

Nanotechnology in Wastewater Treatment



Nanotechnology In Industrial Wastewater Treatment

**Piet Lens, Jurate Virkutyte, Veeriah
Jegatheesan, S. Al-Abed**



Nanotechnology In Industrial Wastewater Treatment:

Nanotechnology in Industrial Wastewater Treatment Dr. Arup Roy, Jayanta Bhattacharya, 2015-01-15 Nanotechnology in Industrial Wastewater Treatment is a state of the art reference book The book is particularly useful for wastewater technology development laboratories and organizations All professional and academic areas connected with environmental engineering nanotechnology based wastewater treatment and related product design are incorporated and provide an essential resource The book describes the application and synthesis of Ca based and magnetic nano materials and their potential application for removal treatment of heavy metals from wastewater Nanotechnology in Industrial Wastewater Treatment discusses the rapid wastewater treatment methods using Ca based nanomaterials and magnetic nanomaterials This is an emerging area of new science and technology in wastewater treatment The main audiences for the book are water industry professionals research scholars and students in the area of Environmental Engineering and Nanotechnology Authors Dr Arup Roy Department of Mining Engineering Geo Environmental Lab Indian Institute of Technology Kharagpur India and Professor Jayanta Bhattacharya Department of Mining Engineering Geo Environmental Lab Indian Institute of Technology Kharagpur India *Advanced Application of Nanotechnology to Industrial Wastewater* Maulin P. Shah, 2023-06-24 This book discusses new and innovative trends and techniques in the application of nanotechnology to industrial wastewater treatment both at a laboratory scale and an industry scale including treatment remediation sensing and pollution prevention The book also explores unique physicochemical and surface properties of nanoparticles it highlights advantages they provide for engineering applications Each chapter covers a different nanotechnology based approach and examines basic principles practical applications recent breakthroughs and associated limitations Nanotechnology applications to wastewater research have significant impact in maintaining the long term quality availability and viability of water Regardless of the origin for example municipal or industrial wastewater the remediation nanotechnology allows water to be recycled and desalinized in addition to simultaneously detecting biological and chemical contamination The book describes a broad area of nanotechnology and water research where membrane processes nanofiltration ultrafiltration reverse osmosis and nanoreactive membranes are considered key components of advanced water purification and desalination technologies that remove reduce or neutralize water contaminants Various nanoparticles and nanomaterials that could be used in water remediation zeolites carbon nanotubes self assembled monolayers on mesoporous supports biopolymers single enzyme nanoparticles zero valent iron nanoparticles bimetallic iron nanoparticles and nanoscale semiconductor photocatalysts are also discussed This book is beneficial for students and academicians to understand the recent research advancements in the field **Nanotech Solutions for Industrial Wastewater** Ashootosh Mandpe, Devaanshi Jagwani, Maulin P. Shah, 2025-10-09 This book explores the transformative field of nanotechnology in wastewater treatment and emphasizes state of the art strategies to address intricate challenges The volume is a valuable guide for professionals researchers and

students involved in industrial waste management Distinguishing itself by providing detailed insights into the application of nanomaterials the book highlights their unique properties including high surface area reactivity and selectivity owing to nanoscale dimensions It meticulously examines nanomaterials efficacy in adsorption catalysis and pollutant transformation which are faster and more efficient treatment than conventional methods The volume encompasses customized nanomaterials for specific pollutants reducing resource consumption in line with sustainability principles The book also explores the compact designs for nanomaterial based treatment systems particularly beneficial for space constrained industries The book bridges a gap between scientific insights and practical applications offering a thorough exploration of waste management methodologies policy frameworks and circular economy integration With a focus on technology transfer capacity building and governance the book shows professionals and stakeholders to implement nanomaterial based approaches Overall it stands as a concise and practical guide seamlessly blending scientific rigor with real world relevance in the field of industrial wastewater treatment

