Project INNOCHEM

Innovating Education of Talents in Chemistry for Business Success in SMEs' Innovations

2014-1-SK01-KA203-000507

ROAD MAP Slovakia

Contents

1. Project INNOCHEM – ROAD MAP FCHPT STU

1.1 Summary of key findings included in the Status Quo Analysis

The Status Quo Analysis of Innochem project summarizes the results of a survey conducted by ZCHFP SR among 20 small and medium-sized enterprises (SMEs) from Slovakia in 2015, focused on the respond which skills and knowledge are important for future chemical engineers or scientists. SMEs that replied to the questionnaire, operating in the following sectors:

- Paints and coatings manufacture;
- Research, production and processing of plastics, recycling waste plastics;
- Production and sale of chemicals for rubber, glass, pharmaceuticals, electronics, printing and food industries;
- Production of detergents and cosmetics;
- Production of chemical specialties, organic synthesis;
- Manufacture of inorganic substances;
- Food industry.

The survey was based on the questions contained in the questionnaire of the European Chemical Industry Council (CEFIC).

Within the survey focused on identification and naming of the most important requests of SMEs in scientific and technical skills of future researchers, product development, organic chemistry, health, safety and environmental and analytical chemistry (including spectroscopic techniques) were included into the most important skills. In terms of the most important business skills for future researchers the innovation management, quality management and understanding of suppliers and customers were indicated. The most important personal skills include the ability of creative thinking and problem solving, foreign languages and intellectual skills, ability to work independently, as well as to work in the team.

Since SMEs are generally focused on producing smaller quantities of products, the development of new products or improvement of the quality of existing products represents the key area. Product innovation essentially implies the further considerations as good theoretical foundations, mainly organic and analytical chemistry – in terms of the synthesis and characterization of the properties of the products/intermediates, where an important role

play analytical methods, especially methods of instrumental analysis (electroanalytical, spectroscopic and separation methods).

The impact on the environment during the production (possible formation of harmful intermediates, final product impact) is significant; the findings of such processes or type of product with minimal possible by-products and negative impact on health and safety have to be taken into account. If we consider that researchers will work in laboratories and engineers directly in the manufacturing sector, the survey shows that for researchers is more important the very good theoretical basis with post-items such as process control, which in turn, is considered as a key capability for engineers. In terms of business-critical skills for researchers it is mainly the management of innovation and quality, since R&D is necessary to know in what areas and how efficiently at the lowest cost to upgrade products and improve their quality.

From point of view of educational process, for people who allow for working in research and development, it is important to have the deeper theoretical fundaments, especially natural sciences. Therefore, the choice of courses should be oriented on study programs, in which the main area is represented by the natural sciences and technical subjects, supplemented with economic/legal courses. The optimal degree programs in MSc. study for R&D is study program Technical Chemistry.

As the most important scientific and technical skills for future engineers regarding the innovations introduction, skills that are directly associated with a good knowledge of the technological process, management, optimization technology, keeping the safe operation of the technology, including the health of workers and environmental protection were identified. In order to introduce innovation in SMEs in the outline of improving the functioning of existing technology, or in the form of new technologies or products, engineers should be able to propose a new large scale operation based on the results of the pilot plant, suggestions for the necessary technical equipment to handle the logistics of the manufacturing process as well as the importance of product lifecycle on the environment.

2 The overall strategy of tertiary education of young talent in chemistry

Based on the characteristics of Slovakia's chemical industry, trends in product innovation in the Slovak Republic, on the most important skills required for innovation with regard to

SMEs and on the basis of the current state of education of engineers and scientists at STU, established in the Status Quo Analysis, it is possible to propose a strategy for tertiary education for young talents in chemistry. MSc. study programs at STU carefully prepared by guarantors and accredited are built to continue in courses for bachelor study provided students with good theoretical basis particularly in the field of organic, inorganic chemistry, physical and analytical chemistry. Extension of these courses, according to the study programs consists of subjects with a focus on technological skills in the field of inorganic, organic technology, design and production optimization, including special analytical methods for quality control of raw materials and products, and environmental protection.

Reserves are in preparation of engineering students and PhD students in existing courses and the inclusion of a subject based on a variety of soft skills, which include entrepreneurial skills, personal skills, as well as scientific and technical skills are necessary. It is important to encourage foreign student mobility, to support talented students through the Socrates Club, to award the best theses and work within the student's scientific and technical activity by enterprises in the chemical and pharmaceutical industries.

