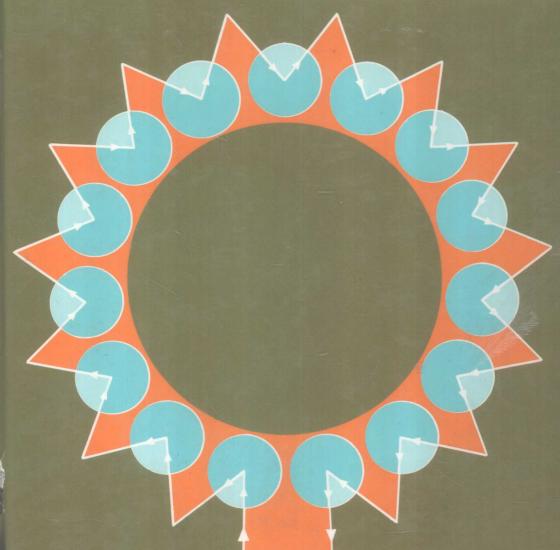
# handbook of ENZYME BIOTECHNOLOGY

second edition

editor ALAN WISEMAN



#### HANDBOOK OF ENZYME BIOTECHNOLOGY

Second Edition

Editor: ALAN WISEMAN, Department of Biochemistry, University of Surrey, Guildford, UK

Since the first edition of Handbook of Enzyme Biotechnology (Ellis Horwood, 1975) was published almost a decade ago, many important advances have been made in this growing scientific discipline. This new book, almost completely rewritten and therefore virtually a new publication, takes due account of these changes, recording up-to-date developments in research. Handbook of Enzyme Biotechnology, Second Edition will have wide application, as did its predecessor and will take its place as one of the most important books in the field

The new work takes a broad overview of enzyme biotechnology today, systematically establishing the theory and practice of large-scale enzyme manufacture and utilization in many fields of industry in the widest sense of the word. As before, Dr. Wiseman has divided the text into two logical, inter-related sections, dealing with principles and practice respectively of enzyme utilization both in free and immobilized form.

The book is extensively documented, as befits an advanced work: and serves to up-date the popular *Topics in Enzyme and Fermentation Biotechnology* series (edited by Alan Wiseman, published in Volumes 1 to 10 by Ellis Horwood). It is a most timely integration into a single volume of the theoretical principles as related to the industrial methodology, essential to the continuing development of the concepts which constitute enzyme biotechnology.

"of great industrial importance — for industrial scientists interested, but with no prior knowledge, it provides an absorbable overview" — T. Bryan Jones, University of Toronto, reviewing the First Edition for Journal of the American Chemical Society.

Readership: Biochemists, chemists, microbiologists, chemical engineers, and all those working in or researching in food science, medical science, organic chemistry, textile chemistry and the textiles industry, the leather industry, paper manufacture, analytical chemistry, pathology, pharmaceutics, clinical chemistry, physical chemistry. Those teaching or studying any of these subjects in universities, colleges and polytechnics.

Dr. Alan Wiseman, editor of this book, graduated in 1956 from Imperial College of Science and Technology, University of London. In 1959 he was awarded a Ph.D. (in the field of biochemistry) by the University of London for research on protein structure carried out at the University of Bradford. After industrial research experience in the fermentation industry he returned to Imperial College's Metabolic Reactions Research Unit, sponsored within the Department of Biochemistry by the Medical Research Council.

He was appointed Lecturer in Biochemistry at the University of Surrey, Guildford, in 1965, and promoted to Senior Lecturer in Biochemistry and Head of the Biochemistry Division from 1978.

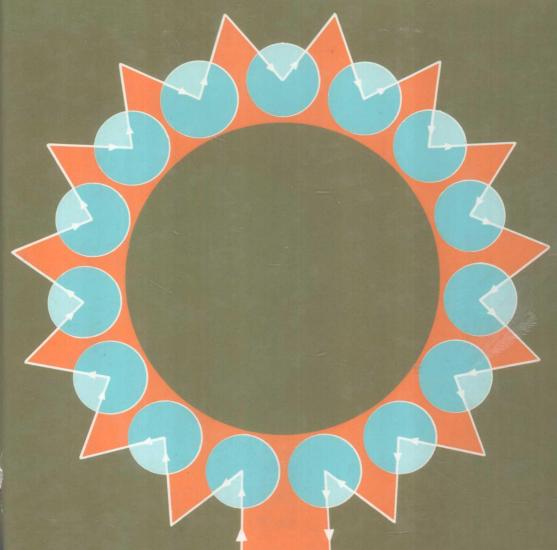
Dr. Wiseman's research on enzymes and proteins has to date yielded more than 100 published papers and 15 books including the first edition of *Handbook of Enzyme Biotechnology*, and Volumes 1-10 of *Topics in Enzyme and Fermentation Biotechnology*, published by Ellis Horwood Limited.

