BIOREACTOR IMMOBILIZED ENZYMES AND CELLS

FUNDAMENTALS AND APPLICATIONS

Edited by
MURRAY MOO-YOUNG

ELSEVIER APPLIED SCIENCE

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Fundamentals and Applications

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生物反应器固定化酶与细胞

基础与应用

BIOREACTOR IMMOBILIZED ENZYMES AND CELLS

Fundamentals and Applications

PREFACE

Bioreactors are at the heart of biotechnological processes and devices which are used in industrial, agricultural and medical applications. They rely on the bioconversion functions of agents in the form of whole living cells or cell-free enzymes which transform raw materials into useful products and/or less undesirable by-products. In recent years there has been a growing interest in bioreactors which employ 'immobilized enzymes and cells', a phrase now generally used to describe biocatalytic systems in which the bio-agents are segregated and/or attached to solid support carriers in contrast to the more conventional systems in which the bio-agents are in free suspension (cells) or are dissolved in a bulk aqueous medium (enzymes). In principle, there are many relative advantages of the immobilized systems.

This publication is a collection of papers which deals with the generic fundamentals and applications of bioreactor immobilized enzymes and cells, covering the complete range of cell types (animal, plant and microbial cells, including bacteria, yeasts and fungi), various types of bioreactor configurations and operations (fixed and fluidized beds, batch and continuous processes) and various types of immobilized techniques (adsorption, entrapment, encapsulation, compartmentalization). For convenience the material is presented according to the following three sections:

1. Techniques and principles in the preparation and characterization of immobilized cells and enzymes.
2. Applications of these systems in the production of useful products, including pharmaceuticals, foods and chemicals.
3. Applications of these systems in waste treatment and environmental pollution control.

The book is based on manuscripts which have been prepared by some of the world's foremost authorities in this area of biotechnology as well

as by researchers who are becoming known as experts in certain aspects of this area. The material should be useful to students and researchers in industrial biotechnology, biochemical engineering, applied biochemistry and related fields.

In the interest of speed, this volume is produced from camera-ready copies of the original author-generated manuscripts. No attempt has been made to unify the text format in terms of such variables as literature referencing system or symbols nomenclature. In addition, only minimal editorial changes have been made to the usage of the English language in the original manuscript to improve context and clarity. (It should be noted that many of the contributors are from non-English-speaking countries.)

In closing, I wish to record my thanks to Kathy Young, one of my research assistants, who did most of the proof-reading and graphics layout of the manuscripts, and to Penny Preis, my secretary, who handled the final stages of this work. Finally, grateful acknowledgement is made to the Natural Sciences and Engineering Research Council of Canada and UNESCO for financial support of the project.

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MATRIX DESIGN FOR MICROBIAL CELL IMMOBILIZATION

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Introduction

Immobilized cells are now generally accepted as biocatalysts as are immobilized enzymes. This is well documented in the literature (1, 2, 3). In most cases the individual contributions can be arranged in two groups, where the first group refers to papers with main emphasis on immobilization methodology and the second group on a selected microbial biocatalytic reaction or process. On the basis of a number of papers from the authors laboratory belonging to both of the afore mentioned groups it seems justified to draw some more general conclusions on the principles of matrix design for microbial cell immobilization.

There are different routes which could be chosen to structurize this discussion. A first route could give priority to structural parameters, as summarized in Table 1.

Structural Parameters		
Chemistry	Precurser Matrix	Toxicity, time scale stability regions hydrophil/phob
Crosslinking density -Porosity		Swelling Permeation, Diffusion Mechanical stability cell growth
Geometry	Size Shape	Transport processes (-O_2, substrates, products) -Radius/thickness -bead, fiber, block, film

Table 1: Summary of Structural Parameters Related to Cell Immobilization