Advanced Water Treatment

Course Overview

This course is designed to provide an advanced overview of 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 4.5 CEUs (45 contact hours) for the *Advanced 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 an advanced understanding 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

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

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Lesson 1 – Control of Corrosion and Scaling

Summary of This Lesson

Some water systems find it necessary to take steps to control corrosion and scaling, not only to comply with federal or state regulations, but to extend the life of plumbing equipment, improve water quality and protect the public health. If the source water for a treatment plant causes corrosion or deposits scale on the system pipes and plumbing fixtures, there is a potential for lead or copper and other trace metals entering the public water supply.

This lesson will provide an overview of the reasons and methods of stabilizing water, controlling corrosion and scaling, and the chemicals involved in corrosion control.

Lesson Objectives

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

- Explain the reasons for stabilizing water
- Explain the basic chemistry of corrosion and scale formation
- List state and federal regulations requiring corrosion control
- Identify and explain the methods for controlling corrosion
- Identify and explain the chemicals and equipment used for corrosion control
- Identify factors to be considered in selecting an appropriate stabilization process
- Explain the operation of a stabilization process
- Identify the common problems encountered in operating stabilization processes

Assignments for This Lesson

- Read Chapter 10 - Specialized Treatment Processes pages 161 –162 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 1
- Answer Review Questions
- Complete the quiz for Lesson 1

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Lesson 2 – Iron and Manganese Control

Summary of This Lesson

Excessive iron or manganese can pose aesthetic, health or operational problems in a public water system. It is important not only to understand how iron and manganese can enter the water supply, but also to be familiar with the risks and treatment processes that remove iron and manganese from drinking water.

This lesson will provide an overview of the problems caused by excessive iron and manganese, the methods of removing iron and manganese, and the monitoring and regulations that govern iron and manganese control

Lesson Objectives

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

- Identify the problems caused by excessive iron and manganese in water
- Explain the methods used for iron and manganese removal
- Identify and explain the equipment and facilities used for iron and manganese control
- List the regulations that apply to iron and manganese in drinking water
- Explain the monitoring and operation of iron and manganese removal processes

Assignments for This Lesson

- Read Chapter 10 - Specialized Treatment Processes pages 150 –152 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 2
- Answer Review Questions
- Complete the quiz for Lesson 2

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Lesson 3 – Lime Softening

Summary of This Lesson

The two most commonly-used water softening processes used in water treatment are lime softening, or the lime-soda ash process, and ion exchange. Ion exchange will be addressed in the next lesson, while this lesson focuses on the occurrence, chemistry and effects of hard water and how lime softening addresses water hardness.

Lesson Objectives

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

- Identify the characteristics and effects of hard and soft water
- List the minerals causing water hardness
- Identify the various types of water hardness
- Identify and explain the equipment used for lime-soda ash softening
- Identify regulations that may affect the softening process
- Explain how softening chemicals are stored and fed
- Explain how softening facilities are operated
- Identify and explain tests used for operational control of the softening process
- Identify and explain special safety precautions for handling softening chemicals

Assignments for This Lesson

- Read Chapter 9 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 3
- Answer Review Questions
- Complete the quiz for Lesson 3

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Lesson 4 – Ion Exchange

Summary of This Lesson

Ion exchange is the most common method for treatment plants to remove unwanted ions, some of which cause water hardness. This lesson will detail the ion exchange process and the developments made in this process. Additionally, we will look at the advantages and disadvantages of this process as a means of water treatment and softening.

Lesson Objectives

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

- Identify the chemicals that can be removed from water using ion exchange processes
- Identify and explain the advantages and disadvantages of ion exchange processes
- Explain the chemistry of ion exchange softening
- Identify and explain the facilities and equipment used for ion exchange softening
- Identify the problems encountered in disposing of wastes from the ion exchange process

Assignments for This Lesson

- Read Chapter 10 – Specialized Treatment Processes pages 162 –164 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 – Adsorption

Summary of This Lesson

Adsorption is the adhesion of atoms, ions, or molecules from a gas, liquid, or dissolved solid on the surface of a solid. In water treatment, adsorption is used primarily to remove organic substances in water that can cause problems from taste and odor complaints to serious health problems. This lesson will provide an overview of the organic compounds that are objectionable and why, the regulations affecting adsorption and organic removal, the safety concerns when using carbon, and the operation and testing of adsorption processes.

