

Title: Functional Classification of Swine Manure Management Systems Based on Effluent and Gas Emission Characteristics

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Interpretive Summary:

Gaseous emissions from swine manure storage systems represent a potential concern to environmental quality and human health due to the release of hydrogen sulfide, methane, ammonia, and volatile organic compounds. The emission rate of gases from stored swine effluent is known to vary between farms and is often independent of the number of animals produced. These attributes often complicate efforts to develop or improve emission abatement methods to meet air quality regulations. Zahn et al. now describe a rapid method to classify swine manure management systems according to their emission and odor nuisance potential. The total concentration of sulfur and phosphorus present in effluent fractions from 29 manure management systems, located throughout the U.S., was shown to predict odor intensity, air-phase concentration of volatile organic compounds, and methane emission rate. Results indicate the method is effective for assessing best management practices or for identifying farms with high odor nuisance potential. The results of this study are important to individual swine producers in the U.S., and to the commodity groups supporting the interests of swine producers (National Pork Producers Council and State pork producer organizations), in that the methods provide producers with the ability to rapidly assess the biological and chemical status or "health" of the manure management system. The methods are also useful for scientists (industry, government, and academia) as a means to measure the performance of treatment strategies that are designed to reduce the emission rate of gases from swine manure management systems.

Technical Summary:

Gaseous emissions from swine manure storage systems represent a concern to air quality due to the potential impacts of hydrogen sulfide, ammonia, methane, and volatile organic compounds on environmental quality, human health, and wellbeing. The lack of knowledge concerning functional aspects of swine manure management systems has been a major obstacle in the development and optimization of emission abatement technologies for these point sources. In this study, a classification system based on gas emission characteristics and effluent concentrations of total phosphorus (P) and total sulfur (S) was devised and tested on 29 swine manure management systems in Iowa, Oklahoma, and North Carolina in an effort to elucidate functional characteristics of these systems. Four swine manure management system classes were identified that differed in effluent concentrations of P and S, methane (CH₄) emission rate, odor intensity, and air concentration of volatile organic compounds (VOCs). Odor intensity and the concentration of VOCs in air emitted from swine manure management systems were strongly correlated ($r^2 = 0.88$). The concentration of VOC in air samples was highest with outdoor swine manure management systems that received a high input of volatile solids (Type 2). These systems were also shown to have the highest odor intensity levels. The emission rate for VOCs and the odor intensity associated with swine manure management systems were inversely

correlated with CH₄ and ammonia (NH₃) emission rates. The emission rate of CH₄, NH₃, and VOCs were found to be dependent upon manure loading rate and were indirectly influenced by animal numbers.