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Abstract Formulary

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Title: Wood-based cryogels as adsorbents for pharmaceutical pollutants

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ABSTRACT (Space limited to 2200 characters)

A global challenge for achieving sustainable and safe water resources is the persistence of organic micropollutants, such as pharmaceuticals, in aquatic environments. One of the strategies to address this problem is to efficiently remove pharmaceuticals from wastewaters.

In this study, adsorption utilizing wood-based cryogels as adsorbents was considered as a simple wastewater treatment method to address pharmaceutical pollution. Wood-based cryogels from cationic cellulose nanofibrils (cCNF) and lignin nanoparticles (LNPs) were developed and their adsorption potential towards diverse types of pharmaceuticals was investigated. LNP-decorated nanocellulose cryogels with increasing amount of LNPs were produced by freeze drying. The cryogels were characterized for their morphology, surface charge density, and mechanical properties. Batch-equilibrium adsorption was performed and the concentration of residual pharmaceuticals in water was analyzed by ultra-high-performance liquid chromatography.

The cryogels showed large interconnected pores, with LNPs randomly distributed on the pore walls. They had a net positive surface charge, which decreased with increasing LNP content. The addition of LNPs increased the resistance of the cryogels towards compressive deformation and improved their springiness. The findings showed that the LNP:cCNF mass ratios influenced the adsorption capacity of the cryogels towards different pharmaceuticals. In general, the addition of LNPs improved the removal of a wide array of pharmaceuticals including the anionic aromatic diclofenac, cationic aromatic metoprolol and tramadol, and neutral aromatic carbamazepine. LNP addition was deduced to provide hydrophobic and amphiphilic character to cCNF cryogels, enabling them to remove pharmaceuticals with different ionic characters. However, the adsorption potential for highly polar metformin and acetaminophen did not increase. Overall, the study demonstrated a green approach by using LNPs to functionalize nanocellulose cryogels.