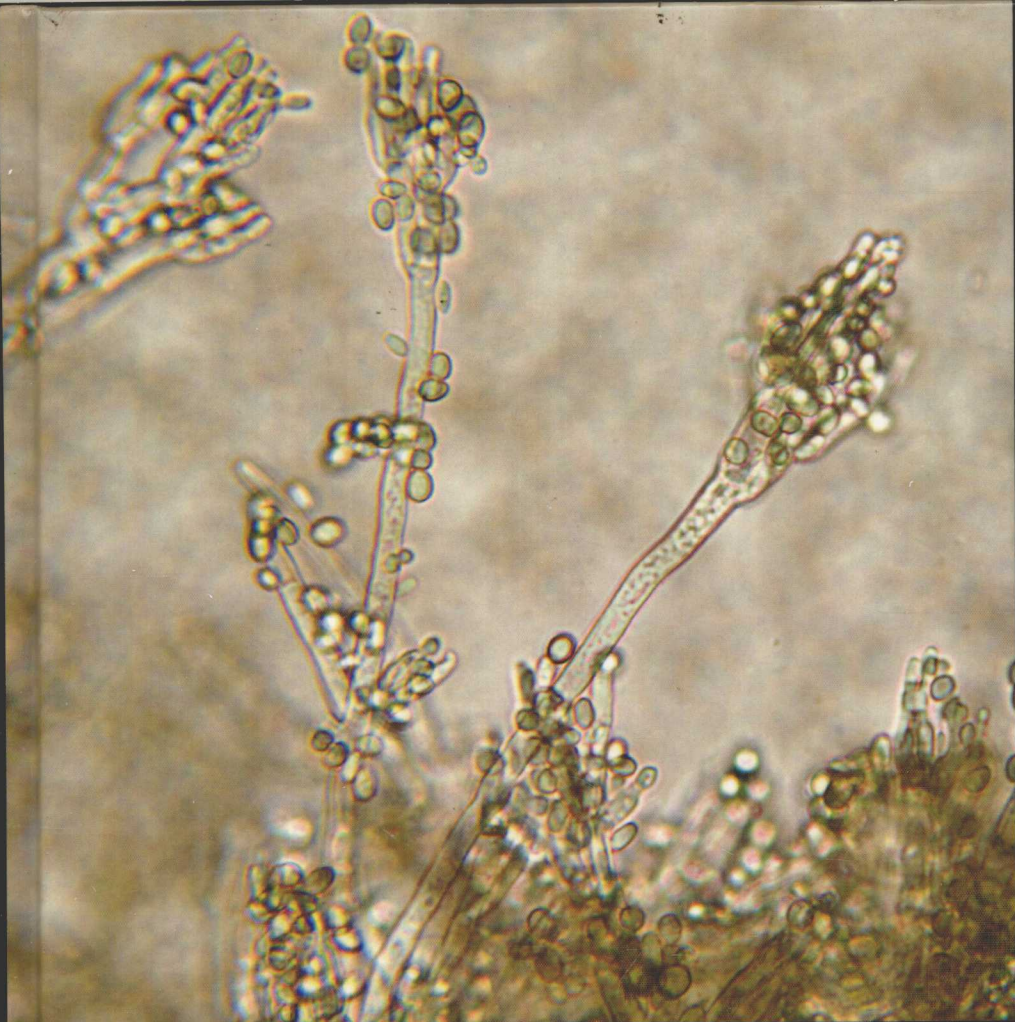


VOLUME 2



UPSTREAM INDUSTRIAL BIOTECHNOLOGY

*Equipment, Process Design, Sensing, Control,
and cGMP Operations*

MICHAEL C. FLICKINGER, EDITOR

 WILEY

UPSTREAM INDUSTRIAL BIOTECHNOLOGY

Equipment, Process Design, Sensing, Control,
and cGMP Operations

Volume 2

Edited By

MICHAEL C. FLICKINGER

Golden LEAF Biomanufacturing Training and Education Center (BTEC)

