OKCHE

SCHOOL OF CHEMICAL ENGINEERING AND MATERIALS SCIENCE THE UNIVERSITY OF OKLAHOMA

Perry Family Gives $500,000

CEMS Research: At the Forefront of a Changing Profession

Spring 1985

Contents

CEMS graduate students studying molecular thermodynamics give an IBM 3081 Mainframe a good workout. From left are Ph.D. candidates Lester Landis and Su Lin and M.S. student Jennifer Howard.

CEMS Research: At the Forefront of a Changing Profession

A whole raft of new ideas is changing the way chemical engineers do chemical engineering. But at the same time the core of the discipline—physics, chemistry, and mathematics—has left them prepared for such new challenges as enhanced oil recovery, large scale digital simulation, biotechnology, and the latest emphasis on materials science.

As a result, this is one of the most exciting times to be involved in chemical engineering research. Today's researcher has the opportunity to invent and develop the processes and design procedures that the next generation of chemical engineers will use. We are excited that part of this work is being done by OU CEMS. Graduate work being done here today will become a standard part of the undergraduate curriculum in the future. This issue of OKCHE gives an overview of the kinds of research being done along with some of its potential significance.

We have three audiences in mind for this overview. We want our alumni to be proud of their school's ongoing involvement in the vitality of their profession and in their country's economy through the development and implementation of new technologies. We also want our financial supporters to know that the programs they are supporting are directly related to the success of projects of significance to them, their company, and their family. And we want potential graduate students to be able to see the exciting and significant research they will have the opportunity to take part in if they choose to pursue a graduate degree at OU CEMS. Here are some samples of what we are doing.

Thermodynamics Research

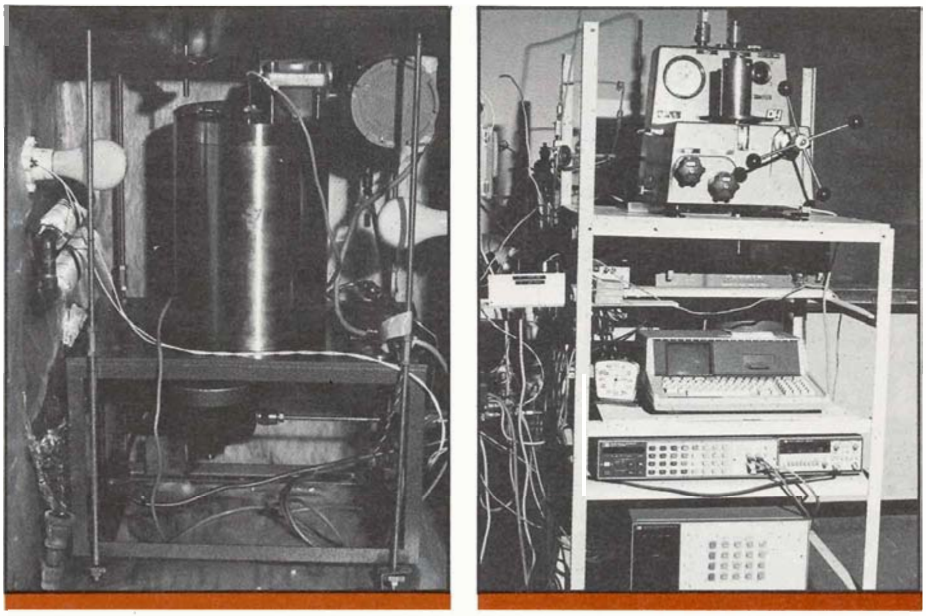
CEMS has been promient in thermodynamics research for a number of years now, as demonstrated by our reception last year (along with OU's petroleum engineering school) of a $500,000 grant from Mobil Oil Company for thermodynamics. Contributions of OU researchers have already had a lasting impact on chemical engineering, such as C.

M. "Cheddy" Slipcevich's earthy approach to thermodynamics, Ken Starling's reference work, *Fluid Thermodynamic Properties of Light Hydrocarbon Systems*, and his development of a new equation of state capable of predicting mixture properties from pure component data near the limits of the accuracy of the original data.

More contributions are already about to make their debut, such as Lloyd Lee's new graduate text in statistical thermodynamics and J. F. Scamehorn's new method for obtaining activity coefficients of surfactant molecules in mixed surfactant micelles.

Current CEMS research work in thermodynamics includes classical and statistical thermodynamics, from thermophysical properties determination by Monte Carlo and/or molecular dynamics simulations to the inextricability between the Gibbs equation and the entropy balance equation. It includes work ranging from development of a new calculus for integral equations to application of the equations of classical statistical thermodynamics to develop new expressions for the adsorption onto reservoir minerals of surfactant molecules used in enhanced oil recovery. It also includes development of new correlations for the natural gas industry and the gathering of new experimental data of greater accuracy than any ever before obtained on natural gas systems.

Among the current opportunities for new graduate research in thermodynamics at OU CEMS are the following: Rex Ellington has recently established a laboratory with Gas Research Institute funding to acquire new extremely accurate data on the compressibility factors of mixtures of natural gas components using the latest in digital control technology. He is also directing a long-term project on the extraction of heavy oils and tars by use of solvents at conditions above their critical points (supercritical extraction). Other objectives of Ellington's group include changing the separation techniques used in refining to develop more efficient processes.



Thermodynamics research in CEMS has a balance of theory and experimentation. From Professor Ellington's lab are, left, high pressure compressibility cell and a precise dead weight gauge and compressibility automation equipment.

Jeff Harwell is doing National Science Foundation (NSF) supported work to obtain thermodynamic parameters for the incorporation of homologous series of compounds into adsorbed surfactant aggregates. The goals of the work are to obtain group contributions for the thermodynamic parameters of interest and to develop and verify a statistically based model of the phenomenon for use in the design of new unit operations. Similar experimental and theoretical work, also NSF supported, is being done on the thermodynamics of the role of electrolytes in the formation of adsorbed surfactant aggregates.

Lloyd Lee is using molecular dynamics simulations to study the role of molecular forces in adsorption of alkanes onto solid surfaces as well as to obtain predictions of thermophysical properties from molecular theory. He is also involved in developing new correlations for predicting the thermodynamic properties of concentrated mixed electrolyte solutions, including the complex mixtures found in oil reservoirs.

