



ADVANCED COURSE

Environmental Biotechnology

26 September - 6 October 2023

Mark van Loosdrecht
Robbert Kleerebezem
Cristian Picioreanu

AIM OF THE COURSE

To learn how to go from microbial opportunity to a full scale process.

Environmental Biotechnology is a rapidly developing, increasingly important branch of science that has implications for both the prevention and clean-up of pollution in domestic and industrial waste streams. This international training course will introduce mixed microbial culture theory and reactor technology in relation to the design and scale-up of advanced treatment processes from the laboratory to the full scale implementation.

The course integrates fundamental aspects of microbiology and biochemical engineering with consideration of practical applications towards process design and scale-up. The advantages and pitfalls of applying biotechnological methods to environmental problems will be emphasized.

Microbiological topics include thermodynamics, kinetics and ecophysiology of pure and mixed cultures, (geo)

biochemical element cycles and biofilm formation.

Biochemical engineering subjects will include mathematical modelling, biomass retention by various separation techniques, mass transport in biofilms and three phase reactors, scale up/scale down, integration of processes and process control, and process design from flask to full scale and back.



BioTechDelft
POSTGRADUATE EDUCATION



THE COURSE

The course has already been held 22 times since 1993 and is based on the profound expertise of the microbiologists and process engineers within the Environmental Biotechnology Group at Delft University of Technology. Internationally known experts from other universities and industry will present the guest lectures.

For a better understanding of the lectures and to enhance active participation by those attending, this intensive training course consists of lectures, exercises, computer simulations (existing, widely used simulation programs) and an excursion to an Aerobic Granular Sludge Waste Water Treatment Plant.

LECTURES

The core lectures are mainly scheduled in the first week. In the first week we will focus on the following themes:

- Basic microbiology, stoichiometry and kinetics
- Thermodynamics and competition
- (Bio)process engineering principles
- Scale up

In the second week we will focus on the computer simulation and case study.

CASE STUDY

A three-day case study will offer the participants the opportunity to practice on the integration of the different topics and to design a process for the treatment of a C, S and N containing industrial waste stream. The results and conclusions will be discussed in a plenary session (Friday).

WHO SHOULD ATTEND?

This Advanced Course is aimed at professionals (MSc, PhD or equivalent experience) in microbiology, biochemistry or biochemical engineering with a basic working knowledge of the two other disciplines. Also, molecular biologists with a microbial background may apply. The course is primarily aimed at those already employed in industry who wish to update their theoretical knowledge and practical insight in this field. In addition, this Advanced Course is an option in the two-year postgraduate programs of Delft University of Technology.

COURSE BOARD

Mark van Loosdrecht
Robbert Kleerebezem
Environmental Biotechnology
Department of Biotechnology
Delft University of Technology
Delft, the Netherlands

Cristian Picioreanu
Environmental Science and Engineering
King Abdullah University of Science
and Engineering
Thuwal, Kingdom of Saudi Arabia

COURSE COORDINATION

Yvonne van Gameren
Jenifer Baptiste
BioTech Delft, Delft University of
Technology
Department of Biotechnology
Delft, the Netherlands

GUEST LECTURERS

Mike Jetten
Radboud Universiteit Nijmegen
Department of Microbiology
Nijmegen, the Netherlands

Andreas Giesen
Royal HaskoningDHV
Amersfoort, the Netherlands

Yuemei Lin
Martin Pabst
Rebeca Gonzalez Cabaleiro
Michele Laurenti
Ludovic Jourdin
Samarpita Roy
Philipp Wilfert
Delft University of Technology
Delft, the Netherlands

COURSE ASSISTANCE

Maxim Allaart
Philipp Wilfert
Sirous Ebrahimi
Zita van der Krogt
Delft University of Technology
Delft, the Netherlands

PROGRAM

TUESDAY 26 SEPTEMBER 2023

Theme: Fundamentals of environmental biotechnology:
basic microbiology, stoichiometry and kinetics

- 08:30 Registration
09:00 Welcome: outline of the course
Robbert Kleerebezem
09:15 Microbial communities
Samarpita Roy
10:15 Stoichiometry of microbial growth
Robbert Kleerebezem
11:15 Kinetic description of microbial growth in axenic and mixed cultures
Rebeca Gonzalez Cabaleiro
12:00 Lunch & Group picture
13:15 Exercises: stoichiometry and kinetics of microbial systems
Robbert Kleerebezem & Rebeca Gonzalez Cabaleiro
18:45 Social drink and buffet

