Advanced Course
Downstream Processing

4 - 8 July, 2016

Aim of the course

The aim of the course is to provide and explain the tools to quantitatively and systematically design integrated downstream processes. Biotechnological engineers need to design compact and clean processes to efficiently separate bioproducts, such as proteins, from dilute complex fermentation broths to the required pharmaceutical degree of purity. Therefore, the general theme of this Advanced Course is the quantitative systematic design of integrated downstream processes.

The course presents the state of the art in downstream processing of biotechnological products. It provides knowledge of different techniques for solid-liquid separation, product release, refolding, concentration and purification of precious biotechnology products with a focus on the total integrated process. An international group of experts from both industry and academia will lecture to assure an optimal balance of practical knowledge and theoretical insight. Subsequently participants will be trained by exercises into the quantitative engineering aspects of bioseparations. At the end of the course, the participants should be able to estimate main equipment dimensions, know qualitative constraints to the integrated bioprocess and have a quantitative insight in process streams, structure and economics.

The course starts with an overview of possibilities and problems typically associated with the recovery of bioproducts. Physico-chemical characteristics of the products, as well as the fermentation broth with its multiple contaminants, are discussed in relation to possibilities for selective separation. Using this information, the general structure of large scale industrial processes will be outlined.

Course description

This one-week course is intensive and has long days. To ensure active participation by those attending, a combination of theoretical (lectures) and practical (exercises, computer simulations and case study) work is offered. Some online preparatory materials will be given to ensure all have the same basic knowledge.

Lectures

The thermodynamical basics and bioseperation principles will be introduced and developed during the course. Special attention will be paid to the unit operations typically used in this field of industry. Every day will be focused around a central theme.
The following subjects will be adressed:
Various solid-liquid separation techniques and cell disruption
application of major concentration techniques such as extraction, adsorption and membrane separation
scientific and industrial aspects of purification by means of precipitation and chromatography
release of intracellular products as well as protein folding in industrial protein processes.

Exercises and case study

Process integration is the binding element in the course. During the course, a case study on the design of an integrated purification process for a recombinant protein will offer the participants the opportunity to practice on the individual unit operations as well as on the integrated process. Finally, possibilities of computer-aided, rational design of integrated separation processes will be demonstrated. The course will be given in English.

Who should attend?

This Advanced Course is aimed at professionals (MSc or PhD level) in (bio)chemical engineering, or in microbiology or biochemistry with a basic knowledge in chemical engineering. The course is primarily aimed at those already employed in industry and who are interested in the separation of biotechnological products. In addition, this Advanced Course is an option in the two-year postgraduate programs of Delft University of Technology.

Location

The course will be held at:
Department of Biotechnology
Delft University of Technology
Van der Maasweg 9
2629 HZ Delft, the Netherlands
http://bt.tudelft.nl

Accommodation

Hotel accommodation can be arranged at your request addressed to biotechdelft@tudelft.nl.

Program, 4 – 8 July, 2016

Monday 3 July 2017

Theme: Today's bioseparation processes.
Mechanical separations: solid-liquid separation

08:45 Registration
09:00 Introduction to the separation processes
Pitfalls and challenges in bioseparation processes
Luuk van der Wielen
10:00 Engineering fundamentals
Mass balances: from batch to continuous counter current processes
Luuk van der Wielen
11:15 Case study: industrial protein production (I)
Marcel Ottens and Exercise Assistances
12.30 Lunch
13:30 Solid-liquid separation: filtration and centrifugation
Marcel Ottens
14:15 Assignment: design of filtration equipment
15:15 Predicting molecular properties. Molecular properties and selection of separation conditions: Equilibrium calculations
Luuk van der Wielen
16:15 Case study: industrial protein production (II)
18:00 Social drink and buffet

Tuesday 4 July 2017

Theme: Mechanical separations: solid liquid separation.
Concentration and design

09:00 Centrifugation in the biopharmaceutical industry
Design considerations of sedimentation and centrifugation processes: from biomass removal to centrifugal extraction
Joe Shultz
10:30 Assignment: centrifugation
11:30 Extractive separation: Solvent selection and equipment design in extraction processes
Marcel Ottens
12.30 Lunch
13:30 Assignment: extraction
14:30 Membrane technology: theory, design & industrial application
Reinoud Noordman
13:30 Assignment: membrane separation
14:30 Case study: industrial protein production (III)
18:00 End of the day

Wednesday 5 July 2017

Theme: Purification processes

09:00 Design of chromatographic separations. Equilibrium theory and column design: Non-linear and mass transfer effects
Marcel Ottens
10:15 Chromatography in industrial practice
Jan-Christer Janson
11:45 Industrial cases and applications of chromatography
Column design and operation from theory and practice
Jeroen den Hollander
12.30 Lunch
14:00 Assignment: chromatography
15:15 Quality by Design
Danielle Horneman
16:30 Case study: industrial protein production (IV)
17:45 End of the day
18:00 Lab tour: High Throughput facilities (optional)

