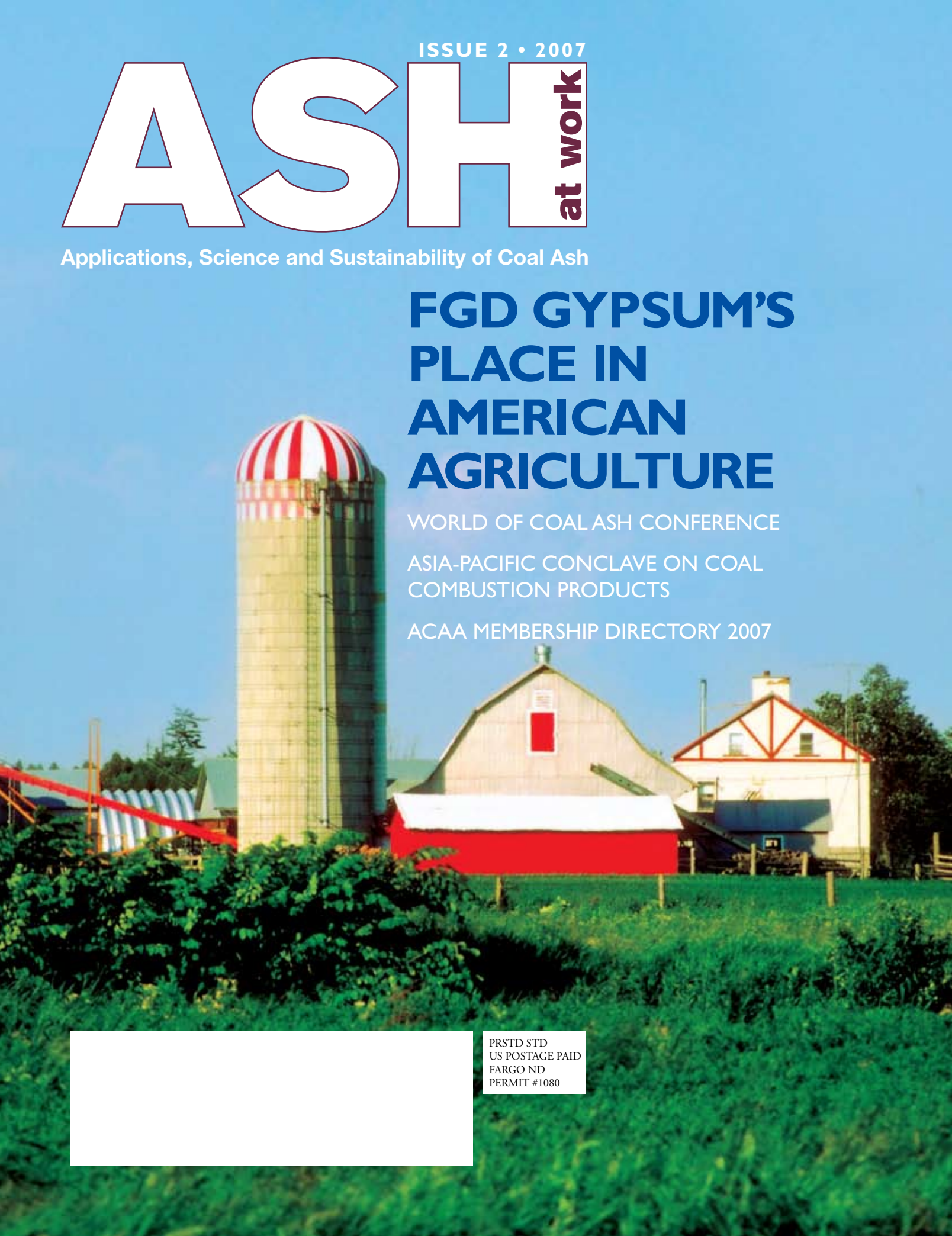
ISSUE 2 • 2007

ASH at work

Applications, Science and Sustainability of Coal Ash



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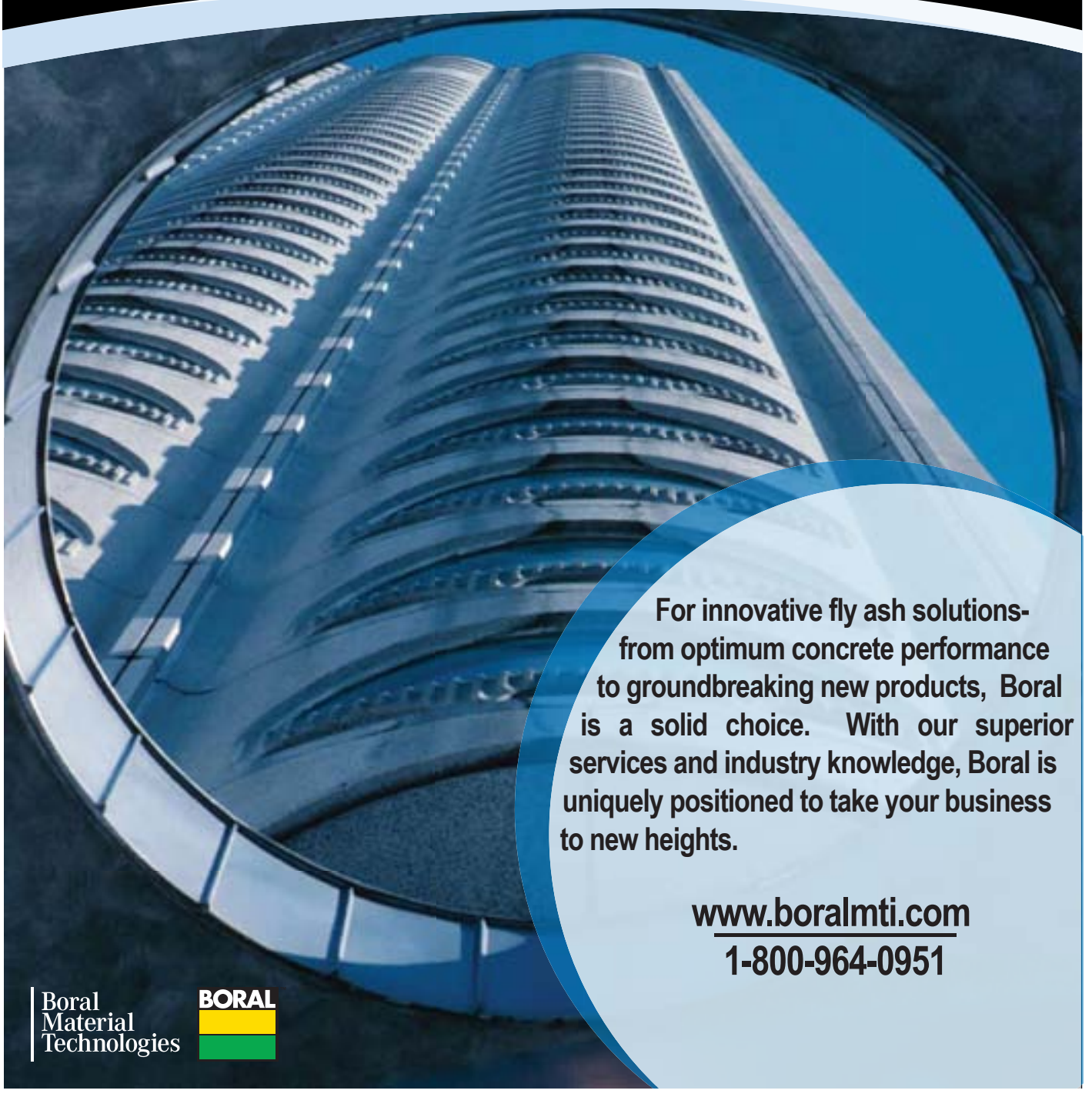

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ASH at work

Applications, Science and Sustainability of Coal Ash

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Cover Photo: Flue gas desulfurization (FGD) gypsum offers the agriculture industry a material that enhances soil quality, while promoting global sustainability. In this issue of *Ash at Work*, Chad Haynes, Ph.D., U.S. Department of Agriculture, explores "FGD Gypsum's Place in American Agriculture." Also, see page 55 for details on the upcoming workshop, "Agricultural and Industrial Uses of FGD Gypsum."

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HISTORY OFFERS A LOOK INTO THE FUTURE

By David Goss, American Coal Ash Association

The entire CCP industry lost a longtime advocate when Mr. John Faber passed away on Feb. 27. As many of you know, John was one of the visionaries that realized f y ash, bottom ash and boiler slag (and later other materials) could be effectively used in many applications without harm to the environment and to great technical and economic advantage.

In March 1967, John and his colleagues conducted the first symposium on f y ash utilization, which was held in Pittsburgh. The Edison Electric Institute, the National Coal Association and the Bureau of Mines sponsored this event attracting more than 500 participants, from the United States, Canada and Europe. The symposium featured 27 formal presentations by leading experts on all major phases of f y ash production, utilization and research. This event subsequently led the way for hundreds of international symposia, meetings, workshops and courses on CCP management and use. WOCA 2007 was but the latest in a distinguished record of events serving the industry and helping spread the good word about CCPs.

While looking over historical files in preparation for this editorial, I realized that many of the issues that John, Al Babcock, Oscar Manz and many others were confronting, were not at all unlike those we talk of today. Topics in that first conference included: "Producing Specification Fly Ash," "Fly Ash in Agriculture," "Public Concern for Environmental Improvement," and "Fly Ash in the Future." Weren't most of these same issues addressed this year at WOCA? A second realization I encountered was that although ACAA has a pretty good collection of historical resources from the early years, our collection is not complete. We are missing some of the early issues of "Ash at Work" (the newsletter), documents known as Executive and Technical memorandums (from the late 1980s and early 1990s), Process and Technical Data documents (1970s) and probably other materials of which we aren't aware. Thanks to Oscar Manz and Tony DiGioia, who loaned the association many of their personal papers for incorporation into our Resource Library, some of the missing items have been located. If, however, you have any early National Ash Association or ACAA printed materials you would be willing to donate or loan to us, we would like to add more to our archives.

In 2008, we enter our fourth decade as one of the world's leading resources for CCP information and outreach. Much has changed in the industry since the National Ash Association (ACAA's predecessor) was established in 1968. Flue gas desulfurization was perhaps an expectation if not a product stream. Today, FGD gypsum has a tremendous potential for new markets and beneficial use. Similarly, clean coal technologies hold promise for the utility industry and we need to be ready to address the new products that will be created by these systems. We are looking at that issue and how ACAA may want to address both the diversity of products we see today, as well as the sustainable contributions this industry makes to the global environment. Also, ACAA is looking at how we may want to celebrate the anniversary that 2008 will represent. Most of us enjoy a celebration, unless we are counting off another large numbered birth date. Expect some interesting changes to ACAA later this fall and next year.

