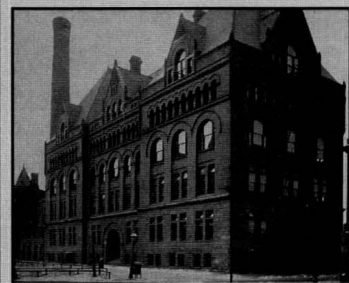


ChE at . . .

Illinois Institute of Technology

*“A Century of Excellence in
Chemical Engineering Research and Education”*



Armour Institute
Main Building



Chairman
William T. McClement

HAMID ARASTOPOUR, DARSH T. WASAN, MARGARET M. MURPHY
Illinois Institute of Technology • Chicago, Illinois

In 2001, Illinois Institute of Technology (IIT) celebrated a century of excellence in chemical engineering education and research. Among the very oldest programs in the country, IIT's program has closely tracked the origin and evolution of the chemical engineering discipline itself. This paper highlights the unique combination of visionary administrators and talented faculty who piloted a once-fledgling program through more than 100 years of rapid scientific and technological change, while at the same time maintaining its continuous excellence and relevance to the needs of society and industry.

PROGRAM ORIGIN/EARLY HISTORY

The very earliest record of chemical engineering studies at the then Armour Institute surfaced in the year 1894 in the joint Department of Chemistry and Chemical Engineering. Under the directorship of Dr. James C. Foye, PhD, LL.D, and professor of chemistry, a four-year curriculum leading to the BS degree in chemical engineering was developed and implemented. According to Dr. Foye, the instruction in chemical engineering was intended “to meet the wants of students who wish to acquire a knowledge of chemistry, as applied to the engineering profession, which will enable them to engage in industries demanding the attainments of both the engineer and the chemist.”^[1] This educational initiative came only six years after George Davis provided the blueprint for a new profession in a series of twelve lectures on chemical engineering in England and, simultaneously, MIT began “Course X (ten),” the first four-year chemical engineering program in the United States. By 1895, the newly named Armour Institute of Technology had established a stand-alone Department of Chemical Engineering as part of the Technical College to be directed by Professor Foye.^[2]

A CENTURY OF CHEMICAL ENGINEERING EXCELLENCE

The chemical engineering momentum begun at Armour by Dr. Foye was temporarily halted by his sudden death on July 3, 1897. By the beginning of the fall semester, all references to chemical engineering were dropped and the official name became the Department of Chemistry, headed by Thomas Allen, professor of chemistry.^[3] One year later, William T. McClement was appointed director of the department and was promoted, at the same time, to professor of chemical engineering. In September 1901, a degree-granting

Department of Chemical Engineering was established with Professor McClement serving as director. All work in chemistry was also placed under his supervision as he became responsible for the administration of what were basically two departments in one.

Under Professor McClement's direction, the Armour student chapter of the American Chemical Society was formed and, on June 19, 1901, the department granted its first BS degree in chemical engineering to Charles W. Pierce. Based on preliminary research, it would appear that Mr. Pierce was one of the first—if not *the* first—African-American chemical engineers in the nation. After leaving Armour, Mr. Pierce was named chief engineer at Normal College (now Tuskegee Institute) in Tuskegee, Alabama, later becoming head of the Mechanical Department at the State Agriculture and Mechanical College (now North Carolina A&T) in Greensboro, North Carolina.^[4] According to Armour ledgers, Mr. Pierce would have paid \$75.00/yr in tuition fees, with an additional annual lab deposit fee of \$5.00!

In addition to the undergraduate curriculum, chemical engineering students could complete one year of resident post-graduate study and investigation or two years of actual engineering work to complete the “degree of chemical engineer.” Professor McClement directed the department until 1906. For the next two years, Associate Professor Oscar Rochlitz would direct chemical engineering studies at Armour, which, by May 1907, had conferred a total of 25 BS degrees in chemical engineering.

PROGRAM EVOLUTION

With the department foundation in place, the next nine decades would see brilliant leadership and program evolution that not only kept pace with rapid industrial change, but also prepared its chemical engineers to lead this dynamic revolution. Since the early tenures of Professors McClement and Rochlitz, the department has been served by seven chairmen to date: H. McCormack (1908-1946), J.H. Rushton (1946-1953), R.E. Peck (1953-1967), B.S. Swanson (1967-1971), D.T. Wasan (1971-1987), H. Arastoopour (1989-2003), and F. Teymour (2003-present).

