RHEOLOGY OF CORN STOVER SLURRIES UNDERGOING DILUTE-ACID PRETREATMENT

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ABSTRACT

Converting biomass into renewable resources such as biofuel has continued interest due to the desire to find alternatives to petroleum-derived products. Lignocellulosic biomass is a feedstock that does not compete as strongly with food resources as grain feedstocks, and it can be sourced from a variety of plants and plant components. Corn stover is a popular source of lignocellulosic biomass in North America due to widespread maize cultivation. One route to producing biofuels from lignocellulosic biomass is via an enzymatic hydrolysis reaction that utilizes enzymes to break down cellulose and hemicellulose into simple sugars. This process typically requires an upstream pretreatment step to make the cellulose and hemicellulose more accessible to enzymes. Pretreatment with a dilute acid solution is often used for this purpose The elucidation of the rheological properties of lignocellulose as it is processed during pretreatment is an important aspect of predicting energy requirements for pumping and mixing the resulting slurries; as well as for designing reactor components. In this work, we seek to characterize the rheological changes that take place in a corn stover feedstock undergoing dilute acid pretreatment. Slurries were prepared and pretreated at the National Renewable Energy Laboratory and rheological properties were tested at the Colorado School of Mines. A custom rheometer geometry was fabricated with stereolithography 3D printing to mitigate sample slip and measurements were made of yield stress and plastic viscosity as a function of the extent of pretreatment. The presentation will include a discussion of the rheological behavior observed during shear stress ramps, the result of fitting the Herschel-Bulkley and the Bingham model to the data sets to obtain reaction-time dependent model parameters. An outlook for generalizing this analysis to other lignocellulosic feedstocks will also be given.