ENVE 302

Environmental Engineering Unit Processes

CHAPTER: 5

Aeorobic Biodegradation of Organic Matter

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AEROBIC REMOVAL OF ORGANIC CARBON

•Aerobic suspended growth systems

complete mix, sequencing batch , plug-flow

Attached growth systems

Dissolved oxygen

Sufficient contact time between wastewater and heterotrophic microorganisms

Nutrients

Aerobic heterotrophic bacteria \longrightarrow

produce extracellular biopolymers that result in formation of biological flocs



Environmental Factors

 $pH \rightarrow$ in the range of 6-9 is tolerable

optimal performance occurs near neutral pH

Reactor DO $\rightarrow 2mg/L$ is commonly used
@concentration above 0.5 mg/L there is little effect of the DO
concentrationon the degredation rate

For industrial ww \rightarrow care must be taken to assume that sufficient C,N,P are available C:N: P = 100:5 :1

 \rightarrow toxic substances

compared to methanotrophs

they may tolerate higher concentration of toxic substances as bacteria responsible for ammonia oxidation (nitrifiers) or s

Oxygen Requirement



Oxygen requirement = total mass of bCOD (or BOD_L) utilized

Endogenous Respirations



Oxygen required =
$$Q(S_0 - S) - 1.42P_{X,bio}$$

Biomass as VSS daily includes; → active biomass →cell debris

$$P_{X,bio} = \frac{QY(S_0 - S)}{1 + k_d \theta_c} + \frac{f_d k_d QY(S_0 - S)\theta c}{1 + k_d \theta_c}$$

g COD cells + g COD oxidized = g COD removed

COD balance accounts for

 \rightarrow cell production \rightarrow COD oxidation



Example: A complete – mix activated sludge system with recyle is used to treat municipal wastewater after primary sedimentation. The characteristics of primary effluent are as follows:

Q=1000 m³/d

bsCOD=192 g/m³

nbVSS=30 g/m³

inert inorganics=10g/m³

The aeration tank MLVSS is 2500g/m3. Using these data and kinetic coefficients given

below, design a system with a 6-d SRT and determine the following.

- a) eff. bsCOD conc.
- b) What value of Q should be used so that MLVSS conc is 2500g/m3
- c) What is the daily sludge production in hg/d as VSS and TSS?
- d) What is the fraction of biomass in MLVSS?
- e) What is Y_{obs} in g VSS/g bsCOD?
- f) What is the oxygen requirement in hg/day?

Example: Design a complete mix activated sludge process to treat 22.464 m³/d of primary effluent to meet a BODe conc less than 30g/m³ (for BOD removal only)

Wastewater Characteristics

 $BOD \rightarrow 140 \text{ g/m3}$ sBOD \rightarrow 70 g/m3 $COD \rightarrow 300 \text{ g/m}3$ sCOD \rightarrow 132 g/m3 rbCOD \rightarrow 80 g/m3 TSS \rightarrow 70 g/m3 VSS \rightarrow 60 g/m3 bCOD / BOD \rightarrow 1.6 ww temp \rightarrow 12^oC Design MLSS (X_{TSS}) conc=3000 g/m3