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AUTHOR Stoakes, K. C.; And Others  
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ABSTRACT

This instructor's guide, designed for use with the curriculum, Plant Operations for Wastewater Facilities, represents a two-year wastewater technology instructional program based on performance objectives designed to prepare undergraduate students to enter occupations in water and wastewater treatment plant operations and maintenance. This document, part B of five parts, covers the topics of Trickling Filtration, Aeration, Secondary Sedimentation and Pond Stabilization. In this guide, the topics and ideas are presented as a series of modules, organized around 16 general objectives common to all processes. The module begins with a statement of purpose which explains what the student will be studying. Next, all the objectives of the module and code numbers keyed to a computerized list of instructional resources are listed. Also included in each module are a glossary of verbs and sections on learning and testing conditions, acceptable performance, instructor activity and student activity. Recommendations on evaluation techniques are included. (BT)

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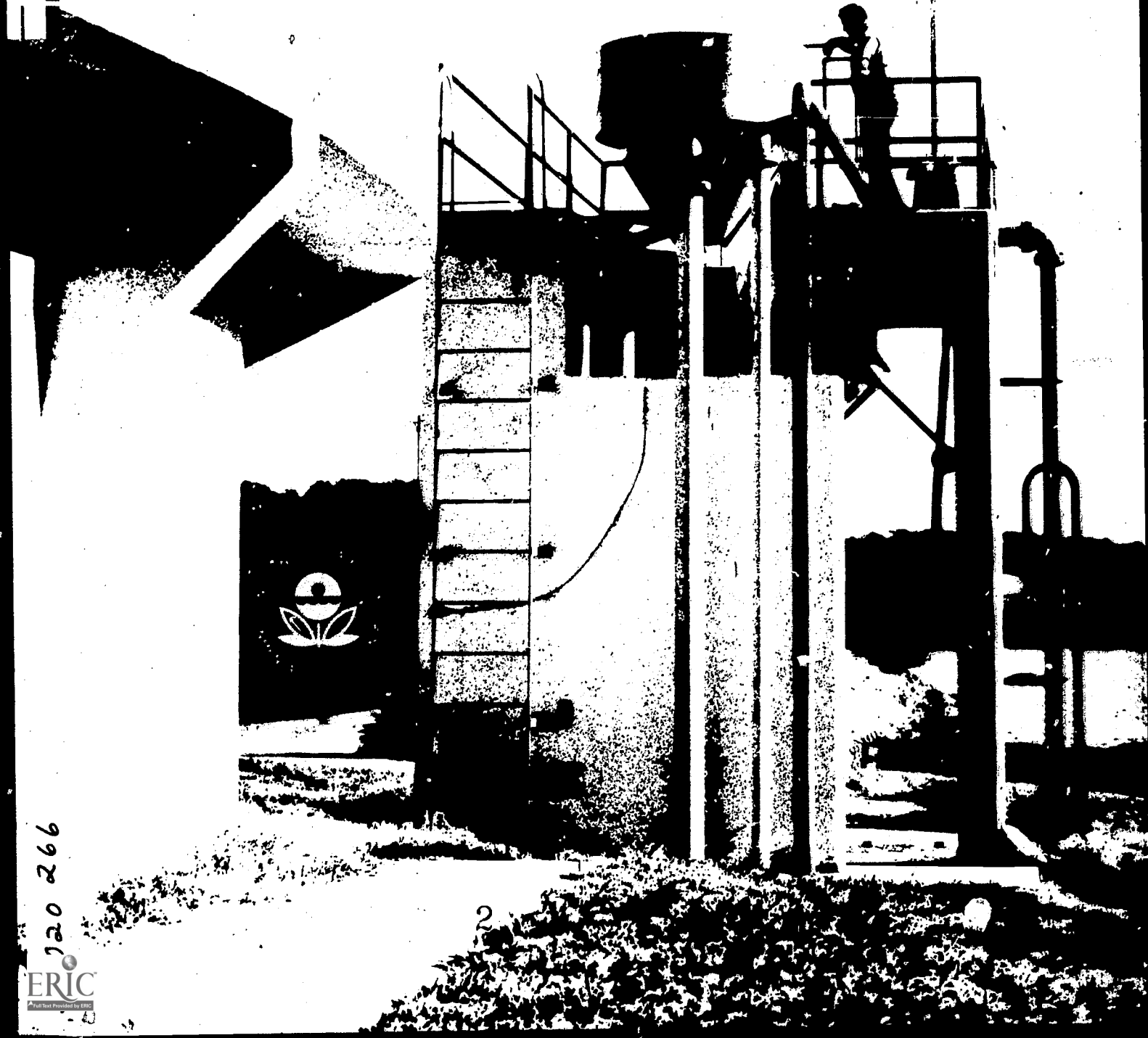
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Volume II  
PART B

# Plant Operations for Wastewater Facilities

Wastewater Technology: A Two-Year Post High School Instructional Program

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*PLANT OPERATIONS FOR WASTEWATER FACILITIES, Part B*

*Trickling Filtration  
Aeration  
Secondary Sedimentation  
Pond Stabilization*

*An Instructor's Guide for Use of Instructional Material  
In Wastewater Technology Training Programs*

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Clemson, South Carolina*

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# For Information

## ON FUNDING OF INSTRUCTIONAL PROGRAMS

*Academic Training Section  
Water Quality Control Manpower Training Branch  
Municipal Permits & Operations Division  
US Environmental Protection Agency  
Washington, DC 20460  
703-557-7335*

## ON PROJECT ADMINISTRATION AND CURRICULA DEVELOPMENT

*John H. Austin, Professor and Head  
Environmental Systems Engineering  
Clemson University  
Clemson, South Carolina 29631  
803-656-3276*

## ON PROGRAM IMPLEMENTATION

*Carl Schwing  
Charles County Community College  
La Plata, Maryland 20646  
301-934-2251*

*James L. Chocklett  
Greenville Technical College  
Greenville, South Carolina 29606  
803-242-3170*

*Peter C. Scott  
Linn-Benton Community College  
Albany, Oregon 97321  
503-928-2361*



## Preface

Since 1970 Charles County Community College, Clemson University, Greenville Technical College and Linn-Benton Community College have been working together to prepare undergraduate students to enter occupations in water and wastewater treatment plant operations and maintenance. Through their efforts a two-year wastewater technology instructional program based on performance objectives has been developed and implemented.

Through a grant from the Environmental Protection Agency called *Criteria for the Establishment of Two-Year Post High School Wastewater Technology Programs (CEWT)* the four colleges set up program criteria and curriculum guidelines which are available in two volumes:

*Program Implementation Procedures*  
*Volume II: Curriculum Guidelines, Criteria for Establishment and Maintenance of Two-Year Post High School Wastewater Technology Programs*

As a result of the implementation of the instructional program at Charles County Community College, Greenville, Technical College and Linn-Benton Community College, six guides for instructors based on the course descriptions in *Plant Implementation Procedures* and the general criterion behaviors of *Volume II* have been prepared. *Plant Operations for Wastewater Facilities*, printed in five parts, is the second in the series which includes:

*Volume I Introduction to Environmental Technology*  
*Volume II Plant Operations for Wastewater Facilities*  
*Volume III Laboratory Control for Wastewater Facilities*  
*Volume IV Management and Supervision Procedures for Wastewater Facilities*  
*Volume V Process Interaction for Wastewater Facilities*  
*Volume VI Advanced Waste Treatment*

### ACKNOWLEDGEMENTS

Since the beginning of the project many persons at the four cooperating institutions, as well as outside consultants have participated in the development of this program. Their efforts which have provided source material for this guide have been acknowledged in the volumes to which they made major contributions. *Plant Operations for Wastewater Facilities* has been written and produced by:

#### Technical Staff

K. C. Stoakes, Instructor, Environmental Technology Department, Linn-Benton Community College



John F. Wooley, Instructor, Environmental Technology Department, Linn-Benton Community College  
John W. Carnegie, Chairman of Environmental Technology, Linn-Benton Community College  
Fred L. Delvecchio, Director of Operator Training, Environmental Systems Engineering, Clemson University  
John H. Austin, Professor and Head, Environmental Systems Engineering, Clemson University

#### Editorial and Production Staff

Ada Louise Steirer, Freelance Editor, Clemson, South Carolina  
Marie N. Sims, Project Secretary, Environmental Systems Engineering, Clemson University  
Charlotte Holmes, Typing Services, Clemson, South Carolina  
Jan Willis, Editorial Assistant, Environmental Systems Engineering, Clemson University  
Eleanor McLasky, Typist, Environmental Systems Engineering, Clemson University  
Roma Norton, Typist, Environmental Systems Engineering, Clemson University  
Linda Flagg, Proofreader, Environmental Systems Engineering, Clemson University



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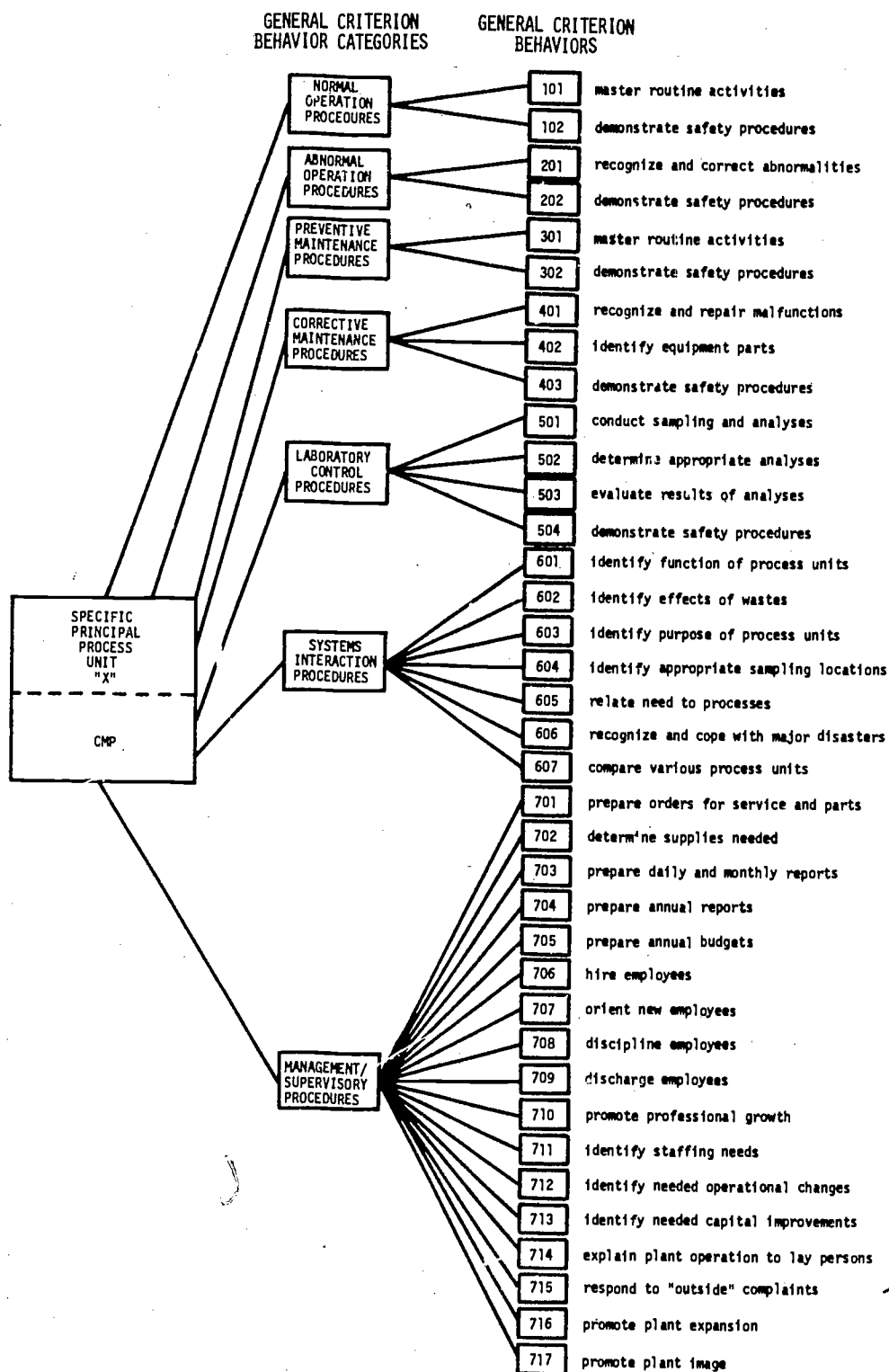


Figure 1: Relationship of general criterion behaviors (performance objectives) to the general categories and composite model plant (CMP).



# Performance Objectives

When the treatment plant operators, educators, consultants and representatives from professional water pollution control organizations came together to develop an effective instructional program, they recommended the use of performance or behavioral objectives because such objectives clearly outline:

1. What the student is expected to do as a result of the instructional program.
2. The conditions under which the student shall do it.
3. The standard of performance.

## COMPOSITE MODEL PLANT

First, they developed a composite model plant (CMP) of twenty-two process units which is really many wastewater treatment plants in one model. Such a mix of process units seldom occurs in a treatment plant, but if a student becomes competent in the operation and management of the CMP he should be able to perform successfully in any treatment plant.

## TASK ANALYSIS

Next, to ensure that the materials were specifically tailored to what the operator does on the job, a task analysis was conducted. They found that the tasks which an operator performs fell into seven general categories which were further divided into 37 tasks or general behaviors. (See figure 1, page vi.) The tasks were organized under:

1. Normal Operation Procedures. These include routine operating activities that do not vary significantly from day to day and that are designed to keep the plant functioning within a normal range of values. For example, the employee conducts routine samplings of the primary sludge and inspects pumping equipment and the wastestream to verify that the process is functioning properly.
2. Abnormal Operation Procedures. These include activities of the plant employee that result from unusual and undesirable conditions of the wastestream. The abnormal procedures enable the plant employee to recognize when the wastestream is abnormal and to return it to an acceptable, normal condition. An abnormal wastestream results when a normal operation procedure is not properly applied, a corrective maintenance procedure is needed or management/supervisory procedures are poor. For example, the plant employee should recognize that a black septic primary sludge sample is an abnormal condition of the wastestream and take appropriate action.
3. Preventive Maintenance Procedures. These include routine maintenance activities of the plant employee which prevent major equipment breakdown and subsequent corrective maintenance. For example, the employee would lubricate bearings and other moving parts, replace worn components and adjust components of the primary sludge pumps.



