

# Handbook of BIOLOGICAL WASTEWATER TREATMENT

*Design and Optimisation of Activated Sludge Systems*

SECOND EDITION

By A.C. van Haandel and J.G.M. van der Lubbe



# Handbook Of Biological Wastewater Treatment Design And Optimisation Of Activated Sludge Systems

**Yi-Tong Ma**



## **Handbook Of Biological Wastewater Treatment Design And Optimisation Of Activated Sludge Systems:**

**Handbook of Biological Wastewater Treatment** Adrianus van Haandel, Jeroen van der Lubbe, 2012-02-20 The scope of this comprehensive new edition of Handbook of Biological Wastewater Treatment ranges from the design of the activated sludge system final settlers auxiliary units sludge thickeners and digesters to pre treatment units such as primary settlers and UASB reactors The core of the book deals with the optimized design of biological and chemical nutrient removal The book 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 It offers a truly integrated cost based design method that can be easily implemented in spreadsheets and adapted to the particular needs of the user Handbook of Biological Wastewater Treatment Second Edition incorporates valuable new material that improves the instructive qualities of the first edition The book has a new structure that makes the material more readily understandable and the numerous additional examples clarify the text On the website [www.wastewaterhandbook.com](http://www.wastewaterhandbook.com) three free excel design spreadsheets for different configurations secondary treatment with and without primary settling and nitrogen removal can be downloaded to get the reader started with their own design projects New sections have been added throughout to explain the difference between true and apparent yield while the section on the F M ratio and especially the reasons not to use it has been expanded to demonstrate the effect of the oxygen recycle to the anoxic zones on both the denitrification capacity and the concept of available nitrate is explained in more detail the latest developments on the causes and solution to sludge bulking and scum formation to show the rapid developments of innovative nitrogen removal and sludge separation problems the anaerobic pre treatment section is completely rewritten based on the experiences obtained from an extensive review of large full scale UASB based sewage treatment plants a new section on industrial anaerobic wastewater treatment three new appendices have been added These deal with the calibration of the denitrification model empirical design guidelines for final settler design STORA STOWA and ATV and with the potential for development of denitrification in the final settler A new chapter on moving bed biofilm reactors Handbook of Biological Wastewater Treatment Second Edition is written for post graduate students and engineers in consulting firms and environmental protection agencies It is an invaluable resource for everybody working in the field of wastewater treatment Lecturer support material is available when adopted for university courses This includes course material for the first 7 modules in the form of PDF printouts and an exercise file with questions and answers and a symbol list Authors Prof dr ir A C van Haandel Federal University of Campina Grande Brazil and Ir J G M van der Lubbe Biothane Systems International Veolia The Netherlands [Handbook Biological Waste Water Treatment - Design and Optimisation of Activated Sludge Systems](#) ,2007 Since its conception almost a century ago the activated sludge system has emerged as the dominant waste water treatment technology with tens of thousands of implementations worldwide The pivotal role played by the activated sludge system was originally due to its high efficiency in COD and suspended solids removal while more

recently new processes for the removal of the macro nutrients nitrogen and phosphorus have easily been accommodated

Biological Treatment of Industrial Wastewater Maulin P Shah, 2021-11-18 Many industrial processes use water as a solvent and therefore produce wastewater containing chemicals from that process. The amounts of these chemicals and the types will vary hugely depending on the industry and the processes running and may include things that are hazardous to health or the environment. This makes the treatment of industrial wastewater both extremely important and highly complex. One route for industrial wastewater treatment is the use of bioreactors. Biological Treatment of Industrial Wastewater presents a comprehensive overview of the latest advances and trends in the use of bioreactors for treating industrial wastewater. Several different types of bioreactor and their applications are discussed alongside trends and considerations important in designing bioreactors. Bringing together a wealth of different approaches and voices, this book will be a useful resource for anyone working in water treatment or looking at how industrial processes can be made more environmentally friendly.

