GreenSolRes

Deliverable 1.7

Report on the engineering package for the 50kta commercial levulinic acid plant

Demonstration of solvent and resin production from lignocellulosic biomass via the platform chemical levulinic acid

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BBI JU

Bio-based Industries Consortium

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About GreenSolRes

The need to establish economic and sustainable large-scale operations for the conversion of renewable resources to chemical building blocks is becoming increasingly urgent in the context of climate change and depleting fossil fuel reservoirs. Pathways for manufacturing of bio-based fuels and chemicals have been developed but often rely on sugar and starch crops for feedstock. The European Demonstration project - GreenSolRes aims at a sustainable and competitive industrial production of the platform chemical levulinic acid (LVA) from non-food lignocellulosic biomass. Further, the conversion of LVA and LVA esters into industry relevant building blocks γ-valerolactone (GVL), 1-methyl-1,4-butanediol (MeBDO) and 2-methyltetrahydrofuran (2-MTHF) will take place by new catalytic methods developed during the course of this project. Finally, these chemicals will be upgraded to solvents and resin monomers to produce high added value adhesives and consumer products.

Project Coordinator

RWTH AACHEN UNIVERSITY

Project Office

SYNCOM

Consortium

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Henkel

Catalysis LIKAT Leibniz-Institut für Katalyse e.V.

SYNCOM

Hybrid Catalysis Custom Synthesis & Screening

vito

BASF We create chemistry

Lenzing Innovative by nature

About this document

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Publishable Summary

The objective of this report was to systematically investigate the critical steps in the conversion of beech wood to levulinic acid (LVA) and its isolation, and to develop a process for the production of purified LVA on a 50 kta scale based on this information.
This report describes in detail one potential LVA production process, conceptually based upon core conversion and purification research at the pilot scale research biorefinery of Aachener Verfahrenstechnik “NGP² Biorefinery”. The overreaching process design converts beechwood chips of specific particle size to LVA by dilute-sulfuric acid catalyzed hydrolysis. Important areas of the biorefinery -feed handling, biomass conversion, biomass residue filtration, product recovery, wastewater treatment, steam generation and utilities- are included in the design.
As a benchmark case study, the information gathered inside beechwood conversion and LVA purification experiments are used in a technoeconomic model. The process parameters are implemented in Aspen Plus and process optimization and heat integration are performed. A detailed analysis of the total capital investment and the cost of manufacture provides a realistic evaluation of the economic feasibility of the biorefinery design. Using a sensitivity analysis, the most important factors for the cost contribution are presented.
In the last part of this report, we investigate potential improvements of the presented design. For instance, we show that the replacement of the batch reactors with continuous digesters, the production of activated carbon out of the solid residues, the biogas production from wastewater and finally the formic acid separation, would reduce the cost of manufacture of LVA from 2.018 €/kg (base case) to 0.914 €/kg (after improvements). This analysis shows the potential of the presented process and the importance of a diverse and detailed investigation of all processing steps.