

Biodiesel and Natural Gas – Fuels for the Future?

Anthony Marchese and Dan Olsen, two of our newer faculty members in the Mechanical Engineering Department, help lead the department's research in energy conversion. Marchese works in the Engines and Energy Conversion Laboratory (EECL) on the combustion chemistry of fuels, in particular biodiesel fuel made from algae. His focus is on understanding and predicting the emissions that are likely to occur through the use of algae-based biodiesel in engines. Olsen also works in the EECL on large stationary and industrial natural gas engines. He works on improving the efficiency and reducing the emissions from the burning of natural gas in these engines. He also works on the applications of digester gas sewage,

coal gas, and straight vegetable oil (aka SVO) as engine fuels.

Marchese has become heavily involved in the algae-based biodiesel research that has been ongoing in the EECL for some time. He is focusing on the emissions aspects of using such fuels. The future potential of this technology is great because algae-based fuels do not compete with food as do corn- or soybean-based fuels; and algae can produce thousands of gallons of fuel per acre-year as compared to tens of gallons per acre-year for food crops, such as corn and soy.

It is possible to use vegetable oil straight in a diesel engine and it is also possible to convert the vegetable oil to biodiesel. To use vegetable oil directly, engine modifications must be made. For example, vegetable oil



Professor Anthony Marchese

is more viscous than diesel fuel so a fuel heater must be installed in order to reduce the fuel viscosity so it will flow through the injectors properly. One of the ways to use SVO is to have a double-tank system in which one tank has ordinary petro-diesel while the other has the SVO.

Straight vegetable oil is different from biodiesel even though both are



Professor Daniel Olsen

biologically based. The process to convert vegetable oil or animal fat into biodiesel uses ethanol or methanol in a process called alcoholysis (often referred to as transesterification) to separate the fatty acids from the glycerol and make the resulting fuel directly usable in an engine designed to run on number 2 petroleum diesel fuel. Is

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ME Advisory Panel Provides External Assessment for Senior Design Projects

The Mechanical Engineering Advisory Panel (MEAP) was formed in the mid-1980s to provide guidance for the department self-evaluation processes and many other topics that help the department maintain its high-quality programs. The agenda items include the status of the department, enrollment, student success at finding jobs, the undergraduate curriculum content, the budget, and strategies for fundraising.

The members of the MEAP are alumni of our programs as well as nonalumni. They are presidents and vice presidents of major corporations, owners of small- and medium-sized



Mechanical Engineering Advisory Board, April 17, 2009, back row, left to right: Richard Buck, Frank Novachek, Durl Jones, Mel Crane, Terry Precht, Jon Pointer, Ernst Ridinger, Patrick Fitzhorn (CSU), John Williams (CSU). Front row, left to right: Rich Schoonover, Jim Dietvorst, Walter Wong, Jeff Gessaman, Sandy Hoefs, Allan Kirkpatrick (CSU), Fred Smith (CSU), Azer Yalin (CSU), Katherine Obermeyer.

engineering firms, business leaders, consultants, and employees of local engineering firms. Because of their unique qualifications, they provide invaluable advice for the improvement of our programs. One program they have strongly supported is the ME Senior Design Practicum. This is our capstone senior design course that satisfies the requirements of the Accrediting Board for Engineering and Technology (ABET) for the B.S.M.E. degree. The MEAP plays a centrally important role in assuring the quality of the ME Practicum by bringing the current world of

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Melvin R. Black Passes Away



Mr. Melvin R. Black

We sincerely regret to inform you that an ME alumnus, Mr. Melvin R. Black, '56, passed away of cancer on Jan. 15, 2009, in Atlanta, Ga. Mel Black was an active supporter of the Mechanical Engineering Department and its students. We will miss his advice and friendship.

Mr. Black (B.S.M.E. 1956), of Fraser, Colo., is survived by his beloved wife of 54 years, Mary Lou Black, of Fraser; his daughter, Sandra Black, of Chicago; his son, David Black of Atlanta, Ga; and a sister,

Donna Jean Cornelius, of Dayton, Tenn.

He was an executive at General Electric his entire career before retiring to Fraser. He taught his two grandsons, Roger and Riley Black of Atlanta, to ski, and worked with disabled skiers for years.

He was a faithful member of the Church of the Eternal Hills in Tabernash and an active community volunteer.

Memorial gifts should be directed to the Mel and Mary Lou Black Scholarship Fund, College of Engineering, Colorado State University, Campus Delivery 1301, Fort Collins, CO 80523-1301.

From the Department Head



Dr. Allan T. Kirkpatrick

Welcome to the Spring 2009 issue of *The Mechanical Engineer*. We have been publishing this alumni newsletter for eleven years, since the Spring of 1998. It has been a great way to update alumni and friends. As I meet alumni around the state and nation, they continue to mention how the newsletter keeps them current on the activities and events in the Mechanical Engineering Department.