Microbial Technologies in Industrial Wastewater Treatment Maulin P. Shah,2023-06-26 Microbial technology using live naturally occurring microorganisms in industrial wastewater treatment is the most effective and innovative method to degrade environmental pollutants such as heavy metals radionuclides xenobiotic compounds organic waste and pesticides or to prevent their contamination of the environment The technology includes several techniques such as biostimulation biogenesis bioaccumulation and biosorption This book describes the limitations and challenges associated with some generally accepted bioremediation strategies and evaluates the possible applications of these corrective strategies to eliminate toxic pollutants from the environment The environmental contamination by both natural and anthropogenic sources is nowadays an international concern To decontaminate soils sediments and water polluted by anthropogenic activities scientists and technologists have developed various technologies over the years however not only do we have to pay a high cost for physical and chemical environmental technologies but also they sometimes are not ecological or safe Therefore we have realized the necessity to develop viable technologies that use microbes and plants to avoid these issues This book is designed for engineers scientists and other professionals who are seeking introductory and advanced knowledge of the principles of nanotechnology and those who work or are interested in the environmental microbiology or bioremediation field

Nano-solutions for Sustainable Water and Wastewater Management Manoj Chandra Garg,Vishnu D. Rajput,Tatiana Minkina,Sushil Kumar Himanshu,2025-06-11 The proposed book aims to provide a comprehensive overview of the advancements and potential applications of nanotechnology in addressing the challenges of water and wastewater management The book intends to explore the latest research findings innovative technologies and emerging trends in utilizing nanomaterials for sustainable and efficient water treatment processes The primary purpose of this new book is to bridge the gap between nanotechnology and water wastewater management by presenting cutting edge research and practical applications The main objective of this new book is to serve as a valuable resource for researchers

engineers policymakers and professionals working in the field of water and wastewater treatment The wide range of topics including nanomaterial synthesis characterization techniques various nanotechnology based treatment processes nanomaterials for contaminant removal nanosensors for water quality monitoring and nanotechnology enabled resource recovery will be covered in this book As the authors of this book our motivation stems from the urgent need to address global water scarcity and pollution issues The nanotechnology holds immense potential in revolutionizing water and wastewater management practices by offering highly efficient cost effective and sustainable solutions By compiling and presenting the latest research and advancements in this field we aim to inspire further research collaboration and innovation in utilizing nanotechnology for the betterment of water resources and environmental sustainability The main goal of this new book is to contribute to the dissemination of knowledge and promote the adoption of nanotechnology in achieving sustainable water and wastewater management worldwide *Separations of Water Pollutants with Nanotechnology* Satinder

Ahuja,2022-04-29 *Separations of Water Pollutants with Nanotechnology* the latest volume in the Separation Science and Technology series offers new solutions for remediating water pollution utilizing nanomaterials with separation methods Current water purification methods are unsuitable inconvenient or expensive so there is a need for new and better processes and techniques Nanomaterials can purify water by removing pollutants such as heavy metals pathogens organic compounds inorganic compounds pharmaceuticals and chemicals of emerging concern These can effectively replace membrane based methods if the right expertise is developed this book helps separation scientists do just that Existing water treatment problems can be solved by applying a nanotechnology based processes antimicrobial nanotechnology zero valent iron nanoparticles nanoadsorbents nano enhanced membranes nanometal oxides and nano photocatalysts The current literature places emphasis on materials chemistry rather than the separation methods used for water purification This new volume presents a collection of chapters that deal with remediation based on separation chemistry Written by leaders in their respective fields from around the world and edited by Satinder Ahuja a leading expert on water quality improvement Covers the environmental impact of anthropogenic nanoparticles and plant derived bionanomaterials which are not contained in other books related to nanomaterials for water purification Illustrates key information visually wherever possible throughout the book e g process diagrams in the nanomaterial synthesis and nanomembrane fabrication chapters electron microscope images and more *Nanotechnology for Sustainable Water Resources* Ajay Kumar Mishra,Chaudhery Mustansar

