Processes for Industrial application of natural Deep Eutectic Solvents

Publieke samenvatting / Public summary

Aanleiding

The traditional kraft pulping process as currently widely applied in the European pulp and paper industry is a very effective and CO2 neutral process. It isolates high quality cellulose with hemicellulose as important strength enhancer, while the lignin serves as a sustainable energy source feeding the process and pulping chemicals are being recovered. Climate change though calls for fossil based carbon to be replaced by biobased carbon, thus creating new opportunities for our natural resources. The lignocellulose pulping concept inherently provides the technology to assist this transformation. This requires a pulping process that yields a lignin that easily isolated from the pulping liquors in a form with effective functionality for conversion to biobased chemical building blocks. These chemical building blocks are crucial for the Dutch chemical industry to green their feedstock. The DES cluster develops energy efficient green chemistry concepts to reach these targets.

Doelstelling

The main objective of the PRIDES project is to develop radically new mild pulping concepts for wood and agro-based lignocellulose raw materials based on Natural Deep Eutectic Solvents with a significant increase in sustainability, cost- and resource-effectiveness. The aim of PRIDES is to further develop and optimise the technologies developed in the ISPT DES cluster and to transfer the scientific findings in novel lignin dissolving DES and recovery to a closed process concept level that

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can be evaluated in relation to the traditional pulping and product conversion processes.

Korte omschrijving

This includes development of fundamental knowledge on the mechanism behind the successful fractionation by these novel natural solvents, required for the specific development of efficient DESs capable of specifically dissolving lignin and keeping the cellulose and hemicellulose intact at the highest quality, to allow total valorisation of the lignocellulosic raw material with the focus on sustainability and technical and economic applicability of the solvent system. The main product is high quality cellulose fibres to replace current kraft fibres in papermaking. In the Provides project the cluster was successful in removing lignin from wood and other lignocellulosics under mild conditions and low energy consumption. Resulting cellulose fibres had low lignin contents. However, hemicellulose was also removed and the cellulose fibres showed degradation: fibres were shortened and the resulting paper strength is low. This might be caused by the acidity of part of the DES components used so fare, but might also be caused by the extreme speed of all simultaneous reactions taking place.

Resultaat

The challenge is to find non-acidic (neutral or alkaline) DESs that are able to break the ß-O-4 linkages and other relevant linkages between cellulose and lignin, while not hydrolysing the cellulose and hemicellulose and not producing unwanted side-products. Insights in the delignification mechanisms achieved so far show that processing time and temperature are very important factors to steer towards a suitable process concept. The concept also includes the development of cost-efficient and sustainable DES regeneration processes for recycling of the DES and recovery of the dissolved components. Lignin and hemicelluloses are to be recovered in high quality for further conversion enabling multiple high market volume applications as to renew the product portfolio and thus increase the business

opportunities and competitiveness of the European pulp and paper industry. Valorisation of these side streams will be further elaborated in a separate project under development in the DES cluster.

De data in deze applicatie is afkomstig van de Rijksdienst voor Ondernemend Nederland (RVO) en wordt in samenwerking met de Topsector Energie ontsloten.
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