

Removal Of Heavy Metals From Aqueous Solution By Zeolite

New Trends in Removal of Heavy Metals from Industrial Wastewater covers the applicable technologies relating to the removal of heavy metals from wastewater and new and emerging trends in the field, both at the laboratory and industrial scale. Sections explore new environmentally friendly technologies, the principles of sustainable development, the main factors contributing to heavy metal removal from wastewater, methods and procedures, materials (especially low-cost materials originated from industrial and agricultural waste), management of wastewater containing heavy metals and wastewater valorization, recycling, environmental impact, and wastewater policies for post heavy metal removal. This book is an advanced and updated vision of existing heavy metal removal technologies with their limitations and challenges and their potential application to remove heavy metals/environmental pollutants through advancements in bioremediation. Finally, sections also cover new trends and advances in environmental bioremediation with recent developments in this field by an application of chemical/biochemical and environmental biotechnology. Outlines the fate and occurrence of heavy metals in Wastewater Treatment Plants (WWTPs) and potential approaches for their removal Describes the techniques currently available for removing heavy metals from wastewater Discusses the emerging technologies in heavy metal removal Covers biological treatments to remove heavy metals Includes the valorization of heavy metal containing wastewater

This book contains information about the technological development of ion exchange in their application for industrial processes. Widely used and well known fields of ion exchange like chromatography and electromembrane technology are described in this book with experimental details. Designing new materials for nanotechnology and nanomaterials as ion exchanger are also explained by experimental proofs. Ion exchange book is suitable not only for postgraduate students but also for researchers in chemistry, biochemistry and chemical technology.

Arsenic - Analytical and Toxicological Studies is a collection of original works focused on arsenic occurrence and chemistry, methods for arsenic determination and removal and arsenic toxicity and health risks. The most commonly used techniques for arsenic quantification and speciation, such as atomic absorption spectrometry, inductively coupled plasma-mass spectrometry, and inductively coupled plasma-emission spectrometry, among others, and the various procedures applied for arsenic separation and removal are exhaustively described. The mechanism of arsenic-induced toxicology, involving arsenic interaction with critical thiols in proteins and the health risks associated with exposure to arsenic, is also discussed.

The rapid progression of technology has significantly impacted population growth, urbanization, and industrialization in modern society. These developments, while positive on the surface, have created critical environmental problems in recent years. Biostimulation Remediation Technologies for Groundwater Contaminants is a critical scholarly publication that examines the release of heavy metals into the environment as a result of human activities and the use of nanoparticles and other technologies to manage and treat the effects of the pollution. Featuring coverage on a broad range of topics such as toxicity of heavy metals, bioremediation, and acclimated bacterial strains, this book is geared toward environmentalists, engineers, academics, researchers, and graduate-level students seeking current research on bioremediation as an alternate way to manage or degrade heavy metal waste.

Municipal and industrial wastewaters contain a wide spectrum of pollutants. Their effective removal presents a challenge for water treatment technology. Biosorption of nutrients and pollutants has been used in sewage treatment since the discovery of the activated sludge process. It is a passive uptake process by which pollutants are adsorbed on the surface of cell walls and/or dissolved in structures of microorganism cells that are present in sludge. Sorbed pollutants remain in the sludge and can be potentially released back into the environment depending on their condition and the reversibility of the pollutant-sludge interaction. An overview of typical biosorption applications for the removal of nutrients, organic pollutants, and metals in wastewater treatment is provided in different areas of their use for the protection of aquatic ecosystems and human health. This book will be of interest to operators of wastewater treatment plants and sludge treatment and disposal facilities as well as to researchers and university students in the field of environmental engineering.

POLLUTANTS AND WATER MANAGEMENT Pollutants and Water Management: Resources, Strategies and Scarcity delivers a balanced and comprehensive look at recent trends in the management of polluted water resources. Covering the latest practical and theoretical aspects of polluted water management, the distinguished academics and authors emphasize indigenous practices of water resource management, the scarcity of clean water, and the future of the water system in the context of an increasing urbanization and globalization. The book details the management of contaminated water sites, including heavy metal contaminations in surface and subsurface water sources. It details a variety of industrial activities that typically pollute water, such as those involving crude oils and dyes. In its discussion of recent trends in abatement strategies, Pollutants and Water Management includes an exploration of the application of microorganisms, like bacteria, actinomycetes, fungi, and cyanobacteria, for the management of environmental contaminants. Readers will also discover a wide variety of other topics on the conservation of water sources including: The role of government and the public in the management of water resource pollution The causes of river system pollution and potential future scenarios in the abatement of river pollution Microbial degradation of organic pollutants in various water bodies The advancement in membrane technology used in water treatment processes Lead contamination in groundwater and recent trends in abatement strategies for it Highly polluting industries and their effects on surrounding water resources Perfect for graduate and postgraduate students and researchers whose focus is on recent trends in abatement strategies for pollutants and the application of microorganisms for the management of environmental contaminants, Pollutants and Water Management: Resources, Strategies and Scarcity also has a place in the libraries of environmentalists whose work involves the management and conservation of polluted sites.

