

Reverse Osmosis and Nanofiltration

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Second Edition



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Science and Technology

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MANUAL OF WATER SUPPLY PRACTICES—M46, Second Edition

Reverse Osmosis and Nanofiltration

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Preface

Reverse osmosis (RO) and nanofiltration (NF) are membrane technologies that can be applied to the treatment of various water sources for the production of drinking water. Membrane technologies can remove organic and inorganic substances from water and can replace or be adjuncts to such traditional treatment methods as sand filtration, primary disinfection, lime and soda softening, ion exchange, and evaporative processes. RO and NF are both pressure-driven membrane processes with similar process configurations and equipment. The main differences between the processes are primary treatment focus (demineralization or salt reduction for RO and hardness and/or organics removal for NF) and the degree of necessary applied pressure (higher for RO). However, the two membrane processes exhibit far more similarities than differences, thus their inclusion in the same manual.

RO was commercialized in the United States in the 1960s and has been used for water desalting applications ever since. NF developed from research and development technology as a lower cost membrane process for softening water and removing organic color.

Membrane technology of all types became particularly applicable to drinking water production in the late 1980s when the amendments to the US Environmental Protection Agency's Safe Drinking Water Act (SDWA) required higher-quality drinking water. The amendments were based on health effects research and the ability to detect contaminants at increasingly lower detection limits using sensitive analytical techniques. Because of their ability to remove or reduce many of the substances addressed by SDWA, membranes will play an increasingly important role in enabling water utilities to meet these regulations.

This manual was developed to provide an overview of RO and NF technology for operators, administrators, engineers, scientists, educators, and anyone seeking an introduction to these processes. An introductory chapter, which discusses an overview of RO and NF processes and applications, is followed by chapters discussing RO and NF process design, facility design, and operations and maintenance. The information contained in these chapters includes history, regulations, theory, terminology, water resources, pretreatment, process technology, posttreatment, concentrate disposal, and membrane and system components, configuration, maintenance, chemistry, costing, and safety.

As this is the second edition of AWWA Manual M46, *Reverse Osmosis and Nanofiltration*, the Membrane Processes Committee and the American Water Works Association welcome comments and suggestions for improving future editions. Please send them as an e-mail attachment to the Water Quality Engineer at eharring@awwa.org or in hard copy to 6666 West Quincy Avenue, Denver, CO 80235.

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