Department of Chemical and Biomolecular Engineering

North Carolina State University, Raleigh

North Carolina, USA



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PREFACE

Upstream Industrial Biotechnology is a compilation of essential in depth articles, organized topically and listed in alphabetical format, for biopharmaceutical, bioprocess and biologics process scientists, engineers and regulatory professionals from the comprehensive seven volumes of the *Encyclopedia of Industrial Biotechnology*. Process development for the manufacture of complex biomolecules involves solving many scientific, compliance and technical problems quickly in order to support pilot, preclinical and clinical development, technology transfer and manufacturing start-up. Every organization develops new processes from accumulated process knowledge. Accumulated process knowledge has a very significant impact on accelerating the time to market (and reducing the financial resources required) of products manufactured using recombinant DNA and living microbes, cells, transgenic plants or transgenic mammals. However, when an entirely new upstream platform is needed, there are few books that will quickly provide the depth of industry-relevant background. *Upstream Industrial Biotechnology* can fill this void as a 2 volume advanced desk reference. These volumes include relevant biology, protein purification and

engineering literature with abundant process examples provide by industry subject matter experts (SMEs) and academic scholars. This desk reference will also be useful for advanced biomanufacturing students and professionals to quickly gain in depth knowledge on how to design processes (and facilities) capable of being licensed to manufacture enzymes, biopharmaceutical intermediates, human and veterinary biopharmaceuticals or vaccines. The opportunity is yours to leverage the combined knowledge from scores of industry professionals from around the world who have contributed to *Upstream Industrial Biotechnology* to reduce the time and cost to deliver engineered proteins, biomolecules and cost-effective biologics to the market and especially to millions of patients worldwide.

Professor MICHAEL C. FLICKINGER, Editor

*Golden LEAF Biomanufacturing Training and Education
Center (BTEC)
Department of Chemical and Biomolecular Engineering
North Carolina State University
Raleigh, North Carolina, 27695-7928, USA*

Contributors

S. Robert Adamson, Genetics Institute, Andover, Massachusetts, USA

Mohamed Al-rubeai, University College Dublin, Belfield, Dublin, Ireland

Ashraf Amanullah, Oceanside Process Research & Development, Genentech. Inc, Oceanside, California, USA

Mikael R. Andersen, Technical University of Denmark, Department of Systems Biology, Lyngby, Denmark

Graham Andrews, MMBD Consulting, Gresham, Oregon, USA

Fabienne Anton, Institut für Technische Chemie, Gottfried Wilhelm Leibniz Universität Hannover, Hannover, Germany

William Apel, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho, USA

Alahari Arunakumari, Medarex, Inc., Bloomssbury, New Jersey, USA

Heino Büntemeyer, Institute of Cell Culture Technology, University of Bielefeld, Bielefeld, Germany

Claudia Berdugo, The Ohio State University, Columbus, Ohio, USA

Lorena Betancor, Instituto de Catalisis, CSIC, Madrid, Spain

Michael J. Betenbaugh, Johns Hopkins University, Baltimore, Maryland, USA

Rebekka Biedendieck, Protein Science Group, University of Kent, Canterbury, Kent, United Kingdom

John R. Birch, Lonza Biologics plc, Berkshire, United Kingdom

Christopher Bork, Genentech Inc., Manufacturing Science and Technology, Oceanside, California, USA

Bugarski Branko, University of Belgrade, Belgrade, Republic of Serbia

Boyke Bunk, Institute of Microbiology, Technische Universität Braunschweig, Braunschweig, Germany

Marco A. Cacciuttolo, Percivia LLC, Cambridge, Massachusetts, USA

F. Garcia Camacho, Universidad de Almeria, Almeria, Spain

Jeffrey J. Chalmers, The Ohio State University, Columbus, Ohio, USA

Leslie Chan, Australian Institute for Bioengineering and Nanotechnology, University of Queensland, Brisbane, Australia

Salim Charaniya, Genentech Inc., Manufacturing Science and Technology, Oceanside, California, USA

Timothy S. Charlebois, Genetics Institute, Andover, Massachusetts, USA

Marvin Charles, Lehigh University, Bethlehem, Pennsylvania, USA

Aaron Chen, Oceanside Process Research & Development, Genentech. Inc, Oceanside, California, USA

