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Characterization of the pretreatment liquor of biomass from the perennial grass, *Eulaliopsis binata*, for the production of dissolving pulp

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HIGHLIGHTS

- The non-wood biomass from *Eulaliopsis binata* was pretreated to producer dissolving pulp.
- A method of "zero release" of the pretreatment liquor (PL) was proposed.
- Hydrolysis or enzymolysis can be omitted during bioethanol production from PL.

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ABSTRACT

To test a biorefinery concept, the non-wood biomass of *Eulaliopsis binata* was treated with dilute acid prior to dissolving pulp production at 160 °C for 30 min. The pretreatment liquor (PL) contained 42.04 g/L sugars, of which 81.46% was xylose and only 2.91% was glucose. Furfural and hydroxymethylfurfural in PL were 0.37% and 0.06%, respectively. Chemical or enzymatic hydrolysis of carbohydrates could be omitted when producing bioethanol with PL because 87.32% of the total sugars were in the form of monosaccharides. Membrane filtration with a molecular-weight cut-off of 100 Da was employed to concentrate the sugars and a concentration of 170.49 g/L was achieved. A method of zero release of the PL is proposed, which consists of ethanol production from the concentrated PL and recycling the permeate stream into the pretreatment process.

1. Introduction

A biorefinery is an industrial facility able to convert lignocellulosic biomass into a range of materials, chemicals, and energy products (Mabee and Saddler, 2006; Chum and Overend, 2001). Existing pulp and paper mills may be viewed as early examples of the biorefinery, with a strong focus on material products. During pulping, most of the lignin and hemicellulose are dissolved in the waste pulping liquor to produce cellulose fibers. The dissolved material in the spent liquor is combusted to produce steam and electricity, and to regenerate the pulping chemicals (Van Heiningen, 2006). The hemicellulose is not fully utilized by this means due to its low heating value. In 2006, a concept to transform a chemical pulp mill into an Integrated Forest Biorefinery (IFBR) which produces higher value-added products such as ethanol, polymers, carbon fibers and diesel fuel besides pulp was proposed. In the IFBR concept, one of the key points is to extract hemicelluloses before pulping and convert them into bioproducts such as bioethanol (Van Heiningen, 2006).

Pretreatment of lignocellulosic materials at elevated temperature with water or dilute acid is a commonly employed and useful method to extract hemicellulose. In the pretreatment liquor, the main components are monomers and oligomers of sugars, acetic acid, aromatic compounds, and other low molecular-weight extractable substances (Liu et al., 2008; Galbe and Zacchi, 2007); however, the sugar concentrations in the pretreatment liquors are relatively low. Thus, separation and purification of the sugars is essential in the biorefinery process and membrane filtration is considered the most cost-effective method to concentrate the sugars in the pretreatment liquor (Liu et al., 2008).

Through pulping and bleaching, pretreated lignocellulosic materials can be used to produce dissolving pulp (Rosli et al., 2003), a low-yield chemically refined bleached pulp (30–40%) with high cellulose (>90%), relatively low hemicellulose (1–10%), and low lignin and mineral (<0.05%) contents (Behin and Zeyghami, 2009; Christov et al., 1998). A wide range of products can be produced from dissolving pulp, including viscose rayon, cellophane,

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