Matjaz Kunaver, J Fundam Renewable Energy Appl 2017, 7:9(Suppl)
DOI: 10.4172/2090-4541-C1-043

2nd Euro Global Summit and Expo on

BIOMASS AND BIOENERGY

October 12-13, 2017 London, UK

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Biomass waste – A source of raw materials and nanocellulose

Cellulose containing Biomass represents an immense and renewable source for the production of bio-fuels and valuable chemicals. A little amount of this is used in industry and the remaining is leftover in huge quantities. Much effort has been devoted in converting these types of biomass into useful industrial and commercially viable products. In recent years, some effective processes have been found, such as thermochemical conversion producing several new products from these renewable resources. An overview of such applications and methods will be presented in this contribution. One of possibilities of converting biomass is the liquefaction. During liquefaction reaction, lignocellulosic components are depolymerized to low molecular mass compounds with high reactivity, high hydroxyl group content and can be used in many useful applications. A high energy ultrasound or microwaves can be used as an energy source to speed up the liquefaction process. The liquefied biomass was used as a feedstock in the synthesis of polyesters, polyurethane foams and adhesives. The same liquefaction process was used for the isolation of the nanocrystalline cellulose from biomass. The method is a novelty and a model procedure for NCC isolation from different natural cellulosic sources with high yields and with high crystallinity index. The process of preparing NCC from different natural sources uses glycols as the main reactant and an acid catalyst in low concentration (only 3%). Here, during the one step reaction, lignin, hemicelluloses and the more disordered components of the cellulosic fibers are liquefied, only the crystalline cellulose remaining as a solid residue. The liquefaction reaction, using glycols and mild acid catalysis, was optimized and applied to four model materials, namely cotton linters, spruce wood, eucalyptus wood and Chinese switch grass. The percent recovery of the nanocrystalline cellulose was from 55.6% for Chinese silver grass to 74.5% for cotton linters. The crystallinity index of the nanocrystalline cellulose was from 62.8% to 80%, the lowest for Chines silver grass and the highest for the cotton linters. The average crystal length was 258 nm and the width 10 nm. The main benefit of the process arises from the ability to prepare stable NCC suspensions in an organic medium at 10 times greater loadings than can be achieved in aqueous suspensions. The liquid residues contain significant quantities of levulinic acid and different sugars that were derived from cellulose and hemicelluloses.

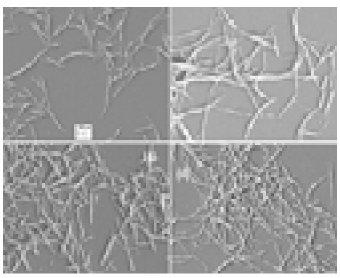

Figure 1. SEM micrographs of NCC: cotton linters (a), chinese silver grass (b), spruce wood (c) and eucalyptus wood (d).

Biography

Matjaž Kunaver has done his MSc from the University of Leeds UK in 1991 and has received his PhD degree in 1998 at the University of Leeds, UK. He is a Senior Scientist Researcher at the National Institute of Chemistry, Laboratory for Polymer Chemistry and Technology, Ljubljana, Slovenia and is an Assistant Professor at the University of Ljubljana and Polymer Technology College. His main fields of research are the utilization of biomass as a feedstock for polymer synthesis and production of nanocellulose. He has published more than 50 original scientific papers and 6 patents.

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