



## Ambr<sup>®</sup> 250 High Throughput and Ambr<sup>®</sup> 250 Modular

Simplifying Progress

Selected Bibliography

**SARTORIUS**

# Ambr<sup>®</sup> 250 High Throughput and Ambr<sup>®</sup> 250 Modular

This bibliography covers many key applications and topics for the Ambr<sup>®</sup> High Throughput and Ambr<sup>®</sup> 250 Modular systems. Cell and product types and application areas are shown as icons on the next page

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# Key

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## Culture Type

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 Cell Therapy

 Chemical

 CHO

 Fungi

 HEK


 Insect Cells

 mAb


 Microbial

 Microcarriers

 Protein

 Stem Cell

 T-Cells

 Vaccine

 Viral Based Therapy


 Yeast


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## Technology

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 Ambr® 250 High Throughput

 Ambr® 250 Modular

 Bioreactor Process Control

 Bioreactor Vessel Characterization

 Consistency | Reproducibility

 Design of Experiment (DOE)

 Multivariate Data Analysis (MVDA)

 Perfusion

 Product Quality

 Scalability

 Spectroscopy

 Transient Transfection

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# Screening



## Parallel Scale-Down Tool to Accelerate Fermenterphile Selection

Jonas Bafna-Rührer, Suresh Sudarsan

Novo Nordisk Foundation Center for Biosustainability, Technical University of Denmark, Kemitorvet, Building 220, 2800 Kgs. Lyngby, Denmark

2022

<https://orbit.dtu.dk/en/publications/parallel-scale-down-tool-to-accelerate-fermenterphile-selection>

**“...the presented scale-down tool can be used to efficiently characterize the performance of microbial production strains in industrial fermentation processes and accelerate fermenterphile selection.”**



## The Next Generation of Cell Factories for Viral Vector Production

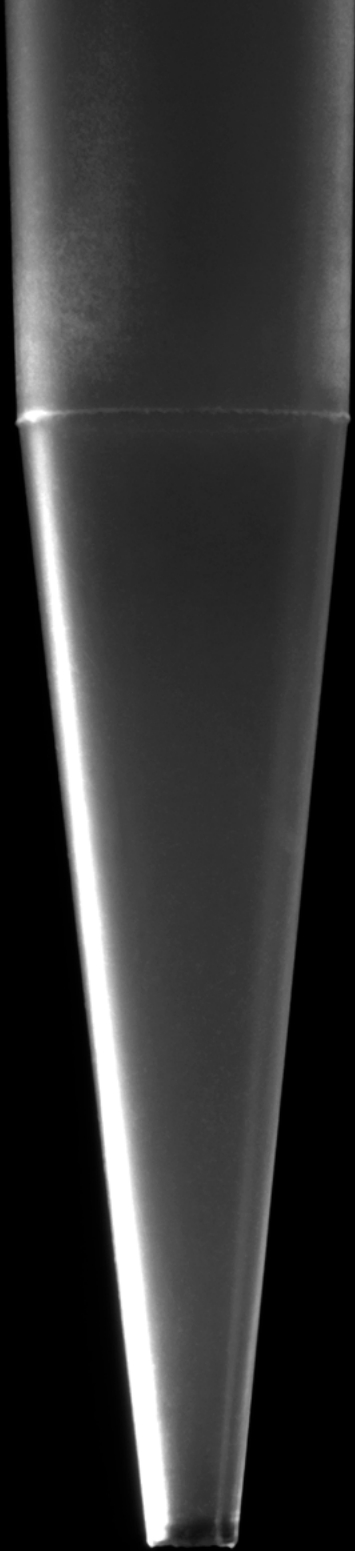
MaryAnn Labant

Genetic Engineering & Biotechnology News

2021

<https://doi.org/10.1089/gen.41.S2.04>

**“...the Ambr® platform, for cell culture, in combination with our design of experiments software... enables manufacturers to take a systematic approach toward optimizing cell culture and transfection parameters.”**





