EXTRACTION AND PROPERTIES OF NANOCELLULOSE FROM HEMP FIBERS

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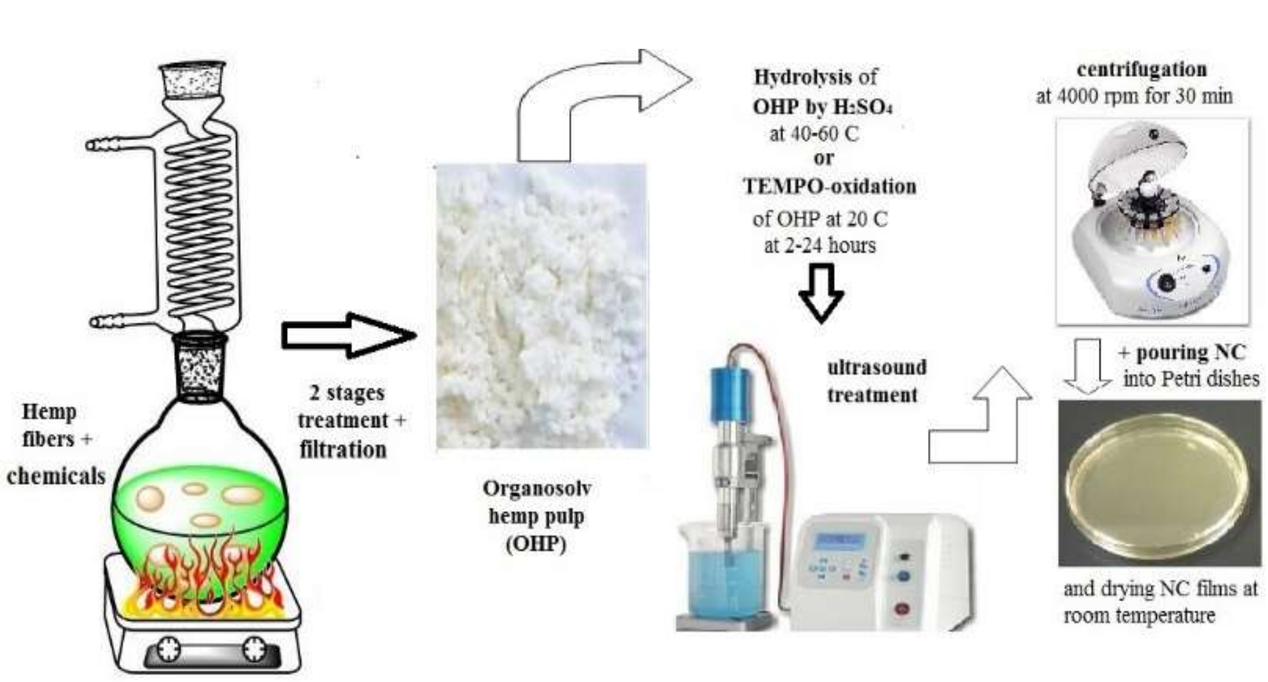
Cellulose is the most common organic compound on Earth. Cellulose is widely used as a source for the production of building materials, paper, textiles and clothing, etc. In recent decades, cellulose has been seen as a source for replacing polymers from exhaustive materials - oil, gas, coal. In particular, this applies to the extraction of nanocellulose from plant raw materials due to its unique properties: high elasticity and a specific surface, high transparency and chemical resistance, biodegradability and biocompatibility, a low production cost in comparison with synthetic polymers and has lightweight. **The purpose of the study** is development of new technology for the production of cellulose by environmentally friendly method and nanocellulose from hemp fibers and to analyze the properties of the obtained nanocellulose from hemp fibers.

