World Academy of Science, Engineering and Technology
International Journal of Chemical and Molecular Engineering
Vol:10, No:07, 2016

Screening of Factors Affecting the Enzymatic Hydrolysis of Empty Fruit Bunches in Aqueous Ionic Liquid and Locally Produced Cellulase System

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Abstract : The enzymatic hydrolysis of lignocellulosic biomass is one of the obstacles in the process of sugar production, due to the presence of lignin that protects the cellulose molecules against cellulases. Although the pretreatment of lignocellulose in ionic liquid (IL) system has been receiving a lot of interest; however, it requires IL removal with an anti-solvent in order to proceed with the enzymatic hydrolysis. At this point, introducing a compatible cellulase enzyme seems more efficient in this process. A cellulase enzyme that was produced by Trichoderma reesei on palm kernel cake (PKC) exhibited a promising stability in several ILs. The enzyme called PKC-Cel was tested for its optimum pH and temperature as well as its molecular weight. One among evaluated ILs, 1,3-diethylimidazolium dimethyl phosphate [DEMIM] DMP was applied in this study. Evaluation of six factors was executed in Stat-Ease Design Expert V.9, definitive screening design, which are IL/ buffer ratio, temperature, hydrolysis retention time, biomass loading, cellulase loading and empty fruit bunches (EFB) particle size. According to the obtained data, IL-enzyme system shows the highest sugar concentration at 70 °C, 27 hours, 10% IL-buffer, 35% biomass loading, 60 Units/g cellulase and 200 µm particle size. As concluded from the obtained data, not only the PKC-Cel was stable in the presence of the IL, also it was actually stable at a higher temperature than its optimum one. The reducing sugar obtained was 53.468±4.58 g/L which was equivalent to 0.3055 g reducing sugar/g EFB. This approach opens an insight for more studies in order to understand the actual effect of ILs on cellulases and their interactions in the aqueous system. It could also benefit in an efficient production of bioethanol from lignocellulosic biomass.

Keywords : cellulase, hydrolysis, lignocellulose, pretreatment
Conference Title : ICCPE 2016 : International Conference on Chemical and Process Engineering
Conference Location : Stockholm, Sweden
Conference Dates : July 11-12, 2016