#### 4. Corrective Maintenance Procedures.

These include maintenance activities of the plant employee that usually result from the breakdown or malfunction of a unit of equipment or a component. For example, the employee would notice whether the primary sludge pump is malfunctioning and know when and how to correct the disorder or when and how to refer the problem to plant maintenance personnel.

#### 5. Laboratory Control Procedures.

These include special and routine activities relating to laboratory analysis, the specification of sampling procedures and locations and the general management of the laboratory facilities. For example, the employee would collect primary sludge samples and conduct the analyses.

#### 6. Systems Interaction Procedures.

These include activities of the plant employee which relate the functioning of specific units of equipment to other process units and to the system as a whole. For example, the employee would determine how the effective functioning of the primary sludge pumps relates to digester performance.

#### 7. Management/Supervisory Procedures.

These include activities relating to employment practices, record keeping, plant operation policy and the establishment of a constructive and realistic rapport between the plant and the community it serves. For example, the employee would keep records on primary sludge pumping, keep an inventory of spare parts and evaluate the adequacy of maintenance procedures by shift personnel.

### CURRICULUM DESIGN

After deciding what process equipment an operator must operate and maintain, and finding out what an operator does through

the task analysis, they listed the objectives a student must master to successfully operate a treatment plant. For example, the student will describe and perform the normal inspection procedure for the primary sedimentation unit including frequency of inspection, conditions to look for and the actions he should take.

### INSTRUCTOR'S GUIDES

The next step was the design of manuals to guide the instructor. In the guides varied learning activities and imaginative innovations which produce more learning than traditional teaching methods are emphasized. The instructional suggestions do not need to be followed slavishly, but should be modified and improved as much as possible.

The instructor's goal is to achieve the objectives of the curriculum by selecting activities which suit the student's needs and help him to master all the information and skills in the course. The most effective learning occurs when the student is a participant in the learning process, not a spectator.

An instructor should use learning activities which approximate the situations which the student will meet *in the treatment plant*. If it is not possible to teach in a treatment plant, *simulated situations* should be set up in the workshop or classroom so that the student can solve rather than discuss problems. *Group discussion* stimulated by *visual materials* is an effective learning technique. Lecturing, however, is inefficient. Because the student is not actively involved during a lecture, the instructor should use lectures sparingly.

# Introduction to Modules of Instruction

In this instructor's guide the topics and ideas are presented as a series of modules, organized around the general objectives stated in the course descriptions for Plant Operation I, II, III and IV and the In-Plant Practicum which are found in the *Program Implementation Procedures* of the CEWT Program. Each module is designed to help the instructor plan a course of study for the operation of a treatment process using the CMP process unit. Each module is organized around sixteen objectives common to all processes.

The modules in *Plant Operations for Wastewater Facilities* are arranged in the order in which the CMP process units occur in the treatment plant. Each process is identified by a letter of the alphabet and the process unit is described in the heading of the module. If the instructor uses the modules in consecutive order, he and his students will follow the treatment of the wastestream from collection to its discharge into the receiving waters. Each module is designed so it can be used as a minicourse in a treatment process. Instructors are urged to group the modules to suit their individual curriculum needs and instructional situations.

Material in the modules can easily be adapted for courses which upgrade the training of operators in normal operation procedures, abnormal operation procedures, preventive maintenance procedures or corrective maintenance procedures by grouping the appropriate objectives from all the modules. For example, an instructor could develop a course

in corrective maintenance by grouping objectives 11 and 12 from each module.

## INSTRUCTIONAL PROCESS UNITS

Each module assumes that the composite model plant unit will be used for instruction in the process. If the recommended unit is not available, an alternate process unit may be substituted and the instructional materials adapted. The recommended CMP units and alternate units for all the processes are listed in table 1, page 4. Two modules on sludge dewatering are included because it is impossible for a student to master operation of this process by learning to operate one process unit. Remember, however, that a student will be more adequately prepared to work in almost any treatment plant if he is trained on the CMP unit. When it is not possible to use the recommended unit, students should be informed about the operation and function of the unit and hands-on training should be conducted on the best alternate unit available.

## PURPOSE OF THE MODULES

The modules in *Plant Operations for Wastewater Facilities* help the student to learn how to operate all the process units in the wastewater treatment plant. Normal operation, abnormal operation, preventive maintenance and corrective maintenance procedures are included. When the course is completed, he will know why each unit is



TABLE I

SPECIFIC PROCESS UNITS RECOMMENDED FOR USE IN IMPLEMENTATION OF THE TWO-YEAR  
POST HIGH SCHOOL WASTEWATER TECHNOLOGY INSTRUCTIONAL PROGRAM

Module	Process	CMP Unit	Recommended Teaching Unit	Alternate Teaching Unit
1	Collection	A	Combined system with industrial waste	Sanitary system with industrial waste
2	Chlorination	B	Vacuum chlorinator with automatic feed to pipe, pneumatic control and electric evaporator	Vacuum chlorinator with automatic feed to pipe, electrical control and electric evaporator
		N	Vacuum chlorinator with automatic feed to pipe and closed-loop pneumatic control	Vacuum chlorinator with automatic feed to pipe and closed electrical control
3	Screening and Grinding	C	Mechanically cleaned bubbler control unit with grinder	Mechanically cleaned electrode-control unit with grinder
4	Grit Removal	D	Aerated unit with bucket elevator	Aerated unit with screw conveyor
5	Primary Sedimentation	E	Rectangular unit with telescopic valve-drawoff, density meter, time clock and trough with scraper	Circular unit with telescopic valve drawoff, density meter time clock and trough with scraper
6	Trickling Filtration	F	Rotary distributor, standard rate unit with dosing tank	Rotary distributor, high rate unit
7	Aeration	G	Diffused air unit with swing-type diffuser producing fine bubbles	Mechanical aeration unit with turbine and sparger
8	Secondary Sedimentation	H	Circular, peripheral-feed unit with suction	Circular, center-feed unit with suction
9	Pond Stabilization	I	Aerobic pond	Facultative pond
10	Thickening	J	Floatation unit with air	Floatation unit with vacuum
11	First Stage Digestion	K	Fixed cover, gas recirculation unit with external heat exchanger	Floating cover, gas recirculation unit with external heat exchanger

Second Stage	L	Floating cover unit with gas storage	Fixed cover unit
12 Digestion			
13 Sludge Conditioning	M	Chemical conditioning unit with counter-current elutriation	None
14a Sludge Dewatering	O	Vacuum filter unit with cloth	Vacuum filter unit with coil
14b Sludge Dewatering	O	Continuous feed centrifuge	None
15 Solids Disposal	P	Multiple hearth incinerator unit	Fluidized bed incinerator unit
16 Effluent Disposal	Q	Direct reuse system	Underground disposal system
17 Flow Measurement	R	Centralized recording and totalizing system including Parshall flume, Venturi meter, magnetic flowmeter and rotameter	None
18 Pumping and Piping	S	System with magnetically connected, pneumatically controlled, diesel driven, centrifugal pumps; speed reducer connected, electrically controlled, motor driven, positive displacement pumps and appropriate piping	None
19 Electric Power	T	System using delta transformers, generators, electrical switchgear, automatic gear, automatic circuit actuators on motors and telemetering with alarms.	System using Y transformers, generators, electrical switchgear, automatic circuit actuators on motors and telemetering with alarms
20 Gas Power	U	System with internally produced gas with high pressure tanks and rotary positive displacement compressors	System with internally produced gas with high pressure tanks and reciprocating compressors



important to the treatment plant and how it affects and interacts with other process units in the treatment system.

#### STUDENT PREREQUISITES

Completion of Introduction to Environmental Technology and courses in basic mathematics and biology qualify the student to enter the course in Unit Operations for Wastewater Facilities. Concurrent courses in basic chemistry and laboratory control are suggested. (See pages 7 to 19 of *Program Implementation Procedures*.)

#### TERMINAL OBJECTIVE

When the student has completed the modules of instruction in this course, he should be able to do the following for each of the processes in the treatment plant:

1. Identify the process unit.
2. Describe the process unit in technical and nontechnical terms.
3. Describe the safety procedures for the process unit and explain how the procedures protect employees and visitors.
4. Identify the components of the process unit. Explain the purpose of each component, how the component works and why it is important.
5. Describe the normal operation procedures for the process unit components.
6. Perform the normal operation procedures for the process unit.
7. Describe and perform the start-up and shut-down procedures for the process unit.
8. Describe the abnormal operation procedures for the process unit.

9. Describe the preventive maintenance procedures for the process unit.

10. Perform the preventive maintenance procedures for the process unit.

11. Describe the corrective maintenance procedures for the process unit components.

12. Perform the corrective maintenance procedures for the process unit components.

13. Perform the safety procedures for the process unit and demonstrate how they protect employees and visitors.

14. Compare other process units to the composite model plant unit.

15. Name and locate the components of the process unit. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.

16. Perform the abnormal operation procedures for the process unit.

#### RESOURCES

The listing of instructional resources suggests materials now available to instructors to accomplish the desired performance in the student.

Instructional materials 1 to 1866 are keyed to the reference, *Instructional Materials Available* which is available from:

Office of Water Program Operations  
US Environmental Protection Agency  
Washington, DC 20460

Two companion volumes to *Instructional Materials Available*, also available from EPA, offer suggestions for selecting audio-visual equipment:

*Selecting Audio-Visual Equipment*  
*Selecting Instructional Media and Instructional Systems*

The following journals list addresses of companies from whom literature about the process units which they manufacture can be obtained:

"Environmental Science and Technology"  
1155 Sixteenth Street, N.W.  
Washington, DC 20036

"Water and Sewage Works"  
434 South Wabash  
Chicago, IL 60605

"Water and Wastes Engineering"  
666 Fifth Avenue  
New York, NY 10019

If suitable materials are not available, instructors are urged to develop their own resources.

#### FORMAT OF THE MODULES

The module begins with a statement of purpose which explains what the student will be studying. Next, all the objectives of the module and code numbers keyed to a computerized list of instructional resources are listed for the instructor's convenience.

Objectives. Each module includes sixteen objectives which bring the student to the performance level required by the terminal objective. The knowledge and skills demanded of the student become more complex as he progresses through the sixteen objectives in a module. He begins by identifying components and learning facts about the components and processes. He uses

these facts to develop concepts and ideas. Finally, he relates the concepts and ideas to each other so that he can make decisions about plant procedures.

A glossary of verbs which follows this introduction defines the verbs used in the objectives so that the instructor is aware of what he is instructing the student to do and so that his evaluation of the student is based solely on what is stated in the objective.

Conditions. The conditions define the circumstances under which the student performs and is evaluated and lists the information, equipment and assistance to which the student will have access. The best available learning and testing conditions should be used. A process unit in a treatment plant or workshop has more impact on the students than photographs and drawings. For example, if the student is to be given a process unit, unit components, photographs or diagrams of a unit, the instructor should provide a process unit. If a process unit is not available, he would use components of the unit in combination with photographs of those components which he does not have available. Line drawings and diagrams should not be used if photographs and manufacturers' illustrations are available.

Acceptable Performance. The acceptable performance expands the objective and details the steps a student must follow to reach the objective. To move on to the next objective, at least 70% of each step or category must be mastered with no repeated errors between modules. For example, no student can complete the course of study if he consistently fails to give attention to moving parts as he



performs safety procedures or to describe the odor as he evaluates the characteristics of the wastestream. In this section the instructor will find the main topics of his lesson plan and for the evaluation of the student's performance.

Instructor Activity. The instructor should get to know his class by working with small groups and with each student. He should encourage students to learn from each other as they work together. He should involve the student in the instructional and learning process. Instructional activities are paired numerically with student activities.

Student Activity. This is a listing of activities which the student will take part in, in order to accomplish the specified performance.

#### EVALUATION TECHNIQUE

The instructor may use or adapt the learning activities listed under instructor activity and student activity as evaluation techniques. The technique chosen should reflect what the objective asks the student to do. For example, if a student is asked to *describe*, the evaluation technique is a *description*. The student should be evaluated under the conditions and to the performance level required for each objective.



## Glossary of Verbs

The glossary of verbs is included here so that the instructor will know exactly what the student is being asked to do to meet his objective. Notice the difference, for example, between the meanings of *identify* and *name*. When a student is asked to identify, the instructor is providing the name of the thing to be identified. But, when the student must name something, he must supply the name.

The list includes all the verbs from the objectives and the acceptable performance sections of all the modules, as well as some verbs used in the instructor and student activities.

	DEFINITION	APPLICATION
APPLY	To make use of as suitable, fitting or relevant.	Apply the preventive maintenance schedule for the second stage digestion unit.
CHECK	To inspect and ascertain the condition of, especially in order to determine that the condition is satisfactory.	Check the characteristics of each component.
COMMENT ON	To express an opinion or attitude about what has been seen or heard.	Comment on employee safety procedures.
COMPARE	To examine the character or qualities of, especially for the purpose of discovering resemblances or differences.	Compare other aeration units to the diffused air unit with swing-type diffuser producing fine bubbles.
CONSIDER	To give thought to with a view to purchasing, accepting or adopting.	Consider availability of replacement parts, capital costs, ease of repair, efficiency, maintenance costs, and so forth.
CORRECT	To alter or adjust to bring to some standard or required condition.	Correct the malfunction.
DEMONSTRATE	To illustrate or explain in an orderly and detailed way with many examples, specimens and particulars.	Demonstrate the start-up procedures in a treatment plant.



	DEFINITION	APPLICATION
DESCRIBE	To represent by words written or spoken for the knowledge or understanding of others, to transmit an image of the identifying features, the nature and characteristics of objects, events and actions.	Describe the safety procedures for the screening and grinding unit.
DEVELOP	To produce or generate.	Develop a picture file of first stage digestion units.
DISCUSS	To talk about, to present in detail, to exchange views or information about.	Discuss treatment plant case histories.
EVALUATE	To examine and make a judgment about quality, significance, amount, degree or condition of.	Evaluate the wastestream for abnormal conditions.
EXPLAIN	To make plain or clear, to present in detail.	Explain the purpose of each component, how the component works and why it is important.
IDENTIFY	To establish the identity of, pick out or single out an object in response to its name by pointing, picking up, underlining, marking or other responses.	Identify the components of the chlorination unit.
INDICATE	To state or express without going into detail.	Indicate whether the process unit is used for secondary sedimentation.
INSPECT	To view closely and critically, to determine quality or state, to detect errors or otherwise appraise.	Inspect a treatment plant.
LIST	To enumerate or specify.	List routine calculations for the pond stabilization unit.
LOCATE	To stipulate the position of an object in relation to other objects.	Locate the components of the trickling filtration unit.



