NATIONAL ENERGY TECHNOLOGY LABORATORY

ACCOMPLISHMENTS

Q3 FY20

Photo courtesy of Brad Deel (EnerVest Operating LLC)

U.S. DEPARTMENT OF ENERGY

NETL ACCOMPLISHMENTS

Quarter 3 – Fiscal Year 2020

NETL Assessed Market Opportunities for High-Performance Alloy

An NETL report identified opportunities to leverage high-performance alloy (HPA) research beyond coal-fired power plants. As market demand for HPAs continues to grow, NETL is in a prime position to contribute to improving these materials. Research activities to enhance current HPAs include convening stakeholders to define challenges and opportunities that bridge supply chains and end-use applications, as well as exchange information to accelerate mutually beneficial objectives. The opportunity to expand research into the largest HPA markets (aerospace, industrial gas turbines, chemical processing or automotive) lies in cost reduction, property enhancements and fabrication flexibility of existing alloys.

NETL Researchers Coauthored Invited Article for Anniversary Issue

NETL researchers coauthored an invited article on nickel-based superalloys for the 50th anniversary issue of the prestigious journal Metallurgical and Materials Transactions (MMT) A. The paper, titled "Solving Recent Challenges for Wrought Ni-Base Superalloys," discussed the status of technology, design and manufacture of advanced superalloys required for fossil energy and aerospace applications. Martin Detrois, Paul Jablonski and Jeffery Hawk contributed to the article by reviewing work to understand the suitability of candidate alloys for multiple applications in advanced-ultra supercritical coal-fired power plants, which will burn hotter and more efficiently than current plants to provide more power with fewer emissions.

Potential of Process for Generating REEs Demonstrated

An NETL-supported collaboration showed potential toward developing an environmentally benign and economically sustainable process for generating rare earth element (REE) products from domestic coal ash sources, marking a step forward in enabling a domestic supply of these critical materials. As part of an NETL-funded cooperative agreement, Battelle Memorial Institute (BMI) and Rare Earth Salts (RES) advanced the development and validation of BMI's acid digestion process, along with RES's novel electrowinning separation and purification process. A subsequent techno-economic assessment indicated that the economics of the process show promise and the technologies investigated demonstrated merit for further investigation and improvement.

NETL Employees Selected for Pittsburgh Federal Executive Board Awards

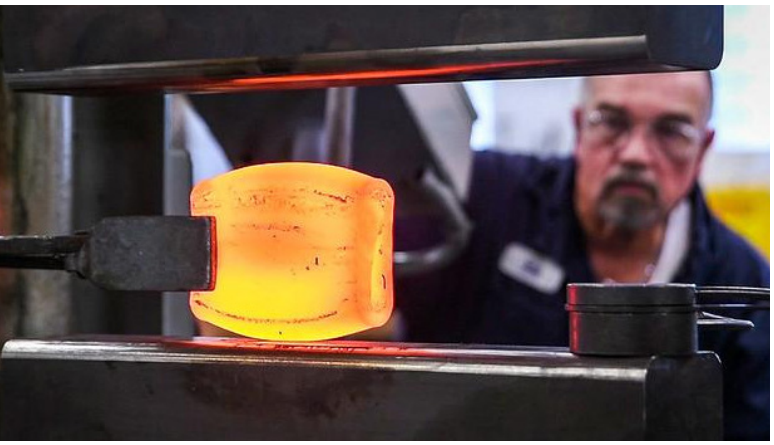
Two NETL employees were selected as 2020 Pittsburgh Federal Executive Board (FEB) Excellence in Government Gold Award winners for their contributions to both the Lab and the community in 2019. Tim Florian, Equal Employment Opportunity manager, reshaped NETL's Diversity & Inclusion program to make training and program offerings more available, thought-provoking and relevant. Larry Kincell, a general engineer in the Lab's R&D Engineering and Facility Operations, volunteered his time to the Marion County Fringe Little League Challengers program in Fairmont, West Virginia, to bring the joy of baseball to children and young adults with disabilities.

New CO_2-SCREEN Software Highlighted Potential of Residual Oil Zones

A new iteration of NETL's CO_2-SCREEN software application is enabling researchers to more accurately estimate carbon dioxide (CO_2) storage potential in previously overlooked locations, opening the door for carbon capture utilization and storage (CCUS) projects on a large scale, along with new enhanced oil recovery operations. Originally developed to estimate prospective CO_2 storage potential in saline and shale formations, the latest version of the Lab's CO_2-SCREEN (Storage prospeCtive Resource Estimation Excel aNalysis) tool can be used for estimations in residual oil zones (ROZs), which can serve as valuable sites for CCUS projects. The U.S. Department of Energy estimates ROZs could contain 100 billion barrels of recoverable oil, representing a substantial yet underutilized source of domestic energy.

NETL Discovered New Ways to Transform Fossil Fuels into Chemicals

Partnering with leading university researchers and industry, NETL advanced the use of fossil fuels in an environmentally responsible manner to generate hydrogen and other forms of chemical energy that will be stored for long durations and used when needed to produce electricity and valuable products, ensuring affordable, reliable and clean electric power for generations of consumers. Hydrogen production technologies are gaining attention because hydrogen, a zero-emission fuel that produces heat and water, is predicted by many to be the energy carrier of the future. Hydrogen energy storage is an enabling mechanism for a future decarbonized hydrogen economy.



