

1.85 WATER AND WASTEWATER TREATMENT ENGINEERING HOMEWORK 7

Question 1 (10 points)

A small community wishes to construct an activated sludge wastewater treatment plant to treat their wastewater. The plant will be maintained by a part-time operator who will check it a few times each week.

The wastewater from the community has an average flow rate of $0.0088 \text{ m}^3/\text{s}$ (0.2 mgd) and an influent substrate concentration of 300 mg/L as COD. Tests on the wastewater indicate the likely concentration of settled sludge from the secondary clarifier will be 12,000 mg VSS/L.

The reactor kinetic constants are $\mu_{\text{MAX}} = 0.4 \text{ hr}^{-1}$, $K_S = 75 \text{ mg/L}$ as COD, $Y = 0.4 \text{ g VSS/g COD}$, and $k_d = 0.004 \text{ hr}^{-1}$.

The design engineer proposes a fully-mixed aeration tank (reactor) with a volume of 25 cubic meters. The design safety factor is to be 20.

You have been asked to evaluate this system – the following are specific parameters you have been asked to calculate.

- a. What is the hydraulic residence time of the reactor? (1/2 point)
- b. What is the minimum allowable sludge age? (1/2 point)
- c. What is the design sludge age? (1/2 point)
- d. What is the biomass concentration in the aeration tank. (1/2 point)
- e. What is the COD concentration in the aeration tank. (1/2 point)
- f. What is the substrate utilization rate (U)? (1/2 point)
- g. What is the food to microorganism ratio (F/M)? (Use the Metcalf & Eddy definition as given in lecture and not the definition given in the textbook.) (1/2 point)
- h. What is the recycle ratio and recycle flow rate? (1/2 point)
- i. What is the sludge wasting flow rate? (1/2 point)
- j. What is the sludge production rate. (1/2 point)

In addition to these specific parameters, the community wants you to do the following:

- k. Provide an evaluation of how this plant will operate (3 points)
- l. Suggest design changes (if any) to improve the design (2 points)