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Enzyme-assisted liquefaction for different fractions of corn stover pellets

Diana Milena Gutierrez , Antonio Gonçalves da Cruz, Xueli Chen, Rosineide Gomes da Silva Cruz, Luana Serra, Ria Corder, Nathan Mosier, David Thompson Thompson, John Aston, James Dooley, Pankaj Sharma, João Ricardo Almeida, Kendra Erk, Eduardo Ximenes, Michael Ladisch

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Abstract

With an increase in population, the world will depend on renewable sources to meet the increasing energy needs. The use of lignocellulosic biomass as a renewable source has been proven efficient for conversion to cellulosic ethanol and capable of contributing to thresholds for energy demand while reducing greenhouse gases by 90% when compared with fossil fuels. However, limitations in feeding and flow within biorefineries are encountered when system plugging occurs due to biomass compaction and a high yield stress for slurries formed during its processing. Furthermore, differences in the biomass source present a challenge to the continuity of operations and reliability in the process. This work explores enzyme-assisted liquefaction for solid loadings up to 30% as an alternative for the creation of slurry from two different types of biomass (pelleted corn stover and cobs) that were liquefied in a fed-batch process using commercial enzymes Celluclast 1.5L or Ctec-2 at 1 FPU/g or 3 FPU/g of dry solids in a 10 mM sodium citrate buffer solution (pH 4.8). Pellets were fed into a 1 L stirred bioreactor according to a predefined fed-batch protocol during the first 5 hours until 30% solid loading was reached. After 6, 24 and 96 hours, samples were taken and characterized with respect to their composition, rheology, and water absorption. Successful slurry creation with dramatically reduced yield stress was achieved for corn stover for both enzymes assessed. Yield stresses of 178 ± 7 Pa (3 FPU, Celluclast 1.5L) and 79 ± 6 Pa (3 FPU, Ctec-2) were measured for corn stover at 24 hours, compared to 6,000 Pa for samples without enzyme. Yield stress was 155 ± 29 Pa (3FPU, Ctec-2) and 257 ± 72 Pa (1 FPU, Celluclast 1.5L) for corn cobs at 24 hours. A profile for 6, 24 and 96h of yield stress measurements and sugar conversion is presented.

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