

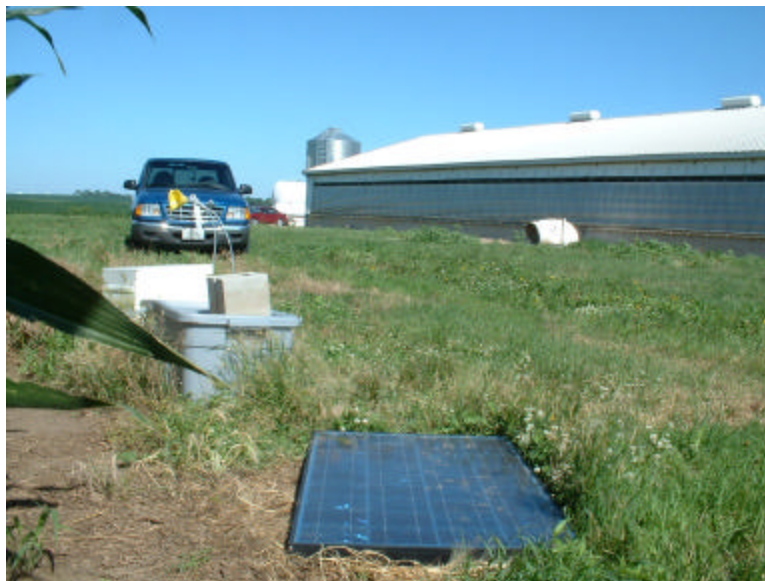
AIR EMISSIONS MONITORING PROTOCOL

NATIONAL PORK BOARD PROJECT #04-126

Steven J. Hoff, Ph.D., P.E.
Professor, Department of Agricultural and Biosystems Engineering
Iowa State University
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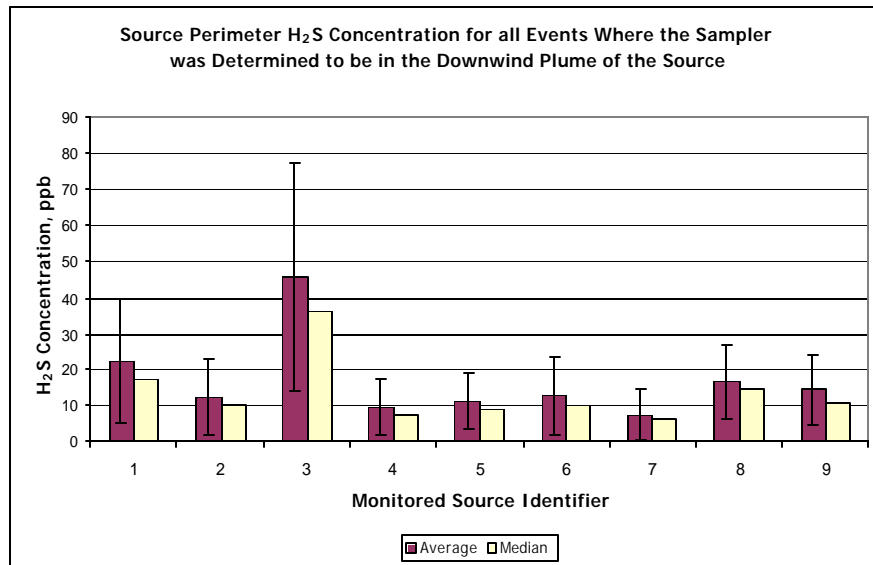
Executive Summary

A research project was conducted from May 2004 through mid-September 2005 to investigate the concentration of hydrogen sulfide (H_2S) at the perimeter of nine swine operations across the state of Iowa, and, to investigate the ammonia (NH_3) and H_2S concentrations near and inside residences located in the community of swine operations and in one area of the state not associated with animal agriculture. The nine sources monitored ranged from sites that housed 1,200 to 4,800 finishing animals. A typical monitoring set-up at one of four compass locations at the perimeter of a source is shown below.



The results indicate that at the perimeter of all nine sources monitored, the overall average H_2S concentration ranged from a low of 1.9 ± 2.7 ppb to a high of 26.3 ± 32.3 ppb. These results included all measurements, whether or not the samplers were determined to be in the downwind plume of the source. If a sampler was determined to be in the downwind plume of the source, or the meteorological conditions were calm, the average measured results at the perimeter of the nine sources ranged from a low of 7.4 ± 6.9 ppb to a high of 45.8 ± 31.8 ppb. In both cases, downwind-only versus all measurements, the maximum perimeter H_2S concentration was recorded at a finishing site where an earthen basin and a concrete formed below-grade basin existed in close proximity to the livestock housing. The downwind-only perimeter results are shown in the figure below. As a frame of reference, the State of Iowa is using a Health Effects Value (HEV) for H_2S of 30 ppb *at a residence located at or beyond the regulated*

separation distance, not to be exceeded more than seven 1-hour averages per year (the Health Effects Standard, HES).