11/12

	DEFINITION	APPLICATION
NAME	To supply the correct name, in oral or written form, for an object, class of objects, persons, places, conditions or events which are pointed out or described.	Name the components of the primary sedimentation unit.
OBSERVE	To pay careful, directed, analytical attention to.	Observe the thickening process during a plant tour.
PERFORM	To carry out an action or pattern of behavior. (Implies an act for which a process or pattern of movement has already been established, especially one calling for skill or precision, or for the assignment or assumption of responsibility.)	Perform the normal operation procedures for the grit removal unit.
POINT OUT	To indicate the position or direction of, especially by extending a finger toward the thing so indicated, to direct someone's attention to.	Point out characteristics which distinguish the first stage digestion unit from other units.
RECOMMEND	To mention or introduce as being worthy of acceptance, use or trial, to advise.	Recommend procedures to correct the unsafe conditions.
SELECT	To choose something from a number or group usually by fitness, excellence, or other distinguishing feature.	Select the reference materials and tools needed to perform the corrective maintenance.

**MODULE 6****TRICKLING FILTRATION**

*A rotary distributor,  
standard rate unit with dosing tank*

*Composite Model Plant Unit F*

**PURPOSE:** *In this module the student will learn to perform all the activities in the objectives as they apply to a rotary distributor, standard rate unit with dosing tank. READ PAGES 1 TO 11 BEFORE USING THIS MODULE.*

- OBJECTIVES:**
- 6.1 *Identify the trickling filtration unit.*
  - 6.2 *Describe the trickling filtration process in technical and nontechnical terms.*
  - 6.3 *Describe the safety procedures for the trickling filtration unit and explain how the procedures protect employees and visitors.*
  - 6.4 *Identify the components of a trickling filtration unit. Explain the purpose of each component, how the component works and why it is important.*
  - 6.5 *Describe the normal operation procedures for the trickling filtration unit components listed on page 17.*
  - 6.6 *Perform the normal operation procedures for the trickling filtration unit.*
  - 6.7 *Describe and perform the start-up and shut-down procedures for the trickling filtration unit.*
  - 6.8 *Describe the abnormal operation procedures for the trickling filtration process.*
  - 6.9 *Describe the preventive maintenance procedures for the trickling filtration unit.*
  - 6.10 *Perform the preventive maintenance procedures for the trickling filtration unit.*
  - 6.11 *Describe the corrective maintenance procedures for the trickling filtration unit components listed on page 17.*
  - 6.12 *Perform the corrective maintenance procedures for the trickling filtration unit components.*
  - 6.13 *Perform the safety procedures for the trickling filtration unit and demonstrate how they protect employees and visitors.*
  - 6.14 *Compare other trickling filtration units to the rotary distributor, standard rate unit with dosing tank (composite model plant unit F).*
  - 6.15 *Name and locate the components of the trickling filtration unit listed on page 17. Name and select reference materials.*



which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.

6.16 Perform the abnormal operation procedures for the trickling filtration unit.

RESOURCES:	3	116	120	125	141	143	144	307	308	309	316
	317	320	321	324	421	459	511	551	552	553	554
	937	990	1033	1034	1399						

<<<<<<>>>>>>

OBJECTIVE 6.1: Identify the trickling filtration unit.

CONDITIONS: Given a unit, a model of a unit or a photograph of a unit.

ACCEPTABLE PERFORMANCE: The student will: Indicate whether the process unit is used for trickling filtration.

INSTRUCTOR ACTIVITY: 1. Point out characteristics which distinguish the trickling filtration unit from other process units.

STUDENT ACTIVITY: 1. Develop a picture file of trickling filtration units. Mark distinguishing characteristics.

<<<<<<>>>>>>

OBJECTIVE 6.2: Describe the trickling filtration process in technical and nontechnical terms.

CONDITIONS: Given photographs of the trickling filtration unit.

ACCEPTABLE PERFORMANCE: The student will: Describe the trickling filtration unit, explaining the meaning of: bacteria bed filter



filter bed  
trickling filter

Describe the process variations, defining:  
roughing filter  
polishing filter  
standard rate filter  
high rate filter  
multiple stage filter

Describe the purpose of trickling filtration.

Describe how trickling filtration affects:  
secondary sedimentation  
effluent disposal  
flow measurement  
pumping and piping

**INSTRUCTOR ACTIVITY:**

1. Use diagrams, photographs and slides to describe secondary sedimentation.
2. Describe the secondary sedimentation process during a plant tour. React to the student's description of the process.

**STUDENT ACTIVITY:**

1. Describe the secondary sedimentation process while viewing photographs, diagrams and slides.
2. Observe and describe the secondary sedimentation process during a plant tour.

<<<<<>>>>>

**OBJECTIVE 6.3:**

*Describe the safety procedures for the trickling filtration unit and explain how the procedures protect employees and visitors.*

**CONDITIONS:**

Given a list of operation and maintenance procedures.

**ACCEPTABLE PERFORMANCE:**

The student will:

Describe the safety procedures for the trickling filtration unit, commenting on:

High-risk activities  
adjusting distributor  
cleaning distributor nozzles  
removing debris from media



walking on media  
working with switches in automatic position  
Sources of danger  
acid wastes  
caustic wastes  
deep wells  
electrical equipment  
explosive gases  
ladders  
moving parts  
open doors and covers  
slippery walks  
toxic gases  
Safety equipment  
first-aid kit  
ladders  
lockout tags and keys  
protective clothing  
railings  
safety treads on stairs and ladders

Explain how the procedures protect employees and visitors.

INSTRUCTOR ACTIVITY:

1. Discuss treatment plant case histories.
2. Describe the conditions in a plant and ask for evaluation.
3. Describe the safety procedures for each operation and maintenance procedure.
4. Prepare slides of sources of danger and high-risk activities.

STUDENT ACTIVITY:

1. Read case histories and comment on employee safety procedures.
2. Evaluate conditions which the instructor has described. Suggest remedies.
3. Role play operation or maintenance procedures. Select proper safety equipment and name the sources of danger and high-risk activities. Develop a manual of safety procedures for the trickling filtration unit.
4. Identify sources of danger and high-risk activities pictured in slides.

<<<<<<>>>>>>

**OBJECTIVE 6.4:**

*Identify the components of a trickling filtration unit. Explain the purpose of each component, how the component works and why it is important.*

**CONDITIONS:**

Given a trickling filtration unit, unit components or a diagram, model or photographs of a unit and a list of components:

**ACCEPTABLE PERFORMANCE:**

The student will:

Identify components of the trickling filtration unit and associated equipment:

bearing	media
blowoff pipe	mercury seal
dosing tank	rotary distributor
fan	siphon breaker
fire-fighting equipment	structure
first-aid kit	underdrain
guy line	vent

Explain the purpose of each component, how the component works and why it is important.

**INSTRUCTOR ACTIVITY:**

1. Point out and name components in diagrams, photographs or models.
2. Arrange photographs or models of components in the workshop for student identification.
3. Point out and name components during a plant tour.
4. Question the students about the purpose of each component, how the component works and why it is important.

**STUDENT ACTIVITY:**

1. Identify the components which the instructor names on diagrams, photographs or models.
2. Identify the components at stations in the workshop in writing.
3. Identify components during a plant tour.
4. Explain the purpose of each component, how the component works and why it is important.

<<<<<<>>>>>>

**OBJECTIVE 6.5:**

*Describe the normal operation procedures for the trickling filtration unit components listed above.*



**CONDITIONS:**

Given a trickling filtration unit or slides or photographs of a trickling filtration unit, a list of components of the unit, a checklist of characteristics and a normal operation procedures manual.

**ACCEPTABLE PERFORMANCE:**

The student will:

Describe the characteristics of each component which the operator checks to determine whether the component is functioning normally, commenting on:

biological growth	motion
color	odor
corrosion	position
deterioration	sound
flow	vibration

Name the sense or indicator which monitors each characteristic.

Explain how often the characteristics of each component must be checked and why the component must be checked on this schedule.

Describe what an operator does if the characteristics of a component indicate that it is not functioning normally, including:

- making adjustments
- deciding about corrective maintenance
- reporting to supervisors
- reporting in written records

Explain why a component's characteristics must be returned to normal.

Describe routine sampling for the trickling filtration process.

List routine calculations for the trickling filtration process.

Describe routine procedures for recording data.

**INSTRUCTOR ACTIVITY:**

1. Describe the characteristics of the components of the trickling filtration unit.
2. Describe the normal operation procedures for the trickling filtration unit. Use color pictures.
3. Describe the normal operation procedures during a slide show of components of the trickling filtration unit.



4. Describe and explain the normal operation procedures during a plant tour. Listen to the student's description of the procedures.

**STUDENT ACTIVITY:**

1. Develop a checklist, listing the components of the trickling filtration unit and their normal characteristics.
2. Develop a manual of normal operation procedures.
3. Describe the normal operation procedures during a slide show of components of the trickling filtration unit.
4. Observe and describe the normal operation procedures during a plant tour.

<<<<<>>>>>>

**OBJECTIVE 6.6:**

*Perform the normal operation procedures for the trickling filtration unit.*

**CONDITIONS:**

Given a trickling filtration unit, the manual of normal operation procedures which the student has developed for the trickling filtration unit and basic references.

**ACCEPTABLE PERFORMANCE:**

The student will:

Check and evaluate the characteristics of each component, explaining his actions.

Perform the procedures which an operator follows if the characteristics of a component indicate that it is not functioning normally.

Perform the routine sampling.

Perform the routine calculations.

Perform the routine record keeping.

**INSTRUCTOR ACTIVITY:**

1. Observe the student demonstrating normal operation procedures in a dry run in a treatment plant.
2. Observe the student performing normal operation procedures in a treatment plant.

**STUDENT ACTIVITY:**

1. Demonstrate the normal operation procedures in a dry run in a treatment plant.



2. Perform and explain the normal operation procedures in a treatment plant.

<<<<<<>>>>>>

**OBJECTIVE 6.7:**

*Describe and perform the start-up and shut-down procedures for the trickling filtration unit.*

**CONDITIONS:**

Given a mock-up, model or photograph of a trickling filtration unit and a trickling filtration unit with the manufacturer's operation manual.

**ACCEPTABLE PERFORMANCE:**

The student will:

Start up and shut down a trickling filtration unit, following the manufacturer's instructions.

**INSTRUCTOR ACTIVITY:**

1. Demonstrate and perform the start-up procedures in a treatment plant.
2. Demonstrate and perform the shut-down procedures in a treatment plant.
3. Observe the student performing the start-up procedures in a treatment plant.
4. Observe the student performing the shut-down procedures in a treatment plant.
5. Observe the student as he evaluates his start-up procedures.
6. Observe the student as he evaluates his shut-down procedures.

**STUDENT ACTIVITY:**

1. Describe the start-up procedures in a dry run in a treatment plant.
2. Describe the shut-down procedures in a dry run in a treatment plant.
3. Perform the start-up procedures in a treatment plant.
4. Perform the shut-down procedures in a treatment plant.
5. Evaluate the operation of the trickling filtration unit to determine whether correct start-up procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)



6. Evaluate the operation of the trickling filtration unit to determine whether correct shut-down procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)

<<<<<<>>>>>>

**OBJECTIVE 6.8:**

*Describe the abnormal operation procedures for the trickling filtration process.*

**CONDITIONS:**

Given a wastestream in a treatment plant or color photographs of a wastestream, a checklist of the conditions of the wastestream and plant records and reference materials.

**ACCEPTABLE PERFORMANCE:**

The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

ammonia nitrogen	odor
application rate	organic and total Kjeldahl
BOD	nitrogen
COD	orthophosphate
color	pH
filter flies	ponding
flow	septic sewage
ice	suspended solids
industrial wastes	temperature
nitrate nitrogen	turbidity
nitrite nitrogen	

Describe the cause and effect of the abnormal condition.

Explain how often the condition of the wastestream must be checked.

Describe what an operator does if he observes abnormal conditions, including:

- operational changes
- reporting to supervisors
- sampling procedures

Describe how the action of the operator will improve the condition of the wastestream.



## INSTRUCTOR ACTIVITY:

1. Describe and explain the abnormal conditions of the wastestream illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures during a slide show.
4. Describe and explain the abnormal operation procedures during a plant tour. Listen to the student's description of the procedures.

## STUDENT ACTIVITY:

1. Evaluate and explain the abnormal conditions of the wastestream which are illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures in a class discussion after a slide show.
4. Evaluate and explain the condition of the wastestream during a plant tour. Describe and explain the abnormal operation procedures.

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## OBJECTIVE 6.9:

*Describe the preventive maintenance procedures for the trickling filtration unit.*

## CONDITIONS:

Given a trickling filtration unit or pictures and drawings of a trickling filtration unit and reference materials, including:

inspection records  
 manufacturer's maintenance guides  
 plant drawings and specifications  
 preventive maintenance schedule

## ACCEPTABLE PERFORMANCE:

The student will:

Describe these preventive maintenance procedures for the trickling filtration unit:

## Cleaning

blowoff pipe

dosing tank

rotary distributor

siphon breaker

structure

underdrain

vent

Lubrication

bearing

fan



Lubrication (continued)	fan
rotary distributor	rotary distributor
Mechanical adjustment	Replacement
bearing	fire-fighting equipment
fan	first-aid kit
guy line	media
rotary distributor	mercury seal
Painting	
dosing tank	

Name the reference materials and tools needed to perform the preventive maintenance procedures.

Explain how often each preventive maintenance procedure must be performed.

Explain how an operator determines whether a component needs preventive maintenance.

Describe what an operator does if a component needs preventive maintenance.

Explain why each preventive maintenance procedure is important.

**INSTRUCTOR ACTIVITY:**

1. Describe and explain the preventive maintenance procedures for the trickling filtration unit.
2. Describe and explain the preventive maintenance procedures during a slide show.
3. Describe and explain the preventive maintenance procedures during a plant tour.

**STUDENT ACTIVITY:**

1. Develop a preventive maintenance schedule and a manual of preventive maintenance procedures.
2. Observe, describe and explain the preventive maintenance procedures during a slide show.
3. Observe, describe and explain the preventive maintenance procedures during a plant tour.

<<<<<<>>>>>>>>

**OBJECTIVE 6.10:**

*Perform the preventive maintenance procedures for the trickling filtration unit.*

**CONDITIONS:**

Given a trickling filtration unit and tools and reference materials, including:  
 inspection records  
 manufacturer's maintenance guides



plant drawings and specifications  
preventive maintenance schedule

## ACCEPTABLE PERFORMANCE:

The student will:

Select the reference materials and tools needed to perform the preventive maintenance procedures.

