

## Introduction To Phosphorus Removal Study Guide

The enhanced biological removal of phosphorus (EBPR) is a popular process due to high removal efficiency, low operational costs, and the possibility of phosphorus recovery. Nevertheless, the stability of the EBPR depends on different factors such as: temperature, pH, and the presence of toxic compounds. While extensive studies have researched the effects of temperature and pH on EBPR systems, little is known about the effects of different toxic compounds on EBPR. For example, sulphide has shown to inhibit different microbial activities in the WWTP, but the knowledge about its effects on EBPR is limited. Whereas the sulphide generated in the sewage can cause a shock effect on EBPR, the continuously exposure to sulphide potentially generated in WWTP can cause the acclimatization and adaptation of the biomass. This research suggests that sulphate reducing bacteria can proliferate in WWTP, as they are reversibly inhibited by the recirculation of sludge through anaerobic-anoxic-oxic conditions. The research enhances the understanding of the effect of sulphide on the anaerobic-oxic metabolism of PAO. It suggests that the filamentous bacteria *Thiothrix caldionitis* could play an important role in the biological removal of phosphorus. It questions the ability of PAO to generate energy from nitrate respiration and its use for the anoxic phosphorus uptake. Thus, the results obtained in this research can be used to understand the stability of the EBPR process under anaerobic-anoxic-oxic conditions, especially when exposed to the presence of sulphide.

Information presented first by the US EPA in September 1987, in Design manual–phosphorus removal. The manual is oriented toward design methods and operating procedures. Cost information from actual phosphorus-removing installations is presented when available. Planning level cost estimates are also included. Annotation copyrighted by Book News, Inc., Portland, OR

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 granular 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.

Biological Phosphorus Removal

Operation of Nutrient Removal Facilities

Design and Construction of Phosphorus Removal Structures for Improving Water Quality

Phosphorus and Nitrogen Removal from Municipal Wastewater

Aerobic Granular Sludge

A Study of Chemical Phosphorus Removal at Four Sewage Treatment Plants

Biological phosphorus (bio-P) removal has become a reliable and well-understood process within wastewater treatment, despite being one of the most complex processes in the activated sludge process. Extended fundamental and full-scale research has been carried out into the bio-P process and the state-of-the-art is described in this report. A summarising historical overview gives insight into the establishment of the appropriate microbiological and biochemical basis of the process and the development of bio-P configurations in practice. Aspects of the bio-P process that have a direct influence on the efficiency of phosphorus removal are subjected to an in-depth investigation. This report presents guidelines for design and dimensioning in order to introduce and/or optimise the bio-P process in practice. Twelve bio-P installations are extensively described and the operational results and experiences are related to existing bio-P knowledge and guidelines. Based on a number of parameters, a comparison is made between the described bio-P plants. A steady state model is verified with extensive periods of practical experience of the plants. The bio-P model, which is provided on CD-ROM (available for download here), offers a reliable insight into the bio-P process, coupled with sensitivity analyses regarding wastewater characteristics and process parameters for the anaerobic volume and the P-ortho concentration in the final effluent. The report ends with a systematic approach to the design of the bio-P process, based on the background of the bio-P process itself, much practical experience and the analysis of operational bio-P plants. Also presented is a systematic approach to tackle operational aspects of the bio-P process in order to generate an acceptable low P effluent concentration. This optimisation of the bio-P process operation is supported by a decision diagram. Biological Phosphorus Removal will be an invaluable source of information for all those concerned with wastewater treatment, including plant managers, process designers, consultants and researchers.

Environmental Microbiology, besides a traditional discipline in Developing fast, because of realization of its importance in Industry, Agriculture Pharmaceutical concerns, Public Health, Geological explorations, bioenergetics and as a mean to exploit new sources of energy useful for various purposes. Environmental Microbiology comprises a crucial element of studies in microbiology. Enabling scientists to explore microbes in greater detail, it gives an insight into how microorganisms behave under non-simulated, natural conditions, although microbes that exist in artificial environments such as bioreactors are also studied. Exploring such processes as microbial ecology, microbially mediated nutrient cycling, geomicrobiology, microbial diversity and bioremediation the subject encompasses a great deal. Environmental Microbiology was born at the dawn of the 'e,environmental era', at the beginning of the 1970s. Thirty years of maturation have led to an exciting and vibrant field that has attracted countless numbers of productive and enthusiastic scientists and students at universities, research centers and government agencies around the world. The present text has been designed to outline the basic and fundamental aspects of Environmental Microbiology to be understood in its right perspective. The modern techniques and designs employed in microbiological applications are discussed in a comprehensive manner which will update the readers of the commercial aspects of microbiology.