Phytoremediation Technology for the Removal of Heavy Metals and Other Contaminants from Soil and Water focuses on the exploitation of plants and their associated microbes as a tool to degrade/detoxify/stabilize toxic and hazardous contaminants and restore the contaminated site. The book introduces various phytoremediation technologies using an array of plants and their associated microbes for environmental cleanup and sustainable development. The book mainly focuses on the remediation of toxic and hazardous environmental contaminants, their phytoremediation mechanisms and strategies, advances and challenges in the current scenario. This book is intended to appeal to students, researchers, scientists and a wide range of professionals responsible for regulating, monitoring and designing industrial waste facilities. Engineering consultants, industrial waste managers and purchasing department managers,

government regulators, and graduate students will also find this book invaluable. Provides natural and eco-friendly solutions to deal with the problem of pollution Details underlying mechanisms of phytoremediation of organic and inorganic contaminants with enzymatic roles Describes numerous, successful field studies on the application of phytoremediation for eco-restoration of contaminated sites Presents recent advances and challenges in phytoremediation research and applications for sustainable development Provides authoritative contributions on the diverse aspects of phytoremediation by world leading experts

The generation of wastes as a result of human activities has been continuously speeding up since the beginning of the industrial revolution. Hence, both optimized waste water treatment technologies and modern tools to assess the effects of pollution sources are necessary to prevent the contamination of aquatic ecosystems The book offers an interdisciplinary collection of topics concerning waste water treatment technologies, water quality monitoring and evaluation of waste water impact on natural environments. We hope that this publication will be helpful for graduate students, environmental professionals and researchers of various disciplines related to waste water.

Over the past few decades the boom in the industrial sector has contributed to the release in the environment of pollutants that have no regulatory status and which may have significant impact on the health of animals and humans. These pollutants also refer as “emerging pollutants” are mostly aromatic compounds which derive from excretion of pharmaceutical, industrial effluents and municipal discharge. Some form of pollutions have also evolved, including the proliferation of acid mine drainage from oxidation or weathering of obsolete and unmanaged excavations around the world; this results mostly in the dispersion of inorganic pollutants in the environment at level surpassing the treatment capacity of conventional techniques. It is recurrent these days to find water treatment plants which no longer produce water that fits the purpose of domestic consumption based on newly established guidelines. This situation has prompted water authorities and researchers to develop tools for proper prediction and control of the dispersion of pollutants in the environment to ensure that appropriate measures are taken to prevent the occurrence of outbreaks due to sudden load of these pollutants in the water system. The chapters in this book cover a wide range of nano and bio-based techniques that have been designed for the real time detection of emerging contaminants in environmental water sources, geochemical models that are continuously improved for the prediction of inorganic contaminants migration from the mine solid wastes into ground and surface waters. Remediation strategies are also discussed and include effective techniques based on nanotechnology, advanced membrane filtration, oxidative and biodegradation processes using various types of nanocatalysts, biocatalysts or supporting polymer matrices which are under advanced investigations for their implementation at large scale for the removal of recalcitrant pollutants from polluted water. This book is divided in two sections, the first section covers the occurrence of emerging pollutants in environmental water while the second section covers state of the art research on the removal of emerging pollutants from water using sustainable technologies. A total of 13 chapters addressing various topics related to the two sections are essentially based on recent development in the respective field which could have a significant impact on the enhancement of the performance of wastewater treatment plants around the world and especially in developing countries where access to clean and safe water remains a daily challenge

This project studies the heavy metal cation adsorption of crosslinked casein, to assess its viability as an alternative means of removing heavy metal ions from the wastewater produced by mining and manufacturing processes.