As we approach our 40th year as an organization, we need to be mindful of both the past and the future. Visionaries like John helped set the path for those of us who are here today. Likewise, we are defining the future of this association and other CCP organizations by the work and research we are conducting today. History offers a valuable hindsight that can be incorporated into a vision for the future.❖

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GREEN HIGHWAYS PARTNERSHIP UPDATE

By David Goss, American Coal Ash Association

The Green Highways Partnership (GHP), first envisioned in June 2004, has gathered momentum in a quiet, but widely encompassing way, like a tide slowly rising. A visit to the GHP Web site (www.greenhighways.org/) reveals the number of partnerships formed within EPA Region 3 — a lengthy and impressive list. Organizations as diverse as the Maryland State Highway Administration, the Industrial Resources Council, Villanova University, the National Ready Mixed Concrete Association, the Conservation Fund, the Chesapeake Bay Watershed Agreement, and many others are collaborating on specific initiatives. Processes and programs incorporate the GHP vision of integrated planning, regulatory f exibility and market-based rewards into day-to-day construction and reconstruction of roads and highways in the mid-Atlantic region.

Of particular interest to ACAA and its members is the work of the Reuse and Recycling Team. Co-chaired by Maria Vickers of the EPA Office of Solid Waste, Jason Harrington of the Federal Highway Administration, and Dave Goss of ACAA, this team has been developing concepts and resources for industrial materials use. The GHP Web site page for the team (www.greenhighways.org/reuse_Recycling.cfm) is populated with information on industrial materials, including coal combustion products. A number of popular ACAA and industry publications are available to download. Another link to EPA guidance documents is accessible, providing many more resources and case studies about EPA programs in support of GHP goals.

The ACAA is involved in planning a workshop at the Conference Center at the Maritime Institute outside Baltimore in late August. The event will target state transportation and regulatory officials from Maryland, Virginia, Pennsylvania and surrounding states to identify opportunities and barriers to using industrial materials. Regulatory and market issues will be addressed to encourage the wider use of CCPs, foundry sands, iron, steel slags and similar materials through specification change and contractor acceptance. The MDSHA's Soils and Aggregates Technology Division is taking a leadership role, along with the FHWA, in inviting specific state officials, contractors and planners to this workshop.

National publications, including *Waste News, U.S. News & World Report, Engineering News Record, Better Roads* and *Surface Transportation* have all featured articles about the GHP. Recently, the American Concrete Pavement Association recognized Dominique Lueckenhoff as the first recipient of its Outstanding Health, Safety and Environmental Stewardship award. Gerald Voight, ACPA president and CEO stated, "The Green

The Green Highways Partnership connects diverse interests to promote best practices in environmental management and construction. A recent workshop at the University of Maryland encouraged these practices for the U.S. Highway 301 Corridor Project, now in the planning phase.

Highways initiative should not be confused as window-dressing for environmental regulations. It is truly a program that balances environmental, economical and societal needs, which is to say the common goal is to meet the needs of all stakeholders."

The EPA's support for this program extends outside Region 3. There is a growing interest across other regions, as well. Regional staff in Atlanta, Chicago, Denver and San Francisco report receiving inquiries from state and private entities about developing partnerships in their areas. Although the program has not been officially expanded nationally, it's clear the concept is well-regarded and doable. In many ways, the GHP supports the changes evolving from the agency. The EPA today is less focused on compliance and enforcement and is instead looking at ways to promote both pollution prevention and sustainability.

Other long-term goals driving EPA research involve developing, applying and demonstrating innovative technologies that solve environmental problems and provide sustainable outcomes. Forming private and public partnerships to address challenging construction projects is one way to implement this goal. For example, a recent workshop at the University of Maryland challenged participants to integrate GHP concepts into planning for the design and eventual reconstruction of the U.S. Highway 301 Corridor in the Waldorf, Md. area. State officials are working with local citizens, environmental groups, engineers, materials providers and contractors to implement the best environmental management and construction practices possible when designing this project. Using CCPs and other industrial materials was one of the three primary topics of discussion. Opening up discussions like this well before a project begins will offer our industry an opportunity to provide information and demonstrate the multiple uses of our materials to designers and planners so they can specify their use where appropriate.

As the GHP gathers momentum, the process may bring transportation sector changes that promote new concepts and different approaches. Collaboration between states, federal agencies and private groups could accomplish actions that were thought impossible 10 years ago.❖

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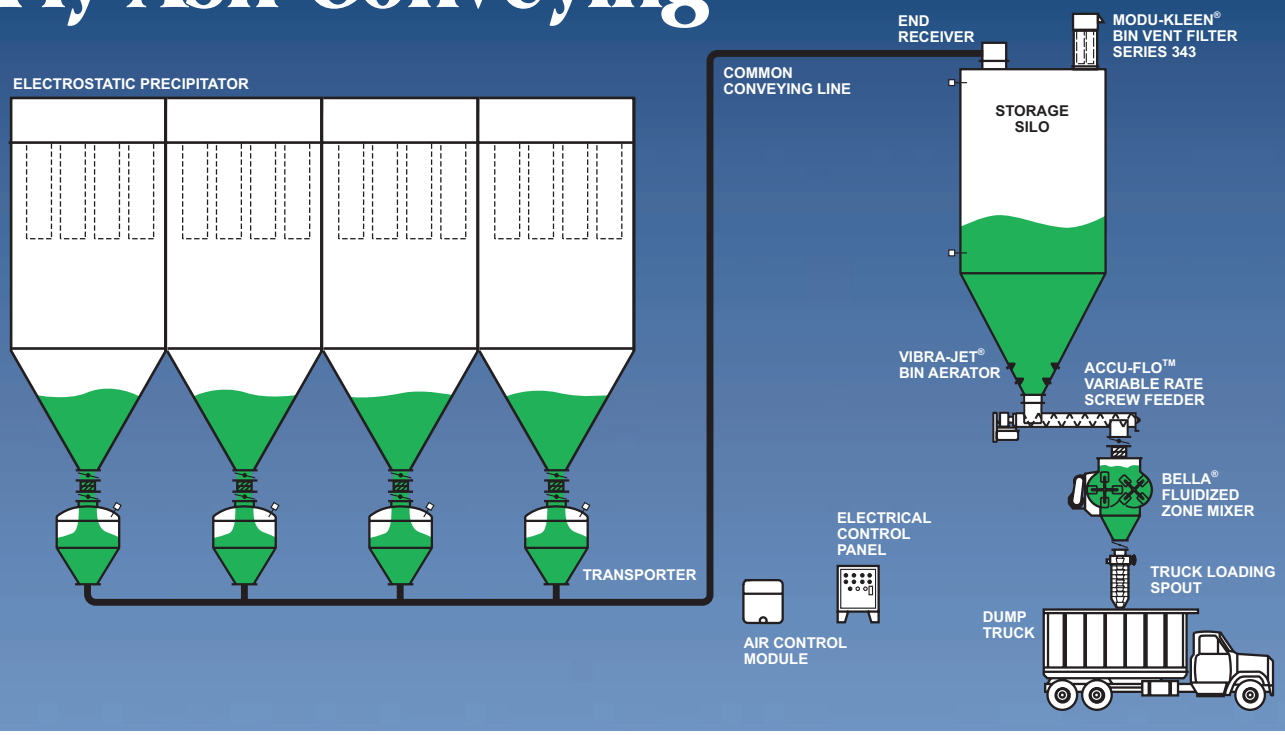

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REHABILITATING ASPHALT HIGHWAYS

Coal fly ash used on Ohio full-depth reclamation projects

By Tarunjit S. Butalia, Ohio State University

Asphalt placed over treated pavement base materials.

This article first appeared in the February 2007 issue of Asphalt Contractor *and is reprinted with permission from the author.*

Much of the almost two million miles of asphalt roadways in the United States are severely distressed and in need of repair or replacement. Over the last few decades increasing traffic demands combined with decreasing funding for repairs, environmental concerns and an emphasis on safe, efficient transportation systems have stimulated research and field demonstration projects to explore methods to reuse and recycle pavement materials.

In response to this need, the Department of Civil and Environmental Engineering and Geodetic Science at Ohio State University has partnered with the two fastest growing counties in Ohio (Delaware and Warren) to construct and monitor two pavement sections where failing asphalt pavements were recycled in 2006 using Ohio coal-generated fly ash as a cementing agent.

"The value of this technology and demonstration project to the contractor is at a minimum two-fold," says Chris Anspaugh, construction manager, Base Construction. "With the price of cementitous additives continuing to rise, in part due to the substantial energy costs involved in producing them, it would be of value to the contractor – from a competitive standpoint – to have alternative products available that will achieve the same end results.

"Secondly, the contractor needs testing data available that can be submitted to the owner to assure them the product will perform as we are claiming," he continues. "This research will go a long way in providing that information." This project will demonstrate that when non-concrete quality fly ash in combination with lime or lime kiln dust are properly incorporated into full-depth reclamation reconstruction of a flexible pavement, the use of fly ash can be economically attractive while offering increased structural and service performance, and should not lead to a degradation of environmental quality.

On this FDR research preservation project, the complete depth of the flexible pavement section – consisting of the asphalt layer, base, sub-base and a pre-determined amount of the underlying existing subgrade soil – was uniformly pulverized, blended with chemical additives (Class F fly ash in combination with lime or lime kiln dust) and compacted to construct a new stabilized-base course. An asphalt overlay was then placed over the stabilized base. Class F fly ash in itself is not self-cementing.

Material before mixing (left) and after mixing (right). Note the fly ash on the left side.

It needs additional lime to undergo a cementitous reaction. It's important to note that fly ash, when used in combination with lime or lime kiln dust, performs two important functions in FDR work:

- Fly ash provides the silica and alumina needed for cementitous reaction with lime to increase the strength, stiffness, and durability of the stabilized-base layer.
- Fly ash acts as a mineral filler to fill the voids in the granular pulverized pavement mix, reducing the permeability of the FDR stabilized base layer.

Lime or lime kiln dust by itself will not provide adequate stabilization for pavement materials deficient in silica and alumina. The addition of fly ash is necessary for cementitous reactions to occur.

CONSTRUCTION PROJECTS

Delaware County (just north of Columbus) is the fastest growing county in Ohio. In collaboration with the Delaware County Engineer's Office, Section Line Road between State Route 42 and Home Road was selected for FDR reconstruction in 2006.

The pavement sampling and design was carried out by EDP Consultants under the supervision of OSU. A total of nine sections were constructed using the following six mixes:

- 4 percent lime with 6 percent fly ash, 8-inch stabilization depth (0.7 miles).
- 5 percent lime kiln dust with 5 percent fly ash, 8-inch stabilization depth (0.6 miles).
- 3 percent lime kiln dust with 1.4 gallons per square yard emulsion, 8-inch stabilization depth (0.7 miles).
- 5 percent cement, 12-inch stabilization depth (0.8 miles).
- 2 percent cement with 1.6 gallons per square yard emulsion, 8-inch stabilization depth (0.3 miles).
- 5-inch mill and fill (two 0.1-mile sections at the north and south ends of the project, as well as a 0.7-mile and 0.1-mile section near the middle of the project).

