Coal Combustion Residual Encapsulation Study

Alabama

Client

Southern Company

Highlights

- Investigates and defines an innovative approach to waste disposal for the coal-fired power industry
- Developing techniques to verify and monitor the performance of encapsulating two waste products to a form that is stable, cost effective, environmentally sustainable, and superior to current disposal methods
- Data suggests paste encapsulation is viable alternative to current disposal methods
- Positively impacts entire coal-fired power industry

DBS&A developed the Coal Combustion Residual Encapsulation Study to help Southern Company and other coal-fired power plant owners develop safe, sustainable, long-term disposal alternatives for waste products. Current disposal methods require extensively engineered and monitored systems, which are expensive and burdensome to regulate. This project is helping to develop a solution to waste disposal that generates an inert and stable product that can be disposed of more safely and cost effectively.

For the initial bench-scale evaluation of the materials, DBS&A scientists prepared a slurry of coal combustion waste products (fly ash and process brine) combined with a small amount of Portland cement using a small mixer.

Building on DBS&A's previous hydraulic conductivity laboratory testing of prepared fly-ash based sample cores, Phase 1 of the project involved a small-scale evaluation of the mixture of waste products. The mixture consisted of materials provided by Southern Company and included fly ash and process brine (the waste products) along with a small amount of Portland cement. DBS&A laboratory personnel mixed the components and poured them in lifts into 12-inch acrylic columns. The initial curing process and several wetting and drying events were monitored using time-lapse photography and six different monitoring sensors. This is an innovative application of equipment typically used to monitor the behavior of soils. Scientists evaluated the columns for crack development and propagation, which can significantly impact a material's hydraulic conductivity. This initial phase of work revealed which sensors remained functional and provided useful data throughout the initial curing process and throughout several wetting and drying events. Cracking was relatively minor in the small scale application, providing valuable insight regarding the behavior of the encapsulated waste.

Based on the success of the Phase 1 research, DBS&A proposed and was awarded the second phase of the project involving construction of a larger-scale investigation in the laboratory using an approximately 4-foot by 3.5-foot vessel (lysimeter) with a sand drainage layer in the bottom. Laboratory personnel poured successive lifts of ash, brine, and cement mixture into the lysimeter. The monitoring sensors that were determined to be successful in the first phase were placed in each lift

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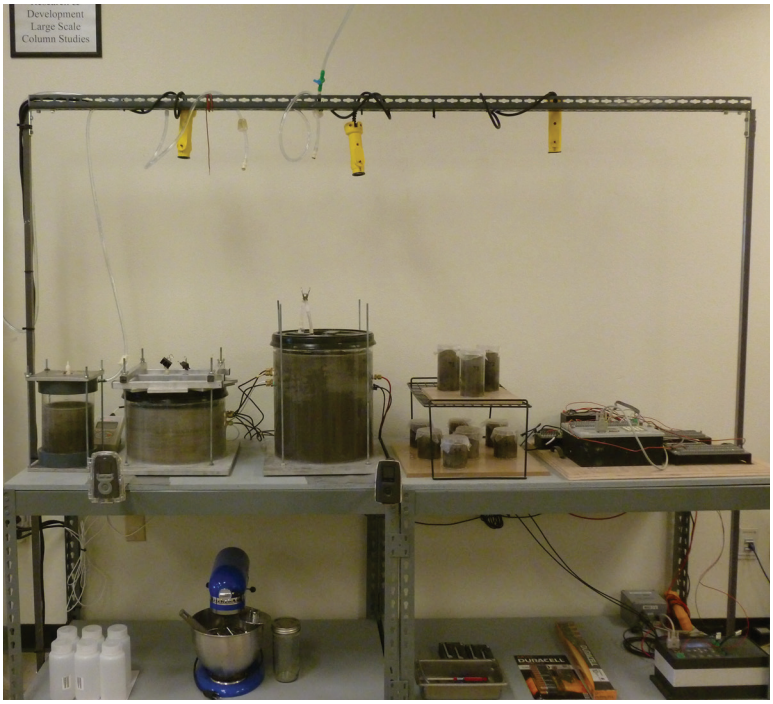
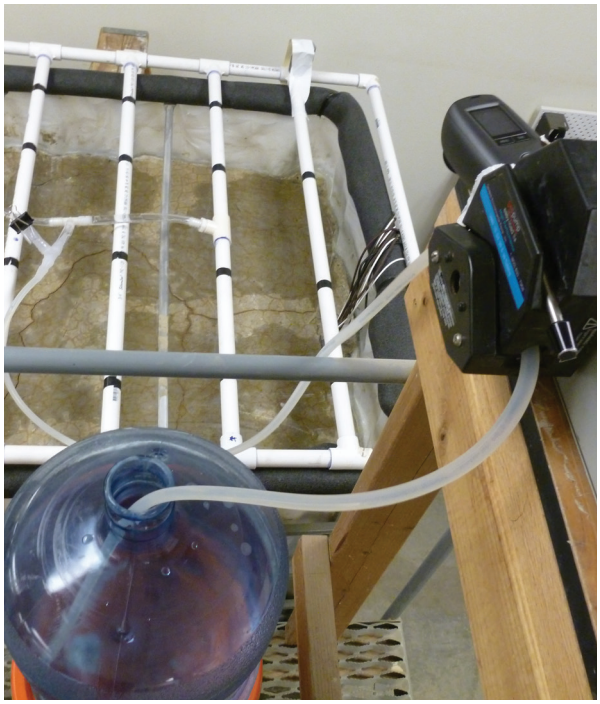
of material to measure temperature, water content, electrical conductivity, thermal conductivity, and water potential. Three lifts were installed over a period of approximately one week. After a curing period of three weeks, scientists added water to the lysimeter to evaluate both the conductivity of the material and water quality of the surficial runoff and any water that percolated through the material. Scientists monitored the sensor output and recorded observations of the material properties during initial curing process and after several wetting and drying events. The laboratory lysimeter study results verified that the paste encapsulated material has a low hydraulic conductivity and a low leaching potential for contaminants. The installation remains fully functional and is being used to track the long-term material properties and water movement through the individual lifts.

Southern Company continued to capitalize on DBS&A's unique understanding and experience with paste encapsulated materials by offering them the opportunity to design, instrument, monitor, and help construct field-scale lysimeters at the Plant Bowen site. The success and lessons learned during the laboratory studies proved invaluable to the successful installation of the field lysimeters. DBS&A continues to monitor the data collected remotely for the installed weather station equipment and lysimeter sensors. The field lysimeters are scheduled to be monitored for one to two years, at which point a larger scale field study will be initiated.





DBS&A custom-designed column tests to collect data from sensors placed in the cured material. The sensors tracked the movement of water through the materials over time. Clear acrylic experimental columns allowed for visual observation and time-lapse photography during the curing process and during subsequent wetting and drying of the material. Another custom-designed and -built apparatus fed with water by a peristaltic pump, allowed laboratory staff to evaluate the amount of water that ran off the surface, rather than penetrating the material, during a mock 1-inch per hour rain event.