

Anaerobic Reactors Biological Wastewater Treatment Volume 4 By Carlos Augusto De Lemos Chernicharo 2007 01 05

Biological Wastewater Treatment: Principles, Model

Biological Wastewater Treatment in Warm Climate Regions gives a state-of-the-art presentation of the science and technology of biological wastewater treatment, particularly domestic sewage. The book covers the main treatment processes used worldwide with wastewater treatment in warm climate regions given a particular emphasis where simple, affordable and sustainable solutions are required. This comprehensive book presents in a clear and informative way the basic principles of biological wastewater treatment, including theory and practice, and covering conception, design and operation. In order to ensure the practical and didactic view of the book, 371 illustrations, 322 summary tables and 117 examples are included. All major wastewater treatment processes are covered by full and interlinked design examples which are built up throughout the book, from the determination of wastewater characteristics, the impact of discharge into rivers and lakes, the design of several wastewater treatment processes and the design of sludge treatment and disposal units. The 55 chapters are divided into 7 parts over two volumes: Volume One: (1)

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Introduction to wastewater characteristics, treatment and disposal; (2) Basic principles of wastewater treatment; (3) Stabilisation ponds; (4) Anaerobic reactors; Volume Two: (5) Activated sludge; (6) Aerobic biofilm reactors; (7) Sludge treatment and disposal. As well as being an ideal textbook, Biological Wastewater Treatment in Warm Climate Regions is an important reference for practising professionals such as engineers, biologists, chemists and environmental scientists, acting in consulting companies, water authorities and environmental agencies.

"Access to safe water is a fundamental human need and therefore a basic human right" --Kofi Annan, United Nations Secretary General Edited by two world-renowned scientists in the field, The Handbook of Water and Wastewater Microbiology provides a definitive and comprehensive coverage of water and wastewater microbiology. With contributions from experts from around the world, this book gives a global perspective on the important issues faced in the provision of safe drinking water, the problems of dealing with aquatic pollution and the processes involved in wastewater management. Starting with an introductory chapter of basic microbiological principles, The Handbook of Water and Wastewater Microbiology develops these principles further, ensuring that this is the essential text for process engineers with little microbiological experience and specialist microbiologists alike. Comprehensive selection of reviews dealing with drinking water and aquatic pollution Provides an understading of basic microbiology and how it is applied to engineering process solutions Suitable for all levels of

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knowledge in microbiology -from those with no background to specialists who require the depth of information

Handbook of Biological Wastewater Treatment: Second Edition deals with the optimized design of biological and chemical nutrient removal. It presents the state-of-the-art theory concerning the various aspects of the activated sludge system and develops procedures for optimized cost based design and operation.

This book reports research on policy and legal issues, anaerobic digestion of solid waste under processing aspects, industrial waste, application of GIS and LCA in waste management, and a couple of research papers relating to leachate and odour management.

This book provides useful information about bioremediation, phytoremediation, and mycoremediation of wastewater and some aspects of the chemical wastewater treatment processes, including ion exchange, neutralization, adsorption, and disinfection. Additionally, this book elucidates and illustrates the wastewater treatment plants in terms of plant sizing, plant layout, plant design, and plant location. Cutting-edge topics include wet air oxidation of aqueous wastes, biodegradation of nitroaromatic compounds, biological treatment of sanitary landfill leachate, bacterial strains for the bioremediation of olive mill wastewater, gelation of arabinoxylans from maize wastewater, and modeling wastewater evolution.

Sludge Treatment and Disposal is the sixth volume in the series Biological Wastewater

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Treatment. The book covers in a clear and informative way the sludge characteristics, production, treatment (thickening, dewatering, stabilisation, pathogens removal) and disposal (land application for agricultural purposes, sanitary landfills, landfarming and other methods). Environmental and public health issues are also fully described. About the series: The series is based on a highly acclaimed set of best selling textbooks. This international version is comprised by six textbooks giving a state-of-the-art presentation of the science and technology of biological wastewater treatment. Other titles in the series are: Volume 1: Waste Stabilisation Ponds; Volume 2: Basic Principles of Wastewater Treatment; Volume 3: Waste Stabilization Ponds; Volume 4: Anaerobic Reactors; Volume 5: Activated Sludge and Aerobic Biofilm Reactors

