

#### Board of the Course

*Prof. J.J. Heijnen*

Biochemical Engineering, Biokinetics

*Prof. M.C.M. van Loosdrecht*

Biokinetics, Applied and Environmental Microbiology

#### Faculty staff

*Ir. M.J. Kampschreur*

Environmental Engineering, Wastewater Treatment

*Dr. R. Kleerebezem*

Environmental Engineering, Wastewater Treatment

*Dr. M.K. de Kreuk*

Environmental Engineering, Wastewater Treatment

*Dr. R.G.J.M. van der Lans*

Biochemical Engineering, Bioreactor Design

*Prof. K.Ch.A.M. Luyben*

Dean of the Faculty of Applied Sciences

*Dr. G. Muyzer*

Molecular Biology

*Dr. C. Picioreanu*

Mathematical Modelling in Biochemical Engineering

#### Guest lecturers

*Prof. K. Chandran*

Columbia University, Dept. of Earth and Environmental Engineering, New York, USA

*Dr. H.V.M. Hamelers*

Wageningen University, Agrotechnology and Food Sciences, the Netherlands

*Dr. R.T.J.M. van der Heijden*

Zuiveringsinformatiedienst, Nijmegen, the Netherlands

*Ir. J. Kruit*

Royal Haskoning, Nijmegen, the Netherlands

*Dr. F. Rogalla*

Black & Veatch, London, United Kingdom

*Dr. M. Strous*

Radboud University, Department of Microbiology, Nijmegen, the Netherlands

#### Course Coordinators

Ms. G.W.J.O. Aggenbach

Dr. L.A. van der Meer-Lerk

Biotechnological Sciences Delft Leiden (BSDL) is a graduate school that started as a joint

initiative in biotechnological research and education of Delft University of Technology and

Leiden University. It is supported by special funds supplied by these universities, the Dutch

government and the European Union.

The BSDL postgraduate educational program features PhD-studies and special two-year

programs for those who wish to tailor their own specialisation to the needs of multidisciplinary

biotechnological research and design. The latter programs are offered by the Institute

Biotechnology Studies Delft Leiden (Institute BSDL) and lead to the degree of 'Professional

Doctorate in Engineering'. It also includes participation in a series of Advanced Courses

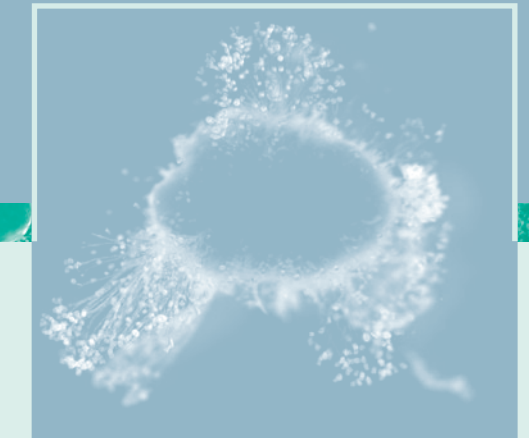
covering the multidisciplinary spectrum of biotechnology:

- MICROBIAL PHYSIOLOGY AND FERMENTATION TECHNOLOGY
- BIOCATALYSIS
- DOWNSTREAM PROCESSING
- ENVIRONMENTAL BIOTECHNOLOGY
- APPLIED GENOMICS OF INDUSTRIAL FERMENTATION
- QUALITY MANAGEMENT IN PHARMA AND BIOTECH (4 MODULES)

## Advanced Course

# ENVIRONMENTAL BIOTECHNOLOGY

June 11 - 20, 2008



#### Further information

Ms. Ger Aggenbach

Dr. Lies van der Meer-Lerk

Course coordinators

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#### Address

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**TU Delft**

Delft University of Technology



Universiteit Leiden



## Aim

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.

