Wastewater Treatment Plant Operator Certification Training Instructor Guide

Module 21: Rotating Biological Contactors

This course includes content developed by the Pennsylvania Department of Environmental Protection (Pa. DEP) in cooperation with the following contractors, subcontractors, or grantees:

The Pennsylvania State Association of Township Supervisors (PSATS)
Gannett Fleming, Inc.
Dering Consulting Group
Penn State Harrisburg Environmental Training Center

A Note to the Instructor

Dear Instructor:

The primary purpose of *Module 21: Rotating Biological Contactors* is to provide an overview of the RBC process and its advantages and disadvantages, to highlight general operation and maintenance issues and to review the typical problems encountered when operating a RBC. This module has been designed to be completed in approximately 4 hours, but the actual course length will depend upon content and/or delivery modifications and results of course dry runs performed by the DEP-approved sponsor. The number of contact hours of credit assigned to this course is based upon the contact hours approved under the DEP course approval process. To help you prepare a personal lesson plan, timeframes have been included in the instructor guide at the Unit level and at the Roman numeral level of the topical outline. You may adjust these timeframes as necessary to match course content and delivery modifications made by the sponsor. Please make sure that all teaching points are covered and that the course is delivered as approved by DEP.

Web site URLs and other references are subject to change, and it is the training sponsor's responsibility to keep such references up to date.

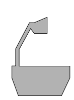
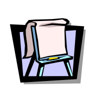
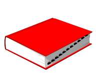
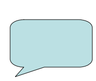
Delivery methods to be used for this course include:

- Lecture
- Quizzes
- Discussion Questions

To present this module, you will need the following materials:

- One workbook per participant
- Extra pencils
- Laptop (loaded with PowerPoint) and an LCD projector **or** overheads of presentation and an overhead projector
- Screen
- Flip Chart
- Markers

Icons to become familiar with include:

Participant Workbook		Instructor Guide	
	Exercise/Activity	Same icons for Participant Workbook apply to the Instructor Guide.	
	Case Study	Ans:	Answer to exercise, case study, discussion, question, etc.
	Discussion Question		PowerPoint Slide
	Calculation(s)		Overhead
	Quiz		Flip Chart
	Key Definition(s)		Suggested "Script"
	Key Point(s)		

Instructor text that is meant to be general instructions for the instructor is designated by being written in script font and enclosed in brackets. For example:

[*Ask participants if they have any questions on how to read the table. Answer any questions participants may have about how to read the table.]*

If your module includes the use of a PowerPoint presentation, below are some helpful controls that you may use within the Slide Show.

PowerPoint Slide Show Controls

You can use the following shortcuts while running your slide show in full-screen mode.

To	**Press**
Advance to the next slide	N, ENTER, or the SPACEBAR (or click the mouse)
Return to the previous slide	P or BACKSPACE
Go to slide <number>	<number>+ENTER
Display a black screen, or return to the slide show from a black screen	B
Display a white screen, or return to the slide show from a white screen	W
Stop or restart an automatic slide show	S
End a slide show	ESC
Return to the first slide	Both mouse buttons for 2 seconds
Change the pointer to a pen	CTRL+P
Change the pen to a pointer	CTRL+A
Hide the pointer and button temporarily	CTRL+H
Hide the pointer and button always	CTRL+L
Display the shortcut menu	SHIFT+F10 (or right-click)
Erase on-screen annotations	E
Go to next hidden slide	H
Set new timings while rehearsing	T
Use original timings while rehearsing	O
Use mouse-click to advance while rehearsing	M

INTRODUCTION OF MODULE: 5 minutes

Display Slide 1—Module 21: Rotating Biological Contactors.

[Welcome participants to "Module 21 – Rotating Biological Contactors." Indicate the primary purpose of this course is to provide an overview of the RBC process and its advantages and disadvantages, to highlight general operation and maintenance issues and to review the typical problems encountered when operating a RBC.]

