INTRODUCTION

The Environmental and Coal Technologies Group at the University of Kentucky Center for Applied Energy Research had the opportunity to research ponded coal combustion by-products. This project began with an extensive exploration and sampling of the inactive ash pond at the Ghent Generating Station in Carroll County, Kentucky. Collecting a representative sample from an ash pond that is 40 feet deep and covers 125 acres is no small task. A few five-gallon buckets of ash scooped from the edge of the pond will not suffice. When attempting to obtain a bulk sample from the inactive ash pond a need was created to collect an undisturbed, representative sample of ash from various known depths of the pond.

Some bulk-sampling techniques involve the use of augers, post-hole diggers, and shovels (Fig. 1). Two immediate problems arise from these methods, 1) a biased sample, and 2) a disturbed sample. The sample is biased because only the upper several feet of the ash is recovered. Therefore, only a small fraction of the ponded ash is sampled at that location, leaving the remaining interval, from the sample depth to the bottom of the pond, unknown. Bulk-sampling techniques are used to collect large amounts of disturbed sample with little regard as to the depth from which it was collected. To solve this problem, the method of vibracoring was used to collect an undisturbed sample from a known depth and provided the ability to sample the entire depth of the ash pond without bias.

VIBRACORING

The vibracoring technique was initially developed to collect core samples from continental shelves, but was later adapted for lake-bottom sediments, swamps, and any other water-saturated sediment. For the ash-pond environment, vibracoring provides a means to collect a representative sample of ash that ranges from silt to gravel-size particles. By understanding the history of ash deposition within the pond, inferences can be made as to the location and concentration of particular ash-sizes, quality, and loss-on-ignition percentages. This method utilizes a concrete vibrator to create high-frequency low-amplitude vibrations that are transferred down a series of aluminum tubes (Fig. 2). Vibrations liquefy a 1 to 2 mm layer of sediment in contact with the inside and outside of the core tube wall, thus allowing penetration through soft sediment. The vibracore system enables the user to extract soft-sediment cores from the entire depth of an ash pond.

Collected core samples are removed from the ground intact and undisturbed regardless of whether they were cored from a depth of 5 feet or 40 feet. A continuous core from the surface of the pond to the bottom provides the same benefits as digging a 40-foot trench into the pond would, on a smaller scale.
The individual layers of ash that were deposited onto the floor of the pond can be seen and described in relation to one another. Small-scale depositional features, which reveal the history of how the pond was filled, can be seen in the cored samples.

The coring system consists of two 20-foot lengths of five-inch aluminum tubing. A coupling is used to connect two 20-foot lengths of aluminum tubing to core 40 feet to the bottom of the coal-ash pond (Fig. 3). The outer-diameter of the coupler is larger than that of the core tube. Initially the wide coupling behaved like a stopper, ceasing penetration when it met the surface of the pond. To bypass this obstacle, an amphibious drill-rig (Fig. 4) was used to auger 20 feet of the vibracored hole. By doing this, the hole was widened allowing the coupling to pass through the hole without touching the sides. Twelve cores, varying from 30 to 40 feet deep, were obtained through the vibracoring method to demonstrate local vertical-variability of the particle-size distributions in the ash pond. Several of the recovered cores contained clay on the bottom, marking the depth at which the core penetrated the bottom of the pond.

Vibracoring the Ghent ash-pond revealed several interesting details that were not evident when the project began. First, the vibracored samples showed abundant layering (Fig. 5) of sand and gravel-size bottom ash, silt-size fly ash, and carbon. This was a surprise because the pond was originally thought to be a homogeneous mixture of fly ash and bottom ash. Another interesting detail was the varying ash-water content from one interval to the next, with increasing depth. There was high variability of moisture content from one layer to the next in the core samples, possibly related to the flow of groundwater within the complex layering of permeable and impermeable layers. For example, while coring it was common to encounter a sequence of layers comprised of one foot of dry ash, followed by eight feet of moist ash, then three feet of pudding-like ash, followed by two feet of dry ash. These intervals reflect the nature by which the ash pond was filled.

**CORE SAMPLES**

Slurried ash entering the pond is sluiced from the power plant several times throughout the day into the northwest corner of the pond, whereas effluent from the pond flows through a spillway located at the northeast corner of the pond (Fig. 6). Stokes’s Law, which describes the rate at which suspended particles settle, best illustrates the settling distribution of ash particle sizes as slurried ash leaves the pipe and enters the standing water. Next, gravel-size bottom-ash particles fall out of suspension, followed by sand-size ash, then silt-size ash, and ultimately the fine fraction of unburned carbon (Fig. 7). Slurry enters the ash pond as a discontinuous flow that occurs several times throughout the day. The result of this cyclic flow creates rhythmic layering of the ash within the pond (Fig. 8). Dark layers typically represent carbon-rich or organic-rich ash, whereas light-colored layers are relatively carbon free. Repetition of light and dark layers can be seen at the megascopic level in core samples,
as well as the microscopic level in polished pellets. This method of ash disposal created a sequence of ash layers that have a decreasing particle-size laterally away from the slurry input. Particle-size analysis of the sample cores indicates an overall coarsening-upward particle-size of ash layers. This is attributed to the process of ash filling the pond; as the slurry-input side of the pond builds up with ash, the slurry flow begins to progress further into the pond. The progression of ash allows coarse ash falling from suspension to settle on the finer ash of a previous slurry inflow.