Scheme of preparation and application of hemp nanocellulose

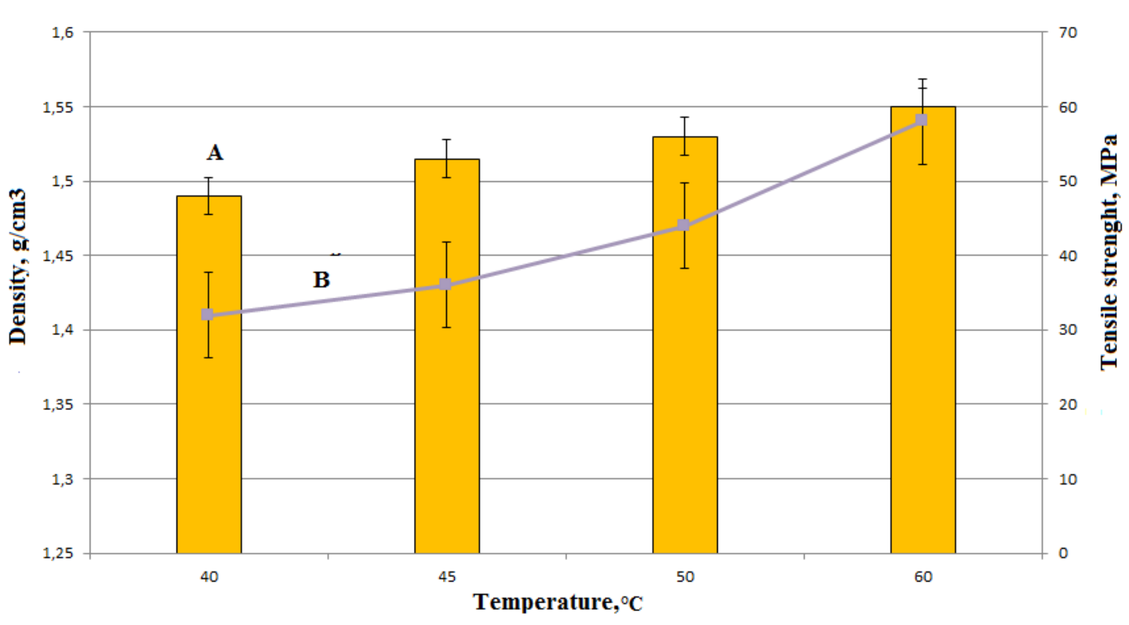


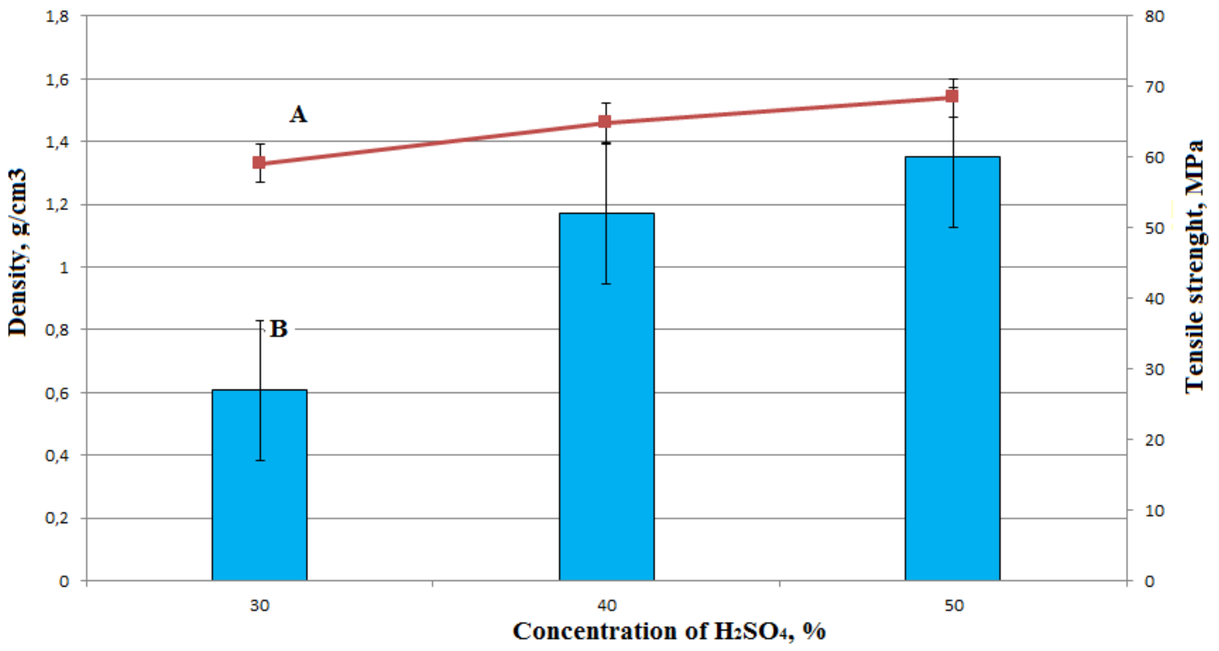
Hemp fiber is naturally one of the most environmentally friendly fibers. In order to obtain nanocellulose at the first stage, hemp fibers were extracted with NaOH solution with concentration 5 %. Cellulose cooking was performed with a mixture of glacial acetic acid and 30% solution of hydrogen peroxide in a ratio of 70:30. The ratio of liquid to solid was 10:1, temperature - 97 ± 2 ˚C and duration 60-180 minutes for both stages of processing. Organosolv hemp cellulose (OHP) had a residual content of lignin from 0.16 to 0.36% and minerals from 0.13 to 0.24%.

