This Week at NETL

May 6, 2013

Regional Partner Initiates Large-Scale CO_2 Injection into Depleted Pinnacle Reef

On April 23, members of the Midwest Regional Carbon Sequestration Partnership (MRCSP) began injecting CO_2 at a rate of 1,050 metric tons per day into Dover 33, a mature, closed reservoir in the Niagaran Reef Complex of northern Michigan. The reservoir is in the late stages of CO_2-enhanced oil recovery being conducted by industry partner Core Energy LLC (Traverse City, Mich.). This large-scale carbon-storage effort is designed to advance understanding of injectivity, improve capacity estimates, and determine the feasibility of utilizing and storing CO_2 in geological formations, particularly carbonate pinnacle reefs. Knowledge gained will lead to a better understanding of how sequestration technologies can best be applied on a regional basis for the benefit of all MRCSP partners and stakeholders. Led by Battelle Memorial Institute (Columbus, Ohio), MRCSP is one of seven NETL-managed regional partnerships that form the centerpiece of national efforts to develop the infrastructure and knowledge-base needed to place carbon capture and storage technologies on the path to commercialization.

NETL Compares Methods for Estimating CO_2 Storage in Saline Formations

To assess how methodology affects estimates of CO_2 storage, NETL researchers compared the results obtained when several publicly available storage-resource-estimation methods were applied to the same data sets. The methods that were applied—some with open boundary conditions that allow displacement of *in situ* fluid away from the injected CO_2 and into neighboring formations, and others with closed boundary conditions limiting injection pressure to the maximum allowable for the formation—each embody inherent uncertainties arising from simplifying assumptions. Statistical analysis revealed that the choice of method influenced CO_2 storage resource estimates far less than uncertainty in the underlying parameters relating to subsurface geology, especially within subsets of methods sharing similar boundary assumptions. The work is detailed in the NETL technical report, *Comparison of Publicly Available Methods for Development of Geologic Storage Estimates for Carbon Dioxide in Saline Formations*.

Model Describes Changes in Wellbore Properties Due to CO_2 and Co-Constituent Injection

Working with collaborators at Penn State and Carnegie Mellon, both members of the NETL-Regional University Alliance (RUA), NETL researchers developed a conceptual model describing the change in wellbore permeability due to interactions among brine, CO_2, hydrogen sulfide (H_2S), and cement. The model was created to help evaluate the performance of existing wellbores in maintaining zonal isolation when CO_2 from industrial sources is stored subterraneously. The model considers how the cement around an existing wellbore can change over the long term following co-injection of CO_2 and H_2S into a geologic formation. The conceptual model accounts for diffusion of the chemical reactants through cement, while a preliminary numerical CrunchFlow model simulates permeability changes due to chemical reaction along a wellbore. The NETL-RUA model joins others being developed by the National Risk Assessment Partnership to predict overall performance of a carbon-storage system.

NETL Discovers Novel Class of Carbon Capture Materials

Researchers at NETL have engineered an extensive family of structurally related metal organic frameworks (MOFs) based on a simple-but-effective design motif called pillared layering. The newly developed materials are

constructed by linking 2-dimensional sheets of a coordination polymer network with organic pillar ligands to form a 3-dimensional porous structure. Several chemically modified versions of the pillar ligands were synthesized to enable preparation of a large family of novel pore-functionalized materials. In all, 40 new sorbents were discovered, with several exhibiting the interesting and unusual ability to transition between open and closed pore structures when adsorbing and desorbing gases. This structurally dynamic behavior appears responsible for the effectiveness of some flexible MOFs in separating CO_2 from light gas mixtures containing nitrogen, hydrogen, or methane. However, this "breathing" phenomenon is poorly understood at the fundamental level, and the newly discovered family of structurally tunable flexible MOFs will help assess its potential as a gas-separation mechanism. The work is described in the April 15 issue of the high-impact American Chemical Society publication, *Inorganic Chemistry*.

Multi-Contaminant Sorbent Captures Trace Impurities in Synthesis Gas

With financial assistance from an NETL-administered Small Business Innovation Research grant, product developers at TDA Research Inc. (Golden, Colo.) have developed a low-cost, high-capacity, high-temperature sorbent that can remove virtually all of the ammonia, hydrogen cyanide, and trace metal contaminants (mercury, arsenic, and potentially selenium) from coal- and coal/biomass-derived synthesis gas in a single process step. The sorbent can be regenerated by pressure swings at low temperature, minimizing the energy input to support the process, and can maintain capacity even after more than 50 operation-regeneration cycles. Preliminary process economic analysis has shown that the capital cost for the TDA sorbent clean-up system is approximately 1% of the integrated gasification combined cycle plant cost. The operating cost (approximately $4 million) for the sorbent clean-up system represents 2–3% of the plant electricity output (based on a 250 megawatt plant and a $90 per megawatt-hour cost of electricity) compared to the operating cost of approximately 10% of the plant electricity output for low-temperature scrubbers. Thus, the cost savings compared to a conventional low temperature scrubber are approximately $17 million per year.

For more information, please contact:
Shelley Martin, DOE National Energy Technology Laboratory, 304-285-0228, newsinfo@netl.doe.gov