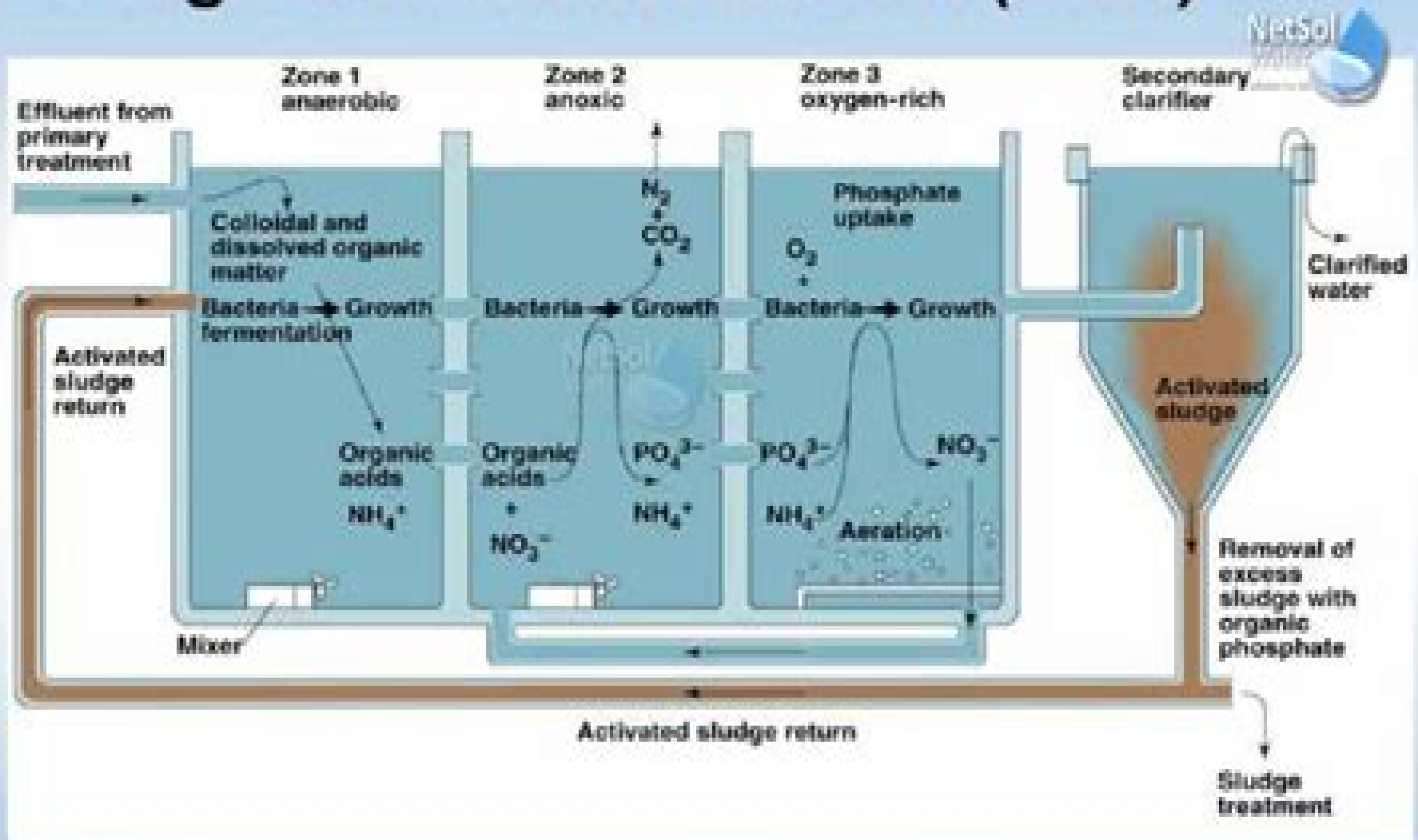


Biological nutrient removal (BNR)



What is Biological Nutrient Removal Process

Biological Nutrient Removal

Carlos D.M. Filipe, C.P. Leslie Grady, Jr.

