NEBRASKA CENTER FOR ENERGY SCIENCES RESEARCH

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Project Title.
Reducing energy to produce corn ethanol by optimizing fermenter operation and off gases treatment

Abstract.
Gaseous emissions from corn ethanol fermentation and the drying of wet distillers grain in ethanol plants are regulated and must be treated. The emissions include carbon dioxide (CO2), ethanol and regulated hazardous air pollutants (HAPs), which vary in concentration through fermentation cycle. Regulatory compliance at ethanol plants using air pollution control equipment is demanding in natural gas and water (6 to 12% of a plant's overall energy). Moreover, water used in CO2 scrubber typically is used in liquefaction and increases the water in the process resulting in more energy requirements for evaporation and/or hauling or drying wet distillers grain.

The proposed project will build on recent studies and on-going field and lab data collection activities and include three elements. The project will collect additional liquid fermenter biochemical data to link to off gas emission data from fermenters to prepare the data for modeling. Models will be created to elucidate relationships between the fermenter's operational strategy and liquid biochemical parameters and the off-gas emissions, especially HAPs. The models will identify relationships to predict HAP and ethanol concentrations through a fermentation cycle, and to optimize fermenter operations (i.e., identify bad batches using off-gas concentrations, and useful surrogate compounds for predicting HAP concentrations). Last and most importantly, an operational model to optimize based on cost and energy usage for the incorporation of innovative air abatement processes will be created in Aspen Plus design and optimization package to compare different off gas emissions control technologies and optimize the design for conditions typical at Nebraska ethanol plants. These modeling results will justify grant funding for field testing of innovative strategies including biotrickling filters. Implementing innovative air emission abatement approaches can reduce ethanol production costs by 2 to 4%, reduce energy needs by 5 to 20%, and Carbon Intensity (CI) (1-3 gCO2E/MJ).