POLYMER SCIENCE AND ENGINEERING

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THE PRIMARY responsibility for the Polymer Science and Engineering graduate course program at the University of Cincinnati rests on four faculty members: Professors F. J. Boerio and R. J. Roe of the Department of Materials Science and Metallurgical Engineering, Professor R. P. Chartoff of the Department of Chemical and Nuclear Engineering and Professor J. E. Mark of the Department of Chemistry. When an incoming graduate student, enrolled in any one of these departments, expresses the desire to pursue polymer specialization, he or she is advised to take a series of four one-quarter core courses offered by the four faculty members. According to the offering sequence, these are: "Introduction to Polymer Science" taught by F. J. Boerio, "Physical Properties of Polymeric Materials" by R. J. Roe, "Polymer Configurations and Rubber-like Elasticity" by J. E. Mark and "Polymer Engineering" by R.P. Chartoff. These four courses are designed to acquaint the students, in an orderly sequence, with fundamentals of most major aspects in polymer science and engineering including preparation, characterization, structure, properties and processing. Descriptions of the courses are listed in Table 1. Topic coverage and the sequence of offerings in all of the courses is closely coordinated among the cooperating faculty members.

Through the experiments students are given opportunities to become thoroughly familiar with the various types of instrumentation likely to be found in any industrial or academic polymer laboratory

The lecture courses are augmented by two one-quarter laboratory course, "Polymer Characterization" and "Polymer Engineering Techniques" (see Table 1). All the four faculty members simultaneously participate in these two laboratory courses on a shared basis and offer a variety of experimental topics according to the areas of their expertise. From among 15 to 20 experimental topics offered in each laboratory, students are free to select any 8 according to their individual interests. Within the two quarter period a student can choose a series of lab experiences which provide a broad exposure to several different topic areas. At the same time those who wish to can narrow their selection to a minimum of different areas and concentrate more in depth on any one, such as polymerization or processing. The possibilities available for individual selection are illustrated in Figure 1. Since progress in polymer science and engineering heavily depend on experiment, the emphasis on laboratory experience for graduate students is a most essential part of the program. Through these experiments students are given opportunities to become thoroughly familiar

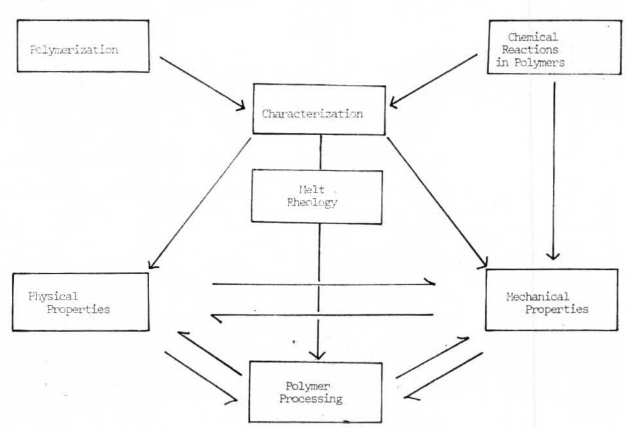

FIGURE 1. Interactions between areas.

with the various types of instrumentation likely to be found in any industrial or academic polymer laboratory. This is valuable for learning useful techniques for their thesis research and gives them an edge in obtaining future employment after they finish their graduate study.

After completing the sequence of basic courses, students are further encouraged to take other elective courses on specialized topics in polymers. These include "Transport Processes in Polymer Systems", "Organic Synthesis of Polymers", "Polymer Spectroscopy" and "Polymer Morphology".

The Polymer Science and Engineering program is a graduate program only at the present, but undergraduate students interested in polymers can become introduced to the basic aspects of polymer science through two elective courses "Polymeric Materials" and "Polymer Technology". The two laboratory courses mentioned above are also offered to advanced undergraduate students. □

TABLE 1. Graduate Polymer Courses

Introduction to Polymer Science **3 credits, Lecture,** Boerio, **Autumn**

Preparation and Characterization of polymers; addition and condensation, molecular weight averages and distributions.

Physical Properties of Polymeric Materials **3 credits, Lecture,** Roe, **Winter**

Solid state structure-property relationships in polymeric materials. The glass transition, structure of crystalline polymers, thermodynamics of polymer solutions and compatibility.

Polymer Configurations and Rubber-like Elasticity **3 credits, Lecture,** Mark, **Spring or Summer**

Configuration dependent properties and their interpretation; statistics of chain dimensions; network formation in crosslinked polymers; thermodynamics and mechanical properties of rubbers; statistical theories of rubber-like elasticity.

Polymer Engineering **3 credits, Lecture,** Chartoff, **Spring**

Fundamentals of polymer processing; design of processing operations and relation to physical and mechanical behavior in solid and molten states; viscometric measurements and melt elasticity; applied viscoelasticity.

Polymer Characterization **2 credits, Lab,** Boerio, Roe, Chartoff, Mark, **Winter**

Experimental investigations of structure and properties of polymers; molecular weight averages and distributions, thermal and mechanical properties, transitions, and crystallinity.

Polymer Engineering Techniques **2 credits, Lab,** Chartoff, Roe, Boerio, Mark, **Spring**

Measurements of viscoelastic properties, viscosity and flow parameters necessary for design of polymer processing equipment; relations between processing data and polymer molecular structure with applications to quality control.

Special Topics in Polymers **3 credits, Lecture, Staff, Winter or Spring**

Intensive coverage of specific topi csin polymer science and technology at a research level. To be offered irregularly three quarters in each two year period. Future topics will include polymer spectroscopy, transport phenomena in polymer systems, surface properties of polymers, organic synthesis of polymers, polymer spectroscopy, and polymer morphology. Offerings to be coordinated between Chemical Engineering, Materials Science, and Chemistry staff.

BOOK REVIEW: Schlenker

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brief summaries of methods of testing and characterization of materials, and the shaping and fabrication of objects. There are many illustrations, but they are not always intergrated with and explained in the text. Many experiments are suggested; some are self-explanatory, but others are not clear with respect to purpose, procedure or significance. An instructor is necessary to supply guidance—and to protect students and equipment. Some statements are inaccurate or misleading, but they are few and unemphasized among the multitude; not much damage is likely to result.

Professor Muir notes that, in spite of the title, the text is about the phenomenology of materials more than the principles and concepts of materials science. The few gestures toward a quantitative approach include a few mechanical testing equations and a statement of Bragg's law, together with the geometric figure customarily used in its derivation. The use of the lever rule is illustrated, but even this mass conservation principle, using only the simplest linear algebra, is not derived.

Should the study of materials be a part of high school curricula? Surely it is more exciting than bookkeeping, conveys more varied skills than typing, and is a valuable adjunct to shop practice or preparation for the building trades. This book would be a suitable text, although injection of a bit more of the formal structure of materials science might make the subject easier to retain. College-bound students should study science and mathematics in high school so they can learn materials science on a more systematic and quantitative level. □