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U.S. Department of
Agriculture
National Institute of
Food & Agriculture



Project Title: *Torrefaction and Densification of Switchgrass to Improve Syngas Quality and Transportation Logistics*

DR. AJAY KUMAR

Project Goal

The overall goal is to evaluate torrefaction and densification as pre-processing options prior to switchgrass gasification.

The specific objectives are to: 1) Study and analyze the selected pre-processing methods, 2) Gasify preprocessed samples and evaluate syngas quantity and quality, and 3) Evaluate mass and energy balances and system logistics for each case.

Project Outcomes

- A graduate student (Ms. Madhura Sarkar) focused on the analysis of preprocessing on biomass properties and syngas obtained through gasification. The team investigated effects of four pretreatments (torrefaction at 230°C, torrefaction at 270°C, densification, and combined torrefaction and densification) on the thermal devolatilization characteristics, gasification and pyrolysis of switchgrass.
- Switchgrass pretreated with combined torrefaction and densification had the highest rate of devolatilization, followed by switchgrass pretreated with densification, switchgrass pretreated with torrefaction at 230°C, switchgrass pretreated with torrefaction at 270°C, and raw switchgrass.
- The pretreatment significantly effected gasification performance. Combined torrefaction and densification had the highest gas yield and efficiencies.
- Torrefaction and densification affected bio-oil composition. Increased torrefaction temperature favored the production of sugars and phenols.
- High pyrolysis temperature favored the production of aromatic compounds.
- Densification favors degradation of cellulose and hemicellulose during pyrolysis.



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