Enhanced Electrokinetic Remediation of Heavy-Metals Contaminated Soil in presence tetrasodium N,N-bis(carboxymethyl) glutamic acid (GLDA) as chelator

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Electrokinetic remediation (EK) is an emerging method that is used to decontaminate soil contaminated with heavy metals. Heavy metal removal rates can be enhanced by applying chelators to the soil; however traditional chelators have shortcomings, such as poor biodegradability (EDTA, DTPA, etc.), high cost (EDDS, etc.), and low complexing abilities (citric acid, NTA, etc.). In this study, we used tetrasodium N,N-bis(carboxymethyl) glutamic acid (GLDA), a novel and cheap biodegradable chelator to enhance the electrokinetic remediation of a heavy metals-contaminated soil. The batch extraction experiments used three types of biodegradable chelators (lactic acid, citric acid, and GLDA) and four EK tests (T1: catholyte controlled at pH 4 without GLDA; T2: only GLDA; T3: bipolar electrolyte controlled at pH 6 with GLDA; T4: cation and anion exchange membranes with GLDA) were conducted. The batch experiments showed that the Cu and Ni extraction rates for GLDA (39% to 48%) were higher than for citric acid (26% to 41%) and lactic acid (0.44% to 25%), and the solution pH had little effect on the GLDA extraction rate. The EK experiments showed that the T3 and T4 treatments had little effect on soil pH and EC. However, T1 greatly decreased soil pH and increased soil EC. A total of 12.9%–20.1% Cu and 24.8%–27.7% Ni were removed from the soil after 8 days of the T3 and T4 treatments. Those removal rates were higher than those obtained with the T1 and T2 treatments. The total Cr removal rates in all treatments were very low (1.55% to 5.70%), which could be due to the high percentage of the residual Cr form. The results for energy consumption indicated that T4 had the lowest energy consumption (19.3 kWh t⁻¹). Therefore, installing cation and anion exchange membranes could increase Cu and Ni removal rates and decrease energy consumption. Furthermore, GLDA could potentially be used during the EK remediation of soil contaminated with heavy metals.

Keywords: Electrokinetic remediation; GLDA; Heavy metal; Ion exchange membrane; pH control

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