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Eco-Friendly Strategies to Regenerate Cyclodextrin-Based Adsorbents

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Extended Abstract

The daily use of chemical compounds for domestic, hospital, agricultural and industrial purposes has inevitably led to their release in water, creating great concern among the scientific community regarding their impact on the ecosystem and human beings. In particular, great attention is focused on the "emerging pollutants" (EPs), which include pharmaceuticals, personal care products, illicit drugs, pesticides, preservatives, surfactants, plasticizers, flame retardants, etc., which are not currently subject to routine environmental monitoring programs nor emission control regime. These substances might be subject to future legislation due to their adverse effect on the environment and human health. Indeed, EPs present suspected mutagenicity, teratogenicity, and carcinogenicity to humans and other animals, and many of them are recognized as endocrine disruptors.

Conventional water treatment techniques, such as biological processes, filtration, coagulation/flocculation, and sedimentation, present limits in the removal efficiencies of EPs. A valuable and promising alternative to remove EPs from treated and wastewater is adsorption, thanks to its high efficiency, low cost, and simplicity of integration into existing Waste Water Treatment Plants. In this contribute we report the results of a study on the use of a water-insoluble cyclodextrin-epichlorohydrin polymer (β-EPI) to remove, by adsorption, Sulfamethoxazole (SMX), chosen as EP model molecule, from water [1,2].

In this study environmentally, friendly treatments were also developed to promote the release of EPs from the adsorbent in order to obtain the regeneration of it, according to one of the objectives of the European Project Life "Clean up" (LIFE 16 ENV/ES/000169).

This β-EPI polymer, already tested as adsorbent for other pollutants, is not only capable of removing effectively SMX by adsorption with short contact times but it is also easily regenerated using a 0.5 M solution of sodium bromide without any loss in the adsorption performance or using hot water at 353 K, obtaining a material that is also more efficient in subsequent adsorption/desorption cycles. As an alternative to desorption, adsorbent material could be regenerated by using advanced oxidation processes for the photolysis of adsorbed SMX. The cost-effectiveness of this polymer, compared to other materials like activated carbons, together with its adsorption capacity, large removal rate, wide spectrum of action, robustness and reusability makes this material interesting for practical applications in waste water treatment in agreement with principles of Circular Economy.

References

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