John Scamehorn is directing an NSF supported study of the thermodynamic nonidealities of mixed surfactant systems of potentially great importance in enhanced oil recovery, which includes both experimental determination of activity coefficients and development of predictive models based on fundamental understanding of the electrostatics and statistical thermodynamics of the systems.

Ken Starling is directing a major effort, supported by the Gas Research Institute, involving collaboration with such European groups as Gasunie, Ruhrgas, Gaz de France, and British Gas to replace the property correlations presently used by the natural gas industry worldwide with new correlations of greater accuracy, greater flexibility (to allow them to handle the more complex gas mixtures which must now be dealt with), and based on the best experimental data available.

Enhanced Oil Recovery (EOR)

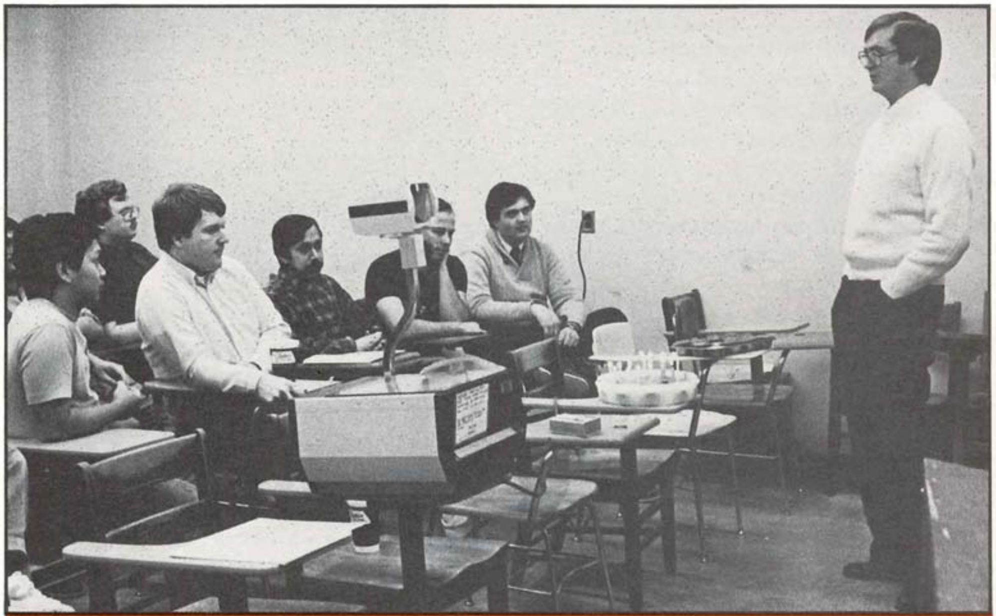
Despite the current "oil glut," petroleum remains one of the strategic international and national resources. Its availability plays a central role in the state of the world's economy as well as in that of the state of Oklahoma. It is not commonly known that most oil reservoirs are shut in with an average of about 65 percent of the original oil in place still unrecovered, in fact, unrecoverable by the technologies of the last decade. The development of economically feasible methods for producing this trapped oil promises to add billions of barrels of oil to proven reserves in the United States alone. The Department of Energy has targeted enhanced oil recovery by surfactant flooding (the injection into a reservoir of molecules capable of reducing oil/water interfacial tensions) as a key technology for long-range research in the mid-'80s, with a goal of seeing commercialization by the mid-'90s.

Scamehorn and Harwell have both collaborative and individually directed projects ongoing in areas of this important emerging technology.

Among the opportunities for research in this area at OU CEMS are the study of surfactant adsorption and the chromatographic movement of surfactant mixtures, both of which presently have deleterious effects on the economics of surfactant flooding. Another major effort is in study of the potentially synergistic effects which can arise from using highly nonideal mixtures of surfactants.

Much of the research to date in surfactant EOR has been aimed at finding a "magic molecule" to release trapped oil; an alternative approach being pursued by Scamehorn is the use of inexpensive mixtures of commercial surfactants which exhibit nonideal behavior to perform better than the individual surfactants which go into the mixture.

Scamehorn and Harwell are also working jointly with researchers at Phillips Petroleum to apply critical scaling theory to the modelling of microemulsions, the behavior of which is now recognized as central to the success of a surfactant enhanced oil recovery flood. A major portion of this project will involve the gathering of experimental data on model microemulsions for the testing of the applicability of the theory. The long-term goal of this project is the development of a group contributions theory of the critical behavior of surfactant/oil/brine mixtures for incorporation in surfactant flooding simulators.