He holds the office of Honorary Recorder of the Biotechnology Group of the Society of Chemical dustry, and is a member of the Kent, Surrey and ex Branch Committee of the Institute of ey, a member of the Biological Council Honorary Secretary of the Industrial Biomistry and Biotechnology Group of the Biomistry and Biotechnology Group of the Biomical Society, and member of the Professional and Education Sub-committee of the Biochemical Society. Dr. Wiseman is a member of the Editorial Board of the Journal of Chemical Technology and Biotechnology (Biotechnology Board).

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#### Editor:

ALAN WISEMAN, PhD, FRSC, MIBiol Department of Biochemistry University of Surrey, Guildford, England



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PRINCIPLES OF INDUSTRIAL ENZYME ISOLATION AND UTILIZATION
Introduction to principles Dr ALAN WISEMAN, Biochemistry Division, Department of Biochemistry, University of Surrey, Guildford, England
General introduction
Introduction to Handbook of Enzyme Biotechnology II,
Principles of Industrial Enzyme Isolation and Utilisation13
Large-scale extraction and purification of enzymes and other
proteins Dr. M. D. SCAWEN and Professor J. MELLING, PHLS Centre for Allied Microbiology and Research, Porton Down, Salisbury, Wiltshire, SP4 0JG, England
Introduction
Extraction by chemical methods
Extraction by physical methods
Isolation and purification
References
Principles of industrial enzymology: Basis of utilization of soluble and immobilized enzymes in industrial processes Dr. P. S. J. CHEETHAM, Tate & Lyle plc, Group Research and De-
velopment, Philip Lyle Memorial Research Laboratory, PO Box 68, Reading, Berkshire, RG6 2BX, England
Glossary of symbols
Introduction
Assay of enzyme activity
Cofactors
The distinctive features of enzymes as catalysts60
Enzyme catalysis
Enzyme kinetics

3.7	The effect of pH on enzyme activity	69
3.8	The effect of temperature on enzyme activity	69
3.9	Enzyme inhibition	
3.10	The various types of enzyme catalyst	71
	A comparison of enzymes with chemical catalysts	
	A comparison of enzymes with fermentations	
3.13	Immobilized biocatalysts	74
3.14	A comparison of immobilized enzymes and cells	79
3.15	An assessment of immobilization supports and methods	82
3.16	Co-immobilized enzymes	86
3.17	Two-phase reactions	87
	Industrial enzyme kinetics	
	Effectiveness factors	
	Steady-state kinetics	
	Intrinsic activity of enzymes — modifying factors	
	Regeneration of cofactors	
	Biochemical reactors	
	Enzyme kinetics in reactors	. 116
3.25	The effect of non-ideal flow on biochemical reactor	
	performance	. 122
3.26	Physical problems in biochemical reactors using	
	immobilized biocatalysts	
	The stability of immobilized biocatalysts	
	Scale-up	
3.29	Discussion	
	Acknowledgements	
	Note in proof	
	References	. 142
Chapter 4	Principles of immobilization of enzymes	
	Professor J. F. KENNEDY, Research Laboratory for the Chemistry of	
	Bioactive Carbohydrate and Proteins, Department of Chemistry, University of Birmingham B15 2TT, England and The North East Wales	
	Institute, Deeside, Clwyd CH5 4BR, Wales and Dr. C. A. WHITE,	
	Vincent Kennedy Ltd., 47 Conchar Road, Sutton Coldfield, B72 1LL,	
4.1	England Classification of immobilized enzymes	147
4.1 4.2	Techniques of enzyme immobilization.	149
4.2	Choice of immobilization method	
4.3 4.4	Outline of properties of immobilized enzymes	
4.4 4.5	Outline of enzyme reactors	
4.5 4.6	Applications and future trends	
4.0	References	
	References	. 201

