

# Introduction to Water Treatment

## **Course Overview**

This course is designed to provide a foundational look at Water Treatment processes and methods. Course material consists of reading assignments, video lectures, review questions, study problems and lesson quizzes.

Course completion requires that the student successfully complete each component of each individual lesson. Review questions and written assignments must be submitted either online or uploaded in a Word document for the professor's review. Lesson quizzes have a minimum passing score of 70%.

Upon successful completion of the course requirements, students will receive a certificate of completion for 4.3 CEUs (43 contact hours) for the *Introduction to Water Treatment* course, which is applicable toward a Certificate in Water Treatment Technology from American Water College.

## **Required Texts**

Textbook: Water Treatment Operator Training Handbook

Edition: Third Edition

Author: Nicholas Pizzi and William C. Lauer

ISBN: 978-1-58321-861-7

## **Educational Objectives**

- To provide students with an overview of water treatment processes
- To provide students with a foundational knowledge of treatment processes at different stages of water treatment
- To acquaint students with the different components of a water treatment plant and their function

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## **Evaluation**

Students will be graded on their performance on each lesson quiz, and their course participation. Unless each unit is completed, the student will not be permitted to advance to the next lesson, and the student will not be awarded credit for completion until all assignments, quizzes and lectures are completed. Please contact our office with any questions.

## **Support**

Students can contact our student support staff with any course-related, content-related, or technology-related inquiries. Our office hours are Monday-Thursday, 9-5 CT, and Friday 9-12 CT.

## **Contact Info:**

Phone Number: (661) 874-1655

Email Inquiries: [Info@americanwatercollege.org](mailto:Info@americanwatercollege.org)

Additionally, students are encouraged to contact their professor directly with any questions or comments.

# Introduction to Water Treatment

## **Lesson 1 – Water Treatment Processes**

### **Summary of This Lesson**

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Most water sources, whether groundwater or surface water, contain contaminants of some kind. The water treatment process is designed to remove those contaminants, providing safe and palatable drinking water. This lesson will look at reasons for treatment, selecting methods of treatment, and water source considerations.

### **Lesson Objectives**

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Upon completion of this lesson, students will be able to:

- Explain why the public water supply must generally be treated
- Identify and explain the advantages and disadvantages of groundwater as a source for the public drinking water
- Identify and explain the advantages and disadvantages of surface water as a source for the public drinking water
- Identify the factors influencing the type of treatment that must be used by a public water system
- Identify potential problems in treatment byproduct disposal
- Identify the different types of point-of-use treatment units and explain their use

### **Assignments for This Lesson**

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- No reading assignment
- Watch the video lecture for Lesson 1
- Answer Review Questions
- Complete the quiz for Lesson 1

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## **Lesson 2 – Treatment of Water at the Source**

### **Summary of This Lesson**

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While most water treatment occurs at a treatment plant, there are some situations where it is economically prudent, or practical, or even necessary, to treat water before it enters the treatment plant. This lesson will look at different reasons for treating water at the source, various source water threats, and different methods of source treatment.

### **Lesson Objectives**

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Upon completion of this lesson, students will be able to:

- Identify the problems that can be caused by algae growth in a water source
- Identify the problems that can be caused by aquatic plants in a reservoir
- Explain the methods of controlling the growth of algae
- Explain why stratification occurs in reservoirs, and how it can be prevented

### **Assignments for This Lesson**

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- No reading assignment
- Watch the video lecture for Lesson 2
- Answer Review Questions
- Complete the quiz for lesson 2

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## **Lesson 3 – Preliminary Treatment**

### **Summary of This Lesson**

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Preliminary treatment, or Pretreatment, is used when the water source contains large debris (rocks, logs, branches, aquatic plants, leaves, etc.) or sand, gravel, and gritty substances. Failing to remove debris and grit may cause equipment damage or failure, clog pumps, and complicate the normal treatment process. Preliminary treatment is also used to remove massive amounts of sediment before entering the treatment plant, to alleviate the burden on the treatment plant's settling or sedimentation basins. Preliminary treatment can also reduce the amount of chemicals used in the treatment process. This lesson will focus primarily on screening, presedimentation and microstraining as methods for preliminary treatment.

### **Lesson Objectives**

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Upon completion of this lesson, students will be able to:

- Identify and explain the function and types of screens used on raw-water intakes
- Explain why presedimentation of surface water is often necessary
- Explain how presedimentation sand-and-grit removal devices work
- Explain what microstrainers are used for and how they separate

### **Assignments for This Lesson**

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- Chapter 4 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 3
- Answer Review Questions
- Complete the quiz for Lesson 3

# Introduction to Water Treatment

## **Lesson 4 – Water Coagulation and Flocculation**

### **Summary of This Lesson**

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Coagulation and Flocculation are the first two steps in conventional water treatment designed to remove turbidity and nonsettling solids from water. Nonsettling solids can be biological organisms, viruses, protozoans, color-causing particles and inorganic solids; not only are the visible nonsettling solids aesthetically unacceptable, but the bacteria and organic matter can cause serious illness if not removed from the water.

This lesson will examine coagulation, the process of adding and rapid-mixing chemical coagulant agents into raw water, and flocculation, the process of slow-mixing chemicals into water to assist in particle buildup. After coagulation and flocculation, the floc is settled out in sedimentation basins, and then filtered to remove any remaining suspended matter, which we'll cover in the following two lessons.