Thursday 6 July 2017

Theme: Purification & formulation processes

9:00 Continuous chromatography and Simulated Moving Bed (SMB) Technology: Practical aspects and implementation for large scale chromatography in industry
Marc Bisschops

10:15 Bulk crystallization: Unit operation design for the crystallization of small and large biomolecules
Geert-Jan Witkamp

11:30 Assignment: crystallization

12.15 Lunch

13:15 Industrial crystallization: Real life examples
Rob Geertman

14:45 The use of continuous operations to enable next generation production economics
Joe Shultz

16:00 Design of an industrial process for purification of biologicals
Michel Eppink

17:15 Case study: industrial protein production (V)

18:15 End of the day

19:00 Course dinner

Friday 7 July 2017

Theme: Process development & process integration

9:00 Rational methodology for protein purification
Beckley Nfor

10:15 High Throughput techniques in downstream process
Jürgen Hubbuch

11:30 Process integration in industry
Matthias Wiendahl

12.15 Lunch

14:15 Case study: industrial protein production (VI)
Presentations of the three winning teams: the strategy DSP award ceremony

14:45 Evaluation of the course

15:00 Farewell drinks

Course Board

Dr. Marcel Ottens
Bioprocess Engineering
Delft University of Technology
Delft, the Netherlands

Prof. Luuk A.M. van der Wielen
Bioprocess Engineering
Delft University of Technology
Delft, the Netherlands

Course coordination

Vincent Renken, MSc, MSc(Ed)
Claudia Westhoff
BioTech Delft
Delft University of Technology
Delft, the Netherlands

Lecturers

Dr. Marc A.T. Bisschops
Pall Life Sciences
the Netherlands

Prof. Michel H.M. Eppink
Synthon BV, Nijmegen and
Bioprocess Engineering
Wageningen University,
Wageningen, the Netherlands

Dr. Rob Geertman
DSM Fibre Intermediates BV
Geleen, the Netherlands

Dr. Jeroen L. den Hollander
DSM Biotechnology Center
Delft, the Netherlands

Dr. Danielle Horneman
Bataviabiosciences
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Prof. Jürgen Hubbuch
Karlsruhe Institute for Technology
Karlsruhe, Germany

Prof. Jan-Christer Janson
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Department of Surface Biotechnology
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Dr. Beckley Kungah Nfor
Crucell
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Dr. Reinoud Noordman
Pentair X-Flow
Enschede, the Netherlands

Dr. Joe Shultz
Novartis
Basel, Switzerland

Dr. Matthias Wiendahl
NOVO Nordisk A/S
Gentofte, Denmark

Prof. Geert-Jan Witkamp
Bioprocess Engineering
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Delft, the Netherlands

Exercises assistance

Debora Gernat
Victor Koppejan
Silvia Pirrung
Marcelo Silva
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Course registration

Please register via the website to attend the course. Deadline for application is 19 June 2017. Applicants will be handled in order of the date of receipt.

Course fee

€ 2.750 in case of payment received before **22 May 2017** or
€ 3.000 in case of payment received after this date. In the event of cancellation before **22 May 2017**, a full refund will be granted, after this date, a 25% fee charge can be made.
To facilitate enrolment of young PhD-students from universities, a limited number of fellowships is available. The course fee with fellowship is € 1.375. To apply, please include a copy of your registration as a PhD-student from your university.

The fee includes course materials, lunches, the buffet on Monday and the course dinner on Thursday. The fee does not cover other meals and lodging.

When the number of participants is too low to have a fruitful course, BioTech Delft will cancel the event no later than six weeks before the start of the course. The course fee will be reimbursed within three weeks after cancellation.
In case a speaker will not be able to present his/her lecture due to unforeseen circumstances, BioTech Delft will arrange an equivalent replacement.

Hotel accommodation can be arranged at your request.

Preparatory texts will be sent after receipt of the course fee, a month before the start of the course. The complete digital course book will be supplied at the start of the course.

BioTech Delft organises biotechnology education at postgraduate level. BioTech Delft closely cooperates with the department of Biotechnology of Delft University of Technology. Since its foundation, in 1987, BioTech Delft has very successfully organised various types of postdoctoral education.

Currently BioTech Delft offers given each year various Advanced Courses covering the multidisciplinary spectrum of biotechnology. The courses have a long track-record dating back to 1988.

- Microbial Physiology and Fermentation Technology (1988)
- Downstream Processing (1989)
- Biocatalysis and Protein Engineering (1999)
- Environmental Biotechnology (1993)
- Genomics in Industrial Biotechnology (2005)
- Metabolomics for Microbial Systems Biology (2010)
- Bioprocess Design (2014)

Further information

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