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Pretreatment of energy cane bagasse with recycled ionic liquid for enzymatic hydrolysis

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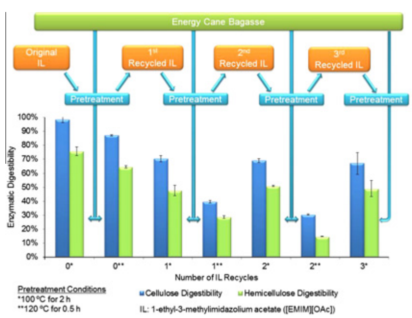
HIGHLIGHTS

- ▶ Recyclable [EMIM][OAc] is effective on energy cane bagasse pretreatment.
- ▶ Enzymatic digestibility decreased as the number of IL recycles increased.
- ▶ Recycled IL pretreatment efficiency improved with adequate temperature and time.

GRAPHICAL ABSTRACT



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ABSTRACT

A previous study revealed that energy cane bagasse (ECB) pretreated with ionic liquid (IL), 1-ethyl-3-methylimidazolium acetate ([EMIM][OAc]), exhibited significantly higher enzymatic digestibility than untreated or water-treated ECB due to delignification and reduction of cellulose crystallinity. This study evaluated the effect of multiple recycled IL on the pretreatment of ECB for enzymatic hydrolysis. ECB was pretreated with [EMIM][OAc] (5% (w/w)) at 100 °C or 120 °C for 0.5 h upto 4 h followed by hydrolysis with commercially available enzymes. The post-pretreatment IL-containing liquid was evaporated at 100 °C for 12 h to remove water and then reused during pretreatment without any further purification. The enzymatic digestibility decreased as the number of pretreatment recycles increased. Decreasing pretreatment temperatures from 120 °C to 100 °C and extending the residence times from 0.5 h to 2 h brought significant improvement to the pretreatment efficiency of recycled [EMIM][OAc] on ECB.

1. Introduction

Lignocellulosic biomass appears to be a prospective renewable energy resource that can be used for the generation of biofuels and bioproducts. A jointed study supported by the US Department of Energy (DOE) and the US Department of Agriculture (USDA) indicated that the land resources in the United States are sufficient to sustain production of over 1.3 billion dry tons of biomass annually, which could be available for large-scale bioenergy and biorefinery industries by mid-21st century while still meeting demand for forestry products, food and fiber (Perlack et al., 2005). Crop residues (sugarcane bagasse, corn stover, rice straw, wheat straw, sorghum bagasse), hardwood (black locust, poplar, eucalyptus), softwood (pine, spruce), herbaceous biomass (switchgrass, Bermuda grass), cellulose waste, and municipal solid wastes are some traditional potential lignocellulosic biomass resources for biofuels production (Aita and Kim, 2010). Energy cane, a hybrid of commercial and wild sugarcanes, is a relatively new and ideal lignocellulose resource. Compared to sugarcane, energy cane has higher fiber content, better cold tolerance, less fertilizer and water input requirements, and longer replanting time (Kim and Day, 2011; Sierra et al., 2008).

Lignocellulose is composed mainly of cellulose, hemicellulose and lignin. The cellulose chain is made up of glucose units joined together by β-1,4 glycosidic bonds. Individual cellulose chains are

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