**Advanced and Innovative Approaches of Environmental Biotechnology in Industrial Wastewater Treatment** Maulin P. Shah, 2023-07-31 This book discusses new and innovative trends and techniques in the removal of toxic and refractory pollutants by means of various microbial biotechnology processes from wastewater both on the laboratory and industrial scales. The book also highlights the main factors contributing to the removal of toxic pollutants as well as recycling environmental impact and wastewater policies after heavy metal removal. In addition, it assesses the potential application of several existing bioremediation techniques and introduces new cutting edge emerging technologies. This book significantly contributes to the wastewater treatment plant industry so that the treatment systems can serve better and more resiliently for the purpose. This book is designed for engineers, scientists and other professionals who are seeking introductory knowledge of the principles of environmental bioremediation technology and for students who are interested in the environmental microbiology and bioremediation fields.

**Handbook of Water and Used Water Purification** Josef Lahnsteiner, 2024-03-25 The book addresses the entire water cycle. The focus is on new technologies, processes, especially in high performance biological treatment, energy recovery, water recycling and reuse. Recommendations with regard to the right technologies, processes for specific situations are provided and a wide range of case studies, especially in emerging markets. In addition, the most modern water terminology with more positive connotations is used. This is especially important in the field of direct and indirect potable reuse (DPR and IPR respectively).

**New Trends in Removal of Heavy Metals from Industrial Wastewater** Maulin P. Shah, Susana Rodriguez-Couto, Vineet Kumar, 2021-04-23 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

**Assessment of Treatment Plant Performance and Water Quality Data: A Guide for Students, Researchers and Practitioners** Marcos von Sperling ,Matthew E. Verbyla ,Silvia M.A.C Oliveira,2020-01-15 This book presents the basic principles for evaluating water quality and treatment plant performance in a clear innovative and didactic way using a combined approach that involves the interpretation of monitoring data associated with i the basic processes that take place in water bodies and in water and wastewater treatment plants and ii data management and statistical calculations to allow a deep interpretation of the data This book is problem oriented and works from practice to theory covering most of the information you will need such as a obtaining flow data and working with the concept of loading b organizing sampling programmes and measurements c connecting laboratory analysis to data management e using numerical and graphical methods for describing monitoring data descriptive statistics f understanding and reporting removal efficiencies g recognizing symmetry and asymmetry in monitoring data normal and log normal distributions h evaluating compliance with targets and regulatory standards for effluents and water bodies i making comparisons with the monitoring data tests of hypothesis j understanding the relationship between monitoring variables correlation and regression analysis k making water and mass balances l understanding the different loading rates applied to treatment units m learning the principles of reaction kinetics and reactor hydraulics and n performing calibration and verification of models The major concepts are illustrated by 92 fully worked out examples which are supported by 75 freely downloadable Excel spreadsheets Each chapter concludes with a checklist for your report If you are a student researcher or practitioner planning to use or already using treatment plant and water quality monitoring data then this book is for you 75 Excel spreadsheets are available to download

**Advanced Biological, Physical, and Chemical Treatment of Waste Activated Sludge** Antoine Prandota Trzcinski,2018-11-02 Recently research efforts aiming to improve energy efficiency of wastewater treatment processes for large centralized wastewater treatment plants WWTPs have been increasing Global warming impacts energy sustainability and biosolids generation are among several key drivers towards the establishment of energy efficient WWTPs WWTPs have been recognized as major contributors of greenhouse gas emissions as these are

significant energy consumers in the industrialized world The quantity of biosolids or excess waste activated sludge produced by WWTP will increase in the future due to population growth and this pose environmental concerns and solid waste disposal issues Due to limited capacity of landfill sites more stringent environmental legislation and air pollution from incineration sites there is a need to rethink the conventional way of dealing with wastewater and the sludge production that comes with it This book provides an overview of advanced biological physical and chemical treatment with the aim of reducing the volume of sewage sludge Provides a comprehensive list of processes aiming at reducing the volume of sewage sludge and increasing biogas production from waste activated sludge Includes clear process flowsheet showing how the process is modified compared to the conventional waste activated sludge process Provides current technologies applied on full scale plant as well as methods still under investigation at laboratory scale Offers data from pilot scale experience of these processes