Lesson Objectives

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

- Explain the occurrence of organic chemicals of concern in groundwater and surface water
- Identify and explain the methods for removing organic chemicals of concern
- Explain the principles of adsorption
- Explain the methods of using powdered and granular activated carbon
- List federal and state regulations that may require the use of adsorption treatment
- Explain the operation and testing of adsorption processes
- Identify and explain special safety precautions that should be observed when using carbon

Assignments for This Lesson

- Read Chapter 10 – Chapter 10 – Specialized Treatment Processes page 148-150 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 5
- Answer Review Questions 1
- Complete the quiz for Lesson 5

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Lesson 6 – Aeration

Summary of This Lesson

Natural aeration occurs when streams or rivers tumble over rocks and the water flow becomes turbulent. The turbulence brings air and water into contact, and the air dissolves into the water.

In water treatment, aeration is used to remove volatile organics from water, reduce the concentration of taste and odor-causing chemicals, to remove carbon dioxide and remove radon gas. When aeration is used, it's usually the first part of the treatment process. This lesson will look at the use and efficiency of aeration, and the problems associated with aeration as part of the treatment process.

Lesson Objectives

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

- Explain how aeration removes or modifies constituents in water
- Identify the troublesome constituents in water that are commonly removed by aeration
- Identify the types of aerators commonly used by public water systems
- Identify common problems associated with the operation of aeration equipment

Assignments for This Lesson

- Read Chapter 10 – Specialized Treatment Processes page 147 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 6
- Answer Review Questions
- Complete the quiz for Lesson 6

Lesson 7 – Membrane Processes

Summary of This Lesson

Chemical dosing to remove contaminants can result in higher levels of DBPs in the water supply, which can cause problems of their own. Membrane processes are an alternative to utilizing disinfection solely in the treatment process. This lesson introduces membrane processes, and the advantages and disadvantages of using membrane as part of the treatment process.

Lesson Objectives

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

- Identify and explain the types of membrane processes
- Identify and explain the principles of microfiltration and nanofiltration/reverse osmosis
- Identify the types of equipment used
- Explain the operation of a membrane system

Assignments for This Lesson

- Read Chapter 11 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 7
- Answer Review Questions
- Complete the quiz for Lesson 7

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Lesson 8 – Water Treatment Plant Residuals

Summary of This Lesson

It is important for water treatment plant residuals, such as sludge, to be handled and disposed of properly in order to ensure that operations continue smoothly and that the treatment plant stays in compliance with the state and federal regulations for water quality. It is crucial to develop a residuals-handling program and maintain adherence to the residuals-handling protocol.

This lesson discusses the purpose of residual dewatering and disposal and the means to accomplish both, and how the residual-handling applies as part of the overall water treatment process.

Lesson Objectives

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

- Explain the importance of residuals handling, dewatering, and disposal to the overall operation of a water treatment plant
- Explain how and why residuals are dewatered
- Explain methods of calculating sludge quantities
- Explain how sludges are removed from water treatment basins
- Explain how solids separation processes are applied to water treatment plant sludges

Assignments for This Lesson

- Read Chapter 6 – Sedimentation pages 79-85 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 8
- Answer Review Questions
- Complete the quiz for Lesson 8

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Lesson 9 – Treatment Plant Instrumentation and Control

Summary of This Lesson

It is important to be familiar with the different instrumentation and controls that are a part of a water treatment plant. These instruments and controls not only monitor flow, control processes with greater precision and improve the safety of the workplace, but they also track data and monitor the condition of equipment, which reduces the workload on operators. This lesson explores the different types of instruments and their purpose in the water treatment process.

Lesson Objectives

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

- Explain the purpose and principal methods used for measuring flow
- Identify and explain the methods of measuring pressure and level
- Explain the principles of equipment automation
- Identify and explain the potential of computers for providing records and operational control in water treatment systems

Assignments for This Lesson

- Read Chapter 13 in Water Treatment Operator Training Handbook
- Watch the video lecture for Lesson 9
- Answer Review Questions
- Complete the quiz for Lesson 9