[Introduce yourself.]

[Provide a brief overview of the module.]

This module contains 3 units. On page i, you will see the topical outline for Unit 1 – General Overview and Unit 2 – General Operation and Maintenance.

[Briefly review outline.]

If you turn the page, you will see the remainder of the outline for Unit 2 and the topical outline for Unit 3 – Typical Operating Problems.

[Continue to briefly review outline.]

UNIT 1: 90 minutes

Display Slide 2 —Unit 1: General Overview.

At the end of this unit, you should be able to:

- Describe the principles of an attached growth biological treatment system and describe how a Rotating Biological Contactor operates.
- Identify the five major components of an RBC and explain their functions.
- Discuss the advantages and disadvantages of using an RBC for wastewater treatment.

Display Slide 3 —Unit 1: General Overview.

The remaining learning objectives for this unit are:

- Describe the concept of staging and how it relates to efficient RBC operation.
- Calculate the treatment removal efficiencies for an RBC.

PROCESS OVERVIEW: 35 minutes

We will begin this unit by reviewing the RBC process.

[Review the information in the workbook.]

Process Description

Review the definition of Rotating Biological Contactor (RBC) in the workbook.

[Review the information in the workbook.]

Display Slide 4—Rotating Biological Contactors.

This slide shows what an RBC looks like.

Physical Description

Now we will review the physical features of RBCs, including the media, the shaft, the drive assembly, the reactor basin and the cover. We will begin with a discussion of the media, including: biological slime growth on the media, rotation of the media, the appearance of the media and sloughing from the media.

Media

Biological Slime Growth

[Review the information in the workbook.]

Rotation of Media

[Review the information in the workbook.]

Appearance of Media

[Review the information in the workbook.]

Sloughing

Review the definition of sloughing in the workbook.

[Review the information in the workbook.]

Display Slide 5—Media Cross Section.

This slide shows a cross section of the media.

Display Slide 6—Media Through the Door of the RBC Cover.

This slide shows what the media looks like through the door of the RBC cover.

.

Shaft

The next part of the RBC we will discuss is the shaft.

[Review the information in the workbook.]

Display Slide 7—The Shaft.

In this slide of a RBC, you can see that the shaft has been clearly identified.

Drive Assembly

Next we will talk about the drive assembly.

[Review the information in the workbook.]

[Review the remaining information in the workbook.]

Reactor Basin

So far we have reviewed the media, the shaft and the drive assembly. Now let's talk about the reactor basin.

[Review the information in the workbook.]

Cover

The final part of the RBC we will discuss is the cover.

[Review the information in the workbook.]

Display Slide 8—An RBC Cover.

This slide shows an example of an RBC cover.

ADVANTAGES: <u>10 minutes</u>

We have completed our review of the RBC process and the physical aspects of the RBC. In this next section, we are going to review some of the advantages of RBCs.

[Review the information in the workbook.]

Review the definition of ponding in the workbook.

[Review the information in the workbook.]

DISADVANTAGES: 10 minutes

Since we have discussed some of the advantages of RBCs, we must also highlight a few of the disadvantages. Let's begin with the lack of flexibility.

Lack of Flexibility

[Review the information in the workbook.]

Sensitivity to Industrial Wastes

Another disadvantage is sensitivity to industrial wastes.

[Review the information in the workbook.]

Possible Low Dissolved Oxygen

A third disadvantage is possible low dissolved oxygen.

[Review the information in the workbook.]

DESIGN AND PERFORMANCE OVERVIEW: 35 minutes

In this final section of the unit, we are going to talk about the design and performance of RBCs. First we will begin by discussing the orientation of the RBCs.

Orientation

[Review the information in the workbook.]

Review the definition of series in the workbook.

Display Slide 9—Series Orientation of Tanks.

This slide shows how the cells are arranged in a series orientation. As you can see, each tank directly follows the next. Now let's take a look at parallel orientation.

Review the definition of parallel in the workbook.

