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Chemical Engineering Education – Current and Future Trends

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Abstract

The chemical industry today is changed from the chemical industry of twenty-five years ago. Clear evidence of this change comes from the jobs taken by graduating chemical professionals in North America, Europe, and some of the Asian countries. Twenty-five years ago, eighty percent of these graduating students went to the commodity chemical industry, exemplified by Dupont, Exxon, Shell, ICI, BASF and Dow, to name a few. Now, twenty percent do. Twenty-five years ago, around ten percent went to product-oriented businesses like PPG, Pfizer, and 3M. Now, fifty percent do. The chemical industry now has a product focus. With this shift of the chemical industry, what should be the curriculum of the chemical engineering degrees at the BSc- and MSc-levels, and, are the skill set of chemical engineers appropriate for this altered chemical industry? While the basic skill set, defined by the core topics (transport phenomena, separations, reaction engineering, etc.) must remain strong, should the applications that currently emphasize commodity chemicals also include new topics such as sustainability, and product design?

In Europe, the European Federation of Chemical Engineering (EFCE) has taken a leading role to define the chemical engineering curriculum. The result has been a set of recommendations for the first (BSc), second (MSc) and third (PhD) cycle chemical engineering education aligned to the Bologna Process. They recommend that students studying towards bachelor and masters qualifications should be measured on their level of knowledge and the understanding they develop, rather than the amount of time they spend with the tutors. According to the Bologna Process, the first and the second cycle degrees should have different orientations and various profiles in order to accommodate a diversity of individual, academic and labour-market needs. Within Europe, two types of higher education in chemical engineering can be found: more research-oriented or more application-oriented first cycle programmes. Both types of studies cover a period of 3-4 academic years and 60 credits per year. After completion of the first cycle, students can continue their study with a second cycle program of chemical engineering with 90-120 credits for a further 18-24 months. For the first and second cycles, the EFCE recommend a set of programme outcomes (knowledge and understanding, engineering analysis, engineering design, investigations, engineering practice and transferable skills) and a set guidelines (core curriculum, teaching and learning, industrial experience, review of the education process and student assessment) to achieve them, with special emphasis to the ability to solve problems. They also propose a minimum set of subjects required to define a course as chemical engineering and the level of achievement that might reasonably be expected at different levels. The talk will give an overview of the recommendations of the EFCE and highlight their implementation at the Technical University of Denmark's chemical engineering programmes. Also, some of the issues related to the changing needs of the chemical industry will be discussed.