This text looks at different effects on the process of biological phosphorus removal. Topics include: biological phosphorus removal processes; process and molecular ecological studies; and the effect of potassium limitation on biological phosphorus removal.

Environmental Microbiology

Biochemistry, Biology, Biotechnology

Proceedings of the International Conference on Advances in Energy and Environment Research (ICAER2016), Guangzhou City, China, August 12-14, 2016

2nd International Symposium for Waste Treatment Lagoons

Trends in Biotechnology Research

Soluble Phosphorus Removal in the Activated Sludge Process

***Inorganic polyphosphates - polymers of orthophosphate linked by high-energy phosphoanhydride bonds - have been found in apparently all forms of life, from bacteria, yeasts and fungi to higher plants and animals. These polymers, which had been neglected for a long time, have become a fascinating area of research in the last few years. This volume summarizes the present state of knowledge about the metabolism and function of inorganic polyphosphates. In addition, the methods to study these polymers as well as the biotechnological applications of inorganic polyphosphates are described. The 15 chapters of this volume, dealing with different aspects of polyphosphate research, are written by experts in the field. This book represents a valuable source of information not only for researchers working on this subject, but also for scientists interested in fundamental aspects of cell and energy metabolism.***

***Issues in Environmental Research and Application: 2011 Edition is a ScholarlyEditions™ eBook that delivers timely, authoritative, and comprehensive information about Environmental Research and Application. The editors have built Issues in Environmental Research and Application: 2011 Edition on the vast information databases of ScholarlyNews.™ You can expect the information about Environmental Research and Application in this eBook to be deeper than what you can access anywhere else, as well as consistently reliable, authoritative, informed, and relevant. The content of Issues in Environmental Research and Application: 2011 Edition has been produced by the world's leading scientists, engineers, analysts, research institutions, and companies. All of the content is from peer-reviewed sources, and all of it is written, assembled, and edited by the editors at ScholarlyEditions™ and available exclusively from us. You now have a source you can cite with authority, confidence, and credibility. More information is available at http://www.ScholarlyEditions.com/.***

***Enhanced biological phosphorus removal (EBPR) has been used for decades to remove phosphorus from municipal wastewater because it allows facilities to meet water quality goals while minimizing chemical consumption and sludge production. However, there is still substantial variability in both the practices applied to achieve EBPR and the level of soluble phosphorus removal achieved. The objective of this research project was to develop information that can be used to help municipal wastewater treatment plants more efficiently and cost effectively remove phosphorus through EBPR processes. This project included detailed analysis of routine water quality and operating data, field testing observations, and special studies conducted over the course of the project to evaluate the variability of EBPR, factors influencing EBPR performance, and the relationship between EBPR and the presence of glycogen accumulating organisms (GAOs).***

***Effect of Sulphide on Enhanced Biological Phosphorus Removal***

***Overland Flow Treatment of Raw Wastewater with Enhanced Phosphorus Removal***

***Water Pollution Control Research Series 17010 EFX 04/70: Phosphate Removal from Wastewaters Using Lanthanum Precipitation***

***Abstracts of Funded Research Fiscal Year 1995***

***The Wolfram Language in the Real World***

***Factors Influencing the Reliability of Enhanced Biological Phosphorus Removal***

***Annotation This manual is ideal for plant managers, operators, design engineers, and regulators looking to gain a better understanding of fundamental biological and chemical processes that are in use at nutrient removal facilities and the ways that operators may use, monitor, and control these processes to meet their facility's treatment goal. Table of contents Chapter 1: Introduction Chapter 2: Wastewater Constituents that Affect Nutrient Removal Chapter 3: Nitrification Chapter 4: Nitrification in Biofilm Reactors Chapter 5: Denitrification Chapter 6: Combined Nitrifying and Denitrifying Systems Chapter 7: Enhanced Biological Phosphorus Removal Chapter 8: Chemical Precipitation of Phosphorus Chapter 9: Enhanced Biological Phosphorus Removal Systems Chapter 10: Combined Nitrogen and Phosphorus Removal Processes Chapter 11: Optimization of Nutrient Removal Systems Chapter 12: Recycle Streams Management Chapter 13: Process Control Using Oxidation-Reduction Potential and Dissolved Oxygen Chapter 14: Process Control, Instrumentation, and Automation Chapter 15: Laboratory Analyses Chapter 16: Case Studies-Nitrification and Denitrification Chapter 17: Case Studies-Enhanced Biological Phosphorus Removal Appendix A Optimization and Troubleshooting Guides This book was prepared by the Operation of Nutrient Removal Facilities Task Force of the Water Environment Federation.***