Display Slide 10—Parallel Orientation of Tanks.

This slide shows how the cells are arranged in a parallel orientation. As you can see, the tanks operate side by side.

[Review the information in the workbook.]

Staging

Now that we have discussed orientation, let's turn our attention to staging.

[Review the information in the workbook.]

Display Slide 11—Four Stages with One Shaft and Flow Parallel to the Shaft.

As we just discussed, each stage of the RBC process can share a common shaft. This is represented in this slide.

Display Slide 12—Four Stages with Four Shafts and Flow Parallel to the Shaft.

This slide shows four stages that run with independent shafts. In this slide, the flow is parallel to the shaft.

Display Slide 13—Four Stages with Four Shafts and Flow Perpendicular to the Shaft.

This slide shows four stages, each of which runs with independent shafts as in the previous slide. The difference is that in this slide, the flow is perpendicular to the shaft.

Typical Treatment Efficiencies

Now that we have talked about the orientation and staging of an RBC, let's spend some time talking about typical treatment efficiencies. Specifically, we will talk about biochemical oxygen demand, total suspended solids and ammonia nitrogen. We will begin with biochemical oxygen demand.

Biochemical Oxygen Demand (BOD)

Review the definition of biochemical oxygen demand in the workbook.

[Review the information in the workbook.]

Total Suspended Solids (TSS)

The next treatment efficiency we will review is total suspended solids, or, TSS.

Review the definitions listed in the workbook.

[Review the information in the workbook.]

Ammonia Nitrogen (NH_3-N)

The final removal efficiency we will discuss is ammonia nitrogen.

Review the definition of ammonia nitrogren in the workbook.

[Review the information in the workbook.]

Percent Removal Calculations

Our final topic of this unit will focus on performing percent removal calculations.

[Review the information in the workbook.]

Review the definition of percent removal calculation in the workbook.

Example

Let's look at an example of how the percent removal calculation is used.

[Review the Example in the workbook.]

Now it's time for you to try a calculation on your own. Complete the exercise on page 1-14 of your workbook and then we will review the answer.

[Have the participants review the Key Points for Unit 1 – General Overview.]

☑ Exercise for Unit 1 – General Overview

1. Given the following information, calculate the percent removal:
Influent Total Suspended Solids = 200 mg/L
Effluent Total Suspended Solids = 19 mg/L.

Ans: $$\text{Percent Removal (\%)} = \frac{\text{(Influent Concentration, mg/L)} - \text{(Effluent Concentration, mg/L)}}{\text{(Influent Concentration, mg/L)}} \times 100$$

$$\text{Percent Removal (\%)} = \frac{(200\text{ mg/L}) - (19\text{ mg/L})}{200\text{ mg/L}} \times 100$$

Percent Removal (%) = 90.5%

2. The two types of RBC drive mechanisms are _mechanical_ and _air_ drives.

3. In a SBR, the drum rotates at approximately _1.5_ RPM and about _40_ % of the media surface is immersed in the wastewater.

4. _Loping_ is the term used to describe uneven shaft rotation.

5. RBCs are typically designed to reduce total BOD to about _15_ to _30_ mg/L.

[Point out that resources are listed on this page.]

We have completed the first unit of this module. Are there any questions about the material we have covered before we move on to unit 2?

UNIT 2: 110 minutes

Display Slide 14 —Unit 2: General Operation and Maintenance.

At the end of this unit, you should be able to:

- List the three types of general factors affecting RBC operation and list two examples of each.
- Calculate the organic loading rate of an RBC.
- Discuss the cause and significance of *Beggiattoa* as it relates to the RBC media biomass.

Display Slide 15 —Unit 2: General Operation and Maintenance.

The remaining learning objectives for this unit are:

- Describe how media rotation speed and media imbalance affects RBC operation.
- Explain the importance of evaluating analysis results for efficient RBC operation.