Significant development of the educational programs began under the leadership of Professor McCormack. Interestingly, the American Institute of Chemical Engineers (AIChE) was established in 1908, the same year that Professor McCormack became department chair. History shows that Professor McCormack was an exceptionally active member of the society and, in 1924, served as a co-founder of the AIChE Chicago Section—the society's first local chapter. In honoring his contributions to the society, the Chicago AIChE local chapter offers the “Harry McCormack Outstanding Senior” award to each of the top students in three chemical engineering departments in the Chicago area. During the tenure of Professor Rushton, the department would reach another critical milestone when Miss Lois Bey became the first co-ed to receive a bachelor's degree in chemical engineering from IIT. The department was also moved from Main Building to its present location in Perlstein Hall.^[5]

In commemoration of Professor Peck's dynamic teaching style and his famous “ten-minute quiz,” the Ralph Peck Lecture Series was established in the late 1970s, and was endowed in the 1990s with funding by department alumni.

During the last two decades, the department has undergone extensive reorganization and program revision. In 1985, under Dr. Wasan's leadership, the Gas Engineering education and research activities moved from the Institute of Gas Technology (now Gas Technology Institute) to the Chemical Engineering Department, under the name of the Energy Technology Program. The scope of this program continued to grow and expand to become the IIT Energy + Power Center. Today, this activity provides the focal point of the Energy and Sustainability Institute, newly established under the leadership of Professors Henry Linden and Hamid Arastoopour.

In 1995, the Pritzker Department of Environmental Engineering merged with the Chemi-



Charles W. Pierce
ChE 1901



Chairman Harry McCormack
(front center) with ChE faculty.



Lois A. Bey
ChE 1950



Chairman Ralph Peck

Undergraduate Program Milestones

1908

Harry McCormack establishes first Unit Operations Laboratory in the nation

1930s

Chemical engineering curriculum begins to shift from chemistry to chemical engineering orientation

1936

*Program receives ABET accreditation
Development of cooperative education program with industry*

1937

Arrival to campus of Professor Olaf Hougen, unit processes expert

1938

Professor Max Jakob, authority on heat transfer, joins IIT

1940

Merger of Armour Institute of Technology with Lewis Institute of Arts and Sciences to form Illinois Institute of Technology

1940s

Specializations developed in chemistry, food technology, instrumentation and control, management and metallurgy

1958

Professor Octave Levenspiel brings chemical reaction engineering to undergraduate curriculum

1980s

*Specializations in biomedical and biochemical engineering
Gas engineering activities incorporated through energy technology specialization
Unit operations expanded to include transport phenomena*

1990s

Specialized courses developed in particle technology, fluidization, pharmaceutical engineering and statistics

1995

Merger of chemical and environmental engineering programs

2000

Chemical engineering begins to reflect growing trend toward biological engineering

cal Engineering Department, marking the origin of the Department of Chemical and Environmental Engineering (ChEE).

The following sections trace the history^[6] and evolution of the department's research and education programs and describe the contributions to the profession by its illustrious faculty and dedicated alumni.

UNDERGRADUATE PROGRAM

In 1908, four years after joining the Department of Chemical Engineering, Professor Harry McCormack assumed the chairmanship of the department—a position he would hold until his retirement from IIT in 1946. Under his direction, the department would make great strides in the advancement of its education programs and maintain a top ranking among all fully accredited chemical engineering departments.

The Unit Operations Laboratory, established at Armour in 1908 by Professor McCormack, provided the first real laboratory instruction in chemical engineering. The Unit Operations outlook was immediately accepted by other schools and soon came to be recognized as an essential part of student training. Students worked in teams of two or three to complete 24 independently developed and continuously modified experiments over a span of three semesters. The result was a chemical engineering graduate who could devise a practical way to evaluate the results of industrial processes and determine the best method to develop these processes.

In 1936, the chemical engineering program received accreditation by the Accreditation Board for Engineering and Technology (ABET) under its first accreditation program. At the same time, a cooperative education program was implemented to enhance the Institute's interaction with industry.

During this time, the development of both undergraduate and graduate education programs received significant impetus from a number of events: the sabbatical visit in 1937 of Professor Olaf A. Hougen, nationally prominent for his work on unit processes in chemical engineering; the arrival in 1938 on the IIT campus of Max Jakob, an internationally recognized authority on heat transfer; and the merger in 1940 of Armour Institute of Technology with the Lewis Institute of Arts and Sciences to form Illinois Institute of Technology.