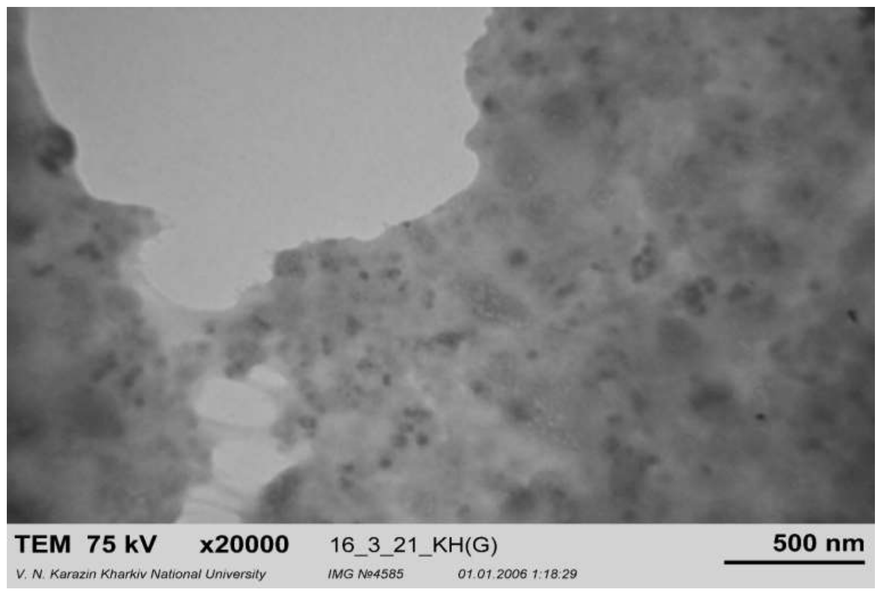
Nanocellulose was obtained from organosolv hemp pulp by hydrolysis process. The hydrolysis process was performed with sulfuric acid with a concentration of 30 – 60 % at a temperature of 40-60 ˚C during 30 – 60 min. To obtain a stable nanocellulose gel, the suspension was treated with ultrasound at a frequency of 22 kHz for 60 minutes.

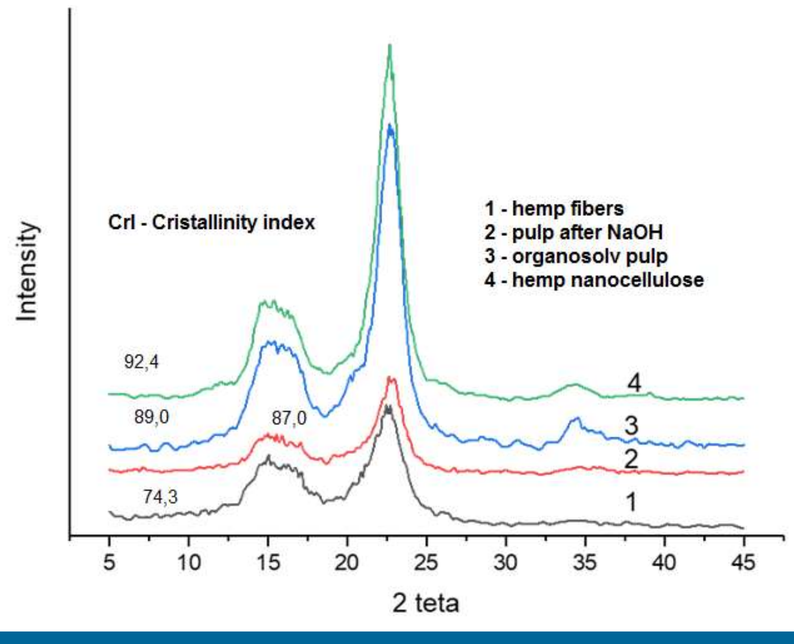
Properties of nanocellulose

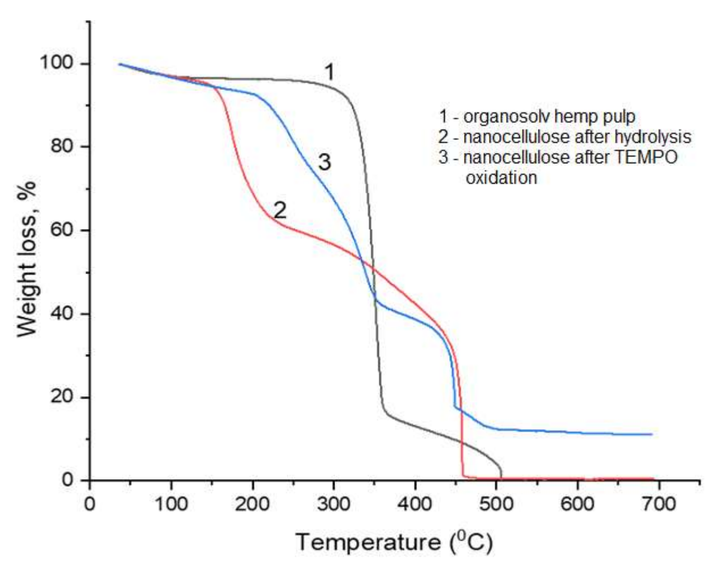
Dependences of density (A) and tensile strength (B) of nanocellulose films on temperature and acid concentration











Conclusion

1. The organosolv hemp pulp has a residual lignin up to 0.36% and mineral content up to 0.24% and is suitable for the production of nanocellulose. 2. Increasing the temperature of the hydrolysis process of organosolv hemp pulp and the concentration of sulfuric acid leads to an increase in the density and tensile strength of nanocellulose films. 3. According to TEM, nanocellulose forms a network of particles with a transverse size up to 100 nm. 4. XRD data confirm the increase in the crystallinity index in the process of thermochemical treatment of hemp fibers. 5. TGA data show greater thermal stability of hemp nanocellulose compared to OHP.