BIOFILTERS FOR ODOR CONTROL

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Gas-phase biofilters are a proven and effective method for reducing odor and other gaseous emissions from swine facilities. The gases are absorbed into a moist biofilm growing on a support media where microorganisms breakdown the gases into carbon dioxide, mineral salts and grow more microorganisms. Widespread adoption of biofilters is stalled because of producer concerns about the space or footprint needed to house a biofilter, initial and operating costs, rodent control and media compaction over time. The objective of our University of Minnesota gas-phase biofilter research is to identify and evaluate alternative media and biofilter designs that effectively manage odors and other gas emissions and addresses producer concerns. The purpose of this project was to evaluate six biofilter media. The media were: wood mulch, lava rock, cedar chips, pine bark nuggets, western pine bark and wood shreds. Media physical properties were assessed by sieve analysis and determining porosity and unit pressure drop versus unit airflow relations. In the phase 1 experiments reduction efficiency and pressure drop were measured in a biofilter media testing unit with six columns with individually controlled airflow rates and moisture control. Percent reduction efficiency was calculated as 100 times the difference between the biofilter inlet air concentration and the biofilter outlet concentration divided by the inlet concentration. In phase 1 the reduction efficiency was evaluated using total reduced sulfur and ammonia measurements. In phase 2, three media, wood shreds, pine bark nuggets and lava rock were placed in duplicate columns and evaluated for pressure drop and total reduced sulfur and ammonia reduction efficiency. In phase 3, pine bark nuggets were used in all six columns with two empty bed contact times (EBCT) (i.e., 1 s and 5 s). The percent total reduced sulfur, ammonia and odor reduction efficiencies were evaluated. Pine bark nuggets and lava rock had the lowest unit pressure drops versus unit airflow rates. The low pressure drop means that the amount of energy required to blow air through the media would be less in gas-phase biofilters made with pine bark nuggets or lava rock compared to the other media evaluated. In phase 1, all six media were effective after the media were seeded with aerated swine manure and compost. Seeding provided a source of nutrients and microorganisms to produce a biofilm on the media. Reduction efficiency for total sulfur removal was between 21 and 75% and between 43 to 80% for ammonia removal. In phase 2, all three media performed well using an average 5 s EBCT. An analysis of variance of the total reduced sulfur and ammonia percent removal results from the two columns of each media measured at multiple time points was performed using the mean value over all time points. No statistically significant differences between media were found for any of the responses. An analysis of variance of the total reduced sulfur, ammonia and odor percent reduction efficiencies for the phase 3 data from the each set of three columns at the two EBCT times (i.e. 1 s or 5 s) was performed using the mean values over all time points. A statistically significant difference between the 1 s and 5 s EBCT was found for each response. For the total reduced sulfur the mean percent reduction efficiency increased from 48% to 91% ($p=0.014$) between 1 s and 5 s EBCT. For ammonia the reduction efficiency increased from 4% to 38% ($p=0.003$) and for odor it increased from 20% to 53% ($p=0.10$). The take home message is that alternative media evaluated for this project can support biofilm growth and may have the potential to provide effective gas-phase air treatment at higher unit airflow rates while using less energy. Additional research is needed with higher and more consistent inlet concentrations.

For more detailed information see

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