Students should be in deeper contact with practice through lectures given by specialists from industrial companies, through practice and professional brigades and also through elaboration of thesis on topics from practice. The key seems to be a possibility for a student to participate in professional practice in companies during their studies. STU annually conducts negotiations and provides students information about the possibilities of passing summer training in companies operating in the chemical, pharmaceutical and food industry in Slovakia. The students from all study programs in the MSc. study at STU have subjected Professional Training with a range of 120 hours per term. The purpose of this subject is to gain knowledge about the fundamental principles and of the activities of the selected operation, development and research department, familiarity with the specific task, the solution of which the student will participate. As well as carrying out professional activities related to assigned tasks in the production, development or research institutes under the supervision of a responsible employee. The aim of the training is mainly to teach students to be able to put into practice the theoretical and methodological knowledge acquired during their university studies. During training students can verify their knowledge and professional orientation and know the possibilities of its application in real life. After graduating student practice presents lessons learned and results achieved during practice.

Currently, students take Professional Training during the summer holidays for three to four weeks. The advantage of passing training during the holidays is the continuous realization and after training and becoming accustomed with the new environment, student has the opportunity to be involved in carrying out professional activities or solution of the problems. Many enterprises during the summer are in summer working mode, which on one hand allows for a deeper engagement to the students, but on the other hand, some parts of SME's operation are shut down and students have no opportunity to see the factory/service in full operation mode. For SMEs it is not exceptional during the summer that at some time are completely closed, which can complicate student graduation training during the summer. In such situation there is a possibility for realization the Professional Training throughout the academic year so the student can regularly one or two days in week to participate in the activities of the enterprise. In the MSc. study is the ability to adjust the time table enabling the students to attend the practice this way. The advantage is that the students regularly throughout the year can perform the specific professional activities, enabling them to gain work habits. Furthermore, if the students are incorporated in the company and have good results or potential, after passing the school, the company may employ them – the company obtains employee who already knows the situation and without too much difficult integrating into the work team.

In terms of the duration of a Professional Training it shows that the period of 120 hours per term is a relatively short time for students to have fully participation in the activities of the enterprise/laboratory, so opening the question about prolongation of the training is offered.

2.1 Key objectives and supporting objectives for implementing the proposed strategy

According to the profiles of graduates of individual study programmes, the engineer's study programme *Control of Technological Processes in Chemical and Food Industries* was chosen for innovation.

2.2 Basic information about the study programme Control of Technological Processes in Chemical and Food Industries

Field of study: Chemical Technologies

Level of study: 2nd

Standard length: 2 years

Form: full-time

Language of instruction: Slovak or English

Number of credits needed for successful finishing the study: 120

Academic title: “Inžinier”, abbreviation “Ing.”

2.3 Characteristics of the study programme and the courses in the study plan

The master degree study provides the full-value technical and economic education aimed at the control, management and economy of production processes, especially in the chemical and food-processing industry. It is the unique study program in the Slovak Republic integrating the knowledge of all areas of chemistry, processing, chemical and food technologies related to the economic and managerial education. Particularly it provides knowledge in enterprise economy, human resources management, corporate finances, marketing, management of the production and logistical processes, strategic control in technologies, mathematical models in decision-making, information technologies, labor and industrial law. From technological aspects it enlarges the education in inorganic and organic technologies, bioelectrochemistry, technology of modern materials. For graduates it provides complete expert, technologic, economic and managerial knowledge in correlative relationships which the industry expects and demands on the present day.

Study plan of the study programme *Control of Technological Processes in the Chemical and Food Industries* has been compiled to meet all the necessary attributes that are defined for the study branch Chemical Technologies for the second level of study. In particular, the study plan of the study program is treated as an interdisciplinary one. Understanding of the natural sciences is emphasized from the viewpoint of the specific needs of the study program *Control of Technological Processes in the Chemical and Food Industries*. Graduates have deeper knowledge in control theory in the field of technology and production processes, they design production and technological processes for managing of production, they understand control, economic management and corporate governance. The study program focuses on specific problems of production management in the chemical, biochemical and food technologies.

