

First Experiences of Teaching of Energy Engineering and Environmental Protection at the Silesian University of Technology

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ABSTRACT: Actually, at technical universities in Poland, only one example of teaching of students simultaneously energy engineering and environmental engineering have place. It just concerns the Silesian University of Technology at Gliwice. 10 years ago, a new Faculty at SUT was founded by merging two former faculties: Mechanical-Power and Environmental Engineering. The new Polish economy and education had created strong needs for a new kind of engineers capable to solve the difficult problems of the clean energy technologies. The Faculty of Energy and Environmental Engineering offers the study in two fields: environmental engineering and energy and power engineering. According to Bologna's Declaration, the European Credit Transfer System, Modular System and two stages of study had been put in execution in this Faculty. The diploma works were and are strictly connected with the needs of industry and regional problem in the field of air and water protection, sewage technologies, waste utilization, power machinery and systems, clean energetics and motorization, thermal power engineering etc. About 2500 graduates had got a job in companies, local governments and enterprises. The faculty offers also several (~20) postgraduate studies both in environmental problems any energy problems. Faculty staff developed strong international cooperation with 35 universities and companies in 16 countries. Students and academic staff take part in European programmes such as Socrates-Erasmus, Leonardo da Vinci, Centre of Excellence Programme, the Vth and the VIth European Programmes and others. The Faculty has got accreditation of education process granted by Polish Committee for Accreditation and has achieved the highest level in the classification of Polish Ministry of Informatics and Sciences.

1 HISTORY

The Faculty of Energy and Environmental Engineering emerged in 1993 as a result of amalgamation of two units: the Faculty of Environmental Engineering (founded in 1955) and the Faculty of Mechanical-Power Engineering (founded in 1953). The reason for establishing the new faculty was twofold. The first aim concerned a new education strategy which goal is to respond to the demands of the changing and rapidly developing Polish and local economy. The situation generated an urgent need for professionals with good background both in energy engineering and environmental engineering and protection. Sought for are engineers having not only the technical expertise and deep understanding of technologies but also aware of their impact on environment and business.

The second goal was to create a strong interdisciplinary research group capable to develop more efficient power generation technologies and utilization processes but also means and technologies of environmental protection. Both aspects are of particular importance for Upper Silesia – the region of former heavy industry which is nowadays under great reconstruction and modernization.

2 STRUCTURE

The Faculty is managed by a Dean elected for 3 years period by representatives of all employed at the Faculty. He is responsible for the day-to-day business, teaching of students and scientific policy. His decisions are implemented by the Faculty Council. He is supervised by the Rector of University. The Faculty consists of 3 institutes, 4 chairs and 1 laboratory:

- Institute of Water and Wastewater Engineering
- Institute of Machines and Power Generation Systems
- Institute of Thermal Technology
- Chair of Heat Supply, Ventilation and Dust Removal Technology
- Chair of Air Protection
- Chair of Technology and Equipment for Waste Management
- Chair of Environmental Biotechnology
- Laboratory of Car Testing.

There are over 300 people of the staff including 36 full professors, 125 assistant professors, 85 PhD students and about 90 supporting staff. The Faculty Council is authorized to confer PhD and DSc degrees both in the field of Mechanical Engineering and Environmental Engineering. All Polish faculties and research institutes are in three years cycle assessed by the Polish Ministry of Science for the quality of their research. The Faculty has achieved the highest rank in this rating.

Tight links connect the Faculty with the industry and local society. The academic staff is involved both in the consulting and in giving special courses for the industry and local government. The industry, in turn, supports the authorities of Faculty in their activities directed towards refurbishing of their laboratories. An active role in maintaining these links plays the society of alumni.