Apply the preventive maintenance schedule for the trickling filtration unit, explaining his actions.

Perform the procedures which an operator follows when a component needs preventive maintenance, explaining his actions.

## INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe student inspection of a treatment plant.
3. Observe the student performing the preventive maintenance procedures in a treatment plant.

## STUDENT ACTIVITY:

1. Small groups of students perform the preventive maintenance procedures in simulated situations in the workshop.
2. Inspect a treatment plant. Evaluate and explain the preventive maintenance procedures.
3. Perform and explain the preventive maintenance procedures in a treatment plant.

<<<<<<>>>>>>

## OBJECTIVE 6.11:

*Describe the corrective maintenance procedures for the trickling filtration unit components listed on page 17.*

## CONDITIONS:

Given a trickling filtration unit or a mock-up, photographs or drawings of a trickling filtration unit, the manual of operation procedures which the student has developed for the trickling filtration unit, tools and reference materials, including:

catalogue of replacement parts  
equipment catalogues  
manufacturer's maintenance guides

**ACCEPTABLE PERFORMANCE:**

The student will:

Describe how an operator evaluates each component of the trickling filtration unit for corrective maintenance, commenting on:

biological growth	motion
color	odor
corrosion	position
deterioration	sound
flow	vibration

Explain why a component has malfunctioned.

Name the reference materials and tools needed to perform the corrective maintenance.

Describe what an operator does when he discovers a malfunction, including:

- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Describe how the operator corrects the malfunction.

**INSTRUCTOR ACTIVITY:**

1. Describe and explain the corrective maintenance procedures for the trickling filtration unit, using diagrams and pictures.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Describe and explain the corrective maintenance procedures during treatment plant tours.

**STUDENT ACTIVITY:**

1. Describe and explain the corrective maintenance procedures in situations described or pictured by the instructor.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Observe, describe and explain the corrective maintenance procedures during a treatment plant tour.

<<<<<<>>>>>>>>

**OBJECTIVE 6.12:**

*Perform the corrective maintenance procedures for the trickling filtration unit components.*





## CONDITIONS:

Given a trickling filtration unit or unit components, the operation procedures manual which the student has developed, tools and reference materials, including:

- catalogue of replacement parts
- equipment catalogues
- manufacturer's maintenance guides
- manufacturer's operation manual

## ACCEPTABLE PERFORMANCE:

The student will:

Evaluate the components of the trickling filtration unit for corrective maintenance, explaining why a component has malfunctioned and commenting on:

biological growth	motion
color	odor
corrosion	position
deterioration	sound
flow	vibration

Select the reference materials and tools needed to perform the corrective maintenance.

Perform the procedures which an operator follows when a component malfunctions, including:

- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Correct the malfunction.

## INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the components in a treatment plant.
3. Observe the student performing the corrective maintenance procedures in a treatment plant.

## STUDENT ACTIVITY:

1. Small groups of students perform and explain the corrective maintenance procedures in simulated situations in the workshop.
2. Evaluate the components for corrective maintenance.
3. Perform and explain the corrective maintenance procedures in a treatment plant.

<<<<<<>>>>>>



- OBJECTIVE 6.13:** *Perform the safety procedures for the trickling filtration unit and demonstrate how they protect employees and visitors.*
- CONDITIONS:** Given a list of operation or maintenance procedures, the student's manual of safety procedures, tools and safety equipment.
- ACCEPTABLE PERFORMANCE:** The student will:
- Identify hazardous conditions in the trickling filtration unit, commenting on:
    - high-risk activities
    - sources of danger
    - safety equipment
  - Explain how the procedures protect employees and visitors.
  - Recommend corrective procedures and correct the unsafe condition.
- INSTRUCTOR ACTIVITY:**
1. Set up simulated situations in the workshop.
  2. Observe the student as he evaluates the safety conditions in a treatment plant.
  3. Observe the student performing the safety procedures in a treatment plant.
- STUDENT ACTIVITY:**
1. Evaluate safety conditions in simulated situations and recommend corrective procedures.
  2. Evaluate safety conditions in a treatment plant and recommend corrective procedures.
  3. Perform the safety procedures in a treatment plant.
- <<<<<<>>>>>>>>
- OBJECTIVE 6.14:** *Compare other trickling filtration units to the rotary distributor, standard rate unit with dosing tank (composite model plant unit F).*
- CONDITIONS:** Given a process unit and reference materials, including:
- equipment catalogues
  - laboratory reports
  - manufacturer's bulletins



manufacturer's operation manuals  
plant maintenance and operation records

**ACCEPTABLE PERFORMANCE:**

The student will:

Compare composite model plant unit F with:  
a rotary distributor, high rate unit.  
a rotary distributor, roughing unit.

Consider:

availability of replacement parts  
capital costs  
dependency on surrounding environment  
ease of repair  
efficiency  
flow-handling capabilities  
maintenance costs  
nuisance to neighbors  
operational costs  
operational skills  
personnel requirements  
reliability  
resistance to upset  
sensitivity of controls  
space requirements  
waste-handling capabilities

**INSTRUCTOR ACTIVITY:**

1. Prepare a chart for tabulation of information about the units.
2. Compare composite model plant unit F with the other units.
3. Help the student to collect information for reports on the advantages and disadvantages of each unit.

**STUDENT ACTIVITY:**

1. List information about the units on a chart.
2. Compare the units in a panel discussion.
3. Write a report on the advantages and disadvantages of each unit.

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**OBJECTIVE 6.15:**

*Name and locate the components of the trickling filtration unit listed on page 17. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.*



## CONDITIONS:

Given a trickling filtration unit, unit components or a diagram, model or photographs of a unit and reference materials, including:

- contractor's plans of trickling filtration unit
- manufacturer's maintenance guides
- operation and maintenance manuals

## ACCEPTABLE PERFORMANCE:

The student will:

Name and locate the components of the trickling filtration unit.

Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.

## INSTRUCTOR ACTIVITY:

1. Point out components of the trickling filtration unit on diagrams, photographs or models.
2. Listen to the student naming the components and the applicable reference materials during a plant tour.
3. Name and display the reference materials which describe the trickling filtration unit and normal operation procedures.

## STUDENT ACTIVITY:

1. Name the components which the instructor points out on diagrams, photographs or models.
2. Name the components which the instructor points out during a plant tour and name the reference materials which apply to the components.
3. Name and select the reference materials which describe the trickling filtration unit and normal operation procedures.

<<<<<<>>>>>>>

## OBJECTIVE 6.16:

*Perform the abnormal operation procedures for the trickling filtration unit.*

## CONDITIONS:

Given a wastestream in a treatment plant and reference materials, including:

- industrial waste records
- operation logs
- operator manuals
- plant performance guides



## ACCEPTABLE PERFORMANCE:

The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

ammonia nitrogen	odor
application rate	organic and total Kjeldahl
BOD	nitrogen
COD	orthophosphate
color	pH
filter flies	ponding
flow	septic sewage
ice	suspended solids
industrial wastes	temperature
nitrate nitrogen	turbidity
nitrite nitrogen	

Select the references he needs to return the wastestream to normal.

Perform the abnormal operation procedures.

## INSTRUCTOR ACTIVITY:

1. Observe the student as he evaluates the wastestream in a treatment plant.
2. Describe the references needed to correct abnormal conditions of the wastestream.
3. Observe the student performing the abnormal operation procedures in simulated situations and in a treatment plant.

## STUDENT ACTIVITY:

1. Evaluate the wastestream in a treatment plant.
2. Select the references needed to correct abnormal conditions of the wastestream.
3. Perform the abnormal operation procedures in simulated situations or in a treatment plant.

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**MODULE 7****AERATION**

*A diffused air unit  
with swing-type diffuser producing fine bubbles*

*Composite Model Plant Unit G*

**PURPOSE:**

*In this module the student will learn to perform all the activities in the objectives as they apply to a diffused air unit with swing-type diffuser producing fine bubbles. READ PAGES 1 TO 11 BEFORE USING THIS MODULE.*

**OBJECTIVES:**

- 7.1 *Identify the aeration unit.*
- 7.2 *Describe the aeration process in technical and nontechnical terms.*
- 7.3 *Describe the safety procedures for the aeration unit and explain how the procedures protect employees and visitors.*
- 7.4 *Identify the components of an aeration unit. Explain the purpose of each component, how the component works and why it is important.*
- 7.5 *Describe the normal operation procedures for the aeration unit components listed on page 35.*
- 7.6 *Perform the normal operation procedures for the aeration unit.*
- 7.7 *Describe and perform the start-up and shut-down procedures for the aeration unit.*
- 7.8 *Describe the abnormal operation procedures for the aeration process.*
- 7.9 *Describe the preventive maintenance procedures for the aeration unit.*
- 7.10 *Perform the preventive maintenance procedures for the aeration unit.*
- 7.11 *Describe the corrective maintenance procedures for the aeration unit components listed on page 35.*
- 7.12 *Perform the corrective maintenance procedures for the aeration unit components.*
- 7.13 *Perform the safety procedures for the aeration unit and demonstrate how they protect employees and visitors.*
- 7.14 *Compare other aeration units to the diffused air unit with swing-type diffuser producing fine bubbles (composite model plant unit G).*
- 7.15 *Name and locate the components of the aeration unit listed on page 35. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.*



7.16 *Perform the abnormal operation procedures for the aeration unit.*

RESOURCES:	3	116	120	125	141	143	144	206	207	208	307
	308	309	316	317	320	321	324	421	459	511	544
	545	546	547	551	552	553	554	586	903	904	937
	990	1033	1034	1089	1399						

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**OBJECTIVE 7.1:** *Identify the aeration unit.*

**CONDITIONS:** Given a unit, a model of a unit or a photograph of a unit.

**ACCEPTABLE PERFORMANCE:** The student will:  
Indicate whether the process unit is used for aeration.

**INSTRUCTOR ACTIVITY:** 1. Point out characteristics which distinguish the aeration unit from other process units.

**STUDENT ACTIVITY:** 1. Develop a picture file of aeration units. Mark distinguishing characteristics.

<<<<<<>>>>>>>>

**OBJECTIVE 7.2:** *Describe the aeration process in technical and nontechnical terms.*

**CONDITIONS:** Given photographs of the aeration unit.

**ACCEPTABLE PERFORMANCE:** The student will:  
Describe the aeration unit, explaining the meaning of:  
activated sludge tank  
aeration basin  
aeration tank  
aerator



contact tank  
 mixed liquor tank  
 pre-aeration tank  
 stabilization basin  
 stabilization tank

Describe the purpose of aeration.

Describe the process variations, defining:

conventional aeration  
 step aeration  
 modified aeration  
 activated sludge  
 contact stabilization  
 complete mix  
 biosorption  
 high rate aeration  
 extended aeration  
 aerated lagoon  
 Kraus process

Describe how aeration affects:

secondary sedimentation  
 effluent disposal  
 flow measurement  
 pumping and piping

**INSTRUCTOR ACTIVITY:**

1. Use diagrams, photographs and slides to describe aeration.
2. Describe the aeration process during a plant tour. React to the student's description of the process.

**STUDENT ACTIVITY:**

1. Describe the aeration process while viewing photographs, diagrams and slides.
2. Observe and describe the aeration process during a plant tour.

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**OBJECTIVE 7.3:**

*Describe the safety procedures for the aeration unit and explain how the procedures protect employees and visitors.*

**CONDITIONS:**

Given a list of operation and maintenance procedures.





## ACCEPTABLE PERFORMANCE:

The student will:

Describe the safety procedures for the aeration unit, commenting on:

High-risk activities  
 hoisting diffusers  
 removing debris from channels  
 working near unrailed pits and wells  
 working with switches in automatic position

Sources of danger

acid wastes  
 caustic wastes  
 deep wells  
 electrical equipment  
 explosive gases  
 gratings  
 loose railings  
 moving parts  
 open doors or covers  
 rotating equipment  
 slippery walks  
 toxic gases  
 wells

Safety equipment

chain gates where diffusers rise up  
 first-aid kit  
 gratings over wye walks  
 life preserver  
 life vest  
 lockout keys and tags  
 protective clothing  
 railings  
 safety harness  
 stair safety treads

Explain how the procedures protect employees and visitors.

## INSTRUCTOR ACTIVITY:

1. Discuss treatment plant case histories.
2. Describe the conditions in a plant and ask for evaluation.
3. Describe the safety procedures for each operation and maintenance procedure.
4. Prepare slides of sources of danger and high-risk activities.

## STUDENT ACTIVITY:

1. Read case histories and comment on employee safety procedures.



2. Evaluate conditions which the instructor has described. Suggest remedies.
3. Role play operation or maintenance procedures. Select proper safety equipment and name the sources of danger and high-risk activities. Develop a manual of safety procedures for the aeration unit.
4. Identify sources of danger and high-risk activities pictured in slides.

<<<<<<>>>>>>

**OBJECTIVE 7.4:**

*Identify the components of an aeration unit. Explain the purpose of each component, how the component works and why it is important.*

**CONDITIONS:**

Given an aeration unit, unit components or diagram, model or photographs of a unit and a list of components.

**ACCEPTABLE PERFORMANCE:**

The student will:

Identify components of the aeration unit and associated equipment:

air filter	indicator light
blower	life jacket
diffuser tube	manometer
elbow joint	meter
fire-fighting equipment	motor
first-aid kit	pipng
foam spray system	pump
gage	railing
harness	safety line
header	valve

Explain the purpose of each component, how the component works and why it is important.

**INSTRUCTOR ACTIVITY:**

1. Point out and name components in diagrams, photographs or models.
2. Arrange photographs or models of components in the workshop for student identification.
3. Point out and name components during a plant tour.
4. Question the students about the purpose of each component, how the component works and why it is important.



## STUDENT ACTIVITY:

1. Identify the components which the instructor names on diagrams, photographs or models.
2. Identify the components at stations in the workshop in writing.
3. Identify components during a plant tour.
4. Explain the purpose of each component, how the component works and why it is important.

<<<<<<>>>>>>>>

## OBJECTIVE 7.5:

*Describe the normal operation procedures for the aeration unit components listed on page 35.*

## CONDITIONS:

Given an aeration unit or slides or photographs of an aeration unit, a list of components of the unit, a checklist of characteristics and a normal operation procedures manual.