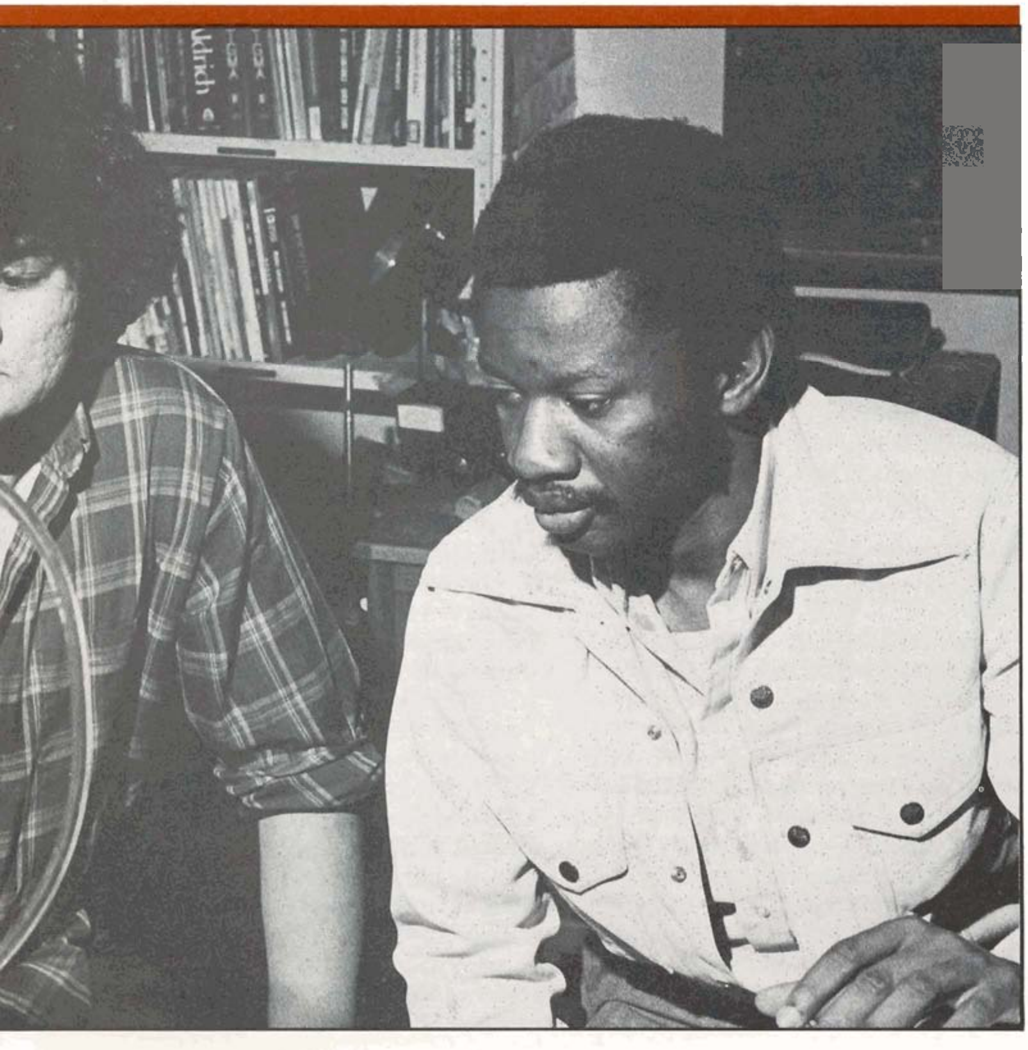
Professor Jeff Harwell addresses the enhanced oil recovery group, which paused to celebrate J. Willard Gibbs' birthday. Graduate student Tim Fitzgerald, seated at far right, is prepared to discuss his recent research progress.

OU CEMS is active in still another enhanced oil recovery area. It is known that the success of any EOR process, including those which do not use surfactants, is to an extent dependent upon one's ability to contact the reservoir with injected fluids; i.e., the problem of volumetric sweep efficiencies. Harwell and Scamehorn have filed a patent application for a new process which makes use of the phase behavior properties of dilute aqueous solutions of surfactants and their chromatographic behavior to selectively seal off watered out portions of reservoirs at arbitrary distances from the well bore. This procedure is designed to divert injected fluids into portions of the reservoir which have high residual oil saturations. This work is just under way, and results of inital laboratory experiments are exciting.

Biotechnology

One of the most promising new technologies of the last decade relates to industrial applications of genetic engineering, by which microorganisms can be altered genetically

CEMS bioseparations group leaders, from left, Professors Radovich, O'Rear, Scamehorn and Harwell in the fermentation laboratory.



so that they produce, as a metabolic by-product, chemical compounds of usefulness to man. Because of the potential for a renewable source of chemical feedstocks, a new market for American agricultural products, and a new ability to mass produce large biological molecules, tremendous resources have already been spent in this field. As a result, a recent *Chemical Engineering Progress* article estimated that within 10 years half of all new chemical engineers will work in the biotechnology area.

Additionally, the continuing application of high technology in medicine—in such areas as design of artificial organs and artificial blood—has opened the biomedical area to chemical engineers as one in which their knowledge of physics, chemistry, and mathematics makes them invaluable contributors to this still developing discipline.

Five OU CEMS faculty members have ongoing research in the biotechnology area. Especially in the area of bioseparations, with an emphasis on dilute solutions, what we believe is the most innovative research in the world is being done today at OU. Four CEMS faculty have traveled to London and discussed a collaborative research agreement with BIOSEP, a national research organization recently established by the British government to spur development of biotechnology in Great Britain. BIOSEP has recognized that a coming bottleneck in the commercialization of many biotechnology processes will be the absence of suitable large scale separations processes designed for the types of problems encountered in biologically based systems.

Opportunities exist for graduate research in several exciting new bioseparations projects in CEMS. Jay Radovich's research group has been developing a new technique combining electrophoresis and

Carl Camp, left, and Ema Ogoro, biotechnology research students of Professor Sam Sofer, prepare to observe the rate of oxygen uptake in an enzyme bioreactor.

membrane separations to more efficiently separate whole blood into cellular and plasma components. This technique has great promise as the basis for a process to separate proteins from cell debris on an industrial scale or to remove the cells from the fermentation broth and has begun to attract considerable industrial attention.

Scamehorn is developing a new process he calls micellar enhanced ultrafiltration under a DOE research grant. Organic molecules of a wide molecular weight range will "dissolve" in surfactant micelles in a dilute aqueous solution. These swollen micelles then have a greater diameter than the target molecules, which allows them to be retained by ultrafiltration membranes of higher molecular weight, thus reducing process costs. Since the target molecules are simultaneously concentrated, what was a waste stream can become a product stream. Besides applying this new process in bioseparations, Scamehorn is investigating waste water clean-up and total internal recycle applications under the DOE grant.

Harwell has NSF support for development of a new process which also uses surfactants in a separation process, admicellar enhanced chromatography (AEC). In AEC, target molecules dissolve in adsorbed surfactant bilayers. When the bilayers become saturated in a process unit, slight changes in the process stream parameters cause desorption of the bilayer and release of target molecules into the process stream at up to one hundred-fold increase in concentration.

Ed O'Rear and Harwell are collaborating on an important modification of this process in which optically active surfactants are used to separate enantiomers or to simply enhance the specificity of any chromatographic process.

Sam Sofer has constructed a special multistage centrifuge device which may have many potential applications in leukemia and other blood-related diseases.

For those students interested in the exciting area of biomedical engineering, O'Rear also has ongoing research in the area of blood rheology, espeically the effects of non-physiological shear stress on blood cells (as those encountered in extracorporeal circulation). As well, he has just received National Institute of Health funding for a study of fluorocarbon blood substitutes and their effects on the life span and deformability of red blood cells.

CEMS faculty members are also active in the area of bioreactor engineering. Sofer has been developing techniques and design procedures for using immobilized whole cells and immoblized enzymes as biocatalysts to produce, for example, ethanol and potentially, pharmaceuticals from agricultural products or byproducts. In addition, these biocatalysts may be applied in the design of an artificial liver.