A red circular graphic with a gradient, appearing as a stylized arrow or a partial circle, located to the right of the authors' names.

Biological Nutrient Removal:

An Operator's Guide to Biological Nutrient Removal (BNR) in the Activated Sludge Process Michael H. Gerardi, 2016-05-19 Contents List of Tables List of Figures PART ONE NITRIFICATION Chapter 1 Introduction Chapter 2 Nitrogenous and Phosphorous Compounds Chapter 3 Nitrification The Basics Chapter 4 Nitrifying Bacteria Chapter 5 Nitrification and Limiting Factors Chapter 6 Promoting Nitrification PART TWO DENITRIFICATION Chapter 7 Denitrification The Basics Chapter 8 Denitrifying Bacteria Chapter 9 Denitrification and Limiting Factors PART THREE BIOLOGICAL PHOSPHORUS REMOVAL Chapter 10 Biological Phosphorus Removal The Basics Chapter 11 EBPR Process Control Abbreviations and Acronyms Glossary Bibliography

Biological nutrient removal BNR the removal of nitrogen and phosphorus from wastewater is a complex process Although the activated sludge process is an efficient technology for the removal of biochemical oxygen demand BOD and total suspended solids TSS it provides less than optimal conditions for the removal of nitrogen and phosphorus and presents numerous challenges to the operator trying to satisfy the many requirements for several different groups of bacteria In addition to satisfying the requirements there are numerous highly variable operational conditions that impact BNR These conditions include changes in strength and composition of the wastewater alkalinity and pH temperature and presence of inhibitory and toxic wastes Even fluctuations in flows especially from inflow and infiltration can adversely impact the aerobic anoxic and anaerobic conditions needed for successful BNR Of the three treatment processes nitrification denitrification and enhanced biological removal nitrification is often the most difficult to achieve Therefore a large portion of this book reviews nitrification Operators of the activated sludge process need to understand the basic biological chemical and physical requirements for BNR in order to improve the performance of these treatment processes An Operator's Guide to Biological Nutrient Removal BNR in the Activated Sludge Process is intended to help operators in the monitoring troubleshooting and process control of BNR Numerous tables and figures are included in the book to help the operator understand the biological and chemical reactions that are involved in BNR processes and how the reactions can be monitored for process control Design of BNR processes is not addressed in this book Design is addressed in numerous engineering publications The book serves to help operators achieve permit compliance for nitrogen and phosphorus discharge limits and obtain cost effective operation

Biological Nutrient Removal (BNR) Operation in Wastewater Treatment Plants : WEF Manual of Practice No. 30 Water Environment Federation, 2005-10-25 BNR is a fast growing method of removing biological pollutants bacteria etc from wastewater Experts from both the Water Environment Federation and the American Society of Civil Engineers have collaborated on this definitive work which is intended to be a practical manual for plant managers and operators who needed current information on BNR

Design and Retrofit of Wastewater Treatment Plants for Biological Nutrient Removal Clifford W. Randall, James Lang Barnard, H. David Stensel, 1998-05-06 This book presents information that can be used for the design and operation of wastewater treatment

plants that utilize biological nutrient removal processes i.e processes that utilize biological mechanisms instead of chemical mechanisms to remove phosphorus and nitrogen from wastewaters The book provides basic fundamentals concepts and theories design of prefermentation units various types of BNR systems and secondary clarifiers retrofitting conventional activated sludge plants modeling considerations and special considerations for BNR systems It includes full scale and pilot plant case histories design examples and retrofit of existing plants

