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Short Communication

Hydrolysis of acid and alkali presoaked lignocellulosic biomass exposed to electron beam irradiation

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HIGHLIGHTS

- ▶ Acid and alkali presoaking with EBI on biomass enzymatic hydrolysis.
- ▶ Alkali soaking enhanced hydrolysis and 59% glucose yield.
- ▶ Synergetic effect on removal of hemicellulose, lowering crystallinity improved enzymatic hydrolysis of the biomass.

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ABSTRACT

In this study, synergetic effect of mild acid and alkali with electron beam irradiation (EBI) on the enzymatic hydrolysis of a selected grass biomass was assessed. Biomass samples prepared by soaking with 1% H_2SO_4, or 1% NaOH, were exposed to 75 and 150 kGy of EBI. Water presoaked biomass was used as control. Hydrolysis of pretreated samples was carried out using cellulase (15 FPU/g biomass) for 120 h. Structural changes were studied by FTIR and XRD analyses. Reducing sugar and glucose yields from enzymatic hydrolysis were significantly higher in acid and alkali presoaked EBI exposed samples. Theoretical glucose yield showed 40% increase from control in alkali presoaked EBI exposed (150 kGy) samples. Removal of hemicellulose, decreased crystallinity and structural changes were major factors for the combined treatment effect favoring the hydrolysis.

1. Introduction

In view of changing global energy demands and concerns about environmental sustainability, many countries have committed targets towards the production of biofuels while maintaining the food security and environmental health. The controversies related to corn-based bio-ethanol production has forced the policy makers and scientists world over to venture into lignocellulosic biomass based biorefinery (Ragauskas et al., 2006). Appropriate utilization of lignocellulosic materials in biorefinery needs careful planning and pretreatments to overcome the key bottleneck in the initial conversion of biomass to fermentable sugars (Kumar et al., 2009). Hence, an ideal pretreatment step should render lignocelluloses completely susceptible to the action of cellulases.

Pretreatment technology has gained significant improvements and numerous methods have been developed due to the focused research interest on second generation biofuels. Acid and alkali pretreatments have extensively been used to remove lignin and hemicellulose and to facilitate enzymatic saccharification (Hendriks and Zeeman, 2009). Generating secondary pollution by the use of pretreatment chemicals has limited the scope of employing high concentration of acids/alkali or any other chemical in the pretreatment. This has led to the development of combinatorial pretreatment methods where; acid, alkali or chemical treatments are combined with physical parameters such as temperature or pressure to enhance the pretreatment efficiency at reduced concentration of chemicals used (Kumar et al., 2009).

Combination of microwave radiation and alkali was used to break down the complex lignin structure in the rice straw biomass for improving the enzyme access to cellulose (Singh et al., 2011). Pang et al., (2012) reported the synergetic effect of steam explosion

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