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puh. 050 577 3736 Sirje Liukko

Press release Breaking down cellulose with only water

Title of the doctoral thesis	Low-molecular-weight Nanocellulose Produced Using Supercritical Water Treatment
Content of the doctoral thesis	Cellulose, the main component of plant biomass such as trees and one of Finland's most precious natural resources, is a fascinating bio-based material with multiple applications. As a long linear polymer, it is important to be able to depolymerize it to shorter chains, also called low-molecular-weight cellulose. The properties of low-molecular-weight cellulose are attractive when searching for new applications, for example in the food and pharmaceutical industries. One interesting and recently developed method to depolymerize cellulose is using supercritical water, which is pure water heated above 374 °C and pressurized above 221 bar. The main benefits of this method are that it is simple and fast: cellulose is depolymerized within fractions of a second. In addition, no other chemicals are required, which makes this process remarkably clean and environmentally friendly. The main objective of this thesis was to optimize the production of low-molecular-weight cellulose using supercritical water treatment. More precisely, the experimental conditions favouring its formation were identified. In addition, this work clarified the range of nanoscale particle shapes and sizes possible to recover once the product precipitates. Finally, a few simple utilization cases were investigated, taking advantage of the attractive properties of this low-molecular-weight material. As a result, relatively larger amounts of low-molecular-weight cellulose could be produced with various average degrees of polymerization, and a significant reduction in the energy requirements. The potential benefits of using this nanocellulosic material was also validated, for example as a stabilizer in two-phase emulsions. Therefore, this thesis work represents an important stepping stone towards the sustainable production and utilization of low-molecular-weight cellulose.
Field of the doctoral thesis	Bioproduct Technology
Doctoral candidate and contact information	M.Sc. (Tech.) Jean Buffiere Jean.buffiere@aalto.fi
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Place of defence	The public defence will take place via remote technology. https://aalto.zoom.us/j/63178856024
Opponent(s)	Professor Andrea Kruse, University of Hohenheim, Germany
Custos	Professor Herbert Sixta, Aalto University School of Chemical Engineering
Link to electronic thesis	https://aaltodoc.aalto.fi/handle/123456789/51
Keywords	Cellulose, supercritical water, biorefineries, green chemistry, oligosaccharides

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