

# CHEMICAL ENGINEERING EDUCATION IN HUNGARY

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Received: May 5, 1988

## Abstract

Education of chemical engineers began in Hungary with the academic year 1863–64. Chemical engineer's degree has been awarded since 1907. The present system of education is a two-level one. At present chemical engineers are trained at two universities: at the Chemical Engineering Faculty of the Budapest Technical University and at the Veszprém University of Chemical Engineering. Both universities also consider postgraduate education of engineers as a fundamental part of their activity.

## Introduction

From the foundation of the Chemical Engineering Faculty at the József Nádor Technical University—the predecessor of the Budapest Technical University—in 1871 until 1948 the education of chemical engineers was uniform, without specialization, of a duration of 4 years, later 4 and a half, and then again 4 years. Following the Tuition Reform in 1948 specialization was introduced. The divisions of inorganic chemical technology, organic chemical technology, as well as agricultural and food chemistry were organized at this time. In the first two years tuition was uniform, and became specialized only in the third and fourth year. The division for inorganic chemical technology ceased at the Faculty of Chemical Engineering in 1952 because its tasks were taken over by the Veszprém University of Chemical Engineering at Veszprém, founded in 1949. The Tuition Reform of 1955 which—correctly—attributed great importance to fundamental education put an end to the specialization. By the reform of the sixties however again some specialized education was introduced both in Budapest and Veszprém. This was connected to the following industrial branches: synthetic organic industry, plastics industry, pharmaceutical industry, biological and food industries, etc. in Budapest, as

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well as inorganic chemical technology, silicate technology, petrochemical technology, radiochemistry, process control, etc. in Veszprém.

By the end of the sixties an explicit demand arose for the training of so-called production engineers (undergraduate students) who would perform tasks in connection with the daily industrial production and production control.

Three possibilities were then offered for the education of chemical production engineers: (1) training at new colleges dedicated to this purpose, (2) training at college faculties to be established in the institutions for the training of chemical engineers (graduate students), and (3) organization of a two-level education system in the above institutions. Considering pedagogical and economic advantages two-level education of chemical engineers was introduced in September 1969. The main pedagogical advantage seemed to lie in the fact that the educational level of chemical engineers can be raised by the introduction of a two-level education system, and the teaching staff available in these institutes for the training of chemical engineers seemed to be suitable for the tuition of engineering students at both levels. Moreover this solution offered the economic advantage of realizing a high standard chemical production engineer education at a lower cost compared to the investment costs of a new college or colleges.

In this two-level education system—after three years of successful learning—undergraduate students obtain their production chemical engineer's degree. Those who meet the prescribed requirements may be granted a diploma in chemical engineering after a further tuition of two years.

In the early seventies advances in science and technologies increased the importance of interdisciplinary subjects setting new tasks to the higher education. During this scientific, technical and economic development several problems arose which could have been solved only by experts versed in the intertwined interdisciplinary subjects of two or more branches of science. To meet this demand two new interdisciplinary sections were organized: system engineering and bioengineering. This does not mean specialization according to industrial branches but involves interdisciplinary subjects. Tuition in these sections was introduced with the academic year 1974/75 and only graduate students were trained.

### **Aims of education**

The aims of education at both universities are practically the same: the students have to acquire sound theoretical knowledge (mathematics, physics, physical chemistry, etc.), and shall already be confronted during their studies with all types of tasks, which may be met in the practical work of a chemical engineer. Thus the students have to acquire laboratory skill, get acquainted

with machines and equipments used in the chemical industry, with principles needed for their optimal operation, they shall get acquainted with a given technology in accordance with the specialization topics of the universities. At the end of education students prepare a thesis comprising technological design and research tasks.

The syllabus of the education of production engineers—besides prescribing knowledge to be acquired in a three-year tuition period—simultaneously prepares able and voluntary students for participation in the education of chemical engineers by means of a so-called criterion subject system.

The non-obligatory criterion subjects are voluntarily registered by the students during the 3rd to 6th term of production engineer training. Completion of these courses is a necessary condition for chemical engineer training (this is one of the criteria for the further study at the second level).

The aim of education of chemical engineers is a training based on the education of production engineers. The training of chemical engineers (second level) is more comprehensive and deeper, as a result of which graduated chemical engineers become capable of undertaking also at a managing level the operational, research, development, and other technical tasks of chemical engineering.