3 EDUCATION

The Faculty provides education for 3000 students and offers:

- Master of Science, full-time courses (for regular students) in:
 - environmental engineering – 1680 students
 - energy and power industry – 870 students
- Bachelor of Science, evening courses in:
 - environmental engineering – 300 students
 - energy and power industry – 150 students
- PhD studies – 85 students
- lifelong learning – 100÷150 students annually

Daily courses are provided in accordance with the European Credit Transfer System and Modular System. The Faculty offers two stages study leading to a Bachelor of Science degree (7 semesters long) or additional (optional) 3 semesters leading to the Master of Science degree. So, full-time courses take 10 semesters and are offered solely to regular students.

In the field of environmental engineering the Faculty offers 8 specializations:

- waste disposal and utilization
- engineering of water, wastewater and soil
- heating systems, ventilation and air protection
- municipal energy engineering
- environmental engineering and clean technologies in industry and motorization
- occupational hygiene and safety

and for evening courses:

- technologies of environmental protection
- technical outfit of buildings

In the field of energy and power machinery the Faculty offers 4 specializations:

- thermal power engineering, cooling and car's exploitation
- power stations and power machinery
- equipment and machinery for waste utilization

and for evening courses:

- exploitation of power machines and equipment

The Faculty offers several postgraduate courses whose topics are adjusted to the current needs of the economy and local society. Currently the Faculty proposes following topics of lifelong learning:

- new technologies in water and waste water treatment
- waste disposal
- energy auditing in industry
- new power technologies – technological, economical and management problems
- environmental protection in energy sector and motorization
- occupational hygiene and safety

- environmental protection techniques in EU directives
- organization and management in energy and environmental sector

About 250 students graduate annually from the Faculty and are employed. About half of the topics of diploma works are strictly connected with the needs of Polish economy and local problems. The examples of the topics of diploma works are listed below:

- Co-combustion of coal and municipal wastes in the 6 MW stoker boiler
- Analysis of waste management of medium-size town (30 000 inhabitants)
- Investigation of NO_x and CO emission during oil combustion under High Temperature Air Combustion technology
- Preliminary design of water treatment station for small towns (10 000 inhabitants)
- Analysis of the system of gas turbine-heat regenerator with the power of 50 MW
- Design of comfortable air conditioning installation for schoolhouses
- Design of central heating installation with solar collector for block of flats
- Numerical modelling of SO₂ and dust concentration distribution in chosen cities (100 000 inhabitants)
- Laboratory investigation of the removal of crude oil contamination from soil
- A combined analysis of heat and mass flow in an infant incubator
- A theoretical and experimental investigation of heat transformer
- A thermodynamic analysis of absorptive heat pump
- The determination of geometrical sizes of the inlet system of internal combustion supercharged engine
- An energy-ecology audit of WR-25 stoker boiler
- A preliminary design of the modernization of 200 MW pulverized coal boiler
- The investigation of the ignition and combustion of biooil in small 25 kW boiler
- Theoretical-economical analysis of small-size thermal-electric power plants with internal combustion engines and gas turbines

The Faculty offers also PhD studies in the field of Power and Environmental Engineering.

The education process is conducted on a high level. The students of the Faculty obtain annually overage 15 special fellowships from Ministry of Education and about 200 Rector fellowships; 4 graduates were awarded by the 'Omnium Studiosorum Optimo' Medal (the best among the excellent) and 40 persons got the prize founded by the local governments and companies. Many influential people in the economy, local and central governments are graduates of this Faculty. For example one of the former Prime Ministers and three ministers of Polish Government are graduates of the Faculty. The Faculty of Energy and Environmental Engineering is one of the first five faculties in Poland which passed the accreditation process.

A profile of graduates of the Faculty is a result of intellectual possibilities of Faculty staff. It should be stressed that the main 'product' of the Faculty it is an excellent engineer. He is able to solve the different difficult problems resulted from human activity in the area of energy production and utilization, motorization, and environmental engineering. To cover such a wide range of problems, the students should have a good background of general knowledge. They have to attend lectures on mathematics, physics, chemistry, biology, computer science, thermodynamics, foreign languages and the principles of the environmental science. These subjects take about 40% of the total volume of syllabus. The next 10% is covered by economic-management subjects.

