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Reducing Energy Needs for Hazardous Air Treatment Emitted During Ethanol Production

Abstract.

Biotrickling Filters (BTFs) are a desirable option for the treatment of dilute volatile organic compounds (VOCs). Replacing traditional air emission controls (chemical scrubbers and regenerative thermal oxidizers (RTOs)) at ethanol production facilities will result in economic and environmental benefits. Utilizing BTFs to treat emissions from fermentation tanks and from distillers dried grains with solubles (DDGS) driers has never been studied. To examine the effect of temperature on the effectiveness of treatment, one of the proposed BTFs will be operated at room temperature while the other will be heated to 60°C – the prevailing temperature of DDGS drier emissions. Both BTFs, in parallel, operated at 31 seconds. Empty bed residence time will be used to study the biodegradation of formaldehyde and acrolein individually at loadings ranging from 1 to 29 and 55 g m-3 hr-1, respectively. In a collaborative effort with Pacific Ethanol East Plant in Aurora NE, the emissions of the fermenters and the DDGS dryers will be measured upstream and downstream the scrubbers and the RTO controlling the emissions of both units, respectively. Biodegradation of HAP mixtures including formaldehyde, acrolein, acetaldehyde, methanol, and ethanol will be studied. Theoretical concentration ratios will be formulated to cover a wide variety of concentrations expected at the facility. Biodegradation of the actual emissions generated at the facility will be evaluated through the BTF. Gaseous streams will be compressed in a gas cylinder at the facility and transported to the laboratory for analysis and testing. Finally, the utilization of the wastewater collected the facility will be examined as an alternate for the nutrient feed. The sampling plan includes measuring concentrations of HAPs, biodegradation byproducts, oxygen, and carbon dioxide in the gaseous phase and total carbon, anions (nitrate, nitrite, phosphates), degradation byproducts in the liquid phase. Identification of microbial species responsible for the biodegradation of all HAPs will be conducted; their diversity and abundance will be monitored.