The FISH Handbook for Biological Wastewater Treatm

With increasing government regulation of pollution, as well as willingness to levy punitive fines for transgressions, treatment of industrial waste is a important subject. This book is a single source of information on treatment procedures using biochemical means for all types of solid, liquid and gaseous contaminants generated by various chemical and allied industries. This book is intended for practicing environmental engineers and technologists from any industry as well as researchers and professors. The topics covered include the treatment of gaseous, liquid and solid waste from a large number of chemical and allied industries that include dye stuff, chemical, alcohol, food processing, pesticide, pharmaceuticals, paint etc. Information on aerobic and

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anaerobic reactors and modeling and simulation of waste treatment systems are also discussed. * Compares chemical and biochemical means of industrial waste treatment * Provides details of technology (i.e. reactors, operating conditions etc) with regard to the biochemistry aspects. * Can be used as a teaching aid for graduate courses and a reference material by practicing environmental scientists and engineers. * Researchers can extract synergy between treatment procedures and various effluents.

The focus of the book is on how to use mass and heat balances to simulate and design biological wastewater treatment processes. All the main processes for biological wastewater treatment are covered viz. activated sludge processes for carbon and nitrogen removal, anaerobic digestion, sequencing batch reactors, and attached growth processes.

Anaerobic Reactors is the fourth volume in the Biological Wastewater Treatment series. The fundamentals of anaerobic treatment are presented in detail, including its applicability, microbiology, biochemistry and main reactor configurations. Two reactor types are analysed in more detail, namely anaerobic filters and especially UASB (upflow anaerobic sludge blanket) reactors. Particular attention is also devoted to the post-treatment of the effluents from the anaerobic reactors. The book presents in a clear and didactic way the main concepts, working principles, expected removal efficiencies, design criteria, design examples, construction aspects, and operational guidelines for anaerobic reactors. The Biological Wastewater Treatment series is based

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on the book Biological Wastewater Treatment in Warm Climate Regions and on a highly acclaimed set of best selling textbooks. This international version is comprised by six textbooks giving a state-of-the-art presentation of the science and technology of biological wastewater treatment. Other books in the Biological Wastewater Treatment series: Volume 1: Wastewater characteristics, treatment and disposal Volume 2: Basic principles of wastewater treatment Volume 3: Waste stabilisation ponds Volume 5: Activated sludge and aerobic biofilm reactors Volume 6: Sludge treatment and disposal Contents: Overview of Treatment Wetlands; Fundamentals of Treatment Wetlands; Horizontal Flow Wetlands; Vertical Flow Wetlands; French Vertical Flow Wetlands; Intensified and Modified Wetlands; Free Water Surface Wetlands; Other Applications; Additional Aspects.

This book presents a state-of-the-art report on the treatment of pulp and paper industry effluents using anaerobic technology. It covers a comprehensive range of topics, including the basic reasons for anaerobic treatment, comparison between anaerobic and aerobic treatment, effluent types suitable for anaerobic treatment, design considerations for anaerobic treatment, anaerobic reactor configurations applied for treatment of pulp and paper industry effluents, present status of anaerobic treatment in pulp and paper industry, economic aspects, examples of full scale installations and future trends.

A new development for the treatment of domestic wastewater is a technology based on

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aerobic granular sludge. Granular sludge can be developed under specific process conditions. Because of the unique properties of this granular sludge, high volumetric loading rates of aeration tanks can be applied. Thanks to excellent settling properties, the separation of treated wastewater and granular sludge can take place at high hydraulic loading rates. Depending on the chosen process configuration good effluent quality can be obtained, complying with the stringent effluent requirements regarding nitrogen and phosphorus, which can be expected in the future. In this way aerobic granular sludge has the potential to contribute significantly to wastewater treatment management. This report describes the results of research carried out at the Technical University of Delft.

Wastewater Characteristics, Treatment and Disposal is the first volume in the series Biological Wastewater Treatment, presenting an integrated view of water quality and wastewater treatment. The book covers the following topics: wastewater characteristics (flow and major constituents) impact of wastewater discharges to rivers and lakes overview of wastewater treatment systems complementary items in planning studies. This book, with its clear and practical approach, lays the foundations for the topics that are analysed in more detail in the other books of the series. About the series: The series is based on a highly acclaimed set of best selling textbooks. This international version is comprised by six textbooks giving a state-of-the-art presentation of the science and technology of biological wastewater treatment. Other titles in the series

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are: Volume 2: Basic Principles of Wastewater Treatment; Volume 3: Waste Stabilisation Ponds; Volume 4: Anaerobic Reactors; Volume 5: Activated Sludge and Aerobic Biofilm Reactors; Volume 6: Sludge Treatment and Disposal
Biofilms in Wastewater Treatment: An Interdiscipli

This book contains a collection of different research activities where several technologies have been applied to the optimization of biodegradation processes. The book has three main sections: A) Hydrocarbons biodegradation, B) Biodegradation and anaerobic digestion, and C) Biodegradation and sustainability.