WEDNESDAY 27 SEPTEMBER 2023

Theme: Fundamentals of environmental biotechnology:
thermodynamics and competition

- 09:00 Basic thermodynamics of biological systems
Robbert Kleerebezem
10:15 Bioenergetics of microbial growth
Rebeca Gonzalez Cabaleiro
11:15 Recent developments in anaerobic wastewater treatment
Robbert Kleerebezem
12:00 Lunch
13:00 Exercises: thermodynamics, competition and growth of mixed cultures
Robbert Kleerebezem & Rebeca Gonzalez Cabaleiro
18:00 End of the day

THURSDAY 28 SEPTEMBER 2023

Theme: Fundamentals of environmental biotechnology:
(bio)process engineering principles

- 09:00 Basic principles of transport processes in bioreactors
Cristian Picioreanu
10:00 Gas-liquid interphase transport
Cristian Picioreanu
11:00 Biofilms and flocs: diffusive transport and modelling of the structures
Cristian Picioreanu
12:30 Lunch
13:30 Exercises on the integration of microbial conversions (zero and first order kinetics) and transport
Cristian Picioreanu
17:00 Visit to research projects at the Department of Biotechnology
Zita van der Krogt
19:00 End of the day

FRIDAY 29 SEPTEMBER 2023

- Theme: Scale-up
09:00 Scale-up of environmental processes using regime analysis
Cristian Picioreanu
12:15 Lunch
13:15 Case study Scale-up: Aerobic granular sludge
Cristian Picioreanu
17:30 Social drink

MONDAY 2 OCTOBER 2023

- Theme: tba
09:00 Extracellular polymeric substances in biofilm: analysis and application
Yuemei Lin
10:15 Water mining
Philipp Wilfert
11:30 Anammox technology
Mark van Loosdrecht
12:30 Lunch
13:00 Bus to excursion aerobic granular sludge WWTP
Nereda Utrecht
Mark van Loosdrecht
16:00 Bus back to Delft

TUESDAY 3 OCTOBER 2023

Theme: Microbial conversions in environmental biotechnology

- 09:00 Meta-genomics
Samarpita Roy
10:00 Metaproteomics to study composition and functional diversity of microbial communities
Martin Pabst
11:00 Metabolomics
Rebeca Gonzalez Cabaleiro
12:00 Lunch
13:00 Case study, part I: analysis of problem
Robbert Kleerebezem/Maxim Allaart/Sirous Ebrahimi/Philipp Wilfert
16:45 Discovery and application of novel anaerobes in the microbial nitrogen and methane cycles
Mike Jetten

WEDNESDAY 4 OCTOBER 2023

Theme: Continuation case study

- 09:00 Case study, part IIa: generation of process options
Robbert Kleerebezem/Maxim Allaart/Sirous Ebrahimi/Philipp Wilfert
11:30 Case study, part IIb: reporting process options and choices
Robbert Kleerebezem/Maxim Allaart/Sirous Ebrahimi/Philipp Wilfert
12:30 Lunch
13:30 Recent microbiology of the N cycle
Michele Laurenti
14:15 Microbial selection principles
Michele Laurenti
15:30 Continuation Case study, part IIb: reporting process options and choices
Robbert Kleerebezem/Maxim Allaart/Sirous Ebrahimi/Philipp Wilfert
17:00 End of the day

THURSDAY 5 OCTOBER 2023

Theme: Continuation of the case study

- 09:00 PHA Production
Robbert Kleerebezem
10:00 Case study, part III: design and calculations on the chosen process options
Robbert Kleerebezem/Maxim Allaart/Sirous Ebrahimi/Philipp Wilfert
12:30 Lunch
13:30 Microbial electrosynthesis
Ludovic Jourdin
14:30 Continuation of the case study, part III
Robbert Kleerebezem/Maxim Allaart/Sirous Ebrahimi/Philipp Wilfert
17:00 Microbiology at the phosphorus cycle
Mark van Loosdrecht
19:00 Course dinner