## Course description

The course has been held annually since 1993 and is based on the 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. The course integrates appropriate 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. For a better understanding of the lectures and to enhance active participation by those attending, this intensive training course consists of lectures, exercises and computer simulations (existing, widely used simulation programs). A three-days case study will offer

the participants the opportunity to practice on the integration of the different topics and to design a reactor for the treatment of a C-, S- and N-containing industrial waste stream. The results and conclusions will be discussed in a plenary session.

The course will be given in English.

A pocket calculator is required.

## 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 up-date their theoretical knowledge and practical insight in this field. In addition, this Advanced Course is an option in the two-year postgraduate programs of the Institute Biotechnology Studies Delft Leiden (Institute BSDL).

## Duration & Location

This Advanced Course will be given on **Wednesday, June 11 - Friday, June 20, 2008**

The course will be held at the **Department of Biotechnology Delft University of Technology Julianalaan 67 2628 BC Delft The Netherlands**  
P +31 15 278 1922  
F +31 15 278 2355  
bsdl-edu@tudelft.nl  
www.bsdl-edu.bt.tudelft.nl

## Accommodation

Hotel accommodation can be arranged at your request addressed to Ms. Ger Aggenbach, office manager. Lunches, the buffet on Wednesday, June 11<sup>th</sup> and the course dinner on Thursday, June 19<sup>th</sup> will be provided. For the other meals, a variety of restaurants may be found in the centre of the city.

# Program, June 11 - 20, 2008

## Wednesday, June 11<sup>th</sup>

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

09.00 **Welcome: outline of the course**

*Mark van Loosdrecht*

09.15 **Microbial metabolic diversity**

*Gerard Muyzer*

10.15 **Stoichiometry of microbial growth**

*Mark van Loosdrecht*

11.15 **Kinetic description of microbial growth in axenic and mixed cultures**

*Mark van Loosdrecht*

13.45 **Parallel sessions:**

**Exercises with the stoichiometry of microbial systems**

**Exercises with kinetics of microbial systems**

18.00 **Social event / Buffet**

## Thursday, June 12<sup>th</sup>

Theme: Fundamentals of environmental biotechnology: thermodynamics, dynamics and competition

09.00 **Thermodynamics and physical chemistry of biological systems**

*Robbert Kleerebezem*

10.00 **Bioenergetics of microbial growth**

*Mark van Loosdrecht*

11.00 **Mixed substrate utilization**

*Gerard Muyzer*

11.45 **Competitive strategies of microorganisms: from concept to practice**

*Gerard Muyzer*

13.30 **Exercises with thermodynamics, competition and growth of mixed cultures**

18.00 **Molecular methods in environmental biotechnology**

*Gerard Muyzer*

## Friday, June 13<sup>th</sup>

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

09.00 **Basic principles of transport processes in bioreactors**

*Mark van Loosdrecht*

10.00 **Gas-liquid interphase transport**

*Rob van der Lans*

11.00 **Biofilms and flocs:**

- diffusive transport

- modelling of the structures

*Cristian Picioreanu*

13.30 **Exercises on the integration of microbial conversions (zero- and first-order kinetics) and transport**

16.45 **Integration of microbial conversion and transport processes in the SHARON-Anammox process**

*Mark van Loosdrecht*

17.30 **Get-together**

## Saturday, June 14<sup>th</sup>

Theme: Microbiology for environmental biotechnology

09.00 **Microbial S-conversions**

*Gerard Muyzer*

10.00 **Microbial P-conversions**

*Mark van Loosdrecht*

11.00 **Microbial N-conversions**

*Marlies Kampschreur*

11.45 **Microbiology of methanogenic processes**

*Robbert Kleerebezem*

## Monday, June 16<sup>th</sup>

Theme: Modelling microbial population dynamics: an engineering approach

WORKSHOP

09.00 **Modelling and simulation of activated sludge systems**

*Mark van Loosdrecht / René van der Heijden*

16.30 **Get-together and Poster session**

## Tuesday, June 17<sup>th</sup>

Theme: Case study of a C-, S- and N-containing industrial waste stream: process and reactor design by integration of microbiology and chemical engineering