Anaerobic Reactors IWA Publishing

Substitute Natural Gas from Waste: Technical Assessment and Industrial Applications of Biochemical and Thermochemical Processes provides an overview of the science and technology of anaerobic digestion and thermal gasification for the treatment of biomass and unrecyclable waste residues. The book provides both the theoretical and practical basis for the clean and high-efficiency utilization of waste and biomass to produce Bio-Substitute Natural Gas (SNG). It examines different routes to produce bio-SNG from waste feedstocks, detailing solutions to unique problems, such as scale up issues and process integration. Final sections review waste sourcing and processing. This book is an ideal and practical reference for those developing, designing, scaling and managing bio-SNG production and utilization systems. Engineering students will find this to be a comprehensive resource on the application of fundamental concepts of bio-SNG production that are illustrated through innovative, recent case studies. Presents detailed scientific and technical information Describes up-to-date

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concepts, processes and plants for efficient anaerobic digestion and gasification of wastes and syngas utilization Compares gasification with anaerobic digestion for different situations Proposes alternative strategies to increase efficiency and overcome energy balance limitations Includes benchmarking data and industrial real-life examples to demonstrate the main process features and implementation pathways of bio-SNG systems from dry and wet waste, both in developed and developing countries

Biomethane Production from Vegetable and Water Hyacinth Waste explores the production of biomethane from vegetable waste and water hyacinth via anaerobic fermentation, focusing on effect factors, control methods and optimization. The book introduces principles and key technologies before proceeding into a deeper exploration of the fundamentals of municipal vegetable waste, such as composition, main indicators, experiment devices, and pretreatment. Processes to produce volatile fatty acids and resource recovery from anaerobic fermentation liquid and residue are described in detail. Other topics covered include the utilization of fermentation products, engineering design of a reaction tank, process parameters, and environmental and economic aspects. The practical, application-oriented approach of this book allows engineering researchers, PhD students, and industry practitioners in the field of biogas and biomethane production, biomass conversion, and waste management to immediately utilize the information it provides. Covers the fundamentals and applications of the use of food waste and water hyacinth for biomethane production through anaerobic digestion Explores core challenges of a biomethane production operation, including details on process optimization and control Includes multiple case studies grounded in current industrial practice Offers practical examples and numerical calculations for large-scale operation Provides a

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representative treatment of a PPP plant considered from a process systems design perspective

Waste Stabilisation Ponds is the third volume in the Biological Wastewater Treatment series. The major variants of pond systems are fully covered, namely .facultative ponds .anaerobic ponds .aerated lagoons .maturation ponds. The book presents in a clear and didactic way the main concepts, working principles, expected removal efficiencies, design criteria, design examples, construction aspects, operational guidelines and sludge management for pond systems. The Biological Wastewater Treatment series is based on the book Biological Wastewater Treatment in Warm Climate Regions and on a highly acclaimed set of best selling textbooks. This international version is comprised by six textbooks giving a state-of-the-art presentation of the science and technology of biological wastewater treatment. Other books in the Biological Wastewater Treatment series: Volume 1: Wastewater characteristics, treatment and disposal Volume 2: Basic principles of wastewater treatment Volume 4: Anaerobic reactors Volume 5: Activated sludge and aerobic biofilm reactors Volume 6: Sludge treatment and disposal

Following in the footsteps of previous highly successful and useful editions, Biological Wastewater Treatment, Third Edition presents the theoretical principles and design procedures for biochemical operations used in wastewater treatment processes. It reflects important changes and advancements in the field, such as a revised treatment of the micr

In recent years the MBR market has experienced unprecedented growth. The best practice in the field is constantly changing and unique quality requirements and management issues are regularly emerging. Membrane Biological Reactors: Theory, Modeling, Design, Management

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and Applications to Wastewater Reuse comprehensively covers the salient features and emerging issues associated with the MBR technology. The book provides thorough coverage starting from biological aspects and fundamentals of membranes, via modeling and design concepts, to practitioners' perspective and good application examples. Membrane Biological Reactors focuses on all the relevant emerging issues raised by including the latest research from renowned experts in the field. It is a valuable reference to the academic and professional community and suitable for undergraduate and postgraduate teaching in Environmental Engineering, Chemical Engineering and Biotechnology.

