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Soil vapor extraction of wet gasoline-contaminated soil made possible by electroosmotic dewatering-lab simulations applied at a field site

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Abstract

© 2017 The Author(s) Purpose: Soil restoration is still mainly carried out ex situ by excavating and replacing the contaminated soil. In situ remediation would reduce the costs of soil transportation and this way, the problem is not merely transferred elsewhere. The present study introduces a field case where the aged, oil-contaminated soil in a former fuel station in Finland was treated in situ sequentially with different methods. Materials and methods: Several approaches, including soil vapor extraction and biostimulation with electrokinetic pumping, were performed in the field. After these treatments, the dense original portion of the soil beneath the gasoline pump location, ca 100 m³, was still contaminated with petroleum-derived volatile organic compounds (VOCs), with concentrations of nearly 10,000 mg kg⁻¹ measured at some hotspots. After a period of electroosmotic water circulation, the electrical field (0.5 V cm⁻¹, DC) was kept connected for 6 months without addition of water, leading to dewatering and warming of the soil. Results and discussion: In contrast to the situation with the original wet soil, VOCs, in lab conditions, were found to volatilize very efficiently from the dewatered soil. When the soil vapor extraction treatment was renewed using perforated tubing installed horizontally at ca 1 m depth in the dewatered soil at the contaminated site, the treatment was efficient and the soil was decontaminated in 5 months. The final VOC concentrations were on average 190 mg kg⁻¹ (n = 13) with the highest value of 700 mg kg⁻¹ at one hotspot. After a risk evaluation, the site was concluded to be sufficiently clean for industrial use. Conclusions: Since with many former fuel stations, the contamination consists of both volatile fractions that are difficult to degrade by biological means and heavier compounds for which biostimulation is often suitable, a combination of different methods may be worth pursuing.

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Keywords

Electrokinetic remediation, Oil hydrocarbon contamination, Soil remediation