An Operator's Guide to Biological Nutrient Removal (BNR) in the Activated Sludge Process Michael H. Gerardi, 2016 Annotation Contents List of Tables List of Figures PART ONE NITRIFICATION Chapter 1 Introduction Chapter 2 Nitrogenous and Phosphorous Compounds Chapter 3 Nitrification The Basics Chapter 4 Nitrifying Bacteria Chapter 5 Nitrification and Limiting Factors Chapter 6 Promoting Nitrification PART TWO DENITRIFICATION Chapter 7 Denitrification The Basics Chapter 8 Denitrifying Bacteria Chapter 9 Denitrification and Limiting Factors PART THREE BIOLOGICAL PHOSPHORUS REMOVAL Chapter 10 Biological Phosphorus Removal The Basics Chapter 11 EBPR Process Control Abbreviations and Acronyms Glossary Bibliography

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Characterizing Mechanisms of Simultaneous Biological Nutrient Removal During Wastewater Treatment P. F. Strom, 2004-01-01 Simultaneous biological nutrient removal SBNR is the removal of nitrogen and or phosphorus in excess of that required for biomass synthesis in biological wastewater treatment systems where there are no defined anaerobic and or

anoxic zones The hypothesis is that one or more of three mechanisms is responsible within individual systems variations in the bioreactor macroenvironment created by the mixing pattern gradients within the floc microenvironment and or novel microorganism activity Understanding of the mechanisms of SBNR can be expected to lead to improved efficiency and reliability in its application Preliminary work documented SBNR in 7 full scale OrbafTM closed loop bioreactors A batch assay demonstrated that novel microorganism activity was of little importance in SBNR at the three plants tested While the floc microenvironment likely plays an important role in nitrogen removal in such plants it cannot explain phosphorus removal A computational fluid dynamics CFD model was developed to elucidate the role of the bioreactor macroenvironment in SBNR This is the first reported application of CFD to activated sludge biological wastewater treatment Although the software and computational requirements limited model complexity it still simulated the creation of dissolved oxygen gradients within the system demonstrating that the anaerobic zones required for SBNR could occur

Biological Nutrient Removal (BNR) Operation in Wastewater Treatment Plants Water Environment Federation, 2005-11-15 BNR is a fast growing method of removing biological pollutants bacteria etc from wastewater Experts from both the Water Environment Federation and the American Society of Civil Engineers have collaborated on this definitive work which is intended to be a practical manual for plant managers and operators who needed current information on BNR

Biological Nutrient Removal (BNR) Operation in Wastewater Treatment Plants, 2006 *Advances in Water and Wastewater Treatment* Martin P. Wanielista, William Wesley Eckenfelder, 1978

Nutrient Removal, WEF MOP 34 Water Environment Federation, 2010-09-28 The Latest Methods for Nutrient Removal from Wastewater This Water Environment Federation resource provides comprehensive information on biological and chemical methods for nitrogen and phosphorus removal from wastewater Nutrient Removal covers environmental and regulatory issues and provides an integrated approach for combined nitrogen and phosphorus removal including details on ammonia and dewatering liquors treatment Natural treatment systems are also discussed in this definitive guide Nutrient Removal covers Nutrients and their effects on the environment Regulation of nutrients in the effluents of wastewater treatment plants Overview of the nutrient removal processes Principles of biological nitrogen removal Nitrification Nitrogen removal processes configuration and process sizing criteria for combined nitrification and denitrification processes Chemical and biological phosphorus removal Sidestream nitrogen removal Structured process models for nutrient removal Troubleshooting for full scale nutrient removal facilities Aquatic natural treatment systems

