

Module 15:

The Activated Sludge Process - Part 1

Answer Key

Unit 1 - General Description of the Activated Sludge Process



What purpose does the activated sludge process serve within wastewater treatment?

Ans: To oxidize and remove soluble or finely divided suspended materials that were not removed by previous treatment (preliminary and primary).



When the biochemical oxygen demand (BOD) of incoming wastewater increases, what happens to the air requirement in the aeration tank?

Ans: Air requirements increase—more food (BOD) encourages biological activity, which in turn requires more air (oxygen).



Let's calculate the sludge age for an activated sludge process if the aeration volume is 0.5 million gallons (MG) and the mixed liquor suspended solids concentration is 2,100 mg/L. The influent flow is 4.0 MG per day and the primary effluent suspended solids concentration is 70 mg/L.

1. Determine the pounds of solids under aeration:

$$2,100 \text{ mg/L} \times 0.5 \text{ MG} \times 8.34 = 8,757 \text{ pounds}$$

2. Determine the pounds of solids in the primary effluent:

$$70 \text{ mg/L} \times 4.0 \text{ MGD} \times 8.34 = 2,335 \text{ pounds per day}$$

3. Divide the solids under aeration by the solids in the primary effluent to get sludge age:

$$8,757 \text{ pounds} / 2,335 \text{ pounds per day} = 3.75 \text{ days}$$



Exercise for Unit 1 – General Description of the Activated Sludge Process

1. Why is air added to the aeration tank in the activated sludge process?

Ans: Air is added to the aeration tank in the activated sludge process to provide oxygen to sustain the living organisms as they oxidize the wastes to obtain energy for growth. The application of air also provides mixing to ensure that the oxygen and food (BOD) are distributed to all the organisms.

2. What does the volatile content of the mixed liquor suspended solids represent?

Ans: The volatile content of the mixed liquor suspended solids represents the amount of microorganisms in the activated sludge process.

3. What influences the amount of air required in an aeration tank?

Ans: The amount of food (BOD) in the wastewater and type of treatment are the principal influences on the amount of air required in the aeration tank.

4. Aerobic organisms grow relatively quickly, efficiently oxidize waste, produce little or no odor, but require a proper amount of dissolved oxygen to function properly.

a. True b. False

5. The conventional activated sludge process produces a high quality of effluent and the process has some ability to absorb shock loads.

6. As the water temperature drops, water will be able to dissolve:

a. more oxygen b. less oxygen

Unit 2 – Aeration

Diffused aeration systems are the most common. Can anyone tell me why this might be true?

Ans: More versatile, mobility, cost effective—can make repairs which do not require shutting down the whole tank, can adjust airflow to be more efficient, etc.



Safety Case Study

You are an operator at a wastewater facility where you will be changing the diffusers in an aeration tank. The aeration lines are equipped with swivel joints, so you can keep the tank in service during the change out. There was a rain shower an hour before the scheduled change out. Please identify safety concerns associated with this operation and how you would address the concerns to make the operation safer.

Ans:

Concern	Possible Solution
Slips, trips, and falls	<ul style="list-style-type: none"> ▪ Make sure the walking surface is clean and dry (remove slime and brush away standing water). ▪ Keep handrails in place, if possible. ▪ Wear fall arrest device.
Drowning	<ul style="list-style-type: none"> ▪ Wear flotation device. ▪ Shut off aeration to the header being serviced.
Overhead falling hazards	<ul style="list-style-type: none"> ▪ Wear hard hats. ▪ Ensure lifting devices are securely attached. ▪ Ensure lifting devices are functioning properly.
Pressurized line	<ul style="list-style-type: none"> ▪ Relieve the line pressure prior to any work. ▪ Wear protective eyewear.



Exercise for Unit 2 - Aeration

1. What are the purposes of aeration?

Ans: To dissolve oxygen into the wastewater and, to mix the mixed liquor suspended solids with the incoming wastewater. Both of these functions are necessary to ensure the survival of the microorganisms that actually remove the contaminants from the wastewater.

2. What is the difference between mechanical and diffused aeration?

Ans: Mechanical is done by contacting atmospheric oxygen with the wastewater, either by drawing air into the water or by splashing water into the air. Diffused aeration is done by oxygen or air being "blown" under pressure into the depths of the wastewater through a diffuser.

3. What are the precautions that must be taken before one attempts to maintain or repair a surface aerator?

Ans: Wear the proper clothing floatation – fall arrest... Turn off machinery. Turn off electricity (tag out/lock out) Wait for motion to STOP.

4. What are some of the hazards that could be found when working on air headers?

Ans: Because of the location of air headers, slips, trips, and falls are potential hazards. Also, if the work involves lifting, such as with a hoist, care must be taken to ensure that the hoist cable is properly connected; that personnel do not work beneath the hoist or the load; that the hoist is in good working order; and that the load is lifted properly. Finally, if the air line is to be opened, pressurized air, carrying dust or small particles, could be released at a high rate of speed unless the pressure is released first under controlled conditions.

Unit 3 – New Plant Start-up Procedures



If your waste treatment plant were missing a particular manufacturer's manual, how would you go about obtaining one?

Ans. Usually the contract specifications require that several copies of manufacturers' manuals be provided. If they are lost, call or write to the manufacturer or contact the manufacturer's representative and request another copy of the manual. If the manufacturer's representative does not have the necessary equipment information, you will need to provide it. Be prepared to provide the equipment serial number, which should have all the necessary information. As additional verification, provide the equipment model number and size, and a purchase contract number if available.



Why should an effluent weir be level?

Ans. An effluent weir should be level to prevent short-circuiting of effluent, to maintain the intended overflow rate, and to minimize solids carry-over, which could occur if high velocity flow patterns are created by the uneven weir setting.



As a review, how is air cleaned before it is compressed and sent to the aeration tank?

Ans. Air filters are used to clean the air.



Blowers should be started prior to admitting primary effluent to the aeration tank. Why?

Ans. Blowers should be started and air should be flowing to the diffusers before primary effluent is admitted to the aeration tank to prevent the diffusers from clogging. Without the air discharging through the diffusers, solids would settle on and stick to the diffusers, but with the air discharging that is less likely.



Exercise for Unit 3 – New Plant Start-up

1. Why must the horizontal pipes containing the air diffusers all be at the same elevation (level)?

Ans: If the diffusers are not all at the same elevation, the higher diffusers will receive too much air and the lower diffusers will not receive enough (or any) air. This is because the higher diffusers would have less water pressure on them so there would be less resistance to flow. Uneven air distribution would make oxygen transfer less efficient and disrupt the normal mixing pattern in the aeration tank.

2. Why should an operator completely check the equipment and structures before startup?

Ans: The main reasons to check equipment and structures prior to startup are to: a) become familiar with the equipment, b) learn how it works, c) learn where all the controls are located, d) make sure it is installed properly, and e) have confidence that it should function properly when started up.

3. The Operations and Maintenance (O&M) manual, if available, should contain a wealth of information concerning how to run the plant.

4. Record plans will summarize the as-constructed information about the plant.

5. Out of level weirs can cause an imbalance of flows in the plant and potentially cause problems with the plant effluent.

a. True b.False
