

Industrial Waste Treatment, Volume 1
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 industrial wastewater treatment plants, emphasizing safe practices and procedures. Information is presented on the importance and responsibilities of an industrial treatment plant operator, why industrial and municipal wastewaters must be treated, regulations governing industrial wastes, sources of wastes, methods for preventing and minimizing wastes at the source, and industrial waste monitoring. Operators learn to operate and maintain flow measurement equipment, preliminary treatment processes (equalization, screening, and pH adjustment), physical–chemical treatment processes (coagulation, flocculation, and sedimentation), pressure and gravity filters (including membrane filters), physical treatment processes (air stripping and carbon absorption), and processes for treatment of metal wastestreams. Operators will also learn to operate and maintain treatment plant instrumentation equipment and systems. Additional chapters address detailed safety procedures and plant maintenance. This course focuses on actual operating procedures and teaches operators to analyze and solve operational problems.

COURSE OUTLINE

The course uses *Industrial Waste Treatment, Vol. I* training manual.

Chapter 1 – The Industrial Plant Operator

OBJECTIVES

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

1. Explain the type of work done by an industrial wastewater treatment plant operator.
2. Describe where to look for jobs in this profession.
3. Find sources of training and further information on how to do the jobs performed by industrial treatment plant operators.

This chapter is designed to fire up the students' interest in being industrial wastewater treatment plant operators and learning how to do the job properly and safely.

Chapter 2 – Industrial Wastewaters

OBJECTIVES

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

1. Give reasons for preventing pollution.
2. Identify various types of waste discharges.
3. Recognize the effects of waste discharges on receiving waters.
4. Describe the different types of solids in wastewater.
5. Explain what happens in a natural cycle.
6. Explain why industrial wastewaters need to be treated.
7. List the general types of manufacturing activities and processes that are sources of industrial wastes or wastewater.

8. Describe the types of industrial wastewaters discharged to sewers.
9. Explain the difference between concentration and mass of pollutants.
10. Describe the effects of industrial wastewaters on wastewater collection, treatment, and disposal systems.

The purpose of this chapter is to describe waste characteristics, to justify why wastes must be treated, and to teach operators about the sources and types of wastewaters generated by various types of industries and the effects of these wastewaters on collection, treatment, and disposal systems.

Chapter 3 – Regulatory Requirements

OBJECTIVES

Following completion of Chapter 3, students should be able to:

1. Describe the role of the Environmental Protection Agency in pollution control efforts.
2. Define the categories or types of industrial dischargers regulated under the Clean Water Act.
3. Explain which types of industrial dischargers are regulated by the National Pollutant Discharge Elimination System (NPDES) permit program.
4. Explain which types of industrial dischargers are regulated by the National Pretreatment Program.
5. List the general types of pollutants governed by the General Pretreatment Regulations.
6. Outline the development of categorical limits.
7. Identify types of industries and facilities subject to the categorical program.
8. Explain the role of local authorities in the control of pollutants.
9. Keep current with changing regulations.

The purpose of this chapter is to provide operators with a background of how the rules and regulations we work with have developed historically and how they are presently applied to the treatment of industrial wastewater.

Chapter 4 – Preventing and Minimizing Wastes at the Source

OBJECTIVES

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

1. Explain the differences between industrial waste treatment and pollution prevention.
2. Describe the industrial treatment facility operator's role in pollution prevention.
3. Identify general types of pollution prevention opportunities in the areas of: (a) good operating practices, (b) material substitution, (c) process modification, and (d) product reformulation.
4. Describe the economic benefits of preventing pollution.
5. Prepare a pollution prevention checklist for their industrial facility.

The purpose of this chapter is to identify sources of wastewater in industrial plants and describe methods that can be used to reduce or eliminate wastestreams. This chapter provides detailed lists of pollution prevention opportunities for a variety of industries.

Chapter 5 – Industrial Waste Monitoring

OBJECTIVES

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

1. Develop an industrial waste monitoring program.
2. Justify an industrial waste monitoring program.
3. Administer and manage the program.
4. Locate sources of industrial waste discharges.
5. Collect and preserve representative samples.
6. Document the “chain of custody” of their sampling program.
7. Develop a monitoring strategy.
8. Conduct their duties in a safe manner.

