Bioremediation Of Contaminated Soils Environmental Science Pollution

Annotation Bioremediation: Applied Microbial Solutions for RealWorld Environmental Cleanup is a fascinating examination of research and its realworld application. Intended for both academics and practitioners, the book presents information on the legal, scientific, and engineering principles behind bioremediation for cleaning up contaminated soil and groundwater sources. Provides global perspective in coverage of a broad range of bioremediation technologies including bioinjection, bioaugmentation, and phytoremediationOffers viewpoints from contributors who are recognized leaders in their fieldsPresents over 130 figures including highquality line drawingsExamines practical examples of bioremediation application, including relevant case studiesDiscusses the interactions of legal, scientific, and engineering principles behind use of bioremediation for cleanup of contaminated land and aquifers.

Microbial Biodegradation and Bioremediation brings together experts in relevant fields to describe the successful application of microbes and their derivatives for bioremediation of potentially toxic and relatively novel compounds. This single-source reference encompasses all categories of pollutants and their applications in a convenient, comprehensive package. Our natural biodiversity and environment is in danger due to the release of continuously emerging potential pollutants by anthropogenic activities. Though many attempts have been made to eradicate and remediate these noxious elements, every day thousands of xenobiotics of relatively new entities emerge, thus worsening the situation. Primitive microorganisms are highly adaptable to toxic environments, and can reduce the load of toxic elements by their successful transformation and remediation. Describes many novel approaches of microbial bioremediation including genetic engineering, metagenomics, microbial fuel cell technology, biosurfactants and biofilm-based bioremediation Introduces relatively new hazardous elements and their bioremediation practices including oil spills, military waste water, greenhouse gases, polythene wastes, and more Provides the most advanced techniques in the field of bioremediation, including insilico approach, microbes as pollution indicators, use of bioreactors, techniques of pollution monitoring, and more

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.

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.

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.

Bioremediation refers to the clean?up of pollution in soil, groundwater, surface water, and air using typically microbiological processes. It uses naturally occurring bacteria and fungi or plants to degrade, transform or detoxify hazardous substances to human health or the environment. For bioremediation to be effective, microorganisms must enzymatically attack the pollutants and convert them to harmless products. As bioremediation can be effective only where environmental conditions permit microbial growth and action, its application often involves the management of ecological factors to allow microbial growth and degradation to continue at a faster rate. Like other technologies, bioremediation has its limitations. Some contaminants, such as chlorinated organic or high aromatic hydrocarbons, are resistant to microbial attack. They are degraded either gradually or not at all, hence, it is not easy to envisage the rates of

clean-up for bioremediation implementation. Bioremediation represents a field of great expansion due to the important development of new technologies. Among them, several decades on metagenomics expansion has led to the detection of autochthonous microbiota that plays a key role during transformation. Transcriptomic guides us to know the expression of key genes and proteomics allow the characterization of proteins that conduct specific reactions. In this book we show specific technologies applied in bioremediation of main interest for research in the field, with special attention on fungi, which have been poorly studied microorganisms. Finally, new approaches in the field, such as CRISPR-CAS9, are also discussed. Lastly, it introduces management strategies, such as bioremediation application for managing affected environment and bioremediation approaches. Examples of successful bioremediation applications are illustrated in radionuclide entrapment and retardation, soil stabilization and remediation of polycyclic aromatic hydrocarbons, phenols, plastics or fluorinated compounds. Other emerging bioremediation methods include electro bioremediation, microbe-availed phytoremediation, genetic recombinant technologies in enhancing plants in accumulation of inorganic metals, and metalloids as well as degradation of organic pollutants, protein-metabolic engineering to increase bioremediation efficiency, including nanotechnology applications are also discussed.

In situ bioremediation--the use of microorganisms for on-site removal of contaminants--is potentially cheaper, faster, and safer than conventional cleanup methods. But in situ bioremediation is also clouded in uncertainty, controversy, and mistrust. This volume from the National Research Council provides direction for decisionmakers and offers detailed and readable explanations of the processes involved in in situ bioremediation, circumstances in which it is best used, and methods of measurement, field testing, and modeling to evaluate the results of bioremediation projects. Bioremediation experts representing academic research, field practice, regulation, and industry provide accessible information and case examples; they explore how in situ bioremediation works, how it has developed since its first commercial use in 1972, and what research and education efforts are recommended for the future. The volume includes a series of perspective papers. The book will be immediately useful to policymakers, regulators, bioremediation practitioners and purchasers, environmental groups, concerned citizens, faculty, and students.