In addition to core undergraduate courses, IIT faculty began to develop several elective courses. This allowed undergraduate students to specialize in various branches of engineering and science, or in economics, management, and allied fields. The arrival to IIT in 1958 of Octave Levenspiel led to the introduction of chemical reaction engineering in the undergraduate chemical engineering curriculum.

During the 1980s, under the leadership of Professor Wasan, specializations in energy technology, polymer, electrochemical, biochemical and biomedical engineering were added. In 1985, the unit operations course was revised by Hamid Arastoopour to include three courses: fluid dynamics and heat transfer, mass transfer operations, and transport phenomena.

During the 1990s, under the leadership of Professor Arastoopour, several required courses were also introduced in the curriculum, such as process thermodynamics, numerical and data analysis, and process modeling and system theory. In addition, several elective courses and specializations in the areas of particle technology and fluidization, bioengineering, energy, pharmaceutical engineering, and statistics were developed. In 1995, after the merger of the environmental and chemical engineering programs, a series of undergraduate elective courses in environmental engineering was also introduced.

Beginning in 2000, in response to the shift in industrial emphasis on biology applications, the department began to increase its activities in biological engineering by hiring new faculty and expanding elective course offerings in this area.

GRADUATE PROGRAM

IIT's graduate program in chemical engineering was established in the early 1930s, with the first MS and PhD degree being awarded in 1933 and 1939, respectively. Integration of the chemical engineering faculty of other universities through their visits to IIT campus, interaction with distinguished colleagues in other departments such as Professor Max Jakob, and initiation of research activities at the Armour Research Foundation, contributed to the development of a successful graduate program.

At this same time, research activities on the development of processes for making petrochemicals from fossil and non-fossil fuels were expanding. The graduate curriculum reflected this expansion as courses were developed in applied chemical engineering thermodynamics, catalysis, fuels and combustion, petroleum refining and chemistry of petroleum hydrocarbons. In the 1950s, fundamental courses including chemical engineering process kinetics, non-Newtonian fluid behavior, chemical reaction engineering, and fluidization, were added. Around 1960, several courses were added to the graduate curriculum including application of mathematics to chemical engineering, unit operations, computational techniques, and transport phenomena.

Industrial short courses have been offered in specific areas of chemical engineering since the 1960s when Professor Peck first taught courses in drying theory and technology. Additionally, in the 1970s and 1980s, many advanced courses in conventional and emerging areas of chemical engineering were developed. These included advanced reaction engineering, process optimization, computer-aided design, topics in biomedical and biochemical engineering, separation processes, particle technology, polymer engineering courses, and interfacial and colloidal phenomena. In addition, inclusion of gas engineering research and education and establishment of energy activities resulted in the gradual addition of several new courses, such as flow through porous media, fluidization and fluid particle systems, and energy/environment/economics. During the mid-1970s, through the generosity of chemical engineering alum William Finkl, the interactive instructional television network (IITV) was established that ultimately enable IIT to broadcast its programs and courses to thousands of IIT students and employed professionals.

In the 1990s, the merger of the chemical and environmental engineering programs brought more than 30 graduate elective courses in environmental engineering as electives for chemical engineering students. In addition, formation of the Center of Excellence in Polymer Science and Engineering and the Center for Electrochemical Science and Engineering, along with pharmaceutical specializations resulted in the development of several elective courses, such as electrochemical engineering, polymer rheology, drug delivery systems, pharmaceutical engineering, and particle processing and characterization. Process modeling, statistical quality, and process control were also among the elective courses developed and offered. The establishment of the Master of Food Process Engineering with the collaboration of the National Center for Food Safety and Technology at IIT enabled the department to provide a series of food safety and processing courses for graduate students. Additionally, the joint Master of Science in Environmental Management program was developed in cooperation with the IIT Stuart Graduate School of Business.

The new millennium brought added program changes and the addition of new courses and faculty in the bioengineering area as the department continued to work to meet the needs of the engineering professional. Fall 2003 saw the introduction of the totally internet-based Master of Gas Engineering program, developed in collaboration with the Gas Technology Institute. A double master of chemical engineering/master of science in computer science program was jointly developed between the ChEE and Computer Science Departments to effectively train the new generation of process engineers.

