ChEn

chemical engineering

2000 newsletter

The Department of Chemical Engineering exists to support the mission of BYU by preparing students for lives of scholarship and continued learning, lives of service, and lives spent contributing to society.

FROM THE CORNER CHAIR

Greetings, alumni! Whether you think of the year 2000 as the beginning of a new millennium or are reserving that designation for 2001, I think that we would all agree that this is a historic time. For the department it's an exciting opportunity to help our students prepare for the future.

Planning for our spring 2002 accreditation review has catalyzed some important activity. As described in previous newsletters, the Accreditation Board for Engineering and Technology (ABET) has dramatically changed the criteria for accrediting undergraduate engineering and technology programs. The new criteria require that we identify the attributes we wish our graduates to have (which include some attributes required by ABET) and develop an ongoing process for measuring those attributes in our students and using that information to improve our program. All of that must be in place prior to our review.

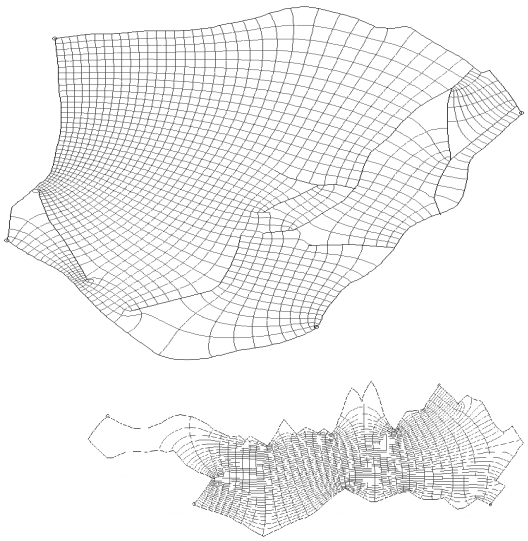
I am happy to report that we are making good progress in responding to the ABET criteria. Our department faculty provided the initial input in defining the desired attributes and related competencies for our graduates, and our Department Undergraduate Committee spent MANY hours compiling, refining, and ranking those attributes and competencies. We have also begun making "measurements" of those attributes in our students. That actually began several years ago when we polled our alumni (you) asking how well prepared your were in a number of areas. (Our thanks to those who responded.) Last October we also brought to campus an advisory board consisting of five of our alumni, four from industrial settings and one from another university, to give us similar feedback and to comment on our list of attributes and competencies. Finally, we have begun gathering more specific data through the examinations we give in our classes.

Armed with the feedback we have already received, our Department Undergraduate Committee spent many more hours and has prepared a recommendation for modifying our curriculum. Two new required classes have been defined to more thoroughly treat several areas of current importance, including safety issues, environmental concerns, ethics, and securing employment (interviewing, resumés, etc.). Some previous requirements will be reduced to make room for these new courses. The recommendation has been approved in principle by the department, and implementation details are being worked out.

It's a good time for change, and the changes we are making will help our graduates take their places as successful and influential leaders in their professions, communities, church, and families.

