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 (%) = $\frac{\text{(Influent Concentration, mg/L) – (Effluent Concentration, mg/L)}}{\text{(Influent Concentration, mg/L)}} \times 100$

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

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.

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

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

Hydraulic Loading = 3.4 gpd/ft^2

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

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

Detention Time (days) = 65.9 days

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) = $\frac{\text{(BOD, mg/L) x (Flow, mgd) x (8.34 lb/gallon)}}{\text{(Area, ft}^2\text{)}}$

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

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

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.

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.