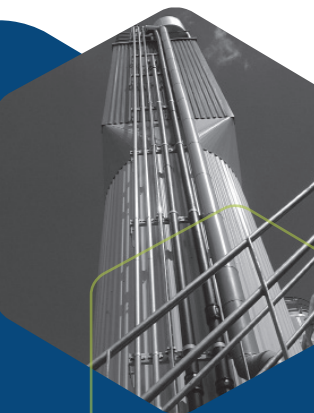
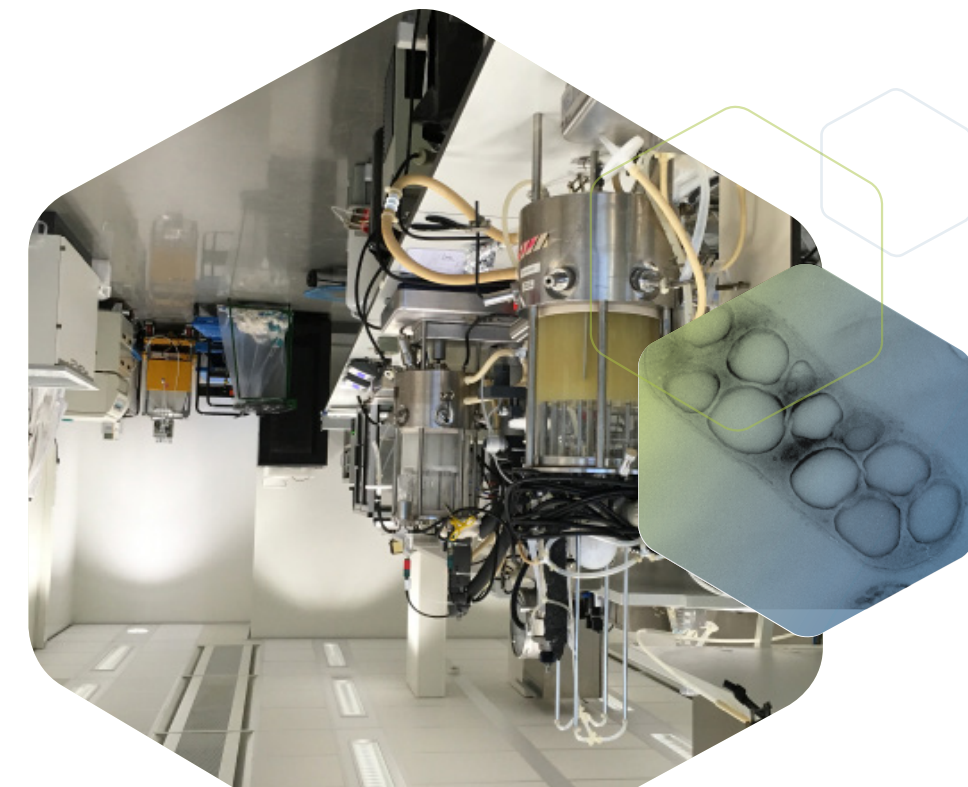
FRIDAY 6 OCTOBER 2023

Theme: Continuation of the case study

- 09:00 Continuation of the case study, part III
Robbert Kleerebezem/Maxim Allaart/Sirous Ebrahimi/Philipp Wilfert
12:30 Lunch
13:30 Reporting of results
Robbert Kleerebezem/Maxim Allaart/Sirous Ebrahimi/Philipp Wilfert
15:15 Closing lecture
Implementation of technology
Andreas Giesen
16:15 Course evaluation

LOCATION

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



COURSE REGISTRATION

Please register via the website to attend the course. Deadline for application is 5 September 2023. Applications will be handled in order of the date of receipt.

COURSE FEE

€ 3.000 in case of registration before 18 July 2023 or

€ 3.250 in case of registration after this date. In the event of cancellation before 1 August 2023, a full refund will be granted, after this date, a 25% fee charge can be made.

To facilitate enrolment of employees from non-profit organisations and universities, a limited number of fellowships is available with a reduced fee of € 2100.- for employees of non-profit organisations and € 1500.- for PhD-students. To apply, please include a copy of your enrolment as a PhD-student from your university.

The fee includes course materials, lunches, drinks, buffet and a course dinner as indicated on the program. 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.

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.



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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 Advanced Courses given each year, 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)*
- *Environmental Biotechnology (1993)*
- *Biocatalysis and Protein Engineering (1999)*
- *Bioprocess Design (2014)*
- *Modelling and Computation for Microorganisms in Bioprocesses (2018)*
- *Integrated Multi-Omics approaches for Improvement of Industrial Microbes (2020)*

FURTHER INFORMATION

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Course coordination

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Advanced
Courses in
Biotechnology

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