ChE *learning in industry*

This column provides examples of cases in which students have gained knowledge, insight, and experience in the practice of chemical engineering while in an industrial setting. Summer interns and coop assignments typify such experiences; however, reports of more unusual cases are also welcome. Description of analytical tools used and the skills developed during the project should be emphasized. These examples should stimulate innovative approaches to bring real world tools and experiences back to campus for integration into the curriculum. Please submit manuscripts to Professor W. J. Koros, Chemical Engineering Department, University of Texas, Austin, Texas 78712.

INTERNATIONAL ENGINEERING INTERNSHIP PROGRAM

At The University of Rhode Island

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Through the cooperative efforts of engineering and foreign language faculty, the University of Rhode Island (URI) offers a five-year International Engineering Program (IEP) that leads simultaneously to both the Bachelor of Arts degree with a major in German and the Bachelor of Science degree in one of the engineering disciplines. Key features of the IEP include separate sections of German language courses specially designed for engineering students, a six-month internship with an engineering firm in a German-speaking country, and a capstone engineering course taught in German by bilingual engineering faculty. In many cases, IEP students also complete internships with IEP partner companies in the Rhode Island area before commencing the European internship experience in the fourth year of the program.

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The program was begun eight years ago with the help of a grant from the Fund for the Improvement of Post Secondary Education (U.S. Department of Education). Since that time, over fifty students have completed their six-month internships abroad, and approximately thirty-five students have graduated from the University with both degrees, several of whom have gone to work for the companies participating in the internship program. The successes of the IEP have led to a growing popularity of the program, which now boasts an enrollment of over eighty students.

The internship program in Germany is a key element to the success of the IEP. The concept serves first of all as a motivator for students to study Germanic language and culture along with their engineering studies. Above all, the internship is the experience that puts study into practice and provides concrete experience for students who plan to practice their careers in a cross-cultural environment. Although arrangements are made in advance for the students by the program's director, expectations on-site are the same as they would be for German students. All work is intended to draw on their engineering background and is carried out exclusively in the German language. The goals are to experience engineering as it is practiced in Germany and to refine

German language and intercultural communication skills, *i.e.,* to put their seven semesters of engineering and language study into practice in a very real situation.

The program was developed through a variety of contacts, many of which have been facilitated through the efforts of the IEP Advisory Board members, a group of Rhode Islanders active in various aspects of international business and technology. Internship opportunities in Germany are maintained with approximately twenty companies through annual visits abroad and through various forms of communication, including mail, telephone, fax, and e-mail. Some companies are subsidiaries or partners of Rhode Island-based American firms; some are the home bases of German subsidiaries in Rhode Island; others are firms that have come to our attention through our earliest contacts in Germany. In each case, the companies agree to provide an organized engineering work experience and both housing and a subsistence-level monthly stipend for the IEP interns. In general, arrangements are made approximately six months in advance in order to ensure enough time for proper arrangements, including the necessary visa and work permit.

As of this year, the program also includes an optional study abroad component. With the support of a grant from FIPSE, URI business, engineering, and language faculty have worked closely with their counterparts at the Technische Universität Braunschweig to develop a one-to-one student exchange through which students may study in their field of expertise at the partner school with full accreditation at the home institution. Five IEP students are in Braunschweig this academic year, some of whom are planning a semester of study and a six-month internship at one of our partner companies. At the same time, five Braunschweig students are currently in Rhode Island pursuing their engineering studies at the advanced undergraduate and graduate levels.

It is important to stress that the program is a full double-degree program that satisfies all requirements for both the Bachelor of Arts and the Bachelor of Science degrees. Several attempts have been made at other institutions to internationalize the engineering curriculum through the addition of a few relevant courses or an intensive summer seminar. URI takes the position, however, that this challenge can only be met through a commitment of additional time at the undergraduate level. Students in the program are expected to take a German language or culture course each semester throughout the five years. They are not recommended for an internship abroad until they have completed at least six semesters of German along with at least three years of their technical studies. The companies in Germany are eager to have young American engineering students participate in their internship programs, but only when they are able to communicate in German and contribute to their technical needs.

URI views its program with a German orientation as a successfully developed model that is equally appropriate for other languages and cultures. German was chosen for the pilot program because of the level of commitment on the German faculty and the presence of several German-speaking faculty in the College of Engineering. URI is currently working on the development of a parallel program in French and is also studying the feasibility of a similar program in Spanish that would serve the needs of Spanish-speaking immigrants in Rhode Island.

Chemical engineering majors in the URI program have an excellent

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opportunity for both U.S. and German internships since the program is strongly endorsed by a local division of the Hoechst Celanese Corporation. Seven IEP students have completed internships with the Hoechst headquarters in Germany, most of whom had the opportunity to work with Hoechst in Rhode Island in advance of the German experience and five of whom subsequently joined Hoechst Celanese on a permanent basis after graduation. Ms. Kristen Verduchi, one of these five students and now a process engineer with this company, offers the following overview of her IEP education at URI:

In May of 1994, I completed the International Engineering Program at the University of Rhode Island following my return from a six-month internship at the headquarters of Hoechst AG in Frankfurt, Germany. The five-year IEP consists of nine semesters with an average of 17 to 19 credits/semester of university study and six months of an internship in Germany. A semester during the fourth or fifth year is spent abroad gaining practical experience at an engineering firm in Germany. The university's program of study provides the theoretical knowledge in the classroom and the internship provides the opportunity to put the engineering knowledge into practice. In this way, the International Engineering Program is not only a novel way to imbue an engineering curriculum with international flavor, but also a way for students to put the classroom theory into practice.

