This Week at NETL

April 1, 2013

Innovative Carbon Capture Solvent Successful at Bench Scale

Analysis of data obtained over 300 hours of parametric testing at the University of North Dakota Energy and Environmental Research Center indicates that, compared to monoethanolamine, ION Engineering's Solvent C has 30% greater carrying capacity, exhibits less degradation, and could be regenerated using half the energy. Real-time measurements taken during testing showed 90% carbon capture and less steam usage. The ionic liquid–amine solvent mixture, being developed in cooperation with NETL, is composed of organic compounds that are compatible with aqueous media, resulting in highly tunable solvents that can be engineered to facilitate CO_2 absorption/desorption.

High Performance Computer Dramatically Speeds NETL Gasifier Simulations

In just 60 hours, the High Performance Computer for Energy and the Environment (HPCEE), housed at NETL's Simulation Based Engineering User Center, completed a 3-D simulation of transport integrated gasifier operation under co-feed air-blown conditions at the National Carbon Capture Center—a type of simulation that, in the past, would have taken two weeks or longer to complete. More than 24,000 computational cores make HPCEE the world's 55th fastest computer and provide NETL researchers a state-of-the-art capability in high performance computing to investigate more complex problems with greater accuracy in less time.

NETL Examines Methane-Reforming Characteristics of Nickel-Substituted Barium Hexaaluminate Catalysts

Hexaaluminates are of interest for reforming methane and CO_2 into synthetic fuels because they are thermally stable at the high temperatures required and because these crystalline oxides easily accept the substitution of a variety of catalytically active metals in their framework lattice and mirror planes, providing a high degree of flexibility in catalyst design. Using high-resolution x-ray diffraction, NETL researchers studied the effect of substituting nickel into a series of barium hexaaluminates, and made the first observations of unit cell contraction and graphite carbon formation resulting from the dry reforming of methane over these catalysts. Contraction of the hexaaluminate unit cell was consistent with the reduction of nickel oxide, which was substituted in the lattice, and CO_2 adsorption onto the catalyst surface correlated directly with the amount of carbon deposited on the surface. The study is detailed in the March 30, 2013, issue of the Elsevier publication *Applied Catalysis A*.

National Academy of Sciences Publicizes Findings on Energy and Mining Workforce

In a report produced in cooperation with NETL, a committee of experts selected by the National Academy of Sciences summarized available data on the current and projected future workforce for the U.S. energy and mining industries—including oil, natural gas, coal, nuclear, solar, wind, geothermal, carbon capture utilization and storage, and nonfuel mineral mining. The data indicated a bright present and future for well-paying energy and mining jobs. Demand for workers at all levels in these industries is expected to remain strong for the foreseeable future because of projected industry growth and the pending retirement of large numbers of experienced workers. The report, *Emerging Workforce Trends in the U.S. Energy and Mining Industries: A Call to Action*, also addresses challenges in meeting workforce demand, recommending several improvements to the U.S. education system that would make it more science-, technology-, engineering- and math-oriented and more responsive to expanding industry needs.

NETL Study Attributes Water Contamination in Abandoned Gas Wells to Coal Mine Drainage

Isotopic and geochemical analyses indicate that artesian discharges of water with high total dissolved solids from a series of gas wells in western Pennsylvania result from the infiltration of acidic, low iron (less than 10 milligrams per liter) coal mine drainage into shallow, sandstone aquifers cemented with siderite (a mineral composed of iron carbonate). The acidity promotes dissolution of the carbonate, and metal- and sulfate-contaminated waters rise to the surface through compromised abandoned gas well casings. Strontium isotope mixing models suggest that neither upward migration of oil and gas brines from Devonian reservoirs associated with the wells nor dissolution of the abundant nodular siderite present in the mine spoil through which recharge water percolates contribute significantly to the artesian gas well discharges. Natural strontium isotope composition can be a sensitive tool for characterizing complex groundwater interactions and can be used to distinguish between inputs from deep and shallow contamination sources, as well as between groundwater and mineralogically similar but stratigraphically distinct rock units. The finding have particular relevance for regions such as the Appalachian Basin, where a legacy of coal, oil and gas exploration is coupled with ongoing and future natural gas drilling into deep reservoirs. Details of the NETL study, conducted jointly with the University of Pittsburgh and others, appear in the April 2013 issue of the Elsevier publication *Applied Geochemistry*.

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