The FDR rehabilitation of the section Line Road was completed in five phases. Milling removed 5 inches of the existing pavement asphalt surface followed by pre-pulverization of the remaining pavement materials to specified depths. The third phase involved treating the pulverized pavement materials with the six admixtures outlined above. Water was then added to the mix and it was compacted immediately. The last phase involved resurfacing the pavement with 5 inches of hot mix asphalt.

In Warren County, just south of Cincinnati, failing pavement was sampled and an appropriate mix design was carried out by EDP Consultants again under the supervision of OSU. Two sections were constructed as follows:

Compaction of the FDR base layer in Delaware County.

- 4 percent lime with 6 percent fly ash, 12-inch stabilization depth (0.32 miles).
- 5-inch mill and fill (0.08 miles).

The five-phase FDR rehabilitation included milling and removal of 4 inches of the existing pavement asphalt surface. Secondly, the remaining pavement materials were pre-pulverized to a depth of 12 inches. The third phase involved treating the pulverized pavement materials with lime at an application rate of 4 percent and allowing the material to mellow for a 24-hour period.

After the mellow period, 6 percent fly ash from Zimmer power plant of Duke Energy was blended into the mix to a depth of 12 inches. Water was added to the mix and it was compacted immediately. The last phase involved resurfacing the pavement with 4 inches of hot mix asphalt.

PAVEMENT INSTRUMENTATION AND MONITORING

During construction, the Delaware and Warren pavement sections were instrumented with the following structural and environmental monitoring devices:

- Strain gauges at bottom of asphalt layer.
- Pressure cells at bottom of stabilized-base layer.
- Pore pressure devices at bottom of stabilized-base layer.
- Linear Variable Displacement Transducers (LVDT) for measuring vertical deflections of pavement.
- Lysimeters installed within the stabilized base to monitor leachate quality.

Data collection from the above monitoring devices is being carried out on a quarterly basis. Falling Weight Deflectometer (FWD) tests (to measure pavement load deflection behavior, resilient modulus of pavement layers and subgrade soil, and base structural layer coefficient) are being carried out by the Ohio Department of Transportation. The FWD tests carried out on the pavement before and immediately after completion of rehabilitation show that FDR of the pavements with fly ash (and lime or lime kiln dust) increased the elastic modulus of the base layer. The fly ash sections exhibited elastic moduli of base layers similar to cement and cement plus emulsion sections. FWD tests will continue to be carried out twice a year to determine the longer term elastic moduli of the various sections constructed in this project.

OBJECTIVE AND GOAL

The overall objective of this work is to demonstrate the effective use of Class F fly ash in combination with lime or lime kiln dust in the FDR of asphalt pavements. This is done by establishing field-verified relationships for the service performance, structural and environmental behavior of FDR pavements constructed using lime-activated fly ash.

The OSU pavement instrumentation is installed at the bottom of the FDR layer (left to right) — pressure cell, pore pressure device and LVDT base — in Delaware County.

There are four interrelated activities. In the first, laboratory studies specifically designed to investigate the physical, chemical, and engineering properties of fly ash FDR mixes were conducted. This allowed the research team to determine the optimal material mixes that were implemented in the two pavement preservation projects. In the second activity, the two highway pavements that were constructed and instrumented in 2006 will be monitored for two years. This is to obtain robust field results on the structural, service and environmental performance of field-constructed FDR bases. In the third activity, existing flexible pavements constructed in Ohio using FDR will be investigated to allow for evaluation of the performance of existing projects for which no performance data has been collected to date. Lastly, the existing outreach and technology transfer efforts of the Coal Combustion Products (CCP) Extension Program at OSU will be focused on county, state, and federal transportation officials and other end users of the technology.

ENVIRONMENTAL BENEFITS

In addition to demonstrating the technology itself, these projects address a very important environmental issue, says Professor William Wolfe of OSU's Department of Civil and Environmental Engineering and Geodetic Science.

"Since the production of one ton of cement produces about one ton of carbon dioxide, which is then released into the atmosphere," he says, "the widespread replacement of cement with fly ash in roadway reconstruction will result in significant reductions in the generation of this greenhouse gas."

This three-year project at OSU, totaling over $2 million, is funded primarily by the Ohio Coal Development Office of the Ohio Air Quality Development Authority with additional support from the Delaware County and Warren County Engineer's Offices, Base Construction, Carmeuse NA, Headwater Resources, and others.

"Last year, two counties in Ohio used Ohio coal-generated fly ash in reclaiming failed asphalt pavements," says Mark Shanahan, executive director of the Ohio Air Quality Development Authority, which manages the Ohio Coal Development Office. "This resulted in more durable highway infrastructure and promoted the recycling of pavement materials and coal combustion byproducts, both of which would otherwise have been landfilled."

Greg Samios, project manager of EDP Consultants Inc. adds, "The unique opportunity of a comparative mix design study has enabled EDP Consultants to increase our knowledge and understanding of how different chemical additives may benefit the recycling industry."❖

Dr. Tarunjit S. Butalia, P.E., is a research scientist and coal combustion products coordinator for the Department of Civil and Environmental Engineering and Geodetic Science at Ohio State University.

This article can be accessed through the following link to the Asphalt Contractor Web site: http://www.forconstructionpros.com/print/Asphalt-Contractor/Features/Rehabilitating-Asphalt-Highways/2FCP4421

Press clippings featuring local media coverage of the conference.

CCP EXPERTS GATHER IN INDIA

Coal Ash Institute of India hosts Asia-Pacific Conclave on Coal Combustion Products

By Melissa Burke, American Coal Ash Association

Last year India produced 130 million tons of CCPs, about 10 million more than the United States. This amount is projected to more than double within 10 years, according to Dr. A.K. Chattergee, executive director of the Coal Ash Institute of India. The Institute hosted the Asia-Pacific Conclave on Coal Combustion Products in Kolkata, India, Feb. 23 to 25, 2007. The event gathered experts throughout the region and the West to discuss technologies and practices for increasing CCP use.

More than 200 people attended, representing seven countries, and 12 states within India, encompassing a broad range of interests from the power industry to consulting firms, cement producers, coal companies, asbestos-cement industry, research and academia, coal ash handling companies, ash processing companies, ash brick makers, environment specialists, individual experts, entrepreneurs, traders and others.

The event's keynote was delivered by Shri Mrinal Banerjee, West Bengal's minister of Power and Non-conventional Energy Sources and Labor Departments. He emphasized the industrial and social relevance of using CCPs and urged participants to

A ribbon-cutting ceremony begins the Asia-Pacific Conclave on Coal Combustion Products at the Hotel Taj Bengal in Kolkata, India. Pictured are Dr. A.K. Chattergee, executive director of the Coal Ash Institute of India; Shri Mrinal Banerjee, minister of Power and Non-conventional Energy Sources and Labor Departments for the Government of West Bengal, India; and others who helped organize the event.

view resource management from the perspectives of demand, supply and value.

The event featured two segments: an exhibition and symposium comprising two plenary sessions; two special sessions and six technical sessions, in which 31 papers were presented. Discussion covered regulatory norms and practices along with management systems in respective countries.

The American Coal Ash Association's Melissa Burke represented the United States, along with Tarun Naik of the University of Wisconsin in Milwaukee. Burke's presentation shared market challenges and opportunities including details on the potential impact of new regulations, as well as the successes of industry partnerships, such as the Coal Combustion Products Partnership of the U.S. Environmental Protection Agency and the Industrial Resources Council of the U.S. National Recycling Coalition. She invited participants to attend the World of Coal Ash conference featured in this issue of *Ash at Work* (on pages 45 to 49). Naik offered insights on increasing f y ash in concrete and building products. Also representing the West was Professor Ravindra Kumar Dhir, University of Dundee, Scotland. He discussed the feasibility of using conditioned and lagooned f y ash in concrete. German native Geor Dirk, owner of Dirk India Pvt. Ltd., delivered what many considered a somewhat controversial issue – blending f y ash directly into concrete instead of using pozzolonic portland cement.

Shri Mrinal Banerjee delivers his keynote address to an audience of nearly 200 people gathered to share the technologies and practices for increasing CCP use.

The conference featured many distinguished speakers from throughout the Asia-Pacific region, including: Dr. Sangmin Nam of the United Nations Economic and Social Commission for Asia-Pacific, Bangkok, Thailand; P. K. Basu, executive director of the Calcutta Electric Supply Corporation Ltd., New Delhi; and Dr. Vimal Kumar, advisor, Fly Ash Utilization Programme, Department of Science and Technology, Government of India. India's coal is about 30 percent ash. Low-ash coal is often imported or beneficiated as partial replacement of domestic supply for power generation. With energy demands rapidly increasing in India and throughout the Asia-Pacific region, CCP use is becoming exponentially critical.

Sahjanand Enterprises of Kolkata, India demonstrated its commercial success replacing red clay bricks with bricks made with f y ash. Their exhibit featured brick-making technology. Other

firms presented ceramic tiles, porous ceramics and flux-blended ceramics using fly ash.

The conference also explored using fly ash in agriculture, with such topics as standardizing an intrinsically variable material; resolving conflicting results of food-chain bioaccumulation due to repeated use of fly ash in soil; preventing leaching and percolation losses; concentrating nutrients in fly ash so that large bulk uses could be brought down in quantity and volume; and achieving success in biological treatment of fly ash such as in vermicomposting.

One session concluded that a high potential for carbon trading exists in India, following discussions – presented and discussed in detail – on identifying, documenting and registering projects.

The conclave concluded with recommendations for the Indian government to reach two national objectives: "Power for All 2012" and "100 percent ash utilization by 2014." As India pursues increasing power generation to meet its needs, the conclave urged greater investment in research and development related to new technologies and their impact on fly ash beneficiation and value. The conclave proposed that government enforce the use of coal combustion products.

Recommendations also targeted the power, construction, finance and transportation industries. The Coal Ash Institute of India plans to increase awareness campaigns aimed at thermal power station engineers so they better understand how to assess coal combustion products as commercial resources. The cement and concrete industry "should look afresh on the techno-commercial merits of using fly ash directly in concrete instead of, or in the form of factory-made PPC (pozzolanic Portland cement)." The conclave also urged a more concerted involvement of financing institutions in "assisting installation of ash-based products … researchers in India often find it difficult to commercialize new technologies." ❖

For more information and a copy of the proceedings, please contact: newwave@vsnl.com.

Sahjanand Enterprises demonstrates its fly ash brick technology during the exhibition at the Asia-Pacific Conclave on Coal Combustion Products.