The purpose of this chapter is to teach students how to justify, develop, and administer an industrial waste monitoring program. Important aspects of an industrial waste monitoring program include knowing procedures to locate sources of industrial waste discharges and how to collect and preserve representative samples. Documentation of the “chain of custody” procedures is critical if legal action is involved. The implementation of a monitoring strategy is very important if the monitoring program is to be successful.

Chapter 6 – Flow Measurement

OBJECTIVES

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

1. List the reasons for measuring flows.
2. Explain the functions of primary and secondary elements.
3. Describe the various types of open channel flow measurement devices.
4. Determine the accuracy of open channel flowmeters.
5. Identify the various types of closed pipe flow metering systems.
6. Identify appropriate flow measurement devices for a variety of treatment plant flows.
7. Prepare a flow-proportioned composite sample.

The purpose of this chapter is to acquaint operators with the various types of flowmeters, their limitations, and factors that could produce inaccurate results.

Chapter 7 – Preliminary Treatment

OBJECTIVES

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

1. Explain the benefits of flow and waste load equalization.
2. Determine whether equalization would benefit their plant.
3. Calculate the minimum volume of an equalization tank needed to accommodate their plant’s wastewater flows.
4. Develop a strategy for operating an equalization tank.
5. Explain the importance of screening industrial wastes before treatment.
6. Describe the various types of coarse and fine screens.
7. Start up, shut down, maintain, and troubleshoot wastewater screens.
8. Explain why pH adjustment is necessary.

9. Describe the major components of a pH probe.
10. List and discuss the factors that influence pH sensor accuracy.
11. Prepare a titration curve.
12. Troubleshoot pH adjustment problems.

The purpose of this chapter is to teach operators how preliminary treatment processes (equalization, screening, and pH adjustment) operate and how they affect the performance of other downstream treatment processes.

Chapter 8 – Physical–Chemical Treatment Processes

OBJECTIVES

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

1. Explain the role of coagulation and flocculation processes in removing suspended solids from industrial wastestreams.
2. Describe various types of sedimentation basins and how they work.
3. Develop an operational strategy for physical–chemical treatment processes.
4. Safety start up, operate, maintain, and shut down the processes.
5. Perform a jar test.
6. Recognize abnormal operating conditions and troubleshoot to determine the cause.
7. Select the most cost-effective chemicals and determine proper dosage.
8. Start up, operate, maintain, and shut down a chemical feed system.
9. Adjust chemical feed rates.
10. Troubleshoot a chemical feed system.
11. Safely store and handle chemicals.

The purpose of this chapter is to teach operators how to safely start up, operate, shut down, and maintain the solids removal processes of coagulation, flocculation, and sedimentation. The chapter explains how to perform jar tests, select appropriate chemicals, determine proper chemical dosages, and operate various types of chemical feed systems.

Chapter 9 – Filtration

OBJECTIVES

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

1. Identify and describe the components of inert-media gravity and pressure filters.
2. Explain how membrane filters operate.
3. Start up and shut down filters.
4. Safely operate and maintain 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 start up, operate, shut down, and maintain filtration systems. The chapter describes the components and operation of inert-media filters (gravity, pressure, and continuous backwash types) and cross flow membrane filters. Operators will also learn how to troubleshoot filtration problems and what to look for when reviewing plans and specifications for filtration systems.

Chapter 10 – Physical Treatment Processes

OBJECTIVES

Following completion of Chapter 10, students should be able to:

AIR STRIPPING

1. Explain the purpose of air stripping in industrial wastewater treatment.
2. Describe how a countercurrent packed tower air stripper removes volatile organic compounds from water or wastewater.
3. List and describe three methods for controlling the stripped volatile organics discharged from an air stripper.
4. Safely start up, operate, and maintain an air stripping unit.
5. Perform routine maintenance on an air stripper.
6. Troubleshoot air stripper performance problems.

