Module 4:
Fundamentals of Wastewater Treatment
Answer Key

Before we move on to Grit Disposal, who can tell me what purpose grit washing serves within wastewater treatment?

Ans: To remove excess organic materials so that when the grit is removed and disposed of, it less likely to attract vermin or cause odors.

What is the purpose of preliminary treatment as it relates to screening and comminution?

Ans: Screening is the initial removal of floating material and larger suspended solids from the wastewater influent stream. The largest wastes are separated from the wastewater by the water flowing through screens and bar racks which prevent them from moving any further into the plant and interfering with the downstream treatment processes. These items must be removed either manually or mechanically. Comminution is the next step in wastewater treatment. During this process, the now largest wastes are made smaller by cutting them into smaller pieces. Once again a screen is used to keep out the larger pieces of waste from the flow. It is then cut into smaller pieces that either a) can reenter the flow and continue through the process, or b) must be removed and disposed of.

List at least two differences between screening and comminution.

Ans: 1. Screening REMOVES the LARGEST materials from the influent wastewater stream. Comminution REDUCES the size of materials in the influent stream by cutting or shredding.

Material generally stays in the wastewater (Exception – wood and plastic materials will not pass cutter and must be removed manually).

2. Bar racks and screens are used to protect downstream equipment from damage by large floating objects. Comminutors generally reduce the size of material, preparing this material for further treatment.

What is the detention time at a plant flow of 2.5 MGD in a circular clarifier is 60 feet in diameter, with a water depth of 12 feet? Take a minute to solve this in the space provided.

Clarifier diameter = 60 feet and depth is 12 feet

Volume = Area * h (height/depth)

Area = π * d * d/4 Note: π/4 =0.785

Volume = 0.785 * $(d)^2$ * h(height/depth)

Volume = (0.785) * $(60)^2$ * 12

= 33,912 cubic feet

Flow = 2.5 MGD

Therefore,

Detention Time = (33,912 cu ft * 7.48 gal/cu ft * 24 hr/day) / 2.5 MGD
= 6,087,882 gal hr/day / 2,500,000 gal/day
= 2.44 hours

Compute the weir overflow rate for a circular clarifier with a 75 foot diameter overflow weir when 3.5 MGD is the flow rate into the unit.

Ans. Weir Length = 3.1416 * 75 feet = 235.6 feet

Therefore, WOR = 3,500,000 GPD / 235.6 feet

= 14,855 gpd/ft

Problem 2.2: Compute the Surface Loading Rate, when: Flow into a rectangular clarifier 40 feet wide by 110 feet long by 12 feet deep is 5.0 MGD.

Ans: Surface area = 40 feet * 110 feet = 4400 sq ft (Note: that depth is not relevant)

Surface Loading Rate = 5,000,000 GPD / 4400 sq ft

= 1136 GPD/sq ft

Problem 2.3: A circular clarifier with a diameter of 125 ft is operating with a forward flow of 6.0 MGD and a return sludge flow of 2.0 MGD. The MLSS is 4,000 mg/L. Compute the solids loading at which the clarifier is operating.

Ans. Applied solids = (6.0 MGD + 2.0 MGD) * 4,000 mg/L * 8.34 lbs/gal

= 8.0 MGD * 4,000 mg/L * 8.34 lbs/gal

= 266,880 lbs/day

Surface Area = (3.1416 * (125 ft)^2) / 4= 12,272 sq ft

Solids loading = 266,880 lbs/day/12,272 sq ft

= 21.75 lbs/day/sq ft

There are several factors that affect proper clarifier operation. List as many as you can.

Ans: Temperature, detention time, short circuits, weir overflow rate, surface settling rate and, solids loading.

What are some indicators of clarifier problems? List several below.

Ans: Floating Sludge (Bulking); black, odorous septic wastewater entering clarifier; black, odorous septic wastewater leaving clarifier; scum in clarifier effluent; sludge hard to remove from hopper; and low sludge solids.

Miscellaneous problems: Surging flow; Slime growth; and Excessive corrosion.
Mechanical problems: Chain/drive problems; Seal problems; and Bearing problems.

What are the operating principles of the trickling filter process?

Ans: Wastewater is passed over the surface of a fixed media, which, in the presence of aerobic conditions, promotes the growth of a biological slime consisting of bacteria, protozoa, and other organisms on the media. These organisms absorb and use much of the suspended, colloidal, and dissolved organic matter from the wastewater. Part of this organic matter is used by the organisms as food for the production of new cells, while another part is oxidized to carbon dioxide and water. Partially decomposed organic matter, dead organisms (film), and excess organisms are washed off the media and out of the filter with the effluent flow, to be subsequently removed by the secondary clarifiers.

List 5 forms of the activated sludge treatment process.

Ans: extended aeration

contact stabilization

complete mix

sequencing batch reactors

oxidation ditches

What 2 aeration methods are used to provide oxygen to the activated sludge treatment process?

Ans: Mechanical

Diffused

Why might solids be found in the secondary clarifier effluent of an activated sludge treatment plant?

Ans: Return Sludge rate out of balance with process requirements

Sludge not settling (bulking) in clarifier

What are the three types of waste treatment ponds? List them below.

Ans. Aerobic

Anaerobic

Facultative
