Summary / Abstract for Public Release

Modeling Feedstock Performance and Conversion Operations
Purdue University

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A significant barrier to the effectiveness of biomass feedstock feeding and handing systems is the lack of understanding of how variability in physical and structural properties of the biomass impact the forces and particle-particle interactions within feeding and handling equipment. Across the Chemical and Mechanical Engineering disciplines, dimensionless numbers such as the Reynolds Number, Nusselt Number, Sherwood Number and others are used to understand the dominant competing properties and forces for a particular unit operation. These parameters allow a quick and accurate determination of whether a particular design will be effective, and thus are solid and indispensable tools for industry.

The objective of this project is to develop dimensionless parameters based on physical, chemical and hydrodynamic properties of corn stover to guide the design of biomass feeding, liquefaction and pumping systems. The Laboratory of Renewable Resources Engineering (LORRE) together with Discovery Park at Purdue University and the Purdue University Schools of Mechanical Engineering, Agricultural and Biological Engineering and Materials Science and Engineering, the Idaho National Laboratory (INL), Forest Concepts, AdvanceBio, and Argonne National Laboratory (ANL) will work together to connect chemical and physical characterization of biomass-derived feedstocks to properties that affect formation of aqueous slurries of corn stover. The ability to form highly concentrated slurries directly from corn stover would enable the stover to be transported as a pumped fluid rather than as a solid material that must be conveyed, resulting in significant savings in pretreatment costs and enhanced operability.

Given the difficulties in start-up of the pioneer biorefineries related to feedstock handling issues, development of a corresponding set of dimensionless parameters for biomass feeding and handling would be transformational for the developing biomass conversion industry. Cornstover constitutes a major feedstock for cellulosic biorefineries and hence was chosen for this work. We anticipate the results from this research will provide new engineering tools for design and operation of biomass processing equipment by engineering firms, component manufacturers, and operators of current and future biorefineries.