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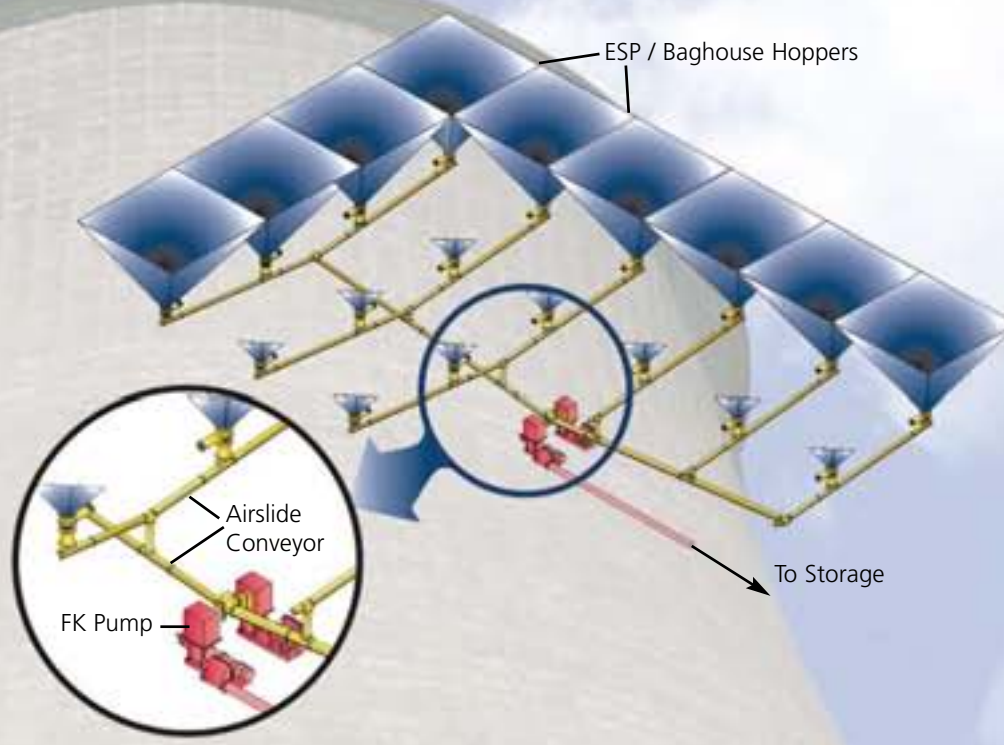

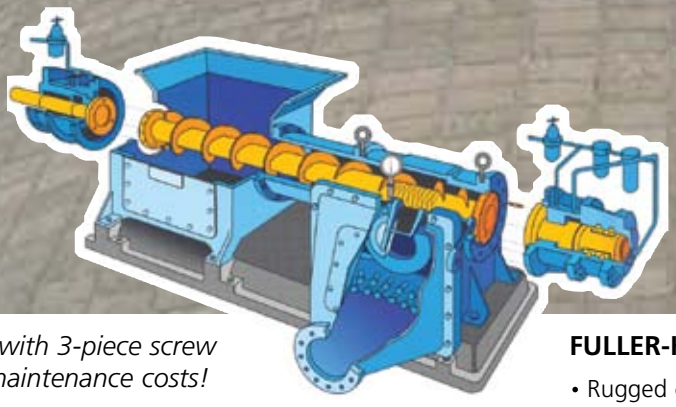

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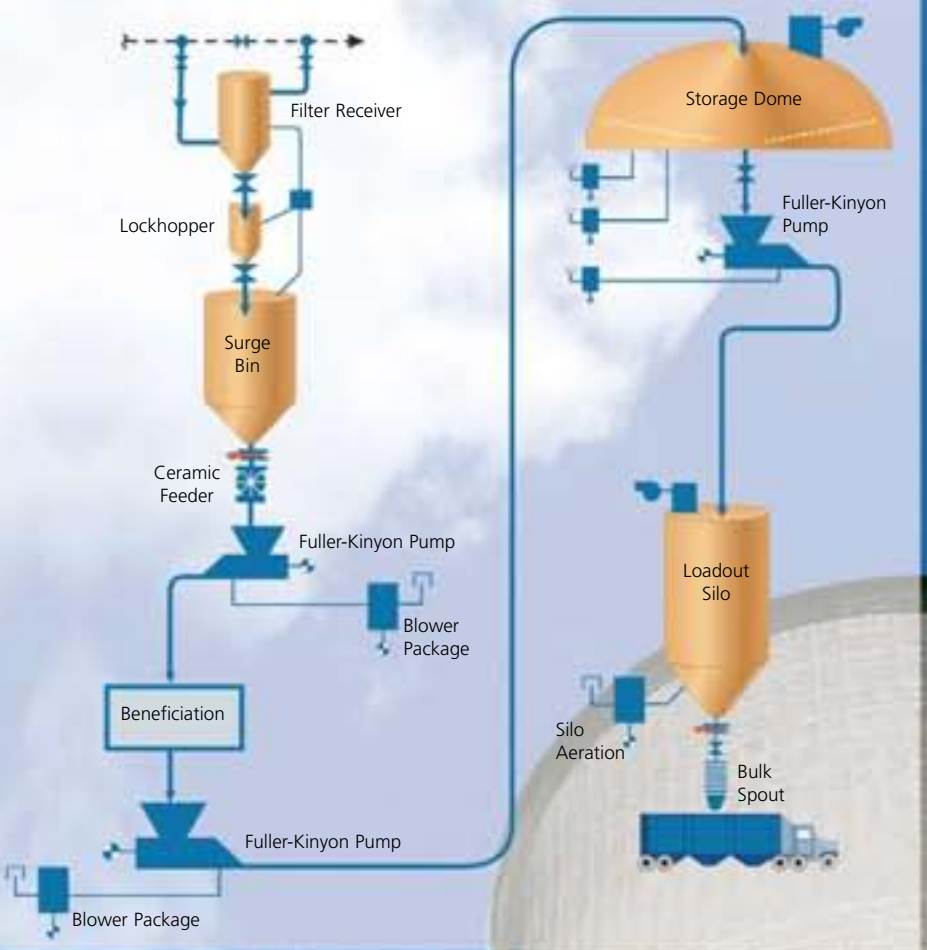

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- Butch Houseknecht, Operations Manager, Separation Technologies, Inc. (STI) Baltimore, Maryland

FLSmidth

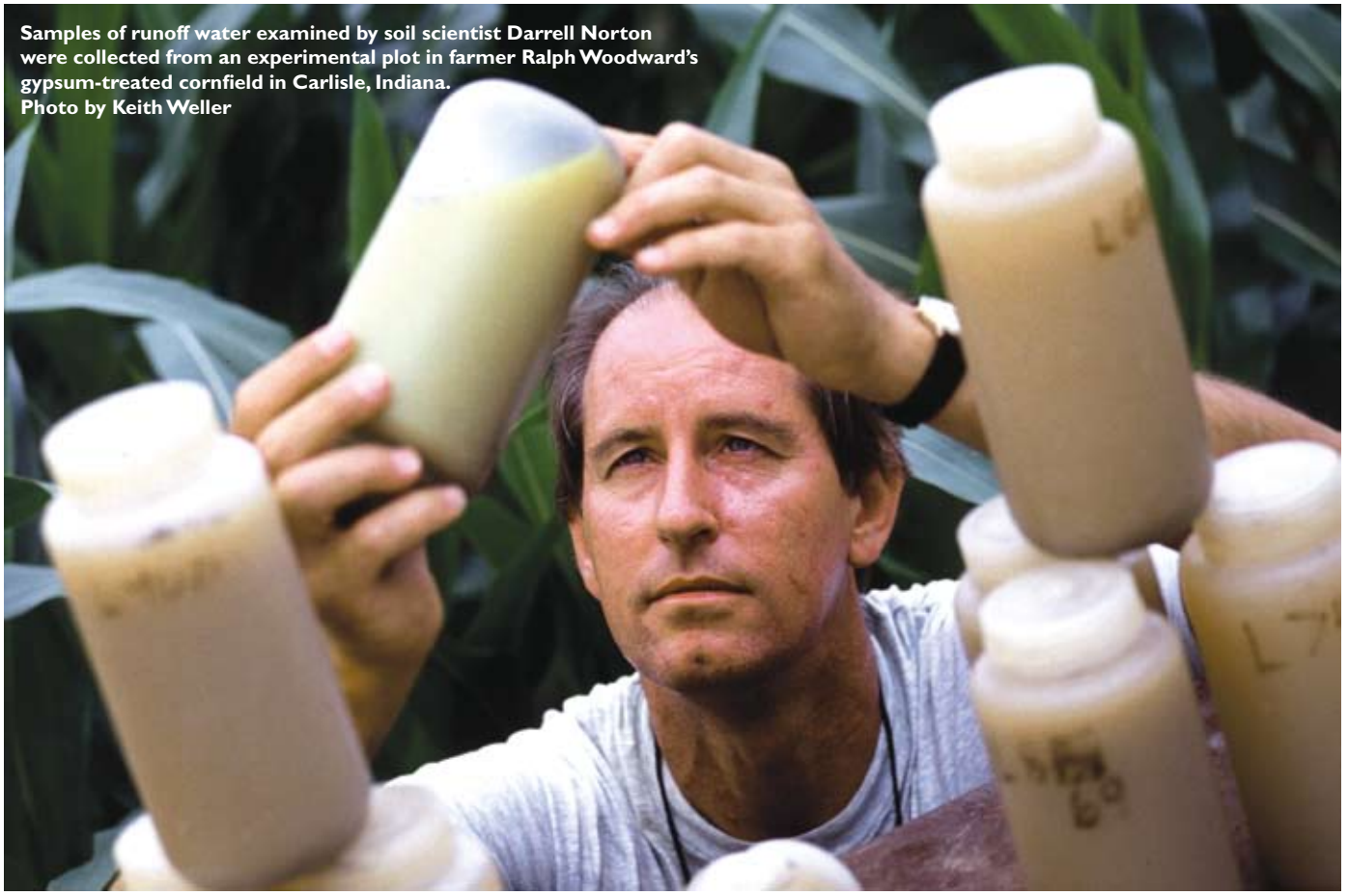
FGD GYPSUM'S PLACE IN AMERICAN AGRICULTURE

By Chad Haynes, Ph.D., U.S. Department of Agriculture, Agricultural Research Service

Surface cracks and soil clumps form when saline-sodic, high-clay soil dries out. Treatment with FGD gypsum and irrigation water flowing into these cracks leaches salts until the aggregates swell and the cracks close up. Photo by Peggy Greb

A priority focus of agricultural research is to maintain and improve the condition of the nation's natural resource base to sustain production of food, feed, fiber and energy crops. Two important parts of this activity are protecting watershed health to ensure clean and abundant water and enhancing the quality of soils to maintain productive working cropland. Soils can be degraded through natural forces (wind, water, temperature extremes) and human activities (agriculture, construction, mining). These forces and activities can result in accelerated soil erosion, loss of organic matter, soil compaction, accelerated soil acidification, and buildup of sodium, other soluble salts and toxic trace elements. Degraded soils result in reduced crop yields; require greater inputs of fertilizer, water and energy for crop production; and pose a greater risk of damage to water, air and wildlife resources. Soil degradation is a major problem in the United States and internationally with approximately one acre in six considered to be impaired to some extent. The U.S. Department of Agriculture – Natural Resources Conservation Service estimates that 100 million acres of cropland in the United States are susceptible to erosion. Measures to control erosion and other causes of soil degradation are needed to maintain the productive capacity of U.S. agriculture while protecting soil, water and air resources.