## ACCEPTABLE PERFORMANCE:

The student will:

Describe the characteristics of each component which the operator checks to determine whether the component is functioning normally, commenting on:

agitation	position
color	pressure
corrosion	sound
flow	temperature
motion	vibration
odor	

Name the sense or indicator which monitors each characteristic.

Explain how often the characteristics of each component must be checked and why the component must be checked on this schedule.

Describe what an operator does if the characteristics of a component indicate that it is not functioning normally, including:

- making adjustments
- deciding about corrective maintenance
- reporting to supervisors
- reporting in written records

Explain why a component's characteristics must be returned to normal.



Describe routine sampling for the aeration process.  
 List routine calculations for the aeration process.  
 Describe routine procedures for recording data.

## INSTRUCTOR ACTIVITY:

1. Describe the characteristics of the components of the aeration unit.
2. Describe the normal operation procedures for the aeration unit. Use color pictures.
3. Describe the normal operation procedures during a slide show of components of the aeration unit.
4. Describe and explain the normal operation procedures during a plant tour. Listen to the student's description of the procedures.

## STUDENT ACTIVITY:

1. Develop a checklist, listing the components of the aeration unit and their normal characteristics.
2. Develop a manual of normal operation procedures.
3. Describe the normal operation procedures during a slide show of components of the aeration unit.
4. Observe and describe the normal operation procedures during a plant tour.

<<<<<>>>>>

## OBJECTIVE 7.6:

*Perform the normal operation procedures for the aeration unit.*

## CONDITIONS:

Given an aeration unit, the manual of normal operation procedures which the student has developed for the aeration unit and basic references.

## ACCEPTABLE PERFORMANCE:

The student will:

Check and evaluate the characteristics of each component, explaining his actions.

Perform the procedures which an operator follows if the characteristics of a component indicate that it is not functioning normally.

Perform the routine sampling.

Perform the routine calculations.

Perform the routine record keeping.



## INSTRUCTOR ACTIVITY:

1. Observe the student demonstrating normal operation procedures in a dry run in a treatment plant.
2. Observe the student performing normal operation procedures in a treatment plant.

## STUDENT ACTIVITY:

1. Demonstrate the normal operation procedures in a dry run in a treatment plant.
2. Perform and explain the normal operation procedures in a treatment plant.

<<<<<<>>>>>>>

## OBJECTIVE 7.7:

*Describe and perform the start-up and shut-down procedures for the aeration unit.*

## CONDITIONS:

Given a mock-up, model or photograph of an aeration unit and an aeration unit with the manufacturer's operation manual.

## ACCEPTABLE PERFORMANCE:

The student will:

Start up and shut down an aeration unit, following the manufacturer's instructions.

## INSTRUCTOR ACTIVITY:

1. Demonstrate and perform the start-up procedures in a treatment plant.
2. Demonstrate and perform the shut-down procedures in a treatment plant.
3. Observe the student performing the start-up procedures in a treatment plant.
4. Observe the student performing the shut-down procedures in a treatment plant.
5. Observe the student as he evaluates his start-up procedures.
6. Observe the student as he evaluates his shut-down procedures.

## STUDENT ACTIVITY:

1. Describe the start-up procedures in a dry run in a treatment plant.
2. Describe the shut-down procedures in a dry run in a treatment plant.
3. Perform the start-up procedures in a treatment plant.



4. Perform the shut-down procedures in a treatment plant.
5. Evaluate the operation of the aeration unit to determine whether correct start-up procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)
6. Evaluate the operation of the aeration unit to determine whether correct shut-down procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)

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**OBJECTIVE 7.8:**

*Describe the abnormal operation procedures for the aeration process.*

**CONDITIONS:**

Given a wastestream in a treatment plant or color photographs of a wastestream, a checklist of the conditions of the wastestream and plant records and reference materials.

**ACCEPTABLE PERFORMANCE:**

The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

ammonia nitrogen	odor
BOD	organic and total Kjeldahl
COD	nitrogen
color	orthophosphate
DO	pH
flow	relative stability
foam	residence time
ice	septic sewage
industrial wastes	SDI
level	sludge age
nitrate nitrogen	suspended solids
nitrite nitrogen	SVI

Describe the cause and effect of the abnormal condition.

Explain how often the condition of the wastestream must be checked.



Describe what an operator does if he observes abnormal conditions, including:

- operational changes
- reporting to supervisors
- sampling procedures

Describe how the actions of the operator will improve the condition of the wastestream.

**INSTRUCTOR ACTIVITY:**

1. Describe and explain the abnormal conditions of the wastestream illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures during a slide show.
4. Describe and explain the abnormal operation procedures during a plant tour. Listen to the student's description of the procedures.

**STUDENT ACTIVITY:**

1. Evaluate and explain the abnormal conditions of the wastestream which are illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures in a class discussion after a slide show.
4. Evaluate and explain the condition of the wastestream during a plant tour. Describe and explain the abnormal operation procedures.

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**OBJECTIVE 7.9:**

*Describe the preventive maintenance procedures for the aeration unit.*

**CONDITIONS:**

Given an aeration unit or pictures and drawings of an aeration unit and reference materials, including:

- inspection records
- manufacturer's maintenance guides
- plant drawings and specifications
- preventive maintenance schedule



ACCEPTABLE PERFORMANCE: The student will:

Describe these preventive maintenance procedures for the aeration unit:

Cleaning	meter
air filter	motor
blower	pump
diffuser tube	valve
foam spray system	Painting
header	blower
manometer	motor
meter	pipng
motor	pump
pipng	railing
pump	valve
railing	Replacement
valve	air filter
Lubrication	diffuser tube
air filter	fire-fighting equipment
blower	first-aid kit
motor	harness
pump	indicator light
valve	life jacket
Mechanical adjustment	manometer
blower	safety line
elbow joint	Wear measurement
gage	blower
header	valve

Name the reference materials and tools needed to perform the preventive maintenance procedures.

Explain how often each preventive maintenance procedure must be performed.

Explain how an operator determines whether a component needs preventive maintenance.

Describe what an operator does if a component needs preventive maintenance.

Explain why each preventive maintenance procedure is important.

INSTRUCTOR ACTIVITY:

1. Describe and explain the preventive maintenance procedures for the aeration unit.
2. Describe and explain the preventive maintenance procedures during a slide show.
3. Describe and explain the preventive maintenance procedures during a plant tour.





## STUDENT ACTIVITY:

1. Develop a preventive maintenance schedule and a manual of preventive maintenance procedures.
2. Observe, describe and explain the preventive maintenance procedures during a slide show.
3. Observe, describe and explain the preventive maintenance procedures during a plant tour.

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## OBJECTIVE 7.10:

*Perform the preventive maintenance procedures for the aeration unit.*

## CONDITIONS:

Given an aeration unit and tools and reference materials, including:  
 inspection records  
 manufacturer's maintenance guides  
 plant drawings and specifications  
 preventive maintenance schedule

## ACCEPTABLE PERFORMANCE:

The student will:

Select the reference materials and tools needed to perform the preventive maintenance procedures.

Apply the preventive maintenance schedule for the aeration unit, explaining his actions.

Perform the procedures which an operator follows when a component needs preventive maintenance, explaining his actions.

## INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe student inspection of a treatment plant.
3. Observe the student performing the preventive maintenance procedures in a treatment plant.

## STUDENT ACTIVITY:

1. Small groups of students perform the preventive maintenance procedures in simulated situations in the workshop.
2. Inspect a treatment plant. Evaluate and explain the preventive maintenance procedures.
3. Perform and explain the preventive maintenance procedures in a treatment plant.

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**OBJECTIVE 7.11:**

*Describe the corrective maintenance procedures for the aeration unit components listed on page 35.*

**CONDITIONS:**

Given an aeration unit or a mock-up, photographs or drawings of an aeration unit, the manual of operation procedures which the student has developed for the aeration unit, tools and reference materials, including:

- catalogue of replacement parts
- equipment catalogues
- manufacturer's maintenance guides

**ACCEPTABLE PERFORMANCE:**

The student will:

Describe how an operator evaluates each component of the aeration unit for corrective maintenance, commenting on:

agitation	position
color	pressure
corrosion	sound
flow	temperature
motion	vibration
odor	

Explain why a component has malfunctioned.

Name the reference materials and tools needed to perform the corrective maintenance.

Describe what an operator does when he discovers a malfunction, including:

- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Describe how the operator corrects the malfunction.

**INSTRUCTOR ACTIVITY:**

1. Describe and explain the corrective maintenance procedures for the aeration unit, using diagrams and pictures.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Describe and explain the corrective maintenance procedures during treatment plant tours.

**STUDENT ACTIVITY:**

1. Describe and explain the corrective maintenance procedures in situations described or pictured by the instructor.



2. Describe and explain the corrective maintenance procedures during a slide show.
3. Observe, describe and explain the corrective maintenance procedures during a treatment plant tour.

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**OBJECTIVE 7.12:**

*Perform the corrective maintenance procedures for the aeration unit components.*

**CONDITIONS:**

Given an aeration unit or unit components, the operation procedures manual which the student has developed, tools and reference materials, including:

- catalogue of replacement parts
- equipment catalogues
- manufacturer's maintenance guides
- manufacturer's operation manual

**ACCEPTABLE PERFORMANCE:**

The student will:

Evaluate the components of the aeration unit for corrective maintenance, explaining why a component has malfunctioned and commenting on:

agitation	position
color	pressure
corrosion	sound
flow	temperature
motion	vibration
odor	

Select the reference materials and tools needed to perform the corrective maintenance.

Perform the procedures which an operator follows when a component malfunctions, including:

- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Correct the malfunction.

**INSTRUCTOR ACTIVITY:**

1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the components in a treatment plant.
3. Observe the student performing the corrective maintenance procedures in a treatment plant.



## STUDENT ACTIVITY:

1. Small groups of students perform and explain the corrective maintenance procedures in simulated situations in the workshop.
2. Evaluate the components for corrective maintenance.
3. Perform and explain the corrective maintenance procedures in a treatment plant.

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## OBJECTIVE 7.13:

*Perform the safety procedures for the aeration unit and demonstrate how they protect employees and visitors.*

## CONDITIONS:

Given a list of operation or maintenance procedures, the student's manual of safety procedures, tools and safety equipment.

## ACCEPTABLE PERFORMANCE:

The student will:

Identify hazardous conditions in the aeration unit, commenting on:  
 high-risk activities  
 sources of danger  
 safety equipment

Explain how the procedures protect employees and visitors.

Recommend corrective procedures and correct the unsafe condition.

## INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the safety conditions in a treatment plant.
3. Observe the student performing the safety procedures in a treatment plant.

## STUDENT ACTIVITY:

1. Evaluate safety conditions in simulated situations and recommend corrective procedures.
2. Evaluate safety conditions in a treatment plant and recommend corrective procedures.
3. Perform the safety procedures in a treatment plant.

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**OBJECTIVE 7.14:**

*Compare other aeration units to the diffused air unit with swing-type diffuser producing fine bubbles (composite model plant unit G).*

**CONDITIONS:**

Given a process unit and reference materials, including:  
 equipment catalogues  
 laboratory reports  
 manufacturer's bulletins  
 manufacturer's operation manuals  
 plant maintenance and operation records

**ACCEPTABLE PERFORMANCE:**

The student will:

Compare composite model plant unit G with:  
 a mechanical aeration unit with turbine and sparger.  
 a diffused air unit with fixed-type diffuser producing fine bubbles.  
 a diffused air unit with swing-type diffuser producing large bubbles.  
 a diffused air unit with fixed-type diffuser producing large bubbles.  
 a flat-plate diffuser.  
 a mechanical aeration unit with brush.  
 a mechanical aeration unit with propeller.  
 an ejector nozzle aeration unit.  
 an ejector aeration unit.

**Consider:**

availability of replacement parts  
 capital costs  
 dependency on surrounding environment  
 ease of repair  
 efficiency  
 flow-handling capabilities  
 maintenance costs  
 nuisance to neighbors  
 operational costs  
 operational skills  
 personnel requirements  
 reliability  
 resistance to upset  
 sensitivity of controls  
 space requirements  
 waste-handling capabilities

**INSTRUCTOR ACTIVITY:**

1. Prepare a chart for tabulation of information about the units.



2. Compare composite model plant unit G with the other units.
3. Help the student to collect information for reports on the advantages and disadvantages of each unit.

**STUDENT ACTIVITY:**

1. List information about the units on a chart.
2. Compare the units in a panel discussion.
3. Write a report on the advantages and disadvantages of each unit.

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**OBJECTIVE 7.15:**

*Name and locate the components of the aeration unit listed on page 35. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.*

**CONDITIONS:**

Given an aeration unit, unit components or a diagram, model or photographs of a unit and reference materials, including:

- contractor's plans of the aeration unit
- manufacturer's maintenance guides
- operation and maintenance manuals

**ACCEPTABLE PERFORMANCE:**

The student will:

- Name and locate the components of the aeration unit.
- Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.

**INSTRUCTOR ACTIVITY:**

1. Point out components of the aeration unit on diagrams, photographs or models.
2. Listen to the student naming the components and the applicable reference materials during a plant tour.
3. Name and display the reference materials which describe the aeration unit and normal operation procedures.

**STUDENT ACTIVITY:**

1. Name the components which the instructor points out on diagrams, photographs or models.



2. Name the components which the instructor points out during a plant tour and name the reference materials which apply to the components.
3. Name and select the reference materials which describe the aeration unit and normal operation procedures.

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**OBJECTIVE 7.16:**

*Perform the abnormal operation procedures for the aeration unit.*

**CONDITIONS:**

Given a wastestream in a treatment plant and reference materials, including:  
 industrial waste records  
 operation logs  
 operator manuals  
 plant performance guides

**ACCEPTABLE PERFORMANCE:**

The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

ammonia nitrogen	odor
BOD	organic and total Kjeldahl
COD	nitrogen
color	orthophosphate
DO	pH
flow	relative stability
foam	residence time
ice	septic sewage
industrial wastes	SDI
level	sludge age
nitrate nitrogen	suspended solids
nitrite nitrogen	SVI

Select the references he needs to return the wastestream to normal.

Perform the abnormal operation procedures.

**INSTRUCTOR ACTIVITY:**

1. Observe the student as he evaluates the wastestream in a treatment plant.
2. Describe the references needed to correct abnormal conditions of the wastestream.



3. Observe the student performing the abnormal operation procedures in simulated situations and in a treatment plant.

STUDENT ACTIVITY:

1. Evaluate the wastestream in a treatment plant.
2. Select the references needed to correct abnormal conditions of the wastestream.
3. Perform the abnormal operation procedures in simulated situations or in a treatment plant.

