

WASTEWATER MICROBIOLOGY

Fourth Edition

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PREFACE TO THE FOURTH EDITION

The field of wastewater microbiology is advancing rapidly, thanks to improved methodology dominated by novel molecular techniques. This is helping environmental microbiologists, molecular biologists, and environmental engineers gain a deeper knowledge of what is inside the wastewater “black box.”

The fourth edition of *Wastewater Microbiology*, compared with the third edition, updates the reader on fundamental and molecular biology topics and deals exclusively with wastewater topics. Furthermore, the present edition of *Wastewater Microbiology* includes a new chapter titled Microbial Source Tracking of Fecal Contamination. This timely topic is of great interest to environmental microbiologists and engineers for tracking the sources of fecal contamination in receiving waters.

What follows are some specific changes/additions to several chapters in the fourth edition. These changes give an indication of the direction of the funded research in wastewater microbiology during the past five years since the third edition was published. The chapters have been reorganized accordingly to reflect those changes and additions.

The molecular methods section of Chapter 1 was significantly expanded, especially the methods of nucleic acid fingerprinting. The polymerase chain reaction (PCR) section was also expanded to include quantitative real-time PCR (qRT-PCR) and competitive PCR (cPCR). Chapter 2 was slightly revised to include some new methods for determining cell viability/activity in environmental samples. In Chapter 3, the section on enhanced biological phosphorus removal (EBPR) was expanded to include the latest information on this topic. Chapter 4 covers the expanding field of epidemiology and public health microbiology. Information has been updated all over this chapter, particularly the sections on noroviruses, enteric adenoviruses, polyomaviruses, coronaviruses, and picobirnaviruses. As regards the protozoan parasites, new information was added concerning *Cryptosporidium*, *Giardia*, and other protozoan parasites. A short section on fungal pathogens was also added. As mentioned earlier, Chapter 6 is new and covers the topic of microbial source tracking of fecal contamination of receiving waters. Chapter 7 covers disinfection, a fertile research field. Much of the new information added to this chapter deals with disinfection byproducts, ultraviolet (UV) disinfection and photoreactivation, solar radiation, photocatalysis, and other emerging technologies such as the use of nanomaterials, ultrasonic energy, or ultrahigh hydrostatic pressure. The new information in Chapter 9 includes advances in new techniques for the study of activated sludge, extracellular polymeric

substances (EPS), and settling of activated sludge flocs. Research on sludge microbiology (Chapter 13) has peaked in the 1980s and 1990s and has since slowed down. The section on risk assessment was expanded a little bit. In Chapter 14, the sections on methanogen classification and methodology and inhibition of anaerobic digestion were expanded. Most of the research on bioaerosols (Chapter 15) being carried out presently deals with the transport of microbial biothreat agents in indoor environments. Little research is focusing on the transport of biothreat agents following wastewater treatment operations. Most of the new information added to this chapter deals with the use of molecular techniques in bioaerosol studies. Chapter 16 was updated and new sections were added to reflect the recent advances in wastewater biotechnology. These new sections include the potential applications of nanotechnology in wastewater treatment and bioelectrochemical wastewater treatment, a field covering the potential use of microbial fuel cells (MFC), microbial electrolysis cells (MEC), and phototrophic cells to eventually produce bioelectricity in large-scale wastewater treatment plants. The section on membrane bioreactors was expanded to reflect advances in membrane technology. In Chapter 17, the section on the fate and treatment of endocrine disruptors, pharmaceuticals, and personal care products in wastewater treatment plants was expanded to address the new research being carried out in this field. A new section on ecotoxicogenomics was added to Chapter 18. Finally, in Chapter 20, the sections on public health aspects of swimming in contaminated recreational waters and risk assessment were expanded.

As were the previous editions, the text in the fourth edition is abundantly illustrated with tables and figures. New figures and tables were included in this edition and some old tables were edited to reflect the latest research data. I take this opportunity to thank my colleagues and their students who published the tables and figures that helped in illustrating this book. I also thank the companies, publishing firms, and research journals that graciously gave me permission to use the figures and tables.

As were the preceding editions, this book is intended for advanced undergraduates, graduate students, and professionals in sciences and engineering in the fields of wastewater microbiology and wastewater engineering. Experience has taught me that this book is useful in many of the disciplines included in environmental/civil engineering programs.

I am indebted to Sejin Youn for patiently drawing several of the new figures added to the fourth edition of this book. I am also grateful to Dr. Karen Chambers, life sciences editor at Wiley, for her enthusiasm in supporting the publication of this book.

I am grateful to my wife Nancy, my daughters Julie and Natalie, my son-in-law Jonathan Rosenthal, my entire extended family, and my dear friends for their love and moral support for bringing this book to completion. Last but not least, my grandson Ari Gabriel Rosenthal has brought joy and hope to our lives. This book is lovingly dedicated to him.

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