



**QUESTION WAY**  
**ANSWER ST**  
**Roy Pelletier**

## Test Your Knowledge of Various Wastewater Treatment Topics

- Given the following data, what is the solids loading rate on this secondary clarifier?
  - Plant influent flow is 5.5 mgd
  - The return activated sludge (RAS) rate is 50 percent of Q
  - There is one 100-ft diameter secondary clarifier
  - The aeration mixed liquor suspended solids (MLSS) is 2,200 mg/L

a. 19.3 lbs/day/ft<sup>2</sup>      b. 8.6 lbs/day/ft<sup>2</sup>  
c. 28.9 lbs/day/ft<sup>2</sup>      d. 15.5 lbs/day/ft<sup>2</sup>
- Which is the highest life form in the activated sludge process: a free swimming ciliate, a stalked ciliate, or a rotifer?
  - a. Free swimming ciliate
  - b. Stalked ciliate
  - c. Rotifer
  - d. They are all the same.
- What is the best definition of a shock load?
  - a. An unexpected bump.
  - b. A strong influent waste strength.
  - c. A high concentration of total suspended solids (TSS).
  - d. A heavy truck load entering the plant.
- Which condition may produce the worst denitrification efficiency in an aeration tank?
  - a. Low air supply
  - b. High aeration dissolved oxygen
  - c. Low aeration dissolved oxygen
  - d. Low solids retention time (SRT)
- Which activated sludge growth phase is considered to have the lowest food-to-microorganism (F/M) ratio, the highest SRT, the lowest sludge yield, and the worst oxygen utilization efficiency?
  - a. High rate aeration
  - b. Extended aeration
  - c. Conventional aeration
  - d. Declining growth
- Which group of bacteria is responsible for conversion of inorganic ammonia in wastewater?
  - a. Carbon eaters
  - b. Methanogens
  - c. Autotrophic
  - d. Heterotrophic
- Which two age parameters are most similar to each other?
  - a. Gould sludge age (GSA) and F/M ratio
  - b. SRT and mean cell residence time (MCRT)
  - c. SRT and GSA
  - d. GSA and MCRT
- Which group of bacteria is most responsible for removal of phosphorus in the biological nutrient removal (BNR) activated sludge process?
  - a. Sludge volume index (SVI)
  - b. GSA
  - c. Autotrophic
  - d. Phosphorus-accumulating organism (PAO)
- How much alkalinity is required to convert 1 lb of ammonia-nitrogen during the nitrification process?
  - a. 7.14 lbs
  - b. 8.34 lbs
  - c. 7.48 lbs
  - d. 4.57 lbs
- What will organic material do in a muffle furnace?
  - a. It will burn.
  - b. It will not burn.
  - c. It will change to inorganic material.
  - d. It will convert to dissolved solids.

Answers on page 62

### SEND US YOUR QUESTIONS

Readers are welcome to submit questions or exercises on water or wastewater treatment plant operations for publication in Certification Boulevard. Send your question (with the answer) or your exercise (with the solution) by email to [roy.pelletier@cityoforlando.net](mailto:roy.pelletier@cityoforlando.net), or by mail to:

**Roy Pelletier**  
Wastewater Project Consultant  
City of Orlando  
Public Works Department  
Environmental Services  
Wastewater Division  
5100 L.B. McLeod Road  
Orlando, FL 32811  
407-716-2971

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## Certification Boulevard Answer Key

### From page 11

1. **A) 19.3 lbs/day/ft<sup>2</sup>**

*Formula*

Solids loading rate, lbs/day/ft<sup>2</sup>

= Total lbs/day entering the secondary clarifier ÷ clarifier surface area, ft<sup>2</sup>

Total lbs/day entering the secondary clarifier

= Total flow entering the clarifier, mgd x MLSS, mg/L x 8.34 lbs/gal

= (5.5 mgd x 1.5) x 2,200 mg/L x 8.34 lbs/gal

= 8.25 mgd x 2,200 mg/L x 8.34 lbs/gal

= 151,371 lbs/day

Clarifier surface area =  $\pi r^2$

3.14 x (50 ft x 50 ft)

= 7,850 ft<sup>2</sup>

151,371 lbs/day ÷ 7,850 ft<sup>2</sup>

= 19.28 lbs/day/ft<sup>2</sup>

2. **C) Rotifer**

Beginning with the lowest life form, the microorganism indicators are amoebas, small flagellates, large flagellates, free swimming ciliates, stalk ciliates, rotifers, nematodes (worms), and water bears. So, of the three indicators listed in the question, the rotifer is the highest life form in the activated sludge process.

3. **B) A strong influent waste strength.**

The term "loading" refers to the demand for oxygen placed on the activated sludge process from the flow being treated. A shock load is a high

demand for oxygen from carbonaceous biochemical oxygen demand (CBOD<sub>5</sub>), chemical oxygen demand (COD), or nitrogen placed on the activated sludge process in a short period of time.

4. **B) High aeration dissolved oxygen.**

Because denitrification is an anoxic reaction, high dissolved oxygen levels in the aeration tank will typically reduce denitrification efficiency.

5. **B) Extended aeration**

In regard to the growth curve of microorganisms, the far right side of the curve has low food availability, slow bug growth, low yield of new cells, high solids inventory, and poor oxygen utilization transfer efficiency. This translates to low F/M ratio, high SRT, low sludge yield, and increased lbs of oxygen required per lb of CBOD<sub>5</sub> destroyed. This extended aeration growth rate is also called "endogenous respiration."

6. **C) Autotrophic**

There are two main groups of autotrophic bacteria that are responsible for the conversion of inorganic ammonia to nitrate. The first group, nitrosomonas, known as ammonia-oxidizing bacteria, convert ammonia to nitrite. The second group, nitrobacter, known as nitrite-oxidizing bacteria, convert nitrite to nitrate. The process of nitrification does not necessarily remove nitrogen from the wastewater; it only converts it to a more stable form.

7. **B) SRT and MCRT**

The SRT and MCRT have similar concepts: lbs of solids in the activated sludge system divided by the

lbs per day of solids LEAVING the process. Typically, SRT is based on total solids, and MCRT is based on volatile solids. The GSA, however, is the lbs of solids in the activated sludge process divided by the lbs per day of solids ENTERING the aeration system.

8. **D) Phosphorus accumulating organism (PAO)**

A PAO, or phosphorus accumulating organism, is responsible for the uptake and removal of phosphorus from the wastewater in a biological nutrient removal (BNR) activated sludge process.

9. **A) 7.14 lbs**

Nitrification consumes alkalinity at the rate of about 7.1 to 7.2 lbs of alkalinity for each lb of ammonia oxidized. Because this action causes the mixed liquor pH to drop, biological denitrification is desirable, which replenishes the alkalinity at a rate of about 3.6 lbs of alkalinity for each lb of nitrate that is consumed as a source of oxygen. The action of denitrification helps to stabilize the MLSS pH in a range acceptable to the nitrifying bacteria.

10. **A) It will burn.**

Organic material, and other volatile matter, will typically burn in a muffle furnace at temperatures of about 550°C. However, just because something burns in a muffle furnace does not necessarily mean that it is biological in nature. For example, a polyvinyl chloride (PVC) pipe shaved into a sample will burn in a muffle furnace; the PVC, however, is neither biology, nor food for the biology.