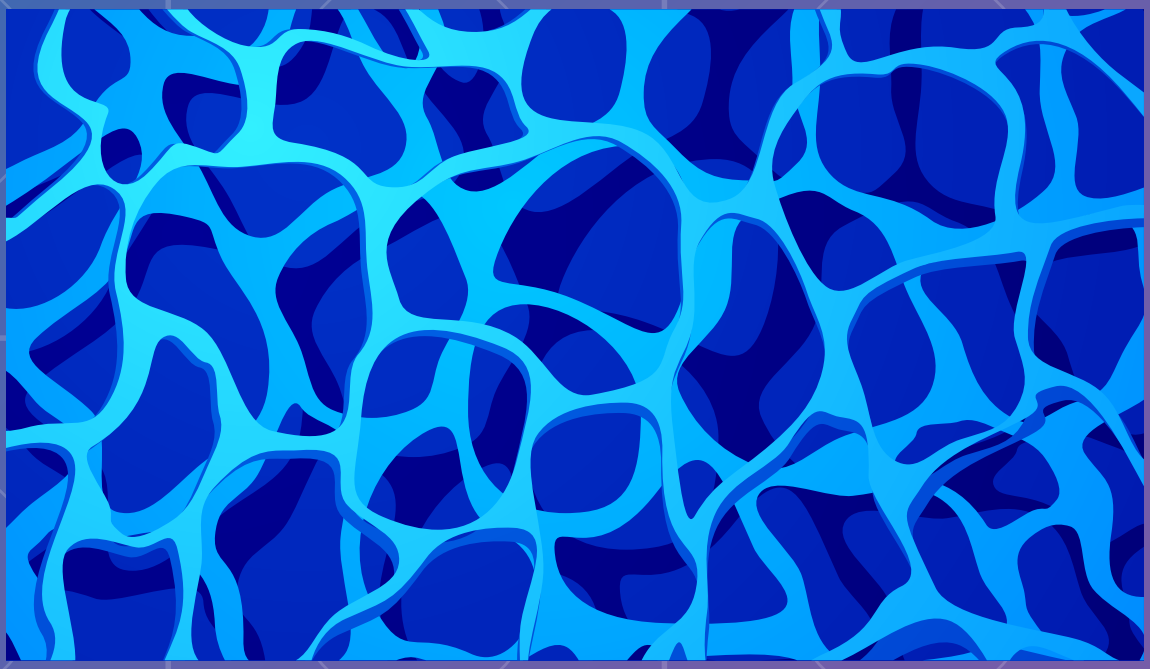
American Water Works Association

Manual of Water Supply Practices

M80



Biological Drinking Water Treatment

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Biological Drinking Water Treatment

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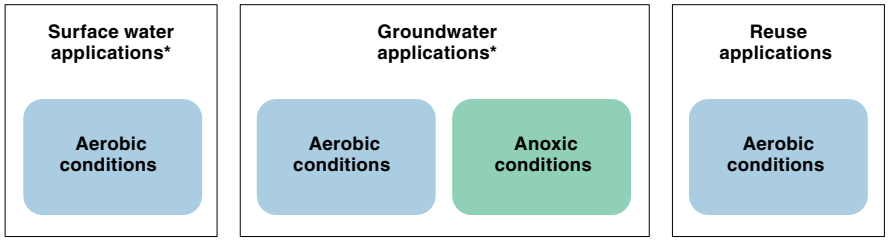
Preface

Biological treatment processes are a sustainable method for removing an array of both inorganic and organic contaminants from water. In biological treatment processes designed for water treatment facilities, microorganisms found in natural water systems grow on engineered surfaces or media (i.e., form a biofilm) and biologically transform or degrade compounds in the process influent. In many cases, conventional filters designed for particle removal are being operated in a way that achieves both particle removal and biological treatment (referred to as biological filtration or biofiltration).

Biological treatment of drinking water has been used since the early 1800s through operation of carbon filters and slow sand filtration without an oxidant residual. As the industry gained a greater understanding of the role of biological instability in managing distribution system water quality, significant work began in the 1980s to optimize biological treatment design and operation. Since that time, the application of biological treatment has expanded with the promulgation of new regulations, such as the Stage 1 and 2 Disinfectants and Disinfection Byproducts Rule in the United States, greater industry acceptance of biological treatment in drinking water with the publication of additional guidance and case studies, and the need for more robust treatment processes to treat both emerging contaminants and alternative water supplies.

Biological treatment processes may occur under either aerobic or anoxic conditions. In aerobic biological treatment, the microorganisms require oxygen to create energy and oxidize contaminants, such as natural organic carbon, dissolved iron and manganese, and ammonia. In contrast, anoxic biological treatment involves microorganisms that mediate electron transfer from an electron donor (e.g., acetic acid) to an electron acceptor (e.g., nitrate) and use the energy generated during the process for growth. Anoxic treatment is used to treat contaminants, such as nitrate and perchlorate.

In the last couple of decades, many project reports, guidebooks, and manuals have been published on individual applications of biological treatment, such as biofiltration. This first edition of AWWA Manual M80, *Biological Drinking Water Treatment*, is the first guidance document covering all common biological treatment processes in practice today, as shown in P-1. This manual begins with an introductory chapter presenting an overview of biological treatment applications, processes, history, and key terminology. The subsequent chapters each focus on one of the four common applications of biological treatment (P-1).



*In some cases, a blend of surface water and groundwater may be treated.

P-1 Four common applications of biological treatment

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Chapter 1

Biological Treatment Overview

Ashley Kent and Lynn Stephens

This Manual of Practice provides guidance on planning, designing, and operating biological treatment processes for treating surface water, groundwater, and reuse. This Manual of Practice synthesizes research findings from studies supported by the Water Research Foundation (WRF), AWWA, US Environmental Protection Agency (USEPA), and others, as well as full-scale experience gained over the last few decades. The purpose of this Manual of Practice is to provide knowledge on common applications of biological treatment and summarize best practices for planning, designing, operating, and monitoring biological treatment processes.

This introduction chapter provides an overview of biological drinking water treatment and defines key concepts that should be understood before reading any of the subsequent chapters. Each subsequent chapter of this Manual of Practice focuses on one of the following biological treatment applications described in Section 1.2.

- Chapter 2: Aerobic Surface Water Biological Filtration
- Chapter 3: Aerobic Biotreatment of Groundwater
- Chapter 4: Anoxic Biological Treatment
- Chapter 5: Aerobic Biofiltration for Reuse

The subsequent chapters all follow a similar organization targeting the key knowledge areas outlined in Figure 1-1.