Many agricultural, industrial and municipal materials are generated each year that may be appropriate as soil amendments to reclaim or improve degraded soils. Some materials such as Coal Combustion Products (CCPs) are already being used to a limited extent in agricultural applications, but broader use of some of these materials could make a major contribution to the sustainability of agricultural systems. Using CCPs in agriculture would promote recycling, reduce or eliminate disposal costs, reduce energy inputs for agricultural operations, and provide low-cost materials to agricultural producers. To be useful in agriculture the CCP would need to have a number of characteristics: (1) the material would need to have physical and chemical properties that would allow it to address one or more topics such as control of soil erosion, improve water infiltration, storage and use in soils, remediate saline and sodic soils, remediate acidic soils, serve as a nutrient source for crops, and reduce movement of nutrients, sediment and agricultural chemicals to water and air; (2) the material would need to have a



Samples of runoff water examined by soil scientist Darrell Norton were collected from an experimental plot in farmer Ralph Woodward's gypsum-treated cornfield in Carlisle, Indiana. Photo by Keith Weller

fairly consistent composition so the outcome of its use would be predictable; (3) the material should be available in large amounts at numerous points around the country so transportation costs to sites where the materials could be used are manageable; (4) the generator and the agricultural user of the material need to be able to make or save money.

Flue gas desulfurization (FGD) materials, generated by removing sulfur dioxide from the flue gases of coal-fired power plants, offer significant potential for use in agriculture. The major use of FGD gypsum generated by wet scrubbers for sulfur dioxide (SO_2) removal is currently gypsum panel production. As more power plants with wet scrubbers and forced oxidation come online, additional large volume uses of FGD gypsum, such as agriculture, will be needed. Dry scrubber materials, containing significant levels of calcium sulfite generally have been landfilled and present a greater challenge for use in agriculture than gypsum at this point. For centuries mined gypsum, chemically described as calcium sulfate ($CaSO_4 \cdot 2H_2O$), has been used as a soil amendment to supply plant nutrients and to improve soil properties. Benjamin Franklin, one of America's first scientists, promoted the use of gypsum as a soil fertilizer. Eugene Hilgard, a pioneer in the area of soil science, observed the ability of gypsum to amend alkali soils in California during the 1880s.

Research to develop beneficial agricultural uses of FGD gypsum has been conducted by university researchers and USDA-Agricultural Research Service (ARS) scientists. A considerable amount of information is available about the beneficial impact of FGD gypsum application on crop yield and crop quality. The solubility of gypsum makes it an excellent source of calcium and sulfur, both essential nutrients for plant growth. Scientists from the University of Georgia have shown that application of gypsum provides a calcium source to crops such as peanuts allowing the plants to be productive and disease free. The sulfur in gypsum also is important for plant growth since sulfur deposition in rainfall has dramatically decreased over the past 20 years. Scientists from The Ohio State University, with financial support from the Electric Power Research Institute have initiated a program to look at beneficial agricultural uses of FGD gypsum at various locations around the country.

FGD gypsum can be used to improve soil chemical and physical properties. ARS scientists from West Lafayette, Ind., found that treatment of field plots with FGD gypsum significantly reduced soil loss and runoff during natural rainfall events. Due to its high purity and fine particle size, FGD gypsum releases electrolytes quickly and prevents soil surface sealing, a leading cause of soil erosion. Surface soil sealing also prevents movement of gases such as nitrogen and oxygen into the soil, thereby limiting plant metabolism and essential plant processes such as biological nitrogen fixation. The ARS scientists found larger and healthier plant root systems after FGD gypsum application, thereby allowing more effective use of soil water and nutrients.

ARS scientists from Oxford, Miss., have investigated the effects of FGD gypsum

Severe soil erosion in a wheat field near Washington State University. Treating soils with FGD gypsum increases soil aggregation, which can limit erosion. Photo by Jack Dykinga

on soil properties and erosion in the southeastern United States. Soils in this part of the country are of poor quality and do not capture and store water efficiently. Therefore, rainfall runoff exacerbates soil erosion and adjacent water bodies are impaired by sediment and nutrients. Since these soils do not store water effectively, crops are susceptible to the effects of drought. The southeastern United States is currently experiencing drought conditions, with many locations running precipitation deficits of 10 inches or more over the past year. These conditions pose a significant challenge to farmers in the region. Coal burning power plants in this region will increase production of FGD gypsum over the next 10 to 15 years. The researchers in Mississippi have demonstrated that FGD gypsum surface applied at 3 tons per acre to a no-till cotton production site dramatically improved soil aggregation and limited erosion. They also found that FGD gypsum improved rainfall infiltration, decreased runoff and reduced erosion on a high-sodium content degraded soil. This research suggests amending the erodible soils of the southeastern United States with FGD gypsum may provide a win-win solution for farmers and coal burning utilities in the region.

While a considerable amount of research has demonstrated benefits of FGD gypsum, additional research will be needed to document the effectiveness, safety and environmental benefits of FGD gypsum and related materials across a range of agricultural uses. Benefits and risks of using these materials including bioavailability of trace elements such as mercury, arsenic and selenium will have to be determined to satisfy the legitimate concerns of generators, regulators and users. More guidelines will need to be developed for specific uses of FGD gypsum to help farmers and their advisors make appropriate agricultural management decisions. In addition, the environmental benefits (water quality improvement, air quality improvement, carbon dioxide emission reduction) resulting from agricultural uses of FGD gypsum will need to be fully documented.

Several programs and policies of the U.S. Department of Agriculture may play a role in implementing more wide-

Soil scientist Darrell Norton (left) and Ralph Woodward, a cooperating corn farmer, assess the effect of field application of gypsum on plant root growth. Photo by Keith Weller

spread use of materials such as FGD gypsum in agriculture. USDA Conservation Programs including the Environmental Quality Incentives Program and the Conservation Security Program provide farmers technical assistance, cost-sharing and financial incentives if they adopt agricultural management practices that provide environmental benefits such as improved air, water and soil quality.

These programs distribute in excess of one billion dollars annually to farmers to use practices that protect and enhance the environment. To be eligible to receive these funds a practice must be recognized as a "standard practice" by the Natural Resources Conservation Service. For example, if FGD gypsum were to be used for erosion control and to reduce movement of sediment and nutrients to surface waters, it will be necessary to document the effectiveness and water quality benefits of the practice across a range of soils, climate and agricultural systems. Documentation of the environmental benefits of an agricultural practice or system of practices could also lead to farmer participation in Environmental Credit Trading Programs promoted by USDA. The 2007 Farm Bill is likely to increase funding in the Conservation Programs and to promote increased biomass production for conversion to renewable fuels such as ethanol and biodiesel. Marginal farmland may need to be used to meet biomass production requirements. Many of these marginal lands could benefit from FGD gypsum application to improve soil properties for biomass production and to protect surface waters from sediment and nutrients in runoff.

Agricultural researchers are very interested in conducting research that will expand beneficial agricultural uses of FGD gypsum and other CCPs. Development of safe and effective uses of these materials will contribute to the sustainability of American agricultural systems. Successful completion of these activities will require a strong partnership involving university researchers, USDA, EPA, DOE, American Coal Ash Association, Electric Power Research Institute, and state regulatory agencies and utilities. Together we can achieve an outcome beneficial to all participants.

Chad A. Haynes, Ph.D., is an American Association for the Advancement Science (AAAS) Science and Technology Policy Fellow at USDA Agricultural Research Service, Natural Resources and Sustainable Agricultural Systems, National Program Staff, Beltsville, MD, and can be reached by e-mail at Chad.Haynes@ars.usda.gov ❖

WASTE NOT, WANT NOT

Promoting Sustainability

By Anne Weir, Association of Canadian Industries Recycling Coal Ash (CIRCA)

Issues surrounding the beneficial use of coal combustion products (CCPs) are not unique to the North American market. It is hoped that discussions now underway in Europe will encourage greater CCP use this side of the Atlantic. The European Commission's (EC) "Interpretative Communication on waste and byproducts"[1] breaks new ground with its inclusive and constructive approach to the classification of materials, products and wastes. This process-oriented guideline suggests an empowered role for CCP producers and users to qualify materials and claim market value in accordance with proven, commercial applications. Potential implications for growth in trade and technological advances could encourage increased recycling, CO2 offsets and other productivity or sustainability improvements.

The focus on end-use applications is a consistent theme in the waste/product debate. Distinguishing between waste and product can be complex, involving close examination of related and potential processes and their outcomes, intentional or otherwise.

The European Commission's February 2007 communication offers a progressive distinction between waste and non-waste. This guideline sets out to "clarify the legal situation for economic operators and competent authorities" and effectively disentangles a material's status with a more positive disposition toward classification according to its merits for further use in the economy. A simple three-part test defines criteria by which a material will not be classified as waste. Further, these definitions are forgiving, i.e., when a material once classified as waste can be redeemed to the status of "recovered product" based on the merits of a useful application.

By contrast, definitions of waste and byproduct more traditionally formulated as a component of waste management legislation are predisposed to classifying a byproduct material as waste. Associated regulations establish barriers to recycling on the basis of a material's intrinsic characteristics without the benefit of "further use" context. The negative connotation conventionally associated with the term "byproduct" tends to carry over into the marketplace, where perception of value and price coalesce. As assurance of environmental responsibility falls to the producer or end user, testing and permitting costs of en demand more of their commitments to innovation and sustainability than the market can support. Clearly, disincentives to recycling byproducts for beneficial use are embedded in our system.

The term "byproduct" recognizes the valuable attributes of secondary materials derived from an intended process. Thus, many CCPs qualify for "beneficial use" in manufacturing, construction and agricultural applications. Sometimes, CCPs "improve upon or exceed the requirements" of the materials they replace,[2] resulting in performance enhancements. In some applications, CCPs recycled into manufacturing processes can improve the environmental footprints[3] associated with their alternatives. Yet it still remains a challenge to recycle CCPs into proven beneficial uses.

The EC's "Communication" surpasses convention to encourage innovation and empower those who can, to recycle. It's more inclusive approach focuses on process, intention and potential for re-use: the classification of the output depends on its intrinsic nature *and* its usefulness to other processes. *Sure, it's what you start with, but even more, it's what you do with it that determines value.* Allowing for the application of new technologies and the impact of market forces to re-qualify materials on a product/

Fly ash used for structural fill is among its many valuable applications. Most commonly f y ash is used as a high-performance substitute for portland cement or as clinker for portland cement production. Cements blended with f y ash are becoming more common. Building material applications range from grouts and masonry products to cellular concrete. Many asphaltic concrete pavements contain f y ash. Geotechnical applications include soil stabilization, road base, structural fill, embankments and mine reclamation. Fly ash also serves as filler in wood (see page 36 featuring Century Wood's LifeTime Lumber) and plastic products, paints and metal castings.

A bottom ash holding pond is pictured. Bottom ash may be used beneficially as a raw feed for manufacturing Portland cement clinker; skid control on icy roads; various geotechnical applications, such as structural fills; land reclamation; replacement for aggregate in f owable fill; in concrete masonry products and other applications.

byproduct/waste continuum is an advance, enabling sustainable practices. The potential implications for trade are similarly positive. Where materials arising from one process can responsibly augment another, diversion from a waste stream can offset CO2 emissions, reduce demand on virgin resources and lower costs. It's win/win and win.