Hussain,2018-02-05 In this book we have summarized recent progresses due to novel nanomaterials for sustainable water resources Book provides a summary of the state of the art knowledge to scientists engineers and policy makers about recent developments due to nanotechnology for sustainable water resources arena The advances in sustainable water resources technologies in the context of modern society s interests will be considered preferably which allow to identify grand challenges and directions for future research The book contributors have been selected from all over the world and the

essential functions of the nanotechnologies have presented rather than their anticipated applications Moreover up to date knowledge on economy toxicity and regulation related to nanotechnology are presented in detail In the end role of nanotechnology for green and sustainable future has also been briefly debated Nano-Bioremediation for Wastewater Treatment Gajendra Singh Vishwakarma,Narendra Kumar,Alok Pandya,Zinia Mohanta,2025-05-20 Invest in Nano Bioremediation for Wastewater Treatment to explore cutting edge techniques that combine nanotechnology and bioremediation equipping you with innovative solutions and expert insights needed to tackle global environmental pollution challenges effectively The coupling of nanotechnology and bioremediation techniques holds great promise for addressing environmental pollution and contamination on a global scale The process of bioremediation uses living organisms such as bacteria fungi or plants to degrade or detoxify pollutants in the environment Nanotechnology involves manipulating materials at the nanoscale typically at the scale of individual atoms and molecules to create novel properties and functionalities Today research is focused on exploring the combined potential of nanomaterials and bioremediation for treating pollutants Nano Bioremediation for Wastewater Treatment will serve as a premier guide for nanotechnology in this field providing information regarding the various challenges that arise from the coupling of nanotechnology and bioremediation techniques Since very limited literature is available on this subject the editors have compiled all the current assays and techniques that provide insights into this topic This book will also cover different fabrication methods and methods for decorating microbial cells on the surface of nanomaterials which is a key factor for synthesizing microbial conjugation as well as prototype designing and integrating developed materials into water purification systems Unlock the potential of cutting edge nano bioremediation techniques for wastewater treatment with practical applications expert insights and sustainable solutions that set you apart in the field Audience Environmental engineers chemists biotechnologists microbiologists nanotechnologists environmental consultants researchers academics and policymakers focused on developing and implementing innovative solutions for wastewater treatment and environmental remediation **Development in Wastewater Treatment Research and Processes** Maulin P. Shah,Susana Rodriguez-Couto,2024-01-13 Development in Wastewater Treatment Research and Processes Innovative Trends in Removal of Refractory Pollutants from Pharmaceutical Waste Water sorts out emerging and burning issues faced by the pharmaceutical industry along with common effluent treatment plans The book provides a comprehensive view of recent advents of various novel advanced and hybrid treatment technologies in pharmaceutical wastewater treatment to treat emerging pollutants released by the pharmaceutical industry in their untreated wastewater In addition the book gives insights into recent developments with a physico chemical and microbiological focus on the treatment of emerging contaminants pollutants present in pharmaceutical wastewater Discusses fundamentals of physico chemical and microbiological wastewater treatment systems advantages limitations and promising solutions of different types of emerging contaminants present in pharmaceutical wastewater Presents recent trends and developments in the removal of refractory

organics pollutants contaminants from pharmaceutical wastewater for achieving sustainable wastewater treatment Covers applications of various advanced and hybrid treatment technologies for the removal of emerging contaminants from pharmaceutical wastewater treatment plants Includes hybrid treatment technologies their design and application in the removal of pharmaceutical wastewater contaminants Addresses challenges for the full scale implementation of bioreactors for pharmaceutical wastewater treatment

