Electrospun nanofibrous lignin material for the adsorption of pharmaceutical residues in wastewater

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1. Introduction - Emerging contaminants represent a challenge for water preservation, threatening humans’ health and all ecosystems [1]. They consist of a variety of molecules ranging from pharmaceutical and personal care products to pesticides and flame retardants detectable in wastewater, sewage effluent, surface water, drinking water, and ground waters at trace amount concentrations (e.g., ng/L, µg/L). Conventional wastewater treatment plants (WWTPs) possess low removal efficiency for those emerging contaminants [2]. Therefore, new technologies capable of removing such residues are needed. Lignin recognized as a renewable, non-toxic and abundant biopolymer is transformed through electrospinning into an anionic nanofibrous nonwoven adsorbent to extract and dispose those contaminants safely from aqueous solution. Electrospinning allows the manufacture of fibres at the micro or nanoscale under the influence of an electric current.

2. Experimental - In this study, nanofibres of alkali lignin and a co-polymer, poly (vinyl alcohol), were electrospun and their adsorption was tested on multiple pharmaceutical contaminants (fluoxetine, venlafaxine, carbamazepine and ibuprofen) in an aqueous solution. Innovative thermal and chemical stabilization processes were developed for preparation of the material for adsorption [3].

3. Results and Discussion - Results showed that the lignin nanofibres, of 156 nm in diameter (see image 1), adsorbed up to 85% of fluoxetine in solution which corresponds to 43 ppm of pharmaceuticals removed from water. Desorption tests also proved the reusability of the nanomaterial produced for at least three adsorption/desorption cycles without any efficiency loss.

4. Conclusions – The use of electrospun lignin/PVA nanofibres is a promising method for the retention of dangerous pharmaceutical contaminants since its high adsorption capacity and reusability has been proved. Moreover, the material is entirely ecological, non-toxic, biodegradable for end-of-life disposal and cheaper than advanced wastewater technologies.

5. References