P1.38

Valorisation of tuna bone waste through its application for the removal of persistent pharmaceuticals from water matrices

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Abstract

The access to safe and clean water is a critical issue faced by our society. One of the major problems is the presence of contaminants of emerging concern (CECs) in water bodies. CECs include pollutants with poor removal rates in wastewater treatment plants, causing adverse effects on ecosystems and humans. Within CECs, pharmaceuticals received increasing attention due to their continuous release into aquatic environments. Therefore, innovative and sustainable solutions to address this problem are needed.

In this work a material for pollutants adsorption was developed from fish bones (tuna), a by-product of the food industry. The powdery material was obtained by pyrolysis of the bones, leading to tuna bone char (TBC), a composite of hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$) and graphitic carbon. The capacity of the TBC to adsorb tramadol (TRA) and venlafaxine (VNF), two pharmaceuticals increasingly detected in the environment, was evaluated. The batch adsorption assays were performed in different aqueous matrices, some simulating real wastewater with different salinity levels (up to 12 g/L).

The results show that TBC can be successfully applied for the adsorption processes of persistent pharmaceuticals, with the salinity levels affecting the efficiency of the removal. Overall, the work presents an alternative strategy for the removal of pharmaceuticals from aqueous matrices whilst contributing for mitigating the solid waste generated by the fish industry.

Acknowledgments

This work was financed by Norte 2020 through Project 3BOOST (POCI-01-0246-FEDER-181302) and the FCT project UIDB/50016/2020. C. Miranda thanks the research grant from FCT, Portugal (2020.06577.BD) and POCH. C. Piccirillo and F. Scalera thank the project PON-SHINE (Potenziamento dei nodi italiani in E-RIHS, CIG: Z902D25DCE, CUP: B27E19000030007).

Keywords

Bone char, Contaminants of Emerging Concern, Circular Economy, Wastewater Treatment