

# *J. M. Smith* *of U. C. Davis*

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**J**OE MAUK SMITH is known at the University of California, Davis, as "Mr. Chemical Engineering". As founding Chair of the Chemical Engineering Department and its tireless protector in its fledgling years, he became so closely identified with his department in the minds of his Academic Senate colleagues across campus that they see him largely as its guardian. His colleagues within the profession give Joe the same appellation, but for a different reason: for his prominence in his field.

As a member of the National Academy of Engineering, J. M. Smith has been accepted by his peers as one of a very select group of engineers. As winner of the Richard H. Wilhelm Award of the American Institute of Chemical Engineers in 1977, he was recognized for "advancing the frontiers of chemical reaction engineering with emphasis on originality, creativity, and novelty of concept and application." He was named to the AIChE Wm. H. Walker Award in 1960. In addition to awards from the American Chemical Society, American Society for Engineering Education, and the Guggenheim Foundation, he has been recognized by the entire faculty of his campus, being named to the highest Academic Senate honor, Faculty Research Lecturer, in 1970.

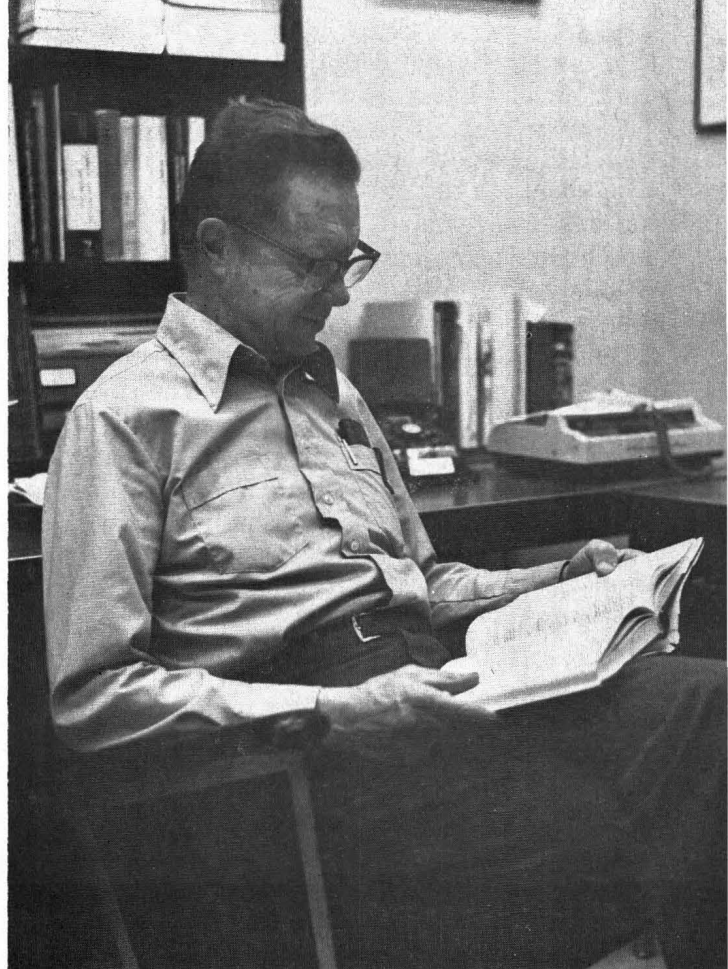
The present Department Chair, Ben McCoy, describes J. M. Smith's contributions in this way:

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**"Dr. Smith makes it a point to get to know students by name. He attends student functions whenever possible and was a regular fan at the Senior class intramural softball games."**

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"Joe has made substantial contributions to the areas of kinetics, reactor analysis, mass transfer, and thermodynamics with both experimental and analytical methods. His career work has resulted in over 260 publications. One most influential paper—N. Wakao and J. M. Smith, "Diffusion in Catalyst Pellets", *Chem. Eng. Sci.* 17, 825 (1962)—was recently identified and honored as one of the most cited in its field. Joe Smith has made major contributions in chromatographic systems. He has pioneered in applying moment methods to the analysis of dynamic response experiments. Adsorption, intraparticle diffusion, dispersion, channeling, chemical reaction, and regeneration are some of the phenomena examined, clarified, and quantified. Whereas in pulse response experiments his students once picked data points off recorder chart paper for subsequent numerical integrations, they now punch buttons on computers to get the temporal moments."