## **Education at the Budapest Technical University**

### *Structure of education*

The education of production engineers at the Budapest Technical University is the task of a single section, the Section of Organic and Biological Chemical Industry. This section has the following branches:

- \* Branch of Organic Synthetic Industry
- \* Branch of Plastics Industry
- \* Branch of Light Chemical Industry
- \* Branch of Pharmaceutical Industry
- \* Branch of Biological and Food Industry.

At the chemical engineering level tuition is carried out in three sections with the following objectives:

At the Section of Organic and Biological Chemical Industry chemical engineering students are trained to be experts able to perform engineering tasks mentioned above in all fields of organic and biological chemical industry. The branches of this section are identical to those of the first level production engineer training.

At the Section of Bioengineering the aim of education is to train on academic level experts for solving the problems of overlapping fields such as

chemical engineering and biological sciences. Particular attention is given to environment protection, water resource management, medicine, biochemistry, dietetics and nutrition, pharmaceutical industry, and other related fields.

The Section of Bioengineering has the following branches:

- \* Branch of Environment Protection
- \* Branch of Health Protection.

At the Section of Systems Engineering experts are trained to perform tasks of technological organization in conjunction with the operation, design, control, development, and overall regulations of chemical engineering systems. At the Section of System Engineering there are no branches of tuition.

In all three sections of chemical engineering education a certain part of the obligatory subjects is allotted to optional obligatory ones, which can be selected from a large number of subjects in order to meet the individual interest of students. Industrial practice is also included in the training of chemical engineers. At the end of chemical engineering education students prepare a thesis, defend it and sit for a final examination before a National Board of Examiners.

Most of the biological subjects of the bioengineering section are taught at special departments of the Faculty of Sciences at the Eötvös Loránd University in Budapest. The representatives of this university also take part in the work of the National Board of Examiners.

#### *Education by evening courses*

In addition to the education of day-time students two-level study by evening courses is also offered at the Section of Organic and Biological Chemical Industry, the structure of which (5 branches) is essentially similar to that of the day-time tuition. Duration of the courses: four year production engineer training, and built on it additional two years of chemical engineering training. There are no bioengineering and system engineering sections, however, in the evening courses.

This form of education looks back to a history of 38 years. The number of participants in this form of education decreased gradually.

#### *Postgraduate education of engineers*

Postgraduate education of engineers offers a two years long well organized training to engineers having at the same time their job in the industry. After successful learning and completion of a state examination a "specialist engineer" diploma is offered to the participants.

At present the following postgraduate courses are offered at the Faculty of Chemical Engineering:

- \* Applied Radiochemistry
- \* Analytical Chemistry
- \* Food Chemistry
- \* Pharmaceutical and Pesticide Chemistry
- \* Chemical Technology
- \* Corrosion Control
- \* Environment Protection
- \* Bioengineering
- \* Plastics Technology
- \* Chemistry of Fibrous Materials
- \* Chemical Unit Operations.

In addition to these sections Budapest Technical University also offers possibility to chemical engineers to obtain a degree in engineering economics by attending two years' postgraduate courses in order to acquire knowledge among others also on the economics of the chemical industry.

At certain specialized engineering sections and within the frame of economist engineer training postgraduate education proceeds within the scope of branches or specialized directions, e.g. at the branch of environment protection the following courses are organized: air pollution control, water pollution control, noise abatement, regional protection and planning, etc. The education of specialist engineers at the Budapest Technical University is directed by the Faculties. Moreover valuable possibilities of postgraduate training are offered by the Institute of Postgraduate Studies for Engineers cooperating with the Faculties in the organization and management of such courses.

### **Education at the Veszprém University of Chemical Engineering**

The former Faculty of Heavy Chemical Technology at Veszprém, founded in 1949, concentrated its educational activities—in compliance with the need of Hungarian chemical industry and the division of labour between this establishment and the Technical University of Budapest—on what its name says: heavy (inorganic) chemical industries. Only two years later the former Faculty ceased to be a part of the Technical University of Budapest and became independent as “Veszprém University of Heavy Chemical Technology”. The name later changed to “Veszprém University of Chemical Engineering”.

