

# Application of Nanoparticles in Reduction of Gas Concentration from Swine Manure

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Odor and gas emission is a major impediment to the growth of the swine industry. A large proportion of these emissions is contributed by manure gases produced from fresh or stored animal manure. Therefore, new gas and odor control technologies should be explored to minimize these emissions. Nanotechnology is a novel technology that has been proven to be effective in the treatment and remediation of pollutants but it has not yet been tested to treat emissions from livestock manure. To test its effectiveness, bench-scale experiments were conducted using three deployment techniques: mixing with the slurry, spraying in the headspace of manure slurry and acting as a filtering medium for the gas emitted from the manure slurry.

Prior to actual testing of nanoparticles with manure slurry, preliminary tests were conducted by passing 50 ppm ammonia, 25 ppm hydrogen sulphide, 1500 ppm carbon dioxide through a packed-bed filter cassette at a flow rate of 500 mL/min. Each filter set-up contains 3 g of commercially-available nanoparticles. Among the six nanoparticles tested,  $\text{Al}_2\text{O}_3$ ,  $\text{TiO}_2$ , and ZnO reduced the target  $\text{NH}_3$  concentration by 85.6%, 85.2%, and 78%, respectively, while MgO, MgO+, and ZnO were able to reduce the target  $\text{H}_2\text{S}$  to below detection level. Magnesium oxide and magnesium oxide plus was able to reduce the concentration of carbon dioxide by 73% and 78%.

In the experiment using the manure slurry, the first part of the study was the identification of the optimum parameters for each deployment method. These were determined by testing different amount of nanoparticles, and by varying the contact or storage time of the treated manure. The identified optimum parameters were used to select the most effective particles from 12 particles that were tested in each deployment method.

**Implications:** Results from this study will benefit the swine industry through the development of practical and effective means for mitigating emissions from swine operations that will enhance the sustainability of the industry.