Environmental Biotechnology. Christopher F. Forster and D. A. John Wase. John Wiley & Sons, One Wiley Drive, Somerset, NJ 08873. 1987. 435 pages. $105, cloth.

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Environmental biotechnology is emerging as a distinct field that combines the disciplines of related molecular life sciences, ecology, and engineering to exploit biological (principally microbial) processes in environmental, waste treatment, and agricultural applications. It is therefore appropriate that the fundamental science and engineering of these disciplines be brought together to identify problems, applications, and opportunities for environmental biotechnology.

Environmental Biotechnology clearly represents a step in the right direction with a focus on water and wastewater treatment and pollution control. Nevertheless, although the general science and engineering audience will find this book to be a useful, well-referenced review, specialists in the field may desire a more integrated treatment of environmental biotechnology with greater emphasis on molecular approaches for ferreting out interactions and optimization in complex biological communities.

The first two chapters of this book present general reviews of aerobic and anaerobic waste treatment practices. Chapter 1 focuses on conventional reactor design criteria, operation, and performance; Chapter 2 includes an overview of the microbiology, biochemistry, and inhibition of anaerobic processes in waste treatment.

Chapters 3 and 4 break the general civil engineering mold in waste treatment and focus on the use of microbial processes in bioleaching of minerals and in composting technology. Included in the short chapter on mineral leaching is a summary of the major mineral sulfides of economic importance and the general role of *Thiobacillus* in the oxidation of sulfide minerals and pyrites and in the production of sulfuric acids and mineral solvents.

Chapter 4 discusses the types and succession of microbial populations and the fate of pathogens in composted wastes. This chapter also offers a good review of composting technology and discusses its application for different domestic and agricultural wastes and criteria for operating efficient exothermic aerobic compost systems. Because these are well-controlled systems that can be operated at elevated temperatures, inoculation with specific organisms for optimization is addressed only briefly. What is lacking, however, is any discussion of fate of xenobiotics—specifically pesticides—during composting.

Chapter 5 deals with the processing and disposal of bulk solid waste either from a specific type of waste or from by-product sludges from waste treatment. Such treatment of solid wastes includes concentrating sludges by thickening or filtration, chemical pretreatment, and aerobic or anaerobic digestion to reduce volumes. This chapter is particularly useful for its discussion of sludge disposal, including landfilling, sea disposal, and incineration, as well as the problem of codisposal of toxic waste and the exploitation of landfill biogenic gas.

Chapter 6, which deals with agricultural alternatives, is particularly interesting. This chapter not only provides a brief review of the "rhizobium experience" (occurrence, inoculation, and competition), but also covers the use of *Lactobacillus* as probiotic supplements and protective dietary aids for cattle, pigs, and chickens. Moreover, the use of bacterial supplements in preconditioning of silage and applications for a variety of pest biocontrol agents are reviewed. Not discussed, however, is the use of recombinant DNA technology in either microbial strain development or in the direct engineering of plants for pest and pesticide resistance.

The use of genetically engineered microbes in the control of environmental pollutants is the focus of Chapter 7. This is a relatively up-to-date chapter that describes the history and current knowledge of microbial degradation of xenobiotic chemicals. Chapter 7 is short and to the point and uses well-characterized degradative pathways and plasmids as models for describing the state of the art. Chapter 7 also points out the need for constructing alternative genetic engineering systems and microbial hosts for development of strains for environmental release. The emphasis on environmental release is important because engineered organisms for pollution control must survive and function in the open environment rather than in the laboratory.

Chapter 8 is concerned with the continuous-flow cultivation of microorganisms targeted to activated sludge systems, and Chapter 9 discusses immobilized cell cultures. Both chapters are well documented and cover fundamental theory and application. Chapter 9 is a particularly lucid summary of immobilized cell systems, including both fixed-film and encapsulated cells in various reactor configurations. This chapter also discusses critical operating parameters and the need for greater understanding of immobilized cell physiology.

Chapters 10 and 11 cover wastewater aeration and process engineering principles. The mathematical description of mass transfer and aeration rates is kept to a minimum with good documentation. Chapter 11 continues the discussion of the physical parameters implicit in fundamental process engineering.

The concluding chapter, "Biopossibilities," is a short summary of problem areas that can be exploited by biotechnology. The focus is exclusively on pollution control and activated sludge plants and on the "fine tuning" of their processes. In this regard, adequate process models and online measurement technology are identified as important and as needing additional work. One might ask, however, what specific variables are to be monitored.

In general, the book is well written and conventional in nature. The chapters are good summary snapshots that focus heavily on the engineering aspects of waste treatment. In this regard, it is most useful for the microbiologist or molecular biologist involved in environmental biotechnology.

Unfortunately, major advances in applying molecular approaches to the study of complex mixed microbial populations and their interactions are not discussed. Another disappointment is that there is little specific problem definition on the engineering side that would help focus ecological and molecular research efforts. Nevertheless, *Environmental Biotechnology* does a good job of discussing the interactions between biological and engineering fields and represents a significant step toward promoting the understanding of integrated environmental biotechnology in general.

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