Announcing the Final Examination of Hannah McLean for the degree of Master of Science

Time & Location: January 23, 2015 at 9:00 AM in Engineering 2 211

Title: An Improved Biosolid Gasifier

As populations increase and cities become denser, the production of waste, both sewage sludge and food biomass, increases exponentially while disposal options for these wastes are limited. Landfills have minimal space for biosolids; countries are now banning ocean disposal methods for fear of the negative environmental impacts. Agricultural application of biosolids cannot keep up with the production rates because of the accumulation of heavy metals in the soils. Gasification can convert biosolids into a renewable energy source that can reduce the amount of waste heading to the landfills and reduce our dependence on fossil fuels.

A recently published chemical kinetic computer model for a fluidized-bed sewage sludge gasifier (Champion, Cooper, Mackie, & Cairney, 2014) was improved in this work based on limited experimental results obtained from a bubbling fluidized-bed sewage sludge gasifier at the MaxWest facility in Sanford, Florida and published information from the technical literature. The gasifier processed sewage sludge from the communities surrounding Sanford and was operated at various air equivalence ratios and biosolid feed rates. The temperature profile inside of the gasifier was recorded over the span of four months, and an average profile was used in the base case scenario.

The improved model gave reasonable predictions of the axial bed temperature profile, syngas composition, heating value of the syngas, gas flow rate, and carbon conversion. The model was validated by comparing the simulation temperature profile data with the measured temperature profile data. An overall heat loss coefficient was calculated for the gasification unit to provide a more accurate temperature profile. Once the model was equipped with a heat loss coefficient, the output syngas temperature matched what was recorded at the MaxWest facility.

The model was then exercised at a constant equivalence ratio at varying temperatures and then using a constant temperature using varying equivalence ratios. The resulting syngas compositions from these exercises were compared to various literature sources. It was decided that some of the reactions kinetics needed to be adjusted so that the change in syngas concentration versus change in bed temperature would more closely match the literature. The reaction kinetics for the Water-Gas Shift and Boudouard reactions were modified back to their original values previously obtained from the literature.

Major: Environmental Engineering

Educational Career:
Bachelor's of Environmental Engineering, BS, 2013, University of Central Florida
Master's of Environmental Engineering, MS, 2015, University of Central Florida

Committee in Charge:
Dr. David Cooper, Chair, CECE
Andrew Randall, CECE Department
Woo Hyoung Lee, CECE Department

Approved for distribution by Dr. David Cooper, Committee Chair, on December 10, 2014.

The public is welcome to attend.