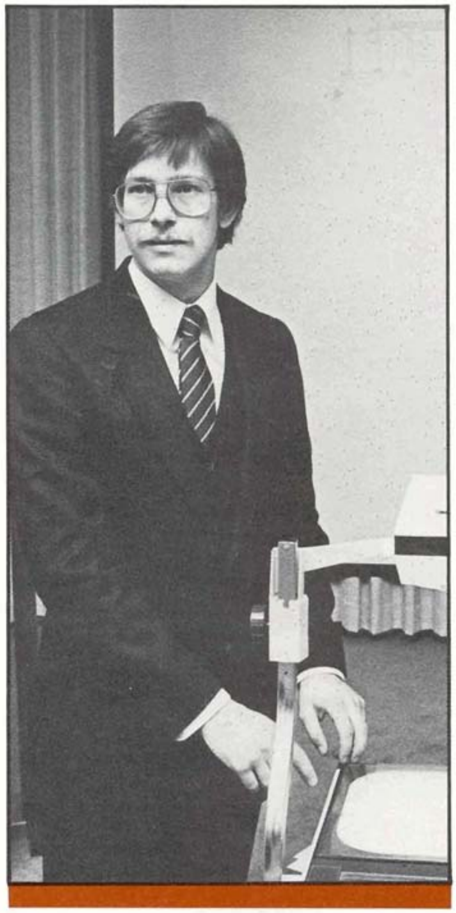
Radovich is continuing a long-term project, originated by CEMS graduate student Stan Yunker, to examine the feasibility of using electric current to enhance the rate of desulfurization of coal and other minerals by sulfur reducing bacteria. This would minimize the environmental effects of wide-scale use of high-sulfur coal, one of our nations most abundant energy resources.

In addition, he is looking at the mass transfer limitations occurring in fermentations that use immobilized whole cell systems, an area in which he has recently published two review articles.

Reaction Engineering

Besides the biochemical reaction processes just described, CEMS is researching in other areas of reaction engineering.

Among the most exciting are two projects directed by Rick Mallinson. As polymers become more and more the chief manufacturing material of the future, the need for obtaining more highly controlled reaction products grows. Among the most promising ideas is the use of emulsions. Emulsions are highly ordered on a molecular scale and



…tuate student Jim Giguere answers a question …erning his biorheology research during a …uate seminar.

are able to produce polymers with unique properties. A great deal of research needs to be done on such reaction systems to enable chemical engineers to make maximum use of the technique in the future. Scale-up of laboratory results is a particularly difficult problem.

Another of Mallinson's projects involves advancing our knowledge of coal pyrolysis reactions. Coal is potentially the most important national resource of the next 50 years, but many of our attempts to use it as a source of liquids are made more difficult by our lack of knowledge of the actual molecular structure of coal and the pathways by which coal reactions proceed. Mallinson is employing the most sophisticated, modern, spectroscopic and chromatographic techniques, and his work is making this resource more usable.

Graduate students Chan Hong Lee, left, and I-Der Lee prepare to study the emulsion polymerization of vinyl acetate in a computer-monitored continuously stirred tank reactor.

Materials Science and Engineering

CEMS is fortunate to have a considerable effort in the area of materials research, with work ranging from corrosion and failure analysis to advanced polymeric materials and ultra thin films.

Bob Shambaugh, who recently returned to academia from Du Pont, is developing equipment to prepare melt-blown thermotropic liquid crystal polymers. These polymers, which can have strengths up to 15 times that of steel, can be formed into lightweight, three-dimensional composite structures which have applications in the aerospace, automotive, and electronics industries.

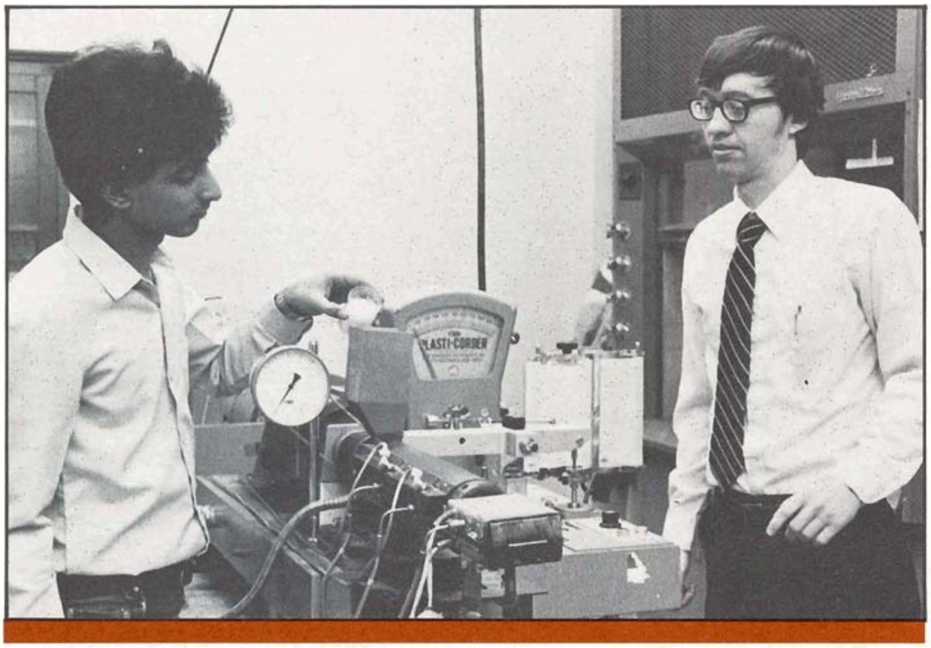
Another of Shambaugh's projects has a "high" profile; NASA is supporting an interdisciplinary effort to develop a new space suit glove for the use of America's shuttle astronauts. Advanced polymeric materials may play an important role in improving the flexibility and safety of suits designed to resist the vacuum, thermal, and radiation hazards of outer space.

Carl Locke, whose book, *Anodic Protection: Theory and Practice in the Prevention of Corrosion*, was recently released, has several corrosion research related projects in progress. One project, supported by the Federal Highway Administration, is directed towards a study of the corrosion properties of a proposed new deicing material. This material, calcium-magnesium acetate (CMA), is being evaluated as a replacement for the corrosive sodium chloride used in quantities up to 12×10^6 tons per year. The corrosion of steel, aluminum and reinforcing steel in CMA are being studied in immersion, spray, dip, and electrochemical tests.