OIL RESERVOIR SIMULATION

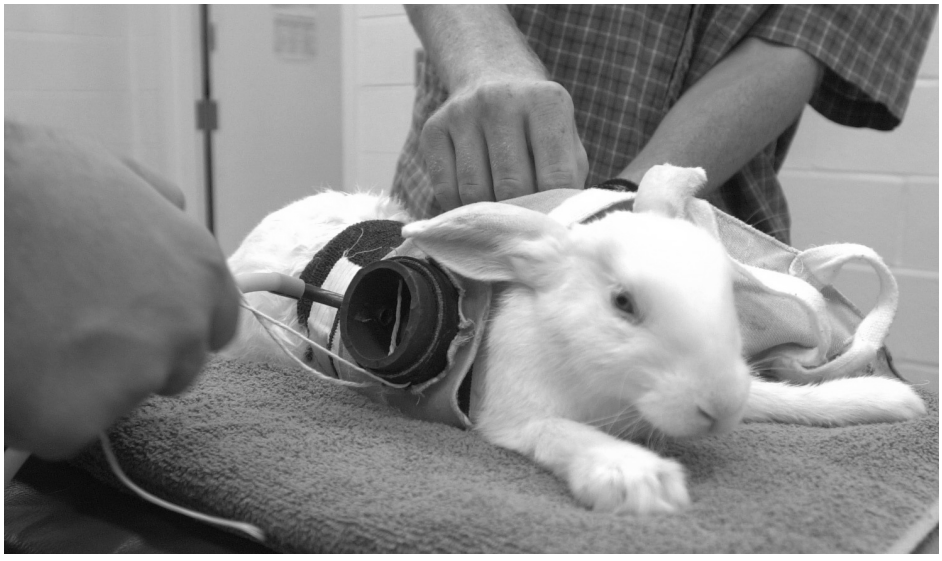
In the past oil reservoirs have been abandoned after producing only 25–30 percent of their hydrocarbons. Today the ability to optimize reservoir development through computer-based reservoir simulation has greatly increased these recovery fractions, thereby keeping the world's supply of oil high, despite a dwindling number of new field discoveries. The International Reservoir Simulation Research Institute (IRSRI) at BYU is a research consortium funded by petroleum companies. IRSRI develops improved mathematical methods of simulating fluid flow in underground petroleum reservoirs. The resulting "reservoir simulators" allow petroleum company engineers to repeatedly produce the oil and gas from an oil field in a virtual environment. They can then compare the resulting produced volumes and associated economics of many development alternatives to optimize the recovery of oil and gas. Reservoir simulators allow engineers to optimize the location of wells, the depth intervals at which fluids are allowed to flow into the wells, and bottom hole pressures. Engineers can also see the effects of secondary production methods involving the injection of water into various wells, as well as the effects of enhanced recovery processes involving the injection of other chemicals, such as CO_2, nitrogen, detergents, polymer solutions, and steam. Details of the mathematical research being done at IRSRI can be seen on the Internet at http://www.et.byu.edu/cheme/IRSRI/IRSRI.html.



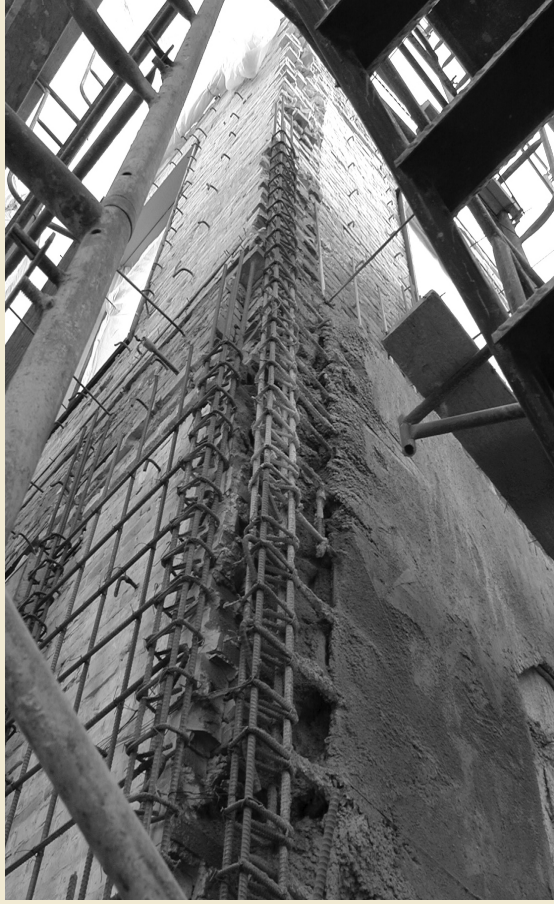
ENHANCING ANTIBIOTIC ACTIVITY WITH ULTRASOUND

Until recently, the scientific world knew very little about biofilms or their medical importance. However, the increasing use of internal and transdermal medical implants has led to a rise in the number of recalcitrant biofilm infections. These biofilm infections are caused by complex, sessile colonies of bacteria encased within an exopolysaccharide matrix that anchors them to the medical implant and helps protect them from antibiotics and disinfectants. They form on the polymers and metals used in biomedical implants including heart valves, hip replacements, and transdermal catheters. In order to treat the biofilms, current research at BYU is investigating a combination of ultrasound and antibiotics. A great deal of information about the ultrasonic enhancement of antibiotics has already been gathered from in vitro experiments in relation to planktonic and sessile (biofilm) forms of organisms, including Escherichia coli, Pseudomonas aeruginosa, and Staphylococcus epidermidis.

