ADVANCES IN WATER AND WASTEWATER TREATMENT

SPONSORED BY
Environmental and Multi-Media Council
and
Environmental and Water Resources Institute (EWRI) of the American
Society of Civil Engineers

EDITED BY
Rao Y. Surampalli
K. D. Tyagi





Published by the American Society of Civil Engineers

Data on file with the Library of Congress

Published by American Society of Civil Engineers 1801 Alexander Bell Drive Reston, Virginia 20191 www.pubs.asce.org

Any statements expressed in these materials are those of the individual authors and do not necessarily represent the views of ASCE, which takes no responsibility for any statement made herein. No reference made in this publication to any specific method, product, process or service constitutes or implies an endorsement, recommendation, or warranty thereof by ASCE. The materials are for general information only and do not represent a standard of ASCE, nor are they intended as a reference in purchase specifications, contracts, regulations, statutes, or any other legal document. ASCE makes no representation or warranty of any kind, whether express or implied, concerning the accuracy, completeness, suitability, or utility of any information, apparatus, product, or process discussed in this publication, and assumes no liability therefore. This information should not be used without first securing competent advice with respect to its suitability for any general or specific application. Anyone utilizing this information assumes all liability arising from such use, including but not limited to infringement of any patent or patents.

ASCE and American Society of Civil Engineers-Registered in U.S. Patent and Trademark Office.

Photocopies: Authorization to photocopy material for internal or personal use under circumstances not falling within the fair use provisions of the Copyright Act is granted by ASCE to libraries and other users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that the base fee of \$18.00 per article is paid directly to CCC, 222 Rosewood Drive, Danvers, MA 01923. The identification for ASCE Books is 0-7844-0741-X/\$18.00. Requests for special permission or bulk copying should be addressed to Permissions & Copyright Dept., ASCE.

Copyright 2004 by the American Society of Civil Engineers. All Rights Reserved. ISBN 0-7844-0683-9 Manufactured in the United States of America.

Contents

Wastewater Treatment

Impact of Global Warming Concerns on Wastewater Treatment Plant Design and Operation
Glen T. Daigger, Ralph A. Peterson, Jay Witherspoon, and Eleanor Allen
Decision Making for Sustainable Development of Wastewater Infrastructure20 Barbara R. Bradley and Glen T. Daigger
Bacterial Production of Bioplastics
Determining the Fate and Biodegradation Kinetics of Toxic Organic Compounds in Activated Sludge Treatment Systems
Recent Advances in Biological Nutrient Removal Technology
Nutrient Removal in Fixed-Film Processes: Current Design Practices
Nutrient Removal Technologies / Alternatives for Small Communities133 Glen T. Daigger
Recent Advances in Wastewater Treatment in Sequencing Batch Reactor
Free-Surface Wetland Technology Assessment
Subsurface-Flow Constructed Wetlands Wastewater Treatment
Constructed Wetlands for Small Community Wastewater Treatment228 Michael H. Ogden
Use of Constructed Wetlands in Water Quality Management

.....

Update on Secondary Clarifiers: Design, Operation, and Performance244 Eric J. Wahlberg
Simultaneous Sewage Sludge Digestion and Metal Leaching
Pathogen Reduction in Municipal Biosolids Treatment Systems
Biosolids Composting
Water Reclamation and Reuse Criteria
Elimination of Overflows and Bypasses in Separate Sanitary Sewer Systems
Utility Competitiveness: A Benchmarking Study341 G David Waltrip and Robert Rutherford
Water Treatment
Watershed Management: Its Importance to Solving Water Supply and Wastewater Treatment Challenges
Occurrence and Control of Altrazine in Midwestern Surface Water Supplies
Radon Removal Technologies for Small Communities
Modeling Water Quality Changes in Distribution Systems
Innovative Methodologies and Technologies for Water Main Rehabilitation and Replacement Program Development
Characterizing Microbial and DBP Risk Tradeoffs in Drinking Water: Application of the CRFM

Innovative Methodologies and Technologies for Water Main Rehabilitation and Replacement Program Development	.440
Characterizing Microbial and DBP Risk Tradeoffs in Drinking Water: Application of the CRFM	.456
Emerging Pathogens and their Relationship to Drinking Water	.473
Cryptosporidium and Giardia Contamination and Removal	.487
Alternative Disinfection Technologies and Strategies for Inactivating Protozoan Cysts Leland L. Harms	. 520
Control of Disinfection By-Product (DBP) Precursors	.527
Management of Water Treatment Plant Residuals	.543
Subject Index	. 583