*Pathogen removal in aerobic granular sludge treatment systems* Mary Luz Barrios Hernández, 2022-02-13 This book describes pathogen removal processes in aerobic granular sludge AGS wastewater treatment systems Faecal indicators E coli Enterococci coliforms and bacteriophages were tracked in full scale AGS facilities and compared to parallel activated sludge CAS systems AGS showed similar removals as the more complex CAS configurations Removal mechanisms investigated in laboratory scale reactors showed that the AGS morphology contributes to the removal processes By tracking E coli and MS2 it was observed that organisms not attached to the granules are predated by protozoa during aeration 18S RNA gene analyses confirmed the occurrence of bacterivorous organisms e g Epistylis Vorticella Rhogostoma in the system Particulate material in the feeding stimulated their development and a protozoa bloom arose when co treating with synthetic faecal sludge 4 % v v An overview of the diverse eukaryotic community in laboratory reactors and real life applications is also provided The microbial diversity of the influent was different compared to AGS and CAS sludge samples However no clear differences were found between them on species level This study contributes to a better understanding of the mechanisms behind pathogen removals in AGS systems

**Engineering Granular Microbiomes** David Gregory Weissbrodt, 2024-02-28 This book reports on the ecological engineering of granular sludge processes for a high rate removal of carbon nitrogen and phosphorus nutrients in compact wastewater treatment plants It provides novel insights into microorganisms and metabolisms in wastewater microbiomes and the use of microbial ecology principles to manage wastewater treatment processes It covers a very comprehensive and inter disciplinary research of systems microbiology and environmental biotechnology From the initial economic assessment of the aerobic granular sludge technology concepts of microbiome science and engineering are developed to uncover and manage the microbial ecosystem of granular sludge Mixed culture biotechnological processes multifactorial experimental designs laser scanning microscopy molecular microbial ecology and bioinformatics methods numerical ecology workflows and mathematical modelling are engaged to disentangle granulation phenomena microbial selection and nutrient conversions across scales The findings are assembled in a guideline for

microbial resource management in granular sludge processes to support knowledge utilization in engineering practice Outputs are integrated in the state of the art of biological wastewater treatment This book addresses both scientists and engineers who are eager to get insights into and engineer microbiomes for environmental biotechnologies It makes a valuable contribution to methods for strengthening the role of wastewater treatment plants for recovering safe water and resources in the context of circular economy and for sustaining health and the environment in an ecologically balanced society *Waste Management: Concepts, Methodologies, Tools, and Applications* Management Association, Information Resources, 2019-12-06 As the world's population continues to grow and economic conditions continue to improve more solid and liquid waste is being generated by society Improper disposal methods can not only lead to harmful environmental impacts but can also negatively affect human health To prevent further harm to the world's ecosystems there is a dire need for sustainable waste management practices that will safeguard the environment for future generations *Waste Management Concepts Methodologies Tools and Applications* is a vital reference source that examines the management of different types of wastes and provides relevant theoretical frameworks about new waste management technologies for the control of air water and soil pollution Highlighting a range of topics such as contaminant removal landfill treatment and recycling this multi volume book is ideally designed for environmental engineers waste authorities solid waste management companies landfill operators legislators environmentalists policymakers government officials academicians researchers and students

*Cost Engineering for Pollution Prevention and Control* Paul Mac Berthouex, Linfield C. Brown, 2021-05-13 Environmental engineers work to increase the level of health and happiness in the world by designing building and operating processes and systems for water treatment water pollution control air pollution control and solid waste management These projects compete for resources with projects in medicine transportation education and other fields that have a similar objective The challenge is to make the investments efficient to get the best project outputs with a minimum of inputs *Cost Engineering for Pollution Prevention and Control* examines how to identify the best solution by judging alternatives with respect to some measure of system performance such as total capital cost annual cost annual net profit return on investment cost benefit ratio net present worth minimum production time maximum production rate minimum energy utilization and so on Key Features Explains how to estimate preliminary costs how to compare the life cycle costs of alternative projects how to find the optimal balance between capital costs and operating costs Emphasis is placed on formulating the problem rather than on the mathematical details of how the calculations are done Provides numerous practical examples and case studies Includes end of chapter exercises dealing with water wastewater air pollution solid wastes and remediation projects The important concepts presented in this book can be understood by those students who have taken an introductory course in environmental engineering Advanced knowledge of process design is not required The material can also be utilized by engineers managers and others who would benefit from a better understanding of how engineers look at problems *Smart*

