

Upscaling of Cellulose Extraction from Hemp Bast Fibers and Production of Cellulose Aerogel Beads: An Industrial Case

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Academia and industry have been developing ways to produce novel materials from renewable bio-based sources. Hemp is cultivated mainly for fiber production, due to its outstanding durability, absorbency, anti-mildew, and anti-microbial activity.¹⁻² We have been developing strategies to upscale the extraction of cellulose from waste hemp fibers, in order to create cellulose aerogel beads. Alkali hydrolysis and bleaching established a simple method to extract high-grade cellulose from hemp waste fibers at the lab-scale.³⁻⁴ Parameters such as the degree of fiber milling and time of residence have been modified, in order to adapt this method to a 2L reactor for industrial purposes. The quality of the extracted cellulose was analyzed by X-ray diffraction and FTIR.

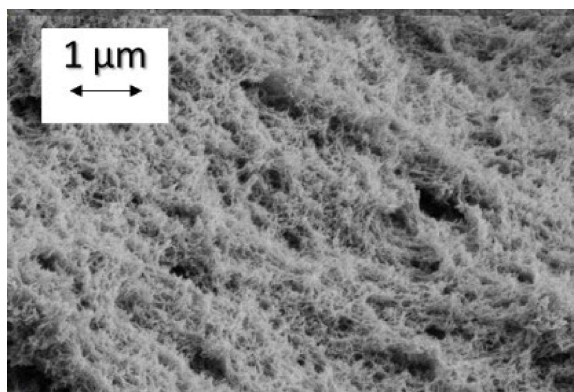


Figure 1: SEM picture of the internal microstructure of a cellulose aerogel.

Source: own.

The extracted cellulose was dissolved using a mixture of NaOH, urea, and water as a solvent.⁵⁻⁷ The cellulose aerogels beads were produced using the Jet-Cutter® from commercial and extracted cellulose. Those samples were characterized, and compared via nitrogen adsorption-desorption isotherm, BJH pore data analyses, density analyses, FTIR and Scanning Electron Microscopy. Highly porous materials were produced from both sources of cellulose, which expanded the use of agricultural wastes at the industrial scale.

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References

- [1] Manaia, J. P., Manaia A. T. & Rodrigues L., *Fibers*, 7(12), 106, 2019.
- [2] Daria, M., Krzysztof L. & Jakub M., *Journal of Cleaner Production*, 268, 122-129, 2020
- [3] Oriez, V., Peydecastaing J. & Pontalier P.-Y., *Clean Technologies*, 2(1), 91-115, 2020.
- [4] Kopania, E., Wietecha J. & Ciechańska D., *Fibers and Textiles in Eastern Europe*, 20, 6B (96), 167-172, 2012.
- [5] Hoepfner S., Ratke L. & Milow B., *Cellulose*, 15, 121-129, 2008.
- [6] Budtova, T. & Navard P., *Cellulose*, 23(1): 5-55, 2015.
- [7] Schestakow M., Karadagli I. & Ratke L., *Carbohydr. Polym.*, 137, 642-649, 2016.