Tuning Biological Nutrient Removal Plants Ken Hartley, 2013-04-30 Tuning Biological Nutrient Removal Plants increases interest in tuning to enhance both performance and capacity to provide insight into typical plant operating characteristics and to stimulate operators interest in studying the behaviour of their own plants The book focuses on understanding of plant behavioural characteristics so that optimum performance can be achieved and maintained Tuning Biological Nutrient Removal Plants is carefully organized to cover influent and effluent characteristics process fundamentals individual process

characteristics overall plant characteristics the evolutionary operation approach to tuning The approach is practical and the use of mathematics is kept to a minimum and information is supplied in graphical and tabular form Real operating data from a wide range of plant experiences is included The book draws on the generosity of many Australian plant owners in permitting their plant data to be incorporated Not all process types are covered but the tuning principles expounded are universally applicable The capacity and performance capabilities of a plant are not fixed both are amenable to on going enhancement through systematic and enthusiastic effort The book helps to set new benchmarks in plant operation Tuning Biological Nutrient Removal Plants is a valuable resource for sewage treatment operations and operations support personnel sewage process design engineers operating authorities consultants contractors operators of industrial wastewater treatment plants and sewage treatment lecturers in chemical engineering departments and other training organisations About the author Ken Hartley B Tech M Eng Sc Fellow Institution of Engineers Australia Member Australian Water Association Member International Water Association Ken Hartley has 45 years experience in the water and wastewater industry He has worked for the South Australian water and wastewater authority consultants GHD and the University of Queensland Since 1998 he has been an independent consulting process engineer

Biological Nutrient Removal IWA Publishing, 2003 *Biological Phosphorus Removal Activated Sludge Process in Warm Climates* Cao Ye Shi, 2011-03-15 Special Offer Cao Ye Shi Author Set Buy all three books together and save a total 76 Biological Phosphorus Removal Activated Sludge Process in Warm Climates presents the results of detailed research on the Enhanced Biological Phosphorus Removal EBPR activated sludge process under warm climate conditions 20oC 30oC which is part of the R D program of Public Utilities Board PUB Singapore The investigations and studies presented in this book are application oriented but at the same time the studies aim at an insightful understanding of the EBPR with the knowledge of the latest development in academic field The focus points are EBPR performance of laboratory scale and full scale activated sludge processes under the site conditions in warm climates The carbon competition and distribution between PAO and GAO and denitrifiers in the process The stoichiometry and kinetics of P release COD uptake in the anaerobic environment and P uptake in the aerobic environment under different temperatures and operating conditions PAO and GAO population fractions shift and dominance studies using FISH and batch tests The inter relationships between the system performance process design and the microbial community EBPR for industrial wastewater high ratio of feed COD P treatment under warm climates Together with the preceding book Biological Nitrogen Removal Activated Sludge Process in Warm Climates published by IWA in 2008 this book fills the gap of biological nutrient nitrogen and phosphorus removal in warm climates and provides unique experiences and knowledge for Process and design researchers and engineers in wastewater research students and academic staff in Civil Sanitation Environment Departments as well as Managers Engineers and Consultants in water companies and water utilities Visit the IWA WaterWiki to read and share material related to this title <http://www.iwawaterwiki.org/xwiki/bin/view/Articles>

