Continuous Simultaneous Saccharification and Fermentation of Pretreated Sugarcane Bagasse to Ethanol

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Ethanol production from cellulosic biomass such as agricultural and forestry residues and dedicated woody and herbaceous crops provides environmental, economic, and energy security benefits. However, current costs are too high for use of cellulosic ethanol as a pure fuel, with the pretreatment and cellulose hydrolysis operations presenting particularly important opportunities for cost reductions. Thus, we are developing continuous fermentation processes to increase biomass conversion, ethanol concentrations, productivity, and enzyme effectiveness and reduce costs. First, sugarcane bagasse was pretreated with acid-catalyzed steam explosion at optimized conditions (0.5-1% H2SO4, 160-180^{o}C, 20-30min) to breakdown the hemicellulose fraction into sugars in the liquid hydrolyzate that was then detoxified by overliming. Next, this stream along with the pretreated solids were continuously fed to a series of fermentors for conversion to ethanol. The recombinant organism KO11 was used first to make ethanol from all of the sugars in the hydrolyzate. Then, as hemicellulose sugars were converted, cellulase enzyme was added to subsequent vessels in this continuous cascade to convert the cellulose in the pretreated solids to ethanol. Data is reported on the total solids concentration, the total conversion of cellulose and hemicellulose, and ethanol concentrations for different operating strategies and enzyme loadings.