Recently Joe and his coworkers have been focusing their attention on trickle-bed reactors. These three-phase systems with gas and liquid flowing over catalytic particles pose interesting challenges with combined fluid mechanics, mass transfer, and chemical reaction phenomena. Current interests also include thermodynamics and

kinetics of supercritical extraction of oil shale and tar sands. As is much of his research, Joe's studies in these areas were motivated by practical questions arising in industrial processes.

Joe's work has gained recognition through his major textbooks, his journal publications, and the prominence of his former students, now dispersed throughout the international chemical engineering community. Professor McCoy reports: "Joe Smith publishes at least eight papers each year, in the most widely read research chemical engineering journals. Nearly all of these have as co-authors graduate students or post-doctoral scholars who go on to responsible positions in corporations and universities around the world. Most of these research associates come to U.C. Davis specifically to study with Joe." Not only have graduate students and postdoctoral students come to Davis to work with him, he has also gone on Fulbright appointments to the Netherlands (1953), Argentina (1963), Spain (1965), Ecuador (1970), and Chile (1970). His two textbooks have influenced a generation of chemical engineers around the world. *Introduction to Chemical Engineering Thermodynamics*, coauthored with Hank Van Ness of Rensselaer, was published in 1949. *Chemical Engineering Kinetics* first appeared in 1956. Both texts are in the McGraw-Hill Chemical Engineering Series, and both are now in their third editions. The texts are filled with problems of practical interest, reflecting Joe's wide-ranging experience in industrial consulting.

His former and current students bear eloquent witness to his teaching effectiveness. Bob Reid of M.I.T. says this of his former professor (CEE 9, 106 (1975)): "Joe really turned me on; he was the first teacher who gave me problems I couldn't solve. As a matter of fact, I'm still using some of them. I had never met a professor who wanted to know you as an individual. If I were working in the lab late at night, he'd stop in, put his feet up on the desk, and talk with me, not necessarily about my thesis, but about almost anything."

Former student Ray Fahien of the University of Florida says, "It is apparent from his numerous papers and several widely adopted books that Joe Smith is a scholar of international stature. But what is not apparent is that he is also a warm, sensitive person who thoroughly enjoys the company of others—as well as a charismatic leader who knows how to motivate people. He does this by imparting a sense of purpose or mission to

every activity in which he is engaged. For example, in his lectures Joe would begin by asking the question: 'Why are we, as chemical engineers, interested in this topic?' In his discussions with beginning graduate students, he would always emphasize the project's importance in science or engineering. His books also first make clear the relevance of each chapter or section before going into the theory.

"Joe also motivates his students by being profuse in his praise for work well done, but sparing in his negative criticism. Even before Skinner became a popular name in engineering education, Joe recognized the motivating effects of positive reinforcement."

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Each year Joe Smith has taught an average of five courses, both graduate and undergraduate, at U.C. Davis. The custom at Davis is to divide the sections of senior chemical engineering laboratory among the faculty. Exercising his usual initiative, curiosity, and innovation, Joe recently devised a new chemical reaction kinetics experiment for the course. In addition to supervising a number of research graduate students and post-doctoral scholars, Joe advises his share of chemical engineering undergraduates.

Students applaud Professor Smith's teaching style, which they characterize as organized and thorough, with lectures clearly and enthusiastically presented. Joe frequently applies the Socratic method in the classroom; all agree the method encourages preparation.