Sustainable Science and Intelligent Technologies for Societal Development Mishra, Brojo Kishore, 2023-09-18 In today's world the pressing challenges of sustainable development and societal progress demand innovative solutions that harness the power of science and technology From climate change to resource depletion and social inequalities the urgency to find sustainable intelligent and ethical approaches has never been greater Academic scholars and researchers play a crucial role in driving these advancements but often struggle to find comprehensive resources that bridge the gap between theory and real world applications The need of the hour is a definitive guide that unites expertise from diverse disciplines and offers practical insights into leveraging sustainable science and intelligent technologies to create meaningful societal development Sustainable Science and Intelligent Technologies for Societal Development edited by Brojo Kishore Mishra of GIET University India is the much awaited solution to the challenges faced by academic scholars and researchers This persuasive book brings together an esteemed collection of leading experts academics and industry professionals all dedicated to addressing global challenges through the lens of applied sciences and intelligent technology applications By presenting a wide range of innovative topics such as renewable energy smart healthcare sustainable finance and more the book serves as a comprehensive resource that empowers scholars with actionable knowledge and innovative ideas The book not only covers the theoretical aspects but also delves into the ethical considerations essential in shaping the future In a world increasingly dependent on technology it is vital to ensure that societal development aligns with principles of inclusivity fairness and environmental responsibility With a focus on the United Nations Sustainable Development Goals SDGs the book provides a clear roadmap for scholars to contribute meaningfully to global progress By offering concrete examples and real world case studies the book enables researchers to grasp the potential impact of their work fostering collaborations that transcend traditional disciplinary boundaries Sustainable Science and Intelligent Technologies for Societal Development is the go to resource for academic scholars scientists researchers innovators industry professionals and students who seek to be effective in the world As a comprehensive guide that blends sustainable science and intelligent technologies with ethical considerations this book equips its readers to create tangible solutions that address pressing global challenges Through collective knowledge and interdisciplinary collaboration this book stands as a beacon of hope and inspiration for driving meaningful societal development paving the way for a more sustainable and prosperous future

Green Metal Nanoparticles Suvardhan Kanchi, Shakeel Ahmed, 2018-10-18 This groundbreaking book uniquely focuses on the exploration of the green synthesis of metal nanoparticles and their

characterization and applications Metal nanoparticles are the basic elements of nanotechnology as they are the primary source used in the design of nanostructured devices and materials Nanomaterials can be manufactured either incidentally with physical or chemical methods or naturally and the high demand for them has led to their large scale production by various toxic solvents or high energy techniques However due to the growing awareness of environmental and safety issues the use of clean nontoxic and environment friendly ways to synthesize metal nanoparticles has emerged out of necessity The use of biological resources such as microbes plant parts vegetable wastes agricultural wastes gums etc has grown to become an alternative way of synthesizing metal nanoparticles This biogenic synthesis is green environmentally friendly cost effective and nontoxic The current multi authored book includes recent information and builds a database of bioreducing agents for various metal nanoparticles using different precursor systems Green Metal Nanoparticles also highlights different simple cost effective environment friendly and easily scalable strategies and includes parameters for controlling the size and shape of the materials developed from the various greener methods

Engineered Carbon Nanotubes and Nanofibrous

Material A. K. Haghi, Praveen K.M., Sabu Thomas, 2018-10-16 Carbon nanotubes with their extraordinary engineering properties have garnered much attention in the past 10 years Because of the broad range of potential applications the scientific community is more motivated than ever to move beyond basic properties and explore the real issues associated with carbon nanotube based applications Presenting up to date literature that presents the current state of the science this book Engineered Carbon Nanotubes and Nanofibrous Material Integrating Theory and Technique fully explores the development phase of carbon nanotube based applications It looks at carbon nanotubes and their applications in diverse areas of science and engineering and considers environmental engineering applications as well This volume is a valuable resource for engineers scientists researchers and professionals in a wide range of disciplines whose focus remains on the power and promise of carbon nanotubes

Handbook of Nanomaterials for Wastewater Treatment Bharat A. Bhanvase, Shirish H. Sonawane, Vijay B. Pawade, Aniruddha B. Pandit, 2021-05-05 Handbook of Nanomaterials for Wastewater Treatment Fundamentals and Scale up Issues provides coverage of the nanomaterials used for wastewater treatment covering photocatalytic nanocomposite materials nanomaterials used as adsorbents water remediation processes and their current status and challenges The book explores the major applications of nanomaterials for effective catalysis and adsorption also providing in depth information on the properties and application of new advanced nanomaterials for wastewater treatment processes This is an important reference source for researchers who need to solve basic and advanced problems relating to the use of nanomaterials for the development of wastewater treatment processes and technologies As nanotechnology has the potential to substantially improve current water and wastewater treatment processes the synthesis methods and physiochemical properties of nanomaterials and noble metal nanoparticles make their performance and mechanisms efficient for the treatment of various pollutants Explains the properties of the most commonly used

nanomaterials used for wastewater treatment Describes the major nanoscale synthesis and processing techniques for wastewater treatment Assesses the major challenges for using nanomaterials on a mass scale for wastewater treatment

