Time & Location: July 31, 2014 at 8:30 AM in Engineering 2 202A
Title: Development of a Chemical Kinetic Model for the Combustion of a Synthetic Gas from a Fluidized-Bed Sewage Sludge Gasifier in a Thermal Oxidizer

The need for sustainability has been on the rise. Municipalities are finding ways of reducing waste, but also finding ways to reduce energy costs. Waste-to-energy is a sustainable method that may reduce bio-solids volume while also producing energy. In this research study bio-solids enters a bubbling bed gasifier and within the gasifier a synthesis gas is produced. This synthesis gas exits through the top of the gasifier and enters a thermal oxidizer for combustion. The thermal oxidizer has an innovative method of oxidizing the synthesis gas. The thermal oxidizer has two air injection sites and the possibility for aqueous ammonia injection for further NOx reduction. Most thermal oxidizers already include an oxidizer such as air in the fuel before it enters the thermal oxidizer; thus making this research and operation different from many other thermal oxidizers and waste-to-energy plants.

The reduction in waste means less volume loads to a landfill. This process significantly reduces the amount of bio-solids to a landfill. The energy produced from the synthesis is beneficial for any municipality, as it may be used to run the waste-to-energy facility. The purpose of this study is to determine methods in which operators may configure future plants to reduce NOx emissions. NOx reacts with volatile organic compounds (VOC) and sunlight to produce ozone (O3) a deadly gas at high concentrations.

This study developed a model to determine the best methods to reduce NOx emissions. Results indicate that a fuel-rich then fuel-lean injection scheme results in lower NOx emissions. This is because at fuel-rich conditions not all of the ammonia in the first air ring is converted to NOx, but rather a partial of the ammonia is converted to NOx and N2 and then the second air ring operates at fuel-lean which further oxidizes the remaining ammonia which converts to NOx, but also a fraction to N2. If NOx standards reach more stringency then aqueous ammonia injection is a recommended method for NOx reduction; this method is also known as selective non-catalytic reduction (SNCR).

The findings in this study will allow operators to make better judgment in the way that they operate a two air injection scheme thermal oxidizer. The goal of the operator and the organization is to meet air quality standards and this study aims at finding ways to reduce emissions, specifically NOx.

Major: Environmental Engineering

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Approved for distribution by Dr. C. David Cooper, Committee Chair, on July 14, 2014.

The public is welcome to attend.