Yusuf Chisti, School of Engineering, Massey University, School of Engineering, Palmerston North, New Zealand

John Chon, Percivia LLC, Cambridge, Massachusetts, USA

Jens Christensen, Merck & Co. Inc, Rahway, New Jersey, USA

Susana Cortez, Institute for Biotechnology and Bioengineering, Centre of Biological Engineering, University of Minho, Braga, Portugal

Rosalie J. Cote, Becton Dickinson Microbiology Systems, Sparks, Maryland, USA

Stefan Dübel, Technische Universität Braunschweig, Institute of Biochemistry and Biotechnology, Spielmannstr, Braunschweig, Germany

John M. Davis, School of Life Sciences, University of Hertfordshire, Hatfield, Hertfordshire, United Kingdom

Frank Delvigne, Fond de la Recherche Scientifique (FRNS-FRS), Bruxelles, Belgium; Faculté Universitaire des Sciences Agronomiques, Unité de Bio-industries/CWBI, Gembloux, Belgium

C.P. Dillon, C.P. Dillon & Associates, Hurricane, West Virginia, USA

Pauline M. Doran, Monash University, Australia

Denis Drapeau, Genetics Institute, Andover, Massachusetts, USA

Hans G. Drexler, DSMZ-German Collection of Microorganisms and Cell Cultures, Braunschweig, Germany

Enrico Drioli, Institute on Membrane Technology, ITM-CNR, At University of Calabria, Rende, Italy

Dieter Eibl, Zurich University of Applied Sciences, School of Life Sciences and Facility Management, Institute of Biotechnology, Wädenswil, Switzerland

Regine Eibl, Zurich University of Applied Sciences, School of Life Sciences and Facility Management, Institute of Biotechnology, Wädenswil, Switzerland

Mario Fernández-Fernández, Universidad de Talca, Talca, Región del Maule, Chile

Gloria Fernandez-Lorente, Instituto de Catalisis, CSIC, Madrid, Spain

Mark Richard Fowler, Leicester School of Pharmacy, De Montfort University, Leicester, United Kingdom

Francisco Gabriel Ación Fernández, Department of Chemical Engineering, University of Almería, Almería, Spain

Felix Garcia-Ochoa, Facultad Quimicas, Universidad Complutense, Madrid, Spain

Maria Gavrilescu, Research Centre for Antibiotics, Iași, Romania

Martin Gawlitzek, Late Stage Cell Culture, Genentech, Inc., San Francisco, California, USA

Craig J.L. Gershater, S.B. Pharmaceuticals, Harlow, Essex, England

Haile Ghebremariam, Medarex, Inc., Bloomssbury, New Jersey, USA

Robert L. Gherna, American Type Culture Collection, Rockville, Maryland, USA

Lidietta Giorno, Institute on Membrane Technology, ITM-CNR, At University of Calabria, Rende, Italy

Ruben Godoy-Silva, The Ohio State University, Columbus, Ohio; Department of Chemical and Environmental Engineering, Universidad Nacional de Colombia, Bogotá, Colombia

Emilio Gomez, Facultad Quimicas, Universidad Complutense, Madrid, Spain

David R. Gray, Chiron Corporation, Emeryville, California, USA

J. Bryan Griffiths, Scientific Consultancy & Publishing, Salisbury, United Kingdom

Emilio Molina Grima, University of Almería, Almería, Spain

Maria J. Guardia, Camino De Purchill, Puleva Biotech Department of Process Engineering, Granada, Spain

Jose M. Guisan, Instituto de Catalisis, CSIC, Madrid, Spain

Elo Harald Hansen, Department of Chemistry Technical University of Denmark Lyngby, Denmark