**Use of Ambr® 250 to Assess Mucic Acid Production in Fed-Batch Cultures of a Marine Trichoderma SP. D-221 04**

Anu Tamminen, Rosaliina Turunen, Dorothee Barth, Virve Vidgren, Marilyn G. Wiebe

VTT Technical Research Centre of Finland Ltd, Tietotie 2, P.O. Box 1000, 02044 Espoo, Finland

2022

<https://doi.org/10.1186/s13568-022-01436-4>

**“The wide bore sampling tips provided for the Ambr® 250 were adequate for sampling these cultures of filamentous fungi.”**



**Modulation of High Mannose Levels in N-Linked Glycosylation Through Cell Culture Process Conditions to Increase Antibody-Dependent Cell-Mediated Cytotoxicity Activity for an Antibody Biosimilar**

Shahid Rameez, Yogender K. Gowtham, Gautam Nayar, Sigma S. Mostafa

KBI Biopharma Inc., Durham, North Carolina, USA  
2021

<https://doi.org/10.1002/btpr.3176>



**A Semi-Empirical Mathematical Model to Specify the PH of Bicarbonate-Buffered Cell Culture Medium Formulations**

Tam T. Duong, James M. Piret, R. Robert Balcarcel

Bayer U.S. LLC, Pharmaceuticals, BD Cell Culture Development, Berkeley, California, USA  
University of British Columbia, Vancouver, British Columbia, Canada

2021

<https://doi.org/10.1002/cjce.24242>

**“The pH model was validated with bioreactors with controlled CO<sub>2</sub> flow; all four solutions made using the recipes derived from the pH model were within 0.01 pH unit of the model pH.”**



## Spent Media Analysis With an Integrated Ce-MS Analyzer of Chinese Hamster Ovary Cells Grown in an Ammonia-Stressed Parallel Microbioreactor Platform

Kathryn Elliott, Ji Young L. Anderson, Colin M. Gavin, Kenion H. Blakeman, Sarah W. Harcum, Glenn A. Harris

Clemson University, 105 Collings Street, Clemson, South Carolina 29634 USA  
2. 908 Devices Inc., 645 Summer Street, Boston, Massachusetts 02210 USA

2020

<https://doi.org/10.12665/J19OA.Elliott>



## Efficient High-Throughput Biological Process Characterization: Definitive Screening Design with the Ambr® 250 Bioreactor System

Mitchell Tai, Mandy Ly, Inne Leung, Gautam Nayar

Biologics Bioprocess Development, Bristol-Myers Squibb, Seattle, WA

2015

<https://doi.org/10.1002/btpr.2142>

**“The Ambr® 250 system demonstrated good scale-down capabilities and was useful for systematic and rapid experimentation that would normally be labor-intensive and prone to human error.”**





# Process Development



## Scalability Evaluation of a 50 L Stirred Tank Bioreactor Platform to Produce Adeno-Associated Viral Vectors (AAV) Using HEK293F Cells

Ambra Albertario, Patricia Curto, Lara Nascimento-Brooks, Daphne Bocciarelli, Kiren Baines, David Vincent

eXmoor Pharma, Bristol, UK  
Sartorius

2022

Request from your Sartorius representative. Celum ID 165621

**“We realized greater improvements in final product titer as well as improvements in production kinetics in the fed batch mode using the Ambr® 250 system.”**



## Accelerating Manufacturing to Enable Large-Scale Supply of a New Adenovirus-Vectored Vaccine Within 100 Days

Carina C.D. Joe, Rameswara R. Segireddy, Cathy Oliveira, Adam Berg, Yuanyuan Li, Dimitrios Doultinos, Nitin Chopra, Steffi Scholze, Asma Ahmad, Piergiuseppe Nestola, Julia Niemann, Alexander D. Douglas

Sartorius

2022

<https://www.biorxiv.org/content/10.1101/2021.12.22.473478v1.full>

**“Our ‘design of experiments’ approach on the Sartorius Ambr® 250 High Throughput Perfusion system identified early perfusion start and intensified perfusion after infection as factors that improved volumetric productivity.”**



## High Density HEK293T Culture for High Yield, High Quality, Stable Adenoviral Vector Production in Ambr® 250 Stirred Tank Reactors