DATA ANALYSIS

Unburned carbon has a low density of 1.35 grams per cubic centimeter (g/cm³) and will stay suspended longer than fly ash or bottom ash, which both have an approximate density of 2.4 g/cm³. As slurried ash is pumped into the pond, the coarsest carbon particles are immediately dropped from suspension. The finer carbon particles are carried with the prevailing current flow and deposited, as described in Stoke’s Law, throughout the extent of the pond.

Figure 9 shows the distribution for the average percent of unburned carbon in the >100-mesh fraction of ash. The four intervals for depths from the surface to 20 feet typify unburned carbon distribution within the pond. As a result of the low density of carbon particles, which allows them to stay in suspension longer, concentrations generally increase toward the far end of the pond.
CONCLUSION
While working within an inactive ash-pond, vibracoring proved to be an inexpensive, more suitable means of collecting ash samples versus bulk-sampling, augering, or other large coring systems. In addition to these benefits, this method aided the collection of unbiased, undisturbed samples at known depths throughout the pond. This ability not only benefits those marketing ash by providing a more accurate resource estimate, but it also provides a means for researchers to better understand the nature of ponded ash, thus paving the way for CAER and others to develop new ash-processing technologies.

Mr. Jewell came to CAER as a graduate student in the UK Dept. of Geology. He is currently a fulltime researcher, while working on his Ph.D. in the Department of Civil Engineering. For more information on this article, contact him at: jewell@caer.uky.edu

NEWS RELEASE
The Institute For Briquetting and Agglomeration

Thomas N. Feldkamp, Executive Director

IBA ANNOUNCES ITS 30TH BIENNIAL CONFERENCE

October 21-24, 2007
Hilton Savannah DeSoto, Savannah, Georgia

For over 50 years, IBA has sponsored this conference on the science and application of agglomeration technology. This year’s meeting will be preceded by a half-day hands-on workshop on “The Basic Principles & Methods of Agglomeration.” The workshop will be an opportunity for newcomers to learn more about the field as well as a refresher for practitioners wishing to stay current. Workshop topics include briquetting, compacting, pelletizing, granulation, extrusion, spray-drying/granulation and tabletting.

Articles are invited that describe practical and theoretical studies of the agglomeration process from any field that practices or might benefit from particle enlargement methods including, but not limited to, Coal, Agrichemicals, Biomass, Ceramics, Charcoal, Chemical, Foods, Iron Ore, Minerals, Pharmaceuticals, and Waste Recycling. Manuscripts from associated fields such as Binders, Particle Size Effects and Flow Behavior, and Quality Control Methods are also encouraged.

Please submit abstracts to: tnfeldkamp@centurytel.net or IBA, Tom Feldkamp, PO Box 297, Manitowish Waters, WI 54545 by May 18, 2007. You may also submit abstracts to: Taulbee@caer.uky.edu. The deadline for manuscripts is July 9, 2007. For more information on the conference or on the IBA, visit our website at www.agglomeration.org

Dr. B.K. Parekh, Senior Research Engineer with the University of Kentucky Center for Applied Energy Research,

has assumed the Editor-in-Chief position for the Coal Preparation journal. For the last four years, Professor Gerald Luttrell of the Virginia Polytechnic Institute was the Editor-in-Chief of the journal. The original founder of the Journal was Prof. Janusz Laskowski of the University of British Columbia. The journal is published quarterly and deals with articles related to the basic science, industrial applications and review articles in the Coal Preparation area. B.K.’s main objective is to maintain the established reputation of the journal and increase its circulation, especially in foreign countries. The editor would welcome your input and suggestions in improving the quality and status of the journal. For more information please contact B.K. at 859-257-0239 or parekh@caer.uky.edu.
Commercial Opportunities in the Energy and Environmental Sectors

Recent fluctuations in gasoline and electricity costs have prompted consumers to consider fuel-efficient automobiles and energy-efficient appliances. While these developments have influenced and perhaps even changed our daily habits as individuals, the adoption of environmental and energy conservation practices has reverberated at the national level: innovative energy policies have been proposed over the past three years under the Energy Policy Act of 2005 and the Advanced Energy Initiative of 2006.

To support and promote exports of efficient and advanced energy technologies, the U.S. Department of Commerce works with U.S. companies in the energy and environmental sectors to identify markets and remove trade barriers to such exports.