Michael A. Hanson, Bio-Manufacturing Sciences Group, Pfizer, New York, USA

Colin Harbour, University of Sydney, NSW, Australia

Scott Harrison, Genetics Institute, Andover, Massachusetts, USA

Martin Hartmann, University of Augsburg, Augsburg, Germany

Martin Hedström, Lund University, Lund, Sweden

K. Heilmann, University of Potsdam, Institute of Biochemistry and Biology, Potsdam, Germany

Lutz Hilterhaus, Institute of Technical Biocatalysis, Hamburg University of Technology, Hamburg, Germany

Richard B. Hitchman, Oxford Expression Technologies Ltd., Oxford Brookes University, United Kingdom

Bernd Hitzmann, Institut für Technische Chemie, Gottfried Wilhelm Leibniz Universität Hannover, Hannover, Germany

- H.J.G. Ten Hoopen**, Delft University for Technology, Delft, The Netherlands
- Wei-Shou Hu**, University of Minnesota, Minneapolis, Minnesota, USA
- Weiwei Hu**, Cell Culture Development, Biogen Idec Inc., San Diego, California, USA
- Erwin Huebner**, University of Manitoba, Winnipeg, Manitoba, Canada
- Sunya Hussain**, Johns Hopkins University, Baltimore, Maryland, USA
- Dieter Jahn**, Institute of Microbiology, Technische Universität Braunschweig, Braunschweig, Germany
- Marco Jenzsch**, Roche Diagnostics GmbH, Pharma Biotech, Penzberg, Germany
- Dirk Jung**, Advanced Materials Science, Department of Physics, University of Augsburg, Augsburg, Germany
- Beth H. Junker**, Bioprocess R&D, Merck Research Laboratories, Rahway, New Jersey, USA
- Christian Kaisermayer**, Project Manager Cell Culture Applications & Support, GE Healthcare, Vienna, Austria
- Gautam Kapoor**, Department of Chemical Engineering, Indian Institute of Technology, Hauz Khas, New Delhi, India
- Linda A. King**, School of Life Sciences, Oxford Brookes University, United Kingdom
- Robert Kiss**, Late Stage Cell Culture, Genentech, Inc., San Francisco, California, USA
- Claudia Kloth**, Medarex, Inc., Bloomssbury, New Jersey, USA
- Arthur L. Koch**, Indiana University, Bloomington, Indiana, USA
- Dhinakar S. Kompala**, University of Colorado, Boulder, Colorado, USA
- Udo Kragl**, Rostock University, Rostock, Germany
- Andreas Lübbert**, Institute of Biotechnology; Centre of Bioengineering, Martin-Luther-University Halle-Wittenberg, Weinbergweg, Halle (Saale), Germany
- Alvaro R. Lara**, Departamento de Procesos y Tecnología, Universidad Autónoma Metropolitana-Cuajimalpa, Cuernavaca, México
- Philippe Langella**, Unité d'Ecologie et Physiologie du Système Digestif (UR910), INRA, Jouy-en-Josas, France
- Jean-Paul Lecomte**, Dow Corning S.A., Seneffe, Belgium
- Gene Lee**, Percivia LLC, Cambridge, Massachusetts, USA
- Mark Leonard**, Genetics Institute, Andover, Massachusetts, USA
- John Lewis**, Crucell NV, Leiden, The Netherlands
- Feng Li**, Oceanside Process Research & Development, Genentech. Inc, Oceanside, California, USA
- Jincai Li**, Oceanside Process Research & Development, Genentech. Inc, Oceanside, California, USA
- Andreas Liese**, Institute of Technical Biocatalysis, Hamburg University of Technology, Hamburg, Germany
- Carsten Lindemann**, Boehringer Ingelheim Pharma GmbH & Co. Biberach/ Riß, Germany
- Andreas Luebbert**, Martin Luther University, Halle, Germany
- Glenn MacIsaac**, Medarex, Inc., Bloomssbury, New Jersey, USA
- Julia F. Markusen**, Bioprocess Research & Development, Merck Research Laboratories, Rahway, NJ
- Bo Mattiasson**, Lund University, Lund, Sweden
- Carol Mclean**, Protein Fractionation Centre, Scottish National Blood Transfusion Service, Edinburgh, Scotland
- J.C. Merchuk**, Ben-Gurion University of the Negev Beer-Sheva, Israel
- B. Micheel**, University of Potsdam, Institute of Biochemistry and Biology, Potsdam, Germany
- Manuel Miró**, University of the Balearic Islands Carretera de Valldemossa, Illes Balears, Spain
- David A. Mitchell**, Universidade Federal do Parana, Curitiba, Brazil
- Eric Morello**, Unité Biologie Moléculaire du Gène chez les Extrêmophiles, Institut Pasteur, Paris, France
- Manuel Mota**, University of Minho, Portugal
- David W. Murhammer**, University of Iowa, Iowa City, Iowa, USA
- Mariam Naciri**, University College Dublin, Belfield, Dublin, Ireland
- Jong Hyun Nam**, Rensselaer Polytechnic Institute, Department of Chemical and Biological Engineering, Troy, New York, USA
- Someet Narang**, Johns Hopkins University, Baltimore, Maryland; MedImmune, Inc. Gaithersburg, Maryland, USA
- Lars Keld Nielsen**, Australian Institute for Bioengineering and Nanotechnology, University of Queensland, Brisbane, Australia

