

CHAPTER 10



AERATED LAGOON

- A suspended growth type

- Similar to activated sludge BUT without sludge recycling
- It usually uses mechanical aerators
- Up till 90% BOD₅ removal
- Hydraulic retention time = 2-6 days
- MLSS = 200 – 400 mg/L
- No settling in the lagoon



Aerated Lagoon

□ Design:

- It is followed by maturation pond(s)
- Depth: 2- 4 m
- Effluent BOD₅ can be divided into two:-
 - Dissolved organics
 - Solid organics

Relationship between influent BOD₅ and (dissolved) effluent BOD₅:

$$F_e = \frac{l_i}{1 + Kt} \quad (10.1)$$

where:

l_i = influent BOD₅

F_e = dissolved effluent BOD₅

K = dissolved BOD₅ removal rate constant

$$K_T = K_{20} (1.035)^{(T-20)} \quad (10.2)$$

BOD₅ effluent (dissolved and non-dissolved), l_e may be computed from the equation below:

$$l_e = F_e + 0.95X \quad (10.3)$$

where:

X = cell concentration in the lagoon,
mg/L

$$= \frac{Y(l_i - F_e)}{1 + bt}$$

Y = yield rate coefficient = 0.6 – 0.7
= mass of developed cells/mass of
BOD used

b = autolysis rate
= 0.07 day⁻¹ at 20°C

Example:

By using the information given below,
design an aerated lagoon system
(including maturation pond):

$$l_i = 200 \text{ mg/L} \quad Y = 0.65$$

$$t = 4 \text{ days} \quad b = 0.07$$

$$T = 20^\circ\text{C} \quad K = 5 \text{ day}^{-1}$$

$$K_1 = 0.3 \text{ day}^{-1} \quad Q = 10000 \text{ m}^3/\text{day}$$

$$l_e = 20 \text{ mg/L (maturation).}$$

Solution:

Assuming $d = 2.5$ m, lagoon surface area:

$$A = \frac{Qt}{d} = \frac{10000(4)}{2.5} = 16000m^2$$

Determine the dissolved effluent BOD₅:

$$F_e = \frac{l_i}{1 + Kt} = \frac{200}{1 + (5 \times 4)} = 9.52 \text{ mg / L}$$

Determine the cell concentration in the lagoon:

$$X = \frac{Y(l_i - F_e)}{1 + bt} = \frac{0.65(200 - 9.52)}{1 + (0.07 \times 4)} = 96.73 \text{ mg / L}$$

Determine the lagoon effluent BOD₅:

$$\begin{aligned}l_e &= F_e + 0.95 X \\ &= 9.52 + (0.95 \times 96.73) \\ &= 101.4 \text{ mg} / L\end{aligned}$$

Assume 60% of the solids settled in the maturation pond

$$l_i = 9.52 + (0.95 \times 0.4 \times 96.73)$$
$$= 46.5 \text{ mg/L}$$

Compute the retention time for maturation pond:

$$l_e = \frac{l_i}{K_1 t + 1} \Rightarrow t = \frac{1}{K_1} \left(\frac{l_i}{l_e} - 1 \right)$$

$$t = \frac{1}{0.3} \left(\frac{46.5}{20} - 1 \right) = 4.42 \text{ days}$$