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Preface

Numerous polluted sites exist worldwide which pose a significant threat to public health and the environment. The polluted sites include chemical spill sites, industrial sites, and mine tailing disposal sites, among others. Due to improper management of hazardous wastes and accidental spillage of hazardous chemicals, these sites are contaminated with a wide range of contaminants such as heavy metals, organic compounds, and explosives. The development and implementation of low-cost and effective remediation technologies have been the foremost priority for environmental professionals over the past several decades. Despite major research accomplishments to date, there are still technological challenges in remediating the contaminated sites.

This special issue contains peer reviewed papers reflecting current research towards the development of innovative technologies to remediate various sites contaminated with a diverse group of contaminants. Generally, the site remediation technologies may be grouped under containment (capping or encapsulation) technologies, ex situ remediation technologies, and in situ remediation technologies that are based on physico-chemical, biological and thermal approaches. The papers included in this special issue describe technologies such as encapsulation, stabilization/solidification, soil washing, bioremediation, and electro-remediation (or electrokinetic remediation) to address contaminants such as heavy metals (e.g., chromium, lead, copper), organic compounds (e.g., benzene, PAHs), and explosives (e.g., 2,4,6-trinitrotoluene, RDX, and HMX). A risk-based approach to remediation is accepted widely, and the establishment of risk-based remedial goals necessitates the use of contaminant fate and transport models that incorporate the transport processes as well as the geochemical reactions accurately.

The paper by Bulusu et al. proposes a remedial approach to abating the problem of acid mine drainage by grouting and encapsulating the pyrite by alkaline coal combustion by-products (CCBs). The papers by Wazne et al. and Moon et al. present a remedial approach to reduce the toxic hexavalent chromium into relatively nontoxic trivalent chromium in chromite ore processing residue (COPR) using the reducing agents calcium polysulfide and ferrous sulfate heptahydrate, respectively.

Isoyama and Wada present a coupled soil washing and immobilization approach to remediation of heavy metals in different types of soils. Clark and Boopathy evaluate two bioremediation methods, namely, soil slurry reactor and land farming technique for the treatment of soil contaminated with explosives (e.g., 2,4,6-trinitrotoluene, RDX, and HMX). Both methods maintained high bacterial population fairly well and reduced the contaminants.

Electro-based remediation technologies have received great attention from researchers in the recent past. Sarahney and Alshawabkeh demonstrated electrolytic transformation of benzene in groundwater into non-toxic end-products under optimum current density. Schmidt et al. coupled electric current and bioremediation for potential in situ remediation of a difficult soil that is very humid clayey silt, with high organic content, with high plasticity, high electrical conductivity, low hydraulic conductivity, low density, large buffering capacity, and high cation exchange capacity. The study showed the feasibility of injecting nutrients in situ and recommended control of changes in pH caused by the application of electrokinetics. Kimura et al. demonstrate the combined use of the electrokinetic (EK) remediation and a ferrite treatment zone (FTZ) for the remediation of a soil contaminated with copper. Copper is transported by electrokinetic processes into the FTZ where it is ferritized with ferrite reagent in soil alkalified by EK process.

Although electrokinetic remediation is a promising technology to remediate fine-grained soils, the transport processes and geochemical reactions that occur during the implementation of this technology are extremely complicated. This complexity is documented in the papers by Kimura et al., Virkutyte and Sillanpää, and Sivapullaiah and Nagendra Prakash. Specifically, Kimura et al. show the formation and stability of a pH junction and the precipitation and accumulation of a metal hydroxide and metal-EDTA at the pH junction. Virkutyte and Sillanpää focus on strategies to hinder the alkaline front migration in copper contaminated lake sediments. Sivapullaiah and Nagendra Prakash analyzed the electroosmotic flow behavior during electrokinetic extraction of heavy metals in an expansive soil containing montmorillonite.

The role of mathematical models in assessing the risk and effectiveness of remediation cannot be underestimated. Javadi and Al-Najjar state that the current mathematical models are not able to adequately describe the leaching of nutrients through soils, often underestimating the risk of groundwater contam-

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ination by surface-applied chemicals, and overestimating the concentration of resident solutes. They present a numerical model for simulation of the flow of water and air, and contaminant transport through unsaturated soils with the main focus being on the effects of chemical reactions. Comparison of the results of the numerical model with the experimental results shows that the model is capable of predicting the effects of chemical reactions.

In summary, this special issue reflects the recent innovations aimed at remediating contaminated sites in an effective manner and it will be of immense use to researchers, educators, practitioners, regulators, and others who are concerned with the protection of public health and the environment.

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