Development in Wastewater Treatment Research and Processes Susana Rodriguez-Couto, Maulin P. Shah, Jayanta Kumar Biswas, 2021-09-11 Removal of Emerging Contaminants from Wastewater through Bio nanotechnology showcases profiles of the nonregulated contaminants termed as emerging contaminants which comprise industrial and household persistent toxic chemicals pharmaceuticals and personal care products PPCPs pesticides surfactants and surfactant residues plasticizers and industrial additives manufactured nanomaterials and nanoparticles microplastics etc that are used extensively in everyday life The occurrence of emerging contaminants in wastewater and their behavior during wastewater treatment and production of drinking water are key issues in the reuse and recycling of water resources This book focuses on the exploitation of Nano biotechnology inclusive of the state of the art remediate strategies to degrade detoxify stabilize toxic and hazardous contaminants and restore contaminated sites which is not as comprehensively discussed in the existing titles on similar topics available in the global market In addition it discusses the potential environmental and health hazards and ecotoxicity associated with the widespread distribution of emerging contaminants in the water bodies It also considers the life cycle assessment LCA of emerging micro pollutants with suitable case studies from various industrial sources Provides natural and ecofriendly solutions to deal with the problem of pollution Details underlying mechanisms of nanotechnology associated microbes for the removal of emerging contaminants Describes numerous successful field studies on the application of bio nanotechnology for eco restoration of contaminated sites Presents recent advances and challenges in bio nanotechnology research and applications for sustainable development Provides authoritative contributions on the diverse aspects of bio nanotechnology by world s leading experts *Nanomaterials in Wastewater Research* Neha Agarwal, Maulin P.

Shah, Vijendra Singh Solanki, Neetu Singh, 2025-06-27 This book explores the perspectives and prospects of nanotechnology in environmental remediation and provides a deep insight into the role of nanomaterials for wastewater remediation The book also focuses on the need for novel developments in the nanomaterials which can target particular contaminants in wastewater It also takes into account the challenges involved in the application of these nanomaterials their social and economic aspects and future directions in multifaceted aspects of nanomaterial use that will facilitate future research to formulate the strategies for environmental restoration Nanotechnology offers new and improved environmental remediation technologies such as nanophotocatalysts nanosensors nanodevices nanofilters and nanoadsorbents for the decontamination of toxic pollutants groundwater and industrial wastewater Considering the capabilities of nanotechnology in controlling eliminating and purifying environmental pollutants it can also be considered as a green technology and an effective tool to achieve sustainable environment **Effects of Nanoparticles on Granular Activated Carbon in Industrial Wastewater**

Treatment Kyongmin Song, 2013 With the introduction of industrial scale manufacturing of nanoparticles and their use in

manufacturing processes it is imperative to accurately predict and model their possible effects on downstream treatment systems A rising concern is the effects of manufactured nanoparticles on wastewater facilities particularly their effects on granular activated carbon GAC GAC is primarily used in industrial wastewater facilities to remove volatile organic compounds VOC from the wastewater effluent so that treatment requirements and discharge limitations can be met The goal of this project is to evaluate the effects of nanoparticles on GAC s ability to adsorb organic compounds Column breakthrough studies were performed to quantitatively model the effects of the presence of silica nanoparticles on GAC s ability to capture trichloroethylene TCE a widely used industrial solvent The column breakthrough data were fitted using the Yoon Nelson empirical model The results of these studies found that there were indeed significant impacts that silica nanoparticles imposed on GAC s ability to adsorb TCE At an influent nanoparticle concentration of 25mg L breakthrough studies found an 18% reduction in the adsorption capacity of GAC These bench scale studies combined with a comprehensive literature review were used to predict the extent that certain nanoparticle concentrations in wastewater influent could affect GAC s adsorption capacity

