Comparing the Efficiency between Living and Non-Living Macroalgal Biomass for Removing Classical and Emerging Contaminants from Complex Mixtures

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Extended Abstract

Due to their relevance to the European economy, combined with a high supply risk, the Rare Earth Elements (REEs) are classified as Critical Raw Materials (CRMs) – crucial for a wide range of emerging low carbon technologies, such as hybrid and electrical cars, wind turbines and high-performance batteries. As their use and demand continue to raise, with associated low recycling rates, larger volumes of waste rich in these elements are expected to be generated and accumulated in marine ecosystems [1,2].

Biosorption has been gathering attention as a feasible, economic, simple, and more environmentally friendly alternative for the remediation of contaminated waters from classical and emergent contaminants [3]. Macroalgae are among the biosorbents with high bioremediation potential. Previous studies using living macroalgal biomass have advocated this as the most effective approach over non-living biomass for REEs removal. [4,5] However, a direct comparison of their efficiency has not yet been addressed for REEs, nor for complex mixtures. Therefore, the present study focused on a mixture that intended to mimic effluents or contaminated waste streams from industries producing, for example, fluorescent lamps or from mining activities. A comparison between the efficiency of the simultaneous uptake of Y, La, Nd, Eu, Gd and Dy (REEs) from an equimolar mixture also containing the classical contaminants Hg, Cd, Pb and As by *Ulva lactuca* and *Gracilaria gracilis* applied as living and non-living biomass was evaluated. Batch sorption experiments were run for 72 h, at previously optimized values of salinity (10) and pH (7.8 – 8.0) by contacting 5 g of living macroalgae, or the corresponding dried mass, with natural seawater spiked with the contaminants under study, at 800 rpm. As and Cd were always less removed from the solution, while the REEs, Hg and Pb were removed, generally over 80 % for living biomass. Therefore, the affinity of the sorbent appears as Hg > lanthanides and Pb > As and Cd. However, for non-living biomass, the removals for REEs were significantly lower, in general, under 40 %. The most effective method to remove REEs and classical contaminants simultaneously turned out to be the application of living biomass, however, the combination of both forms of biosorbent could enable some separation of the metals under study in real contamination scenarios. Regarding the time of the exposure of the biosorbent to the metals under study, despite the application of non-living biomass allowed a faster process, living biomass achieves higher values of removal.

References

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