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Morales Rodriguez, Ricardo; Meyer, Anne S.; Gernaey, Krist; Sin, Gürkan

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An Integral Analysis for Second Generation Bioethanol Production via a Dynamic Model-Based Simulation Approach: An Energy Efficiency Assessment

Ricardo Morales-Rodriguez[1], Anne S. Meyer[2], Krist V. Gernaey[3], Gürkan Sin[1]
[1]CAPEC, [2]BIOENG, [3]PROCESS, Department of Chemical and Biochemical Engineering, Technical University of Denmark, DK-2800 Lyngby, Denmark.

There are different technological routes to biofuels production such as, biohydrogen, biomethane, biobutanol, among others. Bioethanol production from lignocellulosic feedstock has acquired special attention, and its feasibility has been demonstrated at laboratory, pilot and demo-plant scale[1,2,3]. Despite the reported progress and the promising results, however, at present this technology is not cost-competitive compared with first generation bioethanol production or fossil-fuels. Therefore, there is further room for optimisation of the technology and improvement of its cost-effectiveness. The objective of this study is to perform an integral analysis for bioethanol production from lignocellulosic feedstock using a rigorous dynamic modelling approach for the whole process. The bioethanol production includes different sections such as, pre-treatment of the substrate, enzymatic hydrolysis of cellulose, co-fermentation of sugars and downstream processes for purification and recovery of most value-added products. The dynamic model involves both the mass and energy balances coupled with constitutive dynamic equations to assess the process yield and energy efficiency of different bioethanol processes. This study employs the Dynamic Lignocellulosic Bioethanol (DLB 1.0) modelling platform[4], which has demonstrated to describe accurately the dynamics of the pre-treatment, enzymatic hydrolysis and co-fermentation. Moreover, DLB 1.0 is complemented by downstream process models. The results will show and provide further analysis for 2G bioethanol production, aiming to decrease and find a competitive bioethanol production cost that recently was set on $2.35 USD/gallon[5]. Thus, the application of the constructed modelling platform will allow and support the analysis and search of a more reliable and feasible bioethanol production route.

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