Bioethanol Production from Sugarcane Bagasse

Wei-Jen Chen, Jyh-Cherng Shieh, Po-Shen Chou, Wei-Fan Huang,
Szu-Hsien Chang, Che-Wei Yang

Bioenergy Research Center
Department of Bio-Industrial Mechatronics Engineering
National Taiwan University
1, Sec. 4, Roosevelt Rd., Taipei, Taiwan
Tel: +886-2-3366-5348, E-mail: jcshieh@ntu.edu.tw

ABSTRACT

In this study, sugarcane bagasse was pretreated by 0.25 M sulfuric acid at 95℃ for 60 mins under atmosphere pressure. After pretreatment, dried solid fraction was hydrolyzed by mixing enzymes of cellulase from *Trichoderma reesei* C2730 (Celluclast 1.5L) and cellobiase from *Aspergillus niger* (Novozyme 188) under conditions of pH 4.6 and 50℃ for 24 hours with shaking water bath. Different enzyme loadings and substrate ratios were studied to find out the optimum parameters. Hydrolysate was then fermented with *Saccharomyces cerevisiae* BCRC 21685 under conditions of pH 4.6 and 30℃ for 24~48 hours. The effect of additional glucose or evaporation, sterilization, and detoxification were investigated in fermentation step.

As result, 0.52 mg/mL of glucose and 4.29 mg/mL of xylose were observed in liquid fraction and the content of solid fraction showed that 91.85% of semicellulose and 1.46% of cellulose was removed during pretreatment. In hydrolysis step, the enzyme loading of 5 mL Celluclast 1.5L plus 1 mL Novozyme 188 represented the best balance between economy and efficiency. 339.21 mg/mL of yield and 49.25% of conversion ratio were obtained under this enzyme loading with 1% substrate ratio and rising the substrate ratio did not help improving both of them. In fermentation step, without sterilization and detoxification, 26.7 g/L of glucose remains after 48 hours fermentation and ethanol yield was 0.367 g ethanol / g glucose, corresponding to 72% of theoretical ethanol yield. With sterilization and detoxification, glucose was fermented within 24 hours. The ethanol yield was 0.43 g ethanol/g glucose, corresponding to 84% of theoretical ethanol yield. With evaporation to enhance the glucose concentration, the glucose concentration did not decrease to zero until after 30h. The ethanol concentration was 40.7 g/L, corresponding to 79% of theoretical ethanol yield.

Keywords: Acid pretreatment, Bagasse; Bioethanol; Enzymatic hydrolysis; Fermentation