FACTORS AFFECTING PERFORMANCE: 60 minutes

In unit 1, we completed a general overview of RBCs. In this unit, we will talk about general operation and maintenance. We will begin by reviewing the different types of factors that affect RBC performance.

[Review the information in the workbook.]

Physical Factors

One physical factor that affects RBC performance is hydraulic loading. Let's talk about that in more depth.

Hydraulic Loading

Review the definition of hydraulic loading in the workbook.

[Review the information in the workbook.]

Example

Let's look at an example of how hydraulic loading is calculated.

Use flipchart to work through Example in the workbook.

Now it's time for you to do a calculation on your own. Take a few minutes to perform the calculation in your workbook and then we will review the answer.

Calculation

1. Calculate the hydraulic loading of a RBC system with the following data:

8 Stage Systems
RBC Width (Per Stage) = 50 ft
RBC Length (Per Stage) = 200 ft
Influent Flow = 0.275 mgd

Ans:

$$\text{Hydraulic Loading (gpd/ft}^2\text{)} = \frac{\text{Influent Flow, gpd}}{\text{(\# of stages) (area per stage, ft}^2\text{)}}$$

$$\text{Hydraulic Loading} = \frac{(275{,}000 \text{ gpd})}{(8)\ (50 \text{ feet})\ (200 \text{ feet})}$$

$$\text{Hydraulic Loading} = 3.4 \text{ gpd/ft}^2$$

Detention Time

Another physical factor affecting RBC performance is detention time.

[Review the information in the workbook.]

[Review the remaining information in the workbook.]

Let's look at an example of how detention time is calculated.

Example

Use flipchart to work through Example in the workbook.

Now it's time for you to do a calculation on your own. Take a few minutes to perform the calculation in your workbook and then we will review the answer.

Calculation

1. What is the detention time of a 7,250,000 gallon RBC basin with an influent flow rate of 110,000 gallons per day?

Ans:

$$\text{Detention Time (days)} = \frac{\text{Basin Volume (gallons)}}{\text{Influent Flow (gallons/day)}}$$

$$\text{Detention Time (days)} = \frac{7{,}250{,}000 \text{ gallons}}{110{,}000 \text{ gallons/day}}$$

$$\text{Detention Time (days)} = 65.9 \text{ days}$$

Review the definition of short circuiting in the workbook.

Temperature

The third physical factor affecting RBC performance is temperature.

[Review the information in the workbook.]

[Review the remaining information in the workbook.]

Biochemical Factors

We have just finished reviewing several physical factors that affect RBC performance. Now we will talk about some of the biochemical factors that affect performance. We will begin with organic loading.

Organic Loading

[Review the information in the workbook.]

Example

Let's look at an example of how organic loading is calculated.

Use flipchart to work through Example in the workbook.

Now it's time for you to do a calculation on your own. Take a few minutes to perform the calculation in your workbook and then we will review the answer.

Calculation

1. Calculate the organic loading of a RBC with the following data:

Media Surface Area = 108,000 ft^2
Influent Flow = 100,000 gpd
Influent BOD = 325 mg/L

Ans: $$\text{Organic Load (lb BOD/day/1,000 ft}^2) = \frac{\text{(BOD, mg/L) x (Flow, mgd) x (8.34 lb/gallon)}}{\text{(Area, ft}^2)}$$

$$\text{Organic Load} = \frac{\text{(325 mg/L) x (0.100 mgd) x (8.34 lb/gallon) x (1,000)}}{\text{(108,000 ft}^2)}$$

Organic Load = 2.5 lb BOD/day/1,000 ft^2

pH

pH is the next biochemical factor we will review.

[Review the information in the workbook.]

Dissolved Oxygen

The next biochemical factor we will discuss is dissolved oxygen.

[Review the information in the workbook.]

Means of Increasing DO Levels

Let's take a look at some ways DO levels can be increased.

[Review the information in the workbook.]

Alkalinity

The last biochemical factor that affects RBC performance that we will discuss is alkalinity.