The most important areas of core expertise in this field of study are represented as follows:

1. Special chemical technologies: Advanced Inorganic Technology (2 credits), Advanced Organic Technology (3 credits);

2. Technology of material processing: Alternative Energy Sources (2 credits), Advanced Materials Technology (3 credits);
3. The laboratory of the study field: Laboratory of Technological Processes Management (4 credits);

Optimization and management of technological processes: Management in the Production and Logistics Processes (4 credits), Strategic Management in Technology (4 credits), Budgeting in Technology (4 credits), Financial Management (5 credits), Management of Small and Medium-sized Enterprises (2 credits);
Mathematics: Mathematical Models in Decision (5 credits);

4. Applied thermodynamics, kinetics: Applied Thermodynamics (3 credits), Separation Processes (5 credits), Laboratory Practice in Separation Processes (1 credit).

Students also study the social science subjects, to properly fulfill the 2nd level of the university study.

In the first year of their study, students increase and develop knowledge in the field of special chemical technologies including specialized advanced inorganic technology and advanced organic technology. Knowledge in technology is further developed in the field of special materials. The project work is focused on optimizing the management and design of technological processes in chemical engineering. The students of the study program *Control of Technological processes in Chemical and Food Industries* are students of technical specialization and they deepen also knowledge in mathematics and mathematical models.

In the second year of study, the students strengthen their specialization in process control technology through strategic management, budget management, and, ultimately, financial management technology. They deepen their knowledge in technology of material processing, bioelectrochemistry, technology of advanced materials and alternative energy sources. They complement their skills in the economic and social subjects, which represent the basement for future team leaders, project leaders and managers that are able to formulate research problems, to use management methods and techniques, to use control processes and to control quality of materials. Students throughout the study acquire the latest theoretical knowledge in the field of chemical technology with emphasis on the control of technological processes in the chemical and food industries. Students handle using of literature in the studied field. They obtain also skills in using computers for the development of the studied field. They learn to formulate and solve technological problems independently, develop a project for solution of

technological problems and lead research team. It is supposed that some graduates will continue to doctoral studies in Slovakia or at foreign universities.

Project work represents a meaningful part of education in a number of compulsory subjects as e.g. Laboratory of Technological Processes Management, Management of the Production and Logistical Processes, Simulation Training in Management Activities, Master Thesis, Professional Training. The share of credits for the courses focused on the project work in the total number of credits is 37.5%. Project work included in the subjects in the recommended study plan enables to the student to acquire skills and capabilities necessary for future practice of graduates.

Study plan						
Course code	**Course title**	**Guarantor**	**Type of educational activities**	**Range and methods of educational activities**	**Assessment method**	**Credits**
1st term						
Compulsory courses						
N412A2_4I	Advanced Inorganic Technology	prof. Ing. Ján Híveš, PhD.	lecture	2 h, on-site method	exam	2
N422I1_4I	Information Technology I	prof. Ing. Miroslav Fikar, DrSc.	laboratory practice	2 h, on-site method	classified credit	2
N424P0_4I	Enterprise Economy	doc. Dr. Ing. Milan Majerník	lecture, seminar	2/2 h, on-site method	exam	4
N424M1_4I	Marketing in Industrial Enterprises	doc. PhDr. Dušan Špirko, PhD.	lecture, seminar	2/2 h, on-site method	exam	5
Optional courses, the student chooses the courses in the range of 11 credits						
N412T1_4I	Technology of Modern Materials	doc. Ing. Matilda Zemanová, CSc.	lecture, seminar	2/1 h, on-site method	exam	3
N412A1_4I	Applied Thermodynamics	doc. Ing. Vladimír Danielik, PhD.	lecture, seminar	2/1 h, on-site method	exam	3
N424R0_4I	Budgeting in Technologies	doc. Dr. Ing. Milan Majerník	lecture, seminar	2/2 h, on-site method	exam	4
N424S0_4I	Strategic Control in Technologies	doc. Ing. Monika Zatrochová, PhD.	lecture, seminar	2/2 h, on-site method	exam	4
Elective courses						
N424K0_4I	Communicative Skills	doc. PhDr. Dušan Špirko, PhD.	lecture, seminar	2/1 h, on-site method	exam	3
N424F2_4I	Financial Literacy	doc. Ing. Monika Zatrochová, PhD.	lecture, seminar	2/1 h, on-site method	exam	3
N412K1_4I	Corrosion and Materials Protection	doc. Ing. Matilda Zemanová, CSc.	lecture	2 h, on-site method	exam	2
N434T0_4I	Physical Education	prof. PhDr. Miroslav Bobrík, PhD.	seminar	2 h, on-site method	credit	1