Other work is under way to develop further understanding of the corrosion of reinforcing steel embedded in portland cement concrete by chloride ions. Presently, a pore press is being utilized to squeeze pore solution from the cement. The pore solution is analyzed and the corrosion behavior of steel correlated with the analysis of the solution.

Another project is under way to develop electrochemical tests to study the corrosion of steel in high density brine solutions used for completion fluids in the oil field. These tests are to be conducted at temperatures up to 350° F and at elevated pressures. The intent is to develop procedures that could be used to test candidate inhibitors for these highly corrosive systems.

Harwell and O'Rear have extended their work in the use of thin surfactant films in separations by in-



As part of their work to develop a new process for spinning thermotropic liquid crystal polymers, graduate student K. Narasimhan, left, and Professor Bob Shambaugh prepare a small extruder for an experimental run.

The team working on failure analysis projects for the Air Force includes, from left, Aneesh Sadarangani, M.S. candidate; Professor Ray Daniels; Michelle Simmons, M.S. candidate; Philip Perkins, Ph.D. candidate; and Samar Mukherjee, Ph.D. candidate.

vestigating the use of these films to position monomers in an ultra thin film on solid surfaces before polymerization. Among the applications they are investigating for these films are use as a new generation of high two-dimensional homogeneity photoresists in microchip manufacturing, use as corrosion barriers, and use as solid lubricants and drag reducing films. This work will be featured in the April 1985 issue of *High Tech Materials Alert*, a newsletter designed to facilitate transfer of developing new technologies from academia to industry.

Ray Daniels has for a number of years directed studies for the Department of Defense on the causes of failure of various components on military aircraft. Most of these studies have been concerned with accessory equipment, including starter systems and life-support equipment. A project of current interest which has received special funding is the failure of cartridge starter breech chambers. These are chambers used to contain the solid propellent charges fired to effect quick starts of jet engines of SAC aircraft. One cause of breech chamber failures is corrosion. Daniels' students are studying the stress corrosion cracking susceptibility of the breech chamber steel in combustion product residues.

Bob Block's studies of the effects of surface conditions have directed inquiry into both the behavior of the coating and the base metal. The latter problem has been complicated by peculiarities in the deformation characteristics of the near surface layers of the metal independent of whether a coating has been applied. Using observations of the dislocations densities and arrangements as a measure of the extent to which plastic deformation has proceeded, Block has studied the separate roles of the surface and underlying bulk material in coated and uncoated metals.

Engineering Management

Rex Ellington has over 30 years of industrial management experience, including responsibility for engineering for the Cathedral Bluffs oil shale project as vice president of Occidental Oil Shale. He is investigating new methods of project planning, design, and analysis to improve the viability of projects such as those for synfuels. Except for national emergency, the day of the super project may have gone. A metamorphosing plant, with extensive use of modularized construction, may improve economics.

Graduate students David Baugh, standing, and Michelle Simmons break in a Sun workstation, part of the new computer system purchased with a gift from Gulf Oil Corporation.

New Computer System Purchased with Gulf Money

The CEMS Gulf Computer System is now coming on line! Our system was purchased with funds generously donated by the Gulf Oil Foundation in the amount of $150,000.

The system is made up of three Model 120 Sun workstations. These machines each have two megabytes of main memory with hardware floating point boards. A terminal multiplexing board allows each machine to be connected to up to 18 terminals. Currently we have 20 alphanumeric terminals on two machines available to the students and 14 faculty terminals on the third.

We own part of a fourth machine, which serves our 380 megabyte disc system.

All of our machines are connected to one another and to the Engineering Computer Network (ECN) via Ethernet, which allows fast simple communications between machines and systems. Our system is part of a larger system in the college-wide network, which is made up of nine Sun workstations. The other machines, in the industrial, aerospace/mechanical, and electrical/computer science departments, will be primarily used for graphics design type processes such as CAD/CAM, and CAE.

The CEMS system also has a 300-line-per-minute printer, capable of normal alphanumeric output as well as text and graphics. We are also planning to connect two Tektronics graphics terminals to the system to enhance our on-line graphics capability.

With nine like machines making up the system, the standardization should substantially reduce our maintenance and support costs, while allowing us to expand the system in small, low-priced increments as the need and opportunity arise. The system uses the UNIX operating system, which is rapidly becoming the "super-micro" computer system standard.

Future plans include a letter-quality printer (possibly laser), a plotter, and integrating office functions into a system which may then also be connected to the Sun network. We are planning to get the process design programs, such as SIMSCI's PROCESS, (which have been used by the seniors the last two years) on the system before next year. The Sun is certainly rising in CEMS.

Thanks again, Gulf, for allowing us to provide this urgently needed, substantial expansion of computer access to our students.

Nancy Jo and Charles Perry, seated, pose with son Tom and former OU President Bill Banowsky after pledging a $500,000 challenge grant for development of a gaseous fuels research center within CEMS.

Perrys Announce $500,000 Challenge Grant

A $500,000 challenge grant to fund a gaseous fuels research and teaching laboratory has been awarded to the University of Oklahoma by the Perry Foundation of Odessa, Texas.

OU will match the grant on a one-for-one basis with other private funds to provide $1 million for construction of the Perry Laboratory for Gaseous Fuels Research.

The challenge grant is the gift of the family of Charles R. Perry, president of Perry Gas Companies and a 1951 OU chemical engineering graduate, and his wife Nancy Jo. Other participants in the contribution are Mrs. Charles B. Perry, Odessa; Kenneth W. Perry (OU B.S. 1954) and Mary Dean Perry, Dallas; James R. Perry (B.S. 1958) and Harviann Perry, Fort Worth; Beth Perry Sewell, Houston; Charles Thomas Perry (B.S. 1984), a MBA candidate at OU; Nancy M. Perry, an OU junior; Martha Perry Mitchell, Austin; Katherine Perry Foster, Jeffery Perry and Joel Perry, all of Dallas.

Charles Perry explained that the gift from the Perry family is "in grateful appreciation to a university and an industry that have done so much for our entire family for three generations.

"Based on our experience within the natural gas industry, we believe that with such a structure in place, the university can successfully obtain numerous research projects under contract from both private industries and trade associations," said Perry, whose companies trace their existence to 1967 when he purchased Portable Treaters, Inc. with a $2,500 down payment.

