A Set of Complete Technological System-Based Soil Washing for the Remediation of a Heavy Metals-Contaminated Site

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Background/Objectives. Contaminated site remediation has gained greater attention in China despite the somewhat lagging development of the regulatory system. An enormous amount of contaminated sites need to be addressed across China, whereas the funding is quite limited. To solve that inherent conflict, it is urgent to establish a sustainable and risk-based remedial approach for contaminated site management, which takes into account a variety of important factors such as future land use, technology, risk and cost.

Approach/Activities. Soil washing certainly is qualified as such a remediation technology, giving its effectiveness in removing soil contaminants and relatively insensitiveness to contaminant type (although soil washing is most suitable for treating sandy soil). Compared to solidification/stabilization which is the most widely used remediation technology in China to treat heavy metals-contaminated soil, soil washing is more advantageous in that it can achieve significant volume reduction of contaminated soil and require much less post-remediation institutional/engineering control measures. In this paper, the feasibility of applying soil washing coupled with separation and stabilization technology in contaminated site remediation has been evaluated, and a comprehensive technological system has been designed based on the evaluation results of the pilot test discussed as follows.

Results/Lessons Learned. The soil from a metallurgical industry disposal site in southern China was sieved into three soil particle size fractions. The concentrations of Pb, Cd, and Zn in the soil increase with decreasing particle size, with the highest levels observed in the < 0.053 mm soil particle size fraction. However, the 1 to 0.25 mm soil particle size fraction had the largest mass loadings of these heavy metals, with the total content of Pb, Cd and Zn being 32.5%, 30.6% and 30.7% Zn, respectively. The large-size fraction (rocks and gravel) exhibited low levels of heavy metals and readily met the remediation standard upon washing with water. The moderately contaminated soil particle size fraction was subject to washing by HCl and rhamnolipid, which resulted in the removal of 85% Pb, 82% Cd, 67% Zn and 24% As from the soil. The most heavily contaminated soil particle size fraction was further treated by solidification and stabilization following washing by hydrochloric acid, ensuring the treated soil would not be determined as hazardous waste. The technical procedure can be optimized by adjusting soil washing parameters (e.g., grading standards, pH, temperature, washing times etc.) for different soil particle size fractions, thereby achieving high treatment efficiency, less energy consumption, and eventually cost reduction.

In summary, the designed technological system can effectively remove heavy metals from the contaminated soil to be remediated, and achieve significant volume reduction, and most importantly, the recycling of the soil after remediation.