

EDTA Removal of Heavy Metals from Contaminated Soils Using Column Leaching Experiments (Continuous and Pulse Modes)

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Abstract

Consequences of heavy metal accumulation in soils are of great concern. One way of decontaminating heavy metals from soils is using chelating agents, particularly EDTA. In this research, three contaminated soils (with total concentration of these metals of 10.5, 55.8 and 80.6 mmol kg⁻¹) were collected from the surface layer of the lands surrounding a zinc-lead smelting plant in Zanjan province. The extent of Zn, Pb and Cd release by Na₂H₂EDTA (100 mmol kg⁻¹ of dry soil) from these soils in column leaching experiments (both continuous and pulse addition methods) assembled into half of saturated hydraulic conductivity was assessed. In preliminary experiments, the leaching was stopped due to a drop in hydraulic conductivity. Therefore, the continuous addition method was performed with calcium nitrate as the background solution and the pulse addition method was conducted using this background solution coupled with pH adjustment to 8. Based on the results, the percentage removal of Cd as well as Pb was relatively the same for the two addition methods while the removal of Zn was 13% on average higher in the continuous addition method than in the pulse addition method. For both methods, the removal efficiencies followed the order of complex stability constants (as Pb>Zn>Cd) in a limited concentration range of EDTA to complex heavy metals. Furthermore, in contrast to Cd and Pb, a direct linear relationship was found between the percentage removal of Pb and its total amount in the soils. Surprisingly, the Pb concentration was on average only about one-twentieth of the Zn concentration. The breakthrough curves of both methods showed the mobility order of Cd>Zn>Pb. In general, it seems that the removal pattern of soil heavy metals is dependent not only on the soil type but also on the removal method.

Keywords: Complexation, Continuous column leaching, Decontamination, Pulse column leaching, Soil washing, Zinc-lead smelting plant.

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