2nd term						
Compulsory courses						
N423S0_4I	Separation Processes	prof. Ing. Milan Polakovič, CSc.	lecture, seminar	2/3 h, on-site method	exam	5
N423L0_4I	Laboratory Practice in Separation Processes	doc. Ing. Pavel Timár, PhD.	laboratory practice	1 h, on-site method	classified credit	1
N424U0_4I	Accounting in Industrial Enterprises	doc. Ing. Irina Bondareva, PhD.	lecture, seminar	2/2 h, on-site method	exam	5
N400O0_4I	Professional Training	prof. Ing. Ján Híveš, PhD.	Professional training	120 h per term, on-site method	credit	3
Optional courses, the student chooses the courses in the range of 10 credits						
N424I0_4I	Investment Development	doc. Ing. Monika Zatrochová, PhD.	lecture, seminar	1/1 h, on-site method	exam	2
N424F3_4I	Financial Market	doc. Ing. Irina Bondareva, PhD.	lecture, seminar	2/1 h, on-site method	exam	4
N424R1_4I	Management of the Production and Logistical Processes	doc. Ing. Monika Zatrochová, PhD.	lecture, seminar	2/1 h, on-site method	exam	4
N412A3_4I	Alternative Energy Sources	doc. Ing. Vladimír Danielik, PhD.	lecture	2 h, on-site method	exam	2
Elective courses						
N424P1_4I	Corporate Finances	doc. Ing. Irina Bondareva, PhD.	lecture, seminar	2/2 h, on-site method	exam	3
N424N0_4I	Costs and Prices in Industry	doc. Ing. Monika Zatrochová, PhD.	lecture, seminar	2/2 h, on-site method	exam	3
N424M2_4I	Quality Management	doc. Dr. Ing. Milan Majerník	lecture, seminar	2/1 h, on-site method	exam	3
N424R2_4I	Innovation and Change Management	doc. Dr. Ing. Milan Majerník	lecture, seminar	2/1 h, on-site method	exam	3
N424E0_4I	Environmental management	doc. PhDr. Dušan Špirko, PhD.	lecture, seminar	2/1 h, on-site method	exam	3
N434T1_4I	Physical Education	prof. PhDr. Miroslav Bobrík, PhD.	seminar	2 h, on-site method	credit	1

3rd term						
Compulsory courses						
N422I3_4I	Information Technology II	prof. Ing. Miroslav Fikar, DrSc.	laboratory practice	2 h, on-site method	classified credit	2
N413O3_4I	Advanced Organic Technology	prof. Ing. Alexander Kaszonyi, CSc.	lecture	2 h, on-site method	exam	3
424M4_4I	Mathematical Models in Decision-making	doc. Ing. Monika Zatrochová, PhD.	lecture, seminar	2/2 h, on-site method	exam	5
N424R3_4I	Human Resources Management	doc. Dr. Ing. Milan Majerník	lecture	2 h, on-site method	exam	3
N424S1_4I	Simulation Training in Management Activities	doc. Ing. Monika Zatrochová, PhD.	lecture, seminar	2/2 h, on-site method	exam	5
N424L1_4I	Laboratory of Technological Processes Management	doc. Ing. Irina Bondareva, PhD.	laboratory practice	4 h, on-site method	classified credit	4
Optional courses, the student chooses the courses in the range of 8 credits						
N424F4_4I	Financial and economic analysis of the technology	doc. Ing. Irina Bondareva, PhD.	lecture, seminar	3/2 h, on-site method	exam	5
N424F5_4I	Financial management	doc. Dr. Ing. Milan Majerník	lecture, seminar	3/2 h, on-site method	exam	5
N424D1_4I	Tax system	doc. Ing. Irina Bondareva, PhD.	lecture, seminar	2/1 h, on-site method	exam	3
N412B1_4I	Bioelectrochemistry	prof. Ing. Ján Híveš, PhD.	lecture	2 h, on-site method	exam	3
4th term						
Compulsory courses						
N424E1_4I	Ethics and Etiquette in Managerial Activity	doc. PhDr. Dušan Špirko, PhD.	lecture, seminar	2/1 h, on-site method	exam	2
N424R4_4I	Management of Small and Medium-sized Enterprises	doc. Dr. Ing. Milan Majerník	lecture, seminar	2/2 h, on-site method	exam	2
N424P2_4I	Labour and Industrial Law	doc. PhDr. Dušan Špirko, PhD.	lecture, seminar	2/1 h, on-site method	exam	2
N400D0_4I	Diploma Thesis	prof. Ing. Ján Híveš, PhD.	final thesis, state exam	20 h per week /1 h per term, on-site method	exam	24