RESEARCH PROGRAM

In January 1936, Universal Oil Products (UOP), largely through the efforts of Mr. John J.

Graduate Program Milestones

1930s

Graduate education program in chemical engineering established

1940s

Graduate curriculum expanded to reflect research in petrochemical processing

1950s

Curriculum shifted focus from process design toward engineering fundamentals

1960s

Short courses added to curriculum to ensure continued relevance of program to industrial needs

1970s-1980s

Advanced courses added in emerging areas: advanced reaction engineering, computer-aided design, polymer engineering, biomedical and biochemical engineering, gas engineering

1990s

Merger with environmental engineering program adds more than 30 electives to curriculum. Graduate specializations expanded through added ChEE research centers and collaborative programs

2000

New millennium brings expanded programs in bioengineering and delivery modes designed to meet the changing needs of the engineering professional



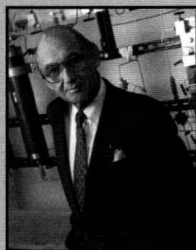
*Chairman J. Henry Rushton
Renowned researcher in
mixing technology.*



*Chairman Bernet Swanson and
students study refinery model.*



*Chairman Darsh Wasan (above)
and Max McGraw Professor
Henry Linden (below),
National Academy of Engineering
members.*



*Excellence in Teaching Award
established in honor of
Chairman Hamid Arastoopour.*

Mitchell, established a research professorship affiliated with the Department of Chemical Engineering. Dr. Vasili Komarewsky was appointed the first UOP Research Professor. His field of research was catalysis in organic chemistry, especially its application to the chemistry of petroleum.

The Armour Research Foundation (ARF, now known as IIT Research Institute), established April 3, 1936, was the first not-for-profit research institute formed in the United States. Research areas that were being conducted in the Department of Chemical Engineering in the late '30s that were compatible with the ARF research activities included catalysis, chemical filtration, chemistry of oils, oil combustion, and heat transfer. In the areas of combustion and heat transfer, significant interaction occurred among researchers between IIT's chemical engineering and mechanical engineering departments and the Institute of Gas Technology (IGT), including Professors Peck and Jakob.

The research interests of the chemical engineering faculty in the 1940s were catalytic reactors, distillation, drying, liquid-liquid extraction, mixing, process control, and hydrogenolysis of coal, oil shale, and petroleum fractions. During this period, Professor Rushton developed a world-renowned research program in the chemical engineering aspects of mixing.

During the next 50 years, the research interests of the chemical engineering faculty were substantially broadened. In the 1950s, the faculty pursued research in fluid dynamics, fluidized bed systems, heterogeneous catalysis, mass transfer, partial combustion, and thermodynamics, and, in the 1960s, research emphasized dispersed phase systems, interfacial phenomena, and reactor engineering. In the 1970s, the research activities of newly recruited faculty were concentrated in the areas of transport phenomena and electrochemical engineering. Research areas pursued in the 1980s included analysis of energy conversion processes, biochemical engineering, colloidal and interfacial phenomena, combustion, enhanced gas and oil recovery, fluidization and gas/solid flow systems, multi-variable control, process dynamics, and biomedical engineering.

In the 1990s, three research centers that exist today at the university were initiated and led by chemical engineering faculty. They include: the Energy + Power Center, the Center of Excellence in Polymer Science and Engineering, and the Center for Electrochemical Science and Engineering. In addition, in 1995, environmental engineering research became a major part of the department's research activity as a result of the merger of the environmental engineering program with chemical engineering. Since 2000, the department has added two new research centers to its areas of expertise: the Particle Technology and Crystallization Center and the Center for Complex Systems and Dynamics. Additionally, in 2004, the Institute for Energy and Sustainability was established as an offshoot of ChEE faculty activities.

OUTSTANDING FACULTY EDUCATORS AND RESEARCHERS

IIT has been fortunate in its history to have had numerous outstanding educators. Professors Swanson, Peck, Wasan, Arastoopour, and Aderangi were honored as recipients of the IIT Excellence in Teaching Award. Professors Peck, Swanson and Wasan were also recipients of the American Society for Engineering Education's (ASEE) Western Electric Fund award for excellence in teaching.