Elevated levels of arsenic and other heavy metals like copper, aluminum, zinc, and selenium in drinking water are found to have deleterious effects on human health. Hence, finding methods for reducing their levels is critical. Iron-coated limestone is used as an adsorption material for the removal of heavy metals from drinking water. Removal of heavy metals by native or uncoated limestone was also observed and used for comparison to and evaluation of the improvement in removal efficiency from the ironcoated material. The removal efficiency with limestone was studied for different concentrations of heavy metals. Kinetic studies were done to determine the decrease in heavy metal concentration as a function of time using limestone. Inductively coupled plasma spectroscopy was used for metal analysis. The effective removal rate of copper and aluminum was found to be four hours and one hour, respectively. This method of removal by using limestone is cost effective, eco-friendly, and hence, of great potential importance for heavy metal removal. Iron-coated limestone is used as an adsorption material for the removal of heavy metals from drinking water. This project will investigate techniques to improve removal efficiency of heavy metals using limestone-based material through adsorption. This research will assist in the development of a granular adsorbent product that will remove metals and that can be manufactured and sold for use at the drinking water source, at point-of-use, or at point-of-entry. Limestone is readily available and its use for metals removal is relatively inexpensive. The technology can be adapted to small, rural water supply systems. Benefits of this research will include a low-cost treatment technology for source reduction that will reduce select metals to below drinking water standards.

Fundamental societal changes resulted from the necessity of people to get organized in mining, transporting, processing, and circulating the heavy metals and their follow-up products, which in consequence resulted in a differentiation of society into diversified professions and even societal strata. Heavy metals are highly demanded technological materials, which drive welfare and progress of the human society, and often play essential metabolic roles. However, their eminent toxicity challenges the field of chemistry, physics, engineering, cleaner production, electronics, metabolomics, botany, biotechnology, and microbiology in an interdisciplinary and cross-sectorial manner. Today, all these scientific disciplines are called to dedicate their efforts in a synergistic way to avoid exposure of heavy metals into the eco- and biosphere, to reliably monitor and quantify heavy metal contamination, and to foster the development of novel strategies to remediate damage caused by heavy metals.

This new book explains advanced and emerging technologies for removing heavy metals from wastestreams and contaminated sites. Separation processes of this type are critical for meeting stringent regulations of priority pollutants, especially arsenic, mercury, and lead, which the text treats in depth. After explaining the chemistry of heavy metals and their transport in various media, the work offers a comprehensive analysis of strategies for separating metals from groundwater, wastewater, contaminated soils, and industrial sludges. Both the basics and the applications of techniques such as ion-exchange, specialized sorbents, novel membranes, advanced precipitates, and electrokinetic processes are presented with a view to current use and potential for future applications such as resource reuse. Information in this volume enables engineers and other investigators to adapt and select the best means to remove and, in certain instances, recover heavy metals.

Pollution of waters by toxic metals is accelerating worldwide due to industrial and population growth, notably in countries having poor environmental laws, resulting in many diseases such as cancer. Classical remediation techniques are limited. This book reviews new, advanced or improved techniques for metal removal, such as hybrid treatments, nanotechnologies and unconventional adsorbents, e.g. metal-organic frameworks. Contaminants include rare earth elements, arsenic, lead, cadmium, chromium, copper and effluents from the electronic, textile, agricultural and pharmaceutical industries.

This state-of-the-art volume represents the first comprehensively written book which focuses on the new field of biosorption. This fascinating work conveys essential fundamental information and outlines the perspectives of biosorption. It summarizes the metal-sorbing properties of nonliving bacterial, fungal, and algal biomass, plus highlights relevant metal-binding mechanisms. This volume also discusses the aspects of obtaining and processing microbial biomass and metal-chelating chemicals into industrially applicable biosorbent products. Microbiologists, chemists, and engineers with an interest in new technological and scientific horizons will find this reference indispensable.

Biochemical Toxicology - Heavy Metals and Nanomaterials provides an overview of biochemical contamination, nanomaterials and toxic metals, and measurement techniques. It explains and clarifies important studies and compares and develops new and groundbreaking measurement techniques in the fields of organic and inorganic pollution and nanoscience. It is highly recommended for professionals and readers interested in the environment and human health.

