Poster E2

Thermochemical Remediation of Waste Residues from Biomass Hydrolysis / Fermentation for Biofuel Production

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Lignocellulosic feedstocks are renewable, abundant and inexpensive resources for the production of next generation biofuels. Significant research is being conducted on the production of biofuels such as bio-oils, ethanol, butanol and syngas (H_2 + CO) from these biomasses. Lignocellulose biomasses are composed of cellulose, hemicellulose and lignin, which make them crucial to hydrolyze and produce fermentable sugars. As a result of biomass hydrolysis through dilute acids and enzymes, the monomeric sugars are released in the aqueous phase, whereas the solid residue consists of considerable amounts of hydrolysis wastes. These hydrolysis wastes are rich in recalcitrant carbon as most of sugars are released in the hydrolysate for fermentation to alcohols.

With the objective of waste valorisation, this study aims at the thermochemical conversion of biomass hydrolysis wastes to produce bio-oils, biochars and gases. The pre-treatment wastes were obtained as a result of dilute H_2SO_4 and enzymatic hydrolysis of pinewood and wheat straw. In this work, pyrolysis of hydrolyzed pinewood and wheat straw was performed at 600°C (heating rate of 5°C/min) for 4 h. The pyrolysis products (biochar, bio-oil and gas) were characterized through CHNS, ICP-MS, BET surface area, FT-IR, Raman spectroscopy, thermogravimetric analysis, X-ray diffraction, GC-MS and NMR. Supercritical water gasification of these residues was also performed at temperature ranges of 300 to 500°C at 25 MPa pressure to evaluate H_2 and CO concentrations in syngas.

Hydrolyzed pinewood wastes had high biochar (41.7 wt.%) and bio-oil (22.3 wt.%) yields compared to wheat straw residues. Biochars from hydrolyzed wheat straw had high amount of alkaline metals such as Na, Mg, K and Ca, indicating beneficial agronomic properties. High calorific values were found for pinewood biochar (31.1 MJ/kg) and wheat straw bio-oil (25.9 MJ/kg). The wheat straw bio-oil contained high amount of phenols and alcohols, contributing to its high heating value. The gases from hydrolyzed pinewood had relatively high H_2 content, suggesting its potential applications as valuable fuels. Research on the valorisation of hydrolysis/fermentation wastes is in its infancy. This presentation will discuss the thermochemical behavior of these wastes in order to provide insights for their pyrolysis and supercritical water gasification applications.