

Engines Lab Research on Algae-Based Biodiesel Fuel

It is always something new and interesting with Bryan Willson and his colleagues at the Department of Mechanical Engineering's Engines and Energy Conversion Laboratory (EECL). Willson, the lab director, is performing research on growing algae and converting it to biodiesel fuel. In previous editions of the ME newsletter, we provided stories about the EECL work to provide bolt-on conversions for two-stroke engines in motortrikes used in the Philippines and elsewhere. Those devices greatly reduce two-stroke engine emissions. Now, we have the opportunity to discuss a research area that is likely to produce biodiesel fuel in an energy-efficient way, perhaps as efficient as mining fossil fuels, but

instead will soak up carbon dioxide and use energy from the sun.

The EECL now is engaged in a multidisciplinary research venture that involves Solix Biofuels, a Fort Collins company that owns much of the technology being developed. Last June, the EECL started with a 50-milliliter algal culture from a species of algae found in the North Sea that, under the proper circumstances, can produce high amounts of lipids in their bodies. The EECL has now countless trillions of algae cells. They are growing them in long rows of flexible transparent tubes arranged to allow for continuous mixing of the algae to encourage efficient photosynthesis of carbon dioxide and energy from the sun. The algae are being grown in the photosynthesis

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Bryan Willson inspects algae cribs.



EECL researchers introduce first algae colony to Solix bioreactor.

Mechanical Engineering Class of '56 Enjoys Reunion

In October 2006, College of Engineering alumni visited campus during homecoming/family week. In conjunction with CSU activities, the College held its annual 50+ Year Homecoming Reunion Dinner on October 7. About 20 alumni, who graduated 50 or more years ago, enjoyed an evening of conversation and sharing memories with classmates. Participants also were treated to a presentation highlighting campus life at CSU in the 1930s, '40s, and '50s.

Mechanical Engineering alumni were well represented by Bob Walker, Ralph Marker, Orval Jones, Don



Left to Right Back Row: William Ashcroft, Robert Walker (ME), Joy Holdeman, Gilbert Johnson, Paul Brown, Orval Jones (ME), and William King. **Front Row:** Leland Gilbert, Ronald Hughes, and Ralph Marker (ME). **Not Pictured:** Mel Black (ME) and Don Bueche (ME).

Bueche, and Mel Black from the class of 1956. Pictured here are the College of Engineering graduating class taken in 1956. There are just three MEs in the picture as indicated in the photo caption.

Orval Jones worked for many years at Sandia National Labs. Bob Walker founded and operated an aerospace company and now owns the Flagg Ranch near Yellowstone National Park. Ralph Marker spent 30 years with NASA, the Air Force Academy, and the Department of the Interior and just completed 20 years with Dynamic Solutions

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Mr. Robert Anderson Passes Away



Mr. Robert Anderson (B.S.M.E. 1943), who achieved noteworthy career successes and significantly impacted the educational experiences of past, current, and future CSU engineering students, passed away on October 28, 2006.

Mr. Anderson was born in Nebraska on November 2, 1920, and after earning his bachelor's degree in mechanical engineering at CSU, he served as a captain in the Army field artillery until 1946.

In 1946, Mr. Anderson began working with Chrysler Corporation as a graduate student in the Chrysler Institute of Engineering; he earned a master's degree in automotive engineering two years later. He held several engineering positions with Chrysler before joining Rockwell International Corporation in 1968 as a corporate vice president and president of the company's Commercial Products Group. He was named a corporate executive vice president in 1969, and elected president and chief operating officer in 1970. He served as Rockwell's chairman and chief executive officer before retiring in 1988 and was then appointed as chairman emeritus.

Mr. Anderson has also served in leadership positions for numerous

national and international organizations. For example, in 1983, President Ronald Reagan named Mr. Anderson to the Presidential Commission on Industrial Competitiveness, which was a panel of 21 labor and academic leaders who were charged with improving the nation's ability to compete in the world marketplace. In 1966, Colorado State University conferred on Mr. Anderson an honorary Doctor of Laws degree and named him the Honor Alumnus for the College of Engineering. In 1985, he received CSU's William E. Morgan Achievement Award.

