

Title: Meta-Analysis of H₂S, NH₃, VOCs, PM₁₀ and PM_{2.5} Emissions from Swine Production Facilities in North America– **NPB #12-022**

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Scientific Abstract:

The goal of this project was to collect currently available measured emissions data or property line concentration data and integrate the results through meta-analysis for air emissions of NH₃, H₂S, VOCs, PM₁₀ and PM_{2.5} from live swine production facilities in North America, including manure storage systems; and to interpret the implication of these data relative to existing or potential federal regulations. Results from more than 80 studies were identified through a thorough literature search. Study results were compiled together with data from the reports of the 11 swine sites (IA4B, NC3B, NC4B, OK4B, IN3B, IN4A, NC4A, OK4A, IA4A, NC3A, and OK3A) in the National Air Emissions Monitoring Study (NAEMS) for the meta-analysis. The response variables were the mean emission rates at each data point in two different units (kg yr⁻¹ hd⁻¹ and kg yr⁻¹ AU⁻¹ for emissions from swine houses; kg yr⁻¹ hd⁻¹ and kg yr⁻¹ m⁻² for emissions from manure storage facilities). Histograms of emission rates usually show a skew-right distribution. The mean emission rates were sensitive due to a few large values while the medians were more robust. The median emission rates from swine houses were 2.78, 0.09, 0.44, 0.09, and 0.015 kg yr⁻¹hd⁻¹, for NH₃, H₂S, VOCs, PM₁₀ and PM_{2.5}, respectively. The median emission rates from swine storage facilities were 2.08, 0.20, and 0.75 kg yr⁻¹hd⁻¹, for NH₃, H₂S and VOCs, respectively. Effect of stage of production, manure system for swine houses, area of manure storage facilities, average pig weight, size of operation (pig number), and air temperature on emission rates were investigated. Regression models for emission rates were developed for each of the pollutants. Farrowing operations had significant higher emission rates than finishing operations on a per head basis for all the pollutants of interest. Accordingly, sizes of swine farm that may trigger the need to report under the Emergency Planning and Community Right-to-Know Act (EPCRA) were estimated to be 1,819 to 3,074 head for

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finishing operations, and 885 to 1,313 head for farrowing operations (emissions exceeding 100 lb NH₃/day). At the distances from 30 to 1185m from swine facilities, the ambient NH₃ concentrations did not vary a lot, and the average NH₃ concentration in literature was 66±66 ppb, which is 66% of the chronic minimum risk levels (MRL) for NH₃. At the distances from 30 to 1185m from swine facilities, the ambient H₂S concentrations in literature was 3.1±6.2 ppb, which is only 16% of the intermediate MRL for H₂S. The average contribution of swine operations in near-source (~15 to 50 m distances) ambient concentrations were 5.8±2.9 µg m⁻³ for PM₁₀ and 1.7±1.1 µg m⁻³ for PM_{2.5}. There are limited data on VOCs emissions from swine operations and more science-based information is needed.