This two-volume book on biomass is a reflection of the increase in biomass related research and applications, driven by overall higher interest in sustainable energy and food sources, by increased awareness of potentials and pitfalls of using biomass for energy, by the concerns for food supply and by multitude of potential biomass uses as a source material in organic chemistry, bringing in the concept of bio-refinery. It reflects the trend in broadening of biomass related research and an increased focus on second-generation bio-fuels. Its total of 40 chapters spans over diverse areas of biomass research, grouped into 9 themes.

Anaerobic sewage treatment using UASB reactors has significantly expanded in the last few decades and is now a consolidated technology in some warm climate regions. Several advantages of the anaerobic process make it a more sustainable option for sewage treatment. However, there are still important constraints related to design, construction, and operation of UASB reactors. Conversely, there is enough knowledge, experience, and proven technology that can be used to effectively tackle all the related drawbacks. This book delivers the most relevant techno-scientific developments from academia and water authorities, comprehensively

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addressing the main aspects of interest in design, construction, and operation of UASB reactors for sewage treatment. Special attention is given to the proper and integrated management of sludge, scum, gaseous emissions, energy recovery, and effluent quality. The main purpose is to provide information and share experiences not yet compiled in the specialized literature on anaerobic sewage treatment. Therefore, a sequence of 12 well-interconnected chapters consolidates the practical knowledge and experiences that important research groups and recognized professionals worldwide have acquired over the past 20 years in demo- and full-scale anaerobic-based sewage treatment plants. Anaerobic Reactors for Sewage Treatment: Design, Construction and Operation can significantly contribute towards a responsible expansion of the anaerobic technology in the world. The book is a valuable tool for engineers, constructors, operators, wastewater utility managers, as well as for students interested in anaerobic processes for sewage treatment.

The IWA Task Group for Mathematical Modelling of Anaerobic Digestion Processes was created with the aim to produce a generic model and common platform for dynamic simulations of a variety of anaerobic processes. This book presents the outcome of this undertaking and is the result of four years collaborative work by a number of international experts from various fields of anaerobic process technology. The purpose of this approach is to provide a unified basis for anaerobic digestion modelling. It is hoped this will promote increased application of modelling and simulation as a tool for research, design, operation and optimisation of anaerobic processes worldwide. This model was developed on the basis of the extensive but often disparate work in modelling and simulation of anaerobic digestion systems over the last twenty years. In developing ADM1, the Task Group have tried to establish common

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nomenclature, units and model structure, consistent with existing anaerobic modelling literature and the popular activated sludge models (See Activated Sludge Models ASM1, ASM2, ASM2d and ASM3, IWA Publishing, 2000, ISBN: 1900222248). As such, it is intended to promote widespread application of simulation from domestic (wastewater and sludge) treatment systems to specialised industrial applications. Outputs from the model include common process variables such as gas flow and composition, pH, separate organic acids, and ammonium. The structure has been devised to encourage specific extensions or modifications where required, but still maintain a common platform. During development the model has been successfully tested on a range of systems from full-scale waste sludge digestion to laboratory-scale thermophilic high-rate UASB reactors. The model structure is presented in a readily applicable matrix format for implementation in many available differential equation solvers. It is expected that the model will be available as part of commercial wastewater simulation packages. ADM1 will be a valuable information source for practising engineers working in water treatment (both domestic and industrial) as well as academic researchers and students in Environmental Engineering and Science, Civil and Sanitary Engineering, Biotechnology, and Chemical and Process Engineering departments. Contents Introduction Nomenclature, State Variables and Expressions Biochemical Processes Physicochemical Processes Model Implementation in a Single Stage CSTR Suggested Biochemical Parameter Values, Sensitivity and Estimation Conclusions References Appendix A: Review of Parameters Appendix B: Supplementary Matrix Information Appendix C: Integration with the ASM Appendix D: Estimating Stoichiometric Coefficients for Fermentation Scientific & Technical Report No.13 Basic Principles of Wastewater Treatment is the second volume in the Biological Wastewater

