19th CONFERENCE ON SUSTAINABLE DEVELOPMENT OF ENERGY, WATER AND ENVIRONMENT SYSTEMS

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BOOK OF ABSTRACTS

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The Potential of Wood-Based Hydrochar for Simultaneous Removal of Pharmaceuticals from Wastewater: Kinetics and Efficiency

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Abstract

The presence of pharmaceuticals in aquatic environments has gained attention due to their bioactive nature and potential to induce adverse ecological and health effects at trace concentrations. Common drugs such as antibiotics, analgesics, and hormones are frequently detected in urban wastewater effluents and water bodies, raising concerns because of bacterial antibiotic resistance, endocrine disruption, and long-term exposure effects. Since traditional wastewater treatment is inefficient in removing pharmaceuticals the European Commission proposed upgrading the treatment processes. Among the advanced treatment technologies adsorption on activated carbon attracts significant research interest. Despite the excellence of its performance, the necessity for environmental protection and greener remediation led to the search for cheaper biosorbents. This study focuses on the adsorption kinetics of pharmaceutical compounds on a wood-based hydrochar (HC) and the removal efficiency from real wastewater. Hydrothermal carbonization of wood sawdust (beech/oak mixture) was performed in a commercial reactor at a fixed temperature (300 °C), a fixed residence time (165 mins), a solid/liquid mass ratio of 1/10, and a pressure of 20 bar. A synthetic mixture of 35 compounds with an initial concentration of each compound of about 50 μg/l was prepared in ultra-pure water. Batch adsorption experiments were performed by mixing 0.5 g of HC with 500 ml of the synthetic mixture on a magnetic stirrer for 24 hours. At different time intervals, 1 ml of the mixture was taken with a syringe and filtrated through a PTFE syringe filter with a pore size of 0.22 μm. The residual concentrations were determined by UHPLC–MS/MS. Batch adsorption experiments were also performed under the same conditions in real wastewater samples and compared to commercial granulated activated carbon (GAC). The adsorption process was fast for most of the compounds. For diltiazem, it took only 20 min to reach the equilibrium, while for the propranolol it took 60 min, and for losartan 360 min. Some of the compounds did not reach the equilibrium even after 24 h. For diclofenac acid, diltiazem, furosemide, losartan, propranolol, and ranitidine (out of 10 compounds found in real wastewater) HC showed a removal efficiency of around 99%. It was more efficient than GAC for removal of diltiazem and furosemide, and less efficient for atenolol, HTCZ, and sotalol. The results indicate that HC has great potential for removing pharmaceuticals from wastewater as an eco-friendly substitution for activated carbon.