Sun Grant Western Regional Center
Oregon State University

A Forest Residue-Based Pyrolysis Biorefinery

Karl Englund, Washington State University (2009-2011)

Overview

Biorefineries have the potential to produce much-needed biofuels, supply valuable bioproducts, utilize waste streams and create jobs in rural communities. Dr. Englund and his research team propose to develop a new forest residue-based Biorefinery for producing bio-oils while concurrently developing formaldehyde-free resin from some of the unusable fractions. This new Biorefinery model uses a pyrolysis process, which applies very high temperatures to convert biomass into various products. This approach will diversify the value of forest biomass.

Progress to Date

The team collaborated with the Garcia-Perez research team to perform tests to identify the effect has performed tests on Douglas fir and hybrid poplar biomass to identify the effect of pretreatment conditions and pyrolysis temperature on the production of anhydrosugars. Preliminary results suggest that the removal of alkaline elements and a mild pyrolysis process (lower temperatures) could be viable methods to enhance the production of anhydrosugars from Douglas fir.

Auger Pyrolysis (using a rotating device to move material through the system) of untreated Douglas fir resulted in 45.5 mass % of liquids, 21.4 mass % of char and 33.0 mass % of gases. The formation of two liquid phases (oily phase and an aqueous phase) and the low yield of oil obtained are clear indications that the dehydration and polycondensation reactions predominates. Auger Pyrolysis of pre-treated Douglas Fir (set with diluted sulphuric acid) resulted in a higher yield of liquid (54.6 mass %), a similar yield of char (20.6 mass %) and lower yields of gases (24.8 mass %). Surprisingly the oil obtained with pretreated biomass was formed by a single oily phase. This result is a clear indication that the pretreatment condition used mitigates the dehydration reactions. The results obtained with pretreated samples are very important because they prove that the Auger pyrolysis of pre-treated samples could lead to the production of oils with properties comparable (a single oily phase) to those reported for the fast pyrolysis (which requires very high temperatures and thus more energy) of untreated samples.

Some of the preliminary results have been presented at international conferences. A peer-review publication and a patent disclosure are in development.

Collaborators

Manuel Garcia-Perez and Marie Laborie, Washington State University (co-PIs)

Hermann Brothers Logging and Construction (industry partner)

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