The remaining area of the syllabus is reserved for different subjects strictly connected with the specializations, it means: heat and power production, energy management, air protection, municipal companies and plants (water supplying, waste management and utilization, heat distribution, sewage management and treatment) and so on. The graduates have also backgrounds of programming and numerical calculations.

In relation to obtaining knowledge, the graduates can get employment in different fields of economy for instance: power and heat plants, agriculture processing plants, metallurgy, municipal services and

companies and local governments and services. The graduates are well prepared to be consultants, energy-ecology auditors, designers or research workers.

4 RESEARCH

The research program of the Faculty encompasses environmental protection and engineering, power generation and energy-economy problems. In the environmental engineering area, the main fields of research activities concern:

- technology and economics of air protection
- heating systems and aerodynamics of ventilation
- dust removal and gas purification
- identification of pollutants and their propagation
- development of the installations for waste utilization
- water protection:
 - water supply for large agglomerations
 - biological and physicochemical processes in water treatment and sewage treatment plants
 - membrane processes in environmental engineering
- management and processing of municipal and industrial wastes
- theoretical and applied research in biotechnology merged with other processes and in eco-toxicology

In the field of energy and power engineering the Faculty is involved in the analysis and improvement of thermal processes arising from power generation, metallurgy and other sectors of industry and local economy. The specific topics of current research comprises:

- theoretical and experimental research and new constructions of turbomachinery
- exploitation and diagnostics of power machines and devices
- optimisation of power systems
- thermodynamics and heat transfer
- calculations of boilers and other thermal devices
- theory and technology of low emission combustion
- renewable sources of energy
- energy-economic analysis in heating and ventilation
- exploitation and diagnostics of internal combustion engines

The research activities described above are obviously ephemeral by nature. With time, rotation of the researchers, current needs of the society, changing priorities of institutions supporting the fundamental and applied research, the subjects of investigations will change.

During the last 10 years the scientific staff of the Faculty got 12 prizes of Ministries (Education, Science or Environment), 2 international prizes (Brussels Eureka'96) and 101 Rector prizes for researches, books and monographs and technological achievements.

5 INTERNATIONAL CO-OPERATION

The units of the Faculty developed various kind of international co-operation in the area of research and education with foreign partners. At present, the research staff of the Faculty takes part in 4 projects connected with the Vth and VIth Framework Research Programmes of EU. At the moment there are 3 Centres of Excellence at the Faculty:

- Environmental Biotechnology
- Energy Efficient Technologies and Systems in Indoor Environment Engineering
- Optimization, Simulation and Environmental Impact of Energy Systems and Processes

However, the basic forms of international collaboration are based on the bilateral contacts with many universities. The Faculty co-operates with 35 European Universities, two in the USA and one in Japan. The Faculty is or was also an active participant of several international research and educational programs like Copernicus, Socrates/Erasmus, COST, Tempus, Leonardo da Vinci, University without the Walls.

6 SUMMARY

In 2003 the Faculty of Energy and Environmental Engineering celebrated the decade of the existence as a new unit of SUT. So, it is a special occasion to evaluate the results. Eleven years ago it was the first, and up to now, the only example of the fusion of the education in the areas of energy and power industry engineering and environmental engineering in Poland. The achieved results are excellent. A new strong interdisciplinary group of scientists was created and a new generation of engineers were educated. About 2500 graduates were employed in economy and local governments. New syllabus and new specializations were invented and introduced. The ECTS and Modular System were put into execution. The Faculty has expanded the co-operation with foreign countries. About 10% of the total volume of educational programmes was covered by economic-management subjects.

The Faculty obtained the highest rank in the classification of the Polish Ministry of Science. The quality of educational process is also confirmed by the accreditation obtained from the Accreditation Committee of Polish Universities of Technology.