From beech wood to itaconic acid: Case study on biorefinery process integration.

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Abstract

Renewable raw materials in sustainable biorefinery processes pose new challenges to the manufacturing routes of platform chemicals. Beside the investigations of individual unit operations, the research on process chains, leading from plant biomass to the final products like lactic acid, succinic acid, and itaconic acid is increasing. This article presents a complete process chain from wooden biomass to the platform chemical itaconic acid. The process starts with the mechanical pretreatment of beech wood, which subsequently is subjected to chemo-catalytic biomass fractionation (OrganoCat) into three phases, which comprise cellulose pulp, aqueous hydrolyzed hemicellulose, and organic lignin solutions. Lignin is transferred to further chemical valorization. The aqueous phase containing oxalic acid as well as hemi-cellulosic sugars is treated by

nanofiltration to recycle the acid catalyst back to the chemo-catalytic pretreatment and to concentrate the sugar hydrolysate. In a parallel step, the cellulose pulp is enzymatically hydrolyzed to yield glucose, which-together with the pentose-rich stream-can be used as a carbon source in the fermentation. The fermentation of the sugar fraction into itaconic acid can either be performed with the established fungi Aspergillus terreus or with Ustilago maydis. Both fermentation concepts were realized and evaluated. For purification, (in situ) filtration, (in situ) extraction, and crystallization were investigated. The presented comprehensive examination and discussion of the itaconate synthesis process-as a case study-demonstrates the impact of realistic process conditions on product yield, choice of whole cell catalyst, chemocatalysts and organic solvent system, operation mode, and, finally, the selection of a downstream concept.

Involved units

Bio Pilot Plant Miriam Agler-Rosenbaum Read more

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