At the beginning curricula consisted of eight semesters which had been gradually extended to ten semesters. During the continuous development of

curricula efforts have been made to fulfil the demands of industry as much as possible. At the beginning classical directions of inorganic chemical technology were considered and other branches developed later.

### *Structure of education*

At present chemical engineering sciences are taught in Veszprém in the following branches:

- i) In the *Branch of Inorganic Chemical Technology* students acquire knowledge in nitrogen technologies (ammonia synthesis, nitric acid production), production of sulphuric acid, fertilizers, alumina, and in electrochemical industries (electrolysis of solutions and melts) and get acquainted with process equipment of such technologies.
- ii) The *Branch of Silicate Chemical Technology*—which is a unique university education profile in Hungary—deals with technologies of silicate industry (ceramics, glass, cement and concrete, enamels, etc.), as well as with material sciences, automation, and complex structural materials.
- iii) In the *Branch of Petrochemical Technology* students become acquainted with products made of petroleum, gas, and coal. They learn thoroughly the fundamentals of up-to-date production technologies.
- iv) In *The Branch of Radiochemistry and Technology* main processes of nuclear technology and methods of radiation protection are taught. Students get acquainted with analytical and technological applications of radioactive tracing methods.
- v) In the *Branch of System Engineering and Process Control* methods are taught for mathematical modelling, computer control and optimization of complex systems.

In 1969—simultaneously with the Budapest Faculty of Chemical Engineering—education was split into two levels: the first level (three years) providing fundamentals in chemistry and general chemical engineering sciences grants a *production chemical engineer's degree*, while the second level (further two years)—based on the first one—grants a full *chemical engineer's degree*.

Although some knowledge on fertilizers was included into the education at the Branch of Inorganic Chemical Technology, this training was always done from the point of view of chemical engineering. In 1970, however, a new section of Agricultural Chemistry started at the Keszthely University of Agricultural Sciences. Students of this section are taught chemistry and chemical engineering in Veszprém. This joint education successfully satisfies the needs of agriculture for agrochemists.

In 1973 a new section started, the *Section of Chemical Industrial Management*. Its curriculum—in addition to the general chemical engineering subjects—consists of management, administration, economy, decision making theory and planning strategies, as well as some environment protection, marketing and law studies.

In 1983 a higher level foreign language tuition was introduced to gifted undergraduate students. For the time being—according to the interest of our students—they are tutored in English in a more intense form, and after having successfully passed the language exams a certain part of their engineering lectures are delivered to them in English.

In 1984 joint tuition was started with the Budapest Technical University, Faculty of Electrical Engineering in instrumentation and measurement techniques. Undergraduates of this section are trained to basic chemical engineering in Veszprém and obtain tuition (three semesters) in methods of up-to-date measurement and instrumentation techniques, as well as digital data processing in Budapest.

Most recently education of mechanical engineers for the chemical and silicate industry—at first on undergraduate level—started also in Veszprém.

### *Postgraduate education*

Postgraduate training courses are offered to engineers and other specialists in the following subjects:

- \* Environment Protection
- \* Instrumental Analysis
- \* Corrosion Control
- \* Glass Industry
- \* Ceramic Industry
- \* Utilization of Secondary Raw Materials (waste utilization)
- \* Petrochemical Technology
- \* Nitrogen Technology.

Short training courses of one to three weeks and full professional specialization courses of four semesters are regularly held, the latter also giving a special degree in the subject selected.

A special form of postgraduate training is the so-called *third level education*. Postgraduates of this kind take part in the scientific research of the university, usually under the guidance of a tutor and learn subjects necessary for their work selected. Successful accomplishment of these studies may result in a Ph. D. degree.

Most of the chemical engineers graduated at these two universities work for the Hungarian chemical industry, and so a very good relationship exists between the industry and universities. Steps were taken to provide continuing education and refreshment courses for chemical engineers. However after the initial enthusiasm little interest is shown towards this form of training so far.

A problem of chemical engineering education is the loss of prestige of engineering. This is a world-wide phenomenon and our work in the future should be oriented towards rebuilding this prestige.

### Acknowledgements

The authors are grateful to *László Ackermann* and *Kristóf Kovács* for their valuable cooperation in preparing the manuscript.

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