Certification Boulevard

Test Your Knowledge of Wastewater Treatment Topics

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1. Which zone of a biological nutrient removal (BNR) plant enhances a release of phosphorus and is responsible for conditioning the phosphorus for later uptake in the downstream zones?

   A. Anoxic
   B. Fermentation
   C. Aerobic
   D. Reaeration

2. How much alkalinity is required to convert 1.0 lb of ammonia-nitrogen during the nitrification process?

   A. 7.2 lbs
   B. 8.34 lbs
   C. 7.48 lbs
   D. 4.6 lbs

3. Which major reaction is most likely to occur in an anoxic zone of a BNR process?

   A. Nitrification
   B. Phosphorus uptake
   C. Denitrification
   D. Reaeration

4. Which laboratory test requires the use of an analytical balance, a drying oven, filter papers, a muffle furnace, and a desiccator?

   A. Volatile suspended solids
   B. Total solids
   C. Biochemical Oxygen Demand (BOD_5)
   D. Settleable solids

5. Given the following data, what is the solids loading rate on the secondary clarifiers?
   - Plant influent flow is 15 million gallons per day (mgd)
   - Return activated sludge (RAS) rate is 85 percent of Q
   - Three (3) 120-ft diameter secondary clarifiers
   - Aeration mixed liquor suspended solids (MLSS) is 2,500 mg/L

   A. 13.8 lbs/day/ft^2
   B. 17.1 lbs/day/ft^2
   C. 25.6 lbs/day/ft^2
   D. 51.2 lbs/day/ft^2

6. Match the closest oxygen demand values, in lbs of O_2 for each pound oxidized or converted, for the following compounds:

   - **Carbonaceous Biochemical Oxygen Demand ($CBOD_5$)**

   A. 0.1 to 0.5
   B. 0.8 to 1.4
   C. 4.0 to 5.0
   D. 5.0 to 10.0

   - **Ammonia (NH_3)**

   A. 0.1 to 0.5
   B. 0.8 to 1.4
   C. 4.0 to 5.0
   D. 5.0 to 10.0

7. 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.
   D. A heavy truck load entering the plant.

8. What is the moisture content of a sludge sample that measures 5.25 percent total solids?

   A. 5.25 percent
   B. 19 percent
   C. 0.05 percent
   D. 94.75 percent

9. What two laboratory analyses are necessary to calculate the food to mass (F/M) ratio?

   A. Aeration mixed liquor volatile suspended solids (MLVSS) and influent $CBOD_5$
   B. Aeration MLSS and oxygen uptake rate (OUR)
   C. Aeration MLVSS and effluent $CBOD_5$
   D. Aeration MLSS and influent $CBOD_5$

10. Which type of bacteria in the activated sludge process is responsible for conversion of inorganic ammonia in wastewater?

    A. Carbon eater
    B. Methanogen
    C. Autotrophic
    D. Heterotrophic

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Certification Boulevard Answer Key

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1. **B. Fermentation**

The fermentation zone of a bardenpho process receives raw wastewater (usually after preliminary treatment) and returns activated sludge (from secondary clarifiers). The MLSS is mixed and not aerated in the fermentation zone for a time period of about one to three hours. This zone, absent of all sources of oxygen, basically activates a group of phosphorus accumulating organisms (PAO), which trade phosphorus for $CBOD_5$. These bugs release phosphorus from their cells and "grab onto" food for later decomposition. A successful fermentation zone will have phosphorus levels in the outlet about two to four times higher than the inlet to the tank.

2. **A. 7.2 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.

3. **C. Denitrification**

Denitrification is an anoxic reaction and will typically be accomplished at the highest rate in an anoxic zone with adequate food supply ($CBOD_5$). The anoxic reaction is elevated to its highest potential when the bugs are hungry and active, the $CBOD_5$ is plentiful, the tank is mixed without any oxygen transfer, and the dissolved oxygen level is near zero.

4. **A. Volatile suspended solids (VSS)**

The VSS test requires the use of an analytical balance, a drying oven, filter papers, a muffle furnace, and a desiccator. The balance is for weighing the sample, the drying oven is for evaporating the moisture, filter papers capture suspended solids on the media, the muffle furnace is to burn volatile solids and allow fixed solids to remain, and the desiccator is to cool the filter paper and prevent moisture from adding weight to the filter paper.

5. **B. 17.1 lbs/day/ft2**

Solids loading, lbs/day/ft²
= Total lbs/day of MLSS entering the secondary clarifiers divided by the total surface area of secondary clarifiers in ft²

Total lbs/day MLSS
= (15 mgd x 1.85) x 2,500 mg/L x 8.34 lbs/gal
= 578,587 lbs MLSS entering the secondary clarifiers

Total clarifier surface area
= π r² x 3 clarifiers
= 3.14 x 60 ft x 60 ft x 3
= 33,912 ft²
= 578,587 lbs/day MLSS ÷ 33,912 ft² surface area
= 17.06 lbs/day/ft²

6. • $CBOD_5$ **B. 0.8 to 1.4**
   • NH_3 **C. 4.0 to 5.0**

7. **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 $CBOD_5$, COD, or nitrogen) placed on the activated sludge process in a short period of time.

8. **D. 94.75 percent**

1.0 - 0.0525 x 100
= 94.75 percent moisture OR
100 - 5.25
= 94.75

9. **A. Aeration MLVSS and influent $CBOD_5$**

The F/M ratio compares the food value as applied to the volatile bug population. The food value is considered to be the $CBOD_5$ content in the influent wastewater, and the volatile bug content is identified by testing the aeration system mixed liquor for its volatile fraction, mixed liquor volatile suspended solids (MLVSS).

10. **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,) converts ammonia to nitrite. The second group, nitrobacter (known as nitrite-oxidizing bacteria), converts nitrite to nitrate. The process of nitrification does not necessarily remove nitrogen from the wastewater; it only converts it to a more stable form.