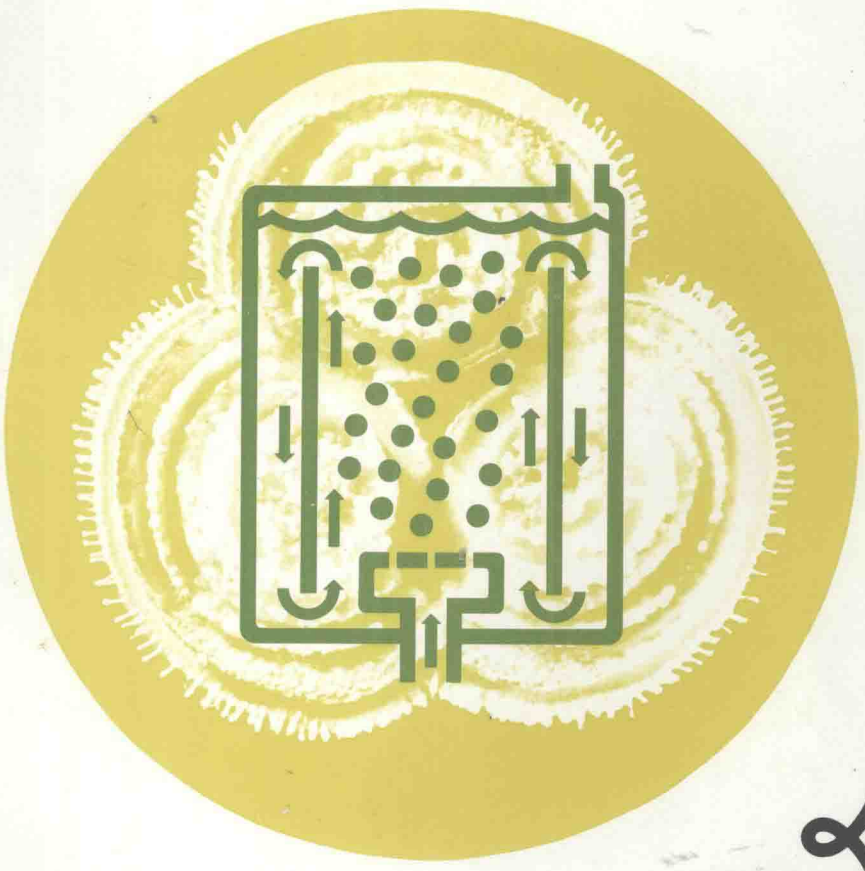
Biotechnology

A Comprehensive Treatise in 8 Volumes
edited by H.-J. Rehm and G. Reed

Volume 8

Volume Editor: W. Schönborn



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Volume 8

Microbial Degradations

Volume Editor:
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Volume 8

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A Comprehensive Treatise in 8 Volumes

Volume 1
Microbial Fundamentals

Volume 2
Fundamentals of Biochemical Engineering

Volume 3
Biomass, Microorganisms for Special Applications,
Microbial Products I, Energy from Renewable Resources

Volume 4
Microbial Products II

Volume 5
Food and Feed Production with Microorganisms

Volume 6a
Biotransformations

Volume 6b
Special Microbial Processes

Volume 7a
Enzyme Technology

Volume 7b
Gene Technology

Volume 8
Microbial Degradations

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Preface

The remarkable metabolic effects of microorganisms have been observed and used in the production of fermented foods and feeds long before any knowledge of the existence of microbes. The degrading activity of the microflora has also been used ingeniously for the recycling of human waste. This caused few problems because the waste consists of naturally biodegradable materials. But the waste collected in densely populated areas surpasses the self-purifying action of mixed microbial communities in their natural habitats of soil and surface water. Man was forced to use the degrading activity of natural microbial ecosystems, and finally to intensify the decomposition of wastes by artificial processes. At first this was achieved by imitating the observed natural process of degradation. The part played by the natural microflora in the degradation of human waste was not recognized until the middle of this century. The know-how and skill of the engineer preceded the scholarship of the microbiologist by several decades. This is just as valid for the biodeterioration of materials other than human waste. The participation of microbes in weathering was only gradually recognized.

Foaming at weirs and sluices of rivers and in sewage plants caused by poorly biodegradable detergents clearly disclosed the significant role of microorganisms in the degradation of surfactant compounds. At present the joint efforts of microbiologists, engineers, and chemists have been brought to bear on further developments of processes for waste disposal and material protection. These efforts fall within the range of the new "biotechnology". Indeed, biological processes of waste disposal are the largest field of application within biotechnology.

Therefore, this volume is a synopsis of microbiological, engineering, and chemical methods as they are used in biological waste treatment and in preventing the biodeterioration of materials. Biological-ecological fundamentals are a common base for both waste disposal and the environmental and material protection. They are treated in Chapter 1. The chapters dealing with special processes treat the kinetics of microbial degradation as well as the process engineering and biochemical aspects. The four larger chapters, 2 to 5, are devoted to the classical waste treatment processes: Activated sludge treatment, trickling filter operation, biomethanation, and processes in artificial freshwater environments. Chapter 6 deals with the use of these processes for industrial wastewater treatment, and gives specific examples. Agricultural use of waste and the use of offal and waste biomass is treated in Chapters 7 and 8. Some chapters treat often neglected biotechnologies and provide new insights into the role of microorganisms in the following fields: Composting (Chapter 10); exhaust gas purification (Chapter 12), and the dumping of refuse and sludge (Chapter 9). A separate chapter deals with the removal of pathogens during wastewater treatment (Chapter 16). Even microbial activity during the processing of drinking water and microbial degradations in sea water are addressed

(Chapters 11 and 13). Work on poorly degradable substances (Chapter 14) and efforts to degrade them by biochemical or genetic engineering methods (Chapter 15) introduce the reader to new ideas for future biotechnologies. The elimination of inorganic pollutants from sewage and wastewater will be treated in connection with other microbial activities on inorganic material, e.g., bacterial leaching and coal desulfurization, in Volume 6b.

Biotechnological degradation is concerned with the protection of the environment by removal of pollutants. Therefore, a survey of legislation and of methods for testing biodegradability have been included (Chapters 21 and 22).

A special section of this volume deals with the biodeterioration of materials. The four chapters 17 to 20 treat diverse materials such as natural organic and inorganic materials as well as man-made materials. Detrimental effects of microbial growth on the surfaces of drinking water installations have been included.

The subjects treated in this volume embrace a large and most important field of biotechnological applications. Many microbiological, biochemical, and engineering fundamentals have already been treated in Volumes 1 and 2. Examples of the recycling of wastes for re-use have been included in Volume 3. Finally, Volume 6a provides much information on microbial transformations and degradations of pesticides and xenobiotic substances as a valuable addition to Chapter 14 which treats poorly degradable substances. These references stress the importance of microbial degradations which is based on the fact that microorganisms in nature constitute the decomposing principle of the biogeochemical cycles.

My thanks are due to all persons who have contributed to the success of this volume: To all authors for their broad knowledge and experience in the diverse subjects; to the editors, Prof. H.-J. Rehm and Dr. G. Reed for critical reading of the manuscripts and valuable advice; to Dr. H. F. Ebel and Mrs. Ch. Schultz of VCH for their constant help with all technical/editorial questions; and last but not least to my wife for her patience.

Frankfurt, July 1986

Wolfgang Schönborn

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