Electrokinetic remediation of heavy metals from a contaminated marine dredged sediment from a European port

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Introduction: Dredged marine sediments are often contaminated with a wide variety of pollutants, such as heavy metals and organic compounds, due to improper management or to industrial activities. This complicates their reuse and contributes to a loss of biodiversity and degradation of the ecosystems, implying also a risk for humans due to the transfer of contaminants to the benthic food chain [1]. Despite decades of research in the development of different methods to decontaminate sediments, there is still not an established method to decontaminate sediments. The electrokinetic technology is one of the most promising methods used in research to remediate sediments, owing to its advantage of extracting both heavy metals and organic compounds. It relies on the application of a low-intensity electric field directly to the material [2]. Basically, the electric field mobilizes ionic species from the material towards the electrodes due to electromigration, where they are collected. On the other hand, non ionic species can be transported due to electrokinetic phenomena, as electroosmosis and electrophoresis.

In this work, different trials were carried out to check the effectiveness of different electrolytic solutions in the removal of heavy metals and the interactions between the pollutants and the material, in order to develop the most suitable treatment for this sediment. Different enhancing solutions were equilibrated with the sediment in order to find the most effective solution to test with the sediment for its remediation in future research.

Methods: A dredged contaminated sediment from a European port was fully characterized and electrokinetic remediation trials were carried out. The decontamination experiments were performed by using the Electroosmotic Cell Device (ECD) described in [3]. Provided that the sediment is contaminated with both heavy metals and organic compounds, the effectiveness of different electrolytic solutions (distilled water and acetic acid) was tested to remove electrokinetically heavy metals and organic compounds. Furthermore, equilibrium tests of enhancing solutions of different nature (distilled water, acetic acid, citric acid, EDTA, oxalic acid, nitric acid, potassium iodide and sodium hydroxide) with the sediment were performed to determine the behaviour of each with the sediment.

Results and discussion: This study shows that there is not just one enhancing solution as the best universal one for all the metals in the sediment and there are several solutions that should be tested as electrolytic solutions in order to reach a whole decontamination. Design of the remediation process should incorporate the particularities of the different contaminants in their interaction with the extracting solutions and the characteristics of the sediment.

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