Engineered activated carbons for improved recalcitrant pharmaceuticals removal during urban wastewater treatment: LIFE Impetus project

Ana S. Mestre[a]*, Marta A. Andrade[a], Rui M. C. Viegas[b], Elsa Mesquita[b], M. Campinas[b], Maria João Rosa[b], Ana P. Carvalho[a]

[a] *Centro de Química e Bioquímica and Centro de Química Estrutural, Faculdade de Ciências, Universidade de Lisboa, 1749-016 Lisboa, Portugal*

[b] *Water Quality and Treatment Laboratory, Urban Water Unit, Hydraulics and Environment Department, National Civil Engineering Laboratory (LNEC), Av. Brasil 101, 1700-066 Lisboa, Portugal*

*Corresponding author: asmestre@fc.ul.pt

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The improvement of pharmaceutical compounds (PhCs) removal during wastewater treatment is the smartest option to avoid their release into the environment, since conventional treatments fail to control several PhCs that end up in recipient water bodies. LIFE Impetus project (LIFE14 ENV/PT/000739) aims to tackle this problem by developing and testing novel powdered activated carbons (PACs) for improved control of PhCs in urban wastewater treatment plants (WWTPs) with conventional activated sludge (CAS) treatment.

PAC adsorption is one of the best available technologies for PhC control, yet its cost-efficiency and sustainability calls for environmental-friendly PACs and process design in a circular economy framework. Novel PACs were prepared using locally available biomass and were benchmarked against commercially available products for the competitive adsorption of a short-list of representative PhCs in synthetic inorganic matrix and in spiked secondary effluents (100 μg/L). The target PhCs were selected considering their worldwide occurrence and persistence in CAS-WWTP effluents, results validated in the two LIFE Impetus plants, and diversity in adsorption key-properties: carbamazepine (neutral, hydrophobic), diclofenac (anionic, relatively hydrophobic) and sulfamethoxazole (anionic, hydrophilic).

A pine nut shell derived PAC obtained by steam activation (PNS77) proved to be the best performing material for the target PhCs and organic matter control, with the highest adsorption capacity and rate both in synthetic and in real wastewaters. Further, by modeling the lab results with the HSDM, it is shown that 80% removal of the target PhCs would be achieved dosing 10 mg/L PNS77 to the CAS bioreactor.