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A Comparative Study of Dilute acid and Ionic Liquid Pretreatment of Biomass and Model Lignocellulosics

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Lignocellulosic biomass has great potential to serve as a low-cost and abundant feedstock for bioconversion into fermentable sugars, which can be subsequently fermented into biofuel. There are several obstacles that remain to be solved in this conversion process, specifically lignin content, crystalline cellulose structure and the presence of ester linkages between lignin and hemicellulose in the plant cell wall limit the enzymatic accessibility of the recovered polysaccharides for efficient saccharification into sugars. Various physical and chemical pretreatment methods are currently employed to break down the biomass recalcitrant structures, and increase their susceptibility to enzymes. Among these techniques, dilute acid pretreatment has been shown as a leading pretreatment process. However, dilute acid hydrolysis can lead to degradation products that are often inhibitory and significantly lower the overall sugar yields. Glucose and xylose degradation products that result from the pretreatment methods include hydroxymethylfurfural (HMF) and furfural, which produce levulinic and formic acids, respectively, which inhibit the subsequent fermentation of sugars to ethanol. Recently, ionic liquids have demonstrated great promise as efficient solvents for biomass with easy recovery of cellulose upon anti-solvent addition. However, to date, no comprehensive side-by-side comparative analysis has been conducted in order to evaluate the dilute acid and ionic liquid biomass pretreatment processes. In this study, we compare ionic liquid and dilute acid pretreatments acting on switchgrass with numerous analytical techniques to gain a better understanding of both techniques and the resultant saccharification yields of fermentable sugars.

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