Alvin W. Nienow, University of Birmingham, School of Chemical Engineering, Birmingham, United Kingdom

Tim L. Noetzel, Roche Diagnostics GmbH, Pharma Biotech, Penzberg, Germany

Rosário Oliveira, Institute for Biotechnology and Bioengineering, Centre of Biological Engineering, University of Minho, Braga, Portugal

J. Ricardo Pérez-Correa, Chemical and Bioprocess Engineering Department, Pontificia Universidad Católica de Chile, Santiago, Chile

Laura A. Palomares, Universidad Nacional Autónoma de México, Cuernavaca, México

Nicolai S. Panikov, Northeastern University, Boston, Massachusetts, USA

Maria Papagianni, Aristotle University of Thessaloniki, Greece

Michael Pohlscheidt, Genentech Inc., Manufacturing Science and Technology, Oceanside, California, USA

David Pollard, Merck & Co. Inc, Rahway, New Jersey, USA

Robert D. Possee, Centre for Ecology and Hydrology, Oxford, United Kingdom

Isabelle Poquet, Unité des Bactéries Lactiques et pathogènes Opportunistes (UR888), Jouy-en-Josas, France

Octavio T. Ramírez, Universidad Nacional Autónoma de México, Cuernavaca, México

Govind Rao, Center for Advanced Sensor Technology, University of Maryland Baltimore County, Baltimore, Maryland, USA

Anurag S. Rathore, Department of Chemical Engineering, Indian Institute of Technology, Hauz Khas, New Delhi, India

Kenneth F. Reardon, Colorado State University, Fort Collins, Colorado, USA

Steve Reid, Australian Institute for Bioengineering and Nanotechnology, University of Queensland, Brisbane, Australia

Grainne L. Riley, School of Chemical Engineering, University of Birmingham, United Kingdom

Peter L. Roberts, R&D Department, Bio Products Laboratory, Elstree, Hertfordshire, United Kingdom

David K. Robinson, Bioprocess Research & Development, Merck Research Laboratories, Rahway, NJ

Liliana Rodolfi, CNR, Istituto per lo Studio degli Ecosistemi, Firenze, Italy

Rodica-Viorica Roman, Chemical Pharmaceutical Research Institute, Iași, Romania

Catherine H. Schein, Sealy Center for Structural Biology and Molecular Biophysics, Sealy Center for Vaccine Development, University of Texas Medical Branch, Galveston, Texas, USA

Thomas Scheper, Institut für Technische Chemie, Gottfried Wilhelm Leibniz Universität Hannover, Hannover, Germany

Gargi Seth, Genentech, Inc., 1 DNA way, South San Francisco, California, USA

Jose María Fernández Sevilla, University of Almería, Almería, Spain

Kevin L. Shade, Novartis Vaccines and Diagnostics, Speke, Liverpool, United Kingdom

Susan T. Sharfstein, Center for Biotechnology and Interdisciplinary Studies, Rensselaer Polytechnic Institute, Troy, New York, USA

