

THE GRADUATE PROGRAM AT THE INSTITUTE OF PAPER CHEMISTRY

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THE INSTITUTE OF Paper Chemistry was established in Appleton, Wisconsin, in October, 1929. The concepts which led to its founding were developed by a small group of men within the Board of Trustees of Lawrence College (now Lawrence University), a liberal arts institution of distinction in Appleton. Prominent among them was Dr. Ernst Mahler, an executive of the Kimberly-Clark Corporation and a chemical engineering graduate of the Technische Hochschule in Darmstadt, Germany, who was undoubtedly influenced by the excellent work in the pulp and paper field at that institution.

It was the aim of the founders that the Institute become a unique partnership between industry and education, with three specific objec-

tives. First, it was to undertake graduate education, "to train men in the basic sciences and technologies applicable to the pulp and paper industry, to a point where these men can assume technical positions applying science to the industry, do research on the development of new principles, and prepare for higher executive or coordinating positions." Second, the Institute was to be a research center, where both staff and students could engage in a broad program of pure and applied studies in areas and disciplines pertinent to the present and future interests of the industry. The third objective, was to develop a comprehensive library, not only serving the academic and research activities of the Institute, but also providing a central source of information for the pulp and paper industry as a whole.

The new Institute started operation early in 1930, in close affiliation with Lawrence College, with one full-time staff member and three students. Many of the classes were taught by Lawrence pro-

fessors, who divided their time between the two institutions. Several staff additions were made during the first year, and more students were admitted in September. The Master of Science degree was first awarded in June, 1931, and the degree of Doctor of Philosophy in June, 1933.

It is evident that the Institute has grown and developed considerably in the forty-eight years since its establishment. Growth always brings change, of course, but there has been remarkably little change in the guiding principles laid down by the founders. The academic affiliation with Lawrence University continues, although the relationship has become more tenuous in the structural sense, and the Institute functions essentially as a separate institution. Educational activities are still concentrated at the graduate level. The academic approach continues to be aimed at breadth with competence, rather than narrow specialization. The existence of a true research environment at the Institute is important since only in such an environment can graduate study be meaningful.

The Institute of Paper Chemistry is a private institution. In a very real sense, it belongs to the pulp and paper industry of the United States. Basic support is accomplished through the mechanism of "member companies"; any company manufacturing pulp, paper, or paperboard in the United States is eligible for membership in the Institute. The members support the Institute through membership dues, which vary in amount depending on the size of the company. That the support of the Institute is widespread is indicated by the fact that its member companies produce a majority of the pulp, paper, and board manufactured in the United States.

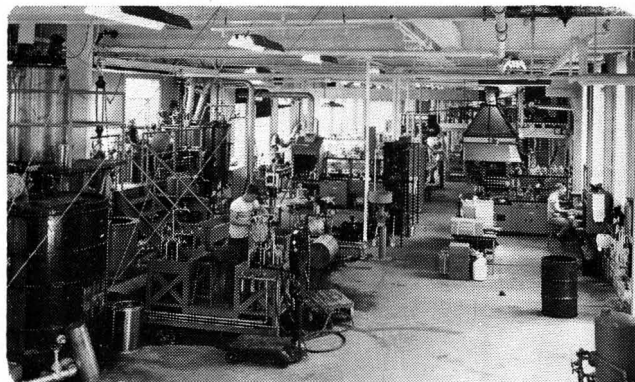
The buildings and equipment of the Institute have a replacement value of about \$17.9 million, and the functional area for education and research is about 225,000 square feet. It is interesting to note that major capital outlays for new buildings and special equipment have been financed separately from operating expenses, and that the Institute has been the recipient of many

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gifts for such purposes from companies, foundations, and individuals. The total staff numbers about 225, of whom about 95 are professional scientists or engineers. This does not include the graduate students, and the research fellows and visiting scientists usually in residence. The operating budget for the current year is approximately \$6 million.

THE ACADEMIC PROGRAM

TURNING NOW TO the academic program, it has been noted that the Institute is primarily a graduate school in engineering and the sciences. The teaching faculty numbers 45 members, organized into five academic departments (Chemistry, Physics and Mathematics, Biology, Engineer-



A general view of the pulping and papermaking laboratory.

ing, and General Studies). Since the opening of the Institute, 780 regular students have matriculated from 187 colleges and universities located in 44 states and 16 foreign countries. The great majority of these students have taken their undergraduate degrees in chemical engineering or chemistry; some did their previous work in biology, physics, or mechanical engineering, and in recent years students have been admitted from undergraduate pulp and paper science and engineering departments.

It is worth noting that the educational philosophy of the Institute, while no longer unique, is still unusual among graduate schools. The objective is to develop the "scientific generalist," or the industrial scientist who is well versed in several disciplines within the physical sciences and engineering; but who is specialist in none. The belief is that people with a broad viewpoint, who understand the inter-relationships among scientific

fields, and can range across the boundaries of disciplines in their pursuit of knowledge and insight, will be the key people in guiding this industry to new vistas and new accomplishments. This concept evolved directly from the desires of

tration. These include process engineering, environmental technology, applied chemistry, fiber resources and materials science.

Advanced seminars are offered in cellulose and lignin chemistry. Courses in biochemistry and

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the founders for competent breadth in the graduates, and has characterized the academic approach ever since.

