Hiroshi Hasegawa Ismail Md. Mofizur Rahman Mohammad Azizur Rahman *Editors*

Environmental Remediation Technologies for Metal-Contaminated Soils



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Krishna R. Reddy, Claudio Cameselle

Environmental Remediation Technologies For Metal Contaminated Soils:

Environmental Remediation Technologies for Metal-Contaminated Soils Hiroshi Hasegawa, Ismail Md. Mofizur Rahman, Mohammad Azizur Rahman, 2015-09-28 This book presents a comprehensive and detailed description of remediation techniques for metal contaminated soils derived from both natural processes and anthropogenic activities Using a methodical step by step presentation the book starts by overviewing the origin of toxicants and the correlated comparative extent of contamination to the environment The legal provisions as proposed or applied in different countries are then discussed to explain the global regulatory situation regarding soil contamination and the extent of consequent concern The core part of this publication describes the major techniques for in situ or ex situ treatment of the contaminated soil to meet the regulatory limits Finally risk evaluation is incorporated giving special attention to possible impacts during or after implementation of the remediation strategies The intrusion of metals in soils mostly occurs from various anthropogenic activities e g agricultural practices industrial activities and municipal waste disposal The volumes of metal contaminated soil are becoming greater than before and are ever increasing due to rapid urbanization intensified industrialization and or population booms in certain parts of the world Hence the options previously proposed such as isolation of the contaminated site or movement of the contaminated mass to a secure disposal site after excavation are becoming unsuitable from the economic point of view and instead decontamination alternatives are preferred This book will help readers such as scientists and regulators to understand the details of the remediation techniques available to deal with the soils contaminated by toxic metals Soil and Groundwater Remediation Technologies Yong Sik Ok, Jörg Rinklebe, Devi Hou, Daniel C.W. Tsang, Filip M.G. Tack, 2020-03-23 This book offers various soil and water treatment technologies due to increasing global soil and water pollution In many countries the management of contaminated land has matured and it is developing in many others Topics covered include chemical and ecological risk assessment of contaminated sites phytomanagement of contaminants arsenic removal selection and technology diffusion technologies and socio environmental management post remediation long term management soil and groundwater laws and regulations and trace element regulation limits in soil Future prospects of soil and groundwater remediation are critically discussed in this book Hence readers will learn to understand the future prospects of soil and groundwater contaminants and remediation measures Key Features Discusses conventional and novel aspects of soil and groundwater remediation technologies Includes new monitoring sensing technologies for soil and groundwater pollution Features a case study of remediation of contaminated sites in the old industrial Ruhr area in Germany Highlights soil washing soil flushing and stabilization solidification Presents information on emerging contaminants that exhibit new challenges This book is designed for undergraduate and graduate courses and can be used as a handbook for researchers policy makers and local governmental institutes Soil and Groundwater Remediation Technologies A Practical Guide is written by a team of leading global experts in the field **Environmental Restoration of Metals-Contaminated Soils**

I.K. Iskandar, 2000-09-12 Written by a multidisciplinary group of scientists from around the globe Environmental Restoration of Metals Contaminated Soils provides a summary of the current environmental remediation technology Topics include Physical Chemical processes for in situ remediation by adding amendments for stabilization The mechanics of metal retention and release from soils Chemical remediation method for soil contaminated with CD and Pb The effect of soil pH on the distribution of metals among soil fractions Physical and electrical separation methods for soil remediation Relationship between the phytoavailability and the extractability of heavy metals An overview on environmental restoration of Se contaminated soils Trace elements in the soil plant system under tropical environment The process of metal removal by chelation using amino acids The effects of natural zeolelite and bentonite on the phytoavailability of heavy metals Metal uptake by agricultural crops from sewage sludge treated soils In many cases an integrated approach to the remediation of metals contaminated soil yields the best results Environmental Restoration of Metals Contaminated Soils explores the emerging issues of the biogeochemistry of trace elements in the environment and provides an approach combining elements from biology geochemistry hydrology and soil physics and chemistry **Biomanagement of Metal-Contaminated Soils** Mohammad Saghir Khan, Almas Zaidi, Reeta Goel, Javed Musarrat, 2011-08-30 Heavy metal contamination is one of the world s major environmental problems posing significant risks to agro ecosystems Conventional technologies employed for heavy metal remediation have often been expensive and disruptive This book provides comprehensive state of the art coverage of the natural sustainable alternatives that use a wide range of biological materials in the removal detoxification of heavy metals consequently leading to the improvement of crops in these soils Novel environmentally friendly and inexpensive solutions are presented based on a sound understanding of metal contamination and the roles of plants and microbes in the management of these toxic soils Written by worldwide experts the book provides not only the necessary scientific background but also addresses the challenging questions that require special attention in order to better understand metal toxicity in soils and its management through bioremediation Recent Developments for in Situ Treatment of Metal Contaminated Electrochemical Remediation Technologies for Polluted Soils, Sediments and Groundwater Krishna Soils ,1997 R. Reddy, Claudio Cameselle, 2009-08-04 An unmatched reference on electrochemical technologies for soil sediment and groundwater pollution remediation Electrochemical technologies are emerging as important approaches for effective and efficient pollution remediation both on their own and in concert with other remediation techniques Electrochemical Remediation Technologies for Polluted Soils Sediments and Groundwater provides a systematic and clear explanation of fundamentals field applications as well as opportunities and challenges in developing and implementing electrochemical remediation technologies Written by leading authorities in their various areas the text summarizes the latest research and offers case studies that illustrate equipment installation and methods employed in real world remediations Divided into nine sections the coverage includes Introduction and fundamental principles Remediation of heavy metals and other inorganic

