

Advanced Course Bioprocess Design

19-23 March 2018

Course board:

Henk Noorman
Gerrit Eggink
Sef Heijnen
Ruud Weusthuis

Aim of the Course

With recent advances in molecular biology and a growing biomass availability for use as industrial feedstock, the bio-based economy is getting a wider range of inputs. Scaling up the bio(techno)logy innovations and implementation in large-scale factories or biorefineries clearly is a present bottleneck: industries are struggling to get the bio-opportunities to the market.

Teachers from universities and companies have joined forces and will present a program that in depth addresses industrial fermentation processes, and is flanked by overviews on upstream and downstream processing. The focus of the course is on design of innovative microbial fermentations, for bio-products such as amino acids and monomers for bio-plastics, complemented with examples of marine and mammalian processes, for micro-algae products and bio-pharmaceuticals. A substantial part (ca. 40% of the time) will be dedicated to a case study, executed in teams of 4-6 participants, on the design of a bioprocess for the production of a chemical (1,4-butanediol). In this case, basic theory on thermodynamics, microbial stoichiometry and kinetics, transport phenomena and scale up/down will be extensively applied and integrated. The team with the best design performance wins the Genomatica Bioprocess Design prize. There are several guest lecturers from leading universities and industries in the bioprocess field, providing latest insights in technology innovations, non-conventional feedstocks and new bio-product categories, complemented with views from the industrial practice. The Advanced Course Bioprocess Design is cooperatively organised by BioTech Delft and graduate school VLAG.

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, case study) work is offered. Some online preparatory materials will be given to ensure all have the same basic knowledge.

Lectures

The core lectures are mainly scheduled in the mornings and will focus on the following themes:

- Rates, thermodynamics and metabolism of micro organisms
- Transport processes in bioreactors
- Fermentation processes and their scale up features

In the early evenings, invited lectures are scheduled on e.g. examples of successful bioprocesses, downstream processing, upstream processing, novel feedstocks and economic aspects of bioprocessing.

Exercises and case study

For a better understanding of the lectures, the theory is applied in exercises on the Monday and Tuesday afternoons. From Wednesday on, the practical work continues in a 2.5 day case study on a real-life bioprocess design question where all theory will be needed. The course will be given in English.

Who should attend?

The course is primarily aimed at academic and industrial specialists (MSc, PhD or equivalent experience) who seek for refreshing and broadening their knowhow and practical insight in Bioprocess Design, to enable progress towards the biobased economy. A background in e.g. (bio)chemical engineering, microbiology or biochemistry and a basic working knowledge of the other disciplines is expected.

Duration/Location

This Advanced Course will be given on 19-23 March 2018

The course will be held at the
Hof van Wageningen
Awickse Allee 9
6701 AN Wageningen
The Netherlands
www.hofvanwageningen.nl
P +31 317 490 133
E biotechdelft@tudelft.nl
W www.biotechnologycourses.nl

Accommodation

Hotel accommodation can be arranged at your request addressed to biotechdelft@tudelft.nl. Lunches, the buffet on Monday and the course dinner on Thursday will be provided.

Program, 19-23 March 2018

Day 1

Monday 19 March 2018

Theme:

Micro-organisms: rates, process reaction and metabolism

08:45	Registration	
09:00-09:30	Introduction and outline Henk Noorman	Chapter 1
09:30-11:00	Downstream Processing Michel Eppink	Chapter 2
11:00-12:15	The process reaction for bioprocess design: a thermodynamic approach Sef Heijnen	Chapter 3
12:15-13:30	Lunch	
13:30-14:00	Calculation of fermentor in- and outflows broth mass using the process reaction Sef Heijnen	Chapter 4a
14:00-15:45	Exercise: obtaining the process reaction	Chapter 4b
15:45-17:30	Continuation of the exercise	
17:30-18:30	Advances in pretreatment of biomass Gerrit Eggink	Chapter 5
18:30	Social drink and buffet	

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Day 2 **Tuesday 20 March 2018**

Theme: *Fermentors: transport*

09:00-09:45	Gas transport Henk Noorman	Chapter 6a
09:45-10:30	Heat transport Henk Noorman	Chapter 6b
10:30-11:30	Mixing Henk Noorman	Chapter 6c
11:30-12:30	Animal cell cultures Dirk Martens	Chapter 7
12:30-13:30	Lunch	
13:30-15:15	Exercise: design of in/outflow, fermentor volume and transport processes	Chapter 6d
15:15-17:30	Continuation of the exercise	
17:30-18:30	Bioprocess design: quick and dirty in 10 steps Sef Heijnen	Chapter 8
18:30	End of day	