[Review the information in the workbook.]

Aerobic Processes Decrease Alkalinity

[Review the information in the workbook.]

Anaerobic Processes Increase Alkalinity

[Review the information in the workbook.]

Microbiological Factors

So far we have discussed physical factors and biochemical factors that affect RBC performance. The last factor we will discuss is microbiological factors that affect performance. Microbiological factors include bacteria, microorganisms and crustaceans.

[Review the information in the workbook.]

Bacteria

Let's start by learning about bacteria.

[Review the information in the workbook.]

[Review the remaining information in the workbook.]

Display Slide 16 —Bacterial Colonies.

This slide shows what bacterial colonies may look like. On the left, you can see that the bacteria are cylindrical in shape while the bacteria on the right are spherical. Now let's talk about the two different types of bacteria: aerobic and anaerobic.

Aerobic Bacteria

[Review the information in the workbook.]

Anaerobic Bacteria

[Review the information in the workbook.]

Microorganisms

Now that we have completed our discussion of bacteria, we are going to move on and talk about microorganisms.

[Review the information in the workbook.]

Protozoa

Let's explore protozoa further.

[Review the information in the workbook.]

Flagellates

[Review the information in the workbook.]

Display Slide 17 —Flagellates.

This slide shows some examples of flagellates. As you can see from both of these pictures, the microorganisms have long hair-like threads which enable them to be mobile.

Ciliates

Now let's learn a little more about ciliates.

[Review the information in the workbook.]

Display Slide 18 —A Ciliate.

This slide is an example of a free-swimming ciliate. In this example, the microorganism is surrounded by cilia, which it uses for mobility.

Display Slide 19 —A Ciliate.

This slide is an example of a stalked ciliate.

Rotifers

The next microorganism we will talk about is rotifers.

[Review the information in the workbook.]

Display Slide 20 —A Rotifer.

This slide is an example of a rotifer. As you can see, the head of the organism is covered with cilia.

Crustaceans

The last type of microorganism we need to review is the crustacean.

[Review the information in the workbook.]

Display Slide 21 —A Crustacean.

This slide is an example of a crustacean. As you can see, it is covered in a shell and has appendages for swimming.

EQUIPMENT DESCRIPTION, MAINTENANCE AND SAFETY: 25 minutes

In this next section of the unit, we are going to talk about the equipment and some of its maintenance and safety issues.

[Review the information in the workbook.]

Media

The media is the first equipment component we will discuss.

Description

[Review the information in the workbook.]

Maintenance

[Review the information in the workbook.]

Safety

[Review the information in the workbook.]

Shaft

The shaft is the next part of the RBC we will review.

Description

[Review the information in the workbook.]

Maintenance

[Review the information in the workbook.]

Safety

[Review the information in the workbook.]

Drive Assembly

Next we will review the drive assembly.

Description

[Review the information in the workbook.]

Maintenance

[Review the information in the workbook.]

Safety

[Review the information in the workbook.]

Reactor Basin

Now let's talk about the reactor basin.

Description

[Review the information in the workbook.]

Maintenance

[Review the information in the workbook.]

Safety

[Review the information in the workbook.]

Orifice/Weir

Let's talk about the orifice/weir.

Description

[Review the information in the workbook.]

Maintenance

[Review the information in the workbook.]

Safety

[Review the information in the workbook.]

Lines and Valves

The last components we will review are the lines and valves. We will talk about the inlet structure and the outlet structure.

Inlet Structure

[Review the information in the workbook.]

Outlet Structure

[Review the information in the workbook.]

ANALYTICAL RESULTS: 25 minutes

In this last section of the unit, we will discuss analytical results and the role they play in ensuring efficient RBC operation. We will talk about sampling and testing considerations, suggested testing parameters, recordkeeping and the uses of data.

Sampling and Testing Considerations

[Review the information in the workbook.]

Suggested Testing Parameters

Now let's take a look at a few suggested testing parameters.

