U.S. Department of Energy • Office of Fossil Energy • National Energy Technology Laboratory

netlog

The NETL newsletter

The September 2006 NETL Newsletter

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NETL Collaborates to Solve Humvee Rollover Problem

NETL researchers are part of a team that is studying modifications to Humvees to prevent them from overturning during combat maneuvering. Other members of the research team include the Army Research Laboratory, Picatinny Arsenal, vehicle manufacturers, and a titanium powder producer.

The Humvee–or, in military nomenclature, the High-Mobility Multipurpose Wheeled Vehicle–is a versatile four-wheel drive military vehicle that can be configured to become a troop carrier, armament carrier, shelter carrier, ambulance, missile carrier, or a scout vehicle.

The vehicle's armored turret provides protection for the crew but it makes the Humvee top-heavy.

Paul Turner, of NETL's Process Development Division, directs the group assisting in the solution to the Humvee's rollover problem. The group's focus is on reducing the weight of the turrets by replacing the steel-based armor with a combination of titanium alloy and transparent alumina. This modification would lighten the turret from more than 1,200 pounds to less than 600 pounds and also increase the protection for the top gunner.

NETL scientists have already made a number of prototype titanium plates using a low-cost powder produced by a novel process invented by a group of Argonne National Laboratory (ANL) scientists. The ANL scientists now have a start-up company and are building a pilot plant in a suburb outside of Chicago, Illinois.

Contact: Paul Turner, 541-967-5863

NETL Helps Chart Roadmap for Multiphase Flow Research

NETL researchers are helping to establish a technology roadmap to improve the design, operation, and troubleshooting of multiphase flow devices in fossil fuel processing plants.

Researchers from across the country came to NETL in June to discuss research problems in multiphase flow with particular relevance to energy technologies and to chart a roadmap for solving those problems.

Of the 62 researchers at the workshop, 24 represented universities, 20 were from industry, 14 came from DOE's

national laboratories, three were from NASA, and one represented the National Science Foundation.

Their vision was to ensure that multiphase science-based computer simulations play a significant role in the design, operation, and troubleshooting of multiphase flow devices in fossil fuel processing plants by 2015.

Discussions focused on four technical tracks: dense gas-solids flows and granular flows, dilute gas-solids flows, liquid-solids and gas-liquid flows, and computational physics and applications.

The findings from the workshop have been compiled into a report, which includes summaries from each of the technical tracks, a technology roadmap, and plans for collaborative research.

Contact: Madhava Syamlal, 304-285-4685

Researchers from NETL, Penn State Apply for Sequestration Patent

Researchers from NETL and the Pennsylvania State University have applied for a patent for a multi-step process for sequestering carbon dioxide using magnesium/calcium-based silicate materials and/or metal oxides from industrial waste streams.

In nature, storage of CO_2 via mineral carbonation is achieved by formation of magnesium/calcium/iron carbonates and dissolution of CO_2 in seawater or saline waters to produce bicarbonate. Although slow, these geologic processes are a safe and permanent method for CO_2 containment.

This invention details surface activation techniques to include chemical activation by acids resulting in produced materials with higher specific surface areas leading to greater carbonation efficiency and higher dissolution of Mg/Ca from its matrix.

Contact: Daniel J. Fauth, 412-386-4618

High Nitrogen, High-Carbon Stainless Steels Show Improved Properties

Stainless steel compositions made by NETL researchers have the potential for tensile and yield strengths at least twice those of conventional stainless steels that contain nickel.

NETL's compositions contain iron (60-65 percent); chromium (15-20 percent); manganese (15-20 percent); minor quantities of nickel, silicon, and molybdenum (less than 2 percent total); and additions of nitrogen and carbon as high as 1.25 percent. The compositions were melted and fabricated using conventional commercial melting practices.

Elevated levels of interstitial nitrogen and carbon additions in the NETL-developed stainless steels improve material properties such as strength, wear, and corrosion resistance. Because manganese is substituted for nickel, these alloys offer significant cost savings over most commercial stainless steels.

They are being evaluated for potential use in oil drilling applications such as drill collars and in high-temperature corrosive applications such as gasification.

Contact: Cindy Powell, 541-967-5803

Sensor Invented by NETL Researchers Detects Flashback with Hydrogen-rich Fuel

NETL researchers have used a novel combustion sensor being developed by NETL and Woodward Industrial Controls to measure flashback for hydrogen-rich fuels.

The Combustion Control and Diagnostics Sensor (CCADS) was patented by NETL for use in natural-gas-fired turbines. Additional development is being performed under a Cooperative Research and Development Agreement between Woodward and NETL through the FE Turbine Technology R&D Program.

Recent tests in NETL's Simulation Validation Combustion Rig with fuels containing up to 80 percent hydrogen confirm that CCADS can be used to measure flashback during combustion of high-hydrogen-content fuels.

