

In situ electrokinetic treatment pilot test of petroleum hydrocarbon contaminated marine sediment

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Introduction: The *in situ* electrokinetic method is a remediation method that has been used successfully in treating petroleum hydrocarbon polluted soils. The method uses electric current to remove contaminants and is based on various electro-chemical processes e.g. electro-osmosis, electrophoresis and electromigration. In this work a pilot-scale test was conducted to assess the effectiveness of the electrokinetic method in treating petroleum hydrocarbon polluted marine sediments *in situ*. The pilot-test was carried out in Töölönlahti Bay in Helsinki, Finland. The sediments in Töölönlahti Bay have been polluted by industrial and municipal wastewaters and contain elevated concentrations of petroleum hydrocarbons and polycyclic aromatic hydrocarbons (PAHs).



Fig. 1: Sediment sampling conducted close to the platform connected to the remediation equipment.

Methods: The pilot-scale *in situ* treatment was tested using three replicate treatment plots and three replicate control plots. Treatment plots consisted of floating anchored platforms connected to the remediation equipment (Fig. 1). On each platform there was a control box that controls 16 electrodes, which were installed 2 m deep in the sediment, creating a 5 x 5 grid. Constant electrical current of total maximum 800 W was applied to each treatment area. The effectiveness of the remediation process was assessed by sampling the sediment in the treatment and control plots. Chemical analyses included petroleum hydrocarbons (fractions C10-C21 and >C21-C40) and

PAH compounds. In addition, effects of the treatment on microbiological activity and community composition were analysed with DAPI staining, quantification of petroleum hydrocarbon degradation genes by qPCR and 16S rRNA sequencing for identification of microbial community composition.

Results: Preliminary results show that petroleum hydrocarbon concentrations (fractions C10-C40) varied between 500-2500 mg/kg (dw) in all of the experiment plots and control areas. Some degradation of petroleum hydrocarbons C10-C40 could be observed temporarily in area 2 and most clearly in area 3, but this has not been confirmed as statistical analysis is not yet finished. In experiment plot 1, there was so far no clear trend of reduction in C10-C40 petroleum hydrocarbons in sediment. PAH sum concentrations were between 5-14 mg/kg (dw). Further analysis of data will be conducted using a linear mixed effects model taking into account between and within plot variation and dependence of temporal replicate results in measured parameters.

Discussion: So far it is difficult to make clear conclusions on the effects of the treatment, due to large variation in the sediment between the test plots. The results show so far that electrokinetic treatment may enhance degradation of petroleum hydrocarbons in one of the plots, but not in the other two plots.

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