pollutants Remediation of organic pollutants Remediation of mixed contaminants Electrokinetic barriers Integrated coupled technologies Mathematical modeling Economic and regulatory considerations Field applications and performance assessment Unique as a comprehensive reference on the subject Electrochemical Remediation Technologies for Polluted Soils Sediments and Groundwater will serve as a valuable resource to all environmental engineers scientists regulators and policymakers

Remediation and Health Risks of Heavy Metal Contaminated Soils Qi Liao, Mariusz Gusiatin, Weichun Yang, 2024-10-18 Soil is the essential foundation for human survival However soil pollution and environmental problems have become increasingly evident in recent years In particular heavy metal pollution at various sites poses a serious threat to human health and ecological safety becoming a significant social issue worldwide Greener and environmentally friendly remediation technologies coupled with accurate evaluation of the potential risks environmental impact and human health of heavy metals in the soil have become urgently required This Research Topic aims to gather the latest advancements in scientific research and applicable studies on i the potential risk or impact of recently problematic heavy metals such as Sb TI and cases of combined heavy metal pollution ii pollution formation migration and remediation of heavy metal in soil and groundwater iii novel methods to treat and reduce heavy metals in contaminated sites iv environmentally friendly remediation technology such as enhanced bioremediation and in situ remediation and v assessment or modeling of the environmental or human Environmental Soil Remediation and Rehabilitation Eric D. van Hullebusch, David health impact of heavy metals Huguenot, Yoan Pechaud, Marie-Odile Simonnot, Stéfan Colombano, 2020-04-22 This book provides a comprehensive overview of innovative remediation techniques and strategies for soils contaminated by heavy metals or organic compounds e.g. petroleum hydrocarbons NAPLs and chlorinated organic compounds It discusses various novel chemical remediation approaches in situ and ex situ used alone and in combination with physical and or thermal treatment Further it addresses the recovery of NAPLs reuse of leaching solutions and in situ chemical reduction and oxidation and explores the chemical enhancement of physical NAPLs recovery from both practical and theoretical perspectives Also presenting the state of the art in waste assisted bioremediation to improve soil quality and the remediation of petroleum hydrocarbons the book is a valuable resource for students researchers and R D professionals in industry engaged in the treatment of contaminated soils

Phytoremediation of Metal-Contaminated Soils Jean-Louis Morel, Guillaume Echevarria, Nadezhda Goncharova, 2006-06-23 Phytoremediation the use of plants to remediate environmental media is being pursued as a new approach for the cleanup of contaminated soils and waters including groundwater Plant assisted bioremediation sometimes referred to as a type of phytoremediation involves the interaction of plant roots and the microorganisms associated with these root systems to re diate soils containing elevated concentrations of organic compounds These techniques could provide cost effective methods of remediating soils and groundwater contaminated with metals radionuclides and various types of organics with fewer secondary wastes and less environmental impact than would be generated using traditional remediation

