NATIONAL ENERGY TECHNOLOGY LABORATORY

ACCOMPLISHMENTS

Q4 FY20

U.S. DEPARTMENT OF ENERGY

NETL ACCOMPLISHMENTS

Quarter 4 – Fiscal Year 2020

NETL Advanced Research to Unlock Alaska's Vast Resources of Heavy Oil

NETL and its partners working on Alaska's North Slope surpassed a major research milestone in the development of technology that could unlock access to significant resources of thick oil trapped in Arctic oil fields. Injection of a benign polymer fluid to produce heavy oil from the Milne Point Field of Prudhoe Bay began in August 2018 as part of an NETL-supported field test. Two years later, the technology has not only demonstrated the ability to extract heavy oil, but also offers a promising solution to address production issues that have challenged energy companies working in the harsh Alaskan environment.

NETL Researchers Made Strides to Prepare STEP Plant

NETL researchers issued recommendations to guide the operation of a first-of-its-kind testing facility to develop next-generation power plants. If successful, testing at this facility will provide a pathway to lower the cost of electricity, shrink the environmental and physical footprint of power generation systems and conserve water. In a paper published in the journal *Applied Energy*, NETL researchers outlined process control models and operating strategies for the new Supercritical Transformational Electric Power (STEP) pilot plant, which is scheduled to open in 2021 on the Southwest Research Institute campus in Texas. The plant is designed to test the use of supercritical carbon dioxide as the working fluid for advanced power generation stations.

NETL-Led Collaboration Developed New Rare Earth Element Extraction Sorbent

In an NETL-supported collaboration with Wayne State University, researchers used a newly developed sorbent and a process previously developed for nuclear applications to produce an economically viable concentration of REEs from domestic coal fly ash, signaling an important step toward commercialization. The new sorbent media successfully concentrated the REEs in a coal fly ash sample taken from a coal-fired power plant near Detroit, resulting in a rare earth oxide powder of more than 13% weight that demonstrated potential for economic viability.

Researchers Developed Next-Generation Carbon Capture Technologies

NETL researchers developed a method to custom-formulate low-cost membranes to more effectively separate carbon dioxide from nitrogen in a high volume of flue gas. This ability to achieve both high selectivity and high permeability during post-combustion carbon capture operations is one of the most difficult problems facing membrane researchers today. The NETL group solved the challenge by chemically binding multiple membrane components with different critical properties into one high-performance material that can be easily scaled up to reduce the costs of large-scale carbon capture operations. The groundbreaking work was featured in the prestigious journal *Cell Reports Physical Science*.

Sensors for Harsh Environments Constructed in Model NETL Partnership

With support from NETL, Tech4Imaging LLC wrapped up two successful projects resulting in the development of a noninvasive, real-time, 3D imaging sensor technology for multiphase flows in advanced energy applications and deep underground. With guidance and financial support from NETL, Tech4Imaging designed, built and tested its sensor systems in commercial-scale applications. The novel sensor technology was built to better understand the physical and chemical interactions of different phases of matter found in fossil energy applications like coal gasifiers, coal-fired power plants, carbon capture systems, oil and gas operations and others. These systems are difficult to accurately measure through traditional point measurement.

NETL Report Highlighted Role of Partnerships in Reducing Methane Emissions

NETL collaborated with Our Nation's Energy (ONE) Future, a coalition of 26 natural gas companies, to calculate the greenhouse gas emission profile and methane emission rates across the group's complete natural gas value chain. The report, *Industry Partnerships & Their Role In Reducing Natural Gas Supply Chain Greenhouse Gas Emissions – Phase 2*, leveraged NETL's world-class life cycle analysis tools and recommended several methane emission reduction strategies specific to various geographic regions within ONE Future's natural gas supply chain. ONE Future comprises some of the largest natural gas production, processing, transmission and storage, and distribution companies in the nation.

NETL Partnered with Pittsburgh Botanic Garden to Complete Rare Earth Elements Research

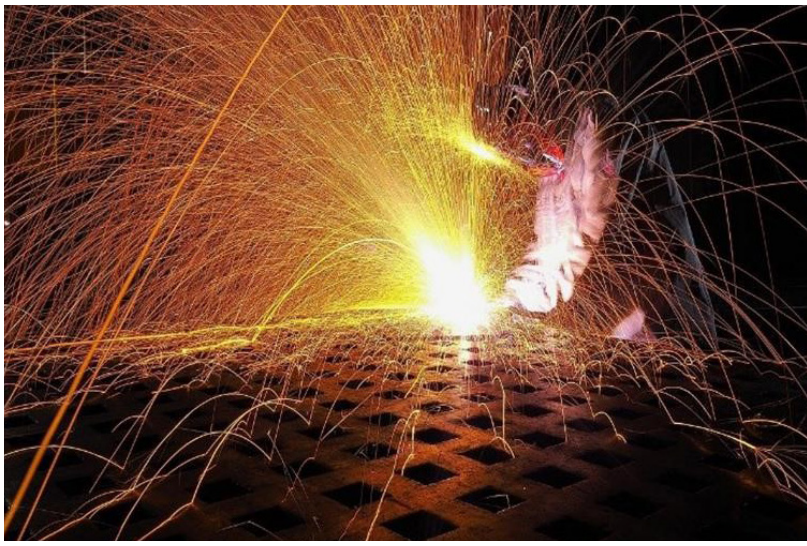
With the completion of a recent field test at Pittsburgh Botanic Garden, NETL researchers demonstrated that the Lab's basic immobilized amine sorbent (BIAS) process could successfully extract REEs from acid mine drainage, potentially providing a reliable domestic supply of these critical materials. Developed on land once actively mined for coal, the Garden is the site of ongoing efforts to treat acidic water that drains from abandoned mining operations. NETL researchers applied the BIAS technology at a small acid mine drainage treatment pool, where the technology demonstrated its ability to extract REEs from drainage containing as little as parts per billion of REEs.