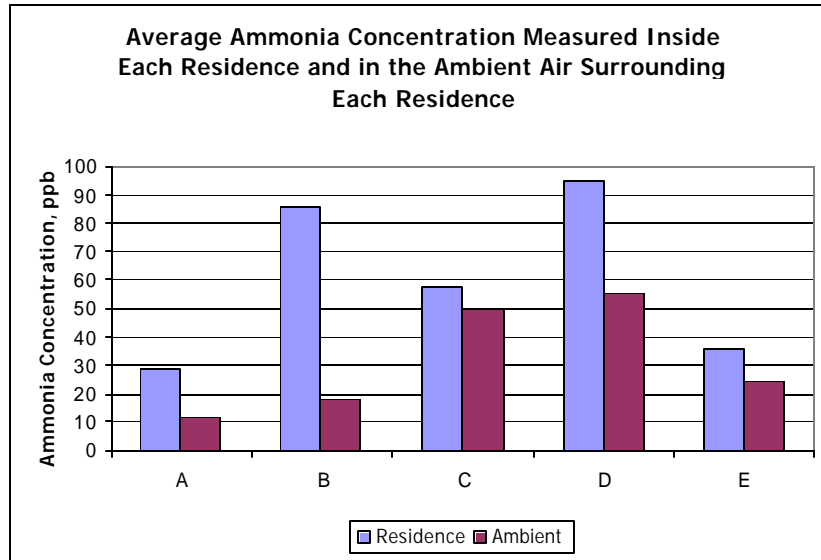


Measurements of H₂S and NH₃ were also collected at five residences, four of which were located near four of the sites monitored for perimeter H₂S levels, with one located in an urban setting far removed from animal agriculture. At each residence a climate controlled Mobile Ambient Laboratory was used to capture gas samples from the air outside the residence (ambient) and air inside the residence. An example set-up at one of the five residences monitored is shown below.

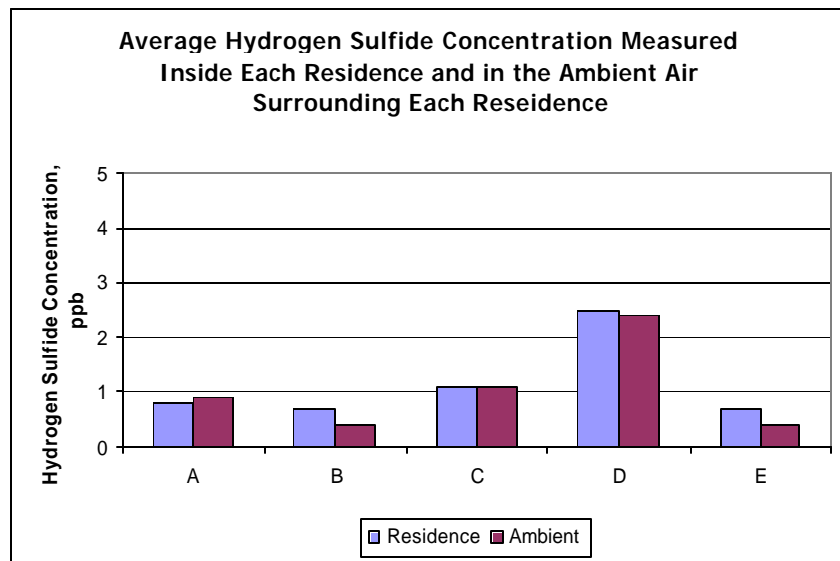


The results, based on the daily averages, indicate that the overall average NH₃ concentration measured inside the homes ranged from a low of 28.6±12.8 ppb to a high of 94.7±28.1 ppb. The overall average NH₃ concentration measured in the ambient air outside the homes ranged from a low of 11.7±5.3 ppb to a high of 55.1±20.6 ppb. The

NH₃ concentrations measured inside the homes were significantly higher than in the ambient air outside of the homes (p<0.01). These elevated inside home NH₃ concentrations persisted whether the residences were upwind or downwind of animal related sources. The figure shown below illustrates these results.



H₂S concentration inside the homes ranged from a low of 0.7±0.2 ppb to a high of 2.5±1.5 ppb. H₂S concentration in the ambient air outside the home ranged from a low of 0.4±0.2 ppb to a high of 2.4±2.4 ppb. These differences were not significant (p>0.50). These results are given in the figure below.



The highest ambient air average for H₂S (2.4±2.4 ppb) and NH₃ (55.1±20.6 ppb) was recorded for a residence located 251 ft to the east of a 4,800-hd deep-pit finishing site and served as the home for the tenants of the farm. For the residence monitored in an urban setting far removed from animal agriculture, the overall average H₂S

concentration outside the home was 0.4 ± 0.2 ppb with the inside home averaging 0.7 ± 0.2 ppb.

The two highest inside home average concentrations for NH_3 were 94.7 ± 28.1 ppb and 85.7 ± 15.3 ppb. These two levels are close to the currently recommended Minimum Risk Level (MRL) for NH_3 , established by the Agency for Toxic Substances and Disease Registry (ATSDR), where a chronic MRL of 100 ppb for NH_3 has been established. If the levels recorded for the two residences specified above would persist for 365 days or more, the ATSDR guidelines for the protection of sensitive populations would be very close to exceeding the ATSDR MRL for ammonia. Evidence from this study suggests that the elevated inside home NH_3 concentrations were the result of inside home sources for NH_3 and not the result of being in the downwind plume of the sources monitored. Subsequent research in a controlled laboratory setting has confirmed several potential inside home sources for ammonia.

Summary Statements

The state of Iowa is currently monitoring NH_3 and H_2S in the ambient air of residences located near ten of the largest swine and poultry operations. These residences are located at or beyond the mandated separation distance. Both NH_3 and H_2S findings will be compared with the ATSDR guidelines given above. The results from this study indicate that inside home sources for both these gases need to be evaluated to ensure that sources for both gases are properly identified for the protection of sensitive populations. The monitoring completed with this current study indicated that NH_3 and H_2S concentrations measured in the ambient air for residences located at or beyond the separation distance fell well below the MRLs as defined by the ATSDR.

Future Work

Work is currently underway using the Air Dispersion Laboratory at Iowa State University to recreate typical components used in residential homes to test components and accessories such as home cleaners, pet accessories, and smoking on internal ammonia concentrations. This work is proceeding to verify the trends in ammonia and hydrogen sulfide found with this research project.

Acknowledgements

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