Elimination by Zeolite LTA is a very effective technique for the removal of heavy metals from aqueous solutions. Zeolite LTA is very good adsorbent for elimination of lead and zinc ions from aqueous solutions economically. The zeolite LTA crystallization from clay was studied under the conditions such as the concentration of alkalinity (5M NaOH), reaction, temperatures (100°C), the reaction times (2h) in addition to, the calcination of kaolin samples was an important factor that influenced on the zeolite LTA synthesis. Its applications in the elimination of heavy metal ions such as Pb²⁺, Zn²⁺, Cu²⁺, Ni²⁺ were studied and showed excellent results. The elimination of Cu²⁺, Ni²⁺, Pb²⁺ and Zn²⁺ in zeolite LTA was investigated and The selectivity sequence for ions removed was Pb²⁺>Cu²⁺>Zn²⁺>Ni²⁺.

At the beginning of the twenty-first century, separation processes presented a comprehensive application of the major operations performed by various industries, such as chemical, food, environmental, and biotechnology. Sorption, one of the preferred separation processes because of its effectiveness at different interfaces, has caught the attention of many scientists. This book is aimed at gaining a general knowledge of sorption and a number of extremely important applications, as well as recognizing its functions and paramount importance in chemical and biochemical plants, including environmental treatment. Moreover, progress in the phenomenon is highlighted in this book. To help provide instruction in the important sorption processes, we have chosen authors who have extensive industrial and academic experience in closing the gap between theory and practice. Crucial progress in the theoretical information section of sorption has been achieved, mainly through the development of new techniques that examine the usage of various sorbents, including nanomaterials for the removal of various pollutants. We have subdivided the book into several sections, one of which is focused on applications of the sorption process, which presents real results of the recent studies and gives a source of up-to-date literature. The relationship between the sorption process and isotherm and kinetics modeling is analyzed in another chapter. This book will be a reference book for those who are interested in sorption techniques from various industries.

A successful modern heavy metal control program for any industry will include not only traditional water pollution control, but also air pollution control, soil conservation, site remediation, groundwater protection, public health management, solid waste disposal, and combined industrial-municipal heavy metal waste management. In fact, it should be a total environmental control program. Comprehensive in scope, Heavy Metals in the Environment provides technical and economical information on the development of a feasible total heavy metal control program that can benefit industry and local municipalities. The book discusses the importance and contamination of metals such as lead, chromium, cadmium, zinc, copper, nickel, iron, and mercury. It covers important research of metals in the environment, the processes and mechanisms for metals control and removal, the environmental behavior and effects of engineered metal and metal oxide nanoparticles, environmental geochemistry of high arsenic aquifer systems, nano-technology applications in metal ion adsorption, biosorption of metals, and heavy metal removal by exopolysaccharide-producing cyanobacteria. The authors delineate technologies for metals treatment and management, metal bearing effluents, metal-contaminated solid wastes, metal finishing industry wastes and brownfield sites, and arsenic-contaminated groundwater streams. They also discuss control, treatment, and management of metal emissions from motor vehicles. The authors reflect the breadth of the field and draw on personal experiences to provide an in-depth presentation of environmental pollution sources, waste characteristics, control technologies, management strategies, facility innovations, process alternatives, costs, case histories, effluent standards, and future trends for each industrial or commercial operation. The methodologies and technologies discussed are directly applicable to the waste management problems that must be met in all industries.

This book serves as a knowledge bank for researchers and graduate students in microbiology, chemistry, and environmental sciences, among others. It focuses on heavy metal in the environment and describes methodologies to immobilize and mobilize heavy metals. It also provides case studies which may be of particular interest to persons in industry.

In general, groundwater is a preferred source of drinking water because of its convenient availability and its constant and good quality. However this source is vulnerable to contamination by several substances. Acceptable quality limits relative to micropollutant contents in drinking water are becoming increasingly lower and efficient elimination treatment processes are being implemented in order to meet these requirements. Metals contaminants at low concentration are difficult to remove from water. Chemical precipitation and other methods become inefficient when contaminants are present in trace concentrations and the process of adsorption is one of the few alternatives available for such situations. This book describes the adsorption method in the removal of selected heavy metals present as cations (Cd²⁺, Cu²⁺ and Pb²⁺) or oxyanions (Cr(VI) and As(V)) using iron oxide coated sand (IOCS) and granular ferric hydroxide (GFH). The effects of pH, natural organic matter (fulvic acid (FA)) and interfering ions (PO₄³⁻, Ca²⁺) on the adsorption efficiency were also assessed. The sorption reactions that take place at the surface of the adsorbent were also described through the surface complexation modelling for Cd²⁺, Cu²⁺ and Pb²⁺ adsorption. Batch adsorption tests and rapid small scale column tests (RSST) were used as laboratory methods.