2.4 Requirements for completion of the study

For proper completion of the study, it is necessary that the student during the study:

1. Passes all compulsory courses and prescribed number of optional courses;
2. Earns the prescribed number of credits;
3. Passes the state exam.

2.5 Staff if the study program

Teachers working in the study program conduct ongoing internationally accepted research activities in the field of study in which the degree program is accredited. This is evidenced by the large number of papers and received grants to support national and international research projects. Most completed projects achieved a very good rating with the notion of achieving the objectives. The international recognition of the results is proved by references in Web of Science (WOS) and Scopus. This fact proves the ability of the university teachers to work in the study program to carry out their own research and regularly publish their results at internationally accepted level. FCHPT and the teachers working in the study program demonstrate their ability to prepare new courses and incorporate them in the curriculum of the study programme. Papers, research activities and the number of teachers working in the study program clearly point to good prospects for the maintenance and development of the study program in the future. Students are actively involved in the research activities through solving project assignments and case studies related to research in the field of study in which the degree program is accredited. They have the opportunity to develop their skills and to apply their theoretical and practical knowledge creatively. Students of the study program have the possibility to use computer simulations and take part in experimental learning forms with the help of Junior Achievement Slovakia, N. O., which provides licensed management simulation programs - banks in action and management simulation exercise. Students work with online economic textbooks. They participate in the project: ”Occupation Entrepreneur“. All these outputs are presented annually at the Students’ Scientific Conference organized as a conference with international participation.

2.6 Graduate profile – Key outcomes of education

The graduate of the engineer’s degree study programme is an engineer with large technological ground, which knows the methods and technologies of inorganic, organic chemistry, separation processes, technology of modern materials and alternative energy

sources. The graduate is competent to design the conception of production process, to manage production technological units and devices and to take into account ecological aspects. The theoretical knowledge qualifies the graduate to manage economics and managerial processes, technological and production processes as well. The knowledge from areas of marketing, human resources management, financial management, production management and investment development makes him proper to the interactive thinking which means to regard not only the technological and economic relationships but also environmental and social aspects. He is competent to IT application and in-plant information system for correct decision-making and control. The graduate obtaines knowledge in the business and financial planning, and he/she has also know-how per quod for the knowledge and skills for his starting business activities.

2.7 Scope of the graduate

The graduate of engineer's degree programme is universal technologically and economic oriented with the wide ability application in many areas of production management, technologic processes, human resource management, the marketing and in other economy spheres. The versatility of education makes possible for the graduate to work as a leader alternatively as an individual worker in the business management, as a controller, project manager etc. Obtained knowledge makes him possible to be of use in the public administration (in tax a financial institutions), in the engineering-investor and consultant organizations as well. He may work as a leader or as an individual worker in the creative teams for the control and production innovation, processes, business managerial systems etc. Theoretical knowledge qualifies him for the advanced form of education and makes him possible to be of use in the educational institutions also. By selection from the optional and compulsory elective subjects, especially from the simulation managerial programs, the graduate obtains the knowledge and know-how, which permit him to be of use as a businessman too.

Recommendations for the study program Process Control Technology in the Chemical and Food Industries

The study program is aimed multidisciplinary, combining technical, technological and managerial skills. However, it is mostly theoretically oriented and lacks a better balance between theory and practice. This could be extended by expanding the capacity of

professional experience, where students could connect previously acquired theoretical knowledge directly in companies.

The most important entrepreneurial skills include innovation management, strategic and visionary management, understanding customers and suppliers, and project management, which are also necessary for the scientist and also for the engineers and the most important personal skills, include creative thinking, communication, teamwork and analytical and rational Troubleshooting. Under the new accreditation will be sought to implement or modify the study plan previously existing objects so that the objects targeted focused on strategic and visionary management, understanding customers and suppliers, project management, how to develop teamwork and project management. Also, the inclusion of courses focused on various soft skills, which include entrepreneurial skills, personal skills, as well as scientific and technical skills.