methods All plants extract necessary nutrients including metals from their soil and water environments Some plants called hyperaccumulators have the ability to store large amounts of metals even some metals that do not appear to be required for plant functioning In addition plants can take up various organic chemicals from environmental media and degrade or otherwise process them for use in their physiological processes Phytoremediation technologies are in the early stages of development with laboratory research and limited field trials being conducted to determine processes and refine methods Additional research including genetic engineering is being conducted to improve the natural capabilities of plants to perform remediation functions and to investigate other plants with potential phytoremediation applications Large areas in Western and Eastern countries are polluted with heavy metals and radionuclides in natural rural urban or industrial areas Metal Remediation Nitish Kumar, 2024-03-28 Heavy metals in general trace elements are one of the major environmental problems Nowadays increasing environmental and global public health concerns related with environmental contamination by heavy metals are well known Moreover human exposure has risen dramatically because of an exponential increase of their use in several activities such as agricultural industrial technological and urban applications. They are presented in soils water and atmosphere and they are a serious risk for the food chain Approximately 10 million contaminated sites have been reported globally occupying approximately 49 42 million acres of land of which 50% is contaminated with toxic heavy metals This situation warrants immediate attention to limit the introduction of heavy metals into soil systems and to remove the prevailing heavy metals from polluted soils However the majorities of existing heavy metal removal technologies are expensive inefficient or generate secondary pollutants Therefore it is of great importance to develop cheaper environmentally friendly and sustainable approaches including the development of new immobilizing agents to manage and rehabilitate heavy metal contaminated soils In the light of the aforementioned facts this book sheds light on this global environmental issue and proposes solutions to contamination through multi disciplinary approaches and case studies from different parts of the world It addresses sustainable heavy metal contamination remediation strategies using the potential applications of recent biological technology such as biotechnology bioremediation phytoremediation biochar absorbent genetic engineering and nanotechnology approaches This book is of interest to researchers teachers environmental scientists environmental engineers environmentalists and policy makers Also the book serves as additional reading material for undergraduate and graduate students of environmental microbiology biotechnology eco toxicology environmental remediation waste **Electrochemically Assisted Remediation of** management and environmental sciences as well as the general audience Contaminated Soils M. A. Rodrigo, E. V. Dos Santos, 2021-06-15 This book provides an overview of the current development status of remediation technologies involving electrochemical processes which are used to clean up soils that are contaminated with different types of contaminants organics inorganics metalloids and radioactive Written by internationally recognized experts it comprises 21 chapters describing the characteristics and theoretical foundations of various

electrochemical applications of soil remediation. The book s opening section discusses the fundamental properties and characteristics of the soil which are essential to understand the processes that can most effectively remove organic and inorganic compounds This part also focuses on the primary processes that contribute to the application of electrochemically assisted remediation hydrodynamic aspects and kinetics of contaminants in the soil It also reviews the techniques that have been developed for the treatment of contaminated soils using electrochemistry and discusses different strategies used to enhance performance the type of electrode and electrolyte and the most important operating conditions In turn the book s second part deals with practical applications of technologies related to the separation of pollutants from soil Special emphasis is given to the characteristics of these technologies regarding transport of the contaminants and soil toxicity after treatment The third part is dedicated to new technologies including electrokinetic remediation and hybrid approaches for the treatment of emerging contaminants by ex situ and in situ production of strong oxidant species used for soil remediation It also discusses pre pilot scale for soil treatment and the use of solar photovoltaic panels as an energy source for powering electrochemical systems which can reduce both the investment and maintenance costs of electrochemically assisted Metals in Soil Zinnat Ara Begum, Ismail M. M. Rahman, Hiroshi Hasegawa, 2019-03-20 The anthropogenic processes input of metals into the atmosphere is estimated to be one to three orders of magnitude higher than natural fluxes Soil acts as the primary sink for anthropogenic metals among the environmental spheres Most metals show indefinite persistence in the ecosphere due to resistance against microbial or chemical assisted degradation This edited book is an attempt to compile reviews and case studies from different researchers focusing on different aspects of soil contamination by metals and its subsequent remediation The book s contents will be useful for researchers and strategists interested in the environmental aspects of soil contamination Twenty Years of Research and Development on Soil Pollution and Remediation in China Yongming Luo, Chen Tu, 2018-01-17 This book reviews the progresses and achievements made in the past 20 years of research on soil pollution and remediation in China and presents 50 review and research articles from all over China including Hong Kong and Taiwan The authors include scientists engineers entrepreneurs and managers from 26 universities 18 institutes 4 leading enterprises and 2 government environmental protection departments. The contents cover fundamental research on soil pollution and remediation technical development project demonstration policy and governance The polluted soil site types include farmland industrial sites mining areas and oilfields with heavy metals cadmium arsenic copper chromium mercury lead zinc nickel etc organic pollutants PAHs PCBs organochlorine pesticides phthalate esters halogenated hydrocarbons etc and metal organic mixed pollutants The remediation techniques mainly include physical and chemical remediation thermal desorption soil vapor extraction in situ advanced chemical oxidation solidification and stabilization phytoremediation phytostabilization phytoextraction by hyperaccumulators phyto prevention by low accumulation plants bioremediation microbial adsorption and immobilization microbial degradation microbe enhanced phytoremediation and

