CE 421/521 Environmental Biotechnology - Fall 2006

Instructional Objectives **for Second Exam**

Public Health Microbiology

Pathogens and Parasites in Domestic Wastewater

1. Be able to describe the epidemiological aspects of pathogens in water and wastewater.
2. Be able to list and describe the common bacterial, viral, and protozoal parasites in water and wastewater.
3. Be able to describe other possible pathogens in water and wastewater.

Indicator Microorganisms and Disinfection

4. Be able to list the criteria for an ideal indicator organism.
5. Be able to describe the characteristics of bacteria that are classified as total coliforms, fecal coliforms, and fecal streptococci.
6. Be able to name the bacteria that are used as indicators in anaerobic environments.
7. Be able to describe the use of bacteriophages as indicator organisms.
8. Be able to explain the use of heterotrophic plate count.
9. Be able to describe the traditional and rapid methods for coliform enumeration in environmental samples.
10. Be able to describe the factors affecting disinfection.
11. Given appropriate data, be able to calculate the number of microorganisms remaining after disinfection for a specific decay constant.
12. Be able to explain the relationship between concentration and contact time.
13. Be able to define and describe the following terms: free chlorine THM, THMFP, chloramination, breakpoint chlorination.
14. Be able to propose alternatives to chlorine for disinfection and state the advantages and disadvantages of each.

Water and Wastewater Treatment Microbiology

Introduction to Wastewater Treatment

15. Be able to state the primary objectives of wastewater treatment.
16. Be able to characterize the main constituents in wastewater and give typical concentrations.
17. Be able to describe the significance and analytical procedures for carbonaceous and nitrogenous BOD, COD, and TOC.
18. Be able to describe the four stages in wastewater treatment and give examples of each.

Activated Sludge

19. Be able to describe the components that comprise an activated sludge system. Be able to define and explain the terms aeration tank, secondary clarifier, MLSS, MLVSS, F/M, HRT, and SRT.
20. Be able to define the following terms and describe their significance in terms of the activated sludge process: SRT, MLSS, MLVSS, SVI, F/M, and sludge wastage.
21. Given appropriate data be able to size an aeration basin for the activated sludge process and determine the recycle rate required to maintain a specified MLSS concentration.
22. Be able to describe modifications to the conventional activated sludge process.

23. Be able to the desired characteristics and typical populations of activated sludge microorganisms.
24. Be able to discuss the attributes of microorganisms that allow good settleability. Be able to define and explain the term SVI.
25. Be able to describe the configurations of activated sludge systems to achieve nutrient removal.
26. Be able to describe the effect of activated sludge on pathogens.

Sludge Bulking and Foaming

27. Be able to explain the common causes for filamentous bulking in activated sludge systems.
28. Be able to list prevalent filamentous organisms and the conditions that lead to their proliferation.
29. Be able to describe the kinetic selection theory and the use of selectors to control bulking.
30. Be able to explain the causes and control of foaming in activated sludge systems and the organisms commonly responsible.

Biofilms and Attached Growth Processes

31. Be able to provide a process description of a trickling filter and a rotating biological contactor.
32. Be able to provide a list of organisms typically found in biofilms typical of those in trickling filters and RBCs.
33. Be able to list the advantages and disadvantages of attached growth processes such as trickling filters and RBCs.
34. Be able to diagram the potentially rate limiting phenomena in biofilm systems.
35. Be able to describe the following with respect to biofilm systems: homogeneous vs. heterogenous biofilms, packing material, sloughing, low/intermediate/high rate, recirculation.

Anaerobic Digestion of Wastewater and Sludge

36. Be able to describe the interrelationship between the various microorganisms in anaerobic systems.
37. Be able to describe the “bucket brigade” as it relates to the breakdown of organics in an anaerobic environment.
38. Be able to list the intermediates in an anaerobic environment and discuss which ones might be used as process indicators.
39. Be able to describe the different process configurations in anaerobic treatment systems, including the configurations recently developed at Iowa State University.
40. Be able to list and discuss the factors that affect anaerobic systems.