Located in Washington, D.C., the Office of Energy and Environmental Industries (OEEI) (housed within the International Trade Administration-ITA) works with trade associations, scientific and research centers, universities, and U.S. Government counterparts (most notably Department of Energy (DOE), Environmental Protection Agency (EPA), State Department, Trade Development Agency, and Export-Import Bank) to advance the development of government policies that enhance the competitiveness of U.S. energy and environmental companies. A team of trade specialists, each of whom covers an energy/environmental sector and a geographical region, collaborates with companies, industry associations, and institutes to ensure stakeholder input into energy and environmental trade policy developments. Some of OEEI’s activities include:

- Developing and implementing an Alternative Energy Initiative;
- Advancing commercial nuclear opportunities, both domestically and internationally;
- Supporting interagency biofuels programs and developments with key trading partners;
- Promoting the Asia Pacific Partnership for Clean Development and Climate, a public/private partnership that promotes sustainable economic growth and poverty reduction in the Asia-Pacific region;
- Supporting international energy events, including the Offshore Technology Conference, Beijing Coal and Mine Event, U.S.-China Oil and Gas Industry Forum, and the International Pittsburgh Coal Conference;
- Collaborating with the ITA’s Commercial Service to support trade promotion activities;
- Managing the Industry Trade Advisory Committee, a public-private partnership through which U.S. industry provides trade policy recommendations to the Administration; and
- Participating in an interagency program to develop an additional set of amendments under EPA’s Spill Prevention, Countermeasure, and Control Rule, which imposes mandatory oil storage requirements on operators of oil facilities.

At the local level, U.S. Export Assistance Centers (USEACS) help small and medium enterprises navigate the export maze and identify market opportunities and trade partners, both domestically and internationally. With over 100 offices in the United States, the USEACS work closely with state trade development offices and local World Trade Centers to locate the most appropriate market opportunities for local clients and businesses. Most USEACS have energy and environmental trade specialists to provide individual company export counseling, pinpoint domestic and international trade shows and events, and identify trade opportunities and leads. The USEACS work within the Department of Commerce network to develop tailored market research reports for U.S. company clients.

The Foreign Commercial Service (FCS) represents the Department of Commerce overseas. Located at over 120 posts abroad, as well as at multilateral development banks, FCS fosters U.S. business development and export opportunities, identifies and resolves trade barriers, and advances the commercial interests of individual U.S. firms. FCS works closely with the local business community and the host government to advance U.S. export opportunities.

From a policy perspective, the energy and environmental programs at the Department of Commerce promote America’s commitment to advancing clean and efficient energy technologies, overcoming our addiction to oil, and implementing the Energy Policy Act of 2005, the first national energy plan in more than a decade. Through these activities, the Department of Commerce leads in supporting and promoting commercially-viable energy efficient technologies and practices worldwide. While the science and R&D of clean energy and energy efficiency continues to evolve, the commercialization of advanced energy and environmental technologies remains the backbone of U.S. industrial competitiveness in both domestic and overseas markets. With the onset of commercialization of energy and environment technologies, public and private partnerships
enhance the trade policy developments that facilitate trade and exports of U.S. energy technologies.

As worldwide attention to energy and environmental issues continues to expand, scientists, researchers, policy makers, and trade specialists will be drawn closer together to provide the most advanced energy efficient technologies to regions of the world where infrastructure is in the development and nascent stages. Americans leading innovation and expertise in clean energy and environmental technologies serve as a link towards economic development overseas, while concurrently contributing to U.S. industrial competitiveness and U.S. commercial expansion worldwide.

For further information on the Energy and Environmental Program within the Department of Commerce, please contact Joe Neuhoff, Director, Office of Energy and Environmental Industries, at Joe.Neuhoff@mail.doc.gov.

The University of Kentucky’s Center for Applied Energy Research presents a short course:

Pollution Control in Power Plants -- Fundamentals and Practical How-To’s
www.caer.uky.edu

Instructors: Bill Downs, Babcock & Wilcox
Scott Pritchard, Cormetech
Jim Neathery, UK CAER

Date: Wednesday, October 24, 2007
Time: 8:00 am – 2:00 pm

Location: Buffalo Trace Distillery Conference Center, Frankfort, Kentucky

Cost: $150.00

Registration: Teresa Epperson
Epperson@caer.uky.edu, (Tel.) 859-257-0200

Registration Deadline: October 1st. (Registration is limited.)

With the implementation of federal regulations - [Clean Air Interstate Rule (CAIR) and Clean Air Mercury Rule (CAMR)] in 2005 and potential legislation on CO₂ reduction, there is a resurgence of interest in technology development regarding air pollution control for power plants and related industries. In this short course, experts from frontline pollution-control entities will cover these four topics: SOx, NOx, mercury and CO₂ reduction. The course will cover fundamental chemistry knowledge related to gas emissions and its mitigation, development history, state-of-the-art control technologies and real world problem solving and analysis. Four PDHs are offered with this course.