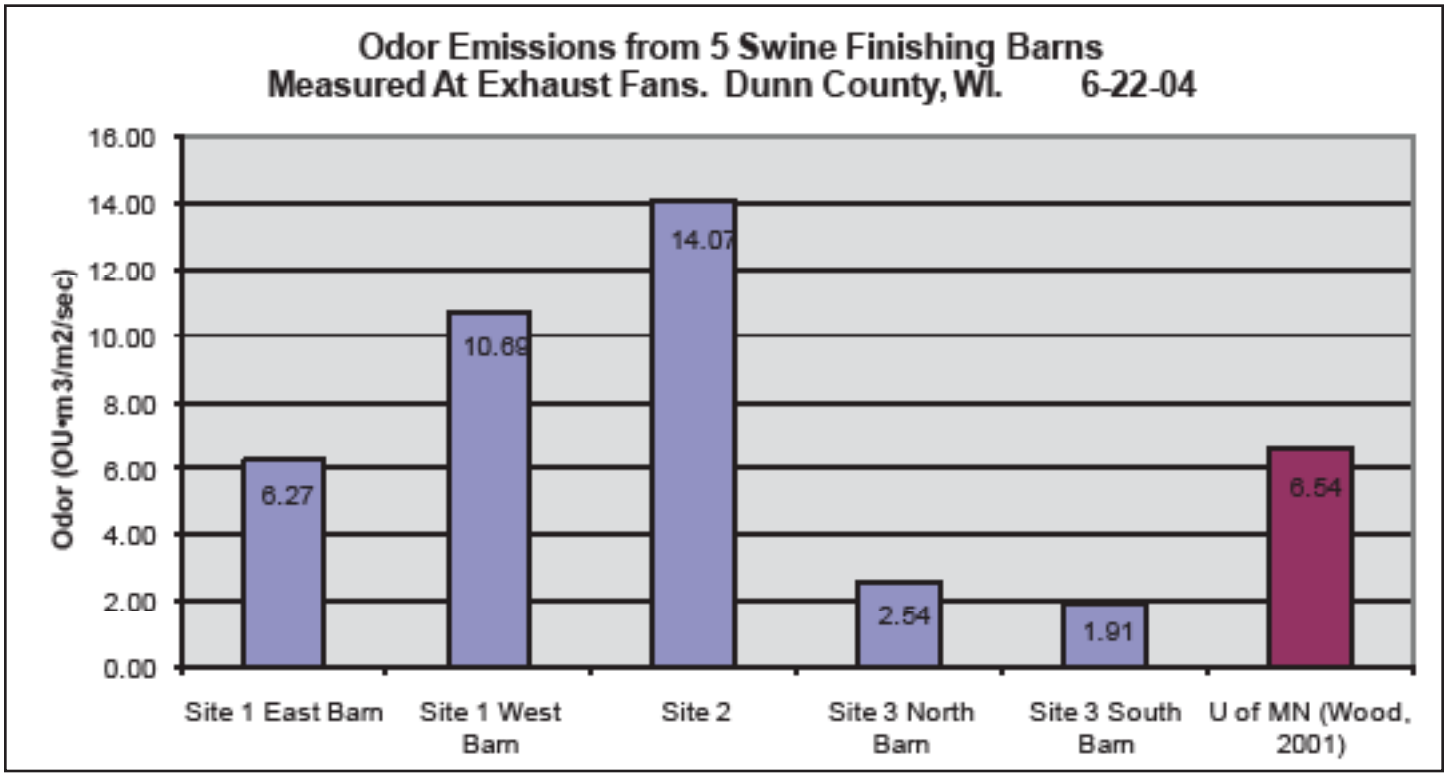


Figure 7. Odor Emissions at 5 Swine Finishing Barns compared to MN study



University of Wisconsin – Extension
DISCOVERY FARMS
University of Wisconsin – Madison

This material is based upon work supported in part by the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, Federal Administration Extension Projects, under Agreement No. 2009-45045-05632.

This fact sheet is part 2 of a 4 part series and can be found along with the rest of the fact sheets on the web at: www.uwdiscoveryfarms.org or by calling the UW-Discovery Farms Office at 715-983-5668.