Optimization of mild bisulfite pretreatment on Pacific Northwest softwood

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Softwoods such as Douglas-fir make up much of the woody biomass inventory in the Pacific Northwest. One of the challenges of converting softwood, however, is that it is recalcitrant towards enzymatic hydrolysis. For biochemical conversion to fuel, chemicals, and co-products, a robust chemical pretreatment is needed. Catchlight Energy has worked with NARA to optimize a process that is robust enough to achieve efficient hydrolysis, yet is less costly than severe processes such as pulping that remove substantial amounts of lignin. Mild bisulfite pretreatment has lower chemical use, shorter residence times, and results in higher yield on wood than bisulfite pulping. This makes it somewhat less costly than pulping, yet it enhances enzymatic hydrolysis significantly. Enzymatic hydrolysis yield was optimized by varying pretreatment conditions, including chip size, pretreating time, temperature, and chemical dose. The process conditions were improved from our previous results to achieve over 50% reduction of fermentation inhibitors while still obtaining 82% of the theoretical sugar yield at a modest enzyme dose. The improved process conditions include a drop in temperature from 165°C to 145°C and a drop in calcium bisulfite dosage from 12% to 6% on wood along with a corresponding increase in cooking time while still achieving a high pulp yield and low lignin solubilisation. A lower temperature test was completed as well. It indicates that lower temperatures are also feasible, but in addition to requiring longer time, the bulk density of the pulp seems to decrease. While the optimization results with respect to enzymatic hydrolysis are evident, the full body of work illustrates that mild bisulfite pretreatment can produce sugars that are effectively fermented by commercial yeast strains over a wide range of conditions.