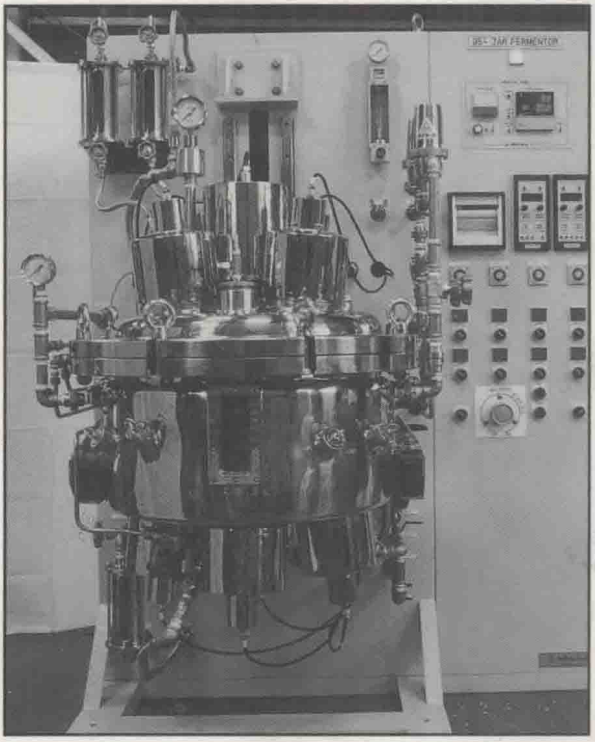
FERMENTATION AND BIOCHEMICAL ENGINEERING HANDBOOK

Principles, Process Design, and Equipment

SECOND EDITION



Edited by
Henry C. Vogel and Celeste L. Todaro

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Principles, Process Design, and Equipment

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DEDICATION

For my parents, Ernest and Charlotte Todaro, whose pursuit of knowledge inspired me and continues to do so.

Preface to the Second Edition

The second edition of the *Fermentation and Biochemical Engineering Handbook,* like the previous edition, is intended to assist the development, design and production engineer who is engaged in the fermentation industry. Particular emphasis is give to those unit operations most frequently encountered in the commercial production of chemicals and pharmaceuticals via fermentation, separation, and purification.

Some theory is included to provide the necessary insight into the unit operation but is not emphasized. Rather, the emphasis is placed on the practical aspects of development, design and operation—how one goes about collecting design data, what are the scale-up parameters, how to select the right piece of equipment, where operating problems arise, and how to troubleshoot.

The text is written from a practical and operating viewpoint, and all of the contributing authors have been chosen because of their industrial background and orientation. Several of the chapters which were in the first edition have been either deleted or replaced by other chapters which are more germane to current fermentation practice. Those chapters which were retained have been updated or have been rewritten to reflect current practice. Several new chapters were introduced to reflect current emphasis on cell cultures, nutritional requirements, statistical methods for fermentation optimization, cross-flow filtration, environmental concerns, and plant design

The editors wish to express their gratitude to Mrs. Connie Gaskill of Heinkel Filtering Systems, Inc., for the wordprocessing assistance she gave to this edition.

Scotch Plains, New Jersey
Bridgeport, New Jersey
September, 1996

Henry C. Vogel
Celeste L. Todaro

Preface to the First Edition

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The text is written from a practical and operating viewpoint, and all of the contributing authors have been chosen because of their industrial background and orientation. Since the handbook concerns fermentation and often the engineers involved in fermentation are not versed in microbiology, it was thought advisable to introduce this subject at the beginning of the book. Similarly, since much of fermentation deals with the production of antibiotics, it was deemed advisable to include some chapters specifically oriented to the production of sterile products.

The engineering using this handbook may wish that other unit operations or different pieces of equipment had been included other than those

selected. The selection was based on the individual contributors and my own experience, over many years of work in the field, with unit operations and pieces of equipment that have been the backbone and workhorses of the industry.

The editor wished to express his thanks to Mr. Stanley Grossel of Hoffmann-La Roche and Mr. John Carney of Davy McKee Corporation for reviewing and editing the draft copies. He also thanks Miss Mary Watson of Davy McKee Corporation for typing assistance, and Mr. Michael Garze of Davy McKee Corporation for his help in producing many of the graphs and illustrations. Dr. Sol Barer, the author of the microbiology chapter acknowledges the valuable input to the Celanese Biotechnology Department, and especially thanks Miss Maria Guerra for her patience in typing and retyping the manuscript.

Berkeley Heights, New Jersey
June 1983

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