# Module 21:
# Rotating Biological Contactors
# Answer Key

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

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.

6. A Rotating Biolgoical Contactor (RBC) is a **secondary** **biological** treatment process which utilizes a rotating shaft surrounded by plastic media discs.

7. RBCs utilize a fixed film media system similar to a **trickling filter.**

8. **Sloughing** is the term used to refer to the process in which excess microbial growth separates from the media and is washed to the secondary clarifiers with the treated wastewater

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

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

Hydraulic Loading = **3.4 gpd/ft²**

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

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

Detention Time (days) = **65.9 days**

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**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:** Organic Load (lb BOD/day/1,000 $ft^2$) = (BOD, mg/L) x (Flow, mgd) x (8.34 lb/gallon)

(Area, $ft^2$)

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

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

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**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. Increased influent flows lead to **increased** hydraulic loading which **decreases** detention time.

3. 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

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

5. Bacteria in SBRs are generally grouped in two broad categories called _**aerobic**_ which require DO and _**anaerobic**_ which do not require DO for respiration.

6. 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**

7. In addition to testing required by your NPDES Permit, it may be important to periodically test for other parameters. Give two examples of additional tests, 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.**

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**Exercise for Unit 3 – Typical Operating Problems**

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

**Low temperatures, organic overload, hydraulic overload, short circuiting and toxic influent material are all problems associated with poor effluent quality. Please see pages 3-2 and 3-3 for the things to monitor and possible solutions for each.**

2. Under what conditions can pH increase sloughing?

**pH values below 5 s.u. or above 10 s.u. can cause increased sloughing. The influent pH should be monitored. If the problem persists, you may want to sample the collection system to identify the cause or source of the variations; develop and implement sewer-use ordinances to prohibit or limit substance discharges and fines if the discharges occur; if pH is too low, add sodium bicarbonate or lime. If the pH is too high, add acetic acid.**

3. Explain how anaerobic conditions cause odor problems.

**Influent wastewater containing toxic or inhibitory substances will stress the microorganisms on the media. The microbial growth may even be completely killed off if the toxicity is severe. Things to monitor are DO levels, the appearance of the growth will turn white in color and the wastewater temperature may be elevated. See page 3-5 for the possible solutions.**

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

**Make sure there is adequate mixing in all basins to minimize snail shell deposits, chlorinate to kill the snails or increase the pH to 10 s.u. *briefly* to kill snails without harming the microbial growth.**