Many industry sectors have come a long way in the last decade to appreciate the potential for beneficial use of CCPs. The drive for productivity and sustainability has resulted in industry and government sponsored educational initiatives[4,5] that support increased recycling rates. We've also come a long way to appreciate the necessity for decisive action to stem emissions CO2 and their impact on our atmosphere. If one considers that the constructive application of CCPs can avoid emissions associated with the processing or manufacturing of the material(s) they replace, the net effects of beneficial use go far beyond the avoidance of landfill to the recovery of intrinsic value, the husbandry of resources, and the greening of industrial processes.

The waste/product debate has imminent implications in the context of clean air legislation options considered for control of mercury emissions. While some mercury control technologies and processes *safeguard* properties of CCPs valued for specific markets, *others render them unusable.* The choice of technology will determine whether we proliferate sustainable processes or compound problems associated with waste. We all will benefit if the long-term values of beneficial use are balanced with capital costs, operating practices and innovative waste management policies when selecting emission-control technologies. ❖

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1. "Communication from the Commission to the Council and the European Parliament on the Interpretative Communication of waste and byproducts"; Commission of the European Communities, Brussels, 21 February 2007 (COM 2007) 59 final.
2. "What are CCPs?"; D. Goss, ACAA: *Energeia,* Vol. 18, No. 1, 2007 UK Centre for Applied Energy Research.
3. "Guidelines for the Selection and Use of Raw Materials in the Cement Manufacturing Process"; Cement Sustainability Initiative, Dec. 2005. www.wbcsdcement.org/pdf/tf2/tf2_guidelines.pdf
4. Government of Canada's Action Plan 2000 on Climate Change; Supplementary Cementing Materials Program. www.scm.gc.ca/ap2k.html
5. Coal Combustion Products Partnership. www.epa.gov/epaoswer/osw/conserve/c2p2/

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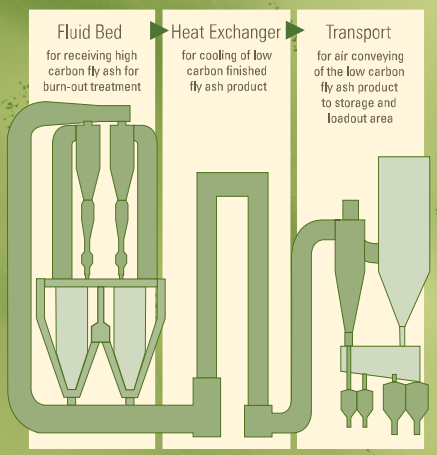

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At AEP, we're proud of our reputation as a leader in the research and use of coal combustion products. As the nation looks for more environmentally responsible building practices, we remain committed to finding new ways to incorporate CCPs as components that enhance building products and contribute to land reclamation, road construction and surface maintenance projects. These applications are reducing the need for landfill disposal of CCPs while replacing significant amounts of newly manufactured building products. When it comes to researching new uses for CCPs, **AEP is there, always working for you.**

From the construction of AEP's generating facilities (above left) to AEP's corporate headquarters building (above right), coal combustion products were specified for their superior engineering characteristics and low cost.

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COAL COMBUSTION PRODUCTS INDUSTRY EDUCATIONAL CHALLENGE

The ACAA Educational Foundation arranged with Boral Material Technologies to provide Class C fly ash to the University of New Hampshire to construct a canoe, named "Cat-Astrophe." The boat placed seventh out of 12 in a concrete canoe competition hosted by Wentworth Institute of Technology at Lake Cochituate in Natick, Ma. Please note: This event was separate from the American Society of Civil Engineer's National Concrete Competition held June 14 to 16, 2007.

The ACAA Educational Foundation was established in 1996 to promote understanding of coal combustion products' management and utilization through communications and outreach initiatives aimed at government and industry decision makers and the public. Foundation initiatives consist of awarding university level scholarships, development and distribution of educational materials, financial support for research and sponsorship of CCP forums.

SCHOLARSHIP

The Foundation promotes the development of industry talent and competency. Students pursuing degrees in CCP-related engineering disciplines, such as material, civil, structural or chemical engineering may qualify for financial assistance. The Foundation also facilitates educational partnerships that increase understanding and knowledge.

PUBLICATIONS

The Foundation shares best practices, case studies, technical information and research findings through a variety of publications and electronic media. The Foundation coordinates and reviews publication of technical papers or reports for the American Coal Ash Association in *Ash at Work*. It is also preparing a new version of the publication "Soil Stabilization and Pavement Recycling with Self-Cementing Coal Fly Ash," to be released later this year.

RESEARCH

The Foundation supports institutions and individuals engaged in CCP research to find new and innovative uses for these materials - uses limited only by imagination. Students and faculty members participate in assisting and advising the Foundation in implementing other mission-related activities.

WORKSHOPS & CONFERENCES

Workshops and conferences supported by the Foundation provide information and opportunities for technology transfer to public and private sector participants. Held in locations across the United States, these events address topics ranging from basic information to in-depth technical studies. The Foundation is the coordinating sponsor of an FGD gypsum workshop to be held in Atlanta, Oct. 23 to 24, 2007. Details are available at www.FGDProducts.org.

THANK YOU

ACAA EDUCATIONAL FOUNDATION SPONSORS

In January 2007, the Foundation began an "Educational Challenge" to raise $50,000 or more by the end of the year. If successful, the American Coal Ash Association will match up to $50,000 dollar-for-dollar. As of the *Ash at Work* editorial deadline the following companies and individuals made contributions to the challenge. We thank these donors for their support of the Coal Combustion Products industry.

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FLY ASH BENEFITS BUILDING INDUSTRY

Fly ash becomes key ingredient in Century's recipe for environmentally sustainable success

By Nisha Vyas Mahler, Century Products LLC

As global concern surrounding the depletion of natural resources continues to mount, manufacturers are striving to develop new alternatives to natural materials that are not only inherently more environmentally friendly, but also "green" in their manufacturing processes. Power utilities are also seeking sustainable uses for the byproducts of burning coal for electricity. These byproducts offer alternatives to the natural materials manufacturers are looking for.

Century's product is ideal for fences, decks, boating docks, and many other applications. Founders envisioned a versatile, durable and environmentally friendly product. Fly ash proved ideal.

Century Products, LLC, for example, is developing an "eco-friendly wood alternative," using fly ash as its main ingredient. The product, named LifeTime Lumber ™, has the look and feel of wood, yet costs less to produce, and meets desired environmental and commercial objectives. Wood product manufacturing is notorious for using water in excess and toxic chemicals, while producing wastewater that must be treated on site. Century's energy-efficient manufacturing process consumes a minimal amount of water and produces zero wastewater emissions. What's more, the product requires no chemical treatment.

Fly ash caught Century's attention because of its chemical and physical attributes as the company sought material substitutes for wood. Fly ash offers a strong crystalline structure; its surface can be quickly and uniformly coated by liquid materials. These characteristics make fly ash compelling in terms of strength. Century also found fly ash readily available and relatively inexpensive.

Consumers benefit from the product's combination of strength, weight, flexibility, water resistance and durability. The product can be nailed, sawed, etc., just like wood. It comes in a variety of colors, does not rot, is impervious to termites and is unaffected by the elements. LifeTime Lumber™ also has a Class B fire rating.

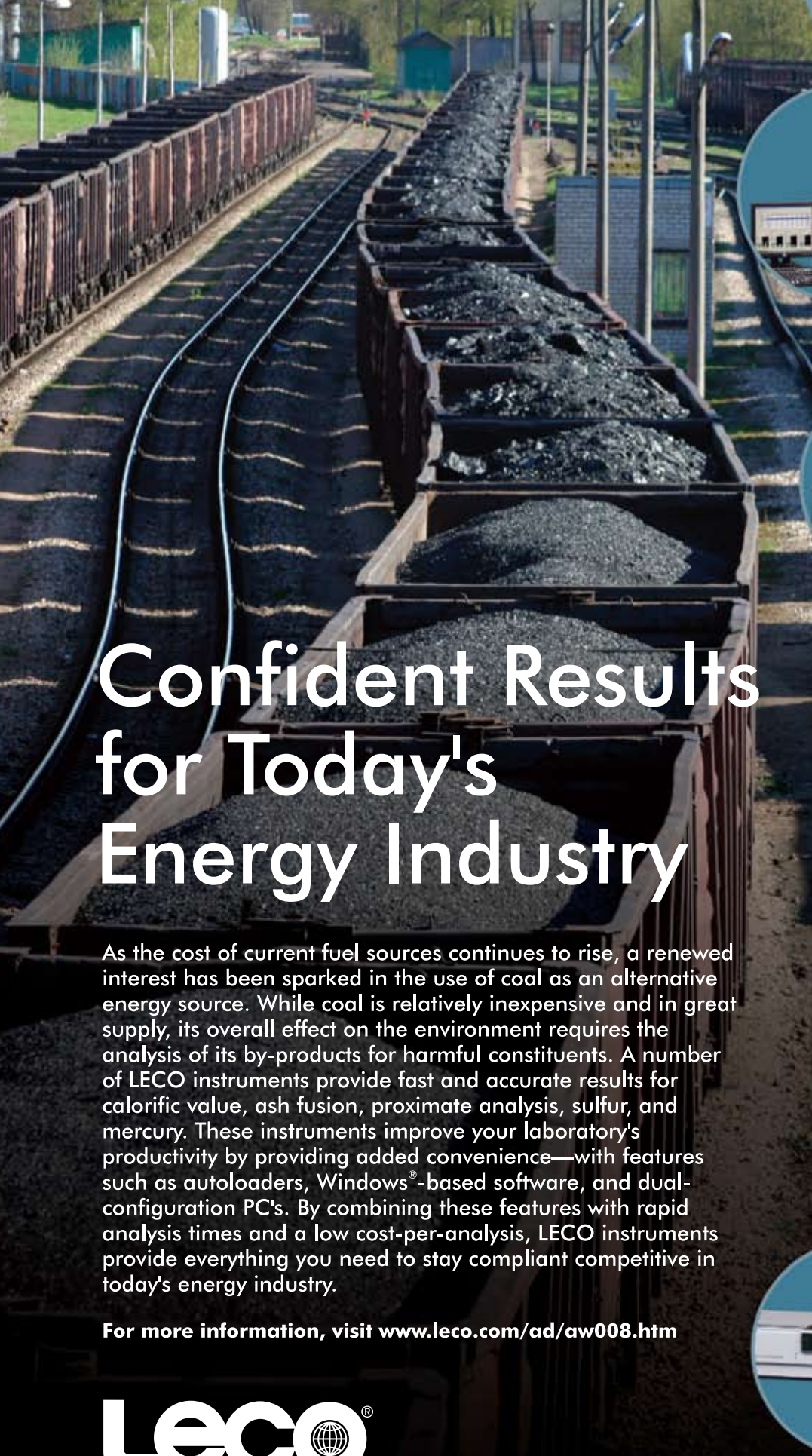
Ameren Energy Fuels and Services (AFS) provided initial funding for the research and development facility to perfect the process. They also provided consultation in selecting and procuring ashes suitable for Century's production. Century adds fly ash directly into the mix, thereby avoiding wood pulverization and plastic sorting/melting processes required by other composite manufacturers.

