

# Current Developments in Biotechnology and Bioengineering



Advanced Membrane Separation Processes for  
Sustainable Water and Wastewater Management –  
Case Studies and Sustainability Analysis



*Editors*

Giorgio Mannina, Ashok Pandey, Christian Larroche,  
How Yong Ng and Huu Hao Ngo



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# Preface

The book titled *Advanced Membrane Separation Processes for Sustainable Water and Wastewater Management – Case Studies and Sustainability Analysis* is a part of the comprehensive series on *Current Developments in Biotechnology and Bioengineering* (Editor-in-Chief: Ashok Pandey), in which overall three books are included on Advanced Membrane Separation Processes for Sustainable Water and Wastewater Management. This book is one of these three books, and it covers advances in the areas of membrane bioreactors (MBR) and provides an excellent, concise, interdisciplinary, and updated overview of MBR technology in terms of pollutants removal, nutrients recovery, and energy production, as well as the energy efficiency of the process and savings. It seeks to give an up-to-date review regarding research developments of MBR systems (including hybrid systems) in wastewater treatment in terms of pollutants removal, nutrients recovery, and energy production, as well as the achievement of energy efficiency of the process itself.

The current challenges that hinder the application and industrialization of MBR technology, knowledge gaps, and future research perspectives are also discussed, including possible strategies to solve the various problems involved. Thus, the book is a valued resource for engineers, scientists, educators, students, and the general public to understand the current developments and future prospects in the field of MBR research. Researchers looking to enter into this endeavor will find substantially detailed material that helps them come up to speed; more experienced practitioners in the field will find this to be a convenient reference source. In this context, this book seeks to bridge the gap between introductory textbooks at one extreme and original research articles at the other.

The book covers different aspects of MBR in wastewater treatment such as fundamental knowledge, sustainability, cost analysis, and case studies. Further, the book focuses on different MBR configurations and hybrid systems in treating a large variety of wastewaters. It also provides state-of-the-art technology development of MBR technology, advantages, and challenges as well as the strategies to overcome the limitations. Finally, the book includes MBR technology in removing the priority substances (PSs) and emerging contaminants of environmental concern as well as evaluates energy potentials in wastewater treatment.

There are 16 chapters presented in this volume, on which a brief overview is provided below. [Chapter 1](#) presents an overall sustainability evaluation of the large-scale MBR plant in terms of technical, environmental, and economical aspects. Authors apply a framework and methodology for a sustainability analysis of the MBR plant to better understand the technical performance of the water reclamation plant with respect to the compliance rate,

stability of effluent quality, removal efficiency, and removal loading. [Chapter 2](#) discusses emerging antifouling control methods that are critically reviewed to cover most of the recently emerging studies and issues related to biofouling control. The mechanical cleaning and chemical cleaning through the addition of different chemical agents are discussed in detail, focusing on the latest emerging chemical approaches. In addition, the role of aeration and the development of different modification strategies are negotiated as well for their effect on membrane fouling mitigation and energy consumption minimization. [Chapter 3](#) presents a baffled membrane bioreactor study in which baffles are inserted in a submerged MBR, and the level of water in the reactor is controlled to facilitate simultaneous nitrification/denitrification without sludge recirculation.

[Chapter 4](#) reviews recent advances of sludge reduction and microbial community structure in membrane bioreactors. Four fundamental mechanisms of sludge reduction, lysis-cryptic growth, uncoupling, predation, and maintenance metabolism, were introduced. [Chapter 5](#) presents recent studies on greenhouse gases from MBR discussing the state of the art and future trends. [Chapter 6](#) promotes a more practical approach to increase organic micropollutants removal through MBR and mitigate fouling. [Chapter 7](#) contains a review of MBR application to tannery wastewater treatment based on the scientific literature. An overview of the tannery wastewater characterization and of the common applied wastewater treatment trains is reported. [Chapter 8](#) reviews literature studies on the influence of the salinity on wastewater treatment from MBR, discussing limits and possible cures. [Chapter 9](#) examines the application of MBR technology in the water sector along the dimensions of sustainability: social inclusion, prosperity, and environmental protection. [Chapter 10](#) presents a novel approach toward a more sustainable MBR process of the self-forming dynamic membrane bioreactor (SFD MBR), where “temporary” filtering layers are formed on a supporting surface made of relatively coarse material. [Chapter 11](#) presents the evaluation of three decentralized plants: (i) one conventional (activated sludge) and (ii) two membrane bioreactors (one aerobic and other anaerobic) from an environmental and economic perspective. [Chapter 12](#) shows results of a case study related to energy and environmental impact of an anaerobic membrane bioreactor treating urban wastewater. [Chapter 13](#) discusses the costs of MBR reporting and some examples on the evaluation of pro and cons with conventional activated sludge systems. [Chapter 14](#) presents literature studies about sludge disposal from MBR reporting solutions for resource recovery and production minimization. [Chapter 15](#) presents a literature review on Integrated Fixed film Activated Sludge-Membrane Bioreactor (IFAS-MBR) Systems with results from case studies. Finally, [Chapter 16](#) provides principal understanding of bio(de)floculation of the activated sludge and factors affecting the bio(de)floculation process in the MBR. We are confident that this book will be profitable to students, professors, researchers, and professionals interested in studying MBR.

We highly appreciate the excellent work done by the authors in compiling the relevant information on different aspects of MBR, presenting case studies and sustainability analysis, which we believe will be very useful to the scientific community. We gratefully acknowledge the reviewers for their valuable comments, which helped in improving the scientific content and quality of various chapters. We also acknowledge the support

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