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**MODULE 8****SECONDARY SEDIMENTATION**

*A circular, peripheral-feed unit  
with suction*

*Composite Model Plant Unit H*

**PURPOSE:**

*In this module the student will learn to perform all the activities in the objectives as they apply to a circular, peripheral-feed unit with suction. READ PAGES 1 TO 11 BEFORE USING THIS MODULE.*

**OBJECTIVES:**

- 8.1 *Identify the secondary sedimentation unit.*
- 8.2 *Describe the secondary sedimentation process in technical and nontechnical terms.*
- 8.3 *Describe the safety procedures for the secondary sedimentation unit and explain how the procedures protect employees and visitors.*
- 8.4 *Identify the components of a secondary sedimentation unit. Explain the purpose of each component, how the component works and why it is important.*
- 8.5 *Describe the normal operation procedures for the secondary sedimentation unit components listed on page 55.*
- 8.6 *Perform the normal operation procedures for the secondary sedimentation unit.*
- 8.7 *Describe and perform the start-up and shut-down procedures for the secondary sedimentation unit.*
- 8.8 *Describe the abnormal operation procedures for the secondary sedimentation process.*
- 8.9 *Describe the preventive maintenance procedures for the secondary sedimentation unit.*
- 8.10 *Perform the preventive maintenance procedures for the secondary sedimentation unit.*
- 8.11 *Describe the corrective maintenance procedures for the secondary sedimentation unit components listed on page 55.*
- 8.12 *Perform the corrective maintenance procedures for the secondary sedimentation unit components.*
- 8.13 *Perform the safety procedures for the secondary sedimentation unit and demonstrate how they protect employees and visitors.*
- 8.14 *Compare other secondary sedimentation units to the circular, peripheral-feed unit with suction (composite model plant unit H).*
- 8.15 *Name and locate the components of the secondary sedimentation unit listed on page 55. Name and select reference materials*



*which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.*

- 8.16 *Perform the abnormal operation procedures for the secondary sedimentation unit.*

RESOURCES:	3	116	120	125	141	143	144	307	308	309	316
	317	320	321	324	421	459	511	551	552	553	554
	937	990	1033	1034	1399						

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**OBJECTIVE 8.1:** *Identify the secondary sedimentation unit.*

**CONDITIONS:** Given a unit, a model of a unit or a photograph of a unit.

**ACCEPTABLE PERFORMANCE:** The student will:  
Indicate whether the process unit is used for secondary sedimentation.

**INSTRUCTOR ACTIVITY:** 1. Point out characteristics which distinguish the secondary sedimentation unit from other process units.

**STUDENT ACTIVITY:** 1. Develop a picture file of secondary sedimentation units. Mark distinguishing characteristics.

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**OBJECTIVE 8.2:** *Describe the secondary sedimentation process in technical and nontechnical terms.*

**CONDITIONS:** Given photographs of the secondary sedimentation unit.

**ACCEPTABLE PERFORMANCE:** The student will:  
Describe the secondary sedimentation unit, explaining the meaning of:  
final clarifier  
final sedimentation tank



secondary basin  
 "sed" tank  
 sedimentation unit  
 settling tank

Describe the purpose of secondary sedimentation.

Describe how secondary sedimentation affects:

trickling filtration  
 aeration  
 thickening  
 first stage digestion  
 second stage digestion  
 sludge conditioning  
 post-chlorination  
 sludge dewatering  
 effluent disposal  
 pumping and piping

INSTRUCTOR ACTIVITY:

1. Use diagrams, photographs and slides to describe secondary sedimentation.
2. Describe the secondary sedimentation process during a plant tour. React to the student's description of the process.

STUDENT ACTIVITY:

1. Describe the secondary sedimentation process while viewing photographs, diagrams and slides.
2. Observe and describe the secondary sedimentation process during a plant tour.

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OBJECTIVE 8.3:

*Describe the safety procedures for the secondary sedimentation unit and explain how the procedures protect employees and visitors.*

CONDITIONS:

Given a list of operation and maintenance procedures.

ACCEPTABLE PERFORMANCE:

The student will:

Describe the safety procedures for the secondary sedimentation unit, commenting on:

High-risk activities

lifting and lowering objects with ropes and pulleys



## High-risk activities (continued)

making adjustments with switches in automatic position  
 raking floating materials from tank surface  
 removing debris from channels  
 working inside tank  
 working near open pits and tanks

## Sources of danger

acid wastes  
 buckets  
 caustic wastes  
 deep wells  
 electrical equipment  
 explosive gases  
 moving parts  
 open doors and covers  
 pits  
 slippery walks and stairs  
 tanks  
 toxic gases  
 water hoses

## Safety equipment

explosion proof flashlight  
 first-aid kit  
 handrails  
 ladders  
 life preserver  
 lockout tags and keys  
 protective clothing  
 stair safety treads

Explain how the procedures protect employees and visitors.

## INSTRUCTOR ACTIVITY:

1. Discuss treatment plant case histories.
2. Describe the conditions in a plant and ask for evaluation.
3. Describe the safety procedures for each operation and maintenance procedure.
4. Prepare slides of sources of danger and high-risk activities.

## STUDENT ACTIVITY:

1. Read case histories and comment on employee safety procedures.
2. Evaluate conditions which the instructor has described. Suggest remedies.



3. Role play operation or maintenance procedures. Select proper safety equipment and name the sources of danger and high-risk activities. Develop a manual of safety procedures for the secondary sedimentation unit.
4. Identify sources of danger and high-risk activities pictured in slides.

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**OBJECTIVE 8.4:**

*Identify the components of a secondary sedimentation unit. Explain the purpose of each component, how the component works and why it is important.*

**CONDITIONS:**

Given a secondary sedimentation unit, unit components or a diagram, model or photographs of a unit and a list of components.

**ACCEPTABLE PERFORMANCE:**

The student will:

Identify components of the secondary sedimentation unit and associated equipment:

baffle	pipng
belt	pulley
collector sweep	pump
coupling	scum tank
density meter	scum trough
drive motor	shear pin
fire-fighting equipment	skimmer
first-aid kit	sludge tank
gate	valve
gear box	variable speed drive
indicator	water seal unit
limit switch	weir
motor	

Explain the purpose of each component, how the component works and why it is important.

**INSTRUCTOR ACTIVITY:**

1. Point out and name components in diagrams, photographs or models.
2. Arrange photographs or models of components in the workshop for student identification.
3. Point out and name components during a plant tour.



4. Question the students about the purpose of each component, how the component works and why it is important.

## STUDENT ACTIVITY:

1. Identify the components which the instructor names on diagrams, photographs or models.
2. Identify the components at stations in the workshop in writing.
3. Identify components during a plant tour.
4. Explain the purpose of each component, how the component works and why it is important.

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## OBJECTIVE 8.5:

*Describe the normal operation procedures for the secondary sedimentation unit components listed on page 55.*

## CONDITIONS:

Given a secondary sedimentation unit or slides or photographs of a secondary sedimentation unit, a list of components of the unit, a checklist of characteristics and a normal operation procedures manual.

## ACCEPTABLE PERFORMANCE:

The student will:

Describe the characteristics of each component which the operator checks to determine whether the component is functioning normally, commenting on:

biological growth	position
color	pressure
corrosion	sound
flow	temperature
motion	vibration
odor	

Name the sense or indicator which monitors each characteristic.

Explain how often the characteristics of each component must be checked and why the component must be checked on this schedule.

Describe what an operator does if the characteristics of a component indicate that it is not functioning normally, including:

- making adjustments
- deciding about corrective maintenance



reporting to supervisors  
reporting in written records

Explain why a component's characteristics must be returned to normal.

Describe routine sampling for the secondary sedimentation process.

List routine calculations for the secondary sedimentation process.

Describe routine procedures for recording data.

#### INSTRUCTOR ACTIVITY:

1. Describe the characteristics of the components of the secondary sedimentation unit.
2. Describe the normal operation procedures for the secondary sedimentation unit. Use color pictures.
3. Describe the normal operation procedures during a slide show of components of the secondary sedimentation unit.
4. Describe and explain the normal operation procedures during a plant tour. Listen to the student's description of the procedures.

#### STUDENT ACTIVITY:

1. Develop a checklist, listing the components of the secondary sedimentation unit and their normal characteristics.
2. Develop a manual of normal operation procedures.
3. Describe the normal operation procedures during a slide show of components of the secondary sedimentation unit.
4. Observe and describe the normal operation procedures during a plant tour.

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#### OBJECTIVE 8.6:

*Perform the normal operation procedures for the secondary sedimentation unit.*

#### CONDITIONS:

Given a secondary sedimentation unit, the manual of normal operation procedures which the student has developed for the secondary sedimentation unit and basic references.



## ACCEPTABLE PERFORMANCE:

The student will:

Check and evaluate the characteristics of each component, explaining his actions.

Perform the procedures which an operator follows if the characteristics of a component indicate that it is not functioning normally.

Perform the routine sampling.

Perform the routine calculations.

Perform the routine record keeping.

## INSTRUCTOR ACTIVITY:

1. Observe the student demonstrating normal operation procedures in a dry run in a treatment plant.
2. Observe the student performing normal operation procedures in a treatment plant.

## STUDENT ACTIVITY:

1. Demonstrate the normal operation procedures in a dry run in a treatment plant.
2. Perform and explain the normal operation procedures in a treatment plant.

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## OBJECTIVE 8.7:

*Describe and perform the start-up and shut-down procedures for the secondary sedimentation unit.*

## CONDITIONS:

Given a mock-up, model or photograph of a secondary sedimentation unit and a secondary sedimentation unit with the manufacturer's operation manual.

## ACCEPTABLE PERFORMANCE:

The student will:

Start up and shut down a secondary sedimentation unit, following the manufacturer's instructions.

## INSTRUCTOR ACTIVITY:

1. Demonstrate and perform the start-up procedures in a treatment plant.
2. Demonstrate and perform the shut-down procedures in a treatment plant.
3. Observe the student performing the start-up procedures in a treatment plant.





4. Observe the student performing the shut-down procedures in a treatment plant.
5. Observe the student as he evaluates his start-up procedures.
6. Observe the student as he evaluates his shut-down procedures.

## STUDENT ACTIVITY:

1. Describe the start-up procedures in a dry run in a treatment plant.
2. Describe the shut-down procedures in a dry run in a treatment plant.
3. Perform the start-up procedures in a treatment plant.
4. Perform the shut-down procedures in a treatment plant.
5. Evaluate the operation of the secondary sedimentation unit to determine whether correct start-up procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)
6. Evaluate the operation of the secondary sedimentation unit to determine whether correct shut-down procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)

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## OBJECTIVE 8.8:

*Describe the abnormal operation procedures for the secondary sedimentation process.*

## CONDITIONS:

Given a wastestream in a treatment plant or color photographs of a wastestream, a checklist of the conditions of the wastestream and plant records and reference materials.

## ACCEPTABLE PERFORMANCE:

The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

BOD	level
COD	pH
DO	sludge density
floating material	suspended solids
flow	velocity
ice	



Describe the cause and effect of the abnormal condition.

Explain how often the condition of the wastestream must be checked.

Describe what an operator does if he observes abnormal conditions, including:

- operational changes
- reporting to supervisors
- sampling procedures

Describe how the actions of the operator will improve the condition of the wastestream.

#### INSTRUCTOR ACTIVITY:

1. Describe and explain the abnormal conditions of the wastestream illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures during a slide show.
4. Describe and explain the abnormal operation procedures during a plant tour. Listen to the student's description of the procedures.

#### STUDENT ACTIVITY:

1. Evaluate and explain the abnormal conditions of the wastestream which are illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures in a class discussion after a slide show.
4. Evaluate and explain the condition of the wastestream during a plant tour. Describe and explain the abnormal operation procedures.

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#### OBJECTIVE 8.9:

*Describe the preventive maintenance procedures for the secondary sedimentation unit.*

#### CONDITIONS:

Given a secondary sedimentation unit or pictures and drawings of a secondary sedimentation unit and reference materials, including:

- inspection records



manufacturer's maintenance guides  
 plant drawings and specifications  
 preventive maintenance schedule

## ACCEPTABLE PERFORMANCE:

The student will:

Describe these preventive maintenance procedures for the secondary sedimentation unit:

Cleaning	motor
baffle	pump
drive motor	valve
gate	variable speed drive
gear box	water seal unit
motor	weir
pump	Painting
scum tank	drive motor
scum trough	gear box
skimmer	motor
sludge tank	pipng
variable speed drive	pump
weir	valve
Lubrication	variable speed drive
drive motor	weir
gear box	Replacement
motor	belt
pump	fire-fighting equipment
variable speed drive	first-aid kit
Mechanical adjustment	indicator
baffle	limit switch
belt	shear pin
collector sweep	Wear measurement
coupling	belt
density meter	collector sweep
drive motor	coupling
gate	pulley
gear box	pump

Name the reference materials and tools needed to perform the preventive maintenance procedures.

Explain how often each preventive maintenance procedure must be performed.

Explain how an operator determines whether a component needs preventive maintenance.

Describe what an operator does if a component needs preventive maintenance.

Explain why each preventive maintenance procedure is important.



## INSTRUCTOR ACTIVITY:

1. Describe and explain the preventive maintenance procedures for the secondary sedimentation unit.
2. Describe and explain the preventive maintenance procedures during a slide show.
3. Describe and explain the preventive maintenance procedures during a plant tour.

## STUDENT ACTIVITY:

1. Develop a preventive maintenance schedule and a manual of preventive maintenance procedures.
2. Observe, describe and explain the preventive maintenance procedures during a slide show.
3. Observe, describe and explain the preventive maintenance procedures during a plant tour.

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## OBJECTIVE 8.10:

*Perform the preventive maintenance procedures for the secondary sedimentation unit.*

## CONDITIONS:

Given a secondary sedimentation unit and tools and reference materials, including:

- inspection records
- manufacturer's maintenance guides
- plant drawings and specifications
- preventive maintenance schedule

## ACCEPTABLE PERFORMANCE:

The student will:

- Select the reference materials and tools needed to perform the preventive maintenance procedures.
- Apply the preventive maintenance schedule for the secondary sedimentation unit, explaining his actions.
- Perform the procedures which an operator follows when a component needs preventive maintenance, explaining his actions.

## INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe student inspection of a treatment plant.
3. Observe the student performing the preventive maintenance procedures in a treatment plant.



