

Functionalization of Biobased Polymers: Synthesis, Characterization and Environmental Applications

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Freshwater is a critical resource for the planet and biopolymers are recently emerging as sustainable adsorbents in wastewater remediation.¹ However, their inherent hydrophilicity limits their use for the adsorption of organic contaminants. This issue can be addressed by modification of hydrophilic biopolymers with hydrophobic molecules, leading to either amphiphilic or hydrophobic materials, depending on the degree of functionalization.²

The growing interest towards biopolymers application in amphiphilic conditions prompted us to explore the preparation of fluorinated cellulosic materials for efficient dye removal from wastewater.³ Nevertheless wastewater is contaminated by several type of compounds among which emerging pollutants, such as perfluoroalkyl acids, pharmaceutically active compounds, oleic residues, microplastic and nano-plastics. To have a wider affinity of adsorbents for different organic pollutants biobased polymers such as cellulose (CE), carboxymethylcellulose (CMC) and chitosan (CS) were functionalized with 1,2,4 oxadiazole molecules differing for the nature of substituents. A highly fluorinate molecule, 3-pentadecafluoroheptyl-5-pentafluorophenyl-1,2,4-oxadiazole (FOX), a long alkyl chain oxadiazole, 3-undecane-5-pentafluorophenyl-1,2,4-oxadiazole (C₁₁-FOX) and an aryl oxadiazole, 5-methoxyphenyl-3-parafluorophenyl-1,2,4-oxadiazole (Aryl-OX) were synthesized and used to the above aim, leading to the corresponding functionalized biopolymers through a nucleophilic aromatic substitution. Structural and thermal stability analysis were performed to confirm the covalent attachment of the heterocyclic moieties onto the cellulosic skeleton. Their adsorption performance against various organic pollutants in aqueous solutions was evaluated after embedding the functionalized biopolymers into sodium alginate hydrogel beads, demonstrating their potential for broad-spectrum wastewater treatment.

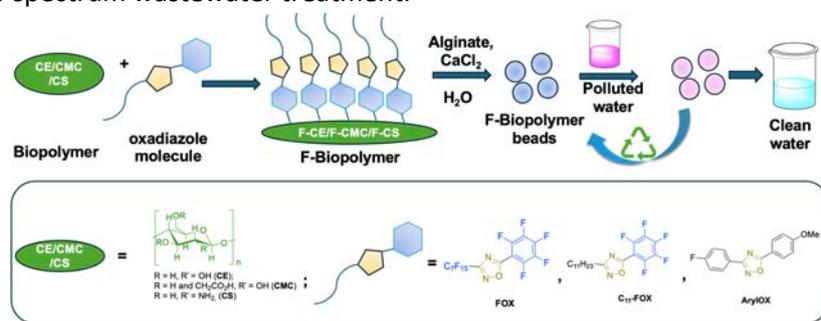


Figure 1: schematic representation of biobased polymers functionalization and application.

References:

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