### **Lesson Objectives**

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Upon completion of this lesson, students will be able to:

- Explain why coagulation and flocculation are necessary in treating most surface water
- Explain the purpose of coagulation and flocculation in the treatment process
- Explain how coagulants work, and the difference between coagulants and coagulant aids
- Identify the different types of equipment used to feed coagulant chemicals
- Explain the basic design principles of rapid-mix facilities
- Understand the regulations that have an impact on the design or operation of the coagulation and flocculation process
- Identify and explain the advantages or disadvantages of various chemicals for coagulation and flocculation, and how they should be selected
- Explain how to properly monitor the coagulation and flocculation process for optimal results
- List and explain safety precautions related to handling chemicals
- Explain how and why proper records of the coagulation and flocculation process should be kept

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## Assignments for This Lesson

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- Chapter 5 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 4
- Answer Review Questions
- Complete the quiz for Lesson 4

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## **Lesson 5 – Sedimentation Basins and Clarifiers**

### **Summary of This Lesson**

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In the conventional water treatment process, sedimentation (also known as “clarification”) is between flocculation and filtration. Water flows slowly through the sedimentation basin or clarifier, allowing sand, grit, pollutants, floc, and other solids to settle out of the water, thus lessening the load on the filters. This lesson will cover types of sedimentation basins, the principles of settling and optimal settling conditions, and collecting sludge for removal.

### **Lesson Objectives**

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Upon completion of this lesson, students will be able to:

- Identify the different types of sedimentation basins
- Identify and explain the different zones and parts of sedimentation basins
- Explain the principles of tube and plate settlers
- Explain the methods of sludge removal
- Identify typical problems encountered in operating sedimentation basins
- List the methods for disposing of sedimentation basin sludge

### **Assignments for This Lesson**

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- Chapter 6 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 5
- Answer Review Questions
- Complete the quiz for Lesson 5



# Introduction to Water Treatment

## **Lesson 6 – Filtration**

### **Summary of This Lesson**

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After coagulation, flocculation, and sedimentation (or clarification), the water is filtered. Filtration is most important in surface water treatment, as groundwater is naturally filtered in most cases. Surface water runoff and contamination pose the more serious threat, which filtration is designed to combat.

This lesson will cover filtration methods and principles, filter media and filtration monitoring for optimal performance and government regulatory compliance.

### **Lesson Objectives**

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Upon completion of this lesson, students will be able to:

- Identify the types of commonly used filtration facilities
- Explain the principle of gravity filter operation
- Explain the differences between pressure filters and gravity filters
- Identify the types of media used in filters
- Identify the types of underdrain systems used in filters
- Identify the types of commonly used filter controls
- Explain the purpose of backwashing filters and how backwashing is performed
- Identify the methods of monitoring filter operation
- Identify the principle regulations governing filtration operations
- Identify common filter operating problems
- List the types of records that must be kept on filter operation

### **Assignments for This Lesson**

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- Read Chapter 7 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 6
- Answer Review Questions
- Complete the quiz for Lesson 6

# Introduction to Water Treatment

## **Lesson 7 – Disinfection**

### **Summary of This Lesson**

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Disinfection is the addition of chemicals to destroy or inactivate disease-causing organisms in water. Viruses, bacteria, fungi, or protozoa can cause symptoms ranging from mild illness to death. Disinfection is not sterilization, but disinfection does remove or inactivate organisms to acceptable levels.

This lesson examines the diseases and organisms that disinfection targets, the methods of disinfection (primarily chlorine or chlorine gas), regulations of disinfection by-products (DBPs), monitoring the disinfection process, and safety procedures for disinfection.

### **Lesson Objectives**

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Upon completion of this lesson, students will be able to:

- Identify the most commonly occurring waterborne diseases in the US
- Explain the methods of disinfecting drinking water
- Explain chlorination principles
- Identify the common points of disinfection application
- Identify the equipment for handling and feeding chlorine gas
- Identify the equipment and facilities used for hypo chlorination
- Identify the equipment used for other disinfection methods
- List state and federal regulations requiring the application of disinfectants to drinking water
- List state and federal regulations of disinfection by-products
- Explain the correct procedures for handling and connecting chlorine cylinders and containers
- Identify chlorine operation problems
- Explain chlorine control tests
- Identify and explain safety equipment and procedures for working with chlorine

### **Assignments for This Lesson**

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- Read Chapter 8 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 7
- Answer Review Questions
- Complete the quiz for Lesson

# Introduction to Water Treatment

## **Lesson 8 – Fluoridation**

### **Summary of This Lesson**

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Fluoride can often be found in most drinking water sources, either as a naturally-occurring ion, or after being added at a treatment plant to provide this essential element for bone and tooth development. Fluoridation is the process of deliberately adding fluoride to the public water supply.

This lesson covers the process and reasons for fluoridation, the regulations affecting fluoridation, monitoring, tests, and safety precautions.

### **Lesson Objectives**

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Upon completion of this lesson, students will be able to:

- List the reasons for obtaining an optimum concentration of fluoride in drinking water
- Identify the long-term effects of excessive levels of fluoride in drinking water
- Identify the chemicals commonly used in fluoridating water
- Identify the equipment used for feeding fluoride to drinking water
- Identify the regulations requiring fluoridation of drinking water
- Explain how fluoride feed equipment is operated
- Identify and explain the operational control tests used when feeding fluoride
- Identify and explain safety precautions to observe in handling fluoride chemicals

### **Assignments for This Lesson**

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- Read Chapter 10 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 8
- Answer Review Questions
- Complete the quiz for Lesson 8