December 2, 2011

Wet Oxidation Pretreatment: Historical Sugars Yield from Loblolly Pine

Washington State University (WSU) is working within the NABC with both the Catalysis of Lignocellulosic Sugars (CLS) and Fermentation of Lignocellulosic Sugars (FLS) teams. The objective is to maximize sugar recovery from loblolly pine and corn stover. WSU is using a wet oxidation pretreatment that employs oxygen at moderate temperature and pressure to break down the structure of the biomass. A hydrolysate with high sugars content is produced that is shared with the NABC partners for conversion to fuels. The requirements given by CLS and FLS are different, and WSU has worked with the partners to produce pretreated samples meeting their respective goals.

WSU's pretreatment system consists of a reactor tank connected to a flash tank of 100 L or 400 L along with the needed utilities. The current configuration is a 10 L reactor with a 100 L flash tank and coming on stream in December 2011 will be a 100 L reactor with a 400 L flash tank. The schematic of the pretreatment process and distribution of various streams of hydrolysate is shown in Figure 1.

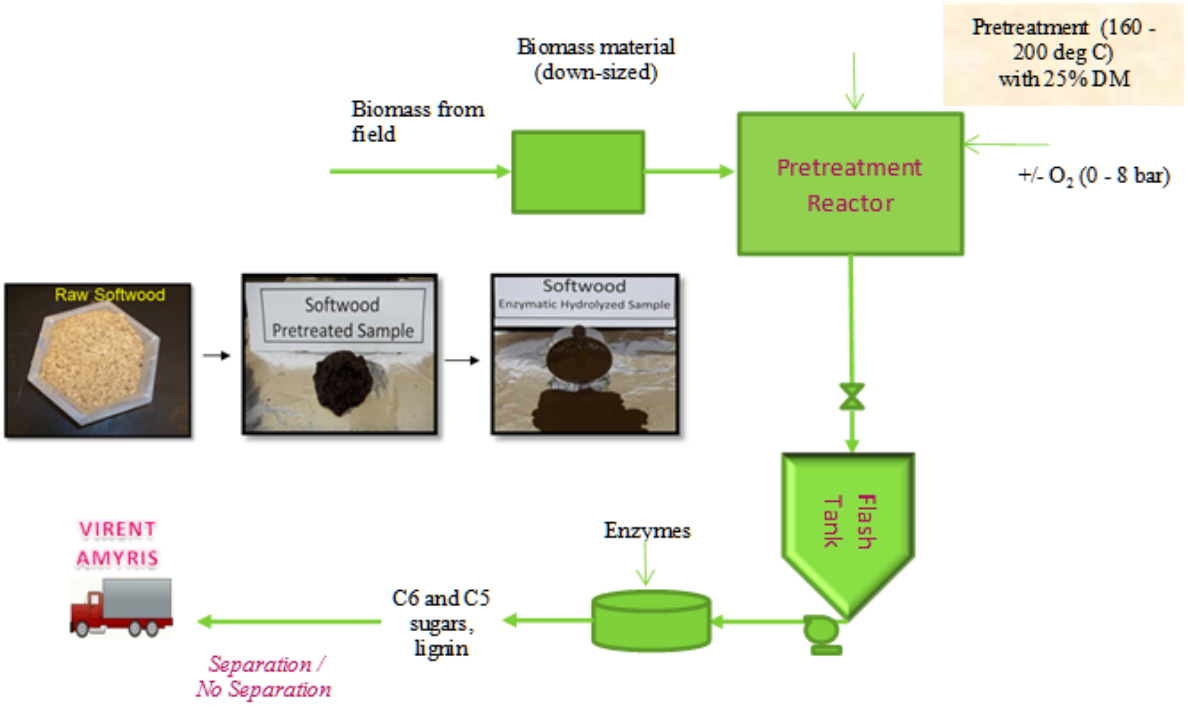

Figure 1: Schematic of the pretreated hydrolysate supply chain

Wet oxidized and enzymatically hydrolyzed samples of pine with up to 290 g/L of sugar monomers (152 g/L of glucose, 67 g/L of xylose, and 68 g/L of other sugars) have been obtained in the NABC project with only 30 mg enzyme protein per gram of cellulose added to the pretreated material. The results show that wet oxidation produces pretreated samples of softwood that can be hydrolyzed with a sugar yield of more than 90%, even for samples with up to 35% dry matter concentrations. *This is the highest yield ever reported for soft wood.*

Type of Biomass	Type of Pretreatment	Sugars Yield (compared to theoretical)	Reference
Softwood	Two-step Steam Pretreatment	80%	Söderström J. et al. (2002)
Picea abies	Wet Oxidation	79%	Palonen H. et al. (2004)
Pinus rigida	Organosolv	75.88%	Park N. et al. (2010)
Spruce chips	Sulfite Pretreatment	64.58%	Zhuetal J.(2009)
Loblolly pine	WSU Wet Oxidation	96.00%	Present study

WSU plans for Phase II include optimization of pretreatment parameters along with further reduction of enzyme requirements for both the Catalysis and Fermentation strategy teams.

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WSU Bench—Scale pretreatment reactor (10L Reactor, 100L flash tank)

NABC National Advanced Biofuels Consortium