This volume provides in-depth coverage of environmental pollution sources, waste characteristics, control technologies, management strategies, facility innovations, process alternatives, costs, case histories, effluent standards, and future trends in waste treatment processes. It delineates methodologies, technologies, and the regional and global effects of important pollution control practices. It focuses on specific industrial and manufacturing wastes and their remediation. Topics include: heavy metals, electronics, chemical, and textile manufacturing.

Nanohybrid and Nanoporous Materials for Aqueous Environmental Pollution Control gives a comprehensive treatment of fabrication methods and their application in environmental remediation, including adsorption, catalysis and signal transfer in pollutant detection. The design, fabrication and application of nanohybrid and nanoporous materials for environmental pollution control are described in detail, along with discussions on their synthesis, characterization, and applications in different aspects of pollutant treatment. Chapters introduce the design and synthesis of magnetic nanohybrid materials, advanced oxide process-photocatalytic degradation of environmental pollutants based on nanomaterials, and nanohybrids of iron based materials for reduction and oxidation of aqueous recalcitrant pollutant. Finally, challenges and suggestions in the application of nanomaterials for environmental pollution control are discussed, as is an analysis of the future perspective of nanomaterials for environmental application.

Presents the most up-to-date developments in this rapidly progressing field Provides suggestions to address challenges and solve current problems related to the application of nanoporous materials

Discusses future trends and perspectives in the area of nanohybrid and nanoporous materials

Emerging Technologies in Environmental Bioremediation introduces emerging bioremediation technologies for the treatment and management of industrial wastes and other environmental pollutants for the sake of environmental sustainability. Emerging bioremediation approaches such as nano-bioremediation technology, electro-bioremediation technology, microbial fuel cell technology, Modified Ludzack-Ettinger Process, Modified Activated Sludge Process, and phytotechnologies for the remediation of industrial wastes/pollutants are discussed in a comprehensive manner not found in other books.

Furthermore, the book includes updated information as well as future directions for research in the field of bioremediation of industrial wastes. This book will be extremely useful to students, researchers, scientists and professionals in the field of microbiology and biotechnology, Bio (chemical) engineers, environmental researchers, eco-toxicology, and many more. Includes the recovery of resources from wastewater Describes the importance of microorganisms in environmental bioremediation technologies Points out the reuse of treated wastewater through emerging technologies Pays attention to the occurrence of novel micro-pollutants Emphasizes the role of nanotechnology in pollutant bioremediation

Much of the convenience of modern life resides in sheet metal, the cowling shield of most machines and appliances. However, the load that this takes off human shoulders has to be carried elsewhere, and the Earth has borne the burden. Many of us woke up to the environmental cost when over a century of industrialization finally surpassed the capacity of nature to assimilate it. International in scope, Heavy Metals in the Environment: Using Wetlands for Their Removal discusses wetland functions and heavy metal contamination. It addresses such questions as: Can systems powered by sunlight handle toxins more effectively than systems running on fossil fuel? At what scale and by what means do we define efficiency? These questions resonate increasingly with a number of global challenges. As inescapable as climate change, you can no longer avoid airborne toxins, acid rain, and polluted water by moving away from them. When the time comes to rely less on fossil fuel-based technology, how will we clean up the aftermath of toxic misadventures? Written by a leader in the growing field of ecological engineering, Heavy Metals in the Environment: Using Wetlands for Their Removal presents scientific studies that illustrate how natural systems use wetlands to adapt to changes in the ecosystem. It focuses primarily on lead, one of the first materials used by developing civilizations and a metal used heavily in the industrial era. The goal: to achieve a better understanding of how natural systems use wetlands to adapt to wastes.

New Trends in Removal of Heavy Metals from Industrial WastewaterElsevier

Heavy metals, such as lead, chromium, cadmium, zinc, copper, and nickel, are important constituents of most living organisms, as well as many nonliving substances. Some heavy metals are essential for growth of biological and microbiological lives, yet their presence in excessive quantities is harmful to humans and interferes with many environmental

This specialist research-level monograph presents an overview of environmentally significant microbe-metal interactions, covering both enzymatic and non-enzymatic reactions.

Biomass presents an authoritative and comprehensive overview of the possibilities for production and use of biomasses of agricultural and industrial importance. Issues related to environment, food, chemicals and energy present serious challenges to the success and stability of nations. The challenge to provide commodities to a rapidly increasing global population has made it imperative to find new technological routes to increase production of consumables while also considering the biospheres ability to regenerate resources. Plant and microbial biomasses are bioresources that may provide solutions to these critical challenges. Divided into five discreet parts, the book covers topics on production of unconventional biomasses and improving of conventional cultures, summarizing a range of useful products derived by biomass. This book provides an insight into future developments in each field and extensive bibliography. It will be an essential resource for researchers and academic and industry professionals in the life sciences.

