Energy Studies

Volume 12 Number 2
November/December 1986

Newsletter of the Center for Energy Studies of The University of Texas at Austin

Energy Studies reports on activities of the Center for Energy Studies and other energy-related news from The University of Texas at Austin. Subscription is free upon request (six issues a year). ISSN: 0743-829X.

The Center for Energy Studies is a multidisciplinary research center, the central liaison for energy research, education, and public service at The University of Texas at Austin. Dr. Herbert H. Woodson is director.

Editor: Jennifer Evans

Program Launched in Process Energetics, Industrial Productivity

A program to research advanced methods of using energy in industrial processes to achieve higher productivity has been formed at the Center for Energy Studies.

The Process Energetics Program is described in a prospectus being prepared for release by January.

Philip S. Schmidt, head of the program, is a professor of mechanical engineering at UT and has served on the faculty for sixteen years. A national expert on process energetics, he is author of *Electricity and Industrial Productivity: A Technical and Economic Perspective* (Pergamon Press, 1984).

Three other UT engineering faculty members—Theodore L. Bergman, Melba Crawford, and John Pearce—and two center researchers—John Andberg and Vince Torres—have joined the program (See "Senior Researchers," page 2).

The Electric Power Research Institute (EPRI) has recently awarded the program a major project, a $492,000 study of industrial drying enhanced by microwaves and radio-frequency (rf) waves. This project will build on results from several previous EPRI-funded projects.

Centerpiece of the program. The researchers are building an experimental facility, a 6-kilowatt microwave-convective drying system, with automated controls and data-acquisition equipment. A second system being designed for the study of rf-enhanced drying will be completed in 1987. These two facilities will perform as the centerpiece of the program, for the near term, said Dr. Schmidt.

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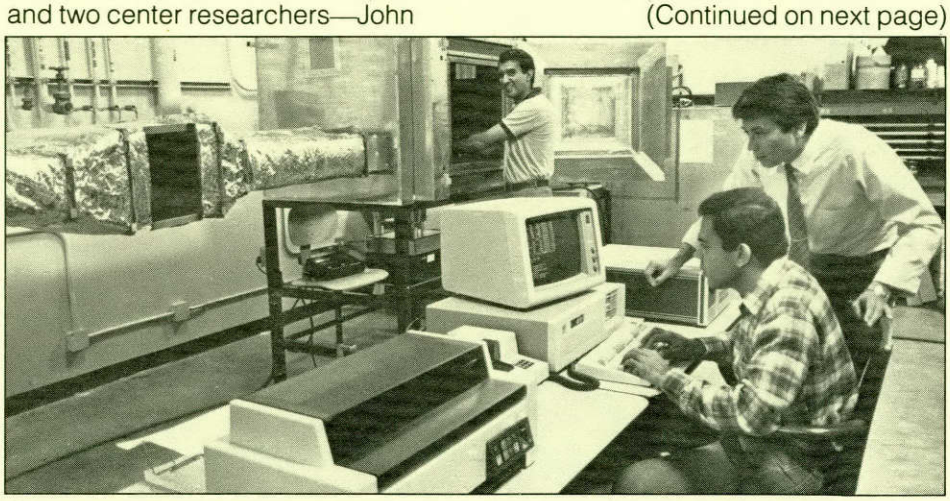
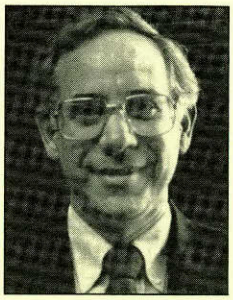
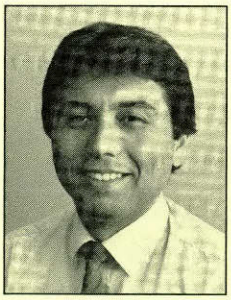
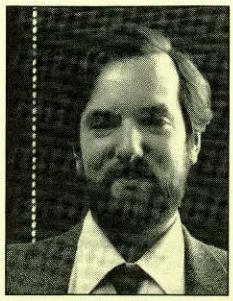
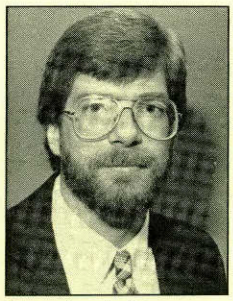


Process energetics researchers ready a 6-kw microwave test system. From left: mechanical engineering graduate students George Terrazas and Nadeem Malik and program manager Vince Torres.

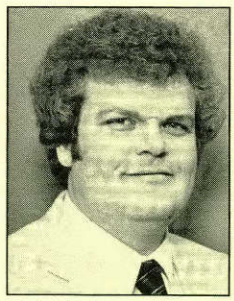

Philip S. Schmidt


Vincent M. Torres


John W. Andberg


Theodore L. Bergman


Melba M. Crawford


John A. Pearce

Facilities for other processes, such as infrared drying and ultraviolet curing, are being considered for the future.

Metal, paper, minerals, food, textiles, plastics, chemicals, ceramics, and wood—all of these and many other products go through energy-intensive manufacturing processes such as heating, forming, drying, and curing. Processes for treating materials with energy pervade most industries.