***Hot waste pickle liquor (ferrous sulfate) as an iron source was successful in precipitating phosphorus from solution in a 115 mgd East Plant of Milwaukee's Jones Island Activated Sludge Wastewater Treatment Plant. An 85 mgd section of the plant receiving the same influent was operated as a control. The East Plant with iron addition, achieved 91.3% removals (0.70 mg/l P effluent residual), while the control West Plant removed 83.1% (1.4 mg/l P residual). Comparison of efficiencies of purification, pH, alkalinity, and microscopic examinations of the sludge microorganism indicated that the addition of unneutralized waste pickle liquor did not adversely affect purification processes.***

***Biotechnology is a collection of technologies that capitalise on the attributes of cells and biological molecules. Biotechnology will help improve the ability to customise therapies based on individual genomics; prevent, diagnose, and treat all types of diseases rather than rely on rescue therapy and provide breakthroughs in agricultural production and food safety. This book offers new research in this growing field.***

***Proceedings of the International Conference on the Use of Constructed Wetlands in Water Pollution Control, Held in Cambridge, UK, 24–28 September 1990***

***WEF Manual of Practice***

***Biological Phosphate Removal from Wastewaters***

***Phosphorus Removal***

***Environmental Impact Statement***

***Advances in Energy and Environment Research***

Constructed Wetlands in Water Pollution Control documents the proceedings of the International Conference on the Use of Constructed Wetlands in Water Pollution Control, held in Cambridge, UK, 24-28 September 1990. This volume contains 70 papers that are organized into 12 parts. Part 1 includes papers such as the need for hydrophyte-based systems in the treatment of waste water from small communities and soil oxygenation in constructed reed beds. Part 2 contains studies on nitrogen and phosphorus removal. The papers in Part 3 are devoted to sewage treatment while Part 4 deals with sludge treatment. Part 5 presents case studies on wetlands, wastewater, and reed bed treatment systems. Part 6 focuses on agricultural waste treatment. Part 7 contains papers on wetland and waste treatment for small populations. Part 8 covers industrial waste treatment while Parts 9 and 10 deal with mining waste treatment. Part 11 takes up the design of treatment systems. Part 12 contains 20 poster papers.

Functional advanced biopolymers have received far less attention than renewable biomass (cellulose, rubber, etc.) used for energy production. Among the most advanced biopolymers known is chitosan. The term chitosan refers to a family of polysaccharides obtained by partial de-N-acetylation from chitin, one of the most abundant renewable resources in the biosphere. Chitosan has been firmly established as having unique material properties as well as biological activities. Either in its native form or as a chemical derivative, chitosan is amenable to being processed—typically under mild conditions—into soft materials such as hydrogels, colloidal nanoparticles, or nanofibers. Given its multiple biological properties, including biodegradability, antimicrobial effects, gene transfectability, and metal adsorption—to name but a few—chitosan is regarded as a widely versatile building block in various sectors (e.g., agriculture, food, cosmetics, pharmacy) and for various applications (medical devices, metal adsorption, catalysis, etc.). This Special Issue presents an updated account addressing some of the major applications, including also chemical and enzymatic modifications of oligos and polymers. A better understanding of the properties that underpin the use of chitin and chitosan in different fields is key for boosting their more extensive industrial utilization, as well as to aid regulatory agencies in establishing specifications, guidelines, and standards for the different types of products and applications.

Biological Phosphorus Removal Activated Sludge Pro

Proceedings of the 9th International Conference, Stockholm, Sweden, 1978

Design Manual

Biological Phosphorus Removal Activated Sludge Process in Warm Climates

Phosphorus Removal from Birmingham, Ala., Calcareous Iron Ores

Grand River Basin Comprehensive Water Resources Study

Inorganic Polyphosphates

This comprehensive book provides an up-to-date and international approach that addresses the Motivations, Technologies and Assessment of the Elimination and Recovery of Phosphorus from Wastewater. This book is part of the Integrated Environmental Technology Series.