After primary in vitro research showed a reproducible and effective means of curing biofilm infections, an animal model was developed to study the feasibility of clinically treating biofilm infections (a mode of infection difficult, if not impossible, to treat with conventional antibiotic therapy). By implanting synthetic disks subcutaneously in rabbits, the research group under the direction of Dr. Bill Pitt was able to create a model of medical biofilm infections and treat them with a combination of the antibiotic gentamicin and low-density ultrasound. This combination differentially reduces bacterial counts on infected polyethylene implants by two orders of magnitude. Although the combined treatment looks promising for E. coli biofilms, they have failed to attain similar results for the bacteria P. aeruginosa. Currently, experiments are being designed and performed to investigate the mechanism of the bioacoustic effect in an effort to expand the range of treatable infections. Using a technique called flow cytometry, as well as a reduced oxygen protocol, they are investigating the role of antibiotic transport and metabolism in the efficacy of bioacoustic therapy. A greater understanding of the antibiotic's ultrasonic enhancement mechanism would enhance physicians' ability to treat dangerous biofilm infections with antibiotics, foregoing the current means of treatment—which requires surgically removing and replacing the infected implant.



AN ENGINEERING STUDY DEMONSTRATED THE TECHNICAL AND ECONOMIC FEASIBILITY OF DEVELOPING THE HISTORIC SQUARE INTO A NEW LIBRARY.



PROFESSOR SMOOT LEADS ACADEMY SQUARE PRESERVATION PROJECT

Under the leadership of Professor Doug Smoot, the Brigham Young Academy (Education) Building has been saved from demolition and will become part of Provo City's new library. During an improbable four-year effort, culminating in 1999, an engineering study demonstrated the technical and economic feasibility of developing historic Academy Square into a new library. After the design was approved by both library and city officials, a city-wide bond election was passed to raise the $16.8 million needed to complement the more than $6 million raised privately for the $23 million project. Jacobsen Construction Co. and 60 subcontractors started renovation and construction work in July 1999, with completion scheduled for spring 2001. Work is currently on schedule and within budget.

The Academy Building, on University Avenue in Provo, was the principal home of Brigham Young Academy—which in 1903 became Brigham Young University—from 1892 until work on the upper campus started in the 1920s. It remained an important campus building until 1975, when the lower campus was closed and sold to private developers. Over the next two decades, the lower campus fell into disrepair from lack of use and neglect, though many unsuccessful attempts were made to preserve the site. When Provo City bought the block in 1994, reclamation finally appeared possible.

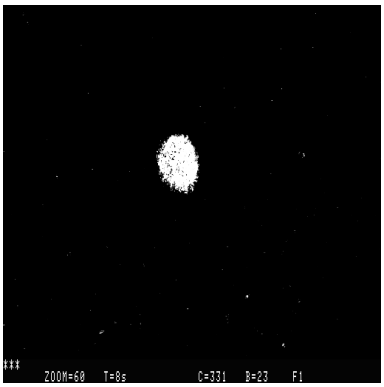
Now only the magnificent old Academy Building, designed by Joseph Don Carlos Young, remains. All other buildings on the lower campus have been razed. The Academy Building itself has been completely demolished inside and had its roof removed, leaving only the thick brick walls and foundation. An interior, steel-reinforced, concrete shell has been tied into the original brick walls, and reconstruction of the interior is in process. A two-story wing is being added to the east, where College Hall once stood, and will be linked to the Academy Building with a beautiful glass entrance. This new complex will triple the current library space, providing a hi-tech library in a setting rich in tradition. An underground parking terrace topped with surface parking will provide 350 parking spaces.

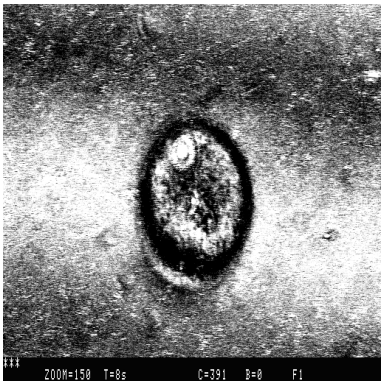
DR. SMOOT HAS BEEN DRIVEN BY HIS LOVE FOR BYU, HIS APPRECIATION FOR THE PIONEERS' SACRIFICES, AND HIS DUTY TO HIS GREAT-GRANDFATHER.

Dr. Smoot is still heavily involved in this project and very excited about the approaching dedication. He has said that this project has been the most demanding experience of his life. Despite the challenges, he has been driven by his love for BYU, his appreciation for the pioneers' sacrifices, and his duty to his great-grandfather, Abraham O. Smoot—the first board president of Brigham Young Academy.

ULTRASONICALLY ENHANCED MICELLAR DRUG DELIVERY

A research group directed by Dr. Bill Pitt is studying methods of delivering high-concentration, anti-cancer drugs directly to cancer cells, while preventing release of the drug to the body in general. Their research includes using polymeric drug carriers to transport chemotherapy agents through the body without prematurely disintegrating and releasing the drug. This precludes the adverse side effects that are caused by the anti-cancer drugs acting on healthy tissue.



