Advanced Course Bioprocess Design

27-31 March 2017

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 27-31 March 2017

The course will be held at the
Delft University of Technology
Science Centre Delft
Mijnbouwstraat 120
2628 RX Delft
The Netherlands
http://sciencecentre.tudelft.nl/
P +31 (0)15 27 85200
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, 27-31 March 2017

Monday 27 March 2017
Theme: Micro-organisms: Rates, process reaction and metabolism

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

Tuesday 28 March 2017
Theme: Fermentors: transport

09:00 Gas transport
Henk Noorman
09:45 Heat transport
Henk Noorman
10:30 Mixing
Henk Noorman
11:30 Biochemistry of energy metabolism and product pathways
Ruud Weusthuis
13:30 Exercise: design in- and outflow, fermentor volume and transport processes
15:15 Continuation of the exercise
17:30 Bioprocess design: quick and dirty in 10 steps
Sef Heijnen

Wednesday 29 March 2017
Theme: Fermentation processes and their scale up features

09:00 Industrial microbial fermentation
Henk Noorman
09:45 Algal processes
René Wijffels
10:45 Animal cell cultures
Dirk Martens

11:30 Exercise 1: Metabolic Design
Ruud Weusthuis
12:30 Excursion to BPF
14:30 Exercise 2: Metabolic Design
Ruud Weusthuis

15:30 Introduction to the case
Henk Noorman
Case study
Calculation of the process reaction stoichiometry
17:30 Scale-up/scale-down approach
Henk Noorman

Thursday 30 March 2017
Theme: Case study

9:00 Case study part 2:
Quantification of in- and outputs (rates, composition) and fermentor broth mass
10:45 Microbial synthesis of reduced compounds for the chemical industry
Gerrit Eggink
13:00 Case study part 3:
- Vessel geometry and quantification of transport processes inside the fermentor
- Strategies for improvements (Genomatica bioprocess design prize)
- Reporting results

17:00 C1 feedstocks fermentation
Liang Wu
19:00 Course dinner

Friday 31 March 2017
Theme: Case study

9:00 Scale-up/scale-down: characteristic times and gradients
Sef Heijnen
9:45 Case study:
Full scale conditions and scale-up/scale-down
11:45 Low-pH fermentation to succinic acid, the basis for efficient recovery
Mickel Jansen
13:45 Final presentations by design teams
Genomatica design prize
15:15 Keynote Lecture
Process design and development: lessons from the industry
Jason Crater
16:15 Farwell drink

Fees and registration

Please register via the website to attend the course. Deadline for application is 13 March 2017. Applicants will be handled in order of the date of receipt.

The course fee

€ 2.500 in case of payment received before 13 February 2017 or
€ 2.750 in case of payment received after this date. In the event of cancellation before 13 February 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 € 1.250. 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.

The complete course book will be supplied at the start of the course.

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

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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. Mickel Jansen
DSM Biotechnology Center
Delft, 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

Bioprocess Pilot Facility
DSM
Delft, the Netherlands

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 until 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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