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BIOREMEDIATION OF HARBOUR SEDIMENTS CONTAMINATED WITH ORGANIC COMPOUNDS: MICROBIAL RESPONSE AND BIODEGRADATION EFFICIENCY

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Abstract

The management of contaminated dredged sediments is a widespread problem and there is a urgent need to develop low cost and environmental friendly strategies able to reduce the concentrations of pollutants at levels which can allow the sediment re-use. Such a need is exacerbated for contaminated harbour sediments periodically dredged to maintain the navigable depths. In this study we carried out different bioremediation experiments on dredged harbour sediments contaminated with hydrocarbons and organotin compounds (mainly tributyltin). In particular we investigated the effects of nutrient amendments (inorganic vs organic compounds), temperature (20°C vs 35°C) and redox conditions (aerobic vs anaerobic) on the metabolism, diversity and composition of bacterial assemblages in relation with their biodegradation performance. The nutrient amendments to the sediments significantly stimulated the growth rate of the microbial assemblages leading to an enhanced biodegradation of hydrocarbons. Similarly a higher temperature determined a significant increase of bacterial growth rates both in aerobic and anaerobic conditions. However, whereas in aerobic conditions this was associated with a significant increase of the degradation rates of hydrocarbons, in anaerobic conditions a significant decrease of hydrocarbon degradation rates in nutrient-enriched systems was observed. Although tributyltin (TBT) was more refractory to biodegradation than hydrocarbons, an increase of the concentrations of its congeners (i.e. DBT and MBT) was observed in a relatively short timescale of bio-treatment (few weeks). Independently by the experimental conditions significant changes of the biodiversity and composition of the bacterial assemblages (determined by different molecular tools) were found together with higher biodegradation performance associated with higher biodiversity levels. Overall our findings suggest that bioremediation strategies able to maintain over time high metabolic rates and high diversity levels of the bacterial assemblages can improve the effectiveness of the bio-treatments on dredged sediments contaminated with different types of organic pollutants.