

## Specification of research equipment

1. Air-lift tower bioreactors of volume 16, 32, 200 dm<sup>3</sup> and bioreactors with impellers of volume 2, 10, 42 dm<sup>3</sup> constructed by our staff.
2. Computer-aided air-lift tower bioreactors and bioreactors with impellers of volume 3 and 15 dm<sup>3</sup> (B. Braun/Sartorius)
3. EK 10 High speed centrifuge (Sigma)
4. R153 Evaporator (Buchi)
5. FUNDABACK TSD Biomass separation filter (Mueller)
6. ELO 04 Ultrafiltrating modulus (Milipore)
7. LS50B Fluorometer (Perkin Elmer)
8. BX 40 Olympus microscope with a fluorescent unit and image analysing system
9. BOD Manometric meter, COD Reactor, DR/2800 spectrophotometer (Hach-Lange)
10. HBB 2448 Laminar chamber (Holten),
11. Set of 6 Spectra/ Chrom chromatographic columns for continuous liquid separation using an ion exchange method.
12. NA 2500 Elementary analyser (CE Instruments)
13. TGA/SDTA 851 Thermobalance (Mettler – Toledo)
14. BMT 963 Ozone generator and analyser (Mess-Technik GmbH)
15. UV-VIS UV 300 Spectrophotometer (Unicam) with a flow cell
16. QMS 200 Quadrupole mass spectrometer (Balzers)
17. KI-12 Calorimetric bomb (Postę – Bit)
18. HPLC Liquid chromatograph and Ultra HPLC with quadrupole mass spectrometer MS (Waters)

## Cyclic Conference "Advances in Bioreactor Engineering"

Since 1983, conferences have been organised under auspices of Process and Chemical Engineering Committee of Polish Academy of Sciences. Due to the rapid development of biotechnology, especially of genetic engineering, there is a need to carry out the investigations in the area of bioreactor engineering. This conference is the nationwide and also international forum to exchange the opinions, share with the obtained results and widen the knowledge in new trends of bioreactor engineering, biochemical engineering, metabolic engineering and lately systems biology.

## Academic staff:

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|--|---------------------|
| 1. prof. dr hab. Stanisław Ledakowicz  | Head of Department  |
| 2. prof. dr hab. inż. Liliana Krzystek | associate professor |
| 3. dr hab. inż. Marcin Bizukojć        | assistant professor |
| 4. dr hab. inż. Jacek Miller           | assistant professor |
| 5. dr inż. Anna Antecką                | assistant professor |
| 6. dr inż. Paweł Głuszc                | assistant professor |
| 7. dr inż. Teresa Jamroz               | assistant professor |
| 8. dr inż. Anna Klepacz-Smółka         | assistant           |
| 9. dr inż. Katarzyna Paździor          | assistant professor |
| 10. dr inż. Beata Pawłowska            | assistant professor |
| 11. dr inż. Paweł Stolarek             | assistant professor |
| 12. mgr inż. Radosław Ślęzak           | assistant           |
| 13. mgr Ewa Stelmach                   | chemist             |
| 14. mgr inż. Włodzimierz Krysztofczyk  | mechanical eng.     |
| 15. techn. Urszula Szalewska           | chemist             |

## PhD students:

1. mgr inż. Lucyna Bilińska
2. mgr inż. Tomasz Boruta
3. mgr inż. Marta Gmurek
4. mgr inż. Anna Kacprzak
5. mgr inż. Krystian Miazek
6. mgr inż. Karina Michalska
7. mgr inż. Magdalena Olak
8. mgr inż. Marta Pawlak



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## **Main research subjects**

### **I. Biotechnology and environmental engineering**

1. Biological removal of mercury from contaminated soil and wastewater by bacteria.
2. Heavy metal removal from contaminated soil and ground by biosorption and bioleaching.
3. Application of advanced oxidation processes for degradation of xenobiotics, including detergents and dyes in industrial wastewater.
4. Utilisation of municipal wastewater and sewage sludge (by a low- and elevated temperature method)
5. Biodegradation of industrial wastewater (textile, pulp and paper and dairy industry)
6. Application of biomass to energy generation
7. Reclamation and inertisation of old landfills
8. Investigation of water and wastewater toxicity
9. Microbial methane oxidation from landfill gas
10. Mathematical modelling of biodegradation processes of wastes

