From the Bench to the Barrel:
Scale-up of Protic Ionic Liquids and Amines for Biomass Pretreatment

Blake A. Simmons
Joint BioEnergy Institute
Lawrence Berkeley National Laboratory
1 Cyclotron Road
Berkeley, CA USA
basimmons@lbl.gov

Achieving low cost and high efficiency lignocellulose deconstruction is a critical step towards widespread adoption of lignocellulosic biofuels. Certain ionic liquid (IL)-based pretreatment processes effectively reduce the recalcitrance of lignocellulosic biomass feedstocks to enzymatic depolymerization, but most ILs require either costly separations following pretreatment or novel IL compatible processes to mitigate downstream toxicity. JBEI has been at the forefront of developing and scaling up ionic liquid (IL) pretreatment technologies for the efficient conversion of lignocellulosic biomass into biofuels and valuable bioproducts. Research efforts have focused on optimizing various aspects of the IL pretreatment process, including the selection of appropriate ILs, pretreatment conditions (temperature, residence time, and biomass loading), and the subsequent enzymatic hydrolysis and fermentation steps. The scale-up studies have demonstrated the effectiveness of IL pretreatment on a range of feedstocks, including switchgrass, corn stover, and woody biomass, achieving high sugar yields and, in some cases, enhanced production of target biofuels such as isoprenyl acetate, a precursor to the SAF dimethyl cyclooctane (DMCO). Key findings include the identification of optimal IL concentrations and pretreatment parameters, as well as the development of strategies for efficient IL recovery and reuse. Furthermore, JBEI researchers have explored the use of distillable protic ionic liquids and amines on mixed feedstocks and the integration of this pretreatment technology with other bioprocessing steps to improve overall process economics and sustainability. These efforts have contributed to the advancement of this biomass pretreatment technology that enables the realization of affordable and scalable biorefineries. This presentation will cover the most recent advances in biomass pretreatment and bioconversion at JBEI, as well as subsequent technology transfer to industry.