"We believe that this laboratory will be successful both now and in the future because we know of no other facility that is dedicated exclusively to research and teaching in gas conditioning and processing," Perry said. "This laboratory can be a valuable support facility for OU's Energy Center and can further assist the university in becoming the energy technology center for the country."

"The university has a long tradition of outstanding research in gaseous fuels," said Martin Jischke, citing in particular research conducted in flame dynamics and the thermodynamics of fuels.

Natural gas is playing a growing role as a fuel worldwide, Jischke noted. "This laboratory will enhance OU'S ability to further research this and other gaseous fuels, which include both fossil and synthetic fuels."

The Perry Laboratory for Gaseous Fuels Research, to be located on OU's south campus, will be administered by the OU School of Chemical Engineering and Materials Science.

CEMS director Carl Locke explained that the laboratory will be dedicated to research and teaching with the primary emphasis on research and development in various processes for the conditioning, treating and enhancement of gaseous fuels. Matching funds will be sought from the gas industry and professional organizations representing that industry.

"This gift is a magnificent act of generosity by Charles Perry and his faimily," Jischke said. "They have been devoted supporters of the university, particularly the School of Chemical Engineering and Materials Science, and this gift is a remarkable continuation of that devotion."

Perry's Handbook and Chemical Engineering at the University of Oklahoma

Every chemical engineer sooner or later uses the infamous *Perry's Handbook*. The official title of the useful compendium is *The Chemical Engineering Handbook*. Many of you may not know that this book has strong ties to the OU School of Chemical Engineering and Materials Science. The sixth edition of *Perry's* was recently published, and we thought everyone would like to know how it is related to CEMS.

The first edition of *Perry's* was published in 1934 by John H. Perry, who, with the assistance of others, completed it by working nights and weekends. Editions two and three were also edited by him. After his death, his son, Robert Perry, took up the standard and edited, with help, the fourth and fifth editions, published in 1963 and 1973, respectively. Since there seemed to be the need for a new edition every 10 years, Bob had begun the process of developing a sixth edition. Unfortunately, he was killed in an automoblie accident in London in 1978.

Now for the University of Oklahoma tie-in.

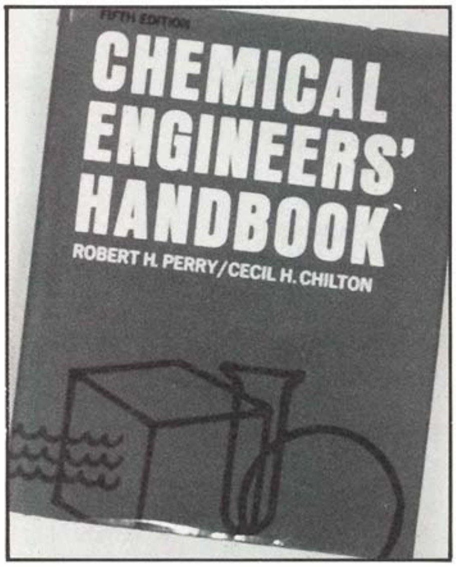
Bob Perry was a member of the chemical engineering faculty at OU from 1965 to 1975. One of his graduate students, a recipient of the Ph.D. degree in chemical engineering from OU, was Don Green, now Conger-Gobel Distinguished Professor of chemical and petroleum engineering at the University of Kansas (Lawrence), where he heads the Tertiary Oil Recovery Project and has served as departmental chairman. As one of Bob's students, Don assisted in the editing of the fourth edition (Don modestly claims to have been a "gopher"). After Bob's death, Don was asked to take up completion of the sixth edition. After some negotiation with McGraw Hill and the Perry Estate, Don was appointed the editor and recently completed this arduous task.

We are proud that the University of Oklahoma has been able to make these important contributions to chemical engineering literature. Next time you have to refer to *Perry's*, think about the OU CEMS tie-in.

CEMS Seeks Old *Perry's Handbook* Copies

Because of Don Green's and OU's important contributions to *Perry*'s, Don at Kansas and the School of Chemical Engineering and Materials Science at OU are both trying to complete their collections of all six editions of the handbook. Don needs a copy of the second edition; CEMS needs copies of the first and fourth editions. If any of you have copies of one or more of these editions which you would be willing to sell or donate, please contact Carl Locke at OU CEMS.

We would appreciate your assistance because this famous series holds for all of us great sentimental value.



Former OU President Bill Banowsky, center, and Martin Jischke, right, converse with Alex Massad, who presented OU's Energy Center with a $500,000 gift for a new thermodynamics research laboratory.

Energy Center Gets $500,000 Mobil Pledge

A $500,000 gift to the University of Oklahoma Energy Center from the Mobil Oil Foundation has initiated the development of a thermodynamics laboratory, which, according to Martin C. Jischke, will be one of the "most vital components of the Energy Center."

Jischke contends that the laboratory "will provide the tools needed by students and faculty to continue to unravel the mysteries of hydrocarbon thermodynamics."

Former OU President William S. Banowsky, who announced the gift in September 1984, termed the gift "of paramount importance in helping to form a sound nucleus from which an international distinguished center of energy research and education can grow."

Alex Massad, a 1944 OU mechanical engineering graduate and executive vice president of Mobil Oil Corporation, delivered the first $100,000 installment of the five-year pledge to OU officials.

"Mobil, as an industry leader and employer of some 200 OU graduates, is proud to lend its support to this ambitious project," he said. "As an alumnus of this university, I am personally gratified Mobil can play a role in the creation of this vital center for students hoping to excel in their chosen fields."

Massad also was the first chairman of the OU College of Engineering Board of Visitors, an organization founded in 1981 which is composed of corporate volunteers who offer advice to the college concerning industry developments.

"The oil industry is in constant need of well-trained and knowledgeable engineers, chemists, geologists and geophysicists," Massad explained. "In the past, the University of Oklahoma has helped fill that need through its related fields of study and surely will continue its role in the future.

The thermodynamics laboratory will enhance the university's ability to continue to provide a high level of education in petroleum-related disciplines," he added. "Undergraduate and graduate students will benefit greatly from this facility, for research and teaching, and they, in turn, will benefit the industry."