Contamination of drinking water is a worldwide problem, and ongoing work is taking place across the globe to address the issues affecting this precious commodity. Focussing on the presence of heavy metals in water, this book addresses the opportunities and challenges of this important area of research. Written and edited by experts working within the area the book highlights new techniques and research methodologies used to treat the widespread issue of dissolved heavy metals in drinking water supplies. The text covers a wide range of topics, including biofiltrations, use of nanotechnology against heavy metals, removal of heavy metals using industrial and agricultural waste, use of surfactants, soil degradation and removal of dyes and pigments from industrial effluents. Providing an up-to-date treatise on this developing field, this text will be essential reading for water and environmental scientists, toxicologists, biochemists and regulators, and anyone interested in the treatment and decontamination of the World's drinking water supplies.

This book highlights the latest research on dissolved heavy metals in drinking water and their removal.

This book provides researchers and graduate students with an overview of the latest developments in and applications of adsorption processes for water treatment and purification. In particular, it covers current topics in connection with the modeling and design of adsorption processes, and the synthesis and application of cost-effective adsorbents for the removal of relevant aquatic pollutants. The book describes recent advances and alternatives to improve the performance and efficacy of this water purification technique. In addition, selected chapters are devoted to discussing the reliable modeling and analysis of adsorption data, which are relevant for real-life applications to industrial effluents and groundwater. Overall, the book equips readers with a general perspective of the potential that adsorption processes hold for the removal of emerging water pollutants. It can readily be adopted as part of special courses on environmental engineering, adsorption and water treatment for upper undergraduate and graduate students. Furthermore, the book offers a valuable resource for researchers in water

production control, as well as for practitioners interested in applying adsorption processes to real-world problems in water treatment and related areas.

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.

This book is the outcome of contributions by many experts in the field from different disciplines, various backgrounds, and diverse expertise. This book provides information on biomass volume calculation methods and biomass valorization for energy production. The chapters presented in this book include original research and review articles. I hope the research presented in this book will help to advance the use of biomass for bioenergy production and valorization. The key features of the book are: Providing information on biomass volume estimation using direct, nondestructive and remote sensing methods Biomass valorization for energy using thermochemical (gasification and pyrolysis) and biochemical (fermentation) conversion processes.

The safe disposal of distillery waste into the environment, as well as its recycling and management, has become a hot topic in developing countries including India. This gross misconduct creates serious environmental and public health hazards. Thus, adequate management of waste has become a priority of environmental engineers and biotechnologists for environmental safety and sustainable development. Recent Advances in Distillery Waste Management for Environmental Safety covers specific, advanced, and updated knowledge on various developed individual and/or innovative, green, and emerging plant-microbe-based technologies' uses for the management and recycling of distillery waste in an environmentally friendly and cost-effective manner for sustainable development. Moreover, this book provides comprehensive, state-of-the-art information on the physicochemical properties, chemical composition, and environmental risks associated with distillery waste. Furthermore, the book also discusses various existing methods and technologies; up-gradation of existing technologies; the advent of newer technologies for the treatment, processing, and disposal of distillery waste; and focus areas for further development. This broad and unique coverage allows treatment firms and regulatory authorities to determine and develop appropriate treatment strategies for site-specific problems of distillery waste remediation. Features: Provides practical solutions for the treatment and recycling of distillery waste illustrated by specific case studies Focuses on recent industry practices and preferences, along with newer approaches for wastewater treatment An instructive compilation of treatment approaches, including advanced physicochemical and integrated/sequential methods Covers biocomposting of sludge and effluent, and biodiesel production from distillery waste for recycling and sustainable development Emphasizes the relationship of metagenomics with organometallic compounds of distillery waste Discusses the role of ligninolytic enzymes and bioreactors in distillery wastewater treatment This book serves as an accessible reference to assist engineering consultants, industrial waste managers, policy makers, environmental engineers, government implementers, researchers, scientists, and a wide range of professionals responsible for regulating, monitoring, and designing industrial wastewater treatment techniques, who aspire to work on the reclamation, recycling, and management of distillery waste or wastewater pollutants for environmental safety and sustainable development.

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