MEMBERS VISIT RENEWABLE ENERGY RESEARCH SITE

CCEFP research members took a tour of the University of Minnesota's West Central Research and Outreach Center's (WCROC) renewable energy facilities located on the UM-Morris campus. Featured on the tour were the combined heat and power biomass gasification systems, biomass combustion system, anaerobic methane digestor, renewable hydrogen and anhydrous ammonia systems, as well as the WCROC's 1.65-MW wind turbine.

The WCROC is part of the University of Minnesota College of Food, Agricultural, and Natural Resource Sciences and celebrated its 100-year anniversary in 2010. In 2004, the University of Minnesota commissioned the Renewable Energy Research and Demonstration Center (RERDC) at the WCROC. The RERDC hosts a variety of renewable energy projects with the dual purpose of generating greater knowledge about renewable energy production and educating the public about energy alternatives to fossil fuel sources.

CCEFP WELCOMES VISITORS FROM IDEMITSU KOSAN

(Top) CCEFP faculty, staff, and students at the West Coast Research and Outreach Center
(Left) Idemitsu Kosan visitors and CCEFP leadership team

Earlier this year, representatives of Idemitsu Kosan visited the University of Minnesota campus to meet the CCEFP leadership team. Attending the visit on behalf of Idemitsu were Toshiyuki Tsubouchi (Advanced Research Laboratories), Jitsuo Shinoda (Lubricants Research Laboratory), Hideo Kamimura and Laura DeNeve (both of Idemitsu Lubricants America). The Idemitsu delegation gave a presentation on the company's history and products. CCEFP leadership provided an overview of the Center and information about the extensive research program. Following lunch at the University Campus Club overlooking the East Bank campus, the visitors were given a tour of the research facilities, met with various faculty members, and ended the day by enjoying dinner at the Origami Restaurant in downtown Minneapolis.

EDUCATION AND OUTREACH NEWS

2012 Fluid Power Scholars and REU Program Wrap Up | BY ALYSSA BURGER, OUTREACH DIRECTOR, UNIVERSITY OF MINNESOTA

(Top) 2012 Fluid Power Scholars
(Bottom) 2012 Research Experiences for Undergraduates

The CCEFP's Education and Outreach Program concluded another summer of exciting activities including the 2012 Fluid Power Scholars Program and the 2012 Research Experiences for Undergraduates (REU) program.

The Fluid Power Scholars (FPS) Program is a collaborative effort between the CCEFP and corporate members of the Center. This program identifies and connects outstanding undergraduate engineering students with the fluid power industry for the purpose of training the next generation of fluid power leaders by offering a three-day fluid power boot camp followed by a summer internship within the company. 2012 is the program's third year. This summer, the Center named nine scholars.

The Center thanks the internship host companies for their support: Case New Holland, Parker Hannifin Corp., Sun Hydraulics, HUSCO International, Caterpillar, John Deere, Deltrol Fluid Products, Eaton Corp., and Sauer-Danfoss.

The Scholars Program has been quite a success: 67% of all scholars found full-time work in the fluid power industry and 50% remain within their host companies.

The Research Experiences for Undergraduates (REU) Program's goal is to provide undergraduate science and engineering students with a summer experience in a university research lab. An objective of the program is to increase the number of top students applying to graduate school in science and engineering areas. The Center hosted 23 REU students to the 2012 program. For the second time, the program kicked off with a fluid power boot camp at Purdue University, lead by CCEFP graduate students, all REU students in attendance. The boot camp provided an opportunity for the Center to fully prepare REUs in fluid power technology for their summer research experience.

* Reprinted from the CCEFP Spring/Summer 2012 newsletter (Issue 18)

RESEARCH NEWS

Multifunctional Fluid Power Components Using Engineered Structures and Materials (Project 2D)

BY DOUGLAS COOK, RESEARCH ENGINEER, MILWAUKEE SCHOOL OF ENGINEERING

Conventional engineered systems involve many components, each serving a single purpose: bearing stress, dissipating heat, attenuating noise, shielding, etc. Integration of multifunctional components into the system can reduce the complexity by reducing the number of parts. If a new component is able to bear mechanical load and serve as a heat sink, then that one component replaces two conventional designs, thereby improving compactness. Component integration also translates into a reduction in the number of energy transfers, hence an increase in system efficiency.

Waste heat is the product of inefficiency, which all power systems have, and as Dr. Kim Stelson (CCEFP director) has previously noted, the average efficiency of today's fluid power systems is 21%. On average, then, more than 75% of the energy into the conventional system is converted to heat! Power systems are sensitive to their operating conditions, so if the system gets too hot or cold, its efficiency drops—20% over 55ºC as measured by Evonik RohMax. Maintaining the optimal operating temperature through thermal management is a crucial aspect of component integration for achieving maximum efficiency. Add-on active cooling (or heating) reduces system compactness and still detracts from the optimal.

Project 2D, "Multifunctional Fluid Power Components Using Engineered Structures and Materials," has collaborated with Test Bed 6 on the development of the portable, active, ankle-foot orthosis. As with all test beds in the Center, the human-assistive orthosis will use fluid power as the driving force. One of the unique design constraints, however, is that the device will be in direct contact with a person. Not only must this system be structurally optimized for minimal weight, it must also employ efficient thermal management that maintains an optimal operating temperature while limiting contact surface temperatures for personal safety (< 41ºC as mandated by the FDA)—making it safe to wear and touch throughout the intended one-hour operating period. To this end, Project 2D has designed and fabricated an integrative, lightweight, multifunctional structure that will enclose the power, i.e. heat, source to protect the wearer and employ passive cooling to maintain an optimal operating temperature without detracting from the system efficiency.

To achieve this, Project 2D is leveraging its past work that defined lattices as lightweight structural materials for components. In Year 5 of the Center, the thermal characteristics of these lattices were derived and tested, where it was found that the surface temperature of the engineered structure was 252% lower than an equal-mass finned heat sink of the same material, at 23 watts! Fluid power components can now be designed with desired load-bearing and thermal-management properties.

To further improve system efficiency and effectiveness, Project 2D has investigated the practicality of thermal energy storage, recovery, and conversion to electrical power. The MEMS pneumatic valve being developed at UMN is one example of a device that could be powered by converted waste heat.

While Project 2D has started at the lower end of the power spectrum, these technologies can be scaled for application to all fluid power systems. Indeed, it has already drawn the interest of a major aerospace manufacturer.

Future research is being proposed to further employ these technologies in the development of a new, compact, high-pressure, high-efficiency pneumatic system that is projected to consume less than five grams (5g) of fuel over one hour of orthosis actuation. The system could also be scaled for applications such as John Deere's Timberjack, Boston Dynamics' Big Dog, and other walking fluid power machines.

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