As a financial supporter of the Department of Mechanical Engineering and the College of Engineering, Mr. Anderson played an instrumental role in establishing the College of Engineering's Rockwell/Anderson Assistant Professorship and the Anderson Computer Lab.

Mr. Anderson is survived by his wife, Diane, and two children, Dr. Robert Anderson Jr., of Blaine, Washington, and Kathleen "Kit" Thomas of Vancouver, British Columbia; two stepchildren, Keri Anderson of Brentwood and Erin Anderson of Tarzana; and four grandchildren.



Students interact with Career and Internship Fair Company Representatives (see story on page 3).

From the Department Head



Dr. Allan T. Kirkpatrick

Welcome to the Spring 2007 edition of the CSU Mechanical Engineering newsletter. The purpose of the newsletter is to keep you informed about new and noteworthy activities going on in the Department. Last fall, we introduced four new professors – in a few short months, they have made excellent progress. Their proposals have been funded in a very competitive environment, and their new laboratories are being set up – allowing our undergraduates and graduate students to start working on important problems. We are actively searching for additional faculty members this academic year.

In this edition of the newsletter, we introduce a new Engines lab research area – biofuels from algae. As the lead article indicates, under the proper conditions, algae can produce lipids, which can be processed to produce biofuels. We also note the 50-year homecoming reunion of the class of 1956 – with five ME graduates in attendance.

We are sorry to note the passing of Mr. Robert Anderson, class of 1943. As the article indicates, Mr. Anderson was a national engineering leader who made many significant contributions to engineering and was a strong supporter of the Department of Mechanical Engineering.

Please note that Engineering Days at CSU is on Friday, April 13, this year. If you are in the Fort Collins area, please stop by and enjoy the student displays. We hope that 2007 is going well for you, and by the time you receive this newsletter, the snow will be gone!

Allan Kirkpatrick

Dr. Allan T. Kirkpatrick



Calendar of Events



Student Competitions:

- 3/23-25 SAE Aero Design West
Van Nuys, Calif.
- 4/13-15 ASME Human Powered Vehicle
Sunnyvale, Calif.
- 5/1-3 SAE Formula Hybrid Competition
Louden, N.H.
- 5/16-20 Formula SAE Race Car Competition
Romeo, Mich.
- 7/1-10 World Open RoboCup Rescue Robot League
Atlanta, Ga.

ME/College of Engineering/University Events:

- 4/13 E-Days and ME Senior Design Practicum
Project Demos
- 4/13 MEAP Board Meeting, Rooms 214-216 LSC
- 4/14 Alumni Green and Gold Gala
Wings Over the Rockies Air and Space Museum,
Denver
- 4/27 ME Prof. Harry Edwards Retirement Reception
LSC University Club and Cherokee Park
Room
- 5/11 Undergraduate Commencement, Moby

Algae-Based Biodiesel Fuel

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mode, but some are able to grow in the dark as well – called the heterotrophic mode. In that case, the algae get their energy from sugars or other dissolved organic matter in their growth environment. Clearly, solar energy is a better way to go – after all, it is free as compared to sugars. However, this introduces the possibility of using the algae to remove organics from wastewater.

In order to get at the lipids, the algae have to be “stressed” at just the right time and for the right amount of time. Stress them too much and their growth rate is significantly reduced. The process of stressing them makes them produce lipids inside their bodies, and at this point, the harvesting process can begin. One common technique for stressing algae is to deplete certain nutrients from the growth media.

The lipids are similar to vegetable oils and cholesterol in our blood streams. The stuff is made up of long carbon-chain molecules that are highly cross-linked with glycerin elements. It is gooey stuff. The algae cells have to be burst open, and then solvents, such as hexane, can

be used to dissolve the lipids. Then, further refining is necessary to finally produce diesel fuel.

