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L Orejuela Escobar et al., J Fundam Renewable Energy App 2016, 6:5(Suppl)
http://dx.doi.org/10.4172/2090-4541.C1.017

2nd International Congress and Expo on

Biofuels & Bioenergy

August 29-31, 2016 Sao Paulo, Brazil

Lignocellulosic biomass fractionation by a deep eutectic solvent and a chelator mediated fenton system

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Biomass is the most abundant material on the earth and can be sustainably produced around the world. Utilization of biofuels has increased over the last 15 years and bioenergy will provide around 30% of the world's energy by 2050. A biorefinery is a system of sustainable, environmentally and resource friendly technologies for production of materials and energy derived from biological raw materials, it replaces fossil based petrochemical industry by the conversion of carbohydrates from lignocellulosic feedstocks into fermentable sugars to produce liquid biofuels. This study attempts to apply the biorefinery concept (fig. 1) to biomass cell wall deconstruction, in a process of three steps - pretreatment, fractionation and hydrolysis; for bioethanol production, an additional fermentation step is required (fig. 2). Plant cell walls are composed of cellulose, hemicellulose, and lignin, which form a recalcitrant barrier against enzymatic digestion and therefore limit the production of biofuels and high–value chemicals. A pretreatment to overcome recalcitrance is needed, processes for selective biopolymer dissolution are of great interest, particularly those which use less harmful solvents and less energy. DES are thermally stable, biodegradable, inexpensive, easy to prepare and they can selectively dissolve biomass polymers. A chelator mediated Fenton system depolymerizes polysaccharides to fermentable sugars and modifies lignin in the lignocellulosic matrix. Combination of the DES technology and CMFs chemistry may provide a solution to explore biorefinery viability (fig. 2). In this study, four different pretreatments were carried out for SG and YP. Samples were treated with choline chloride:glycerol DES (1:2) at 150°C for 2h; also with CMFs reagents incubated in a water bath at 30°C; and a combination of both pretreatments (CMFs+DES and DES+CMFs). The impact of the pretreatments was monitored by the mass loss and by the compositional analysis before and after the pretreatments for mass balance determination. Delignification, enzyme accessibility (biomass porosity) and cellulose crystallinity are key factors in the enzyme hydrolysis performance for fermentable sugars and bioethanol production.

Fig 1. Overall scheme for this research

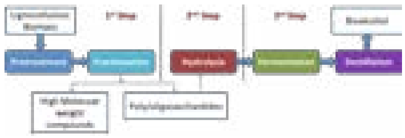

Fig 2. Cell wall deconstruction for biorefinery purposes

Biography

Lourdes Orejuela is a chemical engineer graduated in the Politechnic Institute of Bucharest, Rumania (MSc 1984 in Organic Chemistry Technology). She achieved a MSc degree in Virginia Tech (Wood Science) in 1995. She was appointed as professor in Universidad Central del Ecuador in 1995, in Escuela Politecnica del Ejercito in 1997 and since 1999 is professor in the Department of Chemical Engineering in Universidad San Francisco de Quito, Ecuador. She currently is pursuing a PhD degree in Virginia Tech (Depatment of Sustainable Biomaterials) in the Macromolecular Science and Engineering. Her interest is to develop integrated processes for the utilization of biomass and biomass waste.

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