## STUDENT ACTIVITY:

1. Small groups of students perform the preventive maintenance procedures in simulated situations in the workshop.
2. Inspect a treatment plant. Evaluate and explain the preventive maintenance procedures.
3. Perform and explain the preventive maintenance procedures in a treatment plant.

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## OBJECTIVE 8.11:

*Describe the corrective maintenance procedures for the secondary sedimentation unit components listed on page 55.*

## CONDITIONS:

Given a secondary sedimentation unit or a mock-up, photographs or drawings of a secondary sedimentation unit, the manual of operation procedures which the student has developed for the secondary sedimentation unit, tools and reference materials, including:

- catalogue of replacement parts
- equipment catalogues
- manufacturer's maintenance guides

## ACCEPTABLE PERFORMANCE:

The student will:

Describe how an operator evaluates each component of the secondary sedimentation unit for corrective maintenance, commenting on:

biological growth	position
color	pressure
corrosion	sound
flow	temperature
motion	vibration
odor	

Explain why a component has malfunctioned.

Name the reference materials and tools needed to perform the corrective maintenance.

Describe what an operator does when he discovers a malfunction, including:

- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Describe how the operator corrects the malfunction.



## INSTRUCTOR ACTIVITY:

1. Describe and explain the corrective maintenance procedures for the secondary sedimentation unit, using diagrams and pictures.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Describe and explain the corrective maintenance procedures during treatment plant tours.

## STUDENT ACTIVITY:

1. Describe and explain the corrective maintenance procedures in situations described or pictured by the instructor.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Observe, describe and explain the corrective maintenance procedures during a treatment plant tour.

<<<<<<>>>>>>>

## OBJECTIVE 8.12:

*Perform the corrective maintenance procedures for the secondary sedimentation unit components.*

## CONDITIONS:

Given a secondary sedimentation unit or unit components, the operation procedures manual which the student has developed, tools and reference materials, including:

- catalogue of replacement parts
- equipment catalogues
- manufacturer's maintenance guides
- manufacturer's operation manual

## ACCEPTABLE PERFORMANCE:

The student will:

Evaluate the components of the secondary sedimentation unit for corrective maintenance, explaining why a component has malfunctioned and commenting on:

biological growth	position
color	pressure
corrosion	sound
flow	temperature
motion	vibration
odor	

Select the reference materials and tools needed to perform the corrective maintenance.



Perform the procedures which an operator follows when a component malfunctions, including:  
 evaluation of capabilities of plant personnel to perform the procedures  
 selection of replacement parts  
 record keeping

Correct the malfunction.

INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the components in a treatment plant.
3. Observe the student performing the corrective maintenance procedures in a treatment plant.

STUDENT ACTIVITY:

1. Small groups of students perform and explain the corrective maintenance procedures in simulated situations in the workshop.
2. Evaluate the components for corrective maintenance.
3. Perform and explain the corrective maintenance procedures in a treatment plant.

<<<<<<>>>>>>>>

OBJECTIVE 8.13:

*Perform the safety procedures for the secondary sedimentation unit and demonstrate how they protect employees and visitors.*

CONDITIONS:

Given a list of operation or maintenance procedures, the student's manual of safety procedures, tools and safety equipment.

ACCEPTABLE PERFORMANCE:

The student will:

Identify hazardous conditions in the secondary sedimentation unit, commenting on:

high-risk activities  
 sources of danger  
 safety equipment

Explain how the procedures protect employees and visitors.

Recommend corrective procedures and correct the unsafe condition.



## INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the safety conditions in a treatment plant.
3. Observe the student performing the safety procedures in a treatment plant.

## STUDENT ACTIVITY:

1. Evaluate safety conditions in simulated situations and recommend corrective procedures.
2. Evaluate safety conditions in a treatment plant and recommend corrective procedures.
3. Perform the safety procedures in a treatment plant.

<<<<<<>>>>>>>

## OBJECTIVE 8.14:

*Compare other secondary sedimentation units to the circular, peripheral-feed unit with suction (composite model plant unit H).*

## CONDITIONS:

Given a process unit and reference materials, including:  
 equipment catalogues  
 laboratory reports  
 manufacturer's bulletins  
 manufacturer's operation manuals  
 plant maintenance and operation records

## ACCEPTABLE PERFORMANCE:

The student will:

Compare composite model plant unit H with:  
 a circular, center-feed unit with suction.  
 a rectangular unit.  
 a circular, center-feed unit with scraper.  
 a circular, peripheral-feed unit with scraper.

Consider:

availability of replacement parts  
 capital costs  
 dependency on surrounding environment  
 ease of repair  
 efficiency  
 flow-handling capabilities  
 maintenance costs  
 nuisance to neighbors  
 operational costs  
 operational skills  
 personnel requirements  
 reliability





resistance to upset  
sensitivity of controls  
space requirements  
waste-handling capabilities

**INSTRUCTOR ACTIVITY:**

1. Prepare a chart for tabulation of information about the units.
2. Compare composite model plant unit H with the other units.
3. Help the student to collect information for reports on the advantages and disadvantages of each unit.

**STUDENT ACTIVITY:**

1. List information about the units on a chart.
2. Compare the units in a panel discussion.
3. Write a report on the advantages and disadvantages of each unit.

<<<<<>>>>>

**OBJECTIVE 8.15:**

*Name and locate the components of the secondary sedimentation unit listed on page 55. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.*

**CONDITIONS:**

Given a secondary sedimentation unit, unit components or a diagram, model or photographs of a unit and reference materials, including:

contractor's plans of the secondary sedimentation unit  
manufacturer's maintenance guides  
operation and maintenance manuals

**ACCEPTABLE PERFORMANCE:**

The student will:

Name and locate the components of the secondary sedimentation unit.

Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.



## INSTRUCTOR ACTIVITY:

1. Point out components of the secondary sedimentation unit on diagrams, photographs or models.
2. Listen to the student naming the components and the applicable reference materials during a plant tour.
3. Name and display the reference materials which describe the secondary sedimentation unit and normal operation procedures.

## STUDENT ACTIVITY:

1. Name the components which the instructor points out on diagrams, photographs or models.
2. Name the components which the instructor points out during a plant tour and name the reference materials which apply to the components.
3. Name and select the reference materials which describe the secondary sedimentation unit and normal operation procedures.

<<<<<<>>>>>>>>

## OBJECTIVE 8.16:

*Perform the abnormal operation procedures for the secondary sedimentation unit.*

## CONDITIONS:

Given a wastestream in a treatment plant and reference materials, including:

- industrial waste records
- operation logs
- operator manuals
- plant performance guides

## ACCEPTABLE PERFORMANCE:

The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

BOD	level
COD	pH
DO	sludge density
floating material	suspended solids
flow	velocity
ice	

Select the references he needs to return the wastestream to normal.

Perform the abnormal operation procedures.



INSTRUCTOR ACTIVITY:

1. Observe the student as he evaluates the wastestream in a treatment plant.
2. Describe the references needed to correct abnormal conditions of the wastestream.
3. Observe the student performing the abnormal operation procedures in simulated situations and in a treatment plant.

STUDENT ACTIVITY:

1. Evaluate the wastestream in a treatment plant.
2. Select the references needed to correct abnormal conditions of the wastestream.
3. Perform the abnormal operation procedures in simulated situations or in a treatment plant.

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**MODULE 9****POND STABILIZATION***An aerobic pond**Composite Model Plant Unit I***PURPOSE:**

*In this module the student will learn to perform all the activities in the objectives as they apply to an aerobic pond. READ PAGES 1 TO 11 BEFORE USING THIS MODULE.*

**OBJECTIVES:**

- 9.1 *Identify the pond stabilization unit.*
- 9.2 *Describe the pond stabilization process in technical and non-technical terms.*
- 9.3 *Describe the safety procedures for the pond stabilization unit and explain how the procedures protect employees and visitors.*
- 9.4 *Identify the components of a pond stabilization unit. Explain the purpose of each component, how the component works and why it is important.*
- 9.5 *Describe the normal operation procedures for the pond stabilization unit components listed on page 75.*
- 9.6 *Perform the normal operation procedures for the pond stabilization unit.*
- 9.7 *Describe and perform the start-up and shut-down procedures for the pond stabilization unit.*
- 9.8 *Describe the abnormal operation procedures for the pond stabilization process.*
- 9.9 *Describe the preventive maintenance procedures for the pond stabilization unit.*
- 9.10 *Perform the preventive maintenance procedures for the pond stabilization unit.*
- 9.11 *Describe the corrective maintenance procedures for the pond stabilization unit components listed on page 75.*
- 9.12 *Perform the corrective maintenance procedures for the pond stabilization unit components.*
- 9.13 *Perform the safety procedures for the pond stabilization unit and demonstrate how they protect employees and visitors.*
- 9.14 *Compare other pond stabilization units to the aerobic pond (composite model plant unit I).*
- 9.15 *Name and locate the components of the pond stabilization unit listed on page 75. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.*
- 9.16 *Perform the abnormal operation procedures for the pond stabilization unit.*



RESOURCES:	3	116	120	125	141	143	144	307	308	309	316
	317	320	321	324	421	459	511	551	552	553	554
	937	990	1033	1034	1399						

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**OBJECTIVE 9.1:** *Identify the pond stabilization unit.*

**CONDITIONS:** Given a unit, a model of a unit or a photograph of a unit.

**ACCEPTABLE PERFORMANCE:** The student will:  
Indicate whether the process unit is used for pond stabilization.

**INSTRUCTOR ACTIVITY:** 1. Point out characteristics which distinguish the pond stabilization unit from other process units.

**STUDENT ACTIVITY:** 1. Develop a picture file of pond stabilization units.  
Mark distinguishing characteristics.

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**OBJECTIVE 9.2:** *Describe the pond stabilization process in technical and nontechnical terms.*

**CONDITIONS:** Given photographs of the pond stabilization unit.

**ACCEPTABLE PERFORMANCE:** The student will:  
Describe the pond stabilization unit, explaining the meaning of:  
lagoon  
oxidation pond  
polishing lagoon  
polishing pond  
sewage lagoon  
waste stabilization lagoon  
waste stabilization pond

Describe the purpose of pond stabilization.



Describe the process variations, explaining:  
 ponds in series  
 parallel ponds

Describe how pond stabilization affects:  
 post-chlorination  
 effluent disposal  
 flow measurement  
 pumping and piping

**INSTRUCTOR ACTIVITY:**

1. Use diagrams, photographs and slides to describe pond stabilization.
2. Describe the pond stabilization process during a plant tour. React to the student's description of the process.

**STUDENT ACTIVITY:**

1. Describe the pond stabilization process while viewing photographs, diagrams and slides.
2. Observe and describe the pond stabilization process during a plant tour.

<<<<<<>>>>>>

**OBJECTIVE 9.3:**

*Describe the safety procedures for the pond stabilization unit and explain how the procedures protect employees and visitors.*

**CONDITIONS:**

Given a list of operation and maintenance procedures.

**ACCEPTABLE PERFORMANCE:**

The student will:

Describe the safety procedures for the pond stabilization unit, commenting on:

High-risk activities

- removing debris from channels
- removing debris from pond
- removing vegetation next to electrical wire
- working in boat
- working with switches in automatic position

Sources of danger

- acid wastes
- boat and motor
- caustic wastes
- chuck holes
- contamination by contact



Sources of danger (continued)

- electrical equipment
- electrical wires in damp areas
- herbicides
- holes in fence
- moving parts
- open doors and covers
- pesticides
- short circuits
- slippery dikes
- slippery walks
- soil sterilizers
- toxic gases
- undercut banks
- ungrounded control panel
- wells
- wet grass
- wet rocks

Safety equipment

- adequate lighting
- barricades
- enclosed electrical wires
- fences
- fire-fighting equipment
- first-aid kit
- life preserver
- lockout tags and keys
- locks
- protective clothing
- railings
- safety equipment in boat
- signs

Explain how the procedures protect employees and visitors.

**INSTRUCTOR ACTIVITY:**

1. Discuss treatment plant case histories.
2. Describe the conditions in a plant and ask for evaluation.
3. Describe the safety procedures for each operation and maintenance procedure.
4. Prepare slides of sources of danger and high-risk activities.

**STUDENT ACTIVITY:**

1. Read case histories and comment on employee safety procedures.



2. Evaluate conditions which the instructor has described. Suggest remedies.
3. Role play operation or maintenance procedures. Select proper safety equipment and name the sources of danger and high-risk activities. Develop a manual of safety procedures for the pond stabilization unit.
4. Identify sources of danger and high-risk activities pictured in slides.

<<<<<>>>>>

**OBJECTIVE 9.4:**

*Identify the components of a pond stabilization unit. Explain the purpose of each component, how the component works and why it is important.*

**CONDITIONS:**

Given a pond stabilization unit, unit components or a diagram, model or photographs of a unit and a list of components.

**ACCEPTABLE PERFORMANCE:**

The student will:

Identify components of the pond stabilization unit and associated equipment:

baffle	first-aid kit
chemical conditioning unit	influent line
comminutor	inlet screen
coupling	motor
dike	outlet depth control
diversion box	pipng
drive-reduction gear	pump
effluent line	siphon
fire-fighting equipment	valve

Explain the purpose of each component, how the component works and why it is important.

**INSTRUCTOR ACTIVITY:**

1. Point out and name components in diagrams, photographs or models.
2. Arrange photographs or models of components in the workshop for student identification.
3. Point out and name components during a plant tour.
4. Question the students about the purpose of each component, how the component works and why it is important.





## STUDENT ACTIVITY:

1. Identify the components which the instructor names on diagrams, photographs or models.
2. Identify the components at stations in the workshop in writing.
3. Identify components during a plant tour.
4. Explain the purpose of each component, how the component works and why it is important.

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## OBJECTIVE 9.5:

*Describe the normal operation procedures for the pond stabilization unit components listed on page 75.*

## CONDITIONS:

Given a pond stabilization unit or slides or photographs of a pond stabilization unit, a list of components of the unit, a checklist of characteristics and a normal operation procedures manual.

## ACCEPTABLE PERFORMANCE:

The student will:

Describe the characteristics of each component which the operator checks to determine whether the component is functioning normally, commenting on:

color	odor
corrosion	position
depth	pressure
erosion	slope
exfiltration	sound
flow	temperature
infiltration	vegetation
motion	vibration

Name the sense or indicator which monitors each characteristic.

Explain how often the characteristics of each component must be checked and why the component must be checked on this schedule.

Describe what an operator does if the characteristics of a component indicate that it is not functioning normally, including:

- making adjustments
- deciding about corrective maintenance
- reporting to supervisors
- reporting in written records



Explain why a component's characteristics must be returned to normal.