So, how much fuel can be expected? An average of about 30 percent of the produced mass can be made into fuel, but what about the rest? It turns out to be useful stuff as well. It can be feedstock for making ethanol and methanol, and much of it is protein, which can be made into feed for livestock.

Willson estimates that algae can produce about 7,000 gallons of biodiesel each year per acre. That compares very favorably with biodiesel production from canola of about 100 gallons per year per acre or from palm of about 600 gallons per year per acre.

The research team includes Solix engineers and scientists, ME students (graduate and undergraduate), and students and faculty from other departments. They plan to produce the first gallon of diesel fuel sometime in the summer of 2007. They are not planning a big diesel station at the EECL just yet, but there may be a few of them around not too far into the future.

ME Displays at the 2007 National Western Stock Show

The ME Department sponsored exhibits at the recent National Western Stock Show, held in Denver, Colorado, on January 14 and 15, 2007, continuing the College of Engineering tradition of showcasing the educational and research opportunities at CSU. Pictured below and to the right are some of the ME Department displays.



Professor Susan James represents the ME Biomedical Program.



ME student Caitlyn Brooks and the Cookstove Project.



Heather Menzer, ME student, and the Good Samaritan Robot.

Class of '56 Reunion (continued from page 1)

International. Mel Black spent his career with General Electric in the power generation equipment sector working in engineering, sales, and management activities related to steam turbines, gas turbines, nuclear steam supply systems, and turnkey power plant projects.

Following are some photos taken at the Reunion.



Ralph Marker



Mel Black and Robert Walker



Mel Black and Orval Jones

2007 COE Career Fair

The ME Department joined the College of Engineering (COE) for the COE Fifth Annual Career and Internship Fair on February 20, 2007, at CSU. More than 100 companies and agencies from across the United States, recruiting engineering majors for full-time positions and summer internships, participated in the event, which included 57 companies seeking ME and Biomedical Engineering students. A total of 720 students attended the event (198 were MEs) and met with potential employers to gain insight into company culture and ask questions they may not feel free to ask during formal interviews.

This year's event was tremendously successful – attendance by both employers and students more than doubled since last year's fair. If your company is interested in attending the 2008 COE Career and Internship Fair, please contact John Haines, Engineering Career Liaison, at (970) 491-6220 or e-mail: john.haines@colostate.edu.

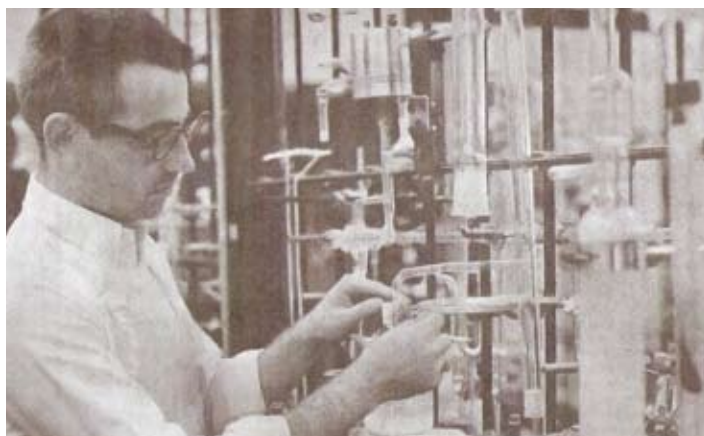
Harry Edwards Retires



Dr. Harry Edwards, 2007.

Dr. Harry Edwards joined the CSU ME Department in 1966 as an assistant professor of mechanical engineering, coming from the University of Arizona, where he was finishing his Ph.D. work in physical chemistry. Edwards immediately was active in research and publishing upon his arrival and became engaged in research on the amounts and effects of silver in the atmosphere. In those early years, he collaborated with faculty members in ME and in other departments on problems associated with the physics and chemistry of cloud processes leading to precipitation.

In 1970, he became the principal investigator (PI) of a large multi-disciplinary project funded by the



Dr. Edwards studies surface properties of silver iodide for cloud seeding – University of Arizona Laboratory, November 1965.

