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Biochars of dead *Posidonia oceanica* leaves as adsorbents of rare-earth elements

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The widespread use of Rare earth elements (**REE**) in cutting-edge technologies has led to a surge in their consumption and the urgency of finding sustainable solutions for their recovery.[1] The European Community included REE in the list of critical raw materials, i.e. the list of materials whose recovery is considered of strategic interest.[2] Among the different REE recovery methods, adsorption is one of the most attracting, in particular when the employed adsorbents come from waste platforms.[3] This contribution presents the results achieved using three biochars coming from the pyrolysis of dead *Posidonia oceanica*, a marine plant whose leaves accumulate in abundance on the sicilian cost, as adsorbents of REE from aqueous solutions. To this end, thermodynamic and kinetic experiments were carried out to study the recovery of La, Nd and Dy ions onto the biochar of *Posidonia oceanica* as it was (**BC**) and after two types of chemical activations, i.e., an acid activation with phosphoric acid (**BCA**) and a basic activation with potassium hydroxide (**BCB**) in aqueous solution at pH = 5 and t = 25°C. The adsorption of REE ions onto BCA, the best adsorbent among those investigated, was also studied, at the same pH, in $NaNO_3$ 0.1 mol L^{-1} to evaluate the effect of ionic strength. Single batch adsorption experiments were also carried out at pH = 3 and 6 to evaluate the effect of pH. Chemical and morphological characterization of adsorbents were carried out by SEM-EDX, FT-IR, elemental analysis, nitrogen adsorption/desorption and pH of point zero charge measurements. The REE adsorption were well described by Langmuir isotherm and, among the adsorbents investigated, the BCA showed the highest q_m value. The q_m of BCA decreases with the decreasing of pH and in presence of $NaNO_3$. The adsorption equilibrium was reached within 8 hours and the kinetic of adsorption was well described by the double exponential equation. Recycling experiments were also carried out to test the reusability of the BCA.

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