Amélie Boulais, Lara Nascimento-Brooks, Shuangqing Yu, Zhicheng Cao, Li Hu, Shuren Feng, Jinlu Du, Cuiling Song, Junjie Luo,

Fiveplus Gene Technology Co., Ltd., China  
Sartorius

2022

Request from your Sartorius representative. Celum ID 165205

# Process Development



## **A Machine-Vision Approach for Bioreactor Foam Sensing**

Jonas Austerjost, Robert Söldner, Christoffer Edlund, Johan Trygg, David Pollard, Rickard Sjögren

Sartorius

2021

<https://doi.org/10.1177/24726303211008861>



## **How to Intensify Upstream Process Development With Ambr® 15 & 250**

James Edwards, Don Traul

Sartorius

2021

<https://www.sartorius.com/en/pr/webinar-how-to-intensify-upstream-process-development-with-ambr15250>



## **Genome-Scale Metabolic Rewiring Improves Titer Rates and Yields of the Non-Native Product Indigoidine at Scale**

Deepanwita Banerjee, Thomas Eng, Andrew K. Lau, Yusuke Sasaki, Brenda Wang, Yan Chen, Jan-Philip Prahl, Vasanth R. Singan, Robin A. Herbert, Yuzhong Li, Deepti Tanjore, Christopher J. Petzold, Jay D. Keasling, Aindrila Mukhopadhyay

Lawrence Berkeley National Laboratory, Berkeley, CA, 94720, USA  
Lawrence Berkeley National Laboratory, Emeryville, CA, 94608, USA

2020

<https://doi.org/10.1038/s41467-020-19171-4>

**“We realized greater improvements in final product titer as well as improvements in production kinetics in the fed-batch mode using the Ambr® 250 system.”**

# Process Development



## Upstream Microbial Process Characterization with Single-Use Bioreactors from 250 mL to 50 L

Lara Nascimento, Marco Leupold, Jens Rupprecht, Alison Rees-Manley, Barney Zoro, Melisa Carpio, Kevin McHugh

Sartorius

2019

Request from Sartorius  
Celum ID 64407



## Advanced Process Development Using Automated Micro Bioreactors Shortens Timelines and Provides Process Solutions for a Rapid Scale Up

Jincai Li, Sunil Chhatre

WuXi Biologics Sartorius

2018

[https://www.brighttalk.com/webcast/10519/318245?utm\\_source=888+Publishing+Ltd&utm\\_medium=brighttalk&utm\\_campaign=318245](https://www.brighttalk.com/webcast/10519/318245?utm_source=888+Publishing+Ltd&utm_medium=brighttalk&utm_campaign=318245)



## Developing New Perfusion Capabilities for Ambr® Bioreactors

Sartorius

2018

Request from your Sartorius representative. Celum ID 65563



## Unveiling Process Characterization Across Scales With Sartorius Upstream Solutions

Lara Nascimento, Marco Leupold, Jens Rupprecht, Alison Rees-Manley, Barney Zoro

Sartorius

2017

Request from your Sartorius representative. Celum ID 62992r



## Process Development of Microbial Plasmid DNA: Fast-Tracking with Modular Single-Use Minibioreactors

Barney Zoro, Andrew Frazer

Cobra Biologics, Keele, UK Sartorius

2017

<https://bioprocessintl.com/upstream-processing/upstream-single-use-technologies/single-use-minibioreactors-process-development-of-microbial-plasmid-dna/>



# Process Development



## Single Use Micro Scale Bioreactor Enables Higher Productivity

Barney Zoro

Sartorius

2016

<https://www.biospectrumindia.com/views/74/7723/single-use-micro-scale-bioreactor-enables-higher-productivity.html>



## Accelerate Your Process Development With High-Throughput, Single Use, Fully Automated Bioreactors

Mwai Ngibuini

Sartorius

2015

<https://www.sartorius.com/download/33378/white-paper-su-auto-bioreactors-new-data.pdf>