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Treatment series, and focus on the unit operations and processes associated with biological wastewater treatment. The major topics covered are: .microbiology and ecology of wastewater treatment .reaction kinetics and reactor hydraulics .conversion of organic and inorganic matter .sedimentation .aeration. The theory presented in this volume forms the basis upon which the other books in the series are built. The Biological Wastewater Treatment series is based on the book Biological Wastewater Treatment in Warm Climate Regions and on a highly acclaimed set of best selling textbooks. This international version is comprised by six textbooks giving a state-of-the-art presentation of the science and technology of biological wastewater treatment. Other books in the Biological Wastewater Treatment series: Volume 1: Wastewater characteristics, treatment and disposal Volume 3: Waste stabilisation ponds Volume 4: Anaerobic reactors Volume 5: Activated sludge and aerobic biofilm reactors Volume 6: Sludge treatment and disposal

"Long-established as an essential reference of the water quality industry, Operation of Municipal Wastewater Treatment Plants, MOP 11 is now available in a revised and expanded Sixth edition. The first major revision in 11 years, this updated classic offers you a complete guide to the operation and maintenance of municipal wastewater treatment plants."--BOOK JACKET.

Anaerobic Sewage Treatment: Optimization of Process and Physical Design of Anaerobic and Complementary Processes focuses on process design and deals with start-up procedures and steady state performance of UASB reactors, as well

as the influence of operation on reactor performance.

Selenium (Se) pollution has led to several cases of severe aquatic ecosystem deterioration due to Se poisoning caused by bioaccumulation over time.

However, the removal of selenate (SeO_4^{2-}) from wastewater streams with co-contaminants has been largely considered as a black box in anaerobic biological systems using mixed consortia. This research aimed at addressing the effect of wastewater characteristics, i.e. co-contaminants such as nitrate (NO_3^-) and sulfate (SO_4^{2-}), heavy metals and pH, on the biological reduction of SeO_4^{2-} and evaluating process integration for Se-laden wastewater treatment with co-contaminants. This study demonstrated that the presence of co-contaminants can actually be beneficial for Se removal provided that the concentrations are carefully monitored and appropriate operating conditions and process configurations are used. The Se removal (total Se and SeO_4^{2-}) efficiency increased by ~30% in the presence of NO_3^- and/or SO_4^{2-} compared to systems with SeO_4^{2-} alone. Additionally, an integrated process of an ion exchange (IX) column and bioreactors showed improved overall removal capacity for SO_4^{2-} and total Se. The knowledge and information gained from this research can help in the advancement and application of biological processes, i.e. predicting of reactor performance, solving specific design or practical problems and

implementing novel treatment techniques for Se-laden mine wastewater. Aerobic Granular Sludge has recently received growing attention by researchers and technology developers, worldwide. Laboratory studies and preliminary field tests led to the conclusion that granular activated sludge can be readily established and profitably used in activated sludge plants, provided 'correct' process conditions are chosen. But what makes process conditions 'correct'? And what makes granules different from activated sludge flocs? Answers to these question are offered in Aerobic Granular Sludge. Major topics covered in this book include: Reasons and mechanism of aerobic granule formation Structure of the microbial population of aerobic granules Role, composition and physical properties of EPS Diffuse limitation and microbial activity within granules Physio-chemical characteristics Operation and application of granule reactors Scale-up aspects of granular sludge reactors, and case studies Aerobic Granular Sludge provides up-to-date information about a rapidly emerging new technology of biological treatment.

The first part of the book is devoted to the activated sludge process, covering the removal of organic matter, nitrogen and phosphorus. A detailed analysis of the biological reactor (aeration tank) and the final sedimentation tanks is provided. The second part of the book covers aerobic biofilm reactors, especially trickling

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filters, rotating biological contractors and submerged aerated biofilters. For all the systems, the book presents in a clear and informative way the main concepts, working principles, expected removal efficiencies, design criteria, design examples, construction aspects and operational guidelines.

