Certification Boulevard

Roy Pelletier

Test Your Knowledge of Wastewater Treatment

1. What is the best definition of a shock load?
   a. An unexpected bump.
   b. A strong influent waste strength.
   c. A high concentration of TSS.
   d. A heavy truck load entering the plant.

2. Which zone of a BNR plant produces 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

3. How much alkalinity is required to convert 1.0 pound of ammonia-nitrogen during the nitrification process?
   a. 7.2 lbs b. 8.34 lbs
   c. 7.48 lbs d. 4.6 lbs

4. 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

5. Which lab test requires the use of an analytical balance, a drying oven, filter papers, a muffle furnace, and a desiccator?
   a. VSS b. TS
   c. BOD_5 d. Settleable solids

6. How is fecal coliform identified in the membrane filter test method?
   a. The number of colonies grown on the filter paper.
   b. The number of positive tubes.
   c. The number of negative tubes.
   d. The number of colonies grown in the tube.

7. What does this formula represent?
   [$^1/_2\pi r^2$ x depth, ft. x 7.48 gals/ft^3]
   a. Volume of a cone in ft^3
   b. Volume of a circular tank in gallons
   c. Volume of a sphere in gallons
   d. Volume of a cone in gallons

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 F/M ratio?
   a. Aeration MLVSS and influent $CBOD_5$
   b. Aeration MLSS and OUR
   c. Aeration MLVSS and effluent $CBOD_5$
   d. Aeration MLSS and influent $CBOD_5$

10. What is a typical RAS-to-Q ratio for an extended aeration activated sludge process?
    a. 10 percent to 25 percent
    b. 25 percent to 50 percent
    c. 1 percent to 2 percent
    d. 75 percent to 100 percent

ANSWERS ON PAGE 82

Readers are welcome to submit questions or exercises on water or wastewater treatment plant operations for publication in *Certification Boulevard*. Mail your question (with the answer) or your exercise (with the solution) to Roy Pelletier, City of Orlando Public Works Department, 5100 L.B. McLeod Road, Orlando, FL 32811. Or send it by e-mail to roy.pelletier@cityoforlando.net.

– CORRECTION: Natural Pipe Slope is Pitch –

Several sharp-eyed readers spotted an error in our December edition of Certification Boulevard. The true-false answer to Question 1 (The natural slope of a pipe is called the "angle of repose.") should be FALSE instead of TRUE.

Fred Gleim, a CCC technician with the city of Naples, writes, "I believe that the answer to Question 1 should be False. The natural slope of a pipe is the pitch. The angle of repose is the slope that granular material forms when it comes to rest."

Gary Gillette, a maintenance foreman for the Fort Pierce Utilities Authority, writes, "I always enjoy going over your test published in the Journal and I encourage my employees to do the same. I do have to call you on the answer of True for Question 1. The angle of repose is defined as the angle between a horizontal line and the slope or surface of unsupported material such as gravel, sand, or loose soil—also called the 'natural slope.'"

Gary Williams, senior environmental specialist with the city of Orlando, offers this definition after some Internet research: "The angle of repose, also referred to as angle of friction, is …the maximum angle of a stable slope determined by friction, cohesion and the shapes of the particles. When bulk granular materials are poured onto a horizontal surface, a conical pile will form. The internal angle between the surface of the pile and the horizontal surface is known as the angle of repose and is related to the density, surface area, and coefficient of friction of the material."

Finally, our resident construction expert with the city of Orlando, Ron Proulx, adds this perspective: "Angle of repose is the sloping back of the ditch/trench walls to a safe level in hopes of eliminating a cave-in on workers. I believe the formula is for every foot of depth, you excavate two feet back away on the sides."

Thanks to Fred, Gary, Gary & Ron for sorting out the correct answer. Question 1, as written in the December issue, is FALSE—Roy

Certification Boulevard Answer Key

From page 33

1. **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.

2. **b. Fermentation**
The fermentation zone of a Bardenpho process receives raw wastewater (usually after preliminary treatment) and return 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 (PAOs), 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.

3. **a. 7.2 lbs**
Nitrification consumes alkalinity at the rate of about 7 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.

4. **c. Denitrification**
Denitrification is an anoxic reaction and will be typically 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 as close as possible to zero.

5. **a. VSS**
The volatile suspended solids (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 evaporation of 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.

6. **a. The number of colonies grown on the filter paper.**
After the required incubation period, the completed filter paper is held under a magnifying glass and the number of colonies that have grown on the paper are counted.

7. **d. Volume of a cone in gallons.**
The formula to calculate the volume in gallons of a cone is:
$^1/_2\pi r^2$ x cone depth, ft. x 7.48 gals/ft^3.

8. **d. 94.75 percent**
1.0 - 0.0525 x 100 = 94.75% 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 bugs population. The food value is indicated with 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.

10. **d. 75 percent to 100 percent**
Extended aeration activated sludge processes typically require higher RAS rates as compared to conventional activated sludge systems. An RAS rate in a conventional activated sludge process is about 20 to 50 percent of the influent flow rate; however, the RAS rate in an extended aeration process is typically between 75 and 100 percent of the influent flow volume.