For example, the subject focuses on innovation management and innovation management change, which is currently classified as optional subjects classified as a mandatory or optional compulsory courses within this curriculum.

For example, the subject focuses on innovation management *Innovation and Change Management*, which is currently classified as optional course, can be involved as compulsory or elective course in this study program. The adjustment of curricula would be more necessary to incorporate the introduction of legislative measures introduced by the European Union (EU; new EU legislation on chemicals apply to all industries dealing with chemicals, and the entire supply chain – taking responsibility of companies for safety chemicals that are marketed, for example. REACH, CLP regulation on biocidal products regulation on the prior informed consent after prior notification, etc.).

It would also be more in the area involved in the educational process practitioners – directly from businesses who have experience gained in real life.

From the perspective of scientific and technical skills would be useful objects oriented chemical technologies expand organic chemistry, the environmental chemistry (chemistry of the environment) and analytical chemistry returned to modern spectral methods.

2.8 Actions to achieve the objectives set

- Deepening of preparation of undergraduate students and PhD. students within the existing courses based on the results of the survey conducted among SMEs.
- Inclusion of new courses based on various soft skills which include managerial skills, personal skills, as well as scientific and technical skills.
- The involvement of practitioners in lectures.
- Extension of offers of professional experience and brigades in SMEs not only during summer but also during the term, in close cooperation with the ZCHPF SR.
- Support of solving theses themes from practice.
- Motivation of students by awarding the best theses and works in the students' scientific and professional activities by enterprises from the chemical and the pharmaceutical industries.
- Make a deeper conversion of the study program "Process control technology in the chemical and food industries."
- Support for international mobility of students.
- Underpinning of talented students through student club Socrates.

2.9 Timetable arrangements

The planned timetable to meet the provisions is follows:

- Deepening of preparing undergraduate students and PhD. students within the existing courses based on the results of the survey conducted among SMEs (continuous).
- The involvement of practitioners in lectures (continuous).
- Extension offers professional experience and brigades in SMEs not only during summer but also during the term, in close cooperation with the ZCHPF SR (March 2017).
- Support of solving theses themes from practice (continuous).
- Motivation of students by awarding the best theses and works in the students' scientific and professional activities by enterprises from the chemical and the pharmaceutical industries (continuous).
- Make a deeper conversion of the study program "Management of technological processes in chemical and food", and prepare an updated curriculum in collaboration with ZCHFP and with practitioners (August 2017).

- Inclusion of new items based on various soft skills, which include managerial skills, personal skills, as well as scientific and technical skills (August 2017).
- Support for international mobility of students (continuous).
- Underpinning of talented students through student club Socrates (continuous).

Annex 1: Example of good practise

Annex 2: Needs of education about chemical legislation

Annex 1

Example of good practise

Surface Coatings II course

Surface coatings are natural or synthetic substances used in the surface finishing of different products. Given that the compositions of surface coatings vary, their applications differ as well. Every type of surface coating has different properties and is suited for a different type of product surface.

The Surface Coatings II course is intended to provide more detailed information about surface coatings and is successfully built upon a previous course held in 2009. The Surface Coatings II course was held in 2011 per the cooperation agreement between the Association of Chemical and Pharmaceutical Industry of the Slovak Republic and the Faculty of Chemical and Food Technology at Slovak University of Technology (STU) in Bratislava.

The objective of the course was to provide an overview of the raw materials used in the formulation of surface coatings, surface pre-treatment technologies, application technologies, testing of surface coatings, colouring techniques and the materials and processes of coating degradation, the preparation of specialists for companies that produce and sell paints, varnishes and additional preparations for their application.

Workers in the coatings industry, technologists, marketing personnel and individual entrepreneurs involved in the production of surface coatings and in other areas were the target group of the course.

Association of Chemical and Pharmaceutical Industry of the Slovak Republic members and non-members participated in the Surface Coatings II course. A total of 12 employees of these companies participated in the course (Figure 1). Participating companies included:

- ColorCompany, s.r.o., Dubnica nad Váhom
- Chemolak, a.s., Smolenice
- PPG Deco Slovakia, s.r.o., Žilina
- Slovlak Košeca, a.s., Košeca
- 3U, s.r.o., Bratislava
- Kora, a.s., Trenčín

The professional curator of the course was prof. Ing. Ivan Hudec, PhD., who is the director of the Institute of Natural and Synthetic Polymers at the Faculty of Chemical and Food Technology at STU in Bratislava. The course covered a total of 50 hours and featured three separate components: lectures, exercises and excursions.