## Evaluation of a Stirred Small Scale Single-Use Bioreactor for Microbial Application

Marco Leupold, Thomas Dreher, Ute Husemann, Mwai Ngibuini, Gerhard Greller

Sartorius

2015

Request from your Sartorius representative. Celum ID 64349



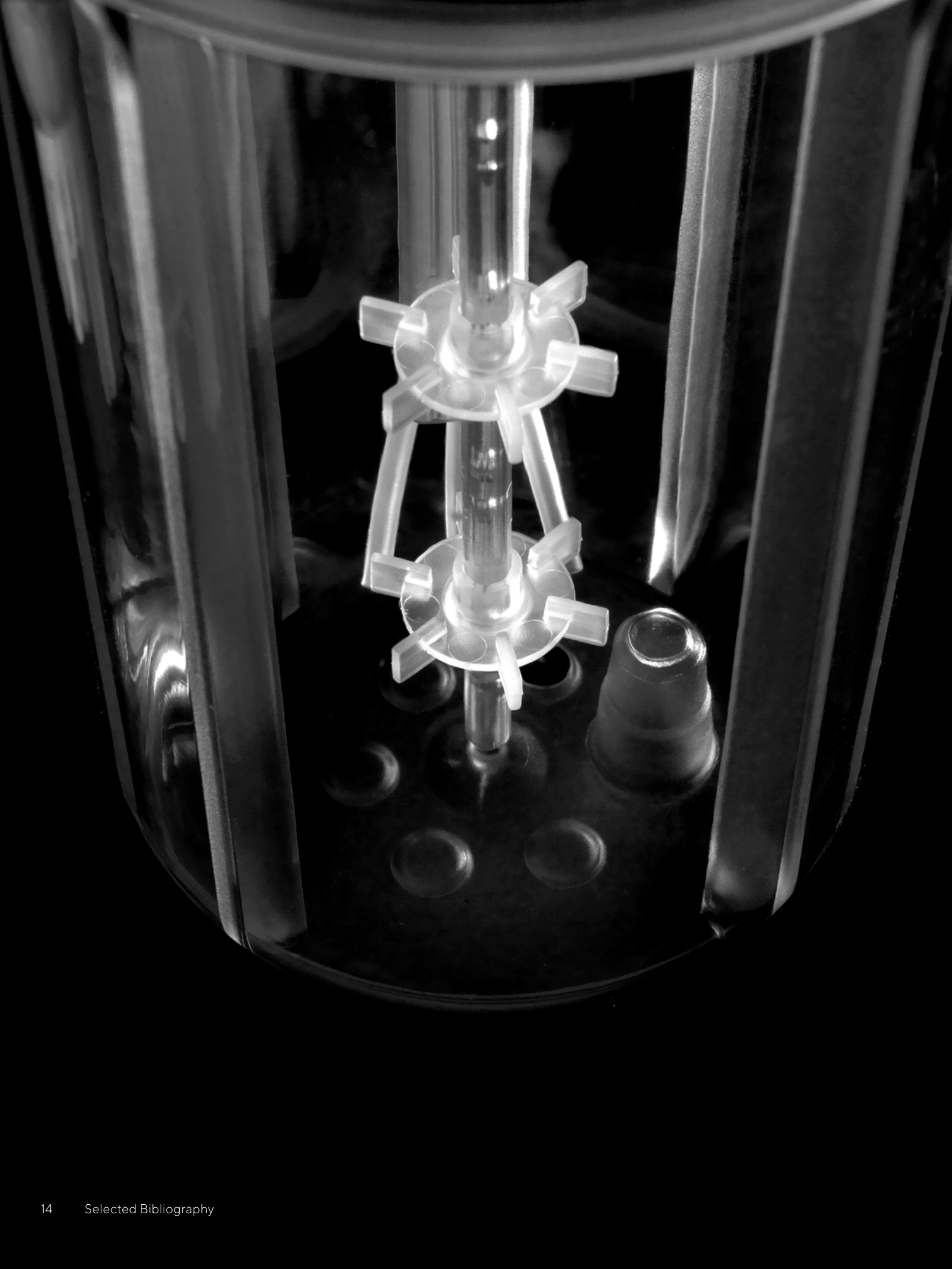
## Automated Mini Bioreactor Technology for Microbial and Mammalian Cell Culture: Flexible Startegy to Optimize Early Process Development of Biologics and Vaccines

