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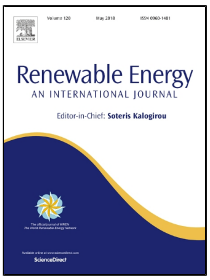

Multi-Objective Optimization of Simultaneous Saccharification and Fermentation for Cellulosic Ethanol Production

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Abstract

A multi-objective optimization of simultaneous saccharification and fermentation process for cellulosic ethanol production was carried out to simultaneously maximize the ethanol yield/cellulose conversion and minimize the enzyme consumption by manipulating the initial sugar concentrations, and cellulose and enzyme loadings. The study was based on an experimentally verified kinetic model. Several bi-objective optimization problems with different combinations of objectives and constraints were solved by a controlled elitist genetic algorithm, a variant of the non-dominated sorting genetic algorithm II (NSGA-II). The optimum operating conditions were verified by experiments. There was significant performance improvement in terms of ethanol yield, cellulose conversion and enzyme loading. An overall 40% reduction of enzyme consumption per ethanol produced was attained at the same ethanol yield (32%) of a non-optimized process. However, the optimum conditions are highly sensitive to the selected kinetic model and associated kinetic parameters therefore, selection of the appropriate kinetic model is critical.

Key words: Simultaneous saccharification and fermentation, Cellulose, Bioethanol, Multi-objective optimization

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