Our new faculty continue to do excellent work. Professor Qian recently received an NSF Career award from the National Science Foundation, and Professor Manivannan recently received a CSU Monfort Professorship, as discussed in more detail in the newsletter. Please note that Professor Byron Winn's *History of the CSU Mechanical Engineering Department from 1870 to 2004* is now available, with more information also given in the newsletter.

On the student side, the senior design Practicum students have been working hard on their senior design projects all year, with the goal of having operational devices by Engineering Days on April 17. Fifteen of the sixteen project groups met this goal, and the feedback from the Mechanical Engineering Advisory Panel evaluators was most positive.

In spite of the economic problems we all are facing, we are pleased to report that your support of our students and our programs remains strong. The Senior Design Practicum is entirely dependent on alumni and friends for support, and we are grateful for your support of this important program.

Allan Kirkpatrick



MEAP Members providing assessment to ME Senior Design Projects, E-Days 2008
Walter Wong (left picture); Mel Crane (center picture); Tom Mancini (right picture)

Calendar of Events

Student Competitions:

- 4/1-7 SAE Aero Design East
Marietta, Ga.
- 5/1-3 ASME Human Powered Vehicle
Portland, Ore.
- 5/4-6 Formula SAE Hybrid
Louden, N.H.
- 6/17-20 Formula SAE Race Car Competition
Fontana, Calif.

ME/College of Engineering/University Events:

- 4/16-17 E-Days and ME Senior Design Practicum
Project Demos
- 4/17 MEAP Board Meeting
Lory Student Center 214-216
- 5/15 Undergraduate Commencement
Moby

Department of Mechanical Engineering
1374 Campus Delivery • Fort Collins, CO 80523-1374
(970) 491-6558; E-mail: mech@engr.colostate.edu

ME Students Place Third in Robot Competition

A team of mechanical engineering students placed third with their robot design in the American Society of Mechanical Engineers (ASME) Student Design Competition held in Boston in October 2008.

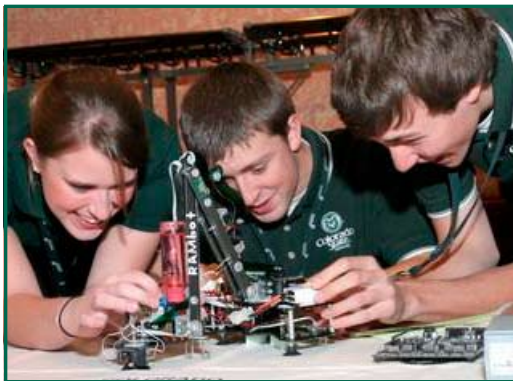
The team was comprised of senior Ross Bulkley, junior Hannah Hudson, and sophomores Matt Stallard and Jim Bettinghouse. The CSU team funded most of their own expenses for the competition, including the robot they built.

The competition required each team to design a robot to assist those who use wheel chairs or have mobility problems. The teams were challenged to build and demonstrate a robot that would wash a residential double-hung sash window without human intervention beyond placing the robot on the lowest window pane.

The Colorado State University team placed third behind Michigan State University and Hong Kong Polytechnic University.



Ross Bulkley, Hannah Hudson, Matt Stallard, and Jim Bettinghouse



ME students calibrating WinRobo Robot

Class Notes will be featured in a future issue of
The Mechanical Engineer
Share Your News!

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Biodiesel and Natural Gas

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biodiesel cleaner than petro-diesel as is commonly claimed? Biodiesel produces significantly lower amounts of particulates in exhaust emissions. However, there is no improvement in oxides of nitrogen (NO_x), a primary contributor to photochemical smog. In fact, there may be an increase of up to around 10 percent in NO_x. Most current diesel engines will run without modification on what is called B20, a mixture of 20 percent biodiesel with 80 percent petro-diesel, but it turns out that higher concentrations of biodiesel in the fuel is likely to produce problems of poor compatibility with some materials currently used in diesel engines.

Can natural gas be used as an engine fuel? In fact, it has been used for many years for the engines that pump natural gas through long-distance gas pipelines used around the world. Large stationary natural

gas engines run on the gas in the pipelines to pressurize and pump the gas at around 1,000 psi through these pipelines. Researchers at the EECL have been conducting research for nearly 15 years on these large engines to improve the efficiency of the engines and to reduce their emissions. Actually, natural gas has no particular advantage in terms of NO_x and CO emissions, but it produces lower concentrations of particulates than do diesel engines and emits lower amounts of Volatile Organic Compounds (called VOCs) compared to diesel engines.

Olsen continues his stationary and industrial natural gas engine research aimed at improving efficiency and lower emissions. Some of his recent work is considering small natural gas engines for distributed electrical power needs and he is starting some new projects on SVO.

ME Advisory Panel

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engineering practice to appropriate levels of emphasis in the Practicum.

This happens in part during the spring meeting of the MEAP, which coincides with our annual Engineering Days event (E-Days) normally held in April.

During their spring meeting, the members of MEAP are assigned E-Days projects they must visit and evaluate. Following are some of the comments and insights provided by members of the MEAP.