Jischke said the laboratory will provide modern, state-of-the-art facilities for research and teaching to serve all disciplines in the Energy Center with primary applications in petroleum and chemical engineering. Renowned as a center for the study of petroleum hydrocarbons, OU has research and education programs in the thermodynamics of hydrocarbon fluids in the School of Chemical Engineering and Materials Science, the School of Petroleum and Geological Engineering and the department of chemistry.

Jischke predicted that the work of the new laboratory "will build on a strong research program in thermodynamics and a long tradition of strength in petroleum engineering, particularly in the production area, where the thermodynamics of reservoir fluids plays a critical role in enhanced oil recovery."

Citing Mobil's ongoing scholarship support in OU petroleum engineering and a recent grant to renovate and expand the engineering branch library, Jischke addressed Mobil's latest show of support.

"It is particularly gratifying when a corporation such as Mobil sees fit to make such a substantial investment in education at the University of Oklahoma. Mobil is an exceedingly generous corporation," he said. "We are grateful for all they have done and are doing for OU."

Notes from the Director

February 25, 1985

The faculty, staff and students of CEMS continue to experience change at the University of Oklahoma. Enrollments in the undergraduate program continue to drop. We have started up our new computer system; the University is looking for a new president; and the students are still having difficulty in finding jobs at graduation.

This spring, the undergraduate enrollment in CEMS is 201 compared to 302 last spring. We think this drop is primarily due to the greatly reduced job opportunities for chemical engineering graduates. The employers have not yet felt this drop since the number of seniors is only slightly lower than that of last year. The junior class, however, is down from 53 to 37. The freshman class is down from 52 to 28. Therefore, as was stated in the last issue of the *OKChE* magazine, the number of B.S. graduates will drop dramatically in the spring of 1985 and will remain at a low level for at least three years after that. We will probably step up our efforts at recruiting high school students during this next year in an attempt to stabilize our enrollments.

There is an article in this issue of *OKChE* about the new computer system recently "started-up" in the department. This long-awaited system is already making an impact on the students. The senior design students began to use the system in writing their design reports very soon after it was made available. We will now be able to include more computer oriented homework and other assignments because of the ready availability of the computation power. The entire College of Engineering is looking at the question of what type of personally owned computation power each incoming student should have. At this time we do not think it is feasible for us to require that each student purchase a $2,000–$3,000 PC because of the cost. In CEMS, we are leaning toward a requirement that each student have a hand-held computer that can be programmed in BASIC. A device including printer and cassette drive can be purchased for $250 or less. This computer has a RAM of at least 4K and can be used for all courses up through the junior year. We will have more to say about this in later issues of the OKChE magazine.

The students graduating this May with a B.S. in chemical engineering are having some difficulty in finding employment. The number of job interviews was up slightly in fall '84 compared to the number in fall '83. However, there does not seem to be much of a change in the number of jobs being offered to the graduates. In a survey of students, the AIChE student chapter found that as of December half of the class had job interview trips and the other half had no opportunities at that time. We think the drop in enrollment plus the subsequent drop in the number of graduates next year will result in a closer balance in jobs and availability of graduates for them. In fact, we may see another shortage of graduates in the next year or two.

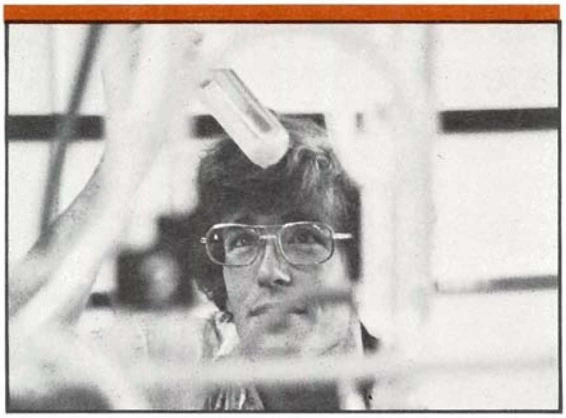
The university is undergoing a dramatic change in leadership at the highest administrative levels. President Banowsky announced his resignation in the middle of December and Martin Jischke, dean of engineering was named interim president. In addition to those changes, we began searching for a new provost last fall. We expect to have a new president named during early summer. After that decision is made, we can expect a new provost. Hopefully, these positions will be filled by the time we publish another issue of the *OKChE* magazine.

Please keep in touch with us as we would like to increase the number of Alumni Notes in each magazine issue. Your former classmates would like to know what you are doing now, and I know you would like to know all about them. Come to see us any time you are in Norman.

Carl E. Locke

Carl E. Locke

What Do Chemical Engineers Do?



Here's an Article for the High Schooler Considering a Career in the Field

Chemical Engineers Solve Society's Problems

By Kate Babchuk

By combining the science of chemistry with the field of engineering, a chemical engineer seeks to solve some of society's most pressing problems and discover more efficient ways of doing things.

What makes this discipline unique, according to Carl Locke, director of the School of Chemical Engineering and Materials Science at the University of Oklahoma, is the application of chemical reactions and physics to create processes that change the chemical or physical properties of material.

The best chemical engineering students are those who enjoy math and science, particularly chemistry, Locke said. Chemical engineers work in a wide variety of fields—combining chemicals to produce more durable plastics, refine petroleum more efficiently, improve the environment, make safer cosmetics, create more effective paints and dyes, or develop better heart, lung and kidney machines. These are only a few of the many areas open to chemical engineers.

Chemical engineers also have become involved in the development of computer chips, an area that necessitated a merging of computer science and electrical engineering, Lock said. Engineers turn chemically produced chips into devices that can be used in computers, he said.

Many students major in chemical engineering to prepare for medical school. Special elective patterns allow OU students to complete a bachelor's degree in chemical engineering and prepare for medical school without requiring much additional coursework, Locke said.

Engineering students are more prepared to study than people in other fields, he added. "Chemical engineering demands a lot from students. Grade point averages are usually high, and students are extremely motivated."

Besides pursuing medical degrees or advanced training in engineering, graduates in chemical engineering also are entering law or business programs, Locke said. One OU chemical engineering graduate is now employed with International Business Machines, Corp., he noted.

"He had volunteered to help OU's business school set up its new computer system," Locke said. "When IBM found out about it, they hired him as a regular staff member."

According to Locke, starting salaries for chemical engineers usually range from $24,000 to $30,000 a year. People with graduate degrees will earn a few thousand dollars more, he said.

