

# Environmental microbiology and bioprocess engineering

## SENIOR SCIENTISTS:

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## Research Field and Subjects

The Microbiology and Bioengineering laboratories combine their efforts to solve, in a concerted way, environmental problems related to agricultural, industrial and societal activities. Their research activities, at the intersection of microbiology and engineering sciences, focus both on the design and control of new and improved bioprocesses and bio-reactors, and on the selection and characterization of microorganisms competent in environmental clean-up processes. Four major topics are developed:

**Bioconversion.** Screening and development of new fungal hosts for the production of degradative enzymes. Development of bioprocesses for the transformation of industrial, urban and agricultural byproducts, including toxic ones, into valuable compounds, renewable energy sources or safe-to-dispose residues.

**Bioremediation.** Screening of bacterial, fungal and mycorrhizal strains and design of bioprocesses for the safe removal of xenobiotics from contaminated agricultural and industrial sites and/or effluents. Development of genomic tools including microarray technologies for the characterization of the dynamics of complex biodegradative microbial communities and rational exploitation of soil biodiversity.

**Bioprocess expertise.** Implementation of new biocatalysts (enzymes and microorganisms) and analytical and control tools in conventional and innovative bioprocesses. Combination of physico-chemical and biological processes for integrated remediation.

**Environmental biosafety.** Set-up of biological methods for the monitoring of opportunistic and pathogenic agents associated with wastewater treatment (including activated sludge). Follow-up of xenobiotic detoxification during bacterial/fungal biotransformation through the use of various biological models (human cells, luminescent bacteria, mutagenic assays, etc).

## Products and Services

- ▶ Targeted screenings of bacterial and fungal strains for bioremediation
- ▶ Development of high-throughput genomic tools for the discovery of novel biodegradation and bioconversion activities

- ▶ Design, start-up, and operation of bioremediation or bioconversion bio- processes
- ▶ Analytical, technological and scientific support for the industrial sector of environmental monitoring and remediation
- ▶ Identification and monitoring of microorganisms in environmental matrices using molecular and microbiological tools

## Main Equipment

- ▶ Bioreactors (from 5 to 2,500 liters)
- ▶ Capillary Electrophoresis (CE)
- ▶ Cryopreservation equipment
- ▶ Gas Chromatography (GC)
- ▶ Integrated bioprocess systems
- ▶ Pulse-Field Gel Electrophoresis (PFGE)
- ▶ Scanning Electron Microscope (SEM)
- ▶ Nucleic Acid Sequencer
- ▶ Spectrofluorimetry

## Representative References

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### Patents

- ▶ DE MYTTENAERE, P., MICHIELS, H., AGATHOS, S., BLACKMAN, G., AND LEDENT, P. (1999) Methods for reducing the effect of detergents upon germination and/or growth of microorganisms. European patent EP 0915061. May 12, 1999. World patent WO99/20571, April 29, 1999.
- ▶ VANHULLE, S., LUCAS, M., MERTENS, V., GOBEAUX, B., BOLS, C.-M., BUCHON, F., WESENBERG, D., AGATHOS, S., CORBISIER, A.-M., (2002) Sustainable process for the treatment and detoxification of liquid waste. World patent WO03/035561, May 01, 2003.

### Awards

Plenary Lecture & Topic Coordinator Award, 6th International Symposium on Environmental Biotechnology (ISEB 2002), Veracruz, Mexico, June 2002 for S. Agathos.

### Partnership

- ▶ Member of *Institut des Sciences de la Vie* (ISV), Louvain-la-Neuve, Belgium
- ▶ Participation in international research networks:
  - Coordination, EU projects "MADDOX" (Belgium, Spain, France, Germany) and "Envirofellows" (partners: all 15 EU member states), "MYRRH" (Belgium, France, Denmark), 5th Framework Programme (FP5), 1998-2002.
  - Coordination EU project "SOPHIED" (29 partners from 11 countries), 6<sup>th</sup> Framework Programme (FP6), 2004-2008.
- ▶ Industrial collaborations in Belgium: Realco, L'Oréal, UCB, Solvay, Wetlands Engineering, ECI, De Poortere, Retrieval
- ▶ Industrial collaborations in EU: GIAT Industries (France), Union Española de Explosivos (Spain), Tauw Milieu (The Netherlands)

### STAFF

Total: 30

### KEY WORDS FOR R&D

aerobic and anaerobic bioprocess  
 bioconversion and biodegradation  
 bioremediation and bioreactor  
 enzymes  
 extremophilic microorganisms  
 heavy metals  
 mycorrhizae  
 pathogens  
 renewable materials and energy  
 wastewater treatment  
 white-rot fungi  
 xenobiotics

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