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# Finite Difference Modeling of Electro-kinetic Process to Remove Lead from Kaolinite

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**Abstract**

A numerical analysis on Electrokinetic (EK) soil remediation process on lead (Pb) was studied. The equation that describes the (EK) is advection-diffusion form of Partial Differential Equation (PDE) that was solved numerically by Finite Difference Method (FDM). The prediction of mathematical model had a good agreement by experimental test for Pb(II) concentration and soil pH along the soil specimen expect near the cathode compartment this phenomena caused by chemical reactions. In mathematical model the constant retardation factor was used and the precipitation reaction and water auto-ionization reaction was neglected. The adsorbed and precipitated Pb(II) was increased when the pH of soil increased and this phenomena occurred near the cathode compartment when acid and base front meet each other and exactly in this area the rate of water auto-ionization increased and the pH prediction had difference by experimental work. In our study was showed that the effect of precipitation and adsorption reaction had a significant effect on removal of contamination and for improve the process for removal cationic contamination the pH of soil specimen soil should keep low.

**Keywords: Pb(II), Electrokinetic, Finite difference, kaolinite.**

## 1. INTRODUCTION

Polluted soil by heavy metals, organic pollutant and radionuclides are the common pollutants in the soil. Lead is in range of cationic heavy metal and dangerous for human health. Lead is present in uncontaminated soils at the range of 10– 84 mg/kg (worldwide means) [1]. For preventing spreading out the pollutants into the other part of soil some methods for soil remediation are used and EK are mainly used for heavy metal pollutant [2]. In EKR, the contamination transports to opposite electrode using Direct Current (DC). The anionic contaminations transport into anode and cationic contaminations transport into cathode. In addition, lead is the least mobile heavy metal in soils, especially under reducing or nonacid conditions [3]. Some mathematical studies based on transport of ions in soil under electric field were carried out. Alshawabkeh and Acar (1996) introduced their model to remediate lead [4]. They considered the chemical reaction (water auto-ionization, precipitation and adsorption) using algebraic equations. Jacobs et al. (1994) used numerical method for zinc contamination and applied a set of algebraic equations for chemical reaction [5]. Kim et al. (2003) developed a model for cadmium and also Kim et al.(2004) generated another model for Lead. In both models they consider the effect of chemical reaction by set of algebraic form of equations but they put constant electric field in their model [5,6]. Park et al. (2003) studied the process of EK on phenol and in their work they introduced an equation for calculating pH in anode and cathode reservoir as the boundary condition [7].

In this Study the Lead concentration and pH into the soil specimen was simulated by numerical analysis. The model is validated by experimental data in literature [3].

## 2. Description of EK theory

The equation which describes the Electrokinetic soil remediation is an advection-diffusion form. The advection –diffusion is a partial differentiate equation (PDE). The PDE consist of four terms which are: 1-ion-migration 2-electro-osmosis 3-diffusion. 4-The electrophoresis.The electrophoresis was neglected in