A heavy backlog of gaseous, liquid, and solid pollution has resulted from a lack of development in pollution control. Because of this, a need for a collection of original research in water and wastewater treatment, industrial waste management, and soil and ground water pollution exists. Advanced Treatment Techniques for Industrial Wastewater is an innovative collection of research that covers the different aspects of environmental engineering in water and wastewater treatment processes as well as the different techniques and systems for pollution management. Highlighting a range of topics such as agriculture pollution, hazardous waste management, and sewage farming, this book is an important reference for environmental engineers, waste authorities, solid waste management companies, landfill operators, legislators, environmentalists, and academicians seeking research on waste management.

Biomaterials And Bioengineering HandbookCRC Press

The pollution of soil and groundwater by heavy metals and other chemicals is becoming a serious issue in many countries. However, the current bioremediation processes do not often achieve sufficient remediation, and more effective processes are desired. This book deals with advances in the bioremediation of polluted soil and groundwater. In the former chapters of this book, respected researchers in this field describe how the optimization of microorganisms, enzymes, absorbents, additives and injection procedures can help to realize excellent bioremediation. In the latter chapters, other researchers introduce bioremediation processes that have been performed in the field and novel bioremediation processes. Thus, the readers will be able to obtain new ideas about effective bioremediation as well as important information about recent advances in bioremediation.

A report on progress in the development of materials used in or on the human body, ranging from biopolymers used in controlled-release drug delivery systems and prosthetic devices to metals used in bone repair and plastics used in absorbable mechanisms such as sutures.

This book combines the results of current research with essential background material to provide complete, in-depth coverage of every aspect of in situ and ex situ bioremediation, as well as an extensive overview of the physical and chemical processes currently available for treating petroleum-contaminated soils. Critical information has been collected and assembled under one cover to provide a convenient reference for anyone who must contend with this worldwide problem. Remediation of Petroleum Contaminated Soils: Biological, Physical, and Chemical Processes describes how to optimize the biodegradation of petroleum hydrocarbons in soil-water systems. It reports on the susceptibility of various petroleum components to biodegradation by microorganisms, and considers all groups of microorganisms for their potential contributions. The book also deals with problem areas such as the transport of organisms, oxygen, or nutrients throughout the subsurface, as well as biodegradation of polynuclear aromatic hydrocarbons (PAHs) and nonaqueous phase liquids (NAPLs). In addition, the book presents a variety of methods for monitoring bioremediation. This reference discusses current soil remediation processes and includes many innovative approaches. It also investigates means of controlling volatile organic compounds (VOCs) and leachate, and addresses methods for collecting and treating these secondary waste streams. The expansive coverage of this book will furnish readers with a wide range of options for developing treatment strategies and for customizing procedures for specific requirements.

Microbe Mediated Remediation of Environmental Contaminants presents recent scientific progress in applying microbes for environmental management. The book explores the current existing practical applications and provides information to help readers develop new practices and applications. Edited by recognized leaders in the field, this penetrating assessment of our progress to date in deploying microorganisms to the advantage of environmental management and biotechnology will be widely welcomed by those working in soil contamination management, agriculture, environment management, soil microbiology, and waste management. The polluting effects on the world around us of soil erosion, the unwanted migration of sediments, chemical fertilizers and pesticides, and the improper treatment of human and animal wastes have resulted in serious environmental and social problems around the world, problems which require us to look for solutions elsewhere than established physical and chemical technologies. Often the answer lies in hybrid applications in which microbial methods are combined with physical and chemical ones. When we remember that these highly effective microorganisms, cultured for a variety of applications, are but a tiny

fraction of those to be found in the world around us, we realize the vastness of the untapped and beneficial potential of microorganisms. Explores microbial application redressing for soil and water contamination challenges Includes information on microbial synthesized nanomaterials for remediation of contaminated soils Presents a uniquely hybrid approach, combining microbial interactions with other chemical and physical methods

This volume focuses on innovative bioremediation techniques and applications for the cleanup of contaminated media and sites. It includes quantitative and design methods that elucidate the relationships among various operational parameters, and waste chemistry that defines the cost effectiveness of bioremediation projects. It also presents numerical models.