Dr. Schmidt said the United States now lags behind several other countries in research to enhance productivity in the process industries.

"Generally speaking, we are behind. We're behind the Japanese, the Europeans, and to some extent the Russians, depending on the technology. In all of those countries there has been significant, long-standing, continuous government support for the improvement of industrial processes—and it is paying off.

"Only in the last few years has the United States, through organizations such as EPRI and the Gas Research Institute (GRI), begun to put together an integrated effort. We are in the catch-up mode."

The meaning of critical mass. Process energetics problems are complex and usually interdisciplinary, according to Vince Torres, manager of the program. The senior researchers in the Process Energetics Program have backgrounds in mechanical engineering, operations research, electrical engineering, and computer modeling.

In establishing a successful program of this kind, "the key thing is critical mass," said Dr. Schmidt. "Critical mass means two things: people and facilities."

"Many industrial firms do not have all of the varied expertise in-house to analyze and design process improvements," Mr. Torres said. Assembling a research facility and a team of experts is costly and time-consuming.

The goal of the Process Energetics Program is to offer research facilities and a group of experts who can perform process energetics research for industrial firms and organizations quickly and inexpensively, while at the same time advancing the state of the art through fundamental studies. The target areas of research include:

- ☐ Microwave- and radio-frequency-enhanced drying
- ☐ Continuous curing of rubber extrusions and moldings with microwaves and hot air
- ☐ Optimization of foundry operations
- ☐ Economic tradeoffs in hybrid (multiple-fuel) processes
- ☐ Use of artificial intelligence in optimizing energy-using operations

The United States has several centers devoted to research in metals processing, but few focusing on the other industries, said Dr. Schmidt. A significant opportunity exists for enhancing productivity through energy-oriented research.

"The induction furnace has kept a lot of US foundries in business by giving them increased flexibility and more ability to compete in the world marketplace, even though the industry as a whole has been declining. We are looking at situations like that—perhaps with technologies that are not as well developed as induction heating, with applications to other industries," he said.

Studying the hybrids. "We are especially interested in the electrotechnologies because, for a number of reasons, they offer some important productivity benefits. In many cases the electrotechnology works best when it's used with a conventional technology."

Microwave-enhanced drying is an example of this type of hybrid technology. Drying with microwaves alone can be prohibitively expensive. The center researchers are studying whether microwaves can be com-

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For More Information about Process Energetics

To find out more about the Process Energetics Program (or to be included on the list to receive its forthcoming prospectus), telephone or write:

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Research Leaders

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Theoretical modeling of heat and mass transfer

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Assistant Professor of Mechanical Engineering
Drying, heat and mass transfer

Melba M. Crawford
Associate Professor of Mechanical Engineering
Operations research, industrial engineering, economic analysis

John A. Pearce
Associate Professor of Electrical and Computer Engineering
Electromagnetic aspects of dielectric heating

Philip S. Schmidt
Professor of Mechanical Engineering
Electrotechnologies, industrial management, and productivity

Vincent M. Torres
Research Associate
Energy and fluids

CES Update

Office of Director

Dale E. Klein, deputy director of the center, has been elected president of the Travis County chapter of the Texas Society of Professional Engineers. He has also been named to UT's Fluor Centennial Teaching Fellowship in Engineering.

Conservation and Solar Energy

Center researchers are **developing an air-conditioning system** that uses a liquid desiccant and that promises an efficiency 32 percent higher than that of a conventional air conditioner.

Design of a prototype is not yet complete. The liquid desiccant dries air within the system by absorbing moisture from it, said conservation researcher John R. Howell. Dr. Howell is chairman of the UT Department of Mechanical Engineering.

A conventional vapor-compression air conditioner must also dry air and does so by cooling it to condense the moisture out.

In the hybrid system, vapor compression is used to lower the air and desiccant temperature; the desiccant removes moisture from the air. The evaporator and condenser each serve secondary purposes: heat from the condenser is used to regenerate the desiccant in part, drying it so that it can be used again. The evaporator surface functions as the site where the desiccant flows in contact with the air to absorb moisture from it.

The chief advantage of the hybrid vapor-compression/liquid-desiccant system is its increased efficiency. And too, the extra cooling capacity often required of a vapor compression system for removing moisture is no longer needed. A hybrid would perform well in a humid or a dry climate, said conservation and solar researcher John L. Peterson.

On the other hand, liquid desiccants (such as lithium bromide, lithium chloride, or calcium chloride) rapidly corrode aluminum and copper. In order for the system to be practical, corrosion-resistant coatings or metals must be incorporated in the design.

Two other participants in the research are conservation and solar researcher Scott C. Silver and visiting scholar Jinwang Tan.

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Jinwang Tan, a visiting scholar from the Nanjing Aeronautical Institute in the People's Republic of China, has joined the Conservation and Solar Energy Program for a year. He will be participating in research on advanced air conditioning, cooling, and heat exchange.