NETL-Supported Project Developed Promising Rare Earth Element Extraction Method From Coal Refuse

In an NETL-supported project with Virginia Tech, researchers developed a safe, efficient processing technology to extract and concentrate REEs from coal refuse material already found throughout the Appalachian region. The Virginia Tech team focused on modified leaching lixiviants, which are liquid media used in hydrometallurgy to selectively extract the desired metal from the ore or mineral. Findings showed novel leaching lixiviants outperformed industry standards in effectively isolating and concentrating REE-enriched clay materials, often at lower doses. The project successfully produced a solution containing a final REE concentrate of 15-18% by weight, exceeding the objective of 2% REE by weight.

NETL Championed High-Tech Welding Program, Job Creation for Appalachia

NETL partnered with the Appalachian Regional Commission (ARC) to establish a job-training program that will help create a high-tech workforce with advanced welding skills to install and service superalloy components in next-generation fossil-fueled power plants, as well as meet the demand for welders with similar skills in the automotive and aerospace industries. NETL manages the program in partnership with ARC, which is the federal economic development agency that serves West Virginia and portions of 12 other states in Appalachia. The initiative is expected to produce a well-trained workforce for good-paying jobs that support cleaner coal and gas power plants across Appalachia. A request for proposals to develop training programs was issued Sept. 21.



NETL Collaboration Awarded Funding to Advance Rare Earth Element Extraction Technology

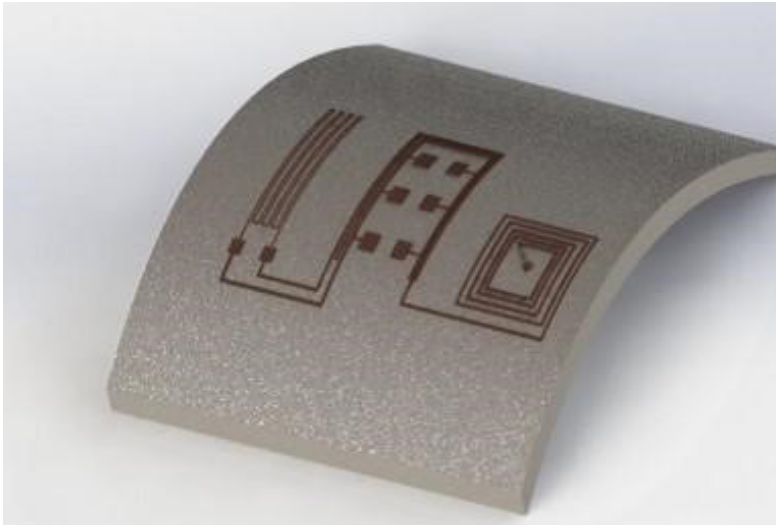
An NETL collaboration with the University of Wyoming to develop technologies and methods for extracting REEs from coal ash took a major step forward with a recently awarded grant from the U.S. Department of Energy's Technology Commercialization Fund. The project is working to scale up a patent-pending, NETL-developed extraction technology and will ultimately result in a pilot-scale production facility. By demonstrating the economically viable production of REEs from coal-related feedstocks, the project has potential to launch a new industry in extracting critical REE materials from the ash of Wyoming's Powder River Basin coals.

NETL Developed New Model for Sustainable Freshwater Use by Power Plants

Most U.S. thermoelectric power plants rely on fresh water for cooling, which can be a problem when local water supplies are scarce. A new model called Available Water Remaining for the United States (AWARE-US), developed by Argonne National Laboratory and NETL, will help communities balance the competing demands for water use among the power, agricultural, industrial and residential sectors. The Microsoft Excel-based model incorporates water supply and demand data across the nation at the county level to assess both geographical and temporal variability in available water resources, providing a greater understanding of regional and seasonal water stress impacts of water consumption.

NETL-Sponsored University Training Project Created Highly Sensitive Strain Gauges

As part of the NETL-managed University Coal Research program, a team led by Carnegie Mellon University completed a project that contributed to the training of several university students and researchers while advancing sensor technology to measure strain in extreme environments. The team leveraged advanced 3D printing techniques to create new in situ monitoring sensors capable of measuring the strain, or pull, on an object — even in the high-temperature environments of fossil energy applications. The team's novel sensors have potential to lead transformative improvements in system performance and efficiency, resulting in more affordable and reliable energy for the nation.



NETL Partnership with Industry Strengthened U.S. Pipeline Network

An NETL-led research effort with Oceanit Laboratories Inc. produced an ultra-thin surface treatment that could significantly improve the reliability of the nation's energy pipeline network by reducing corrosion and surface friction on pipe walls. During the four-year project, Oceanit accelerated the development of a novel friction-reducing agent called DragX, which bonds to the pipe to create a durable internal surface that provides flow assurance while preventing corrosion and debris adhesion. DragX uses nanocomposite technology that requires minimal surface preparation, is effective at a fraction of the thickness of other coatings and has a cure time of less than two hours.

NETL-Supported Collaboration Developed Flexible Rare Earth Element Extraction Method From Low-Rank Coal Ash

With support from NETL, researchers from the University of North Dakota and Pacific Northwest National Laboratory identified unique pathways and pretreatments to extract REEs from low-rank coal (LRC) ash in a more economical and environmentally sustainable manner. The process can be adjusted to adapt to the differing chemical and physical properties of the LRC ash. The research team conducted an extensive characterization effort, which was a vital step in developing the method for extraction and recovery of the contained LCR REEs.