Wastewater Treatment Reactors: Microbial Community Structure analyzes microbial community structure in relation to changes in physico-chemical parameters, the gene content (metagenome) or gene expression (metatranscriptome) of microbial communities in relation to changes in physico-chemical parameters, physiological aspects of microbial communities, enrichment cultures or pure cultures of key species in relation to changes in physico-chemical parameters, and modeling of potential consequences of changes in microbial community structure or function for higher trophic levels in a given habitat. As several studies have been carried out to understand bulking phenomena and the importance of environmental factors on sludge settling characteristics, which are thought to be strongly influenced by flocculation, sludge bulking, foaming and rising, this book is an ideal resource on the topics covered. Presents the state-of-the-art techniques and applications of omics tools in wastewater treatment reactors (WWTRs) Describes both theoretical and practical knowledge surrounding the fundamental roles of microorganisms in

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WWTRs Points out the reuse of treated wastewater through emerging technologies Covers the economics of wastewater treatment and the development of suitable alternatives in terms of performance and cost effectiveness Discusses cutting-edge molecular biological tools Gives in-depth knowledge to study microbial community structure and function in wastewater treatment reactors

Sludge Reduction Technologies in Wastewater Treatment Plants is a review of the sludge reduction techniques integrated in wastewater treatment plants with detailed chapters on the most promising and most widespread techniques. The aim of the book is to update the international community on the current status of knowledge and techniques in the field of sludge reduction. It will provide a comprehensive understanding of the following issues in sludge reduction: * principles of sludge reduction techniques; * process configurations; * potential performance; * advantages and drawbacks; * economics and energy consumption. This book will be essential reading for managers and technical staff of wastewater treatment plants as well as graduate students and post-graduate specialists.

This book presents recent developments in advanced biological treatment technologies that are attracting increasing attention or that have a high potential

for large-scale application in the near future. It also explores the fundamental principles as well as the applicability of the engineered bioreactors in detail. It describes two of the emerging technologies: membrane bioreactors (MBR) and moving bed biofilm reactors (MBBR), both of which are finding increasing application worldwide thanks to their compactness and high efficiency. It also includes a chapter dedicated to aerobic granular sludge (AGS) technology, and discusses the main features and applications of this promising process, which can simultaneously remove organic matter, nitrogen and phosphorus and is considered a breakthrough in biological wastewater treatment. Given the importance of removing nitrogen compounds from wastewater, the latest advances in this area, including new processes for nitrogen removal (e.g. Anammox), are also reviewed. Developments in molecular biology techniques over the last twenty years provide insights into the complex microbial diversity found in biological treatment systems. The final chapter discusses these techniques in detail and presents the state-of-the-art in this field and the opportunities these techniques offer to improve process performance. Anaerobic digestion processes for the treatment of wastewaters and sludges are well over 100 years old. The anaerobic process is a natural gasification process, producing very useful end-products. It has taken a long time to prove that these

processes are useful tools in sustainable development. A breakthrough was the development of the Upflow Anaerobic Sludge Bed reactor by Professor Gatzke Lettinga. This showed that the anaerobic process could be operated as a highly effective and high-rate wastewater treatment process, opening the way to its implementation under practical conditions. It has, so far, been a struggle to prove the feasibility of anaerobic treatment, despite the obvious advantages in energy consumption, sludge production, and required land area; its drawbacks, i.e. required effluent polishing, odours, sensitivity to toxic compounds, made potential users reluctant to choose anaerobic instead of the conventional aerobic systems. However, as shown by the contributions in this issue, intensive research has overcome most of these drawbacks. To celebrate the career of Professor Lettinga, leading experts on anaerobic digestion processes were invited to highlight the state-of-the-art and future developments in their specific fields of interest. Seminar topics included microbiology, treatment of industrial wastewaters, xenobiotics and extreme environments, the biological S-cycle, treatment of domestic wastewater and the history of anaerobic digestion. The selected 20 papers in these proceedings represent the state of the art of anaerobic digestion, highlighting its impacts and potentials. They also recognised the stimulating role of Professor Gatzke Lettinga in this development and agree

with him that anaerobic digestion's full potential is still unexploited.

There have been many significant microbiological, biochemical and technological advances made in the understanding and implementation of anaerobic digestion processes with respect to industrial and domestic wastewater treatment. Elucidation of the mechanisms of anaerobic degradation has permitted a greater control over the biological parameters of waste conversion and the technical advances achieved have reduced the time and land area requirements and increased the cost-effectiveness and efficiency of the various processes presently in use. By product recovery in the form of utilisable methane gas has become increasingly feasible, while the development of new and superior anaerobic reactor designs with increased tolerance to toxic and shock loadings of concentrated effluents has established a potential for treating many extremely recalcitrant industrial wastestreams. The major anaerobic bioreactor systems and their applications and limitations are examined here, together with microbiological and biochemical aspects of anaerobic wastewater treatment processes.

