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Nanocrystalline cellulose from laboratory to pilot plant production and its use

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A highly efficient and eco-friendly procedure for rapid preparation of nanocrystalline cellulose (NCC) from biomass was developed and optimised. It was achieved by liquefaction of amorphous part of cellulose, lignin and hemicelluloses in ethylene glycol under acidic catalysis. The feedstock can be any cellulose containing biomass or its waste.

Lignocellulosic biomass was dispersed in glycol and methane sulfonic acid (3%) was used as a catalyst. During the liquefaction reaction liquefaction the amorphous part of cellulose, lignin and hemicelluloses were liquefied and the NCC was isolated as a residue, rinsed with a mixture of glycol and water and centrifuged. The product was a NCC suspension in water or any polar organic solvent. The crystallinity index was from 75% to 84% and the yield was more than 67% when using cotton as the starting material. The NCC was characterized by SEM microscopy, X-ray diffraction and NMR spectroscopy. The average particle size was between 200 nm and 500 nm, with diameter from 15 nm to 30 nm. The method was also tested in the pilot plant reactor with 250 lit capacities. The utilization of ultrasound during the liquefaction reaction decreased the reaction time for 40%.

Thus produced NCC was used in water based acrylic coatings improving the scratch resistance, as reinforcement in different polymer composites increasing the mechanical strength, in packaging films enhancing the barrier properties and in paper production improving the printability.

The LCA analysis proved the eco-friendliness of the process since the impact on the environment is much reduced if compared to well establish methods.

Biography

Matjaz Kunaver finished his MSc at the University of Leeds UK and has received his PhD degree at the same university. He is a senior scientist – researcher at the National Institute of Chemistry, Department for [Polymer Chemistry and Technology](#), Ljubljana, Slovenia and assoc. professor at the University of Ljubljana and [Polymer Technology](#) faculty. His main fields of research are the utilization of biomass as a feedstock for polymer synthesis, energy production and nowadays isolation of [nanocellulose](#) with new effective methods. He has published more than 56 original scientific papers and 6 patents. He is a member of editorial board of several scientific journals.