Ninth International Conference on Water Pollution Research focuses on the methods, measures, and technologies involved in the treatment of wastewater, including the treatment of sludges and pollutants in bodies of water. The selection first offers information on carbon adsorption as an advanced wastewater treatment process, nitrification of surface water, and methods for measuring the thickenability of sludges. Topics include factors that influence adsorption, principle of biological nitrification, and characterization of sludges. The text also discusses the utilization of pulped newsprint as a conditioning aid in the vacuum filtration of a municipal sludge and the purification of pulp-bleaching wastewater with aluminum oxide. The publication reviews the properties and treatment of lime-algae sludge, concept of filterability, prediction of bacterial pollution in sea water, and the role of retained particles in deep bed filtration. The text also describes the immediate and continuous measurement of activated sludge quantity in sewage biological treatment tanks; comparative assessment of pollution loadings from non-point sources in urban land use; and wastewater control technology in steam-electric power plants. The book is a vital reference for readers interested in water pollution research.

This thesis presents work carried out to further the understanding of the use of waste Acid Mine Drainage (AMD) solids to remove phosphorus from wastewaters. AMD can result in serious pollution and so is often treated by the Coal Authority in the UK the resultant solids being a costly disposal issue. Currently the Water Framework Directive (WFD) is putting increased strain on technology used to remove phosphorus at WasteWater Treatment Works (WWTWs). The work presented in this thesis therefore investigates the use of a problematic waste to provide a novel solution to the issue of phosphorus removal at WWTWs. There has been previous work carried out on the use of both AMD solids and AMD–cement pellets to remove phosphorus from wastewaters. This thesis builds upon this work, firstly the phosphorus removal achieved by unpelleted materials studied in this thesis are compared to those studied by others through the comparison of adsorption isotherms. Mirroring other studies, the principal material studied in this thesis was then pelleted using Portland cement as a binder. Phosphorus removal by these pellets in batch tests was determined and optimised. Phosphorus removal was found to increase with a reduction in pellet size and an increase in test length up to the maximum length studied of three weeks. This increase in performance was attributed to the introduction of a calcium phosphate precipitation removal mechanism as a result of the use of cement as a binder for the pellets. This was highlighted through the correlation of phosphorus removal with a drop in calcium concentrations and pH values. It was concluded that the end product of this precipitation was hydroxyapatite. Continuous column tests were performed on the pellets, it was found that the pellets not directly involved in phosphorus removal were still having their reactivity leached out by passing water and so when these pellets became involved in removal, the columns quickly failed.

Proceedings of an IAWPRC Specialized Conference held in Rome, Italy, 28-30 September, 1987

Design and Retrofit of Wastewater Treatment Plants for Biological Nutrient Removal

Modeling Biological Phosphorus Removal in Activated Sludge Systems

National Research Initiative Competitive Grants Program

Phosphorus Removal with Pickle Liquor in an Activated Sludge Plant

Motivations, Technologies and Assessment of the Elimination and Recovery of Phosphorus from Wastewater

The 2016 International Conference on Advances in Energy and Environment Research (ICAER 2016) took place on August 12-14, 2016 in Guangzhou, China. ICAER 2016 has been a meeting place for innovative academics and industrial experts in the field of energy and environment research. The primary goal of the conference is to promote research and developmental activities in energy and environment research further to promote scientific information exchange between researchers, developers, engineers, students, and practitioners working all around the world. The conference will be organized every year making it an ideal platform for people to share views and experiences in energy and environment research and related areas. ICAER 2016 is dedicated to presenting and publishing novel and fundame environment research fields. Scholars and specialists on ICAER 2016, originating from over 10 countries or regions, have shared their knowledge and interesting research results. During the conference, an international stage was prepared for the participants to present their theoretical studies and practical applications.

Over the past twenty years, the knowledge and understanding of wastewater treatment has advanced extensively and moved away from empirically based approaches to a fundamentally-based first principles approach embracing chemistry, microbiology, and physical and bioprocess engineering, often involving experimental laboratory work and techniques. Many of these experimental methods and degree that they have been accepted as reliable tools in wastewater treatment research and practice. For sector professionals, especially a new generation of young scientists and engineers entering the wastewater treatment profession, the quantity, complexity and diversity of these new developments can be overwhelming, particularly in developing countries where access to advanced level treatment is not readily available. In addition, information on innovative experimental methods is scattered across scientific literature and only partially available in the form of textbooks or guidelines. This book seeks to address these deficiencies. It assembles and integrates the innovative experimental methods developed by research groups and practitioners around the world. Experimental Mett part of the internet-based curriculum in wastewater treatment at UNESCO-IHE and, as such, may also be used together with video records of experimental methods performed and narrated by the authors including guidelines on what to do and what not to do. The book is written for undergraduate and postgraduate students, researchers, laboratory staff, plant operators, consultants, and other. 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, v 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.

