Solvent Based Pretreatment for Fractionation and Enhanced Enzymatic Hydrolysis of Lignocellulosic Biomass

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Cellulosic biomass is a renewable, carbon neutral resource that can be used to generate chemicals that replace petroleum products. Optimal processes for biomass utilization separate the raw material into its constituent parts: hemicellulose, cellulose and lignin, and then offer effective strategies to utilize the chemical components of each part. Dilute acid pretreatment is an effective pretreatment for removal of the hemicellulose component but the remaining cellulose - lignin mixture is still difficult to utilize. In this work we show that a second stage of pretreatment with N-Methyl Morpholine N-Oxide (NMMO) both helps to separate the cellulose and lignin and makes the cellulose more readily digestible by cellulase enzymes. This allows for a near complete fractionation of the biomass into streams that can be easily converted into sugars and other high value chemicals.

Specific work accomplished so far has examined the treatment of corn stover and sugar cane bagasse. The corn stover was initially subjected to dilute acid treatment with a sulfuric acid solution and the bagasse was treated with phosphoric acid. The resultant material was then dissolved in NMMO solution and then reprecipitated as an amorphous material. This mass was then reacted with a commercial cellulase enzyme mixture to generate glucose. In both cases, the materials treated with both acid and NMMO, showed the same final conversion to sugars in 24 hours that took 72 hours with acid treatment alone.

In this presentation we will show the details of the treatment strategy, compare the reactivity of materials with different treatments and show the overall mass balance for biomass fractionation.