National Science Foundation and known as the lead project researching environmental contamination by lead. This project provided much of the definitive research done in the United States dealing with lead in the environment resulting from automobiles burning leaded gasoline. Lead, also present in paint and other sources, became known to have

serious deleterious effects on human health and later was largely removed from the products and materials.

Edwards later became the PI of the Waste Minimization Assessment Center (WMAC), a project funded by the Environmental Protection Agency (EPA) that dealt with reducing waste in manufacturing processes. In this context, waste includes solid, liquid, or gaseous waste streams as well as wasted energy. With the assistance of student teams, hundreds of visits to companies and agencies were made to conduct waste minimization audits and provide recommendations to improve manufacturing and other processes to minimize waste production. Their work was well received, and most of their recommendations were implemented.

As time went on, the center took on a broader set of objectives, and it became the Industrial Assessment Center (IAC) funded by the Department of Energy. The IAC continued audits of plant sites to minimize waste but also to maximize productivity. Both the WMAC and IAC provided many opportunities for our undergraduate students to work in an important subject area, gain practical experience in an industry setting, and do real hands-on engineering work. Many students

found an excellent start to their careers because of their experiences in this activity.

Edwards' work has been recognized by numerous awards including U.S. Department of Energy, Industrial Assessment Center Service Award (two times); City of Fort Collins Award for Eight Years of Service on City of Fort Collins Air



Dr. Edwards receives his 40-year service award from CSU President Larry E. Penley.

Quality Advisory Board; Colorado Governor's Colorado Pollution Prevention Award; Engineering Deans Council Award, Colorado State University; and numerous others.

Edwards has always been among the top teachers in our department, known for excellent lectures, tough examinations, high standards, and a dry wit. He taught classes at all levels ranging from the freshman level to the advanced graduate level. ME subjects included thermodynamics, air pollution control, pollution prevention, and engineering design. He also taught thermodynamics, chemistry of the atmosphere, and air pollution measurement in the Department of Atmospheric Science and quantitative chemical analyses in the Department of Chemistry as well as pollution prevention at the University of Denver, an evening course, for a period of 10 years starting in 1991.

Of his students and career at CSU, Edwards says, "Of all my duties at CSU, those that gave me the most satisfaction involved working with students in the classroom and in the research laboratory. I shall always be grateful for the opportunities that CSU gave me to work with such bright, energetic, and dedicated students. Additionally, I am grateful for the opportunities that various sponsored projects provided to work

with some of the most creative and productive faculty members at CSU."

Edwards also volunteers for service in the community. From 1994 to 2001, Harry served on the City of Fort Collins Air Quality Advisory Board. This board provides recommendations to City

Council on issues that affect air quality in the community. Since 2002, Harry has served on the City of Fort Collins Citizen Review Board (CRB); he was elected chairperson in 2006. The CRB reviews internal investigations arising from complaints involving police officers.

Edwards, an avid pistol shooter, participates in various local and regional target-shooting matches. His awards include first place in the Colorado hunters' pistol class A state championship in 1994, first place in the Colorado small-bore hunters' pistol class A state championship in 1995, and first place in the Columbine Pistol Club indoor match in 1998. He reloads center-fire ammunition and recently assembled a new small-bore target pistol fitted with a lightweight high-tech barrel, a match trigger, and an electronic holographic sight.

Harry and his wife, Marilyn, are planning their retirement and the opportunities that it brings to travel and enjoy living in Colorado including playing tennis at high altitudes, which they have enjoyed on courts in Breckenridge, Silverthorne, and Durango.

The Department is planning a retirement party for Edwards on April 27, 2007, from 3 to 5 p.m. in the Lory Student Center University Club. Please attend if you can and catch up on old times with Harry.

Class Notes will be featured in a future issue of
The Mechanical Engineer.

Share Your News!

We enjoy hearing from our alumni. Please help us celebrate your personal and professional accomplishments. Send your update to:

E-mail: SupportEngineering@colostate.edu

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