

Membrane Technology for Wastewater Reclamation

Wastewater treatment, Pollutants, Membrane filtration, Membrane bioreactors, Reverse osmosis, Fouling, UV oxidation, Process control, Implementation, Economics, Commercial plants design

by Mark Wilf

with chapters by Craig Bartels, David Bloxom, James Christopher, Adam Festger, Kenny Khoo, Val Frenkel, Jill Hudkins, Jennifer Muller, Graeme Pearce, Rod Reardon, Alan Royce



This is the second guidebook on commercial membrane technology written by a team of membrane technology professionals and published by Balaban Desalination Publications. The material included in the first guidebook (first published in 2007) mainly covers brackish and seawater desalination technology and applications. This guidebook is dedicated to the membrane technologies applied in wastewater reclamation processes. The reasons for a separate book on wastewater reclamation technology are related to the unique treatment challenges, potential of sufficient availability and affordable economics of utilizing this water source: The water sources, used for wastewater reclamation, are highly contaminated with constituents that embody conditions of environmental

and health concern. Therefore, specialized and highly reliable treatment technologies are required for applications that involve water reuse; Wastewater is available in abundant quantities at locations that allow convenient conveyance to the treatment facilities and distribution of treated effluent to potential users; Energy requirement of the treatment process is low compared to other alternatives of augmentation of water supply; Advances in membrane technology for wastewater reclamation contributed to its increasing recognition as a reliable technology for cost effective production of high quality effluents.

The objective of this book is to describe commercial treatment technologies and explain in simple engineering terms modern membrane applications in wastewater reclamation processes. Examples of design and process calculations and case studies are provided to illustrate methods of system design, calculation of process parameters and evaluation of process economics.

The book content was formulated to serve as a reference for configuration and design processes of membrane systems in wastewater reclamation and reuse applications for project engineers, plant designers, planners, utility directors and operations managers, involved in municipal and industrial reclamation projects. It is also anticipated that the book will provide information on practical approaches of these technologies and processes to scientists and academics interested in commercial wastewater reclamation applications.



1 Introduction

2 Wastewater

Introduction/ Characteristics of wastewater feed streams/ Water quality required for reuse/ Wastewater treatment process/ Legislation

3 Introduction to membranes in wastewater treatment

Background/ Why use membranes?/ Markets/ Cost analysis

4 Fundamentals of membrane filtration

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Flux and permeability/ Filtrate quality/ Advantages of membrane pre-treatment for RO/ Integrity

5 Membrane filtration – commercial membranes & modules

History of UF/MF membrane development/ UF/MF products / Manufacture of UF/MF products / Module format and system configuration

6 Membrane filtration system design

Background/ Flux selection/ System configuration/ Selection and sizing of system components/ Indicative capital and operating costs/ Case studies: Orange County, California, USA, Public Utilities Board (PUB), Singapore, Benidorm and Rincon de Leon, Spain, Sulaibiya, Kuwait, Western Corridor, Brisbane, Australia

7 Membrane bioreactors – commercial membranes and modules

Membrane materials and properties/ Modules configuration/ Effluent quality/ Modes of operation

8 Fundamentals of membrane bioreactors

Comparison of MBR with the conventional activated sludge process/ Hydraulic terms