The tests assessed the sensor's potential for in situ monitoring in turbines fueled by coal-derived syngas or hydrogen fuels for FutureGen. The results are important because high-hydrogen-content fuels are more prone to flashback, which can damage combustion hardware.

Contact: Jimmy Thornton, 304-285-4427

Sensor to Monitor Combustion Instabilities Receives Patent

A patent has been issued for a sensor that uses flame ionization sensing to monitor combustion instabilities. The sensor was invented under a Cooperative Research and Development Agreement (CRADA) between NETL and Woodward Governor Company.

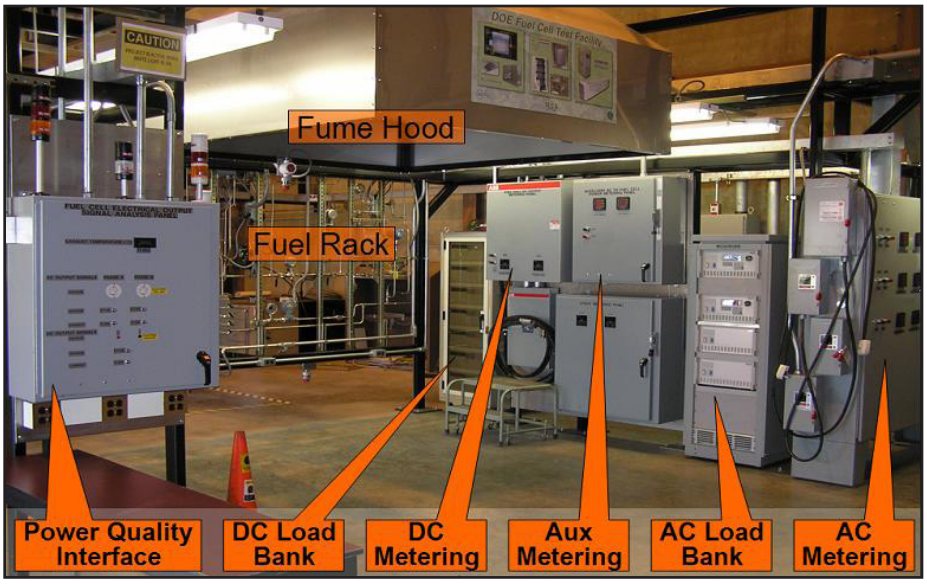
NETL co-inventors on the joint patent with Woodward are Jimmy Thornton, George Richards, and Douglas Straub. This patent is included in a licensing agreement, which granted rights to Woodward for NETL's previously patented Combustion Control and Diagnostics (CCADS) sensor.

In 2002, researchers in NETL's Office of Research and Development were beginning to work with Woodward under a CRADA to develop a prototype of CCADS and test the prototype at a representative turbine condition in NETL's combustion rig.

The resulting data analysis and discussions led to the joint invention.

NETL and Woodward are working under a second CRADA to address CCADS commercial R&D issues and sensor development for monitoring hydrogen combustion. Woodward is marketing CCADS to gas turbine manufacturers for commercial deployment. The deployment of CCADS technology is expected to facilitate improved performance and lower emissions in advanced power systems.

Contact: Jimmy Thornton, 304-285-4427



NETL Researchers Testing Second SECA Phase I Prototype Fuel Cell

Researchers in NETL's Office of Research and Development have begun verification testing of the second Solid State Energy Conversion Alliance (SECA) Phase I solid oxide fuel cell prototype delivered to NETL.

The prototype unit, developed by FuelCell Energy of Danbury, CT, and Versa Power Systems of Golden, CO, was started up on July 26 using pipeline natural gas fuel.

The first solid oxide fuel cell prototype tested in the Department of Energy's (DOE) Fuel Cell Test Facility at NETL was developed by Delphi Corporation.

The purpose of both of these tests is to acquire performance and degradation data that will confirm the results obtained by the two developers.

The DOE Fuel Cell Test Facility (DFC) provides independent verification of the performance and efficiency of SECA prototype fuel cells developed by industry teams. SECA is the flagship solid oxide fuel cell technology development program of DOE's Office of Fossil Energy. Successful development of these solid oxide fuel cells is an important part of DOE's program to make greater use of hydrogen as an energy source.

Most fuel cells use hydrogen or a hydrogen-rich fuel along with oxygen from air to create electricity by an electrochemical process. Hydrogen may be produced from sources such as fossil fuel and even renewable energy sources.

In addition to the Fuel Cell Test Facility, NETL has two other important facilities devoted to development and deployment of fuel cells. The Solid Oxide Fuel Cell Experimental Laboratory (SOFCEL) is a test stand for fundamental solid oxide fuel cell development. And the Hybrid Performance Project (HYPER) Facility is used to study fuel cell control strategies for hybrid systems that combine turbines and fuel cells.