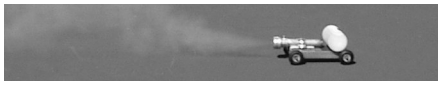


This research group is currently encapsulating a potent anti-cancer drug, doxorubicin (DOX), in a polymeric micelle. These special polymers form a hydrophobic core and a hydrophilic outer shell upon dissolution in water, and the hydrophobic drugs associate with the hydrophobic portion of the polymers and do not interact with the hydrophilic surroundings. They have found that they can release the drug from the polymeric micelle on demand by applying ultrasound. Their concept is to focus ultrasound on a tumor, thus releasing and activating the drugs at the cancer site only.

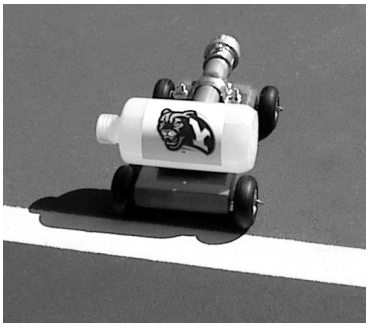
The polymeric drug carrier can protect cells from the action of DOX for at least nine hours of exposure, which shows that the drug carrier is effective in sequestering the drug. They have also found that human Leukemia cells (HL-60) sustained large amounts of DNA damage when ultrasound is applied to the drug in its polymeric carrier. To optimize the release of the drug, Dr. Pitt's group has developed an ultrasonic-fluorescence detection chamber that measures the release of DOX as a function of ultrasound frequency, power density, and polymer carrier concentration. The results showed an increase in DOX release as the ultrasound intensity was increased and ultrasonic frequency was decreased. Furthermore, after the ultrasound was turned off, the drug was re-encapsulated in the polymer within 0.5 seconds. This suggests that any DOX released in the vicinity of the ultrasonicated tumor, but not taken up by the tumor cells, may be re-encapsulated after it flows out of the tumor region.

This new technology has promising applications in the treatment of localized cancers by preventing unwanted drug interactions with healthy host cells, and thus reducing the side effects associated with conventional chemotherapy. The therapy is noninvasive and can be carefully controlled via the application of the ultrasound. They are now preparing to do an in-vivo study using an animal model.

ROCKET CAR COMPETITION



The BYU AIChE student chapter sent a team to compete in the Chemical Engineering Car Competition at the Rocky Mountain States AIChE Regional Conference. The goal of the competition was to build a car, powered entirely by a chemical reaction, that would go between 15 and 30 meters, carrying between 0 and 500 ml of water. The payload and the distance traveled by the car were not announced until one hour before the competition began. The car could not use any electrical or mechanical means to stop. The car that stopped closest to the finish line won the competition. An accompanying poster was required of each competing team for a separate poster competition. The seven-member BYU team placed second in both the poster and car performance portions of the competition.



SCHOLASTIC RECOGNITION

Magna Cum Laude

Stephen Jeffrey Burdick
Reed Jacob Hendershot
Leonard Franklin Pease III

University Honors

Nicole Lynell Hatch
Christine Merrell

Phi Kappa Phi

Christine Merrell
Leonard Franklin Pease III
Michael Richard Sherman
Brian Curtis Stephenson
Robynn Stoddard
Cary Swapp

Tau Beta Pi

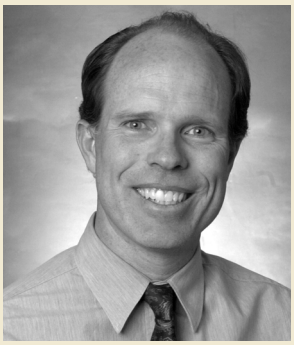
Stephen Jeffrey Burdick
Reed Jacob Hendershot
Christine Merrell
Leonard Franklin Pease III
Brian Curtis Stephenson
Robynn Stoddard
Daniel Eric Wright

Cum Laude

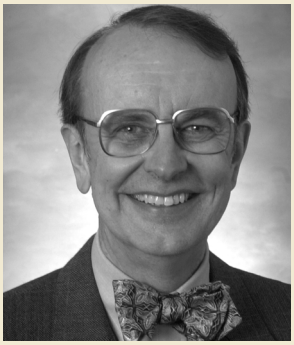
Michael Richard Sherman
Brian Curtis Stephenson
Robynn Stoddard
Nancy Ann Zundel