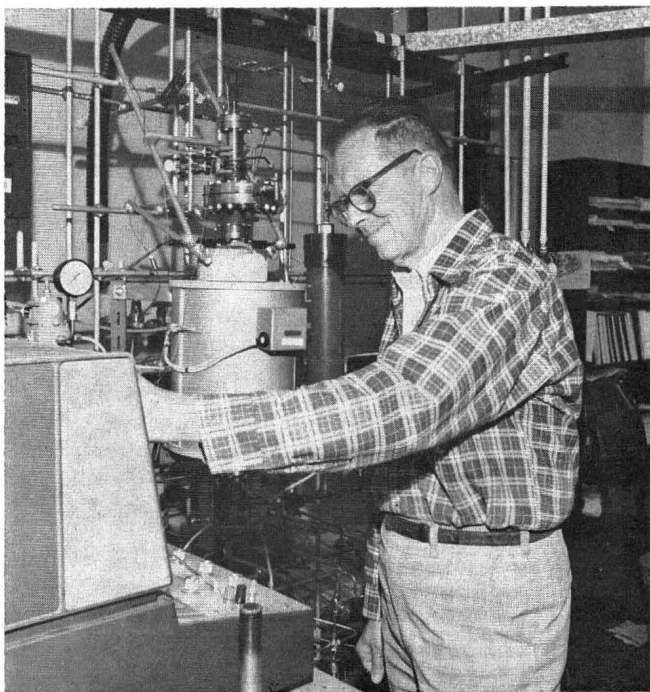
One of Smith's recent undergraduate students, Anne McGuinness of the Class of '82, gave this view of Joe as a lecturer, lab instructor, and mentor: "Any overview of his accomplishments cannot neglect his ability as a teacher. Dr. Smith received the AIChE Outstanding Teacher Award from the Davis chapter in 1982, his 21st year of teaching here. Dr. Smith begins his lectures with a short review of homework, emphasizing the important aspects of the problems. When introducing new material he calls on students in class to answer questions, insuring that the class is following the development of his presentation. He

is always willing to stop his lecture to answer questions and uses them to clarify his points.

"In laboratory courses, Dr. Smith has students review their proposed experiments with him prior to lab sessions. He uses these sessions to ask questions and stimulate the students to look at other possible aspects of the experiment.

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Speaking of his methods of guiding students in research Joe recently said: "As the years go



**Joe examines output data from reactor for super critical extraction of oil shale.**

by it becomes ever more clear to me that there are many effective ways to collaborate with students in chemical engineering research. The most effective approach for one professor may not be suitable for another. Hence, the following comments represent simply a single procedure which has been useful for me. For research which is at least in part experimental it is helpful to visit students in the laboratory each day. Perhaps there seems little to discuss, but, from a general conversation about the problem and apparatus, new ideas and new approaches usually emerge. During these discussions it may be helpful to present unanswered technical questions to the student. Also it is stimulating to offer challenges in the direction and extent of the research that are per-

haps a bit beyond reasonable expectations in the time available. On the other hand, students seem to be discouraged if a thesis problem is not clearly defined beforehand, but is left open-ended. Of course research cannot be described in detail in advance, but the impression can be given to the student that diligent application to a particular phase of a research project should result in a thesis in a reasonable amount of time.

"Formal, weekly meetings, for which the student must summarize prior work and plan for future studies, have merit. When there are data to analyze, such weekly meetings might last several hours. During routine aspects of the project, the meetings may last but a few minutes. Nevertheless, the idea of having a weekly meeting where the students will have time to talk to the faculty member at length, and must summarize their thoughts, seems to be helpful. Also, in working with graduate students it is often valuable to have the students write down in a clear fashion their progress during a previous period and their plans for future work. The act of putting thoughts and results on paper requires clear thinking about the project."

The care for and attention to students, the constant "offering of challenges", and the insistence on clarity in expression of these remarks characterizes Joe Smith's teaching methods. He claims to have learned some of these from his own teachers and colleagues.

