TESTING BIOCHAR AS SORBENT TO DECREASE SAMARIUM MOBILITY IN CONTAMINATED AREAS

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Samarium (Sm), a rare earth element of lanthanides group, is an emerging contaminant that has been found in wastes resulting from agricultural and industrial activities, especially in China. There are many evidences of watersheds that, due to contamination by industrial wastes, specially mine tailings, contain Sm at high concentration levels, such as the case of Baotou Area containing up to 130 μg Sm L^{-1} (1). Besides, some works have also reported that the Sm concentration in lands treated with rare earth-rich fertilizers or irrigated by the abovementioned contaminated water sources is abnormally high, e.g., 492 mg kg^{-1} in Bayan Obo (2). This concomitant soil contamination is also of special concern since soils can act as sink of Sm that can be further incorporated in the food chain or reintroduced into water sources due to irrigation and raining processes. Biochars are increasingly being considered as sorbents for the removal of inorganic pollutants from contaminated waters (Doumer, 2016), but also as soil amendments as they may have a high sorption capacity for several inorganic pollutants, and they are also low-cost materials that may improve soil properties as water holding capacity, nutrient status and pH. However, secondary effects on soil solution composition, as the increase in the dissolved organic carbon (DOC), jeopardize their application for several pollutants, such as heavy metals forming soluble chelates with organic matter compounds. Moreover, biochar will decrease contaminant mobility in soils only when the sorption capacity of biochar exceed that of the soil in various orders of magnitude, considering the low dose (often lower than 10% w/w) with which they will be applied. Therefore, laboratory assays are required to assess the sorption properties of a biochar before using it at field level as soil amendment or as sorbent for water filtration. In the case of lanthanides, there are scarce data on their mobility in soils and on their sorption by biochars. In this work, we examine the capacity of a set of biochars of varying pH and DOC, to sorb Sm, as representative for lanthanide pollutants, in a wide range of Sm concentrations. Biochar concentration-dependent sorption capacities were compared with those of activated charcoal and of a by-product from the metallurgical industry (coal fines). Results indicated high sorption capacities at low Sm concentration range (up to distribution coefficients of 10^4 L/kg), with desorption rates lower than 1%. Distribution coefficients of Sm in biochar significantly decreased when increasing Sm concentration levels, indicating saturation of the sorption sites of the material with maximum sorption values very similar to the cation exchange capacity of the biochar and suggesting that the main interaction mechanism was cation exchange. The implications of the use of biochars in soil remediation actions as well as in the treatment of contaminated waters are also discussed.

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