Describe routine sampling for the pond stabilization process.

List routine calculations for the pond stabilization process.

Describe routine procedures for recording data.

**INSTRUCTOR ACTIVITY:**

1. Describe the characteristics of the components of the pond stabilization unit.
2. Describe the normal operation procedures for the pond stabilization unit. Use color pictures.
3. Describe the normal operation procedures during a slide show of components of the pond stabilization unit.
4. Describe and explain the normal operation procedures during a plant tour. Listen to the student's description of the procedures.

**STUDENT ACTIVITY:**

1. Develop a checklist, listing the components of the pond stabilization unit and their normal characteristics.
2. Develop a manual of normal operation procedures.
3. Describe the normal operation procedures during a slide show of components of the pond stabilization unit.
4. Observe and describe the normal operation procedures during a plant tour.

<<<<<<>>>>>>>

**OBJECTIVE 9.6:**

*Perform the normal operation procedures for the pond stabilization unit.*

**CONDITIONS:**

Given a pond stabilization unit, the manual of normal operation procedures which the student has developed for the pond stabilization unit and basic references.

**ACCEPTABLE PERFORMANCE:**

The student will:

Check and evaluate the characteristics of each component, explaining his actions.



Perform the procedures which an operator follows if the characteristics of a component indicate that it is not functioning normally.

Perform the routine sampling.

Perform the routine calculations.

Perform the routine record keeping.

**INSTRUCTOR ACTIVITY:**

1. Observe the student demonstrating normal operation procedures in a dry run in a treatment plant.
2. Observe the student performing normal operation procedures in a treatment plant.

**STUDENT ACTIVITY:**

1. Demonstrate the normal operation procedures in a dry run in a treatment plant.
2. Perform and explain the normal operation procedures in a treatment plant.

<<<<<<>>>>>>>>

**OBJECTIVE 9.7:**

*Describe and perform the start-up and shut-down procedures for the pond stabilization unit.*

**CONDITIONS:**

Given a mock-up, model or photograph of a pond stabilization unit and a pond stabilization unit with the manufacturer's operation manual.

**ACCEPTABLE PERFORMANCE:**

The student will:

Start up and shut down a pond stabilization unit, following the manufacturer's instructions.

**INSTRUCTOR ACTIVITY:**

1. Demonstrate and perform the start-up procedures in a treatment plant.
2. Demonstrate and perform the shut-down procedures in a treatment plant.
3. Observe the student performing the start-up procedures in a treatment plant.
4. Observe the student performing the shut-down procedures in a treatment plant.
5. Observe the student as he evaluates his start-up procedures.



6. Observe the student as he evaluates his shut-down procedures.

**STUDENT ACTIVITY:**

1. Describe the start-up procedures in a dry run in a treatment plant.
2. Describe the shut-down procedures in a dry run in a treatment plant.
3. Perform the start-up procedures in a treatment plant.
4. Perform the shut-down procedures in a treatment plant.
5. Evaluate the operation of the pond stabilization unit to determine whether correct start-up procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)
6. Evaluate the operation of the pond stabilization unit to determine whether correct shut-down procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)

<<<<<<>>>>>>

**OBJECTIVE 9.8:**

*Describe the abnormal operation procedures for the pond stabilization process.*

**CONDITIONS:**

Given a wastestream in a treatment plant or color photographs of a wastestream, a checklist of the conditions of the wastestream and plant records and reference materials.

**ACCEPTABLE PERFORMANCE:**

The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

- |                   |                            |
|-------------------|----------------------------|
| alkalinity        | ice                        |
| ammonia nitrogen  | industrial wastes          |
| BOD               | level                      |
| COD               | nitrate nitrogen           |
| coliforms         | nitrite nitrogen           |
| color             | odor                       |
| DO                | organic and total Kjeldahl |
| floating material | nitrogen                   |
| flow              | orthophosphate             |
| foam              | pH                         |



relative stability  
septic sewage  
settleable matter

short circuiting  
suspended solids  
temperature

Describe the cause and effect of the abnormal condition.

Explain how often the condition of the wastestream must be checked.

Describe what an operator does if he observes abnormal conditions, including:

operational changes  
reporting to supervisors  
sampling procedures

Describe how the actions of the operator will improve the condition of the wastestream.

**INSTRUCTOR ACTIVITY:**

1. Describe and explain the abnormal conditions of the wastestream illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures during a slide show.
4. Describe and explain the abnormal operation procedures during a plant tour. Listen to the student's description of the procedures.

**STUDENT ACTIVITY:**

1. Evaluate and explain the abnormal conditions of the wastestream which are illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures in a class discussion after a slide show.
4. Evaluate and explain the condition of the wastestream during a plant tour. Describe and explain the abnormal operation procedures.

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**OBJECTIVE 9.9:**

*Describe the preventive maintenance procedures for the pond stabilization unit.*

**CONDITIONS:**

Given a pond stabilization unit or pictures and drawings of a pond stabilization unit and reference materials, including:

inspection records  
 manufacturer's maintenance guides  
 plant drawings and specifications  
 preventive maintenance schedule

**ACCEPTABLE PERFORMANCE:**

The student will:

Describe these preventive maintenance procedures for pond stabilization unit:

Cleaning	comminutor
baffle	coupling
comminutor	diversion box
dike	drive-reduction gear
diversion box	motor
effluent line	pump
influent line	valve
inlet screen	Painting
motor	drive-reduction gear
outlet depth control	motor
pump	pipng
siphon	pump
Lubrication	Replacement
drive-reduction gear	fire-fighting equipment
motor	first-aid kit
pump	Wear measurement
valve	comminutor
Mechanical adjustment	coupling
baffle	dike
chemical conditioning unit	

Name the reference materials and tools needed to perform the preventive maintenance procedures.

Explain how often each preventive maintenance procedure must be performed.

Explain how an operator determines whether a component needs preventive maintenance.

Describe what an operator does if a component needs preventive maintenance.

Explain why each preventive maintenance procedure is important.



## INSTRUCTOR ACTIVITY:

1. Describe and explain the preventive maintenance procedures for the pond stabilization unit.
2. Describe and explain the preventive maintenance procedures during a slide show.
3. Describe and explain the preventive maintenance procedures during a plant tour.

## STUDENT ACTIVITY:

1. Develop a preventive maintenance schedule and a manual of preventive maintenance procedures.
2. Observe, describe and explain the preventive maintenance procedures during a slide show.
3. Observe, describe and explain the preventive maintenance procedures during a plant tour.

<<<<<<>>>>>>>

## OBJECTIVE 9.10:

*Perform the preventive maintenance procedures for the pond stabilization unit.*

## CONDITIONS:

Given a pond stabilization unit and tools and reference materials, including:

- inspection records
- manufacturer's maintenance guides
- plant drawings and specifications
- preventive maintenance schedule

## ACCEPTABLE PERFORMANCE:

The student will:

Select the reference materials and tools needed to perform the preventive maintenance procedures.

Apply the preventive maintenance schedule for the pond stabilization unit, explaining his actions.

Perform the procedures which an operator follows when a component needs preventive maintenance, explaining his actions.

## INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe student inspection of a treatment plant.
3. Observe the student performing the preventive maintenance procedures in a treatment plant.



## STUDENT ACTIVITY:

1. Small groups of students perform the preventive maintenance procedures in simulated situations in the workshop.
2. Inspect a treatment plant. Evaluate and explain the preventive maintenance procedures.
3. Perform and explain the preventive maintenance procedures in a treatment plant.

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## OBJECTIVE 9.11:

*Describe the corrective maintenance procedures for the pond stabilization unit components listed on page 75.*

## CONDITIONS:

Given a pond stabilization unit or a mock-up, photographs or drawings of a pond stabilization unit, the manual of operation procedures which the student has developed for the pond stabilization unit, tools and reference materials, including:

- catalogue of replacement parts
- equipment catalogues
- manufacturer's maintenance guides

## ACCEPTABLE PERFORMANCE:

The student will:

Describe how an operator evaluates each component of the pond stabilization unit for corrective maintenance, commenting on:

color	odor
corrosion	position
depth	pressure
erosion	slope
exfiltration	sound
flow	temperature
infiltration	vegetation
motion	vibration

Explain why a component has malfunctioned.

Name the reference materials and tools needed to perform the corrective maintenance

Describe what an operator does when he discovers a malfunction, including:

- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping





Describe how the operator corrects the malfunction.

**INSTRUCTOR ACTIVITY:**

1. Describe and explain the corrective maintenance procedures for the pond stabilization unit, using diagrams and pictures.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Describe and explain the corrective maintenance procedures during treatment plant tours.

**STUDENT ACTIVITY:**

1. Describe and explain the corrective maintenance procedures in situations described or pictured by the instructor.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Observe, describe and explain the corrective maintenance procedures during a treatment plant tour.

<<<<<<>>>>>>>>

**OBJECTIVE 9.12:**

*Perform the corrective maintenance procedures for the pond stabilization unit components.*

**CONDITIONS:**

Given a pond stabilization unit or unit components, the operation procedures manual which the student has developed, tools and reference materials, including:

- catalogue of replacement parts
- equipment catalogues
- manufacturer's maintenance guides
- manufacturer's operation manual

**ACCEPTABLE PERFORMANCE:**

The student will:

Evaluate the components of the pond stabilization unit for corrective maintenance, explaining why a component has malfunctioned and commenting on:

color	odor
corrosion	position
depth	pressure
erosion	slope
exfiltration	sound
flow	temperature
infiltration	vegetation
motion	vibration



Select the reference materials and tools needed to perform the corrective maintenance.

Perform the procedures which an operator follows when a component malfunctions, including:

- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record-keeping

Correct the malfunction.

**INSTRUCTOR ACTIVITY:**

1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the components in a treatment plant.
3. Observe the student performing the corrective maintenance procedures in a treatment plant.

**STUDENT ACTIVITY:**

1. Small groups of students perform and explain the corrective maintenance procedures in simulated situations in the workshop.
2. Evaluate the components for corrective maintenance.
3. Perform and explain the corrective maintenance procedures in a treatment plant.

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**OBJECTIVE 9.13:**

*Perform the safety procedures for the pond stabilization unit and demonstrate how they protect employees and visitors.*

**CONDITIONS:**

Given a list of operation or maintenance procedures, the student's manual of safety procedures, tools and safety equipment

**ACCEPTABLE PERFORMANCE:**

The student will:

Identify hazardous conditions in the pond stabilization unit, commenting on:

- high-risk activities
- sources of danger
- safety equipment

Explain how the procedures protect employees and visitors.



Recommend corrective procedures and correct the unsafe condition.

**INSTRUCTOR ACTIVITY:**

1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the safety conditions in a treatment plant.
3. Observe the student performing the safety procedures in a treatment plant.

**STUDENT ACTIVITY:**

1. Evaluate safety conditions in simulated situations and recommend corrective procedures.
2. Evaluate safety conditions in a treatment plant and recommend corrective procedures.
3. Perform the safety procedures in a treatment plant.

<<<<<<>>>>>>>>

**OBJECTIVE 9.14:**

*Compare other pond stabilization units to the aerobic pond (composite model plant unit I).*

**CONDITIONS:**

Given a process unit and reference materials, including:  
 equipment catalogues  
 laboratory reports  
 manufacturer's bulletins  
 manufacturer's operation manuals  
 plant maintenance and operation records

**ACCEPTABLE PERFORMANCE:**

The student will:

Compare composite model plant unit I with:  
 a facultative pond.  
 an anaerobic pond.

Consider:

availability of replacement parts  
 capital costs  
 dependency on surrounding environment  
 ease of repair  
 efficiency  
 flow-handling capabilities  
 maintenance costs  
 nuisance to neighbors  
 operational costs  
 operational skills  
 personnel requirements



reliability  
 resistance to upset  
 sensitivity of controls  
 space requirements  
 waste-handling capabilities

## INSTRUCTOR ACTIVITY:

1. Prepare a chart for tabulation of information about the units.
2. Compare composite model plant unit I with the other units.
3. Help the student to collect information for reports on the advantages and disadvantages of each unit.

## STUDENT ACTIVITY:

1. List information about the units on a chart.
2. Compare the units in a panel discussion.
3. Write a report on the advantages and disadvantages of each unit.

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## OBJECTIVE 9.15:

*Name and locate the components of the pond stabilization unit listed on page 75. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.*

## CONDITIONS:

Given a pond stabilization unit, unit components or a diagram, model or photographs of a unit and reference materials, including:

contractor's plans of the pond stabilization unit  
 manufacturer's maintenance guides  
 operation and maintenance manuals

## ACCEPTABLE PERFORMANCE:

The student will:

Name and locate the components of the pond stabilization unit.

Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.



## INSTRUCTOR ACTIVITY:

1. Point out components of the pond stabilization unit on diagrams, photographs or models.
2. Listen to the student naming the components and the applicable reference materials during a plant tour.
3. Name and display the reference materials which describe the pond stabilization unit and normal operation procedures.

## STUDENT ACTIVITY:

1. Name the components which the instructor points out on diagrams, photographs or models.
2. Name the components which the instructor points out during a plant tour and name the reference materials which apply to the components.
3. Name and select the reference materials which describe the pond stabilization unit and normal operation procedures.

<<<<<>>>>>

## OBJECTIVE 9.16:

*Perform the abnormal operation procedures for the pond stabilization unit.*

## CONDITIONS:

Given a wastestream in a treatment plant and reference materials, including:

- industrial waste records
- operation logs
- operator manuals
- plant performance guides

## ACCEPTABLE PERFORMANCE:

The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

alkalinity	nitrate nitrogen
ammonia nitrogen	nitrite nitrogen
BOD	odor
COD	organic and total Kjeldahl
coliforms	nitrogen
color	orthophosphate
DO	pH
floating material	relative stability
flow	septic sewage
foam	settleable matter
ice	short circuiting
industrial wastes	suspended solids
level	temperature



Select the references he needs to return the waste-stream to normal.

Perform the abnormal operation procedures.

INSTRUCTOR ACTIVITY:

1. Observe the student as he evaluates the wastestream in a treatment plant.
2. Describe the references needed to correct abnormal conditions of the wastestream.
3. Observe the student performing the abnormal operation procedures in simulated situations and in a treatment plant.

STUDENT ACTIVITY:

1. Evaluate the wastestream in a treatment plant.
2. Select the references needed to correct abnormal conditions of the wastestream.
3. Perform the abnormal operation procedures in simulated situations or in a treatment plant.

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