Integrated Approaches for Enhancing the Efficiency and Applicability of Electro-Kinetic(EK) Remediation Technology

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Remediation of contaminated groundwater and geoformations has been one of the challenging issues in the field of geo-environments. Low cost, low environmental impact and high efficiency are basic requirements for any remediation technologies. Although a few technologies are available for immobilizing heave metals in geoformations, in situ removal of heavy metals from groundwater and/or geo formations is very difficult due to strong adsorption, low mobility and/or various interactions within geoformations. A so called pump-and-treat method is applicable only for the geoformations having high permeability and low adsorption. For remediation of low permeability geoformations, the only perspective technology is Electro-Kinetic (EK) method. Although a lot of bench scale laboratory experiments, mostly on ideal soil samples like kaolinite and illite, practical applications of the Electro-Kinetic method in the field are still in the stage of trial experiments due to the lack of fundamental referable data for the design, low recovery rates, high cost for commercialized electricity, and/or unacceptable long periods for remediation.

To enhance the efficiency and applicability, and to decrease environmental impact associated with using the Electro-Kinetic (EK) Remediation technology, integrated approaches and considerations have been proposed in this study. The integrated approaches and considerations include 1) the use of a portable GPS together with XRF (X-ray Fluorescence) for a quicker mapping of pollutant concentrations; 2) electrical resistivity tomography for investigating distribution of electrical resistivity as well as indirect judging of geological structure of polluted geoformation; 3) development of a large scale modeling test system for examining the applicability of Electro-Kinetic method for a specific soil to be remediated in situ; 4) the use of natural, clean energy, like solar cells, to decrease the cost of using commercialized electricity and to increase the applicability at sites where commercialized electricity is not available; 5) recover heavy metals in deposited forms for possible use of them.

Practical examinations of the items illustrated that 1) in situ mapping is efficient and helpful for screening out the areas that need to be remediated; 2) electrical resistivity tomography can provide useful information for judging structure boundaries of geoformation and for predicting electrical current during Electro-Kinetic (EK) remediation; 3) different phenomena may occur between laboratory and in-situ experiments due to boundary conditions. This may affect practical design for the Electro-Kinetic (EK) technology; 4) the use of solar energy is convenient. Total cost efficiency can be obtained due to the durability of solar cells; 5) heavy metals deposited onto the electrode plate can be visible, and thus can be recovered as resources.