

Water Treatment

Fourth Edition



**American Water Works
Association**

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Project Manager/Copy Editor: Melissa Valentine

Production Services: TIPS Technical Publishing, Inc.

Cover Design: Cheryl Armstrong

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Library of Congress Cataloging-in-Publication Data

Pizzi, Nicholas G.

Water treatment / by Nick Pizzi. -- 4th ed.

p. cm. -- (Principles and practices of water supply operations series)

Rev. ed. of Water treatment. 2003.

ISBN-13: 978-1-58321-777-1

ISBN-10: 1-58321-777-0

1. Water--Purification. I. American Water Works Association. II. Title.

TD430.W368 2010

628.1'62--dc22

2010004525

CIP

ISBN 10: 1-58321-777-0

ISBN 13: 978-1-58321-777-1



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Association**

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Foreword

Water Treatment is part two in a five-part series titled Principles and Practices of Water Supply Operations. It contains information on commonly used water treatment processes and an overview of treatment plant instrumentation and control.

The other books in the series are

Water Sources

Water Transmission and Distribution

Water Quality

Basic Science Concepts and Applications (a reference handbook)

References are made to the other books in the series where appropriate in the text.

The reference handbook is a companion to all four books. It contains basic reviews of mathematics, hydraulics, chemistry, and electricity needed for the problems and computations required in water supply operations. The handbook also uses examples to explain and demonstrate many specific problems.

Acknowledgments

The fourth edition of *Water Treatment* includes the latest in new technology, with expanded emphasis on membranes and recycle issues. The material has been further organized to better coordinate with the other books in the series. The author of the revision is Nicholas G. Pizzi.

Special thanks are extended to Dave Hardy and Mike Barsotti, who provided technical review of all or portions of the fourth edition.

Introduction

The availability of drinking water in the world is becoming increasingly scarce. A growing population, climatic changes, and environmental and biological pollution of source waters have created new challenges in the field of drinking water treatment. Population shift to arid climates creates a demand for water and makes it difficult for aquifers to replenish at suitable rates. In the United States alone, states in the West, Southeast, Southwest, and Northeast experience severe droughts. Global warming has melted ice caps, raising the level of seawater and causing saltwater intrusion for populations situated near coastal areas. Biological infestation of freshwater supplies by mussels and toxic algae create treatment challenges. Water utilities are forced to use and treat groundwater and surface water sources that previously would have been rejected because of the extensive, costly, or technically unfeasible treatment required.

Today water treatment is accomplished using less chemicals, yet provides better protection against pathogens. Customer drinking water contains fewer chemical by-products from disinfection and is safer to drink. Conventional water treatment processes have been improved and new technologies, such as membranes and advanced oxidation processes, have been developed. Stricter certification requirements are in place to ensure that materials used for water treatment systems do not add contaminants to the treated water.

The current regulatory environment challenges the water industry to provide its customers with water that not only tastes good but is the safest it has ever been.

THE OPERATOR'S ROLE IN TREATMENT

Qualified, dedicated, and capable water treatment plant operators are responsible for providing potable and palatable water to the public. Failure to provide safe drinking water 24 hours each day and 365 days each year can result in the outbreak of waterborne disease. Several high-profile cases of water operator error in North America have been documented, and the need for highly qualified water treatment operators is readily apparent.

Treatment plant operators manage, maintain, and repair water treatment plant facilities and distribution systems. The duties of a water treatment plant operator vary widely. In general, an operator may be expected to

- Operate mechanical equipment, including pumps, filters, meters, and chemical feeders;
- Operate electrical and electronic equipment, including motors, controllers, automatic monitors, recorders, and standby power systems;
- Calibrate, maintain, service, repair, and replace various mechanical, electrical, and electronic equipment;
- Determine proper chemical dosages and control chemical applications for the treatment processes;
- Inventory, order, and store chemicals;
- Inventory and maintain an appropriate stock of spare parts for equipment;

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- Keep accurate and complete records of treatment operations and submit required reports to government agencies in accordance with the Safe Drinking Water Act;
- Collect water samples for testing by state or commercial laboratories;
- Perform fundamental laboratory analyses;
- Maintain a safe working environment;
- Perform regular preventive maintenance on various types of equipment;
- Perform general plant maintenance and housekeeping;
- Be informed on local, state, and federal regulations affecting the water system;
- Be informed on new technology and investigate improved equipment or methods of operation that could improve the efficiency or safety of treatment plant operations;
- Recommend to supervisors any repairs, replacements, or improvements that should be made to the treatment system; and
- Interact with the public in a calm and knowledgeable fashion.

To perform these duties successfully, an operator must possess good judgment and understand the fundamentals of mathematics, hydraulics, controls, electricity, microbiology, and chemistry. Training and experience in the operation, maintenance, repair, and replacement of water treatment plant equipment is mandatory.

An operator must understand how and why the treatment process works to better perform his or her public relations role and explain the purpose and operation of a treatment plant to the media, civic organizations, and city council members. Chief operators are often responsible for training and certification.