Mwai Ngibuini

Sartorius

2014

<https://www.sartorius.com/download/8850/bioprocess-vol-12-sup-5-data.pdf>



# Working With Scale Down Models



## Shedding Light On the Dark Art Of Bioprocess Scaling

Kevin McHugh, Sinyee Yau-Rose, Katy McLaughlin

Sartorius

2022

<https://www.biopharminternational.com/view/shedding-light-on-the-dark-art-of-bioprocess-scaling>



## (8F) Ambr® 250 Scale-Down Model Limitations and Mass Transfer Characterization

Brian Kwan, John Bowers, Gaurav Chauhan, Arpan Bandyopadhyay, Wai Lam Ling

Merck & Co., Inc.,  
University of Iowa  
University of Minnesota

2020

<https://www.aiche.org/proceedings/people/brian-kwan>

“Cell culture process development and process characterization studies leverage bench-scale bioreactor systems as scale-down models for large scale manufacturing. The Ambr® 250 micro-scale bioreactor platform is a bench-scale system that offers customizable automation and individualized bioreactor control to support high-throughput workflows.”



## Webinar - The Concept of Upstream Scaling: From Theory to Practice

Vincent Lam, Sherwin Ting, Sinyee Yau-Rose

Sartorius

2020

<https://www.sartorius.com/en/pr/webinar-the-concept-of-upstream-scaling-from-theory-to-practice>



## Scale-Down Models to Support Process Characterization

Barney Zoro, Kevin McHugh

Sartorius

2020

<https://doi.org/10.12665/J19OA.Zoro>



## Webinar - Introducing BioPAT® Spectro - Scalable Raman Spectroscopy Platform for Ambr® and Biostat STR® Bioreactors

Svea Cheeseman, Dan Kiopec

Sartorius

2020

<https://www.sartorius.com/en/pr/webinar-the-concept-of-upstream-scaling-from-theory-to-practice>

# Working With Scale Down Models



## A Rapid, Low-Risk Approach for Process Transfer of Biologics from Development to Manufacturing Scale

Sebastian Ruhl, Naomi de Almeida, Melisa Carpio, Jens Rupprecht, Gerhard Greller, and Jens-Christoph Matuszczyk

Sartorius

2020

<https://bioprocessintl.com/upstream-processing/upstream-single-use-technologies/biostat-str-bioreactors-a-rapid-low-risk-approach-process-transfer-of-biologics-from-development-to-manufacturing-scale/>



## A Novel, Risk-Based Approach for Predicting the Optimum Set of Process and Cell Culture Parameters for Scaling Upstream Bioprocessing

Adrian Stacey, Jochen Scholz, Sinyee Yau-Rose

Sartorius

2020

Request from your Sartorius representative. Celum ID 114923



## From Early Stage to Late Stage Development: How to Characterize a Perfusion-Base

Perrine Rouel, Tom Jeffery

The Janssen Pharmaceutical Companies of Johnson & Johnson  
Sartorius

2019

<https://biopharma-asia.com/webinars/from-early-stage-to-late-stage-development-how-to-characterize-a-perfusion-based-vaccine-production-process-using-qbd/>



## Systematic Evaluation of High-Throughput Scale-Down Models for Single-Use Bioreactors (SUB) Volumetric Gas Flow Rate as the Criterion

Xiaolin Zhang, Joseph Moroney, Linda Hoshan, Rubin Jiang, Sen Xu

Merck & Co., Inc., 2000 Galloping Hill Road, Kenilworth, NJ 07033, USA

2019

<https://doi.org/10.1016/j.bej.2019.107307>

**“The highly comparable culture performance between Ambr® 250 and SUBs suggest that high throughput systems could be directly scaled up to production scales without the need of intermediate scales such as bench scale bioreactors, and the suitability of the Ambr® 250 systems for accelerated process development and characterization.”**