Chapter 5	Enzymes in clinical analysis — principles Dr. B. J. GOULD, Department of Biochemistry, University of Surrey, Guildford, Surrey, GU2 5XH, England and Dr. B. F. ROCKS, Department of Pathology, The Royal Sussex County Hospital, Brighton, East Sussex, BN2 5BE, England	
5.1	Introduction	. 208
5.2	Measurement of substrate concentration with enzymes	. 211
5.3	Measurement of enzymes	. 220
5.4	Immobilised enzymes for measuring substrate concentration	. 223
5.5	Enzyme immunoassay (EIA)	. 232
5.6	The future	. 240
	References	. 241
Part B	INDUSTRIAL UTILIZATION OF ENZYMES AND CELLS	
Chapter 1	Introduction to enzyme utilization	
Chapter 2	Practical aspects of large-scale protein purification Dr. M. D. SCAWEN and Professor J. MELLING, PHLS Centre for Applied Microbiology and Research, Porton Down, Salisbury, Wilt- shire, SP4 OJG, England	
2.1	Introduction	. 247
2.2	Enzyme inactivation	. 247
2.3	Containers and ancillary equipment	. 248
2.4	Liquid transfer	. 250
2.5	Bacterial disruption	. 252
2.6	Centrifugation	. 254
2.7	Tangential flow filtration	. 258
2.8	Concentration	. 259
2.9	Chromatography	. 261
2.10	Affinity chromatography	. 271
	References	. 273
Chapter 3	The applications of enzymes in industry Dr. P. S. J. CHEETHAM, Tate & Lyle plc, Group Research and Development, Philip Lyle Memorial Research Laboratory, PO Box 68,	
3.1	Reading, Berkshire, RG6 2BX, England Introduction	274
3.1	Production of enzymes	276
3.2	Uses of enzymes — general comments	279
3.3 3.4	Sources of enzymes	286
3.4	The isolation, purification, and formulation of enzymes	288
3.3	The isolation, pullification, and followation of one, most in it	

3.6	Legislation on the use of enzymes	. 290
3.7	Enzyme manufacturers	. 293
3.8	Biochemical applications	
3.9		. 299
3.10	Medical uses of enzymes	. 309
3.11	The use of enzymes as catalysts in organic chemistry	. 310
3.12	Restriction endonucleases	. 318
3.13	Biochemical processing	. 320
3.14	Applications of enzymes in the food industry	. 323
3.15	Use of enzymes in the extraction of natural products	. 361
3.16	Detoxifying enzymes	. 362
3.17	Enzyme-based detergents	. 364
3.18	Use of enzymes as cleansing agents	. 364
3.19	The leather industry	. 365
3.20	Textiles	. 365
3.21	Papers manufacture	. 366
3.22	Antibiotics	. 366
	Penicillin acylase	
3.24	Cephalosporins	. 368
3.25	Miscellaneous uses of biocatalysts	. 369
3.26	Conclusion	. 370
	Note in proof	
	References	. 373
Chamton 4	Data an Architecture of the 1991 of the	
Chapter 4	Data on techniques of enzyme immobilization and	
	bioaffinity procedures Professor J. F. KENNEDY, Research Laboratory for the Chemistry of	
	Bioactive Carbohydrate and Proteins, Department of Chemistry Uni-	
	versity of Birmingham B15 2TT, England and The North East Wales	
	Institute, Deeside, Clwyd CH5 4BR, Wales and Dr. C. A. WHITE, Vincent Kennedy Ltd, 47 Conchar Road, Sutton Coldfield, B72 1LL,	
	England	
4.1	Introduction	380
4.2	Entrapment	
4.3	Carrier binding	
4.4	Crosslinking	411
4.5	Immobilized cells	413
4.6	Other immobilized biologically active molecules	
	References	417
Chapter 5	Enzymes in clinical analyses — data	
	Dr. B. J. GOULD, Department of Biochemistry, University of Surrey, Guildford, Surrey GU2 5XH, England, and Dr. B. F. ROCKS, Depart-	
1	ment of Pathology, The Royal Sussex Country Hospital, Brighton.	
]	East Sussex, BN2 5BE, England	

5.1	Introduction and acknowledgement
5.2	Substrates measured enzymically in clinical laboratories 421
5.3	Enzymes measured by coupled enzyme systems in clinical
	laboratories
5.4	Immobilized enzymes for measuring substrates 435
5.5	Enzymes used in enzyme immunoassay (EIA)435
	References
Indov	129



## PRINCIPLES OF INDUSTRIAL ENZYME ISOLATION AND UTILIZATION

### Introduction to principles

Dr. ALAN WISEMAN, Biochemistry Division, Department of Biochemistry, University of Surrey, Guildford, England

#### 1.1 GENERAL INTRODUCTION

The first edition of Handbook of Enzyme Biotechnology, edited by Alan Wiseman, was published in 1975 by Ellis Horwood, and this most successful book was later translated into Japanese (1977) and Czech (1981). Part I of that book covered the principles of enzyme production and utilization, while Part 2 was a collection of data for use in industrial and other applications, of enzymes. Many specialist topics were mentioned in this source book, although only a few were subjected to detailed analysis. This led therefore to a series of books, Topics in Enzyme and Fermentation Biotechnology, published from 1977 by Ellis Horwood.