09.00 **Aerobic granular sludge: from concept to practice**

*Merle de Kreuk*

10.15 **Case study, Part I: analysis of problem**

*Sef Heijnen a.o.*

13.30 **Case study, part IIa: generation of process options**

*Sef Heijnen a.o.*

16.45 **Case study, Part IIb: reporting process options and choices**

*Sef Heijnen a.o.*

18.00 **Anaerobic methane oxidation**

*Marc Strous*

## Wednesday, June 18<sup>th</sup>

Theme: Scale-up/scale-down

09.00 **Scale-up/scale-down of (environmental) biotechnological processes using regime analysis**

*Karel Luyben*

11.30 **Case study: scale-down**

*Karel Luyben / Cristian Picioreanu*

16.45 **Presentation of the results**

*Karel Luyben / Cristian Picioreanu*

18.00 **Sustainability aspects of wastewater treatment**

*Jans Kruit*

## Thursday, June 19<sup>th</sup>

Theme: Continuation of the case study of a C-, S- and N-containing industrial waste stream

09.00 **Use of genomics to study nitrification processes**

*Kartik Chandran*

10.00 **Case study, Part III: design and calculations on the chosen process options**

*Sef Heijnen a.o.*

13.30 **Microbial fuel cell: principles and technology**

*Bert Hamelers*

14.30 **Continuation of the case study, Part III**

*Sef Heijnen a.o.*

18.30 **Course dinner**

## Friday, June 20<sup>th</sup>

Theme: Continuation of the case study

09.00 **Case study, Part IV: scale-up**

*Sef Heijnen a.o.*

13.30 **Reporting of results**

*Sef Heijnen a.o.*

15.15 **Insights into intercultural innovation - from pilot to prototype to plant**

*Frank Rogalla*

16.00 **Evaluation of the course**

16.15 **Farewell drink**

## Fees & Registration

Please complete and return the form below if you are interested to attend the course or would like to receive information on other courses. Applicants will be handled in order of the date of receipt.

The course fee is:  
€2500.- in case of payment received before **May 1<sup>st</sup>, 2008** or  
€2750.- in case of payment received after this date.  
In the event of cancellation before May 1<sup>st</sup>, 2008, a full refund will be granted, after this date, a 25% fee charge will be made.  
To facilitate enrollment of employees from non-profit organisations and universities, a limited number of fellowships is available with a reduced fee of €1850.- for employees and €1000.- for PhD-students. To apply, please include a curriculum vitae and a copy of your personal registration and position at your non-profit organisation or university.

The fee includes course materials, lunches, the buffet on Wednesday 11<sup>th</sup> and the course dinner on Thursday 19<sup>th</sup>. The fee does not cover other meals and lodging.

Hotel accommodation can be arranged at your request.

*Enterprises in the Netherlands can apply for the "Extra belastingaftrek (120%) van bedrijfsinvesteringen in scholing" (www.belastingdienst.nl) or in English: Additional tax deduction (120%) for company investment in education.*

Preparatory texts will be sent after receipt of the course fee. The complete set of course books will be supplied at the start of the course.

## Advanced Course Environmental Biotechnology

- I wish to attend the course of June 11 - 20, 2008  
 I would like to receive information of the other courses of BSDL  
 Please, send me announcements of the future **Advanced Course Environmental Biotechnology**

Family name, title, Mr/Ms \_\_\_\_\_ First name \_\_\_\_\_

Organisation/Company \_\_\_\_\_

Address \_\_\_\_\_

Phone \_\_\_\_\_

Fax \_\_\_\_\_

Email address \_\_\_\_\_

Educational background \_\_\_\_\_

Diet wishes \_\_\_\_\_

Date / Signature \_\_\_\_\_