## Scale-Down Model Qualification of Ambr® 250 High Throughput Mini-Bioreactor System for Two Commercial-Scale mAb Processes

Matthew Manahan, G Michael Nelson, Jonathan J. Cacciatore, G Jessica Weng, Sen Xu, G Jennifer Pollard

Merck & Co., Inc., Kenilworth, New Jersey

2019

<https://doi.org/10.1002/btpr.2870>



120721 kLa Tips

SCENARIOS

Scenario

Configurations

Configuration

Simple Metrics

Simple Metric

Simple Metric 1

Relative Metrics

RESULTS

Results set

Scenarios > Scenario

Scenario

Configuration

Ambr® 250 High Throughput | Cell Culture Vessel  
Sparger: open pipe  
Impeller: 3-blade segment impeller

Liquid volume (L)  
Proportion of O2 in gas mix

Simple Confidence Metric

Simple Metric

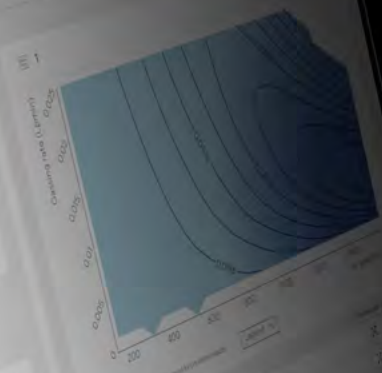
kLa - Prefer particulate kLa

Simple Metric 1

Tip speed - Prefer particulate Tip speed

Results > Result set

Result set:



# Working With Scale Down Models



## An Industrial Perspective on Scale-Down Challenges Using Miniaturized Bioreactors

Tannaz Tajseleiman, Lisa Mears,  
Ulrich Krühne, Krist V. Gernaey, Sjeff  
Cornelissen

Technical University of Denmark,  
Building 229, 2800 Kgs.Lyngby,  
Denmark,  
Novozymes A/S, Krogshøjvej 36,  
2880 Bagsvaerd, Denmark

2019

<https://doi.org/10.1016/j.tibtech.2019.01.002>



## Scale-Down Model Development in Ambr® Systems: An Industrial Perspective

Viktor Sandner, Leon P. Pybus, Graham  
McCreath, Jarka Glassey

FUJIFILM Diosynth Biotechnologies  
Belasis Avenue, Billingham, TS23 1LH,  
UK

University of Newcastle  
Newcastle Upon Tyne, NE1 7RU, UK

2018

<https://doi.org/10.1002/biot.201700766>

“...combinatorial improvements in process understanding (matching of mass transfer and cellular stress between scales through computational fluid dynamics and in vitro analysis), experimental design (advanced risk assessment and statistical design of experiments), and data analysis (combining uni- and multi-variate techniques) will ultimately yield Ambr® SDMs [scale-down models] applicable for future regulatory submissions”



## High-Throughput Process Development for Biopharmaceuticals

A.A. Shukla, S. Rameez, L.S. Wolfe,  
N. Oien

KBI Biopharma Inc., 2 Triangle Drive,  
Research, Triangle Park, Durham, NC  
27709, USA

2017

[https://doi.org/10.1007/10\\_2017\\_20](https://doi.org/10.1007/10_2017_20)



## Characterization of TAP Ambr® 250 Disposable Bioreactors, as a Reliable Scale-Down Model for Biologics Process Development

Ping Xu, Colleen Clark, Todd Ryder,  
Colleen Sparks, Jiping Zhou, Michelle  
Wang, Reb Russell, Charo Scott

Bristol-Myers Squibb, 519 Route 173  
West, Bloomsbury, NJ 08804

2016

<https://doi.org/10.1002/btpr.2417>

“The benefit of using a 24 array Ambr® 250 system instead of 5 L bioreactors is that it can significantly reduce cost and time as per our cost analysis, as well as expand the capacity for complicated DOE studies, which would typically overwhelm a multi 5 L system.”

