RESEARCH ABSTRACT
ENVIRONMENT

Title: Mitigation of Air Emissions from Swine Buildings through the Photocatalytic Technology Using UV/TiO_2– **NPB #13-088**

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Scientific Abstract:

The objectives of the study are to develop a prototype unit of photocatalytic reactor using UV light/TiO_2 for mitigation of air emissions from swine buildings; and to test the photocatalytic reactor in a research nursery swine building and determine its effectiveness on multiple air emission constituents, including H_2S, NH_3, N_2O, CH_4, and VOC. A five-stage honeycomb configuration is used for fabrication of the photocatalytic reactor. In the lab test, the reactor significantly reduced H_2S and NH_3 concentrations in air samples from emissions of swine manure, and it showed potential to reduce CH_4 as well. Effectiveness of the reactor increased with increasing residence time. At residence time of 32 seconds, the reactor was able to reduce H_2S and NH_3 concentrations by 93% and 86% respectively. In the field test, the reactor was used to treat exhaust air from a nursery swine house. Due to high air velocities in the exhaust air and thus very short residence time (0.018-0.042s), the photocatalytic reactor was not effective for all the measured air pollutants (H_2S, NH_3, N_2O, CH_4, and VOC) when the concentrations of pollutants in air flow from the exhaust fan of the swine house were at normal levels. However, it was able to reduce H_2S significantly when the H_2S concentration level was low even at the very short residence time. It was estimated that, for every ppb of H_2S concentration in the target air flow, a residence time of 0.04 seconds will be needed for effectively reducing it by half. Similarly, for every ppm of NH_3 concentration in the target air flow, a residence time of 0.3 seconds will be needed for effectively reducing it by half. This information can be used for proper sizing of the photocatalytic reactor. The photocatalytic reactor has a side effect of increasing N_2O concentrations, which may be caused by oxidation of NH_3 and other nitrogen compounds in the air flow. The effect of the photocatalytic reactor on VOC was not confirmed in our tests, partly due the limitation of the measurement instruments.