In recent years, there have been significant advances in the techniques of sampling and analysis, which has allowed the more accurate recording of environmental levels of many substances present in the environment. At the same time, processes for the remediation of contaminated matrices have evolved, through the application and/or combination of biological, physical, and chemical procedures.The purpose of this book is to present new studies aimed at determining levels of environmental pollution in various parts of the world. It also shows new alternatives for the remediation of contaminated matrices.

Bioremediation for Environmental Sustainability: Approaches to Tackle Pollution for Cleaner and Greener Society discusses many recently developed and successfully applied bio/phytoremediation technologies for pollution control and minimization, which are lacking more comprehensive coverage in previous books. This book describes the scope and applications of bio/phytoremediation technologies and especially focuses on the associated eco-environmental concerns, field studies, sustainability issues, and future prospects. The book also examines the feasibility of environmentally friendly and sustainable bio/phytoremediation technologies to remediate contaminated sites, as well as future directions in the field of bioremediation for environmental sustainability. Illustrates the importance of microbes and plants in bio/phytoremediation and wastewater treatment Includes chapters on original research outcomes pertaining to pollution, pollution abatement, and associated bioremediation technologies Covers emerging bioremediation technologies, including electro-bioremediation, microbial fuel cell, nano-bioremediation, constructed wetlands, and more Highlights key developments and challenges in bioremediation and phytoremediation technologies Describes the roles of relatively new approaches in bio/phytoremediation, including molecular engineering and omics technologies, microbial enzymes, biosurfactants, plant-microbe interactions, genetically engineered organisms, and more

Traditional reliance on chemical analysis to understand the direction and extent of treatment in a bioremediation process has been found to be inadequate. Whereas the goal of bioremediation is toxicity reduction, few direct, reliable measures of this process are as yet available. Another area of intense discussion is the assessment of market forces contributing to the acceptability of bioremediation. Finally, another important component is a series of lectures and lively exchanges devoted to practical applications of different bioremediation technologies. The range of subjects covers a wide spectrum, encompassing emerging technologies as well as actual, full-scale operations. Examples discussed include landfarming, biopiling, composting, phytoremediation and mycoremediation. Each technology is explored for its utility and capability to provide desired treatment goals. Advantages and limitations of each technology are discussed. The concept of natural attenuation is also critically evaluated since in some cases where time to remediation is not a significant factor, it may be an alternative to active bioremediation operations.

The remediation of environmental pollutants has become a relevant topic within the field of waste management. Advances in biological approaches are a potential tool for contamination and pollution control. The Handbook of Research on Microbial Tools for Environmental Waste Management is a critical scholarly resource that explores the advanced biological approaches that are used as remediation for pollution cleanup processes. Featuring coverage on a broad range of topics such as biodegradation, microbial dehalogenation, and pollution controlling treatments, this book is geared towards environmental scientists, biologists, policy makers, graduate students, and scholars seeking current research on environmental engineering and green technologies.

Green Sustainable Process for Chemical and Environmental Engineering and Science: Biosurfactants for the Bioremediation of Polluted Environments explores the use of biosurfactants in remediation initiatives, reviewing knowledge surrounding the creation and application of biosurfactants for addressing issues related to the release of toxic substances in ecosystems. Sections cover their production, assessment and optimization for bioremediation, varied pollutant degradation applications, and a range of contaminants and ecological sites. As awareness and efforts to develop greener products and processes continues to grow, biosurfactants are garnering more attention for the potential roles they can play in reducing the use and production of more toxic products. Drawing on the knowledge of its expert team of global contributors, this book provides useful insights for all those currently or potentially interested in developing or applying biosurfactants in their own work. Provides an accessible introduction to biosurfactant chemistry Highlights the optimization, modeling, prediction and kinetics of key factors supporting biosurfactant-enhanced biodegradation processes Explores a wide range of biosurfactant applications for remediation and degradation of pollutants

