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Production and Purification of Monosaccharides by Hydrolysis of Sugar Cane Bagasse in an Ionic Liquid Medium

Authors : T. R. Bandara, H. Jaelani, G. J. Griffin

Abstract : The conversion of lignocellulosic waste materials, such as sugar cane bagasse, to biofuels such as ethanol has attracted significant interest as a potential element for transforming transport fuel supplies to totally renewable sources. However, the refractory nature of the cellulosic structure of lignocellulosic materials has impeded progress on developing an economic process, whereby the cellulose component may be effectively broken down to glucose monosaccharides and then purified to allow downstream fermentation. Ionic liquid (IL) treatment of lignocellulosic biomass has been shown to disrupt the crystalline structure of cellulose thus potentially enabling the cellulose to be more readily hydrolysed to monosaccharides. Furthermore, conventional hydrolysis of lignocellulosic materials yields byproducts that are inhibitors for efficient fermentation of the monosaccharides. However, selective extraction of monosaccharides from an aqueous/IL phase into an organic phase utilizing a combination of boronic acids and quaternary amines has shown promise as a purification process. Hydrolysis of sugar cane bagasse immersed in an aqueous solution with IL (1-ethyl-3-methylimidazolium acetate) was conducted at different pH and temperature below 100 ºC. It was found that the use of a high concentration of hydrochloric acid to acidify the solution inhibited the hydrolysis of bagasse. At high pH (i.e. basic conditions), using sodium hydroxide, catalyst yields were reduced for total reducing sugars (TRS) due to the rapid degradation of the sugars formed. For purification trials, a supported liquid membrane (SLM) apparatus was constructed, whereby a synthetic solution containing xylose and glucose in an aqueous IL phase was transported across a membrane impregnated with phenyl boronic acid/Aliquat 336 to an aqueous phase. The transport rate of xylose was generally higher than that of glucose indicating that a SLM scheme may not only be useful for purifying sugars from undesirable toxic compounds, but also for fractionating sugars to improve fermentation efficiency.

Keywords : biomass, bagasse, hydrolysis, monosaccharide, supported liquid membrane, purification
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