Topics 1 (1977) reviewed enzyme synthesis in continuous culture, foam separation of biological materials, aeration of culture fluids, enzymic modifications of antibiotics, patents, glucose isomerase, and cytochromes P450. Topics 2 (1978) reviewed enzymes immobilized on inorganic supports, enzyme electrodes and enzyme-based sensors, antibiotic-inactivating enzymes, biological treatment of aqueous wastes, and stabilization of enzymes. Topics 3 (1979) reviewed the uses of oxyanions in enzyme equilibrium displacement, developments in microbial extra-cellular enzymes, rennets and cheese, scale-up of fermentation processes, and new and modified invertases and their applications. Topics 4 (1980) reviewed enzymes in therapy, medical uses of proteolytic enzymes, solid substrate fermentation, measurement of process variables, and immobilized microbial cells. Topics 5 (1981) reviewed immobilized coenzymes, large-scale enzyme extraction and recovery, aspects of Gramicidin S, papain, and alcohol dehydrogenases. Topics 6 (1982) reviewed 4-hydroxycoumarin antibiotics, microbiological aspects of secondary metabolites, enzyme stabilization, beer fermentation, and microbial oxygenases. Topics 7 (1983) reviewed immobilized plant and animal cells, disordering macromolecular structure for enzyme attack, microbial enymes in the biodegradation of sulphated surfactants, thermophilic, anaerobic, and cellulolytic bacteria, monoclonal antibodies, immobilized enzymes in water and

air purification, and the limitations of fermentation processes for utilization of food wastes. Topics 8 (1984) reviewed xylanses: function properties and applications, biological control of nitrogenous pollution in waste water, and computers and microprocessors in industrial fermentation. Topics 9 (1984) reviewed the physiology of hydrocarbon-utilizing microorganisms, applications of reactive dyes in biotechnology and biochemistry, application of immobilized enzymes to fundamental studies on enzyme structure and function, and progress with design of enzymes and mimics. Topics 10 (1985) is in press.

Many theoretical possibilities have come to fruition in the ten years since the first edition of the *Handbook of Enzyme Biotechnology* was published. Nevertheless, a vast number of such possibilities have not emerged at industrial level, so far as one can ascertain, perhaps because of a lack of the real scientific information required for success. Another factor is always the economics of a suggested process at any particular time.

Once again, the *Handbook* sets out to summarize in concise form the principles and practice associated with industrial enzymes in their widest sense. We have therefore extended the coverage to the range of enzymes used in clinical laboratories, where repeated use of these procedures gives rise to a part of the general 'industrial' requirement for enzymes.

#### 1.2 INTRODUCTION TO PART A OF HANDBOOK OF ENZYME BIO-TECHNOLOGY II, PRINCIPLES OF INDUSTRIAL ENZYME ISOLATION AND UTILIZATION

The most important principles involved in enzyme utilization are becoming clearer with the move towards the use of immobilized enzymes in various forms. Much of classical enzyme kinetics has needed to be remoulded towards the particular general requirement of product formation — and indeed in every process the key features of enzymology have to be re-established. Stability and stabilization of enzymes is often of great importance in this context. (See Part A: sections 3.27 and 4.4 and review by Mozhaev & Martinek, (1984)).

Enzymes are bought and sold, by activity rather than by weight. There is no need to use a more highly purified, or modified, enzyme than is necessary for the particular process, as work done on the enzyme will be expensive. Nevertheless, the presence of inhibitors could make the prediction of the effect of the enzyme difficult, especially in enzyme kinetic terms. Deciding if the process will really work on a large scale may defy prediction.

Many of the important principles are associated with the use of a variety of immobilized enzyme reactors. This area of enzyme engineering is of great importance in assessing the practicalities of the particular application of the immobilized enzyme or immobilized cell (see Part A: Chapter 3). But first the enzyme must be successfully isolated (see Part A: Chapter 2) and immobilized (see Part A; Chapter 4). Some of the most sophisticated applications of

enzymes, however, are to be found in clinical biochemistry, and here the use of antibodies has allowed the development of a variety of remarkable techniques such as enzyme immunoassay (see Part A: Chapter 5). The reader is referred to Part B of the book for data, practical details, and applications.

#### REFERENCES

Mozhaev, V. V. & Martinek, K. (1984) Enzyme & Microbial Technology, 6, 50-59.

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