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Resistivity imaging during electrokinetic remediation of sediments: practical challenges in the field

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The use of geophysical techniques such as electrical resistivity and impedance tomography have proven to be effective for the investigation and monitoring of a variety of environmental processes.
This study investigates the possibility of using resistivity imaging to monitor the progress of electrokinetic remediation, a decontamination process based on electrochemical methods.
The resistivity is a parameter of great theoretical and practical interest. On one side, resistivity is strictly related to the pore fluid composition and provides information about the chemical state of the material subjected to remediation. On the other side, knowing the evolution and distribution of resistivity is of practical importance both at the design stage and during operation because it directly affects the electrical energy expenditures.
Monitoring of electrokinetic processes both in laboratory and in field is usually carried out by point measurements and sample collection from discrete locations. Resistivity imaging is effective in providing low-cost, non-destructive, high space and time resolution mapping.
During electrokinetic remediation an electric field is applied to the contaminated matrix to extract the pollutants. In the field, array of electrodes are generally employed to apply the electric field, arranged in a two-dimensional grid. The electrodes are installed inside wells to allow the circulation of electrolytes employed to enhance the extraction of the pollutants.
In this study we describe the practical challenges both in the measurements and in the data processing encountered during the tomographic imaging of marine sediments subjected to electrokinetic remediation in a 150 m3 ex-situ treatment plant.
In such system there are a number of constraints to overcome in order to obtain an effective tomographic image of the sediments: (1) the electric field applied for remediation cannot be powered off, thus this field represents the source for current injection for the resistivity measurements, (2) the applied electric field signal is irregular and noisy because it is generated by high power current regulators, (3) the environment is extremely corrosive and special care must be taken choosing the electrode material, (4) a number of disturbances, such as the influence of the wells and pipes on the electric field distribution must be taken into account, (5) the electric field is generated by all the electrode couples operating simultaneously (the current injection is produced by multiple electrodes).