Pilot Scale Study of Biological Phosphorus Removal Using a Modified UCT Process

Constructed Wetlands in Water Pollution Control

Instrumentation and Control of Water and Wastewater Treatment and Transport Systems

Removal of Phosphorus from Water Using Treated Acid Mine Drainage Solids and Pellets Made Thereof

Phosphorus: Polluter and Resource of the Future

Nitrogen Control and Phosphorus Removal in Sewage Treatment

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.

The purpose of this book is to introduce the phosphorus (P) removal structure as a new BMP for reducing dissolved P loading to surface waters from non-point source pollution, provide guidance on designing site-specific P removal structures, and provide instruction on use of the design software, "Phrog" (Phosphorus Removal Online Guidance). The book initially provides a review of the nature and sources of non-point source P pollution, examines short and long term solutions to the problem, and provides detailed theory on design and operation of the P removal structure. As with many areas of study, one of the best methods of communicating concepts is through illustrations and examples. This book is no exception; several years of experience in studying P sorption and constructing P removal structures at multiple scales and settings is utilized for providing real examples and applications. With an understanding of the P removal structure established, the reader is instructed on how to obtain all of the necessary inputs for properly designing a site-specific P removal structure for meeting a desired lifetime and performance, or predict the performance and lifetime of a previously constructed P removal structure. For the readers who already possess the Phrog design software or are interested in obtaining it, one chapter is dedicated to detailed use of the software as demonstrated with various examples of structure design and also prediction.

Biological Phosphate Removal from Wastewaters contains the proceedings of an International Association on Water Pollution Research and Control Specialized Conference held in Rome, Italy on September 28-30, 1987. Contributors review advances that have been made in the removal of biological phosphates from wastewaters, both at the fundamental scientific level and in the practical application of the process.

Topics range from the fundamental microbiology and biochemistry of the enhanced biological removal of phosphate to the practical full-scale plant experiences with phosphorus removal and sludge handling from such processes. This text is comprised of 43 chapters; the first of which describes the utilization of polyphosphate as an energy reserve in *Acinetobacter* sp. and activated sludge. Attention then turns to metabolic control in polyphosphate-accumulating bacteria and its role in enhancing biological phosphate removal. The biochemistry and energetics of biological phosphorus removal are also considered. The next section is devoted to process modeling and includes chapters that explore the kinetics of biological excess phosphorus removal; factors affecting anaerobic stabilization during biological phosphorus removal; and the behavior of magnesium in biological phosphate removal. In the next section, bench/pilot-scale studies are presented; one of which investigated the reduction of returned phosphorus from a sludge treatment process. The book concludes with a discussion on phosphate removal mechanisms and pilot- and full-scale experiences. This book will be of interest to students, practitioners, and policymakers in water pollution control.

Advances in Chitini/Chitosan Characterization and Applications

Enhanced Biological Phosphorus Removal

Process Design Manual for Phosphorus Removal

Principles and Practice, Second Edition

Experimental Methods in Wastewater Treatment

Issues in Environmental Research and Application: 2011 Edition

***Instrumentation and Control of Water and Wastewater Treatment and Transport Systems contains the proceedings of the International Association on Water Pollution Research and Control (IAWPRC) Workshop on Instrumentation and Control of Water and Wastewater Treatment and Transport Systems held in Houston, Texas and Denver, Colorado, from April 27 to May 4, 1985. The papers explore advances in instrumentation and control of water and wastewater treatment and transport systems. This book consists of 122 chapters divided into 18 sections and opens with a brief description of the IAWPRC Study Group on "Instrumentation, control, and automation initiatives in various countries such as Germany, Japan, and the UK. The following chapters focus on instrument testing, data acquisition and transmission, and monitoring and control of water transport systems and water treatment plants. Distribution network control for water supply systems is considered, along with telemetry control systems and integrated data systems. The final chapter describes an automatic measuring device which uses a computer and image processing technology for measuring the length of filamentous microorganisms in activated sludge. This monograph will be a useful resource for engineers and those concerned with water pollution control.***

***Ninth International Conference on Water Pollution Research***

***Phosphorus Removal from Wastewater***

***Proceedings of the 4th IAWPRC Workshop Held in Houston and Denver, U.S.A., 27 April - 4 May 1985***