Contaminated Soils offers state-of-the-art technologies for detection and remediation of diesel contaminated soils that can be used by environmental professionals to maximize the practical application of theory. The book covers all aspects of assessment of soils contaminated by diesel fuel and discusses the most successful remediation techniques currently available. These techniques include the use of hydrocarbon analyses for environmental assessment and remediation, physical and biological treatments, and vent walls for enhancing biodegradation of contaminated soils. The development of a monoclonal antibody immunoassay for detecting gasoline and diesel fuel in the environment and a comparison of the purge and trap procedure versus the extraction procedure for detecting kerosene and diesel fuel No. 2 are examined as well. The book concludes with a chapter discussing human health-based soil cleanup guidelines for diesel fuel No. 2. Contaminated Soils is a must for professionals concerned with the quality of groundwater and hazardous waste cleanup, regulators, oil company officials, and libraries. Features:

The huge expansion of the chemical and petroleum industries in the twentieth century has resulted in the production of a vast array of chem ical compounds and materials that have transformed our lives. The associated large-scale

manufacturing, processing and handling activi ties have caused a serious deterioration in environmental quality and created threats to human health. These negative impacts have led to responses and regulations requiring remedial action in support of envi ronmental sustainability. of biotechnological methods through bioremediation, Application has gained prominence as an option for soil remediation methods. Bioremediation is a multidisciplinary approach where biologists, chem ists, soil scientists and engineers work as team to develop and imple ment remediation processes. Bioremediation has now been used successfully to remediate many petroleum-contaminated sites. However, there are as yet no commercial technologies commonly used to reme diate the most recalcitrant contaminants. Nevertheless, bioremediation is a rapidly advancing field and new bio-based remedial technologies are continuing to emerge.

"This unique, single-source reference offers a thorough treatment of the remediation of soils contaminated by hazardous wastes and the scientific and engineering issues that must be addressed in creating practical solutions for their reclamation."

Volume 9 of the series presents 38 technical papers covering a wide range of environmental issues, including Bioremediation, Chemical Oxidation, Heavy Metals, MTBE, Phytoremediation, Radiation, Regulatory and Legal issues, Remediation, Risk Based Cleanup and Site Assessment. Contributing authors are drawn from across the spectrum of interest: government agencies, academic institutions, the consulting community and industrial companies.

Bioremediation is an eco-friendly, cost-effective and natural technology targeted to remove heavy metals, radionuclides, xenobiotic compounds, organic waste, pesticides etc. from contaminated sites or industrial discharges through biological means. Since this technology is used in in-situ conditions, it does not physically disturb the site unlike conventional methods i.e. chemical or mechanical methods.

Bioremediation and Bioeconomy provides a common platform for scientists from various backgrounds to find sustainable solutions to environmental issues, including the ever-growing lack of water resources which are under immense pressure due to land degradation, pollution, population explosion, urbanization, and global economic development. In addition, large amounts of toxic waste have been dispersed in thousands of contaminated sites and bioremediation is emerging as an invaluable tool for environmental clean-up. The book addresses these challenge by presenting innovative and cost-effective solutions to decontaminate polluted environments, including usage of contaminated land and waste water for bioproducts such as natural fibers, biocomposites, and fuels to boost the economy. Users will find a guide that helps scientists from various backgrounds find sustainable solutions to these environmental issues as they address the topical issues crucial for understanding new and innovative approaches for sustainable development. Provides a compilation of new information on phytoremediation not found in other books in the present market The first book to link phytoremediation and the bioeconomy Includes strategies to utilize contaminated soils for producing bioresources and co-generation of value chain and value additions products

This book will discuss the effective and sustainable technological approaches for remediation of contaminates via eco-friendly usage of microbes. The primary focus will be on the role of microbes, particularly bacteria and fungi, for the degradation and removal of various xenobiotic substances in the environment. The book will also emphasize molecular approaches and biosynthetic pathways of microbes, and present gene and protein expression studies for bio-deterioration techniques. New innovative and sophisticated green technologies for waste minimization and waste control will be presented, as well as the potential of microbes for various techniques of bioremediation, including bio-sorption, bio-augmentation, bio-stimulation, to clean contaminated environments.

