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Upgrading underutilized biomass feedstock for cost-efficient biofuels production employing the circular bioeconomy approach

Lignocellulosic biomass is the only renewable resource on earth that holds the key to a sustainable production of fuels and chemicals without compromising food security. Furthermore, plant biomass has the potential to significantly decrease and eventually substitute the use of oil-derived products of environmental concern, increase energy independence, and enhance rural economy The sustainable production of biofuels and bioenergy is currently driven by three important factors: 1) ever increasing demand for food and energy; 2) diminished oil reserves and unstable oil prices; 3) growing concerns over global climate change and greenhouse gas emissions. As current cost of lignocellulose conversion to bioenergy exceeds the cost of fossil fuels, development of economically-viable production systems would require the use of low-value biomass and waste streams that are currently underutilized. Utilization of underused biomass feedstock is in alignment with the circular bioeconomy concept and has at least two major advantages over any other lignocellulosic raw materials: 1) as cost of raw materials may comprise 30-70% of total product cost, this approach significantly lowers the overall production costs of biofuels; 2) significantly reduce (or eliminate) the waste treatment costs. In the circular bioeconomy concept, the waste product from one manufacturing system becomes the raw material in another, therefore minimizing waste, carbon footprint and greenhouse gas emissions. This presentation will discuss opportunities for valorization of biomass side-streams of low or negative value such as municipal solid waste, saw dust, primary sludge, and crude tall oil. Biofuels of interest include biohydrogen, bioethanol and biodiesel. In addition to biofuels, the potential for production of value-added biochemicals and biomaterials, that enhance the economics of any biorefinery-based technology, as well as related technological challenges will be critically reviewed and discussed.

Recent Publications

1. A Alhammad, P O Adewale, M Kuttiraja and L P Christopher (2018) Enhancing enzyme-aided production of fermentable sugars from poplar pulp in presence of non-ionic surfactants. Bioprocess and Biosystems Engineering. Doi: 10.1007/s00449-018-1942-z.
2. L P Christopher, H Kumar and V P Zambare (2014) Enzymatic biodiesel: challenges and opportunities. Applied Energy. 119:497-520. Doi:10.1016/j.apenergy.2014.01.017.
3. L P Christopher (2012) Integrated Forest Biorefineries: Challenges and Opportunities (2012). Royal Society of Chemistry. ISBN 978-184973-321-2.

4. S Talluri, S M Raj and L P Christopher (2013) Consolidated bioprocessing of untreated switchgrass to hydrogen by the extreme thermophile *Caldicellulosiruptor saccharolyticus* DSM 8903 (2013). Bioresource Technology. 139:272-279. Doi: 10.1016/j.biortech.2013.04.005.
5. L P Christopher (2012) Adding value prior to pulping: Bioproducts from Hemicellulose. In: Global Perspectives on Sustainable Forest Management. InTech. 225-246.

Biography

Lew P Christopher holds a Master's Degree in Chemical Engineering, PhD Degree in Biotechnology and has more than 20 years of industrial and academic experience. Currently he serves as the Director of the Biorefining Research Institute at Lakehead University, Canada. His research mission is to add value to the emerging bioeconomy by applying an integrated biorefinery approach to the development of renewable energy technologies. He is a Member of the Editorial Board of several international biotechnology journals, advisory boards, and professional societies. He has made over 400 scientific contributions to the field of bioprocessing of lignocellulosic biomass.

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