The capstone of the course was a final written exam.

The course schedule and the names of the individual lectures are presented Table 1.

Table 1 Schedule of the Surface Coatings II course

Date	Name of specific topic	Number of hours	Lectures	Exercises, practical component
29 January 2016	Registration and start of course	1	-	-
29 January 2016	Surface coatings – an introduction	3	3	-
29 January 2016	Surface coatings – components of surface coatings	4	4	-
5 February 2016	Basics of corrosion and corrosion protection for metal materials	5	4	1
5 February 2016	Basics of colorimetry	3	3	-
12 February 2016	Methods of evaluation of properties of coatings and paints, plasmachemical treatment of surfaces	4	-	4
12 February 2016	Surface coatings – compositions of paints - pigments, additives, fillers	4	4	-
18 February 2016	Excursion to Chemolak Smolenice	2	-	2
18 February 2016	Methods of testing coatings and paints,	2	1	1
19 February 2016	Fundamentals of rheology of polymer systems	4	4	-
19 February 2016	Excursion to CEPOMA Nitra	4	-	4
26. February 2016	Methods of testing coatings and paints	3	3	-
26 February 2016	Physical and physical-chemical aspects of dispersion, formulation of surface coatings	5	5	-
4 March 2016	Degradation of polymers and protecting polymers from ageing	4	4	-
4 March 2016	Final exam, completion of course	2	-	2

All participants successfully completed the Surface Coatings II course. A celebratory event to mark the completion of the course and to hand over course completion certificates was held on 4 March 2016 at the Facility of Chemical and Food Technology at STU in Bratislava. Figure 2 shows the celebratory award of certificates to course participants.
Ing. Silvia Surová, on behalf of the Association of Chemical and Pharmaceutical Industry of the Slovak Republic and Ing. Monika Bakošová, CSc. and prof. Ing. Ivan Hudec, PhD, on behalf of the Facility of Chemical and Food Technology at STU in Bratislava attended the celebratory event concluding the course.

The participants can use the knowledge and experience they gained in their current jobs, while building on them and continuing to develop their skills and knowledge, thereby contributing to their personal growth and the development of companies producing surface coating

Figure 1 Course participants

Figure 2 Celebratory award of certificates

Annex 2

Needs of education about chemical legislation

The issue of the importance of chemical legislation has recently become a major issue. It is important for those companies whose activity is related to chemistry. Therefore, when looking for new employees, they are also interested in knowledge about chemical legislation. As there is an absence of a subject regarding legislation in the curriculum, there is an effort to include chemical legislation into the curriculum.

Principles of chemical legislation:

- Regulations and responsibilities
- Basic obligations of producers, importers, distributors and downstream users
- Sources of information
- Safety data sheet
- European Chemicals Agency (ECHA)

Important Regulation:

- CLP Regulation (1272/2008 EP)
- REACH Regulation (1906/2006 EP)
- Chemical Law (67/2010 Z.z)

CLP Regulation

The Classification, Labelling and Packaging (CLP) Regulation ((EC) No. 1272/2008) is based on the United Nations' Globally Harmonized System (GHS) and its purpose is to ensure a high level of protection of health and the environment, as well as the free movement of substances, mixtures and articles.

CLP is legally binding across the Member States and directly applicable to all industrial sectors. It requires manufacturers, importers or downstream users of substances or mixtures to classify label and package their hazardous chemicals appropriately before placing them on the market.

One of the main aims of CLP is to determine whether a substance or mixture displays properties that lead to a hazardous classification. In this context, classification is the starting point for hazard communication.

CLP sets detailed criteria for the labelling elements: pictograms, signal words and standard statements for hazard, prevention, response, storage and disposal, for every hazard class and category. It also sets general packaging standards to ensure the safe supply of hazardous substances and mixtures. In addition to the communication of hazards through labelling requirements, CLP is also the basis for many legislative provisions on the risk management of chemicals.

