RESEARCH ABSTRACT

ENVIRONMENT

Title: Mitigation of ammonia from swine barns through UV treatment of exhaust air **NPB #08-117**

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Scientific Abstract

The feasibility of using deep UV treatment for abatement of ammonia in livestock and poultry barn exhaust was examined in series of laboratory scale experiments. These experiments simulated moving exhaust air with controlled UV wavelength and dose, NH_3 concentrations, humidity, and presence of H_2S. Ammonia, initially at relevant barn exhaust concentrations in air, is completely, or at least substantially, reduced by irradiation with 185 nm light. The irradiation chamber consisted of 13 low pressure Hg lamps irradiating a 7.6 m quartz coil (1 mm wall thickness) after passing through approximately 25 mm ambient air. Each lamp provides an output of 8 W 254 nm irradiation and 0.02 W 185 nm irradiation. Both the ambient air and quartz walls reduce the intensity of 185 nm light significantly, so a more realistic "immersion" lamp setup, as would be used in the actual application of the technology would be considerably more efficient. Additionally, more efficient 185 nm lamps are certainly available. Nonetheless, this setup, ammonia could be reduced to undetectable levels (< 1 ppm) in dry air from initial concentrations of 50 ppm, using a hydraulic residence time of 3.9 minutes. Approximately 50% reduction would be obtained with a hyraulic residence time of 1 minute. Reactions were monitored using chemiluminescence detection, GC-MS, and high resolution FTIR, of which the latter was found to be the most informative and flexible. Detected nitrogen-containing products included N_2O (derived from N_2 in the air), NH_4NO_3, and HNO_3. It is presumed that atomic oxygen is the primary photochemical product that begins the oxidative cascade. The data show that removal of NH_3 is plausible, but highlights concerns over ozone and N_2O emission. Addition of water at near 100% relative humidity does curtail ammonia removal, but also reduces ozone and N_2O formation by 80-90%. Addition of 15 ppm H_2S reduced N_2O by approximately 15% but did not have a significant effect on ozone or ammonia.

These research results were submitted in fulfillment of checkoff-funded research projects. This report is published directly as submitted by the project's principal investigator. This report has not been peer-reviewed.

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