Rotating Machines and Power Electronics

Amr Amin, an electrical engineer from Egypt, has joined the Rotating Machines and Power Electronics Program as a post-doctoral research associate.

Separations Research Program

A model for predicting the performance of different **supercritical solvents and cosolvents** has been developed by separations researchers.

"The attractive feature of the model," said Keith P. Johnston, assistant professor of chemical engineering, "is that it can be used to predict the approximate behavior of certain new systems without the need to do many laboratory experiments. That's the beauty of it."

Supercritical extraction is a novel technology in which dense gases, or "supercritical solvents," are used at pressures of 800 to several thousand pounds per square inch to separate liquids or gases. Decaffeination of coffee is one of the most widely known applications, and supercritical extraction holds promise for separations of other foods, heavy oils, pharmaceuticals, specialty chemicals, and hazardous wastes.

The systems, or combinations, studied included carbon dioxide, fluoroform, ethane, and ethylene as the supercritical fluids; acetone, methanol, ethanol, and octane as cosolvents; and various aliphatic and aromatic hydrocarbons as the solutes.

Dr. Johnston said that in several of the systems studied, both the selectivity and the yield of the extraction were improved by using methanol as the cosolvent.

Three chemical engineering graduate students have participated in the research: Joe M. Dobbs (now with Philip Morris), Sunwook Kim, and Joe M. Wong.

■

Douglas R. Lloyd, an associate professor of chemical engineering and researcher in the Separations Research Program, traveled to Korea in mid-October to consult with the Korean government on development of materials for membrane separations. He delivered the plenary lecture at the biannual meeting of the Korean Polymer Society.

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Three research engineers have joined the staff of the program and will be working in the areas of extraction, distillation, stripping, adsorption, and membranes. The three are Christopher Martin, formerly with Fisher Controls; Frank Seibert, who in August received his PhD in chemical engineering from UT; and Cheri Wooten, who received her BS in chemical engineering from UT in May. ■

The University's Project Quest Committee has awarded four IBM microcomputers to the Center for Energy Studies. The computers will be used for research in process energetics, membrane separations, and energy conservation. A grant program, Project Quest was started in 1984 at The University of Texas at Austin and is supported by IBM and Apple Computer.

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bined with conventional hot air to dry materials at a cost lower than that of either process alone, while achieving the speed of drying and improved product quality possible with microwaves.

Other projects now under way deal with (1) using natural gas and electricity in optimum combinations in metal foundries and (2) developing and applying a new method to compare the economics and intrinsic values of competing processes, an approach called *form value studies*.

Types of studies. The research undertaken in the Process Energetics Program will fall into three areas:

- ☐ *Technology development* designates experimental research and process modeling.
- ☐ *Economic analysis* covers questions of cost and process optimization, usually by means of computer modeling.
- ☐ *Strategic studies* involve analyzing overall impacts of industrial process changes on the national economy, markets, and energy demand patterns.

Technology transfer is a high priority in program planning.

"Getting the results of our research, as well as that of others around the world, into the hands of people who can use them is a critical step if our program is to have a meaningful effect on the marketplace," said Dr. Schmidt. This transfer will be accomplished through a variety of modes, including publications, videotapes, regular university courses, short courses, and seminars (see "Electrotechnology Course," this page).

A number of utilities have expressed interest in the program. They see process energetics research as a way to expand markets for electricity and natural gas, while stabilizing their existing base of industrial customers.

"Many utilities in the Northeast started aggressive marketing toward industrial users of electricity several years ago," he said. "Now too, in our section of the country, the Southwest, we are getting into the mode where utilities have to make a concerted effort to maintain and build their industrial load."

For utilities coping with declining industries in their service areas, with excess generation capacity, or with load management concerns, working with industrial customers to improve their productivity can be an avenue to mutual prosperity.

"Our major focus currently is on research that will be of value to all potential users—more fundamental research. In time, the unique nature of our facilities and staff will allow us to take on a limited amount of work with a proprietary component. In this type of research, we will be most interested when open publication of certain results can be arranged, while still protecting the proprietary interests of the supporting organization," said Dr. Schmidt. ■

Electrotechnology Course Offered in Dec. and Jan.

Two experts on electrotechnologies will teach a four-day short course, "Industrial Electrification: Technology and Economics," December 2-5 in West Lafayette, Indiana, and January 12-15 in Austin, Texas.

The course is sponsored by Purdue University, The University of Texas at Austin, and the Electric Power Research Institute. The cost of $695 includes tuition and course materials.

The course is useful to industrial marketing specialists, planners, and forecasters at utilities and to engineers and managers in the process manufacturing industries. Topics to be covered include (1) process and fuel competition; (2) advanced electrotechnologies for metals reduction, metal fabrication, nonmetal bulk material production, and nonmetal fabrication; and (3) R&D and long-term trends in industrial electrification.

Philip S. Schmidt and Frederick T. Sparrow will teach the course. Dr. Schmidt is head of the center's Process Energetics Program and a UT professor of mechanical engineering. Dr. Sparrow is director of the Institute for Interdisciplinary Engineering Studies at Purdue University and is a professor of both engineering and economics.

For more information, contact

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