Harlan’s Crops and Man A scientific and historical study of crops and their age-old relationship with human civilization The cultivation and harvesting of crops have been at the heart of human culture and development for thousands of years. As we have grown from hunter-gatherers into agrarian societies and industrial economies, our ongoing relationship with the plants that feed us and support our manufacturing has also evolved. So too, of course, have those plants themselves, with the combined forces of shifting climates, selective plant breeding, and genetic modification all working to alter their existence in profound and fascinating ways. Coming some 30 years after its previous incarnation, the third edition of Harlan’s Crops and Man marks an exciting re-examination of this rich topic. Its chapters lay out the foundations of crop diversity as we know it, covering topics that range from taxonomy and domestication to the origins of agricultural practices and their possible futures. Highlights include:ui Archeological and anthropological studies of agriculture’s history and development Detailed examinations of the histories and classifications of both crops and weeds Explanations of taxonomic systems, gene pools, and plant evolution Studies of specific crops by geographical region Updated to include the latest data and research available, this new edition of Harlan’s Crops and Man offers an illuminating exploration of agricultural history to all those engaged with plant science and the cultivation of crops.

This book is a compilation of detailed and latest knowledge on the various types of environmental pollutants released from various natural as well as anthropogenic sources, their toxicological effects in environments, humans, animals and plants as well as various bioremediation approaches for their safe disposal into the environments. In this book, an extensive focus has been made on the various types of environmental pollutants discharged from various sources, their toxicological effects in environments, humans, animals and plants as well as their biodegradation and bioremediation approaches for environmental cleanup.

Soil is an irreplaceable resource that sustains life on the planet, challenged by food and energy demands of an increasing population. Therefore, soil contamination constitutes a critical issue to be addressed if we are to secure the life quality of present and future generations. Integrated efforts from researchers and policy makers are required to develop sound risk assessment procedures, remediation strategies and sustainable soil management policies. Environmental Risk Assessment of Soil Contamination provides a wide depiction of current research in soil contamination and risk assessment, encompassing reviews and case studies on soil pollution by heavy metals and organic pollutants. The book introduces several innovative approaches for soil remediation and risk assessment, including advances in phytoremediation and implementation of metabolomics in soil sciences.

The pollution of soil and groundwater by harmful chemical compounds and heavy metals is becoming very serious in many countries. Although remediation is necessary as soon as possible, the performance of conventional bioremediation processes is not sufficient. This book deals with advances in bioremediation and phytoremediation processes by using excellent strains and a combination of processes. In the chapters of this book, the researchers have introduced the overall status of contamination; the characteristics of bioremediation using halobacteria, Candida yeast, and autochthonous bacteria; and phytoremediation using macrophytes. Moreover, other researchers introduced a process using biochar and electric currents, and this combination of processes and phytoremediation enhances the overall process.

Bioremediation for Environmental Sustainability: Toxicity, Mechanisms of Contaminants Degradation, Detoxification and Challenges introduces pollution and toxicity profiles of various organic and inorganic contaminants, including mechanisms of toxicity, degradation, and detoxification by microbes and plants, and their bioremediation approaches for environmental sustainability. The book also covers many advanced technologies in the field of bioremediation and phytoremediation, including electro-bioremediation, microbial fuel cells, nano-bioremediation, constructed wetlands, phytotechnologies, and many more, which are lacking in other competitive titles existing in the market. The book includes updated information, as well as future directions for research, in the field of bioremediation of industrial wastes. This book

is a reference for students, researchers, scientists, and professionals in the fields of microbiology, biotechnology, environmental sciences, eco-toxicology, environmental remediation, and waste management, especially those who aspire to work on the biodegradation and bioremediation of industrial wastes and environmental pollutants for environmental sustainability. Environmental safety and sustainability with rapid industrialization is one of the major challenges worldwide. Industries are the key drivers in the world economy, but these are also the major polluters due to discharge of potentially toxic and hazardous wastes containing various organic and inorganic pollutants, which cause environmental pollution and severe toxic effects in living beings. Introduces pollution and toxicity profiles of environmental contaminants and industrial wastes, including oil refinery wastewater, distillery wastewater, tannery wastewater, textile wastewater, mine tailing wastes, plastic wastes, and more Describes underlying mechanisms of degradation and detoxification of emerging organic and inorganic contaminants with enzymatic roles Focuses on recent advances and challenges in bioremediation and phytoremediation, including microbial enzymes, biosurfactants, microalgae, biofilm, archaea, genetically engineered organisms, and more Describes how microbes and plants can be successfully applied for the remediation of potentially toxic industrial wastes and chemical pollutants to protect the environment and public health