*Technologies in Urban Engineering* Olga Arsenyeva, Tetyana Romanova, Maria Sukhonos, Ihor Biletskyi, Yevgen Tsegelnyk, 2023-12-18 This book offers a comprehensive review of smart technologies and provides perspectives on their applications in urban engineering. It covers a wide range of applications from manufacturing engineering and transport logistics to information and computation technologies providing readers with fresh ideas for future research and collaborations. The book showcases selected papers from the International Conference on Smart Technologies in Urban Engineering STUE 2023 hosted by O M Beketov National University of Urban Economy in Kharkiv, Ukraine. The conference held on June 8-10, 2023, aimed to address the complex rehabilitation of areas damaged by military conflicts and natural disasters. The contributions within this book offer a wealth of valuable information fostering a meaningful exchange of experiences among scientists in the field of urban engineering. By delving into this book, readers explore innovative approaches to tackle urban challenges, gain insights from experts, and contribute to the advancement of smart technologies for the betterment of cities worldwide.

**Biomass to Energy Conversion Technologies** Pratima Bajpai, 2019-10-22 Biomass to Energy Conversion Technologies: The Road to Commercialization examines biomass production, biomass types, properties, and characterization, and energy conversion technologies with an emphasis on the production of a gaseous fuel to supplement the gas derived from the landfilling of organic wastes. Landfill gas is used in gas engines to produce electricity. The book discusses the integration of both fermentation and anaerobic digestion in a biorefinery concept that allows the production of ethanol along with biogas to be used to produce heat and electricity, thus improving overall energy balance. Included case studies based on worldwide projects discuss both risks and challenges. The main studies on the combination of both bioethanol and biogas production processes are reviewed, and the strength and weakness of the integrated treatment for industrial application are highlighted. The book also considers gasification technologies and their potential for biomass gasification and lists the advantages and disadvantages of using biomass as a source of energy, the path of commercialization of the various processes, energy-related environmental issues. Highlights commercialization and technological risks. Discusses challenges, limitations, and future prospects of third and fourth generation biofuels. Includes integration of both fermentation and anaerobic digestion in a biorefinery concept. Discusses energy-related environmental issues: Greenhouse effect, acid rain, air pollution.

**Toxicity and Waste Management Using Bioremediation** Rathoure, Ashok K., Dhatwalia, Vinod K., 2015-12-02 Bioremediation is an emerging field of environmental research. The objective of a bioremediation process is to immobilize contaminants, reactants, or to transform them into chemical products that do not pose a risk to human health and the environment. *Toxicity and Waste Management Using Bioremediation* provides relevant theoretical and practical frameworks and the latest empirical research findings on the remediation of contaminated soil and groundwater using bioorganisms. Focusing on effective waste treatment methodologies and management strategies that lead to improved human and environmental health, this timely publication is ideal for use by environmental scientists, biologists,