[Review the information in the workbook.]

Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS)

Let's begin with BOD and TSS.

[Review the information in the workbook.]

pH

Another testing parameter is pH.

[Review the information in the workbook.]

Dissolved Oxygen (DO)

In addition to BOD, TSS and pH, DO is another testing parameter.

[Review the information in the workbook.]

Ammonia Nitrogen (NH_3-N)

The final testing parameter we will review is ammonia nitrogen.

[Review the information in the workbook.]

Recordkeeping

Now that we have finished discussing testing parameters, let's review some recordkeeping requirements.

[Review the information in the workbook and then add the following:]

It is impossible to remember every thing that happens about a plant so proper recordkeeping goes beyond just having sufficient information to satisfy the regulatory requirements.

Uses of Data

Now we will talk about how data can be used, beginning with process loading rates.

Process Loading Rates

[Review the first bullet item and then add the following:]

It is necessary to know if you are within design limits for an RBC.

[Review the second bullet item and then add the following:]

This will allow the operator to determine if upstream processes, such as a primary clarifier, are operating properly.

Treatment Efficiency

Data is also used to monitor and maintain treatment efficiency.

[Review the information in the workbook.]

Graphing

Data is also used for graphing purposes.

[Review the first bullet item.]

Display Slide 22 —An Example of a Graph.

This slide shows how a graph can be used to detect trends. At this particular plant, the influent BOD averages approximately 150 mg/L with a maximum monthly average of 250 mg/L (September to November). TTSS appears to average approximately 110 mg/L per month with a maximum month average of 140 mg/L in September. This graph shows that there is a nice correlation between BOD and TSS concentrations.

[Review the second bullet item and then add the following:]

Putting data into a spreadsheet such as Lotus or Excel will allow for quick graphing.

Display Slide 23 —An Example of a Graph.

The graph on this slide is an example of how a graph can show unusual results. The historic influent BOD average appears to be around 150 mg/L but in September, the BOD averaged around 275 mg/L. There are several explanations for this. The wastewater collection system lines could have been flushed, thereby sending excessive BOD and TSS to the plant, or, an industrial user in the system could have discharged high concentration wastewater. Additionally, the TSS concentration was higher than the BOD concentration for this month, indicating excessive grit or non-organic solids to the plant.

[Review the third bullet item and then add the following:]

As an example, if one or more years are plotted, maybe able to predict when efficiency may decrease. At this point, we have now completed the second unit of this module. Are there any questions I can answer before we move on to the third and final unit?

[Have the participants review the Key Points for Unit 2 – General Operation and Maintenance.]

Exercise for Unit 2 – General Operation and Maintenance

1. The length of detention time is a critical factor in determining which processes such as BOD and nitrification will occur in a RBC.
   a. True b. False

2. The highest removal efficiencies in an RBC will occur in:
   a. cold weather
   b. warm weather
   c. temperature has no effect
   d. none of the above

3. When oxygen is not available, anaerobic bacteria can use nitrate (NO_3) or sulfate (SO_4) as alternative oxygen sources.
   a. True False

4. Bacteria in SBRs are generally grouped in two broad categories called _aerobic_ which require DO and _anaerobic_ which do not require DO for respiration.

5. List the six main RBC structures that were discussed in this unit:
   a. media
   b. shaft
   c. reactor basin
   d. drive assembly system
   e. orifice / weir
   f. lines, valves and underdrains

6. In addition to testing required by your NPDES Permit, it may be important to periodically test for other parameters. Give two examples of additional test, how often they should be sampled and where the sample should be obtained (such as influent, primary clarifier, effluent, etc...)

   Answers may vary:

   BOD, CBOD and TSS once per week influent, primary effluent and final effluent.

   Test pH daily on plant influent and final effluent.

   Test DO daily on final effluent.

