Application of bioelectrochemical systems for the remediation of a historically contaminated marine site in Chile

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Microbial electrochemical technologies may be a suitable strategy for the bioremediation of petroleum hydrocarbons-polluted sediments, by overcoming the electron acceptor limitation because of the presence of an inexhaustible electron acceptor. In this work, BESs-based experiments were conducted to evaluate the bioremediation under anaerobic conditions of chronically petroleum hydrocarbons-polluted sediment of a brownfield in Viña del Mar (CHL). Three BES-based approaches were set up at a laboratory scale, including a microbial fuel cell, a microbial electrochemical cell, a microbial electrochemical snorkel (Closed Circuit, Pol-MERC, Snorkel) and ran in parallel with controls (Open Circuit, Natural Attenuation). These technologies were combined with the addition of compost to the sediment matrix. Even though the biodegradation of hydrocarbons was very low in the first 42 days of treatment, the sequencing of the 16S rRNA gene on metagenomic DNA showed a clear differentiation of the microbial community that was established on the anode from the ones on the cathode and in the sediment. On the anode of each system, there was an enrichment in genus of the Geobacteraceae family, known to be electrochemically active bacteria and hydrocarbon degrading bacteria. The Snorkel configuration showed the greatest enrichment, while the anode of the Open Circuit acted only as conductive support for the growth of these microorganisms. Chemical analyses suggest that probably sulphate reduction at the beginning of the experiment, and iron (III) reduction close to the anode after 42 days of treatment, are the main terminal electron-accepting processes in the systems. The systems stimulated the growth of anaerobic biofilm, starting point for the stimulation of anaerobic hydrocarbon degradation.