Leire Urbina et al., J Chem Eng Process Technol 2018, Volume 9
DOI: 10.4172/2157-7048-C1-011

Two different routes for the preparation of bacterial cellulose/chitosan filtration membranes for copper removal in wastewaters

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The presence of copper ions in wastewaters is a very serious problem extended in the electrical, leather, fungicidal or paper industries[1]. Recent research is focused on the development of chitosan (Ch) membranes for wastewater purification processes since this biopolymer contains a large number of free amino groups which are highly reactive for the chelation reaction of metal cations[2]. Traditionally, glutaraldehyde has been used as a cross-linker of Ch to improve the chemical and mechanical resistance of the membranes, but its main drawback lies with the toxicity[3], so other alternatives are being investigated. In this context, nanocellulose materials have also gained attention in this area due to their mechanical performance and high specific surface area[4]. Bacterial cellulose (BC), a biopolymer biosynthesized by some bacteria, offers new possibilities in this field due to its highly crystalline 3D network-like structural conformation with excellent mechanical properties in wet state[5]. In this work, environmentally friendly membranes by *in situ* and *ex situ* routes based on BC as a template for the Ch as functional entity for the elimination of copper in wastewaters have been developed. BC/Ch composites were prepared *ex situ* by immersing the previously biosynthesized BC wet membranes in 0.6 and 1% (v/v) Ch prepared in 0.5% acetic acid solution under shaking conditions. BC/Ch composites were prepared *in situ* by the supplement of chitosan (addition of 0.50 and 0.75% (w/v) Ch) into the culture medium used for the BC biosynthesis. The influence of the preparation route on the interactions between components, mechanical properties, morphology, and pore structure was evaluated. Two routes led to bionanocomposites with different aspect and physico-chemical properties. The morphological characterization suggested a better incorporation of Ch into BC matrix through the *in situ* route. Finally, the cooper removal capacity of these membranes was analyzed and the reusability of the membranes was assessed.

Recent Publications:

1. Karim, Z., Mathew, A., Grahn, M., Mouzon, J., & Oksman, K. (2014). Nanoporous membranes with cellulose nanocrystals as functionalentity in chitosan: Removal of dyes from water. Carbohydrate Polymers. 112: 668-676.
2. Wang, B., Zhu, Y., Bai, Z., Luque, R., & Xuan, J. (2017). Functionalized chitosan biosorbents with ultra-high performance, mechanical strength and tunable selectivity for heavy metals in wastewater treatment. Chemical Engineering Journal. 325: 350-359.
3. Mitra, T., Sailakshmi, G., & Gnanamani, A. (2014). Could glutaric acid (GA) replace glutaraldehyde in the preparation of biocompatible biopolymers with high mechanical and thermal properties. Journal of Chemical Sciences. 126: 127-140.
4. Karim, Z., Claudpierre, S., Grahn, M., Oksman, K., & Mathew, A. (2016). Nanocellulose based functional membranes for water cleaning: Tailoring of mechanical properties, porosity and metal ion capture. Journal of Membrane Science. 514: 418-428.
5. Hu, W., Chen, S., Yang, J., Li, Z., & Wang, H. (2014). Functionalized bacterial cellulose derivatives and nanocomposites. Carbohydrate Polymers. 101: 1043-1060.

Biography

In 2015 Leire Urbina earned a PhD grant funded by the Basque Government and incorporated as a researcher to the "Materials + Technologies" Group in the Department of Chemical and Environmental Engineering of the UPV / EHU. Strong background in polymers, advanced materials and nanotechnology and biotechnology areas. Her research is based on the use of biomass by-products and wastes for the production of new materials with high added value that can be used in various industrial sectors. Concretely she is working in the development and optimization of biosynthetic pathways to produce biopolymers via bacteria (bacterial cellulose and polyhydroxyalkanoates) using agricultural residues as a source of nutrients and the processing of their bionanocomposites. The investigation is focused on the influence of biosynthetic conditions on the final properties and generated micro/nanostructures and the development of functional (bio)nanocomposites with improved properties for applications in biomedicine and for environmental uses in the elimination of pollutants in wastewaters.

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