Susan T. Sharfstein, University at Albany, College of Nanoscale Science and Engineering, Albany, New York, USA

Robert Shawley, Late Stage Cell Culture, Genentech, Inc., San Francisco, California, USA

Masaru Shiratori, Late Stage Cell Culture, Genentech, Inc., San Francisco, California, USA

Christian Sieblist, Institute of Biotechnology; Centre of Bioengineering, Martin-Luther-University Halle-Wittenberg, Weinbergweg, Halle (Saale), Germany

Martin S. Sinacore, Genetics Institute, Andover, Massachusetts, USA

David Smith, CAB International Europe United Kingdom, Egham, United Kingdom

Benjamin Sommer, Faculty of Technology, Fermentation Engineering, University of Bielefeld, Bielefeld, Germany

Koti Sreekrishna, Procter & Gamble Co., Cincinnati, Ohio, USA

Winfried Storhas, Mannheim University of Applied Sciences, Mannheim, Germany

Deidre M. Stuart, Queensland University of Technology, Brisbane, Australia

Wei Wen Su, University of Hawaii, Honolulu, Hawaii, USA

Shyamsundar Subramanian, Merck & Co. Inc., West Point, Pennsylvania, USA

Robert D. Tanner, Vanderbilt University, Nashville, Tennessee, USA

Pilar Teixeira, Institute for Biotechnology and Bioengineering, Centre of Biological Engineering, University of Minho, Braga, Portugal

Colin R. Thomas, School of Chemical Engineering, University of Birmingham, United Kingdom

Mario R. Tredici, Università degli Studi di Firenze, Firenze, Italy

Radu Z. Tudose, Technical University Gh.Asachi Iași, Iași, Romania

Richard M. Twyman, John Inness Centre, Norwich, United Kingdom

Cord C. Uphoff, DSMZ-German Collection of Microorganisms and Cell Cultures, Braunschweig, Germany

Patricia S. Vary, Northern Illinois University, DeKalb, Illinois, USA

Manojlović Verica, University of Belgrade, Belgrade, Republic of Serbia

Natarajan Vijayasankaran, Late Stage Cell Culture, Genentech, Inc., San Francisco, California, USA

Nedović Viktor, University of Belgrade, Belgrade, Republic of Serbia

James C. Warren, Merck & Co. Inc., West Point, Pennsylvania, USA

Ning Wei, Faculty of Technology, Fermentation Engineering, University of Bielefeld, Bielefeld, Germany

Bruce Whitelaw, Roslin Institute, Roslin, Midlothian, United Kingdom

Erik M. Whiteley, Geron Corporation, Menlo Park, California, USA

Ronnie Willaert, Flanders Interuniversity Institute for Biotechnology, Vrije Universiteit Brussel, Brussels, Belgium

Jack Wilson, ABEC, Inc., Allentown, Pennsylvania, USA

Jian-Jiang Zhong, Key Laboratory of Microbial Metabolism, Ministry of Education, School of Life Sciences & Biotechnology, Shanghai Jiao Tong University, Shanghai, China; State Key Laboratory of Bioreactor Engineering, School of Biochemistry, East China University of Science and Technology, Shanghai, China

Tan-Che Zhou, Molecular Biochemical Engineering Group, Key Laboratory of Microbial Metabolism, Ministry of Education, School of Life Sciences & Biotechnology, Shanghai Jiao Tong University, Shanghai, China

Wen-Wen Zhou, Molecular Biochemical Engineering Group, Key Laboratory of Microbial Metabolism, Ministry of Education, School of Life Sciences & Biotechnology, Shanghai Jiao Tong University, Shanghai, China

Weichang Zhou, Genzyme Corporation, Framingham, Massachusetts, USA

Graziella Chini Zittelli, CNR, Istituto per lo Studio degli Ecosistemi, Firenze, Italy

Marko Zlokarnik, Chemical Process Engineering, University of Köln, Cologne, Germany

Volume 2

**Equipment, Process Design, Sensing,
Control, and cGMP Operations**

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CONTROL, AND cGMP OPERATIONS**

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PART IV

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