SPOTLIGHTS

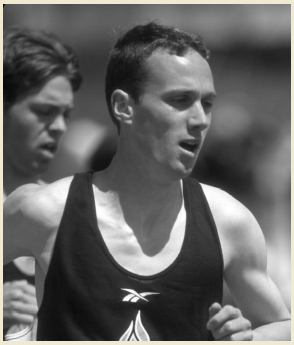
Dr. William Pitt received a college commendation for outstanding research this past year (see related articles). Among his many accomplishments, he directed seven graduate students and numerous undergraduates, produced five publications, and generated over $200,000 for research. He lectured this June at the University of Groningen in Holland, which sent one of their PhD candidates to work with Dr. Pitt's research group at BYU. In July he gave one of the invited plenary lectures at Biofilms 2000, an international conference sponsored by the National Science Foundation and the American Soceity for Microbiology.



Dr. Hugh B. Hales, director of IRSRI at BYU (see related article), has served for the past year as chair of the Salt Lake Section of the Society of Petroleum Engineers. Although Utah is not usually thought of as an oil-producing state, 206 different companies produce oil or gas here, and more than one hundred engineers belong to the Salt Lake SPE Section. They meet monthly and hear presentations from some of the world's experts in petroleum engineering. The SPE also offers scholarships to area students. This year Joseph Pergler, a BYU chemical engineering PhD candidate, received one of four area scholarships.



John Hedengren, a junior in chemical engineering, was the 1999 Mountain West Conference cross country champion and was named the league's Cross Country Athlete of the Year. Also a distance runner for the BYU track team, the Richland, Washington, native placed seventh in the 5,000-meter and third in the 10,000-meter races at the MWC Outdoor Track and Field Championships. As a result of his academic and athletic accomplishments, Hedengren was named to the GTE Academic All-District VIII teams during both the cross country and track seasons. This chemical engineering student was one of 10 student athletes selected for first team honors from 15 different schools across the western United States. He is currently "characterizing radioactive waste" in preparation for waste cleanup while interning at the Hanford Nuclear Reservation in Washington state.



Paul Goodman has been awarded both the National Science Foundation Graduate Fellowship and the Whitaker Biomedical Engineering Graduate Fellowship. Approximately 900 National Science Foundation Fellowships are awarded each year, and Paul is one of the eight students at BYU awarded fellowships this year. The NSF Fellowship provides a $10,500 cost-of-education allowance and a $16,200 stipend per year, for three years. The Whitaker Foundation awarded 38 fellowships nationally this year. This fellowship provides up to $15,000 for tuition and assessed fees and an $18,500 stipend per year, for up to five years. Although he retains the honor of having received both, he is only able to accept one. Paul has accepted the Whitaker Foundation Graduate Fellowship.

This year students from the **BYU Chapter of AIChE** took honors at the Rocky Mountain States AIChE Regional Conference held March 23–25 at the University of Utah. In the Rocky Mountain Region, the states Arizona, Colorado, New Mexico, Utah, South Dakota, Wisconsin, and Wyoming were represented by a total of 14 student chapters. The conference has two competitions: the Student Paper Competition and the Chemical Engineering Car Competition. This year BYU students **Nicole Hatch** and **Brendan Wright** took first and third places, respectively, in the Student Paper Competition. The students were judged on their poise, organization, presentation skills, and the quality of the information in their paper. In the Chemical Engineering Car Competition, BYU took second place both in the car competition and in the related poster competition (see related article). Nicole Hatch and the Chemical Engineering Car Competition team will compete against chemical engineering students from around the country at the annual AIChE meeting this November in Los Angeles.

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HOMECOMING 2000

October 20, 2000

Calling all chemical engineering alumni to join us for a banquet held in your behalf October 20, 2000, from 6:00 to 7:00 p.m. in 3280 Ernest L. Wilkinson Student Center (WSC). After dinner you will be entreated to hear from a special guest speaker, Dr. Robert L. Millet, who is currently dean of Religious Education at BYU. Dr. Millet will speak for 30–60 minutes.

The activities for alumni during Homecoming do not stop there. Tickets for the BYU football game on October 21 vs. San Diego State will be available for purchase at a discounted price of $10 each. If you would like football tickets, please let us know by September 15.

We welcome all that visit BYU during Homecoming Week to come up and say hello to your former professors. We are still located in 350 Clyde Building, in the southeast corner of the third floor.

Please contact us by phone at (801) 378-2587 or by e-mail at cheme@byu.edu to let us know (1) whether or not you will attend the banquet and/or football game and (2) the number of people attending.