NETL Tapped Machine Learning for Superior Alloys

A groundbreaking NETL study demonstrated that machine learning (ML) and data analytics can be used to design next-generation alloys needed to operate fossil fuel-based power plants with greater efficiency and produce affordable electricity while lowering emissions of greenhouse gas. The study validated the application of ML analysis to enable more rapid and exceptionally accurate design of high entropy alloys (HEAs) — critical materials for ultra-efficient power generation. Components made from HEAs will enable power plants to burn less fuel, operate with greater efficiency and withstand the stresses of frequent power plant startups and shutdowns required for integrating of renewable energy sources into the grid.

NETL Engineer Recognized for Outstanding Achievement

Richard Dennis, whose professional accomplishments at NETL span 35 years, was named a Fellow in the American Society of Mechanical Engineers (ASME), a prestigious honor the society awards to members for significant engineering achievements. Dennis currently manages a research portfolio that focuses on developing revolutionary, near-zero-emission advanced turbines to produce electricity using fossil fuels. He also leads efforts to advance high-efficiency, low-cost power generation based on supercritical carbon dioxide (sCO_2) power cycles and serves in a leadership role in the NETL-supported development of a sCO_2 pilot plant test facility located on the Southwest Research Institute campus in San Antonio, Texas. Engineers who are named ASME Fellows receive a membership grade of distinction in the society.

NETL Partnered in Investigation of Unconventional Reservoirs in Central Appalachia

As part of an NETL-supported field laboratory that is characterizing and assessing the potential economic value of unconventional shale resources in Central Appalachia, Virginia Tech and industry partner EnerVest Operating LLC drilled out the surface casing shoe of a 15,000-foot characterization well to investigate and characterize the resource potential for multi-play production. The emerging stacked unconventional plays (ESUP) project is evaluating the resource potential of multiple stratigraphic units possibly leading to further natural gas development and job growth in the Central Appalachian region, which hosts an abundance of hydrocarbon resources such as coalbed methane, shale and other unconventional resources.

Photo courtesy of Brad Deel (EnerVest Operating LLC)

NETL Assessed Resource Adequacy in Texas

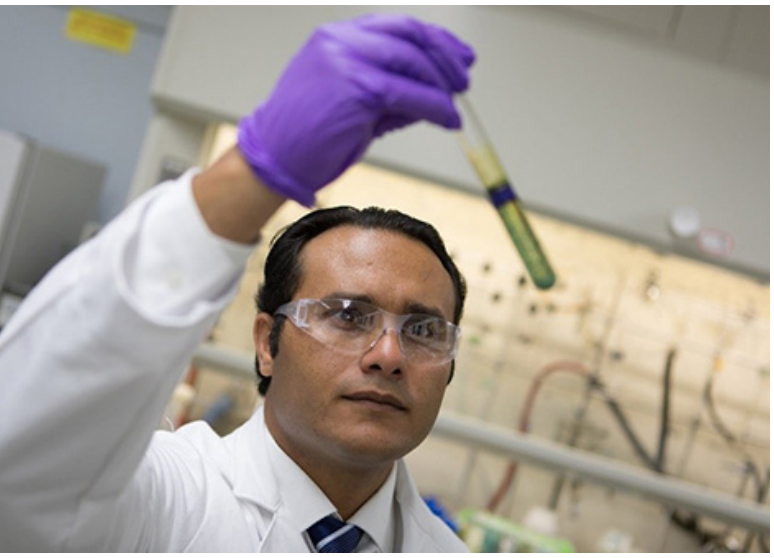
An NETL report showed that grid operators in the Electric Reliability Council of Texas (ERCOT) may be forced to use extraordinary measures to ensure the operation of the Texas power system during the 2020 summer and current Coronavirus pandemic. The study examined four scenarios and assessed the potential for resource adequacy and reliability concerns under those scenarios. According to the findings, three of the four scenarios could result in an increased risk for Energy Emergency Alerts and a need for emergency operator actions to ensure the reliable delivery of electricity to the more than 25 million people served by ERCOT. The report highlights one way DOE monitors and maintains awareness of critical energy economy sectors and the important role of fossil energy in providing energy security.

REE Extraction Project Exceeded Expectations

As part of an NETL-funded cooperative agreement, researchers from the University of Utah and Virginia Tech evaluated a new, low-cost technology to extract and recover an enriched, mixed REE oxide (REO) product from coal-based resources. The project team successfully obtained six different coal waste samples with REE concentrations that exceeded the project's requirement. The subsequent technology evaluation began with selectively separating resources from coal waste, followed by passing bio-oxidized and conditioned solutions over columns of coal (known as heap leaching). The resulting REEs were concentrated and then recovered. The project far exceeded its goal of 2-8% by weight mixed REO product, successfully producing 36.7% mixed REOs equivalent by weight.

NETL Supported Exploration of Nanofiltration for REEs

NETL marked progress toward securing a domestic source of REEs from the nation's abundant coal resources. With support from NETL, the Research Triangle Institute (RTI) tested the efficacy of various approaches to REE recovery and enrichment (with a targeted concentrated goal of 2% by weight mixed REE) from acid mine drainage (AMD) samples using a combination of novel technologies. The RTI team assessed several technologies for REE concentration and recovery, including nanofiltration, in which polymer and ceramic membranes inserted in a tubular structure filter extract the valuable elements from AMD effluent streams.



New Process Developed for CO_2 Separation

NETL researchers made progress in solving one of the most difficult problems associated with developing post-combustion CO_2 capture technology. The team developed a new process to create a chemically bound, dual-layer membrane, or sorbent, that combines the benefits of high permeability and high selectivity — two material qualities that are usually mutually exclusive — to more effectively separate CO_2 from nitrogen found in power plant flue gas. This first-of-its-kind research could offer a path toward commercially viable carbon capture operations that will enable the continued use of affordable, abundant fossil energy while reducing CO_2 emissions.

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