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Ryan J. Stoklosa, Andrea del Pilar Orjuela, Leonardo da Costa Sousa, Nirmal Uppugundla, Daniel L. Williams, Bruce E. Dale, David B. Hodge, Venkatesh Balan

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Techno-economic comparison of centralized versus decentralized biorefineries for two alkaline pretreatment processes

Ryan J. Stoklosa,^{1,2} Andrea del Pilar Orjuela,¹ Leonardo da Costa Sousa,^{1,2} Nirmal Uppugundla,^{1,2} Daniel L. Williams,^{1,2} Bruce E. Dale,^{1,2} David B. Hodge,^{1,2,3,4} * Venkatesh Balan^{1,2} *

¹ Department of Chemical Engineering and Materials Science, Michigan State University, East Lansing, Michigan 48824, USA

² Great Lakes Bioenergy Research Center, Michigan State University

³ Department of Biosystems and Agricultural Engineering, Michigan State University, East Lansing, Michigan 48824, USA

⁴ Division of Sustainable Process Engineering, Luleå University of Technology, Luleå, Sweden

* Corresponding author

Abstract

In this work, corn stover subjected to ammonia fiber expansion (AFEXTM) pretreatment or alkaline pre-extraction followed by hydrogen peroxide post-treatment (AHP pretreatment) were compared for their enzymatic hydrolysis yields over a range of solids loadings, enzymes loadings, and enzyme combinations. Process techno-economic models were compared for cellulosic ethanol production for a biorefinery that handles 2000 tons per day of corn stover employing a centralized biorefinery approach with AHP or a de-centralized AFEX pretreatment followed by biomass densification feeding a centralized biorefinery. A techno-economic analysis (TEA) of these scenarios shows that the AFEX process resulted in the highest capital investment but also has the lowest minimum ethanol selling price (MESP) at \$2.09/gal, primarily due to good energy integration and an efficient ammonia recovery system. The economics of AHP could be made more competitive if oxidant loadings were reduced and the alkali and sugar losses were also decreased.

Keywords: AFEX, AHP, pretreatment, enzyme hydrolysis, biorefinery, techno-economic analysis.

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