Although it is possible to proceed directly to the Ph.D., most students who enter the Institute for graduate study first undertake the Master of Science program. This comprises a sequence of lecture, laboratory, and classroom studies, with a limited research requirement. While any student's specific program may vary somewhat with background and interests, the major requirement lies in a series of courses undertaken by all students. These are designed to insure that each student develops an adequate background in chemistry, physics, biology, mathematics, and ChE, so that the student has ample opportunity to apply learned principles to real problems in pulp and paper technology.

The basis of the program is an interdisciplinary core of courses in thermodynamics, surface chemistry, chemistry of natural products, mechanics of deformable media, and structural plant science. In addition, a sequence in applied science and engineering is required which covers pulping and bleaching processes, dynamics of papermaking, chemical recovery technology, colloid chemistry of papermaking materials, and physical properties of fibrous structures. Courses in mathematics are provided for those who need to enhance their backgrounds in this area. Students who have not previously studied ChE are required to complete elementary courses in this field.

INTEGRATION OF DISCIPLINES

ONCE THIS BASIC foundation is laid, much emphasis is placed upon the inter-relationships among fields and the integration of disciplines. Where possible, emphasis is given to systems and situations pertinent to the pulp and paper industry. Students elect one set of areas of concen-

genetics are offered. Advanced ChE courses in process control, kinetics, applied mathematics, fluid mechanics, and heat and mass transfer continue the work in this area. Other general studies and optional courses are available. In addition, each student is required to spend a modest amount of time on an individual research problem of limited scope.

At the Ph.D. level, all of the work is on an individual basis. The student's first requirement is to develop and demonstrate the capacity for independent investigation by satisfactorily completing a program called "Preparation for Research." This approach was developed at the Institute some years ago to replace the former written and oral qualifying examinations for doctoral study. In "Preparation for Research," the student is assigned a series of complex problems, each of which may be in a different area of science or technology. The student is required to analyze the problem, search the literature, plan a research program aimed at its solution, and defend the efforts before a faculty committee. The student is not required to undertake the research or to solve the problem. The faculty members evaluate the student's performance, and attempt to help develop capacities for research planning. Normally, about one month is spent on each problem, and a student may be required to complete two or three, depending upon performance. Successful completion of this requirement results in the student's admission to doctoral candidacy, and clears the way for the one remaining task, the doctoral thesis.

The doctoral thesis must of course be specific, and an excursion in depth. The thesis is left as much as possible in the hands of the student, so that he or she derives the maximum educational benefit. The student may work in any area of faculty interest and must choose the thesis topic,

(subject, of course, to faculty approval). A faculty advisory committee guides the work and reviews quarterly progress reports but leaves the initiative with the student as he or she is capable of accepting it. On completion of the research, the student presents the thesis and defends it before an examining committee appointed to represent the faculty. Students spend an average of two calendar years on their thesis research.

M.S. candidates must complete one summer of work experience in the pulp and paper industry in order to gain practical experience. Requirements for the Ph.D. include two summers of work experience. Usually, this requirement is met as early as possible in the program, so that full time can be devoted to the thesis in the latter stages.

At the beginning of the academic year, normally about 100 regular graduate students are in residence, including an entering class of about 35 new members. This decreases gradually during the year, as students complete their work. About one third of the student body are Doctoral candidates, engaged in thesis research. After Commencement in June 1977, the Institute had awarded about 554 Master's degrees and about 351 Ph.D.'s.

The great majority of regular students receive financial support in the form of a fellowship and tuition scholarship. The amount of the grant depends upon the student's marital and family status, and generally is adequate to provide essential living expenses in addition to tuition and fees. The graduates are free agents. They have no obligation to seek employment in the pulp and paper industry, although a high fraction of them do so.

OTHER ACADEMIC ACTIVITIES

IN ADDITION TO THE regular graduate program, other academic activities are worthy of note. There are the special students, for example, who are not candidates for an advanced degree, but who are sent to the Institute by their sponsors for intensive study, (usually for a period of one academic year). Special students elect courses appropriate to their interests and study with the regular graduate students.

Each year, the several Postdoctoral Research Fellows in residence at the Institute, engage in research under some member of the faculty. The Institute frequently plays host to visiting scientists who may be in residence for specific purposes.

Research at the Institute is directed toward

the long range needs of the industry and spans a broad spectrum of engineering and science. Faculty participate in a large number of funded research projects. Examples are the investigation of a new O_2 -alkali pulping process, laser Raman and x-ray diffraction studies on cellulose, development of methods to eliminate scaling in black liquor evaporators, structural analyses of the performance of corrugated containers, studies of retention and drainage in the papermaking process, environmental investigations of trace contaminants, and cell fusion and plant tissue culture applications.

Student research provides a significant complement to the overall research program. Examples of current M.S. research projects include the investigation of the hydrodynamics of pulp suspensions, development of computer models for waste treatment processes, studies of the enzymatic degradation of starch in whitewater systems, and determination of the rheological behavior of corrugating adhesives. Current Ph.D. theses include studies of the degradation of carbohydrates in alkaline systems, investigations of the surface properties of cellulosic materials and analysis of fiber-fiber bond strength.

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This research activity is evidence that the unique academic-industry partnership produces a setting particularly conducive to graduate student research. The Institute of Paper Chemistry, created in response to the needs of one of the largest industries in this country, continues to develop, with the support of the industry, to meet its requirements. The interdisciplinary graduate program is a product of this special relationship with the pulp and paper industry. The academic mission of the Institute continues to be the integration of a broad spectrum of disciplines and the application of the integrated whole to the solution of the problems of this industry. □