Topic: A Comparison of Subcritical Water and Steam Explosion Pretreatments for Enzymatic Hydrolysis of Sugarcane Bagasse

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ABSTRACT

Lignocellulosic biomass is mainly composed of cellulose, hemicellulose, and lignin. To convert lignocellulosic biomass to biofuels/chemicals, the process is usually obtained from (1) a pretreatment step for cellulose crystallinity reduction by the hydrolysis of hemicellulose and delignification, and (2) an enzymatic hydrolysis step of cellulose to produce sugar monomers. Subcritical water and steam explosion are selected as the pretreatment because these pretreatments provide biomass more readily for enzymatic digestion. In sugarcane-producing countries like Thailand, there is an abundant opportunity for the use of sugarcane bagasse. Thus, sugarcane bagasse is selected as the efficient feedstock to produce sugar monomers. The optimum conditions of pretreatment were identified and compared systematically to enhance the enzymatic digestibility of the cellulose fraction for subsequent sugar conversion. In addition, the technical feasibility of process in large scale for biorefinery industry was evaluated.

Central composite design and response surface methodology were used to optimize the subcritical water pretreatment conditions of temperature, time, and biomass/water ratio The optimum conditions of subcritical water were 170.59 °C, 19.31 min, and 1:6.64 bagasse to water ratio which resulted in the reducing sugar yield 297.09 mg/g pretreated (48.76% glucose yield) while the optimal conditions of steam explosion were 200 °C and 5 min with water soaking which led to the highest amount of sugar yield of 353.37 mg/g pretreated (59.12% glucose yield). This indicated that the use of steam explosion pretreatment could be suitable for increasing enzymatic digestibility of sugarcane bagasse. Moreover, the subcritical water pretreatment in 1000 L reactor resulted in the reducing sugars yield of 196.30 mg/g pretreated with the pretreatment conditions at 160 °C for 2 h using 1:12 bagasse to water ratio. The work indicates the potential on scaling up the developed pretreatment process in biorefinery industry.

Keyword: Lignocellulose; Bagasse; Pretreatment; Subcritical water; Steam explosion