ACTIVATED CARBON ADSORPTION

1. Describe how activated carbon removes contaminants from a wastestream.
2. Start up, operate, and shut down a carbon adsorption unit.
3. Identify and correct abnormal operating conditions.
4. Operate and maintain an activated carbon adsorption system in a safe manner.
5. Review plans and specifications for a carbon adsorption system.

The purpose of this chapter is to explain how air stripping removes volatile organic compounds (VOCs) from wastestreams and how activated carbon removes various types of contaminants from industrial wastestreams. Other purposes include teaching operators how to safely start up, operate, shut down, maintain, and troubleshoot air stripping and carbon adsorption systems and how to regenerate activated carbon.

Chapter 11 – Treatment of Metal Wastestreams

OBJECTIVES

Following completion of Chapter 11, students should be able to:

1. Explain the need to treat metal wastestreams.
2. Identify the sources of metal wastestreams.
3. Operate and maintain neutralization, metal precipitation, cyanide destruction, and complexed metal treatment facilities.
4. Collect, treat, and dispose of sludges generated by these treatment processes.
5. Troubleshoot treatment facilities described in this Chapter.
6. Safely perform the duties of an operator of these facilities.

The purposes of this chapter are to identify the types and sources of metal wastestreams in industrial facilities and to teach operators how to operate several common treatment processes for metals removal. Treatment of metal wastestreams often involves use of some of the other treatment processes described earlier in this training manual. This chapter takes a wide view of the whole sequence of operations involved in the treatment of metal wastestreams. It identifies sources of wastes, tells how to operate the metals removal processes and handle the resulting sludges, describes typical instrumentation and control systems, explains sampling procedures and reviews flow measurement techniques, suggests maintenance and troubleshooting strategies, and emphasizes the critical importance of using safe procedures and safety equipment.

Chapter 12 – Instrumentation

OBJECTIVES

Following completion of Chapter 12, students should be able to:

1. Explain the purpose and nature of measurement 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 industrial wastewater treatment facilities.
5. Identify symptoms of measurement and control system problems.

The 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.

Chapter 13 – Safety

OBJECTIVES

Following completion of Chapter 13, students should be able to:

1. Identify the types of hazards they may encounter operating an industrial wastewater treatment facility.
2. Recognize unsafe conditions and correct them whenever they develop.
3. Organize regular “tailgate” safety meetings.
4. Develop the habit of always thinking safety and working safely.

NOTE: Special safety information is given in other chapters because of the importance of safety considerations at all times.

The purpose of this chapter is to teach operators how to identify safety hazards and unsafe conditions and do their jobs safely.

Chapter 14 – Maintenance

OBJECTIVES

Following completion of Chapter 14, students should be able to:

1. Develop a maintenance program for their plant, including equipment, buildings, grounds, channels, and tanks.
2. Start a maintenance recordkeeping system that will provide them with information to protect equipment warranties, to prepare budgets, and to satisfy regulatory agencies.
3. Schedule maintenance of equipment at proper time intervals.
4. Perform maintenance as directed by manufacturers.
5. Recognize symptoms that indicate equipment is not performing properly, identify the source of the problem, and take corrective action.
6. Start and stop pumps.
7. Unplug pipes, pumps, and valves.
8. Explain the operation and maintenance of sensors, transmitters, receivers, and controllers.
9. Determine when they need assistance to correct a problem.

NOTE: Special maintenance information is given in the previous chapters on treatment processes where appropriate.

The purpose of this chapter is to teach operators how to develop a maintenance program, keep maintenance records, schedule maintenance at the proper time intervals, and perform maintenance.

TIME ASSIGNMENT

Text Pages: The course uses the training manual *Industrial Waste Treatment, Volume 1* (948 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 629 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 239 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 226 comprehensive review questions. Projected average response time is one minute per question.

Objective test questions: The course contains 536 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 | 948 | 3,792 |
| Questions | 2 | 629 | 1,258 |
| Discussion questions | 2 | 239 | 478 |
| Review questions | 1 | 226 | 452 |
| Objective test questions | 1 | 536 | 536 |
| Total (minutes) | | | 6,516 |
| Total (hours) | | | 109 |