In the '60s and '70s, the department was privileged to have the services of another outstanding teacher, Professor William Langdon. In appreciation for his dedication to teaching, the department's award for teaching excellence was named after him until 2001. At that time, the teaching award was renamed for Hamid Arastoopour, recipient of both the IIT and the department's excellence in teaching awards.

Throughout the department's history, the research and teaching contributions of the chemical engineering faculty have been widely recognized by the American Association of Chemical Engineers (AIChE) and numerous other professional societies and scientific organizations (see sidebar on next page).

DYNAMIC AND LOYAL ALUMNI

Many of the department's alumni have achieved success and received widespread recognition for their leadership roles in the chemical enterprise. A number of alumni have served as the chief executive officers of major corporations and organizations, some of which include: Martin Marietta (Bernard Gamson), A. Finkl & Sons (William Finkl), Great Lakes Chemical (John Sachs), Energy Research Corporation (Bernard Baker), UOP (Maynard "Pete" Venema), Institute of Gas Technology and Gas Research Institute (Henry Linden), ARCO Chemical (Alan Hirsig), Pabst Brewing Company (Harris Perlstein), and Hyosung Industries (S.R. Cho).

Several ChE alumni have held national office in the American Institute of Chemical Engineers (AIChE), including past presidents Dr. James Oldshue and Dr. John Sachs. The late Professor W. Robert Marshall served as past president of AIChE and was a member of the National Academy of Engineering. Joining him in the Academy are ChE alumni Henry Linden, Kenneth Bischoff, David Edwards, and James Oldshue.

Although a majority of our alumni have pursued professional careers in industry, over the years, a significant number have joined the faculties at IIT and other institutions. IIT chemical engineering faculty currently include alumni Henry Linden (chemical engineering) and Hamid Arastoopour, Dimitri Gidaspow, and Javad Abbasian (gas engineering/gas technology). Today, more than 30 IIT department alumni hold academic positions in the United States and abroad, with several of them occupying positions of academic leadership.

IIT alumni have historically been loyal supporters of the endeavors of their alma mater. The most notable fundraising round to date began on November 21, 1996, when longtime trustees Robert A. Pritzker and Robert W. Galvin provided a challenge grant to IIT of \$125 million. This gift, at the time, represented the largest charitable gift ever promised to an institution of higher education in Illinois, launched a five-year \$250 million fundraising campaign. In 1997, in response to the Pritzker/Galvin Challenge, the ChEE Department launched its own highly successful capital campaign. These funds continue to be used to establish endowed graduate and undergraduate scholarships, endow chaired professorships, and to enhance departmental educational and research facilities. At the end of the campaign, the market value of all endowments and pledges, including matching funds, stood at more than \$12 million.

WITH GRATITUDE

On the occasion of the Centennial of its founding, the IIT Department of Chemical and Environmental Engineering acknowledges with thanks the visionary administrators, talented faculty and exemplary alumni for their contributions to the advancement of the chemical engineering profession since its very origin.

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Renowned Faculty Educators and Researchers

■ Hamid Arastoopour

*AIChE Fluor Daniel Lectureship
Award in Fluidization,
Donald Q. Kern Award,
Fluidized Processes
Recognition Award,
Ernest W. Thiele Award*

■ Ali Cinar

AIChE Thiele Award

■ Dimitri Gidaspow

*AIChE Donald Q. Kern Award,
Fluor Daniel Lectureship
Award in Fluidization,
NSF Special Creativity Award*

■ Octave Levenspiel

*AIChE R.H. Wilhelm Award,
ASEE Chemical Engineering
Division Lectureship Award*

■ Henry Linden

*Member of the National
Academy of Engineering,
Energy Award of the
U.S. Energy Association,
ACS Henry Storch Award,
AIChE Thiele Award,
Lowry Award of the U.S.
Department of Energy*

■ Demetrios Moschandreas

*Lifetime Achievement Award of
the International Society for
Exposure Analysis*

■ Kenneth Noll

*Ripperton Award of the National
Air and Waste Management
Association*

■ J. Henry Rushton

AIChE William Walker Award

■ J. Robert Selman

*Research Award of the Energy
Technology Division of The
Electrochemical Society*

■ Darsh Wasan

*Member of the National Academy
of Engineering,
ASEE Western Electric Teaching
and Lectureship Awards,
ACS Colloid or Surface
Chemistry and Langmuir
Lectureship Awards,
AIChE Thomas Baron and Thiele
Awards,
NSF Special Creativity Award*