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Effects of Biomass Composition and Pentose Fermentation on the Economics of Ethanol Production from Lignocelluloses Using Non-Sulfuric Acid Pretreatment

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Abstract

For the purpose of climate change mitigation, we previously reported bioethanol production from lignocelluloses using non-sulfuric acid pretreatments such as hydrothermal and mechanochemical treatments. In that study, to estimate the economics of the process by sensitivity analysis, a simulator was constructed and used to determine the effects of plant capacity, feedstock cost, enzyme cost, and enzyme loading on ethanol production costs. In this study, the effects of biomass composition and ethanol fermentation performance were quantitatively considered using the simulator. It was quantitatively determined that the effect of the degree of pentose conversion for broadleaf trees was larger than for conifers. For conifers, the fermentation of pentose should be conducted at a high reaction rate. A reaction rate above approximately 112%/day was required; without that, the production cost increased even if the ethanol yield increased. For broadleaf trees, the production cost decreased when the reaction rate was above approximately 12.5%/day. The development of pentose fermentation with a high reaction rate will be important in order to realize an economical bioethanol production process.