

**Advanced Waste Treatment  
Office of Water Programs  
California State University, Sacramento  
(9.0 Continuing Education Units)**

**COURSE DESCRIPTION**

This course is designed to train operators in the practical aspects of operating and maintaining wastewater treatment plants, emphasizing safe practices and procedures. Information presented includes detailed descriptions of the equipment and advanced treatment processes used for odor control, pure oxygen activated sludge treatment, solids removal from secondary effluents, residual solids management, enhanced biological control including nitrogen and phosphorus removal, and wastewater reclamation. Operators also learn to operate and maintain treatment plant instrumentation equipment and systems. The residual solids management chapter contains information on sludge types, characteristics, and quantities; sludge thickening using gravity thickeners, dissolved air flotation units, centrifuges and thermal conditioning as well as wet oxidation and elutriation; dewatering with pressure filtration (plate and frame, belt, vacuum), centrifuges and drying beds; volume reduction using composting, mechanical drying, incineration, and lagoons; and disposal methods for dewatered or liquid stabilized sludge. This course focuses on actual operating procedures and teaches operators to analyze and solve operational problems.

**COURSE OUTLINE**

The course uses *Advanced Waste Treatment* training manual.

**CHAPTER 1. ODOR CONTROL**

**OBJECTIVES**

Following completion of Chapter 1, students should be able to:

1. Determine the source and cause of odors.
2. Respond to odor complaints.
3. Solve odor problems.

The main purpose of this chapter is to teach operators how to identify the causes and sources of odors, respond to odor complaints, and solve odor problems.

**CHAPTER 2. ACTIVATED SLUDGE**

**(PURE OXYGEN PLANTS AND OPERATIONAL CONTROL OPTIONS)**

**OBJECTIVES**

Following completion of Chapter 2, students should be able to:

1. Safely operate and maintain a pure oxygen activated sludge plant.
2. Review the plans and specifications for a pure oxygen system.
3. Describe the various methods of determining return sludge and waste sludge rates and select the best method for their plant.
4. Operate an activated sludge process that must treat both municipal and industrial wastes.
5. Operate an activated sludge process that must treat strictly an industrial waste.
6. Operate an activated sludge process to produce a nitrified effluent.

The main purpose of this chapter is to teach operators how to safely start up, operate, shut down, and maintain pure oxygen activated sludge processes. Other purposes include teaching students how to develop operational strategies for the activated sludge process and how to treat industrial wastes using the activated sludge process.

### **CHAPTER 3. RESIDUAL SOLIDS MANAGEMENT**

#### **OBJECTIVES**

Categories of residual solids management processes contained in this chapter include thickening, stabilization, conditioning, dewatering, volume reduction, and land disposal. Following completion of Chapter 3, with regard to the processes in these solids handling and disposal categories, students should be able to:

1. Explain the purposes of the processes.
2. Properly start up, operate, shut down, and maintain these processes.
3. Develop operating procedures and strategies for both normal and abnormal operating conditions.
4. Identify potential safety hazards and conduct their duties using safe procedures.
5. Troubleshoot when a process does not function properly.
6. Review plans and specifications for the processes.

The purpose of Chapter 3 is to teach students about several of the most widely used methods for handling and disposing of wastewater treatment residual materials. The chapter teaches students how to operate thickening, stabilization, conditioning, dewatering, and volume reduction processes. It also describes methods for disposing of both liquid and solid industrial waste residuals and discusses the regulations that govern disposal of the wastes.

### **CHAPTER 4. SOLIDS REMOVAL FROM SECONDARY EFFLUENTS**

#### **OBJECTIVES**

Following completion of Chapter 4, students should be able to:

#### **CHEMICALS**

1. Describe the proper procedures for using chemicals to remove solids from their treatment plant's secondary effluent.
2. Operate and maintain chemical feed equipment.
3. Safely store and handle chemicals.
4. Review plans and specifications of chemical feed systems.
5. Start up and shut down a chemical feed system.
6. Perform a jar test.
7. Select the most cost-effective chemicals and determine proper dosage.
8. Troubleshoot a chemical feed system.
9. Develop an operational strategy for a chemical feed system.

#### **FILTRATION**

1. Identify and describe the components of gravity and pressure filters.
2. Explain how membrane filters operate.
3. Safely operate and maintain filters.
4. Start up and shut down filters.
5. Troubleshoot a filtration system.



6. Develop operational strategies for inert-media and membrane filtration systems.
7. Review plans and specifications for filter systems.

The purpose of this chapter is to teach operators how to safely start up, operate, shut down, and maintain solids removal processes using chemicals and several types of filtration processes. The chapter explains how to perform jar tests, select appropriate chemicals, determine proper chemical dosages, and operate various types of chemical feed systems. It also describes the operation, maintenance, and troubleshooting procedures for gravity and pressure filters as well as membrane filters.

