UTC Spotlight

University Transportation Centers Program

May 2008

U.S. Department of Transportation, Research and Innovative Technology Administration

This monthly report from the University Transportation Centers Program highlights some of the recent accomplishments and products from one of the University Transportation Centers (UTCs) managed by the U.S. Department of Transportation's Research and Innovative Technology Administration.

University Converts Crude Beer into Hydrogen

Missouri University of Science and Technology (Missouri S&T)[1] recently announced a novel and robust process for converting ethanol into hydrogen—*E-H*$_2$ technology. This new process, developed by Missouri S&T's National University Transportation Center, uses bio-based feedstock, specifically crude beer derived from agricultural ethanol, to produce hydrogen for fuel cells and power generation applications as well as transportation fuel. This research supports the transition of our nation's economy from one dependent on fossil fuels to one based on renewable hydrogen.

[1] Formerly the University of Missouri—Rolla.

Technological Advantages

The *E-H*$_2$ process has several distinct advantages over existing technologies:

- It is a compact, energy-efficient process that eliminates the costly and energy intensive steps needed to produce ethanol; instead, it uses crude ethanol beer—without further need of filtration, distillation, or refining.
- It has the potential to improve safety by substantially reducing the need to distribute and transport dangerous flammable chemicals.

Photo courtesy of Missouri S&T

Administrator Brubaker and UTC representatives traveled aboard a hydrogen-powered bus between meetings on the Missouri S&T campus. Left to right: Stephen Costa (Volpe Transportation), Brent Franzel (Cardinal), Angie Rolufs (Missouri S&T), Jan Brecht-Clark (RITA), Paul Brubaker (RITA), John Sheffield (Missouri S&T), Steve Tupper (Missouri S&T), Rex Tennyson (USA Tours).

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- The *E-H_2* process' ability to utilize unrefined crude ethanol beer complements and augments the emergent technology that produces ethanol from lignocellulosic sources such as corn stover, switch grass, and wood chips.

Other Benefits

Ethanol boosts the economic development of agricultural communities, adds value to agricultural products, helps clean America's air, and strengthens national security by moving America toward energy independence. Hydrogen is an excellent energy carrier with a high energy content by mass, burns cleanly, is abundantly available in compound forms, and is also renewable.

By using a bio-based feedstock, more specifically agricultural ethanol and its crude beer, to produce hydrogen, the *E-H_2* process provides a direct link between the ethanol economy and the hydrogen economy. Ethanol to hydrogen, via supercritical water reformation, optimally uses ethanol in water at the same concentrations found in crude ethanol beer and can readily handle all the impurities in crude ethanol beer without the need of extensive filtration.

In Summary

First, this approach allows elimination of the expensive and energy intensive separation of water from ethanol. Second, ethanol does not need to be transported in its highly refined and hence flammable and corrosive state. Third, the water content in crude beer is enough to carry out the subsequent reformation reaction and the associated water can be sterilized *in-situ*, thus reducing the environmental burden via minimization of wastes. Fourth, crude ethanol beer can be used not only for conventional production of oxygenated blends of gasoline and E-85, but also for direct conversion into hydrogen.

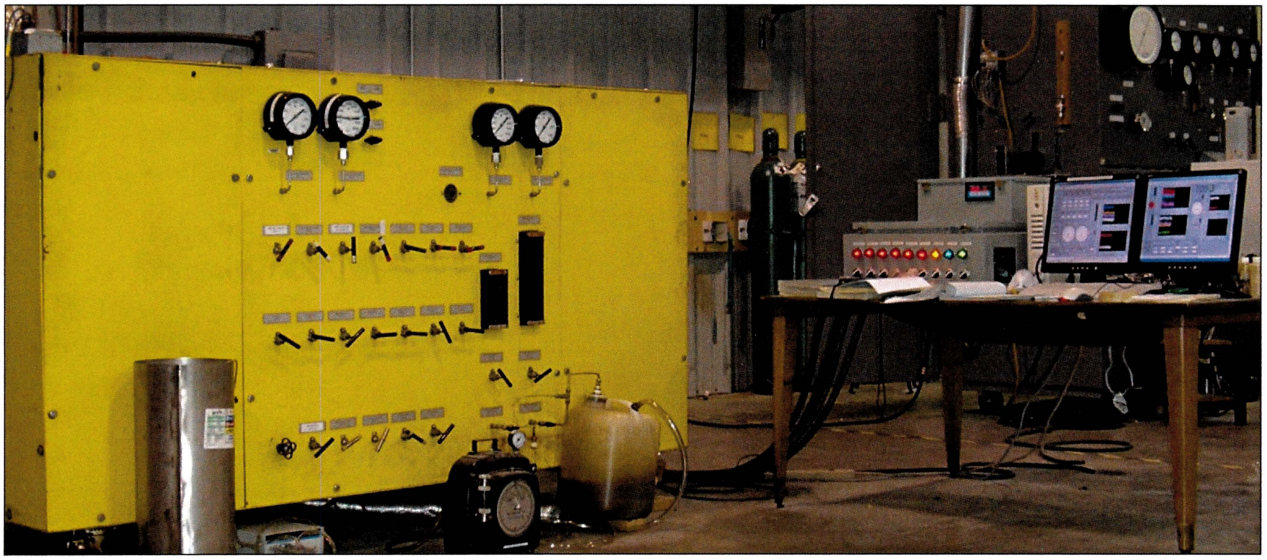

Photo courtesy of Missouri S&T

MST H2 Process System Panoramic View.

About This Project

DOT invests in the future of transportation through its University Transportation Centers Program, which awards grants to universities across the United States to advance the state-of-the-art in transportation research and to develop the next generation of transportation professionals. The DOT grant supporting this research was awarded to the National University Transportation Center at the Missouri Uinversity of Science and Technology (Missouri S&T), where John Myers, Ph.D. (jmyers@mst.edu), is the interim director.

The principal investigator for this project is Sunggyu Lee, Ph.D. (Leesu@mst.edu), of the Department of Chemical and Biological Engineering at Missouri S&T in Rolla, Missouri.

Additional information on this project can be found at:
http://web.mst.edu/~leesu/hydrogen.html

For additional information on the DOT UTC Program, see utc.dot.gov

Photos on banner by: Elvis Santana and Carl Silver