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Day 3

Wednesday 21 March 2018

Theme:

Fermentation processes and their scale-up features

09:00-09:45	Industrial microbial fermentation Henk Noorman	Chapter 9
09:45-10:45	Algal processes Rene Wijffels	Chapter 10
10:45-11:30	Animal cell cultures Dirk Martens	
11:30-12:30	Metabolic design: example and exercises (part 1) Ruud Weusthuis	Chapter 11
12:30-13:00	Lunch	
13:00-14:30	Excursion to Algea Parc	
14:30-15:30	Metabolic design: example and exercises (part 2) Ruud Weusthuis	Chapter 11
15:30-17:00	<u>Start of the case study</u> Introduction to the case study Henk Noorman	Chapter 18
	Part 1 of the case study <i>Calculation of the process reaction stoichiometry</i>	Chapter 18
17:30-18:30	Scale-up/scale-down approach Henk Noorman	Chapter 12
18:30	End of day	

ADVANCED COURSE BIOPROCESS DESIGN 2018

Day 4 **Thursday 22 March 2018**

Theme: *Case study*

09:00-10:45	Part 2 of the case study <i>Quantification of in- and outflows (rates, composition) and fermentor broth mass</i>	Chapter 18
10:45-12:30	Microbial synthesis of reduced compounds for the chemical industry Gerrit Eggink	Chapter 13
12:30-13:00	Lunch	
13:00-17:00	Part 3 of the case study <i>Vessel geometry and quantification of transport processes inside the fermentor</i> <i>Strategies for improvements</i> <i>Reporting results</i>	Chapter 18
17:00-18:00	C1 feedstocks fermentation Liang Wu	Chapter 14
19:00	Course dinner	

ADVANCED COURSE BIOPROCESS DESIGN 2018

Day 5 **Friday 23 March 2018**

Theme: *Case study*

09:00-09:45	Scale-up/scale-down: characteristic times and gradients Sef Heijnen	Chapter 15
09:45-10:45	Part 4 of the case study <i>Full scale conditions and scale-up/scale-down</i>	Chapter 18
11:45-12:45	Ruber as cell factory for lactic acid production at low pH Ruud Weusthuis	Chapter 16
12:45-13:45	Lunch	
13:45-15:15	Final presentations by the design teams Genomatica design prize	
15:15-16:15	<i>Keynote lecture</i> Process design and development: lessons from the industry Jason Crater	Chapter 17
16:15	Farewell drink	

Course leader

Prof. Henk Noorman

DSM Biotechnology Center and
Delft University of Technology
Delft, the Netherlands

Course Board

Prof. Gerrit Eggink

Biobased Products and Bioprocess
Engineering
Wageningen University
Wageningen, the Netherlands

Prof. Sef Heijnen

Cell Systems Engineering,
Delft University of Technology
Department of Biotechnology
Delft, the Netherlands

Dr. Ruud Weusthuis

Biobased Commodity Chemicals
Wageningen University
Wageningen, the Netherlands

Course coordination

Vincent Renken, MSc, MSc(Ed)

Claudia Westhoff

BioTech Delft, Delft University of
Technology
Department of Biotechnology
Delft, the Netherlands

Dr. Fré Pepping

Graduate School VLAG
Wageningen University
Wageningen, the Netherlands

Guest Lecturers

Jason Crater

Genomatica Inc.
San Diego, CA, USA

Prof. Michiel Eppink

Synthon BV, Nijmegen and
Bioprocess Engineering
Wageningen University, Wageningen,
the Netherlands

Dr. Dirk Martens

Bioprocess Engineering
Wageningen University
Wageningen, the Netherlands

Prof. René Wijffels

Bioprocess Engineering
Wageningen University
Wageningen, the Netherlands

Dr. Liang Wu

DSM Biotechnology Center
Delft, the Netherlands

Exercises

Dr. Amit Deshmukh

DSM Biotechnology Center
Delft, the Netherlands

Excursion

Dr. R. Bosma

AlgaePARC
Wageningen University & Research
Wageningen, the Netherlands

Fees and registration

Please register via the website to attend the course. Deadline for application is 5 March 2018. Applicants will be handled in order of the date of receipt.

The course fee

€ 2.500 in case of payment received before 8 January 2018 or
€ 2.750 in case of payment received after this date. In the event of cancellation before 22 January 2018, 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 € 1.250. To apply, please include a copy of your registration as a PhD-student from your university.

PhD/PDEng students working in the Department of Biotechnology of TU Delft, or in the graduate school VLAG may apply for the special reduced fee of € 625.

To apply, please include a proof of your registration as a PhD student at one of these institutes.

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 materials 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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Course coordination

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