Additionally, the following processes are part of CLP:

- Harmonized classification and labelling
- *Alternative chemical names in mixtures*
- *C&L Inventory*
- *Poison centres*

Obligations under the CLP Regulation

In terms of the use of the chemicals and mixtures on the EU market, there are additional requirements for manufacturers and importers under the CLP Regulation. The provisions of the CLP Regulation will be effective for chemicals from December 1, 2010 and for mixtures from June 1, 2015. The chemicals were to be classified, labelled and packaged according to Directive 67/548/EHS by December 1, 2010 and classified according to Directive 67/548/EHS and according to the CLP Regulation from December 1, 2010 to June 1, 2015, and labelled and packaged under the CLP Regulation. The mixtures should be classified, labelled and packaged by June 1, 2015 according to Directive 1999/45/EC. Directives 67/548/EHS and 1999/45/EC were repealed with effect from June 1, 2015. From those dates, labelling and packaging conditions will fundamentally change in all EU Member States. This Regulation is a GHS implementation that has been prepared at UN level. For this short period of time, businesses had to cope with the revision and change of hazard identification and awareness of this hazard through new types of labelling.

REACH Regulation

REACH is a Regulation of the European Union, adopted to improve the protection of human health and the environment from risks that can be posed by chemicals, while enhancing the competitiveness of the EU chemicals industry. It also promotes alternative methods for the hazard assessment of substances in order to reduce the number of tests on animals.
In principle, REACH applies to all chemical substances; not only those used in industrial processes but also in our day-to-day lives, for example in cleaning products,
REACH stands for Registration, Evaluation, Authorization and Restriction of Chemicals.

Obligations under the REACH Regulation

Obligations under the REACH Regulation entered into force on June 1, 2007. Under this new chemical legislation, if a businessman produces or imports more than 1 tonne of chemicals per year (except for CRM substances – carcinogen, mutagen and reprotoxic), the businessman is required to register the substance within the specified time limits. Substances which are not registered (unless exempted) may not be placed on the market in the EU. The registrant during registration collects the requested information, share this information with other registrants and submit them to the European Chemicals Agency (ECHA).

Deadlines for submission of the registration documentation:

- December 1, 2010 for carcinogenic, mutagenic and reprotoxic substances (CMR substances of categories 1 and 2) in quantities > 1 t/year, for substances classified as very toxic to aquatic organisms (R50/53) in quantities > 100 t/year, for other substances which are manufactured or imported in quantities > 1 000 t/year,
- June 1, 2013 for substances manufactured or imported in quantities of 100-1000 t/ year,
- June 1, 2018 for substances manufactured or imported in quantities of 1-100 t/year.

Regarding the deadline for the registration of chemicals produced and/or imported into the EU in quantities of 1-100 t/year, it is reasonable to assume that the above mentioned quantities will be mainly burdened by small and medium-sized businesses. The registration obligations

must be fulfilled not only by chemical companies but also by non-chemical businesses from any industry if they import chemicals or mixtures for their use.

Chemicals Act 67/2010

In the Slovak Republic compliance with the provisions of both mentioned EC Regulations is regulated by Act No. 67/2010 Coll. on the Conditions for marketing chemical substances and chemical preparations, and on changes and amendments to certain acts (the Chemical Act). It establishes the competence of the state administration bodies, including supervision, maintaining the supervision of compliance, the imposition of corrective remedies and the imposition of sanctions for breaches of this Act (§ 32); if the remedy is not remedied within the stipulated time limit, the competent control authority will start the procedure for withdrawal of the substance or mixture or product from the market.

Summary

Without the compliance requirement of the REACH and CLP Regulations and their introduction into action (production, import), businesses cannot do business in this area, i.e. if they do not register imported or manufactured substances or mixtures, it will in practice mean (among other sanctions) denied import and manufacture of these chemical substances or mixtures.

Under the REACH Regulation, the system of sanctions in the event of infringement of the provision of this Regulation shall be laid down by the Member States and they shall take all measures necessary to ensure that they are implemented. Similarly, even in the case of the application of the CLP Regulation, Member States have to impose sanctions for non-compliance with this Regulation and take the necessary measures to ensure that the requirements for classification, labelling and packaging of chemicals are applied.

For the reasons set out above, it is necessary for chemistry graduates to have an overview of the chemical legislation that each business must follow. Therefore, there is also an effort to introduce the study of chemical legislation into the curriculum.