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Test Your Knowledge of Various Wastewater Treatment Topics

1. Which type of solid is typically the highest percentage in the total solids profile of raw wastewater?

   a. Suspended
   b. Dissolved
   c. Colloidal
   d. Settleable

2. Given the following data, what is the solids loading rate on the secondary clarifiers?
   - Plant influent flow is 14.0 mgd
   - The return activated sludge (RAS) rate is 55 percent of Q
   - There are two 120-ft diameter secondary clarifiers
   - The aeration mixed liquor suspended solids (MLSS) is 3,450 mg/L

   a. 27.6 lbs/day/ft^2
   b. 8.6 lbs/day/ft^2
   c. 18.9 lbs/day/ft^2
   d. 35.5 lbs/day/ft^2

3. Which is the lowest 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.

4. Which condition may produce the best denitrification efficiency in an aeration tank?

   a. High air supply
   b. High aeration dissolved oxygen (DO)
   c. Low aeration DO
   d. Low MLSS

5. Which activated sludge growth phase is considered to have the highest food-to-microorganisms (F/M) ratio, the lowest solids retention time (SRT), the highest sludge yield, and the best oxygen utilization efficiency?

   a. High-rate aeration
   b. Extended aeration
   c. Conventional aeration
   d. Declining growth

6. What is the term when ammonia-N and organic-N are added together?

   a. Total Kjeldahl Nitrogen (TKN)
   b. Soluble organic nitrogen (SON)
   c. Total nitrogen (TN)
   d. Combination of NO2 and NO3 (nitrite and nitrate): NOx

7. 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

8. 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 organisms (PAO)

9. How much alkalinity is required to convert 1 lb of ammonia-nitrogen during the nitrification process?

   a. 7.2 lbs
   b. 8.34 lbs
   c. 7.48 lbs
   d. 4.6 lbs

10. 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 51

LOOKING FOR ANSWERS?

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Certification Boulevard Answer Key

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1. **B) Dissolved**
Typically, the dissolved solids fraction is about 80 percent of the overall total solids concentration.

2. **A) 27.6 lbs/day/ft²**
Formula
Total lbs/day entering the secondary clarifier ÷ total clarifier surface area

624,374 lbs/day ÷ 22,608 ft² = 27.6 lbs/day/ft²

Total lbs/day entering the secondary clarifier =
(14.0 mgd + 7.7 mgd) x 3,450 mg/L x 8.34 lbs/gal = 624,374 lbs/day

Clarifier surface area = 3.14 x (60 ft x 60 ft) = 11,304 ft² x 2 clarifiers = 22,608 ft²

3. **A) Free swimming ciliate**
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 free swimming ciliate is the lowest life form in the activated sludge process.

4. **C) Low aeration DO**
Because denitrification is an anoxic reaction, low dissolved oxygen levels in the aeration tank will typically improve denitrification efficiency.

5. **A) High-rate aeration**
In regard to the growth curve of microorganisms, the far left side of the curve has high food availability, fast bug growth, high yield of new cells, low solids inventory, and excellent oxygen utilization transfer efficiency. This translates to high F/M ratio, low SRT, high sludge yield, and lowest pounds of oxygen required per pound of CBOD5 destroyed. This high rate aeration growth rate is also called "log growth."

6. **A) TKN**
TKN (Total Kjeldahl Nitrogen) is the combination of ammonia-nitrogen and organic-nitrogen. Typically, the majority of TKN of domestic raw wastewater is in the ammonia form.

7. **B) SRT and MCRT**
The SRT and MCRT have similar concepts: pounds of solids in the activated sludge system divided by the pounds per day of solids LEAVING the process. Typically, SRT is based on total solids, and MCRT is based on volatile solids. Gould Sludge Age (GSA), however, is the pounds of solids in the activated sludge process divided by the pounds per day of solids ENTERING the aeration system.

8. **D) PAO**
PAO, or phosphorus-accumulating organisms, are responsible for the uptake and removal of phosphorus from the wastewater in a BNR activated sludge process.

9. **A) 7.2 lbs**
Nitrification consumes alkalinity at the rate of about 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 550oC. However, just because something burns in a muffle furnace does not necessarily mean that it is biological in nature. For example, a PVC pipe shaved into a sample will burn in a muffle furnace; the PVC, however, is neither biology, nor food for the biology.