combined remediation merging multiple technologies The governance and policy section mainly explores laws and regulations criteria and standards financial guarantees and the industrial market for soil environment and pollution Environmental Biotechnologies for Bioremediation of Contaminated Lands and Soil by Microbes, prevention Plants and Earthworms Rajiv Kumar Sinha, Dalsukh Valani, Shweta Sinha, 2010 Bioremediation is a soft bioengineering technique to clean up contaminated lands and soils using microbes plants and earthworms It is also a technique to stabilise the eroded lands and prevent soil erosion Microbes are adapted to thrive in adverse conditions of high acidity alkalinity toxicity and high temperature Under favourable conditions of growth microbes can biodegrade and biotransform the complex hazardous organic chemicals into simpler and harmless ones Environmentalists are viewing microbes such as yeast bacteria algae diatoms and actinomycetes as an eco friendly nano factories for metal remediation This book addresses these issues regarding the benefits of microbes plants and earthworms in bioremediation Remedial Options for Metals-Contaminated Sites Battelle Memorial In, 1995-09-25 The expertise of EPA research scientists has been combined to produce this comprehensive handbook Remedial Options for Metals Contaminated Sites Drawing from an extensive EPA study of metals contaminated sites this book describes the sources physical makeup and chemical behavior of metal containing wastes and state of the art technologies for their remediation The book first explores the origin of waste and how the waste matrix and contaminants interact crucial factors in understanding environmental fate and transport and in selecting appropriate remediation technologies Following this solid grounding in environmental chemistry the book describes methods to remediate metal containing wastes including immobilization chemical and biological treatment and separation concentration options Remedial Options for Metals Contaminated Sites also explores the current applications and limitations of these technologies It is a valuable resource for personnel involved in the management treatment or minimization of metals contaminated wastes Fundamentals of Site Remediation John Pichtel, 2019-07-31 This new edition discusses chemical and engineering principles as they apply to the cleanup and removal of hazardous chemicals from soil and groundwater There is emphasis on environmental chemistry soil science microbiology and plant science The first part of the book provides an overview of the recent history of environmental contamination and the formulation of relevant regulations for hazardous waste site remediation This part also provides a background for several salient aspects of site remediation e g soil science the site assessment process The second part of the book examines field remediation technologies including phytoremediation bioremediation and several chemical and physical technologies Theory of operation practical considerations and possible environmental impacts and other consequences of their use are discussed Covers both metal and hydrocarbon based contamination and remediationMany competitors only address one industry or source of contamination this title provides an overview of all of the sources Presents both the assessment of contaminated sites and the technologies currently available for environmental cleanup Effective for use in field situations and for academic i e university course use Two new chapters i the

use of nanomaterials for remediation of contaminated soil and water and ii revegetation of severely disturbed sites

Remediation of Soils Contaminated with Metals Iskandar Karam Iskandar, D. C. Adriano, 1997 **Technology** Alternatives for the Remediation of Soils Contaminated with As, Cd, Cr, Hg, and Pb ,1997 **Heavy Metals** Contaminated Soil Project, Resource Recovery Project, and Dynamic Underground Stripping Project, 1994 The Department of Energy DOE established the Office of Technology Development EM 50 OTD as an element of Environmental Restoration and Waste Management EM in November 1989 OTD has begun to search out develop test and demonstrate technologies that can now or in the future be applied to the enormous remediation problem now facing the DOE and the United States public in general Technology demonstration projects have been designed to attack a separate problem as defined by DOE The Heavy Metals Contaminated Soil Project was conceived to test and demonstrate off the shelf technologies dominantly from the mining industry that can be brought to bear on the problem of radionuclide and heavy metal contamination in soils and sediments The Resource Recovery Project is tasked with identifying developing testing and evaluating new and innovative technologies for the remediation of metal contaminated surface and groundwater An innovative twist on this project is the stated goal of recovering the metals formerly disposed of as a waste for reuse and resale thereby transforming them into a usable resource Finally the Dynamic Underground Stripping Project was developed to demonstrate and remediate underground spills of hydrocarbons from formations that are 1 too deep for excavation and or 2 require in situ remediation efforts of long duration This project has already been shown effective in reducing the time for remediation by conventional methods from an estimated 200 years at the Lawrence Livermore National Laboratory LLNL to less than one year The savings in time and dollars from this technology alone can be immeasurable Advances in Environmental Technologies Ji Zhao, Reza Iranpour, Xin Yong Li, Bo Jin, 2013-08-16 Selected peer reviewed papers from the 2013 2nd International Conference on Energy and Environmental Protection ICEEP 2013 April 19 21 2013 Guilin China

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