- Students are doing a better job this year of discussing their projects with us.
- Establishing and managing a schedule is the hardest thing to communicate to students.
- Most teams demonstrated a strong sense of ownership in their projects. This is very good and a big improvement over past years.
- There is strong evidence of resourcefulness on the part of many of the student teams.
- Gantt charts were used and were emphasized with the student teams.

- CSU ME is doing great with hands-on, get-it-built projects.
- It was suggested we talk early in the Practicum year about anticipating delays and problems. The absolute deadline of April 18 (E-Days) comes up much faster than students think.

Brett Anderson, a long time member of the MEAP says, "The Senior Design Practicum at CSU is an exceptionally well-thought-out and well-run course. It allows the students a chance to get some hands-on experience with what it will be like in the real world. They have to deal with time constraints, budgets, supplier issues, and all the other challenges that occur in industry. CSU has been a leader in incorporating this type of course in the curriculum and by involving the MEAP members along with student and faculty input, the course continues to improve and is one of the best in the country."

The department is grateful for the hardworking MEAP members who provide this invaluable assessment of the program. For a current listing of MEAP members, please visit the ME webpage at <http://www.engr.colostate.edu/me/pages/meap.html>.

ME Faculty Receive Prestigious Recognition

Two of our faculty members have received prestigious awards in the past few months. Professor Xianghong Qian received a CAREER award from the National Science Foundation and Professor Mani Manivannan was appointed to a Monfort Professorship by Colorado State University.



Professor Xianghong Qian

Qian's NSF Faculty Early Career Development award, identified as a CAREER award, offers one of the National Science Foundation's most prestigious awards in support of junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education, and the integration of education and research.

Her five-year award focuses on the development of an integrated research and education program in biofuels, which will aid in the commercialization of biofuels as an alternative to fossil fuels. Development of biofuels, such as liquid alkanes from biomass as a replacement for fossil fuels, will have tremendous societal impacts: biofuels are renewable and sustainable energy sources whereas fossil fuels are not; and use of biofuels can help minimize emissions of greenhouse gases to the environment thus limiting global warming. The research focuses on understanding the fundamental processes governing the conversion and selectivity of glucose to 5-Hydroxymethylfurfural (HMF) and improving HMF yield. The conversion yields from biomass carbohydrates remain critical issues, particularly from glucose, the most

abundant monomer sugar from biomass. Currently the HMF yield from glucose is very limited and extremely sensitive to the processing conditions, particularly the solvent. Understanding the effects of solvent on the mechanism(s) and energetics for glucose to HMF conversion will provide significant insights into developing the cost-effective conversion processes and improving HMF yields.



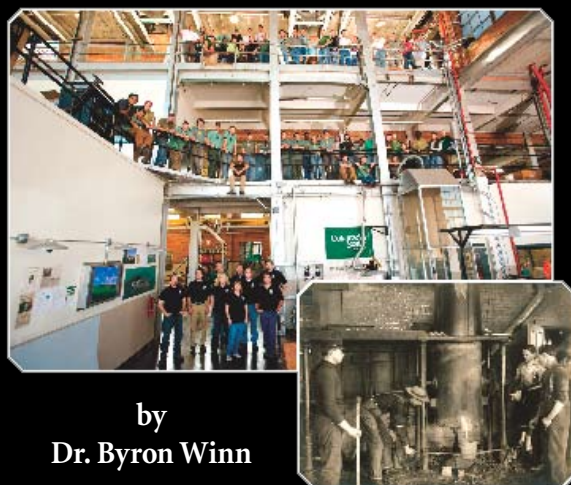
Professor Mani Manivannan

Manivannan received a prestigious Monfort Professor Award, an award established through a gift from the Monfort Family Foundation to help the University recruit and retain top-quality faculty. Two such awards were given as a result of a nomination process that included input from all eight colleges of the University. The Monfort Professors program allows the University to establish a special funding program to support innovative research and teaching. Selected through competitive process, the professor positions receive additional support for teaching.

Manivannan has a strong research passion for interdisciplinary renewable energy materials research where he continues to make significant contribution to developing research areas and transitioning the research to benefit and meet societal needs. He enthusiastically contributes to education and outreach activities by mentoring undergraduate and graduate students and building international partnerships to strengthen Colorado State University's mission and goals.

A History of the Mechanical Engineering Department

At Colorado State University: 1870 to 2004



by
Dr. Byron Winn

Colorado
State
University

Dr. Byron Winn Publishes Mechanical Engineering History Book

Dr. Byron C. Winn, professor emeritus of mechanical engineering, has authored and published the book, *A History of the Mechanical Engineering Department at Colorado State University: 1870 to 2004*. The 258-page, hardcover book has numerous photographs and anecdotes about former students and faculty members.

The cost of publishing the book was donated by Dr. Winn and the proceeds will support the senior design practicum and scholarships.

The book is available through the ME Department with a \$100 or greater contribution to the Senior Design Practicum. Please make checks payable to Colorado State University and send to Carol Sarantos, Mechanical Engineering Department, Campus Delivery 1374, Colorado State University, Fort Collins, CO 80523-1374.

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