Bioremediation is an emerging field of environmental research. The objective of a bioremediation process is to immobilize contaminants (reactants) or to transform them into chemical products that do not pose a risk to human health and the environment. Toxicity and Waste Management Using Bioremediation provides relevant theoretical and practical frameworks and the latest empircal research findings on the remediation of contaminated soil and groundwater using bioorganisms. Focusing on effective waste treatment methodologies and management strategies that lead to improved human and environmental health, this timely publication is ideal for use by environmenal scientists, biologists, policy makers, graduate students, and scholars in the fields of environmental science, chemistry, and biology.

"Offers thorough coverage of the remediation of soils contaminated by hazardous wastes, including materials, analytical techniques, cleanup design and methodology, characterization of geomedia, monitoring of contaminants in the subsurface, and waste containment. Cites specific case studies in hydrocarbon remediation that offer a concise overview of possible technological approaches."

Bioremediation is a process applied to restore contaminated sites using biological tools. The success or failure of this process usually depends on an understanding of the biotechnological process as well as the strengths and weaknesses of the ecotoxicological tools used for its evaluation. This useful book offers a unique treatment of the subject, linking soil ecotoxicity tests, bioremediation and environmental risk assessment. It also, describes the inter-relationships between the laboratory and field ecotoxicologist, the biotechnology consultant and different international environmental regulatory agencies and explains how they seek to achieve a successful evaluation of contaminated site restoration.

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.

Bioremediation, or enhanced microbiological treatment, of environments contaminated with a variety of organic and inorganic compounds is one of the most effective innovative technologies to come around this century! Practical Environmental Bioremediation: The Field Guide presents updated material, case histories and many instructive illustrations to reflect the evolving image of this fast-emerging industry. Bioremediation technology has witnessed great strides towards simplifying treatability formats, finding new approaches to field application, more potent nutrient formulations, monitoring protocols and the resulting general improvement in results. This new guide condenses all current available knowledge and presents necessary technical aspects and concepts in language that can be readily comprehended by the technical student, experienced scientist or engineer, the aspiring newcomer, or anyone else interested in this exciting natural cleanup technique.

Toxic substances threatens aquatic and terrestrial ecosystems and ultimately human health. The book is a thoughtful effort in bringing forth the role of biotechnology for bioremediation and restoration of the ecosystems degraded by toxic and heavy metal pollution. The introductory chapters of the book deal with the understanding of the issues concerned with the pollution caused by toxic elements and heavy metals and their impacts on the different ecosystems followed by the techniques involved in monitoring of the pollution. These techniques include use of bio-indicators as well as modern techniques for the assessment and monitoring of toxicants in the environment. Detailed chapters discussing the role of microbial biota, aquatic plants, terrestrial plants to enhance the accumulation efficiency of these toxic and heavy metals are followed by remediation techniques involving myco-remediation, bio-pesticides, bio-fertilizers, phyto-remediation and rhizo-filtration. A sizable portion of the book has been dedicated to the advanced bio-remediation techniques which are finding their way from the laboratory to the field for revival of the degraded ecosystems. These involve bio-films, micro-algae, genetically modified plants and filter feeders. Furthermore, the book is a detailed comprehensive account for the treatment technologies from unsustainable to sustainable. We believe academicians, researchers and students will find this book informative as a complete reference for biotechnological intervention for sustainable treatment of pollution.

The quality of agricultural soils are always under threat from chemical contaminants, which ultimately affect the productivity and safety of crops. Besides agrochemicals, a new generation of substances invades the soil through irrigation with reclaimed wastewater and pollutants of organic origin such as sewage sludge or cattle manure. Emerging pollutants such as pharmaceuticals, nanomaterials and microplastics are now present in agricultural soils, but the understanding of their impact on soil quality is still limited. With focus on in situ bioremediation, this book provides an exhaustive analysis of the current biological methodologies for recovering polluted agricultural soils as well as monitoring the effectiveness of bioremediation.