Abstract

The impacts of climate change have resulted in more research in strategies to mitigate greenhouse gas emissions. Carbon dioxide removal technologies like biochar production can help reduce greenhouse gas emissions. Biochar production is a carbon-negative process where most of the carbon in the biomass is retained in biochar, which can be stored to prevent its release as CO_2. Biomass pyrolysis produces a gaseous product that can be used as a fuel, making it a desirable and relevant pyrolysis product to study.

In this thesis, the composition of the syngas produced from biomass pyrolysis is analyzed to characterize how syngas changes depending on pyrolysis conditions and feedstock variability. Four syngas species were analyzed (CO_2, CH_4, CO, and H_2) at pyrolysis temperatures of 500-800^{o}C, for four different feedstocks: walnut shells, peanut shells, corncobs, and sunflower seed shells. For all feedstocks, syngas composition was primarily CO_2 and CO at lower pyrolysis temperatures whereas it was primarily CO and H_2 at higher pyrolysis temperatures. Feedstock variability was shown to influence syngas composition. Significant variations in percentage of syngas species were observed among the feedstocks from 500-800^{o}C, which was similarly found by other research groups using different feedstocks. At low pyrolysis temperatures, syngas composition is influenced by primary pyrolysis of the biomass. Evidence of secondary reactions and feedstock inorganics were found to affect syngas composition as pyrolysis temperature increased. A linear correlation was found between the elemental composition of the feedstock and the percent composition of each syngas species at 800^{o}C. This finding can be used in future pyrolytic gas studies to predict changes in syngas composition based on pyrolysis temperature and feedstock.