# Working With Scale Down Models



## Case Study: Causing a Stir: How Single-Use, Mini Bioreactors Can Revolutionize Bioprocess Scale-Up

Mwai Ngibuini

Sartorius

2015

<https://www.thefreelibrary.com/Case+study%3a+causing+a+stir%3a+how+single-use%2c+mini+bioreactors+can...-a0430546667>



## Automated Disposable Small-Scale Bioreactor for High-Throughput Process Development Implementation of the 24 Bioreactor Array

Rachel Bareither, Marina Goldfeld, Chris Kistler, Andrew Tait, Neil Bargh, Robert Oakeshott, Kristin O'Neill, Linda Hoshan, David Pollard

Merck & Co, Inc., 2000 Galloping Hill Road, Kenilworth, NJ 07033, USA  
Sartorius

2015

<https://www.sciencegate.app/document/10.4155/pbp.14.64>

**“This work demonstrated the ability of the automated system to accelerate process development by executing a single statistical design of experiments, with a wider range of parameters, up to 3-5 times faster than conventional approaches”**





### Process Development for Improved Car-T Production Utilizing an Automated Perfusion Stirred-Tank Bioreactor

Tiffany Hood, Fern Slingby, Winfred Geis, Viktor Sander, Nicola Bevan, Quentin Vicard, Qasim A. Rafiq

University College London, United Kingdom

Sartorius

2022

Request from your Sartorius representative. Celum ID 166464



### Webinar: Single-use Technologies for Viral Vector Production

Lara Nascimento-Brooks, Franziska Bollmann

Sartorius

2021

<https://www.icheme.org/membership/communities/special-interest-groups/biochemical-engineering/events/03-02-21-single-use-technologies-for-viral-vector-production/>



### Design and Development of a New Ambr® 250 Bioreactor Vessel for Improved Cell and Gene Therapy Applications

Marco Rotondi, Ned Grace, John Betts, Neil Bargh, Elena Costariol

University College London, Gower Street, London WC1E 6BT, UK  
Aston Medical Research Institute, School of Life and Health Sciences, Aston University, Birmingham B4 7ET, UK  
University of Birmingham, Edgbaston, Birmingham B15 2TT, UK  
Sartorius

2020

<https://doi.org/10.1007/s10529-021-03076-3>

**“The new vessel resulted in significantly higher cell densities for T-cell Dynabead cultures compared to the original Ambr® 250 and static T-flask culture. The new vessel also demonstrated the ability to support hMSC microcarrier cultures and resulted in higher cell densities compared with spinner flask cultures.**

**This study has shown that new Ambr® 250 platform gives significant improvement over the original vessel for cell and gene therapy applications involving beads and microcarriers and will support process development activity for cellular therapies.”**



**Webinar - Ambr® 250 Modular  
- UCL - Process Development of  
Primary Human T-Cells**

Qasim Rafiq, ,Elena Costariol, Fernanda  
Masri, Lara Nascimento-Brooks

UCL  
Sartorius

2019

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representative



**Establishing the Scalable  
Manufacture of Primary Human  
T-Cells in an Automated Stirred-Tank  
Bioreactor**

Elena Costariol1, Marco Rotondi,  
Arman Amini, Christopher J. Hewitt,  
Alvin W. Nienow, Thomas R.J.  
Heathman, Martina Micheletti and  
Qasim A. Rafiq

University College London, London,  
WC1E 6BT, United Kingdom  
Aston Medical Research Institute,  
School of Life and Health Sciences,  
Aston University, Birmingham,  
B4 7ET, UK

University of Birmingham, Edgbaston,  
Birmingham, B15 2TT UK

Hitachi Chemical Advanced  
Therapeutic Solutions (HCATS),  
4 Pearl Court, Allendale, NJ, 07401

2019

<https://doi.org/10.1002/bit.27088>

**“Not only can T-cells be cultured  
in stirred-tank bioreactors, but that  
higher impeller agitation speeds  
facilitate higher cell densities with no  
adverse impact on cell quality.”**




**Germany**

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Phone +49 551 308 0

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[www.sartorius.com](http://www.sartorius.com)