Contact: Randall Gemmen, 304-285-4536

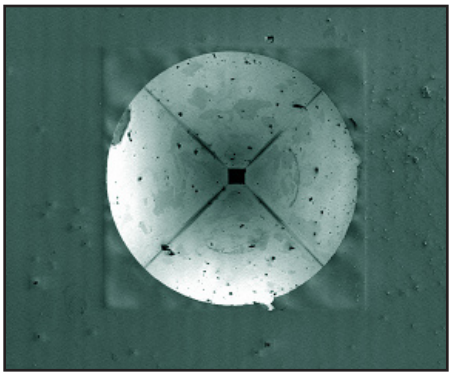
Researchers Determine Sulfur Transfer Mechanisms in Oxy-Fuel-Fired Combustion Systems

Results of a study by NETL scientists in the Office of Research and Development are being used to develop an integrated pollutant removal system for cleaning oxy-fuel combustion gas and capturing CO_2 for sequestration.

The researchers have completed initial tests to identify important parameters in the response of oxy-fuel combustion gas to SO_2 removal techniques. An experimental section that synthesizes hot flue gas and bubbles it through a buffered aqueous solution was used to evaluate the effects of process temperature, SO_2 and CO_2 content, and reagent identity on sulfur transfer to the solution. As air is replaced by flue-gas in oxy-fuel firing, nitrogen levels decline and CO_2 levels increase, creating a dramatically different off-gas from which sulfur must be removed.

On completion of tests in the experimental matrix, the sulfur transfer results showed that the quantity of SO_2 in the flue gas outweighs all other factors in determining efficiency of sulfur absorption into the solution. Higher levels of CO_2 in synthetic oxy-fuel combustion gas decreased SO_2 absorption.

Contact: Paul Turner, 541-967-5863



NETL/WVU Discover Method for Improving Piezoelectric Response in High-Temperature Material

Researchers at West Virginia University and NETL's Office of Research and Development have discovered a method to improve the piezoelectric response of aluminum nitride, which can be used to develop high-temperature sensors and actuators for advanced power systems. The piezoelectric response is the generation of mechanical strain in materials subjected to an applied voltage.

Researchers expect to use aluminum nitride for developing high-temperature actuators that can provide distributed in-situ flow control to optimize performance in advanced power technologies such as hydrogen-fired turbines and solid oxide fuel cells. This is analogous to using direct fuel injection rather than carburetors on automobile engines for improved performance. The research was accomplished through a new university research initiative funded by NETL's Advanced Research Program.

Contact: Peter Hensel, 304-285-4073

Load-Based Speed Control Tested on HYPER Facility

The capability of NETL's Hybrid Performance Project (HYPER) has been expanded to enable independent speed control of the turbine in response to changes in the applied electric load.

Tests of the new load control unit show that the gas turbine generator can manage up to four times more thermal energy than without load control. This improvement is important for transient plant operation.

NETL researchers use the HYPER facility to obtain performance data on highly efficient fuel cell gas turbine hybrid systems, and this new capability allows for more realistic dynamic testing of hybrid cycles that involve fuel cells and gas turbines.

Contact: Larry Lawson, 304-285-4735

Industry to Put NETL-developed Sorbents to Challenging Mercury Capture Test

ADA-ES, Inc., a pollution control and testing company in Littleton, CO, has requested novel sorbents from NETL for slipstream testing at American Electric Power's Conesville Plant in Ohio.

NETL will provide at least six sorbents for bench-scale experiments on mercury capture. The flue gas at Conesville contains high levels of sulfur trioxide, which impedes the capture of mercury by conventional activated carbon sorbents. Sulfur trioxide is present at significant levels within flue gases derived from high-sulfur coals and in plants where it is added as a fly ash conditioning agent.

Contact: Evan J. Granite, 412-386-4607

Mineral Additives Investigated for Well-Plugging Cements

NETL researchers are investigating degradation behavior of well-plugging cements in saline environments at high carbon dioxide injection pressures.

Safe storage of CO2 in depleted oilfields and/or saline aquifers is dependent on the integrity of cements used to plug legacy and CO2 injection wells. Evaluation of the post-test cement cores is under way. Additional tests are being done to determine the reproducibility of the initial results and identify the most effective mineral additive.

Contact: Paul Turner, 541-967-5863

PSDF Data Confirm MFIX Predictions

Results predicted months earlier by NETL researchers using the MFIX (Multiphase Flow with Interphase eXchanges) software show good agreement with experimental data being obtained at the Power Systems Development Facility's (PSDF) new gasifier in Wilsonville, AL.

The success of these predictions and other simulation results is being shared with engineers and technology managers at Southern Company and KBR/Halliburton, who are involved in the design of a Clean Coal Power Initiative (CCPI) commercial-scale transport gasifier based on the new PSDF gasifier design.

NETL researchers had presented the MFIX simulation results for the new gasifier design during the June PSDF review meeting.

Contact: Chris Guenther, 304-285-4483

Video Feature

netlog is a quarterly newsletter which highlights recent achievements and ongoing in-house research at NETL. Any comments or suggestions, please contact Paula Turner at paula.turner@netl.doe.gov or call 541-967-5966.