policy makers graduate students and scholars in the fields of environmental science chemistry and biology      Biological Wastewater Treatment: Principles, Modeling and Design Guang-Hao Chen, Mark C.M. van Loosdrecht, G.A. Ekama, Damir Brdjanovic, 2020-07-15 The first edition of this book was published in 2008 and it went on to become IWA Publishing's bestseller. Clearly there was a need for it because over the twenty years prior to 2008 the knowledge and understanding of wastewater treatment had advanced extensively and moved away from empirically based approaches to a fundamental first principles approach based on chemistry microbiology physical and bioprocess engineering mathematics and modelling. However the quantity complexity and diversity of these new developments was overwhelming for young water professionals particularly in developing countries without readily available access to advanced level tertiary education courses in wastewater treatment. For a whole new generation of young scientists and engineers entering the wastewater treatment profession this book assembled and integrated the postgraduate course material of a dozen or so professors from research groups around the world who have made significant contributions to the advances in wastewater treatment. This material had matured to the degree that it had been codified into mathematical models for simulation with computers. The first edition of the book offered that upon completion of an in depth study of its contents the modern approach of modelling and simulation in wastewater treatment plant design and operation could be embraced with deeper insight advanced knowledge and greater confidence be it activated sludge biological nitrogen and phosphorus removal secondary settling tanks or biofilm systems. However the advances and developments in wastewater treatment have accelerated over the past 12 years since publication of the first edition. While all the chapters of the first edition have been updated to accommodate these advances and developments some such as granular sludge membrane bioreactors sulphur conversion based bioprocesses and biofilm reactors which were new in 2008 have matured into new industry approaches and are also now included in this second edition. The target readership of this second edition remains the young water professionals who will still be active in the field of protecting our precious water resources long after the aging professors who are leading some of these advances have retired. The authors all still active in the field are aware that cleaning dirty water has become more complex but that it is even more urgent now than 12 years ago and offer this second edition to help the young water professionals engage with the scientific and bioprocess engineering principles of wastewater treatment science and technology with deeper insight advanced knowledge and greater confidence built on stronger competence      Microbial Fuels Farshad Darvishi Harzevili, Ir Serge Hilgsmann, 2017-09-18 The book will highlight major trends and developments in the field of microbial fuels with contributions from a number of highly experienced researchers. It will serve as a comprehensive reference for industrial stakeholders scientists researchers and graduate students interested in microbial fuels. The aims of this work are to present the technologies and perspectives taking into account different socio economical contexts. A specific chapter will focus on the general perspectives of microbial fuels for low income and emerging countries      **Membrane and Membrane-Based**

**Processes for Wastewater Treatment** Maulin P. Shah, 2023-03-14 The proposed book mainly sorts out emerging and burning issues faced day to day by municipal and industrial wastewater treatments. It also provides a comprehensive view of recent advances in hybrid treatment technologies for wastewater treatment, addresses the current limitations and challenges of applying these tools in wastewater treatment systems. This book gives an insight about recent developments in membrane technology for wastewater treatment. Industrial wastewater contains a large variety of compounds such as heavy metals, salts and nutrients which makes its treatment challenging. Thus the use of conventional water treatment methods is not always effective. In this sense, membrane based hybrid processes have emerged as a promising technology to treat complex industrial wastewater. The present book analyses and discusses the potential of membrane based hybrid processes for the treatment of complex industrial wastewater along with the recovery of valuable compounds and water reutilization. In addition, recent and future trends in membrane technology are highlighted. **FEATURES** The properties, mechanisms, advantages, limitations and promising solutions of different types of membrane technologies are discussed. The optimization of process parameters is addressed. The performance of different membranes is described. The potential of nanotechnology to improve the treatment efficiency of wastewater treatment plants is presented. The application of membrane and membrane based hybrid treatment technologies for wastewater treatment is covered.

**Sustainable Water Treatment** Zainura Zainon Noor, Noor Salehan Mohammad Sabli, 2017-04-07 This book focuses on green and innovative wastewater treatment technologies that promote sustainability. It discusses a variety of biological, physical and chemical treatment technologies. It covers biological processes for recovery of value added products from wastewater and gives an overview of enzymatic hydrolysis and bioremediation of wastewater using immobilized enzyme and fungus. It offers a case study and future trends of wastewater treatment through membrane bioreactor technologies, describes advanced chemical physical processes for recalcitrant pollutant and emphasizes the use of low cost materials and cost effective treatment methods.

*Innovative Wastewater Treatment & Resource Recovery Technologies: Impacts on Energy, Economy and Environment* Juan M. Lema, Sonia Suarez Martinez, 2017-06-15 This book introduces the 3R concept applied to wastewater treatment and resource recovery under a double perspective. Firstly, it deals with innovative technologies leading to Reducing energy requirements, space and impacts. Reusing water and sludge of sufficient quality and Recovering resources such as energy, nutrients, metals and chemicals including biopolymers. Besides targeting effective C-N-Re-Thinking which implies a substantial flowsheet modification and Re-Imagining with completely new conceptions. Tools are presented for Modelling, Optimising and Selecting the most suitable plant layout for each particular scenario from a holistic technical, economic and environmental point of view.

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