The undergraduates who plan to undertake the dual degree IEP must decide to do so early in their college careers, for one must complete approximately four years of the IEP curriculum prior to traveling to Germany for an internship at an engineering firm. Declaring participation in the program early also has the advantage of making the student eligible to intern at a Rhode Island engineering firm in his/her field prior to going to Germany. It is this opportunity and subsequent ones that I will describe here.

My summer assignment following completion of the first year of the undergraduate IEP was an internship at Hoechst Celanese Corporation in Coventry, Rhode Island. I worked during the summers of 1990-92 as an engineering intern in the Process Engineering Department, carrying out projects such as those listed below, each of which provided me with practical skills and hands-on training not taught in the classroom:

- *Investigation of the composition of a waste-air stack from pharmaceuticals' processes using a Fourier Transform Infrared instrument and development of a user manual.*
- *Survey of plantwide lighting for the Narragansett Electric Efficiency Program.*
- *Development of piping and instrumentation diagrams of pharmaceuticals' processes and of plantwide steam and condensate lines.*
- *Study of pressure relief devices.*

Following completion of the fourth year of study, I applied through the URI program to Hoechst AG in Frankfurt am Main, Germany, for a professional internship. Between June and December of 1993, I interned in the Process Engineering Department in Environmental Engineering at Hoechst AG. In this extraordinarily diverse work environment and culture, I experienced a new lifestyle and adapted to new customs and to a new style of communication.

New friends from various parts of the world as well as professional relations with the employees from Hoechst AG were among the many benefits of the internship. Understanding and respect for the German culture (or any foreign culture) is the key to successful relations in professional and personal German life. One must not be overcome by culture shock, but must accept the foreign culture with an open mind, must be willing to attempt new things, and must modify one's thinking patterns. Success in a foreign work environment is representative of how well-suited one is to change and therefore to success in the constantly changing world. It was with this mode of thinking that I was able to learn about environmental engineering from the chemists and technical assistants at Hoechst AG in Frankfurt.

For the six months between June and December of 1993,

TABLE 1
Source Material on the
International Engineering Program
John M. Grandin, Author

- "German and Engineering: An Overdue Alliance," *Die Unterrichtspraxis,* **22**, 146-152 (1989)
- "Deutsch Für Ingenieure: Das Rhode Island Programm," in *Das Jahrbuch Deutsch als Fremdsprache,* **15**, 297-306 (1989)
- "Developing Internships in Germany for International Engineering Students," *Die Unterrichtspraxis,* **2**, 209-214 (1991)
- "The Changing Goals of Language Instruction," (with Kandace Einbeck and Walter von Reinhart) in *Languages for a Multicultural World in Transition,* ed. Heidi Byrnes (Lincolnwood, Illinois: National Textbook Company and Northeast Conference) 123-163 (1992)
- "International Experience for Engineers," (with H. Viets), in *The International Journal of Engineering Education,* **9**(1), 93-94 (1993)
- "The University of Rhode Island's International Engineering Program," in *Language and Content: Discipline and Content-Based Approaches to Language Study,* ed. Merle Krueger and Frank Ryan (Lexington, Massachusetts: D.C. Heath and Company), 130-137 (1992)

CALL FOR PAPERS

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I conducted study, design, and testing on an experimental absorption facility in a laboratory. There, I designed a laboratory-scale test facility and investigated the absorption capabilities of several packings used to purify a waste-air stream using infrared spectroscopy. The experimental and theoretical results of the design, testing, and analysis were documented and distributed to Hoechst AG for review and to URI for academic credit. The report submitted to the language and chemical engineering departments (in both English and German) earned me two additional credits toward the language degree, in addition to the six credits awarded for the internship abroad. It was this report that was later submitted to and presented at the 1994 American Institute of Chemical Engineers' paper contest during my last year at URI.

I am grateful to URI and to the creators of the IEP for establishing such a fantastic undergraduate curriculum that affords engineering students the opportunity to study and work in an engineering field in Germany. The industry needs engineering students who are bilingual, for we are entering a time when global competition in business demands international ties, relationships, and communication. The IEP trains engineering students for the global marketplace.

Subsequent to the internships at Hoechst Celanese Corporation in Coventry and following the six-month internship in Frankfurt, I applied to Hoechst Celanese Corporation in Coventry for a permanent position as a process engineer/process safety engineer—I joined the company in that capacity in June of 1994. I felt that my educational background and internship experience in chemical engineering with both the home and the parent companies corresponded quite well with the job requirements. Since I joined the company, I have greatly enjoyed the challenging work in the process engineering/process safety position and can report that the dual degree has provided me with important tools. I find myself conversing in German quite regularly with native Germans assigned to our facility and with visitors from Germany. In addition, I provide the service of translating technical documents from Germany for process engineers.

Although Hoechst Celanese plays a major role in the practical education of chemical engineering students in the IEP, it is not the only regional firm cooperating with the URI program. Several students have also worked in a parallel manner, for example, with a division of TRW in nearby Massachusetts. To date, TRW has employed several chemical engineering students from the program in local summer internship situations, three of whom have completed six-month internships with TRW subsidiaries in Germany. Among the four IEP grads who have gone to work full-time for TRW, two are chemical engineers with assignments in materials engineering and airbag deployment technology.

URI and its partners in the private sector take pride in the development of the IEP as a model for the global education of young engineers. Engineering educators are challenged to prepare students for the international nature of their fields today and also for the contemporary needs of research, design, and manufacturing. URI believes that the best response to these challenges is through genuine interdisciplinary cooperation within the structure of higher education, *e.g.*, engineering and language, as well as through carefully coordinated partnerships between higher education and those companies who will be employing our future graduates.

Additional source material on the International Engineering Program is presented in Table 1 for those readers who are interested in further information. ❐