

## Hydrogen Sulfide from NC Hog Farms

By Steve Schliesser, February 6, 2003

Animal farm operations, particularly hog production, have become a major business in NC. According to the 2002 National Agricultural Statistics, NC produced 16% of the United States hogs. Growth in this industry has leveled off since 1997 due to a Legislative moratorium. There are now over 3,000 swine farms with approximately 10 million animals in NC. The majority of the hog farms are concentrated in Duplin and Sampson counties, both in the southeast, which produce 40% of NC hogs.

In the late 1990's NC authorities determined that the primary toxic air pollutant of concern from animal operations was ammonia. A natural by-product of manure decomposition, it is highly soluble in water and has a tendency to accumulate. Ammonia volatilizes and is released into the air rapidly when manure dries, and quickly transforms from a gas into very small (fine) particles. The environmental problems with ammonia (NH<sub>3</sub>) and other nitrogen compounds problem are largely being addressed; NC has become a national center for atmospheric ammonia emissions and deposition due to the combined efforts of the Legislature, NCSU/UNC, and industry.

In contrast, any potential issue with hydrogen sulfide (H<sub>2</sub>S) from NC animal operations has gone largely unnoticed. Given its relative obscurity, there has not been a systematic effort to measure and characterize H<sub>2</sub>S air emissions for three reasons:

1. No animal operations in NC have air permits. Division of Air Quality (DAQ) rules state that unless an odor management plan fails, no control technology is required on an animal operation and no air permit is necessary. Therefore, animal operations are not required to report any air emissions.
2. Several factors make emissions from NC farms different than those in other parts of the country, i.e., regional variation in farm configuration and pollution control best management practices. With good reason, H<sub>2</sub>S is perceived to be less of a problem in NC.
3. Measurement techniques were poor. Manure processing lagoons are the most emissive location. The combination of poor instrument detection limits and the inherent difficulties in measuring representative fugitive emission levels from an area source have made estimating emissions problematic nationwide.

The EPA has compiled H<sub>2</sub>S emissions estimates for some animal operations. EPA developed emission factors for hog lagoons, based on an unpublished test report at a mid-western hog farm.<sup>1</sup> Although estimates are available for swine operations, significant data gaps exist for southern farms types and animal waste processing steps. Assuming that EPA emission factors are applicable to NC hog farms, there would be over 40 million lb/yr coming from hog operations, or over 3 times the emission amount from the fertilizer and pulp/paper industries combined.

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<sup>1</sup> U.S. EPA, Emissions from Animal Feeding Operations, Draft, August 2001, accessed in February 2003 at <http://www.epa.gov/ttnchie1/ap42/ch09/draft/draftanimalfeed.pdf>

However, there are strong reasons supporting that the EPA reported H<sub>2</sub>S emission factors are much greater than those for a NC hog farm. Following are responses from three NCSU faculty concerning available information on H<sub>2</sub>S from NC hog lagoons.

Mr. Ron Sheffield, NCSU Animal Waste Specialist. Hog lagoons in NC and other southern states contain purple sulfur bacteria (PSB). PSB consume and use sulfur compounds, such as H<sub>2</sub>S, as nutrients for cell growth. As a result, occurrence of PSB reduces the release of H<sub>2</sub>S emissions from hog lagoons. Given its natural ability to reduce H<sub>2</sub>S emissions, midwestern universities (such as NE and MN) are studying ways to promote growth of PSB in their hog lagoons as a H<sub>2</sub>S management practice.

Dr. Viney P. Aneja, NCSU Professor, Department of Marine, Earth and Atmospheric Sciences ([Viney\\_Aneja@ncsu.edu](mailto:Viney_Aneja@ncsu.edu)). The opportunity of doing complimentary H<sub>2</sub>S measurements at the hog lagoons (i.e., take H<sub>2</sub>S measurements while doing ammonia measurements) was considered, but then declined primarily due to strong indications that H<sub>2</sub>S was not a major issue. At the normal pH of 7.8 to 8.0 of NC hog lagoons, low levels of H<sub>2</sub>S emissions. When pH is decreased to 4-6, H<sub>2</sub>S is more likely to be emitted because more of it is present in the H<sub>2</sub>S form. Accordingly, Dr. Aneja expects that the EPA emission factors, based on Midwestern lagoon with lower pH, overstate H<sub>2</sub>S emissions from NC hog lagoons. Dr. Aneja also expressed interest in the opportunity of doing a joint study with DAQ on H<sub>2</sub>S emissions from NC hog lagoons.

Dr. Wayne Robarge, NCSU Professor, Soil Chemistry ([wayne\\_robarge@ncsu.edu](mailto:wayne_robarge@ncsu.edu)). Dr. Robarge has worked with DAQ for a couple of years on hog lagoons and is not aware of any H<sub>2</sub>S emission data. Except for blockages in the drain systems or during flushing events in the houses, no one really seems to detect H<sub>2</sub>S. He doubts it is being masked by the other odors. One of his students recently looking at sulfate conditions in six lagoons over time. However, he did not do any direct determinations of sulfide concentrations in the lagoon. Dr. Robarge is also working with Susan Shiffman at Duke, who has studied H<sub>2</sub>S extensively for years. She is measuring H<sub>2</sub>S concentrations related to odor measurements in regards to the evaluation of alternative technologies. Dr. Robarge also expressed interest in the opportunity of doing a joint study with DAQ on H<sub>2</sub>S emissions from NC hog lagoons. He proposed looking at the lagoon aqueous chemistry to measure sulfur concentrations in solution. This would allow him to estimate H<sub>2</sub>S emissions.

On the premise that the EPA emission factor data were appropriate, DAQ modeled an actual, representative NC farm with 4,000 hogs. The results showed that the farm would be in compliance with the current H<sub>2</sub>S AAL (1500 ppb) as well as both proposed 24 hr H<sub>2</sub>S AALs (23 ppb and 83 ppb). However, the maximum 1-hour modeled concentration was approximately three times higher than the proposed 40 ppb 1-hour AAL.

In summary, DAQ believes that the EPA H<sub>2</sub>S emission factors significantly over-estimate H<sub>2</sub>S releases from NC hog farms. However, we clearly concede that a data gap exists, and recommend that a study(s) on H<sub>2</sub>S emissions from NC hog lagoons be conducted in the near future.