1.85 WATER AND WASTEWATER TREATMENT ENGINEERING
HOMEWORK 7 – DUE APRIL 26, 2005

Question 1 (5 points)

An activated sludge wastewater treatment plant has a design flow rate of 0.088 m^3/s (2 mgd) and an influent substrate concentration of 300 mg/L as COD. Sludge is recycled to the aeration tank from the secondary clarifier at a flow rate of 0.013 m^3/s (0.3 mgd). The ratio of biomass concentration in the recycle to that of the aeration tank effluent is 6.5 and the design hydraulic detention time is 2 hours. The aeration tank is fully mixed and the kinetic constants are μ_{MAX} = 0.4 hr^{-1}, K_S = 75 mg/L as COD, Y = 0.4 g VSS/g COD, and k_d = 0.004 hr^{-1}.

a. What is the sludge age? (1/2 point)
b. Calculate the fraction of the influent COD removed in aeration tank. (1/2 point)
c. At what sludge age would the biological reactor cease removing COD? (1/2 point)
d. What is the food to microorganism ratio (F/M)? (1/2 point)
e. What is the cell concentration in the aeration tank? (1/2 point)
f. Compute the sludge production rate. (1/2 point)
g. Provide an evaluation of how this plant is currently operating (2 points)

Question 2 (4 points)
Viessman and Hammer Question 12.58:

The aeration tank for a completely mixed aeration process is being sized for a design wastewater flow of 7500 m^3/d. The influent BOD is 90 mg/L. The design effluent BOD is 7 mg/L. Recommended design parameters are a sludge age of 10 days and MLVSS of 1400 mg/L. Selection of these values takes into account the anticipated variations in wastewater flows and strengths. The kinetic constants from a bench-scale treatability study are Y = 0.60 mg VSS/mg BOD and k_d = 0.06 per day. Calculate the volume of the aeration tank, the hydraulic residence time of the aeration tank, the food/microorganism ration, and the excess biomass in the waste-activated sludge (i.e., the sludge production rate).