When Century was founded in 2002, the partners' vision was to achieve the maximum degree of sustainability, balancing environmental, economic and social principals into the way they do business and how they manufacture.

In late 2006, LifeTime Lumber ™ received recycled content certification from the International Organization for Standardization, U.S. Green Building Council and Scientific Certification Systems. With certification, Century's product conforms to criteria under the Leadership in Energy and Environmental Design (LEED®) Green Building Rating System™. Certification by LEED is a nationally accepted benchmark for the design, construction and operation of high-performance green buildings. The program offers architects, engineers, interior designers, construction managers or anyone in the market for a green building product, with guidance and resources to improve their buildings' performance.

With its environmentally friendly properties and manufacturing process, as well as its ability to act as a durable alternative for wood in traditional applications, products like LifeTime Lumber™ offer potential opportunities for fly ash producers and marketers to find new uses for otherwise unusable by-products or as they're known in the industry, "Coal Combustion Products." Likewise, incorporating these types of products into construction creates a viable component for today's burgeoning green construction industry. ❖

Nisha Vyas Mahler is vice president of Century Products, LLC and can be reached by e-mail at mahlern@ltlumber.com.



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TECHNOLOGY MEETS AGGREGATE

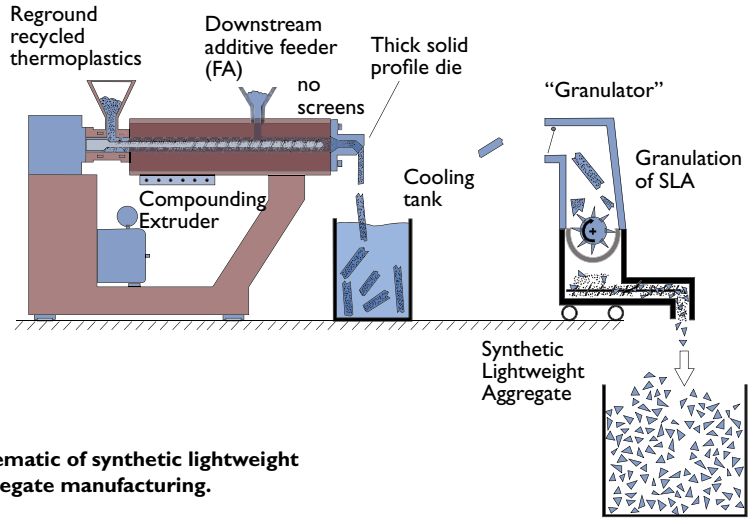
New technology for synthetic lightweight aggregate creates material from various qualities of ash

By Charles Wilson, INNERT Co. and Christopher Swan, E3 Innovative Materials

Each year in the United States, approximately 950 million tons of coal is consumed for electricity generation and industrial use. Today, approximately half of all electricity generated in the United States is via coal combustion. This makes coal the most extensively used and important source of energy, however, one of the issues faced with coal combustion is what to do with the approximately 123 million tons of coal combustion products (CCP) produced annually. Fly ash represents approximately 71 million tons of this annual CCP production, of which 40 percent is reused, mostly in the construction industry. The remaining material is most of en disposed of in landfills. The cost of CCP's disposal increases annually with one estimate at $1 billion per year – a figure most likely to increase as landfill space becomes restricted.

Utilization of f y ash is limited by many technical factors; one being that CCPs must meet certain chemical requirements. For example, in an effort to meet the standard for nitrous oxide (NOx) emissions, many coal burning facilities have adopted processes in which ammonia is added af er combustion to react with the NOx to form harmless byproducts. While NOx emissions are greatly reduced, the resulting ash has excessive levels of ammonia, which renders the f y ash no longer ideal for use in making concrete due to ammonia leaching and volatilization. Another is an elevated level of carbon content. Current ASTM standards require a carbon content of less than 4 percent for use of f y ash in most concretes.

New technology for the production of synthetic lightweight aggregates (SLAs), an innovative construction material created from the co-extrusion of recycled mixed plastics and f y ash, was first developed in the late 1990s as a potential method to bind f y ash into a usable aggregate form. More than 41 million metric tons of thermoplastics were produced in 2006 in the United States and Canada, yet less than 10 percent were recycled. Previous work has shown that SLAs can be utilized in geotechnical applications, concrete and asphalt applications.



Schematic of synthetic lightweight aggregate manufacturing.

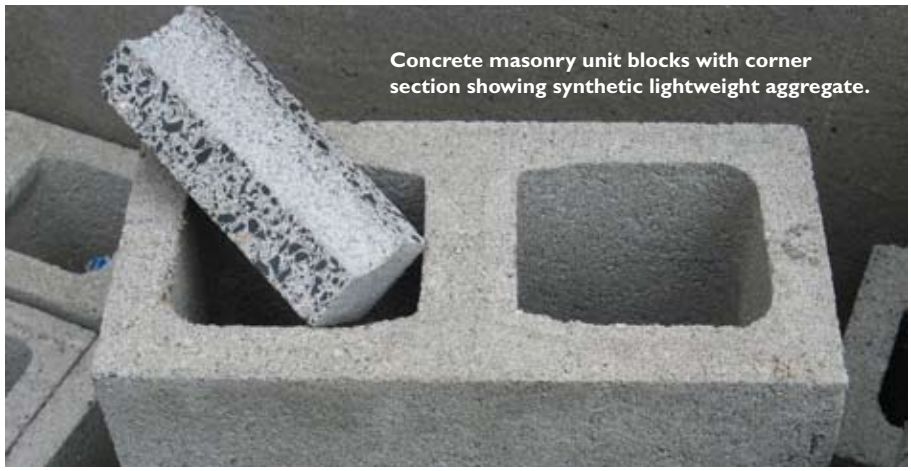
The work on SLAs has been centered at Tuf s University and the University of Massachusetts at Lowell. SLAs are manufactured by melt-blending a f y ash "filler" with plastics at the desired proportions using a co-rotating intermeshing twin-screw extruder (Schematic shown below, lef). The resulting granulated material resembles dark gray sand and fine gravel. A key benefit of the manufacturing process is the potential to use even poor quality f y ashes in making the aggregates, especially those high in carbon content.

Solid die and resulting synthetic lightweight aggregate after granulation.

Over the last decade, SLA research has focused on the physical and mechanical properties of various SLA compositions in geotechnical, concrete, and asphalt applications. Work has also been done in manufacturing SLAs, including different SLA formulations and manufacturing methods, and laboratory and industrial plant scale manufacturing methods. The results of these efforts indicate a strong potential for the large-scale production and use of SLAs in engineered applications.

PILOT SCALE PRODUCTION OF SLA

A pilot scale manufacturing effort was performed at a private research and development facility in Ramsey, N.J. The



Concrete masonry unit blocks with corner section showing synthetic lightweight aggregate.

materials shipped to the facility were (1.) a mixed plastic dry blend, and (2.) high carbon coal f y ash. The mixed plastic formulation was "dry blended" and contained a variety of plastics shown in the chart above.The high carbon f y ash (HCFA) was supplied by a New England utility and had a carbon content in the range of 20 percentage.

The process used to produce the SLA at the facility led to an SLA that contained 80 percent f y ash and 20 percent mixed plastic. Approximately 10,000 pounds of material was produced. Unlike the lab scale process, this SLA could be produced via "open discharge" at the end of the extruder, greatly enhancing the SLA throughput (previous page). With proper extrusion equipment sizing, it is believed that an SLA production rate of 15,000 pounds per hour can be achieved. The open discharge system would produce SLA with an irregular shape having an average length of three-quarter inch to 1 inch. This product can be further granulated and sieved to achieve the desired aggregate size distribution.

A trial run producing concrete masonry unit (CMU) blocks was performed at a full-scale facility located in Worcester, Ma. The CMU production process consisted of mixing the necessary dry components (sand, SLA and cement) with water and then transferring the mixture via automated equipment to produce CMU blocks. The production process consisted of placing pre-measured amounts of fresh masonry mix into a set of three molds (8-inch by 8-inch by 16-inch blocks). The masonry inside the molds was then subjected to pressure and vibration to form the blocks. Once the CMUs were ejected from the mold(s) they were allowed to cure in a temperature-controlled chamber (140 degrees F) for three days. The usual CMU mix design to produce "medium-weight" block consists of a sand-cement-expanded clay-shale-slate lightweight aggregate (Norlite™) weight ratio of 2-to-0, 4-to-1. The SLA-based block was produced by simply substituting the Norlite for SLA (they have similar bulk densities). Approximately 150 CMU blocks were produced and are being stored at Tuf s University.

SYNTHETIC LIGHTWEIGHT AGGREGATE USED IN HOT MIX ASPHALT

It has been shown that SLA can be used as a partial substitution of a traditional stone aggregate in hot mix asphalt (HMA). Laboratory studies included preparation of aggregate blends and HMA mixes with zero percent, 5 percent, 10 percent, 15 percent and 20 percent SLA by weight. Tests included resilient modulus and rut testing with a wheel tracking equipment at 60 degrees C. The results indicate that the inclusion of SLA increases the resilient modulus of HMA by 200 percent to 250 percent. In addition, the resistance to rutting is greatly enhanced as the depth of rutting decreased 57 percent to 73 percent as SLA was incorporated into HMA. The increased stiffness for blends with higher SLA content would then allow for the design of relatively thinner pavement layers.

Fly ash that does not meet standards for present commercial uses can now be combined with mixed waste plastics to manufacture a synthetic lightweight aggregate that can be used in a variety of applications. Utilities can directly benefit by saving in disposal costs. They can also reduce their carbon footprint through decreased transportation and delivery of these f y ashes to disposal facilities outside the state of origin. In all, this technology creates a material manufactured from 100 percent waste materials benefiting utilities, the waste plastics industry, and the various industries in which SLAs can be utilized.

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Polymer percentage by weight for SLA manufacturing

- 1.5% Achrylonitrile Butadiene Styrene Engineered Thermoplastic (ABS); e.g. Computer and computer monitor housings.
- 4% Polystyrene (PS) #6 Post Consumer Recyclable Material; e.g. clear trays for holding food such as cookies, etc.
- 8.5% High Impact Polystyrene (HIPS); e.g. polystyrene with the addition of a rubber compound for impact modification.
- 14.5% Low Density Polyethylene (LDPE) #4 Post Consumer Recyclable Material; e.g. yogurt containers, shrink wrap film for palletized material.
- 16.2% Polyethylene Terephthalate (PET) #1 Post Consumer Recyclable Material; e.g. consumer drinking water bottles.
- 25.5% Polypropylene (PP) #5 Post Consumer Recyclable Material; e.g. cream cheese container, large plastic souvenir soda/beer cups.
- 30.1% High Density Polyethylene (HDPE). #2 Post Consumer Recyclable Material; e.g. plastic detergent bottle.