SELECTION OF DOMESTIC WASTEWATER TREATMENT SYSTEMS IN WARM CLIMATE REGIONS **Microbial Granulation Technology for Nutrient Removal from Wastewater** Yu Liu, Lei Qin, Shu-Fang Yang, 2007 Aerobic granulation technology for wastewater treatment has been widely exploited in recent years. Currently, research on aerobic granulation is being intensively conducted in universities, institutes, private or public interest research organisations world wide. This book provides the latest research outcomes on the fundamentals and applications of this technology for biological nutrient removal from wastewater. The book offers researchers and practitioners in wastewater treatment engineering up to date knowledge and understanding of this novel nutrient removal biotechnology **Biological Nutrient Removal from Municipal Wastewater** Zhirong Hu, 2020-05-27 This text offers a systematic review and summary on the development of biological nutrient removal (BNR) in fundamental research and practical applications. It provides the latest information about state of the art BNR technology in wastewater treatment including new filtration and membrane systems. This guide presents extensive coverage of several basic BNR biochemical processes: nitrification, denitrification and EBPR; three types of BNR processes: conventional single sludge systems, recently developed two sludge systems and MBR BNR systems; recently widely used process modeling and simulation technology and key aspects of process design, operation and control Phosphorus and Nitrogen Removal from Municipal Wastewater Richard I. Sedlak, 1991-10-07 This valuable new book offers practical guidance regarding the design and operation of systems for reducing effluent nitrogen and phosphorus. The principles of nitrogen and phosphorus removal are discussed including sources of nitrogen and phosphorus in wastewater, removal options, nitrogen and phosphorus transformations in treatment process, selection and treatment. The book also covers the design and operation of nitrogen and phosphorus removal systems including system options, system design, facility design, facility costs and operation. Practical case studies are provided as examples of successful system implementations that may be able to help you decide what will work best in your plant Biological Wastewater Treatment, Revised and Expanded Carlos D.M. Filipe, C.P. Leslie Grady, Jr., 1998-10-15 Written by noted experts in the field sharing extensive academic and industrial experience, this thoroughly updated Second Edition covers commonly used and new suspended and attached growth reactors. The authors discuss combined carbon and ammonia oxidation, activated sludge, biological nutrient removal, aerobic digestion, anaerobic processes, lagoons, trickling filters, rotating biological contactors, fluidized beds and biologically aerated filters. They integrate the principles of biochemical processes with applications in the real world, communicating approaches to the conception, design, operation and optimization of biochemical unit operations in a comprehensive yet lucid manner Nutrient Removal from Wastewaters Nigel J. Horan, 1994-10-06 Topics in the book include novel processes, removal of ammonia and nitrogen, retrofitting/upgrading treatment plants for nutrient removal and operating experiences at full scale plants. Nutrient removal from wastewaters is a critical topic in every region. Problems can arise from domestic sewage, industrial wastewater or rainwater runoff *Biological Nutrients' Removal in the Anaerobic/Anoxic/Oxic Wastewater Treatment Process* Changyong

Wu, 2021 Anaerobic anoxic oxic A2 O is one of the most widely used processes in municipal wastewater treatment plants for simultaneous biological nitrogen and phosphorus removal. The A2 O process has many advantages such as simple configuration and short hydraulic retention time (HRT) etc. In addition, it is easy to operate. Therefore, A2 O will be continuously chosen as the main option in all kinds of newly designed and built wastewater treatment plants. Though the A2 O process has been used widely, it has some inherent contradictions which are difficult to overcome. For example, the contradiction between substrate competition and SRT makes the high nitrogen and phosphorus removal unable to be achieved simultaneously. As a result, the removal efficiency of the system cannot be further improved. In the past 10 years in China, the wastewater quality very obviously changed with the improvement of living conditions. At present, municipal wastewater with a low C/N ratio is rather common in most countries in the world. The lack of a carbon source will make the inherent contradictions of the A2 O process become serious. Therefore, the conventional design parameters of the A2 O process are needed to adjust or the configuration of the A2 O process should change to fit the change of the wastewater quality. According to this, this book systematically describes how to improve the nitrogen and phosphorus removal efficiency of municipal wastewater with low C/N ratio and effectively utilize the carbon resource in the influent of wastewater. This publication is useful for students, researchers, and engineers whose major focus is municipal and the environment.

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.

Advancing a Post-anoxic Biological Nutrient Removal Process

Selecting for Nitrification Felicity J. Appel, 2015. Wastewater is treated biologically with activated sludge to remove the nutrients phosphorous and nitrogen. In accomplishing wastewater treatment, selecting for nitrification in the aeration phase can optimize the nutrient removal process to conserve energy and carbon while enhancing phosphorous and nitrogen removal. This thesis investigated the ability of sequencing batch reactors (SBRs) operated in a unique post-anoxic denitrification mode, a process referred to as BIOPHO PX trademark under development by Dr. Coats, to remove nutrients while controlling aeration length and residual DO concentration at different solids retention times (SRTs) with the goal to induce and sustain nitrification. Phosphorus removal of 97% and nitrogen removal of 82% were achieved with this process configuration.

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