   Ammonia Nitrogen (NH_3-N) can be tested weekly or daily on influent and final effluent even if your NPDES Permit does not require it. This testing will provide a baseline in case action is needed in the future.

[Point out that resources are listed on this page.]

UNIT 3: 40 minutes

Display Slide 24 —Unit 3: Typical Operating Problems.

At the end of this unit, you should be able to:

- Identify four potential causes of poor quality effluent in an RBC.
- Discuss the causes of excessive biomass sloughing and how it contributes to poor quality effluent.
- Discuss the laboratory testing used to investigate a possible organic overload.

Display Slide 25 —Unit 3: Typical Operating Problems.

The remaining learning objectives for this unit are:

- Explain the consequences of cold weather operation on an RBC.
- Describe how the appearance of the media can indicate potential operational problems.

POOR EFFLUENT QUALITY: 15 minutes

In unit 1, we completed a general overview of RBCs. In unit 2, we talked about general operation and maintenance. In this final unit, we will review typical operating problems you may encounter with RBCs. Specifically, we will talk about problems associated with poor effluent quality, problems associated with excessive sloughing, problems associated with odors and problems associated with equipment malfunction. Let's begin by taking a look at the problems associated with poor effluent quality, things to monitor and possible solutions to these problems.

Problems and Solutions Associated with Poor Effluent Quality

Typical problems associated with poor effluent quality include low temperatures, organic overload, hydraulic overload, short circuiting and toxic influent material. Let's discuss each of these in more depth.

[Review the information in the table in the workbook.]

[Continue to review the table in the workbook.]

EXCESSIVE SLOUGHING: 10 minutes

Next we will discuss problems associated with excessive sloughing. Typical problems include toxic influent, excessive pH variations and unusual variation in flow and/or organic loading. Let's spend a few minutes reviewing these in more detail.

Problems and Solutions Associated with Excessive Sloughing

[Review the information in the table in the workbook.]

ODORS: 5 minutes

Now we will turn our attention to problems associated with odors. These problems include anaerobic conditions and short circuiting.

Problems and Solutions Associated with Odors

[Review the information in the table in the workbook.]

EQUIPMENT MALFUNCTION: 10 minutes

Our final group of problems is those associated with equipment malfunction. Equipment malfunctions can occur because of excessive snail shells, shaft malfunctions and motor malfunctions.

Problems and Solutions Associated with Equipment Malfunction

[Review the information in the table in the workbook.]

[Have the participants review the Key Points for Unit 3 – Typical Operating Problems.]

Now that we have completed our discussion of the typical operating problems associated with RBCs, take a few minutes to complete the exercise on page 3-8 of your workbook. After you have completed the exercise, we will review the answers.

Exercise

1. List three problems associated with poor effluent quality and the solution(s) for each.

Ans: Low Temperatures – Cover RBC units to conserve heat.

Organic Overload – Install equalization tanks; place added treatment units in service; install supplemental aeration equipment; recirculate secondary clarifier effluent.

Hydraulic Overload – Install equalization tanks.

Short Circuiting – Install manifolds; provide multiple inlets and outlets; change location of inlets and outlets; keep inlets and outlets as far apart as possible; eliminate dead zones.

Toxic Influent Material – Sample the collection system; develop and implement sewer use ordinances; install equalization tanks; install supplemental aeration equipment; recirculate secondary clarifier effluent.

2. Under what conditions can pH increase sloughing?

Ans: If pH values are below 5 s.u. or above 10 s.u.

3. Explain how anaerobic conditions cause odor problems.

Ans: Influent wastewater containing toxic or inhibitory substances will stress the microorganisms on the media. The microbiological growth could even be completely killed off if the toxicity is severe.

4. Explain how the problem of excessive snail shells can be resolved.

Ans: Ensure adequate mixing in all basins to minimize the snail shell deposits; kill the snails via chlorination; increase the pH to 10 s.u. for a brief period to kill snails.

We have now completed the entire RBC module. Are there any questions regarding any of the information we have discussed today?