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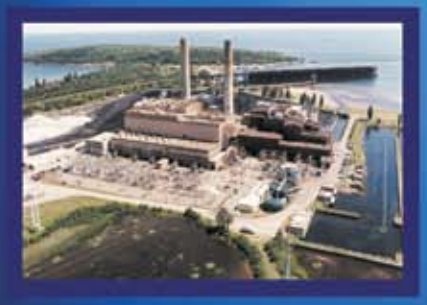

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WORLD OF COAL ASH CONFERENCE

Another banner year in 2007

By Melissa Burke, American Coal Ash Association

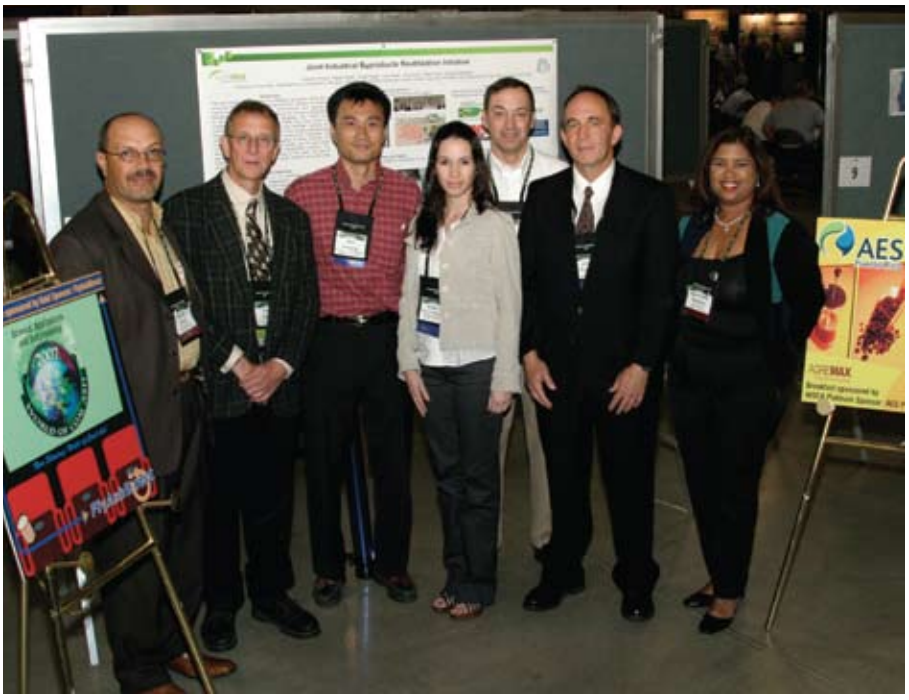
The World of Coal Ash Conference held May 7 to 10, 2007 attracted more than 500 guests representing 21 countries. This biennial event is organized jointly by the American Coal Ash Association and University of Kentucky's Center for Applied Energy Research. These organizations first came together in 2005, combining previously separate international symposia. The first WOCA was held in Lexington, Ky. This year's location was the Northern Kentucky Convention Center in Covington, near Cincinnati.

Distinguished attendees (left to right) William Wolfe, Ishwar Murarka, Behrad Zand, Tom Jansen and Ken Ladwig were joined at WOCA `07 by more than 500 guests from 21 nations around the world.

Catherine Vial of the U.S. Department of Commerce gave an overview of the opportunities for companies to expand trade and business relationships outside of the United States. Her plenary presentation gave an international perspective to the opening session.

Irina Putilov addresses the audience during a session on managing ash transport and handling. She, along with her father, Dr. Vyacheslav Y. Putilov of the Industrial Ecology Academy, represented the Moscow Power Engineering Institute. This was Ms. Putilov's second visit to WOCA.

Participants enjoyed an extraordinary variety of topics pertinent to the CCP industry. All levels of understanding from novice to expert were accommodated. The conference began with a heartily attended welcome reception and proceeded with an agenda comprised of four parallel sessions over three days,

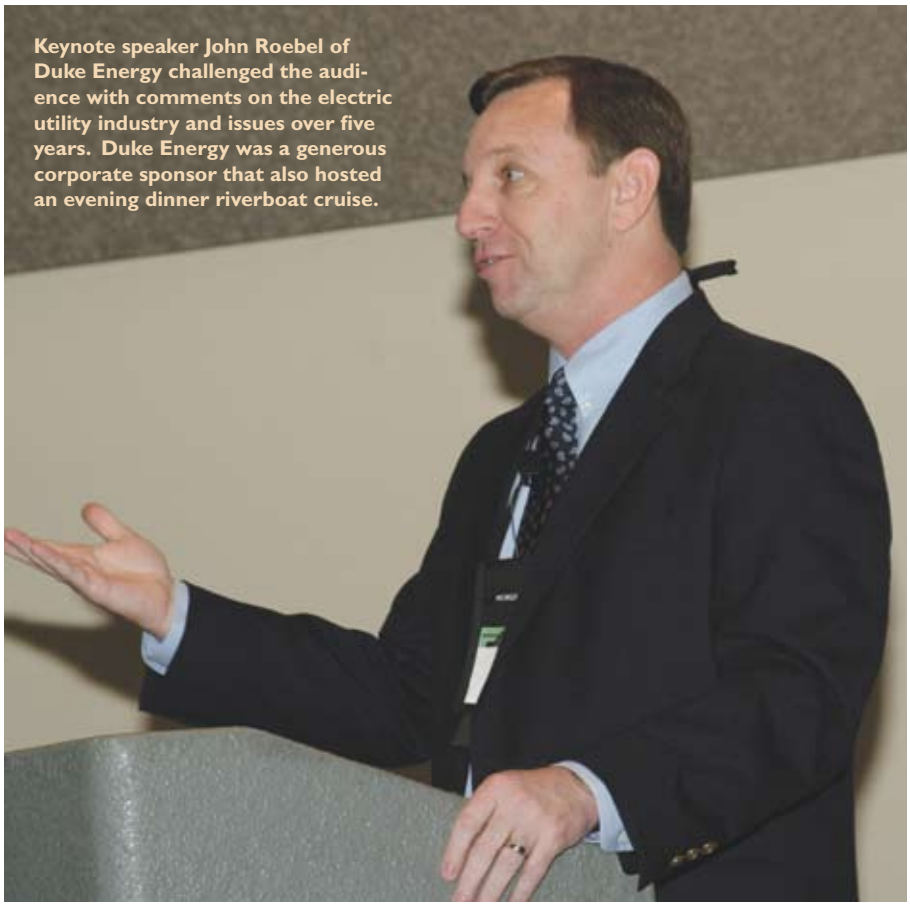


John Sager (second from right), Dr. Tom Robl (second from left) of UKCAER and Dave Goss of ACAA congratulate representatives of the University of Puerto Rico who submitted three posters for the Poster Session. These posters were later selected for the Poster Award along with one submitted by Robin Guynn of Environmental Resources Management.

Dr. Rodney Andrews, acting director of the University of Kentucky Center for Applied Energy Research welcomes attendees to WOCA `07. The conference was jointly organized by UKCAER and ACAA this year and in 2005. Both organizations recognize the value and strength of this partnership and the value its diverse program brings to the Coal Combustion Products community.

plus an extensive poster session. Representatives ranged from utility producers to marketers, architects, engineers, contractors, concrete producers, waste and disposal managers, researchers, members of academia, and key government representatives. While exhibitors increased 10 percent over the previous WOCA, sponsorships surged more than 250 percent.

Duke Energy's John Roebel, senior vice president of Engineering and Technical Services, gave the first plenary address. He challenged the audience with comments on the electric utility industry and issues facing the CCP industry over the next five years. The other two plenary speakers included Maria Parisi-Vickers and Catherine Vial. Ms. Vickers serves as deputy director of the Office of Solid Waste with the U.S. Environmental Protection Agency. She spoke about the value and future of the Coal Combustion Products Partnership (C2P2). The Partnership links government and industry to reduce barriers to using



Keynote speaker John Roebel of Duke Energy challenged the audience with comments on the electric utility industry and issues over five years. Duke Energy was a generous corporate sponsor that also hosted an evening dinner riverboat cruise.

Maria Parisi-Vickers of the U.S. Environmental Protection Agency's Office of Solid Waste spoke about the numerous EPA initiatives related to CCPs and other industrial materials that can be used beneficially. She addressed the success of C2P2, the Green Highways Partnership, Beneficial Use Summits and other efforts to promote these sustainable activities.

Robert Wright of the U.S. Department of Energy, Dr. Chad Haynes of the U.S. Department of Agriculture and Dr. Warren Dick of The Ohio State University (left to right) visit at the Agricultural Research Service booth. The USDA presence this year was a first for WOCA and emphasizes the importance that agricultural uses for CCPs, especially FGD gypsum, have for the industry.

Geaunita Caylor and her sister, Gaylyn Helfenberger, helped process many registrants. Assisted by other members of staff from the Center for Applied Energy Research and ACAA, the registration desk was the focal point for arrivals, message exchange, non-conference activities and Kentucky hospitality.

Chris Doyle, of Saiia Construction (a first time exhibitor at WOCA) visits with attendees at WOCA

CCPs, including legal, institutional, economic, market, informational, and others. Ms. Vial serves as team leader in the Environmental Industries Office of the U.S. Department of Commerce. She informed the audience on how best to tap into the many resources of the International Trade Administration available in pursuing business overseas.

International delegates addressed CCP issues in their respective countries, offering a look at global trends, research, challenges and new and emerging technologies. Among the issues discussed were governments that regard CCPs as waste. Many nations, however, are realizing that CCPs offer significant economic, environmental and societal advantages.

Perspectives on regulations were offered by U.S. speakers who explored how new air quality control measures may impact CCP quality and inadvertently create larger byproduct streams. Fly ash and concrete chemistry were issues important for those who produce or have ASTM C 618 quality ash available. Mercury was another hot topic with speakers talking about the potential affects of

Dr. Wolfgang vonBerg and Dr. Richard Kruger were two of the more than 80 international attendees who participated at WOCA this year.

mercury capture and emerging technologies that may overcome related barriers to use in the future. Discussions also addressed mercury leaching and potential re-release. Solutions to the complexities facing the CCP industry were explored in the context of power plant design, operating systems and conditions, and the wide variety of other factors.

The World of Coal Ash concluded with tours (limited availability) of the Miami Fort Power Station owned by Duke Energy and the Silver Grove wallboard plant owned by LaFarge.

The award for best poster was presented to both Robin Guynn of Environmental Resources Management and the University of Puerto Rico at Mayagüez. The Bart Thomas Award had not yet been awarded as of the Ash at Work editorial deadline. This honor recognizes the conference's best oral presentation. For more information please visit:
www.worldofcoalash.org/awards/bartthomas.html

WOCA post-conference details are available at:
www.worldofcoalash.org/proceedings.html

The next World of Coal Ash will be held May 4 to 7, 2009 in Lexington, Ky. To learn more please visit:
www.worldofcoalash.org.❖

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