## **CHAPTER 5. PHOSPHORUS REMOVAL**

### **OBJECTIVES**

Following completion of Chapter 5, students should be able to:

1. Explain the need for phosphorus removal and describe some of the different systems used for this purpose at various treatment plants.
2. Place a phosphorus removal system into service.
3. Schedule and safely conduct operation and maintenance duties.
4. Sample influent and effluent, interpret lab results, and make appropriate adjustments in the treatment process.
5. Recognize abnormal operating conditions, understand the cause, and take corrective action to ensure proper phosphorus removal.
6. Inspect a newly installed phosphorus removal facility to determine if installation has been proper.
7. Review plans and specifications for a phosphorus removal system.

The purpose of this chapter is to show students how to remove phosphorus from wastewaters using a modification of the activated sludge process as well as chemical removal by lime precipitation and alum flocculation. Removal of phosphorus by the luxury uptake method is described in detail.

## **CHAPTER 6. NITROGEN REMOVAL**

### **OBJECTIVES**

Following completion of Chapter 6, students should be able to:

1. Explain why nitrogen is removed from wastewater.
2. Identify the types of nitrogen removal systems.
3. Describe nitrification and denitrification processes.
4. Operate nitrification and denitrification processes.
5. Describe the differences between suspended growth and fixed film reactors.
6. Explain how ammonia stripping, breakpoint chlorination, and ion exchange processes remove nitrogen.

The main purpose of this chapter is to teach operators how to safely start up, operate, shut down, and maintain treatment processes used for nitrogen removal. The processes described include nitrification using suspended and attached growth reactors, nitrogen removal by ammonia stripping, and breakpoint chlorination.

## **CHAPTER 7. ENHANCED BIOLOGICAL (NUTRIENT) CONTROL OBJECTIVES**

Following completion of Chapter 7, students should be able to:

1. Explain how an enhanced biological treatment system can be used to improve biological treatment process control and performance.
2. Set priorities when more than one treatment objective must be met.
3. Operate and maintain enhanced nitrogen and phosphorus removal systems.
4. Operate and maintain enhanced SVI control to prevent sludge bulking.
5. Operate and maintain the Bardenpho process.
6. Review plans and specifications for an enhanced biological treatment system.

The purpose of this chapter is to show students how various modifications of the activated sludge process can be used to remove nitrogen and phosphorus from wastewaters and to enhance overall treatment results. The chapter also explains how to set priorities when it is necessary to accomplish more than one objective with a biological treatment system. System flexibility is an important consideration in enhanced biological treatment; therefore, this chapter presents an extensive review of the factors that should be considered when reviewing plans and specifications for such a system.

## **CHAPTER 8. WASTEWATER RECLAMATION AND REUSE OBJECTIVES**

Following completion of Chapter 8, students should be able to:

1. Describe the various methods of wastewater reclamation and reuse.
2. Develop operational strategies for wastewater reclamation and reuse facilities.
3. Safely operate and maintain a wastewater reclamation and reuse facility.
4. Monitor a wastewater reclamation and reuse program and make appropriate adjustments in treatment processes.
5. Review the plans and specifications for a wastewater reclamation and reuse facility.

The main purpose of this chapter is to teach operators how to safely start up, operate, shut down, and maintain treatment processes used to reclaim wastewater.

## **CHAPTER 9. INSTRUMENTATION AND CONTROL SYSTEMS OBJECTIVES**

Following completion of Chapter 9, students should be able to:

1. Explain the purpose and nature of instrumentation and control systems.
2. Identify, avoid, and correct safety hazards associated with instrumentation work.
3. Recognize various types of sensors and transducers.
4. Read instruments and make proper adjustments in the operation of wastewater treatment facilities.
5. Identify symptoms of measurement and control system problems.

The main purpose of this chapter is to teach operators how to read instruments, maintain instruments and controls, and determine the location and cause of instrument and control failures and take corrective action. Operators must realize that if they do not know what they are doing or are not authorized to work on instrumentation, they must request help.



## TIME ASSIGNMENT

**Text Pages:** The course uses the training manual *Advanced Waste Treatment* (757 pages). The average word count on a page from the training manual is 950 words. Some pages contain tables, graphs, or illustrations to enhance the presentation of information. It is assumed that readers spend equal time studying tables, graphs, and illustrations as they would spend reading the equivalent amount of text. Therefore, each page is assumed to contain the equivalent of 950 words. Accepted average adult reading speed is 200 – 250 words per minute. Therefore, each page is projected to require four minutes of student time for each reading.

**Questions:** The course contains 562 assessment questions integrated into the reading. Each question requires a written response consisting one or more sentences. Projected average review question time is two minutes per question.

**Discussion questions:** The course contains 159 discussion questions. Each discussion question requires a written response consisting one or more sentences. Projected average discussion question time is two minutes per question.

**Review questions:** The course contains 147 comprehensive review questions. Projected average response time is one minute per question.

**Objective test questions:** The course contains 366 objective test questions. Projected average response time is one minute per question.

Component	Minutes per Component Unit	Number of Component Units	Time to Complete Units
Text pages	4	757	3,028
Questions	2	562	1,124
Discussion questions	2	159	318
Review questions	1	147	294
Objective test questions	1	366	366
<b>Total (minutes)</b>			<b>5,130</b>
<b>Total (hours)</b>			<b>86</b>