### **II. Biochemical and bioprocess engineering**

1. Development of the process of biosynthesis to minimize hazardous wastes
2. Application of ion exchange to separation and purification of organic acids (e.g. lactic and citric acid)
3. Investigations of filtration and microfiltration processes of biosuspensions
4. Bioprocesses integrated with separation of products together with their purification using non-conventional methods
5. Design and development of mixing and aerating devices in bioreactors
6. Application of digital image analysis to investigate the morphology and physiology of molds and fungi
7. Kinetics, modelling and optimization of the following bioprocesses:
  - Laccase biosynthesis,
  - Lovastatin biosynthesis,
  - Citric acid biosynthesis,
  - L-lysine biosynthesis,
  - Food colours biosynthesis,
  - Biogas production,
  - Fodder yeast production

## **List of grants financed by the State Committee for Scientific Research and Ministry of Science and Higher Education in the years 1994 – 2012**

1. Development of a biosynthesis process to minimize hazardous wastes
2. Degradation of dye and/or detergent solutions under an influence of ozone
3. Biodegradation of organic fractions of household wastes
4. Biodegradation of textile waste water after ozone-chemical pre-processing
5. Modelling and development of mixing and aerating devices in fermentors
6. Kinetics of the aerobic degradation of organic fraction of municipal solid wastes
7. Degradation of polyaromatic hydrocarbons by advanced oxidation processes
8. Influence of pressure on the morphology of *A. niger* mycelium and biosynthesis of citric acid
9. Utilization of sewage sludge and industrial wastewater by pyrolysis
10. Application of ozone and advanced oxidation processes to enhance biodegradation of leachates
11. Separation of organic acids from fermentation broth by the ion exchange method
12. Decolourization of wastewater by advanced oxidation processes
13. Application of digital image analysis to modelling the growth of *A. niger*
14. Removal of mercury from industrial wastewater by biosorption and biotransformation
15. Strategy of performing laccase biosynthesis in various types of bioreactors
16. Bioprocesses integrated with product separation – within the frame of the ordered project “Multi-phase and multi-functional bioreactors for basic chemical, biochemical and environmental protection processes”
17. Analysis and modelling of the gas-solid processes using microreactors within the frame of the project “Multi-phase and multi-functional bioreactors for basic chemical, biochemical and environmental protection processes”.
18. Optimisation of lovastatin biosynthesis by *Aspergillus terreus*.
19. Kinetics of biooxidation of methane from landfill gas
20. Optimization of the properties of a solid photocatalyst for singlet oxygen generation
21. Utilization of organic fraction of municipal solid waste and sewage sludge in anaerobic conditions
22. Quantitative formulation and classification of bioreactor models considering the most recent achievements in molecular biology

23. Integration of membrane and biological processes in textile wastewater treatment
24. Kinetics of aerobic biostabilization of municipal landfills
25. Photochemical degradation of xenoestrogens in the water environment
26. Technology of water and heat recovery from textile wastewater – the target project
27. Integrated technology of bioutilization of municipal solid wastes from landfills – the development project.
28. Integrated technology of biological removal of mercury from industrial wastewater – the development project
29. Reduction of nitrogen oxide emission to the atmosphere by ozonolysis – within the frame of the project “Engineering of the processes of hazardous and greenhouse gases emission reduction and utilization”
30. Inertisation of municipal landfills – within the frame of the project “Engineering of the processes of hazardous and greenhouse gases emission reduction and utilization”.
31. Kinetic model of laccase biosynthesis by *Cerrena unicolor* and the application of the enzyme to degradation of chosen aromatic structures.
32. Biodegradation of azo dyes in textile wastewater by the anaerobic/aerobic sequential method.
33. Conversion process of biomass and biodegradable wastes by means of methane fermentation in the frame of the ordered project: “New technologies of energetic utilization of biomass and biodegradable wastes”.
34. Implementation of stoichiometry and kinetics of biochemical processes in modelling of wastewater treatment.
35. Kinetic investigation of xeroestrogen degradation – *n*-butylparaben by means of direct photolysis and in the presence of hydrogen peroxide.
36. IGRE - Development of species index and optimisation of energetic plants production technology POIG – project co-financed by EU from EFRR

### **International project:**

1. 3-STEPS (Starter To Environmental Problem Solution) - Tempus II within the frames of The V Frame Programme of the European Union.
2. BIOMERCURY – Worldwide remediation of mercury hazards through biotechnology, No. NMP2-CT-2004-505561 within the frames of The VI Frame Programme of the European Union
3. REMOVALS – Reduction, modification & valorisation of sludge, FP6-2004-Global Change & Ecosystem No.18525 505561 within the frames of The VI Frame Programme of the European Union
4. Enzymes for industrial application. Scientific and technological cooperation joint project for year 2007 – 2008 with CSIR Biosciences, Pretoria South Africa