"I was first introduced to chemical engineering in a most fortunate way with William N. Lacey teaching a course to two students using the classical book authored by Walker, Lewis, and McAdams. During that period at the California Institute of Technology with the small number of chemical engineering students, all chemical engineering courses were taught by William Lacey and Bruce Sage. These men were specialists in thermodynamics and I was fortunate enough to be able to take, while employed by Chevron Research, a graduate course in thermodynamics with Bruce Sage. These professors taught me some of the elegance and precision involved in thermodynamic thinking and also introduced me to the fascinating area of the interaction of chemical and physical processes which constitutes the essence of chemical engineering."

Of Dr. Lacey's continuing influence Smith goes on to say: "Dr. Lacey, along with Walter Dayhuff of Chevron Research, was instrumental in teaching me how to write clearly. Dr. Lacey

was kind enough to review a chapter in my first attempts to write a text on chemical engineering thermodynamics. He found 37 split infinitives which he brought to my attention in a gracious way. Ever since a split infinitive has, figuratively, jumped off the page at me."

He was equally "fortunate" in his professors at MIT where, he says, "my interest in thermodynamics was further enlarged by the experience of taking graduate-level courses with Harold Weber. The contrast in approach to the laws and applications of thermodynamics from these two institutions was, at first, perplexing and confusing. With the passage of time, the strong points of the methodical, careful approach at Cal Tech and the thought-provoking, more applied methods at MIT provided a more complete and satisfying understanding of the subject.

"Thesis work with W.K. Lewis was an inspiration. One of the most lasting benefits of this association was learning the importance of being able to generate new ideas about chemical engineering problems. Dr. Lewis was an inspiring innovator and his students could not help but see the beauty and advantages of innovative approaches to difficult problems. Dr. Lewis had no patience with inferior work and transferred this characteristic to his co-workers." The same might be said by the students of Dr. Smith.

Joe Smith's influence on students is not limited, however, to those he individually reached in lecture rooms or labs. Not only is he "the man who wrote the book", he is also one of "the men who built the College at UC Davis".

Roy Bainer, Dean Emeritus of the College of Engineering at UC Davis, describes Joe's herculean efforts in these early years. "Hired as a chemical engineer in the Department of Food Science and Technology, Smith was a member of the UC Davis faculty when the possibility of the College was being considered. Local committees were appointed to develop curricula in the main disciplines, utilizing the engineering talent at Davis. For example, Dr. Smith of Food Science and Technology was asked to chair a Committee for Chemical Engineering." When the local committee's report was accepted, chemical engineering was approved as part of the College of Engineering, not, as at Berkeley, as part of the School of Chemistry. To continue with Dr. Bainer's account: "This meant that Dr. Smith could serve as first chairman of chemical engineering at Davis and could become involved in hiring new faculty



**Essie and Joe Smith enjoying a departmental social function.**

and the planning of the new building. . . The current enrollment in engineering at Davis reached 1900 students twenty years after the Regents' establishment of the College. Much of the credit for success must go to the many contributions of Dr. Smith".

Not only the College benefited from Joe Smith's talents as an administrator. The chemical engineering department owes its existence to his persuasive advocacy. After discussing the struggle to establish a separate department ("It became clear that if chemical engineering were to develop as a recognized discipline at Davis a separate department was necessary"), Joe describes the continuing struggle, familiar to chemical engineering educators everywhere, the need for which he attributes "to a lack of understanding of the essence of chemical engineering": "After the establishment of the department our worries about developing a strong program were not completely eliminated. It seemed a continual struggle during the late sixties to justify inclusion of sufficient credits in chemistry and separate courses in thermodynamics and fluid mechanics, distinct from the existing courses in these subjects taken by all other students in the College of Engineering."