Application of Nanotechnology for Resource Recovery from Wastewater Jitendra Kumar Pandey, Syed Mohammad Tauseef, Suvendu Manna, Ravi Kumar Patel, Vishal Kumar Singh, Ankit Dasgotra, 2024-02-06 Most of the time industrial wastes contain recoverable resources that would be useful in other applications For example greywater have enough nutrient to support the growth of microalgal biomass that are useful for biofuel production Similarly solid waste generated in metal extraction industries often contain high concentration of other metals that could be extracted using various processes This book presents a critical overview on the current nanotechnologies that are being utilized for extraction of valuable resources from various industrial and domestic wastes This book presents research reviews and case studies on the extraction of metal organic compounds energy and nutrients from waste through nanotechnological interventions

Innovative Nanocomposites for the Remediation and Decontamination of Wastewater Kumar, Azad, 2022-05-27 Industry wastewater is a major contributor to environmental pollution with chemicals such as dyes acids fungicides and more creating a threat to the environment Nanocomposites of heterogeneous photocatalysis can be used to cure such problems due to its efficiency and ease of use as well as the fact that it turns toxic chemicals completely to carbon dioxide and inorganic acids With toxic chemicals posing a tremendous threat to ecological wellbeing and human health it is integral that a variety of nanocomposites are studied for their use in the degradation of toxic and hazardous chemicals Innovative Nanocomposites for the Remediation and Decontamination of Wastewater describes the synthesis of nanomaterials and its application for the protection of the environment It presents studies on the photodegradation of the various toxic and hazardous chemicals by different nanocomposites as well as the decontamination of bodies of water through the use of various nanocomposites Covering topics such as dye degradation novel biomaterials and structural modification this premier reference source is a vital resource for environmental scientists construction managers compliance

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Application of Nanotechnology in Water Research Ajay Kumar Mishra, 2014-06-23 Details the water research applications of nanotechnology in various areas including environmental science remediation membranes nanomaterials and water treatment At the nano size materials often take on unique and sometimes unexpected properties that result in them being tuned to build faster lighter stronger and more efficient devices and systems as well as creating new classes of materials In water research nanotechnology is applied to develop more cost effective and high performance water treatment systems as well as to provide instant and continuous ways to monitor water quality This volume presents an array of cutting edge nanotechnology research in water applications including treatment remediation sensing and pollution prevention Nanotechnology applications for waste water research have significant impact in maintaining the long term quality availability and viability of water Regardless of the origin such as municipal or industrial waste water its remediation utilizing nanotechnology can not only be recycled and desalinized but it can simultaneously detect biological and chemical contamination *Application of Nanotechnology in Water Research* describes a broad area of nanotechnology and water research where membrane processes nanofiltration ultrafiltration reverse osmosis and nanoreactive membranes are considered key components of advanced water purification and desalination technologies that remove reduce or neutralize water contaminants that threaten human health and or ecosystem productivity and integrity Various nanoparticles and nanomaterials that could be used in water remediation zeolites carbon nanotubes self assembled monolayer on mesoporous supports biopolymers single enzyme nanoparticles zero valent iron nanoparticles bimetallic iron nanoparticles and nanoscale semiconductor photocatalysts are discussed The book also covers water borne infectious diseases as well as water borne pathogens microbes and toxicity approach

Nanotechnology for Water and Wastewater Treatment Piet Lens, Jurate Virkutyte, Veeriah Jegatheesan, S. Al-Abed, 2013-07-14 The rapid development of nanoscience enables a technology revolution that will soon impact virtually every facet of the water sector Yet there is still too little understanding of what nanoscience and nanotechnology is what can it do and whether to fear it or not even among the educated public as well as scientists and engineers from other disciplines Despite the numerous books and textbooks available on the subject there is a gap in the literature that bridges the space between the synthesis conventional and more greener methods and use applications in the drinking water production wastewater treatment and environmental remediation fields of nanotechnology on the one hand and its potential environmental implications fate and transport of nanomaterials toxicity Life Cycle Assessments on the other *Nanotechnology for Water and Wastewater Treatment* explores these topics with a broad based multidisciplinary scope and can be used by engineers and scientists outside the field and by students at both undergraduate and post graduate level

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