London, June 1986

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Anaerobic technology has become widely accepted by the environmental industry as a cost-effective alternative to the conventional aerobic process. In addition, with the intrinsic advantages of energy saving, reduced sludge yield, and production of biofuel, anaerobic process will be the favored green treatment technology for sustainable environment in years to come. Written by 40 renowned experts from 13 countries/regions, this book consists of 18 chapters compiling state-of-the-art information on new developments in various aspects of anaerobic technology. These include development of new types of reactors, uses of molecular techniques for microbial studies and mathematical modeling, productions of bio-hydrogen by fermentation and microbial electrolysis cell, as well as broadening applications to the treatment of municipal wastewater, effluents from chemical industry and agricultural wastes with high lignocellulose content. Contents: Overview and Outlook: The Route of Anaerobic Waste (Water) Treatment Toward Global Acceptance (G Lettinga) Full-Scale Applications: Developments of New Anaerobic Treatment Technology in France (R Moletta) Applications and New Developments of Biogas Technology in Japan (Y-Y Li & T Kobayashi) Anaerobic Sewage Treatment Using UASB Reactors: Engineering and Operational Aspects (J B Van Lier et al.) Application of UASB Technology for Sewage Treatment with a Novel Post-Treatment Process (S Uemura & H Harada) Emerging Technologies: Anaerobic Granulation and Granular Sludge Reactor Systems (J H Tay et al.) Anaerobic Membrane Reactors (D C Stuckey) The Anaerobic Baffled Reactor (ABR)

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Keywords: Biofuel; Green Energy; Anaerobic Digestion; Anaerobic Technology; Wastewater Treatment; Bio-Hydrogen

The anaerobic process is considered to be a sustainable technology for organic waste treatment mainly due to its lower energy consumption and production of residual solids coupled with the prospect of energy recovery from the biogas generated. However, the anaerobic process cannot be seen as providing the 'complete' solution as its treated

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effluents would typically not meet the desired discharge limits in terms of residual carbon, nutrients and pathogens. This has given impetus to subsequent post treatment in order to meet the environmental legislations and protect the receiving water bodies and environment. This book discusses anaerobic treatment from the perspective of organic wastes and wastewaters (municipal and industrial) followed by various post-treatment options for anaerobic effluent polishing and resource recovery. Coverage will also be from the perspective of future trends and thoughts on anaerobic technologies being able to support meeting the increasingly stringent disposal standards. The resource recovery angle is particularly interesting as this can arguably help achieve the circular economy. It is intended the information can be used to identify appropriate solutions for anaerobic effluent treatment and possible alternative approaches to the commonly applied post-treatment techniques. The succeeding discussion is intended to lead on to identification of opportunities for further research and development. This book can be used as a standard reference book and textbook in universities for Master and Doctoral students. The academic community relevant to the subject, namely faculty, researchers, scientists, and practicing engineers, will find the book both informative and as a useful source of successful case studies.

The book covers the subject of membrane bioreactors (MBR) for wastewater treatment, dealing with municipal as well as industrial wastewaters. The book details the 3 types of MBR available and discusses the science behind the technology, their design features,

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operation, applications, advantages, limitations, performance, current research activities and cost. As the demand for wastewater treatment, recycling and re-use technologies increases, it is envisaged that the membrane separation bioreactor will corner the market. Contents Membrane Fundamentals Biological Fundamentals Biomass Separation Membrane Bioreactors Membrane Aeration and Extractive Bioreactors Commercial Membrane Bioreactor Systems Membrane Bioreactor Applications Case Studies

Low Cost Wastewater Bioremediation Technology: Innovative Treatment of Sulphate and Metal Rich Wastewater provides users with an authoritative guide on the technologies, processes and considerations needed for the treatment of Sulphate and Metal rich wastewaters. In this book, the authors not only explain the associated technologies, but also provide suitable alternatives to commercial treatment in terms of performance and cost effectiveness. As enormous quantities of sulphates and metal-rich contaminants are released into the environment each year, the technologies noted in the book provide the most eco-friendly, low cost and efficient alternatives available. Covers the efficiency of treatment in terms of scale, efficiency and effectiveness of different bioremediation technologies for wastewater remediation Discusses the economics of treatment and the development of suitable alternatives in terms of performance and cost effectiveness

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