Professor Smith worked equally hard on campus recruiting for his department. Contributing to the struggles on behalf of the department in those early days were Steve Whitaker and Dick Bell, who joined it in 1964 and 1965, respectively; Ben McCoy and Alan Jackman, both alumni of Minnesota, arrived in 1967 and 1970; Ruben Carbonell and Dave Ollis, both with backgrounds at Princeton University, joined the department

**Continued on page 47.**

actor design books. On the other hand, the authors have barely touched upon catalyst deactivation, and the discussion of intra particle diffusion limitation and multiplicity in catalyst pellets is very limited. The fifth and the last chapter is on Gas-Liquid and Liquid-Liquid Reaction. The material in this chapter is better presented than in most other books and is very useful to the design engineers.

The authors have completely neglected non-catalyzed gas-solid reactions and a very common class of reactors, namely slurry reactors.

The book can be useful as a reference book for chemical engineers in industry but its utility as an undergraduate or a graduate text seems very limited. This is due not only to the lack of mathematical approach but also because it contains no problems for students to solve. Finally, the book does not represent the state of the art since most of the references are pre-1975. □

## J. M. SMITH

Continued from page 9.

in 1973 and 1980; and Pieter Stroeve and Dewey Ryu, are the most recent additions.

While Joe has always emphasized to his colleagues that undergraduate education is a vital part of the UC Davis chemical engineering program, he has also promoted the ideal of strong and varied graduate training. Although Joe is planning a partial retirement to begin in the fall of 1984, he expects to continue to teach and work with graduate students and postdoctoral scholars on chemical engineering research. In view of the personal characteristics he has so far exhibited, it is not anticipated that Joe will retire to a life of leisure and abandon. His single-minded pursuit of achievement in solving chemical engineering problems is probably the critical factor in Joe's success. Undoubtedly, the robust creativity and inexhaustible energy have been important ingredients as well, but his exacting commitment to getting the job done and done well has made the difference between routine and monumental accomplishment.

In all the aspects of chemical engineering education—exemplary research, the writing of textbooks, teaching classes, the guiding of students (graduate and undergraduate) in their research, and administration—Joe Smith has earned and will continue to deserve his Davis title, "Mr. Chemical Engineering". □

## DIGITAL CONTROL EXPERIMENT

Continued from page 31.

tive control ( $k_c = 3.53$  volt/volt,  $\tau_D = 0.1$  seconds), and proportional-integral-derivative control ( $k_c = 3.53$ ,  $\tau_I = 20$ ,  $\tau_D = 0.1$ ). Introduction of integral action eliminates the offset (at much longer time than shown in the graph), and less oscillation is shown with P-I-D control.

Fig. 5 represents the effect of sampling time on the system with only proportional control action.

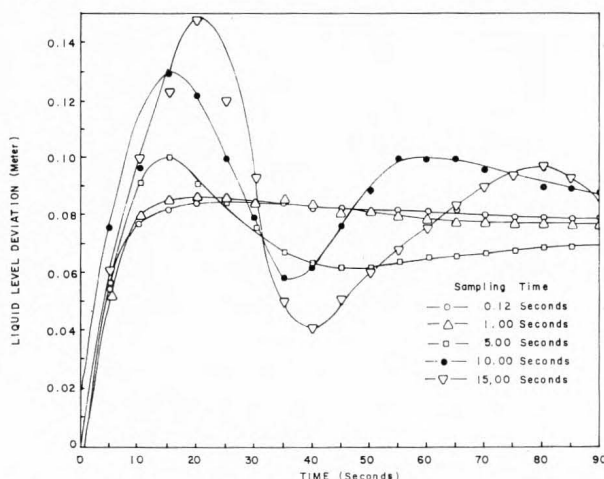


FIGURE 5. Effect of sampling time on system with proportional control.

Increasing the sampling time resulted in higher overshoot and more oscillation. What is interesting is that the system which is first order starts to act like a second order system with decreasing damping coefficient as the sampling time increases. Similar responses are obtained for P-I and P-I-D control.

It should be pointed out that the present undergraduate process control course at NJIT does not cover direct digital control. With this experiment, and the introduction of z-transforms, students can get a very good understanding of discrete sampling and direct digital control. □

## ACKNOWLEDGMENT

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