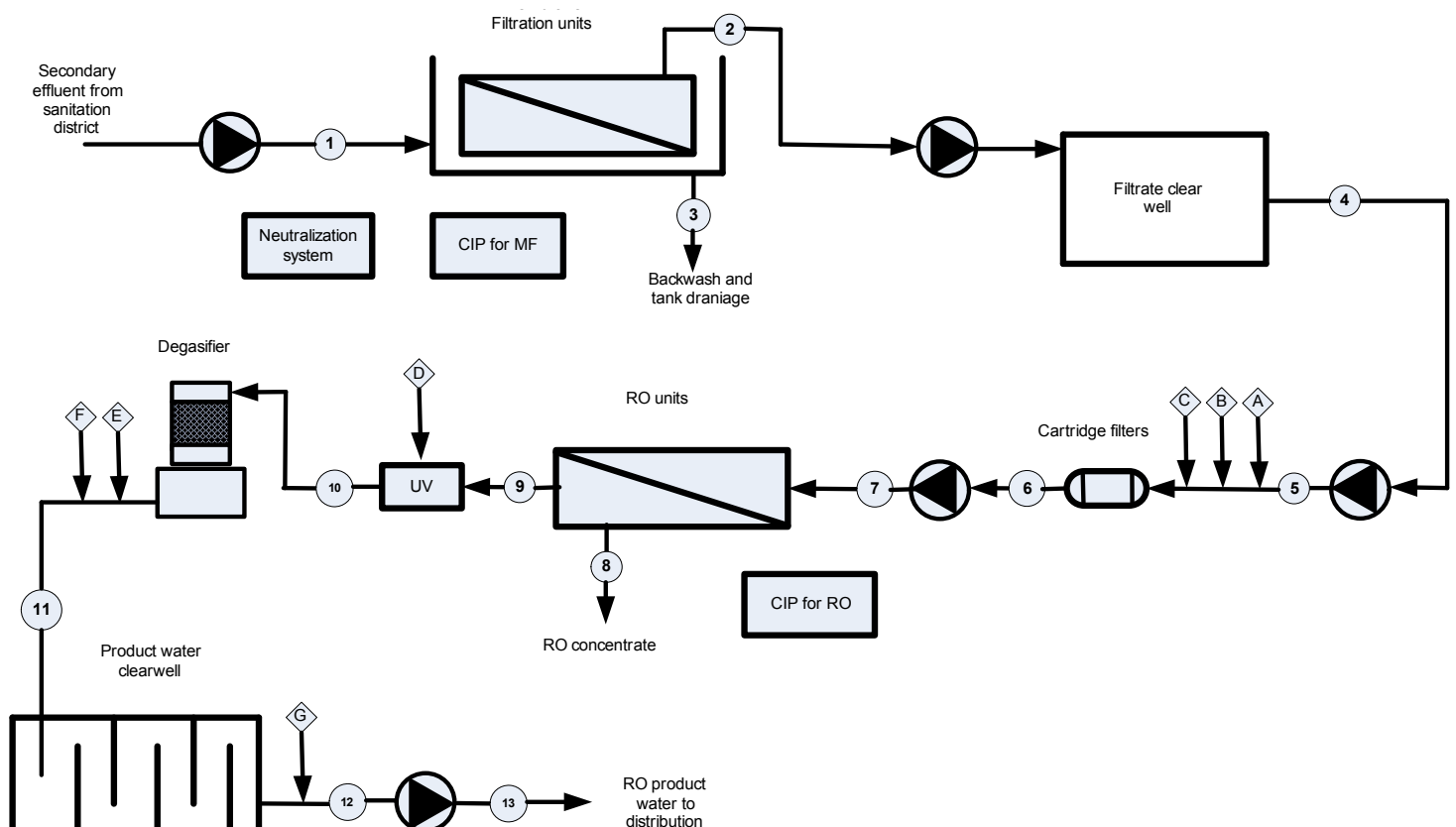
9 Membrane bioreactors system design

System configuration and operating sequence/ Process components/ Process alternatives/ Footprint/ System operating parameters/ Influent design parameters/ Biological process/ Phosphorous reduction process/ System hydraulics/

Sludge management/ Membrane permeability restoration/ Usage of chemicals/ Energy requirement/ Membrane replacement rate/ Selection and sizing of system components/ Membrane unit/ Major system components/ Auxiliary equipment/ Materials of construction/ System layout

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13 RO unit configuration

Pressure vessels/ Membrane assembly unit/ Concentrate staging / Permeate flux and flow distribution/ Permeate staging (two pass system)

14 Calculation of system performance

Manual method of membrane system performance calculations / Use of computer programs for projection of membrane performance

15 Parameters of RO process design

Feed water composition/ Indicators of RO feed water quality/ Membrane fouling/ Permeate flux rate/ Recovery rate/ Membrane replacement rate

16 RO system design

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Monitoring system operation / Normalization of membrane performance

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19 Restoration of membrane performance

Introduction/ Fouling phenomena/ Evaluation of fouled membranes/ Cleaning procedures

20 Project implementation

Project Feasibility/Planning/ Pilot Testing/ Design stages/ Permitting/ Procurement methods/ Start-up and testing/ Training

21 Economics of membrane treatment projects

Cost components/ Calculation of components of product water cost/ Present worth value

22 Examples of commercial plant data and design

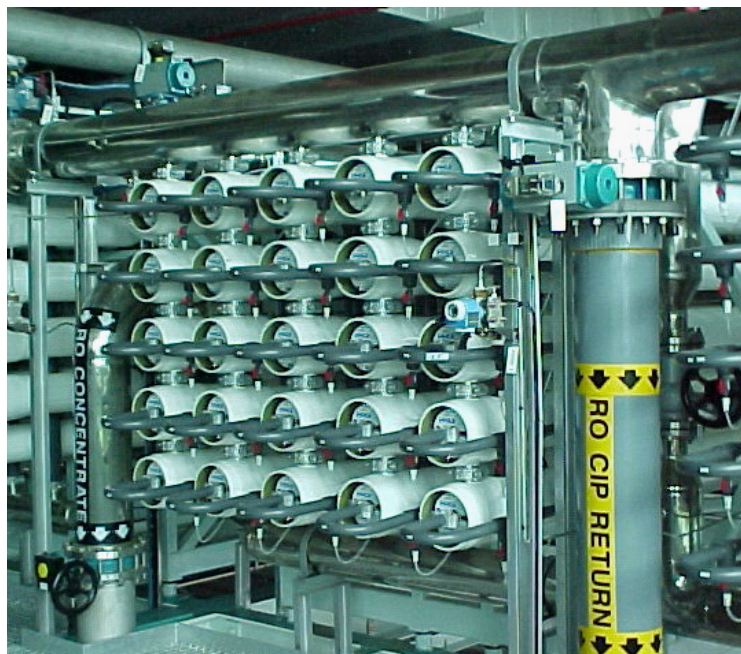
Ground water reclamation/ Singapore wastewater reclamation plants/ US wastewater reclamation plants/ Wastewater reclamation at other locations/ Case studies: Singapore, Dow Corporation – Filmtec, Terneuzen

23 Process control

Introduction/ Designing of instrumentation and control system/ Access levels/ Specification of scope of work/ Performance optimization through process optimization/ Control system redundancy/ Implementation of control system

24 Appendixes

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Guidebook

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Process, Design, Applications and Economics

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with chapters by Leon Awerbuch, Craig Bartels, Mike Mickley, Graeme Pearce and Nikolay Voutchkov

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