Abatement of Ammonia and Hydrogen Sulfide Emissions from a Swine Lagoon Using a Polymer Biocover

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ABSTRACT

The purpose of this research was to determine the efficiency of a polymer biocover for the abatement of H_2S and NH_3 emissions from an east-central Missouri swine lagoon with a total surface area of 7800 m^2. The flux rate of NH_3, H_2S, and CH_4 was monitored continuously from two adjacent, circular (d = 66 m) control and treatment plots using a nonintrusive, micrometeorological method during three independent sampling periods that ranged between 52 and 149 hr. Abatement rates were observed to undergo a temporal acclimation event in which NH_3 abatement efficiency improved from 17 to 54% (p = <0.0001 to 0.0005) and H_2S abatement efficiency improved from 23 to 58% ($p < 0.0001$) over a 3-month period. The increase in abatement efficiency for NH_3 and H_2S over the sampling period was correlated with the development of a stable anaerobic floc layer on the bottom surface of the biocover that reduced mass transfer of NH_3 and H_2S across the surface. Analysis of methanogenesis activity showed that the biocover enhanced the rate of anaerobic digestion by 25% when compared with the control. The biocover-enhanced anaerobic digestion process was shown to represent an effective mechanism to counteract the accumulation of methanogenic substrates in the biocovered lagoon.

IMPLICATIONS

Emissions of NH_3 and H_2S above 45.4 kg/day are subject to reporting requirements under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; 40 C.F.R. Part 302). Determination of whether emissions from concentrated animal feeding operations (CAFOs) approach these reporting thresholds depends on the accurate measurement of emission rates under field conditions. In addition, the development of strategies for the abatement of emissions from CAFOs may allow CAFOs with emissions approaching the reporting thresholds to avoid CERCLA reporting requirements. The research results described here provide important insight into the successful use of micrometeorological methods for monitoring NH_3 and H_2S emissions from animal waste lagoons and for the effective evaluation of emission abatement strategies.