Besides completing as much math and science as possible, Locke said high school students preparing for a major in chemical engineering should be able to write well and communicate their knowledge effectively. OU's program requires students to take a three-hour technical writing course before graduating.

Scholarships are available to students through OU's Program of Excellence, a scholarship service offered to students who have compiled superior records and are interested in a chemical engineering major. Applicants must have a B-plus grade average in high school or previous college work, show leadership abilities, and be highly recommended by teachers. The program provides scholarships to students who remain academically qualified for up to four years.

For more information on OU's chemical engineering program, students should write to the OU School of Chemical Engineering and Materials Science, 202 W. Boyd, Norman, OK, 73019, telephone 405/325-5811. Applications for OU's Program of Excellence can be obtained from high school principals or counselors, or by writing to the chemical engineering school.

Alumni Notes

1940s

Grover S. Ramsey, BSChE '44, completed a three-month consulting assignment with the Q & Q Holding Co. in Bangkok, Thailand, as a volunteer executive with the International Executive Service Corp., an organization that sends American businessmen to help owners and practitioners of private enterprise in developing countries.

1960s

Henry P. Sheng, PhD '68, professor of chemical engineering at California State Polytechnic University, was awarded an exceptional merit service award for 1983–84 by the school in recognition of his contributions to the university in the areas of teaching, service, and professionalism. Sheng holds six patents granted by the U.S. Patent Office and performs as a concert pianist.

Donald Waller, BSChE '64, is building infrared detectors for Santa Barbara Research Center in Paso Robles, Calif.

1970s

Pankaj Mehta, MSMetE '76, was promoted by General Electric to manager of Laser Process Development following his award in October of a patent for a "Method and Apparatus for Repairing Metal in an Article." Filed in seven countries, the patent covers a novel technique for repairing mismachined or worn out aircraft engine components using high-powered lasers. Following a vacation to Europe and India, Mehta will relocate from Cincinnati to Schenectady to assume his new position. Mehta is currently working toward his PhD in MetE.

Joseph P. Baehl, BSChE '79, has been promoted to supervising reservoir engineer at Exxon Company, U.S.A., Oklahoma City, and will be transferring to Houston in June.

1980s

William Kastens, BSChE '82, is teaching chemistry in a government high school in Cameroon, West Africa, in a tour of duty with the Peace Corps.

Sharon Potter, BSChE '83, is a process engineer for AT&T Technology Systems in Orlando, Fla.

Faculty Update

Professor Rex T. Ellington is one of two OU professors working with MIT on a multi-national investigation of integrated energy systems. Early applications include combined cycle power generation at 47 percent efficiency to improve competitiveness of Oklahoma natural gas. Tonnage recovery of CO_2 for EDR is being examined for the possibility of recovering more than 500 million barrels of Oklahoma oil. The project involves individuals from the U.S.A., West Germany, Canada, Taiwan and Japan.

Professor Jeff H. Harwell received $130,000 over two years from the National Science Foundation for development of a new low-energy separation process he has invented.

Professor Lloyd L. Lee attended the annual AICHE meeting in 1984 in San Francisco and presented two papers on "Electrolyte Solutions" and "Thermodynamics of Mixtures."

Professor Carl E. Locke presented the keynote speech with an invited paper on the corrosion of steel in concrete to the American Society for Testing and Materials. Locke attended the annual meeting of the Transportation Research Board and presented two papers, one on pore press work with concrete and the other on work on calcium magnesium acetate as a new road deicing compound.

Professor Edgar A. O'Rear graduated his first two M.S. students during 1984. O'Rear published three papers and contributed to a book during the year. He presented a paper at the IX International Congress on Rheology in Acapulco.

Professor John M. Radovich visited Harwell Laboratories in England the week of March 7–14 to discuss future collaboration with the BIOSEP group. Radovich and OU graduate student Stan Yunker presented a paper on enhanced microbial desulfurization using a novel electrolytic fermentation process to the seventh Symposium on Biotechnology for Fuels and Chemicals held May 15th in Gatlinberg, Tenn. Radovich served as co-chairman of the Recent Advances in Separation Technology at the AICHE national meeting on August 25 in Seattle. He attended the Gas Conditioning Conference held in Norman on March 5. He conducted a joint presentation with Yun-Ching Lu on Pilot Plant Studies of CO_2 Absorption by DEA.

Professor John F. Scamehorn chaired the Governor's Task Force on Enhanced Oil Recovery in the state of Oklahoma this fall. He will be presenting some of the task force conclusions to various groups around the state in the next few months.

Professor Robert L. Shambaugh is participating in an interdisciplinary spacesuit design competition sponsored jointly by NASA and the American Society of Engineering Education. A team of 15 undergraduate and graduate students are involved with Dr. Shambaugh and Dr. Brian Peacock of OU Industrial Engineering, Dr. Alfred Stritz of OU Aerospace, Mechanical and Nuclear Engineering, and Dr. Jerry Hordinsky of OU Health Sciences. The techniques of materials selection, ergonometric design, and mechanical modeling by finite element analysis are simultaneously being brought to bear on the problem of improving the space suits, particularly the gloves, used by America's shuttle astronauts. Highlights of the effort have been several trips by the students and faculty to confer with NASA researchers at the Johnson Space Center in Houston.

Professor Kenneth E. Starling continued to direct several research projects with a consistent total funding of $800,000. He continued as chairman of the Executive Committee of the International School of Hydrocarbon Measurement, which meets annually at the Oklahoma Center for Continuing Education on OU's Norman Campus.

Representatives from Exxon meet with former OU President Banowsky and Engineering Dean Martin Jischke to present grant.

CEMS Receives Portion of $44,000 Exxon Foundation Gift

CEMS was one of eight OU academic departments to share grants totaling $44,500 from the Exxon Education Foundation of New York.

The funds are unrestricted and can be used by the departments for any educational purpose, said Exxon officials who visited the OU campus to present the grants.

"The beneficiaries of these grants are the students who will receive increased excellence in their educational opportunities," said OU President William S. Banowsky in accepting the grants.

CEMS received $8,000.

Representatives from Exxon who presented the grants were Richard D. Goddard, technical adviser for regulatory affairs in Midland, Texas; Paul Henderson, Midland operations manager; and Burt Culp, district production geologist from Oklahoma City.