ASH at work

Application, Science and Sustainability of Coal Ash

WHAT ARE CCPs?

BENEFITS OF USING FLY ASH

WORLD OF COAL ASH

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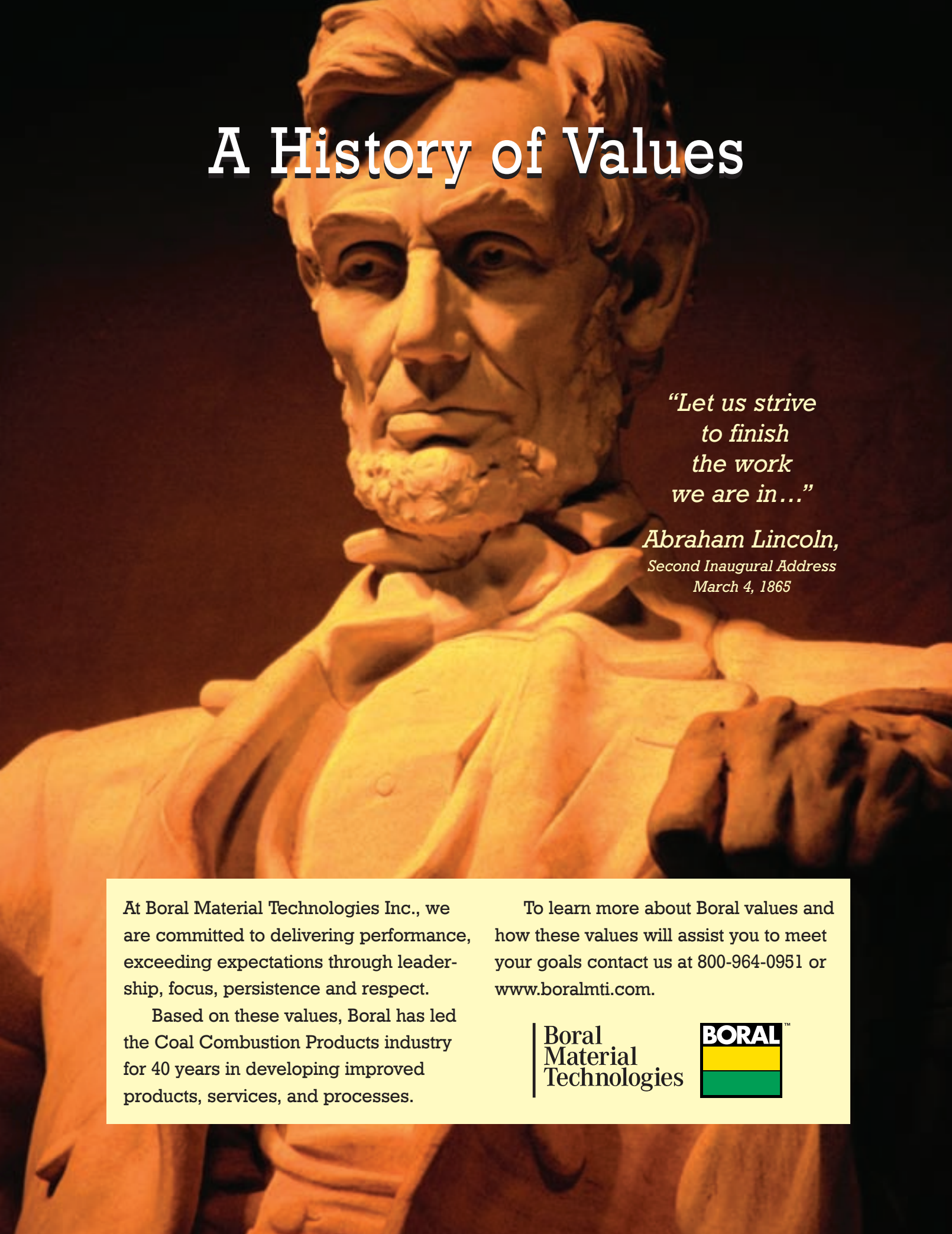

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Second Inaugural Address
March 4, 1865

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ASH at work

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Photo: Denver Metro Convention & Visitors Bureau

WELCOME TO THE INAUGURAL ISSUE OF *ASH AT WORK*

By Harry C. Roof

This new publication follows in the footsteps of the previous American Coal Ash Association (ACAA) newsletter of the same name. As in those previous issues, this magazine will provide news, reports, interviews and important information to the ash industry.

It is our goal to publish *ASH at Work* at least twice annually and, within a few years, distribute it quarterly. The editorial content will include articles by ACAA members, as well as other individuals and organizations with an interest in Coal Combustion Products (CCPs).

ACAA went through a transition in 2000 and some predicted that it would not survive. Contrary to those predictions, we *have* survived and, what's more, we are growing. Thanks to the efforts of many volunteer members, who spent countless hours maintaining the framework and enthusiasm of the mission, ACAA is flourishing. I also would like to extend my thanks to my employer, Boral Material Technologies Inc., for its support and allowing my time to be given to ACAA. And, finally, with the selection of David Goss as executive director, we found an individual with the outstanding leadership and management skills to successfully coordinate the work of the many people involved in this revitalization process of ACAA.

As I prepare to step down as chairman in June, I want to express my sincere appreciation to each person in our member organizations who participated, responded and assisted in whatever ways they were asked. I especially want to thank Vice Chairman Tom Jansen, who will soon take over the chairmanship. Tom has spent many long hours, in addition to his full time work with WE Energies, helping define and refine the direction of the association. I also want to thank Secretary Treasurer Dr. Raul Deju of ISG Resources. Raul has been instrumental in helping re-establish a sound financial footing and providing administrative and fiscal oversight of ACAA.

The diversity of our membership gives ACAA the depth of resources needed to respond to CCP issues.

In addition to these officers, many people served as chairs of standing committees, task teams and subcommittees. Each member of these task teams and committees also gave their support to ACAA on technical issues, governmental activities, communications, outreach and planning that allowed ACAA to continue. Our membership stands at 30 producers, 18 marketers and 22 other organizations involved in ash utilization, research and services. In January 2004, 14 new members joined ACAA and, since then, we have added three more. The diversity of our membership gives ACAA the depth of resources needed to respond to CCP issues. Our electric generation members produce nearly 50 percent of all the total coal ash generated annually in the United States and our marketing members manage and sell more than 90 percent of all the ash produced.

Harry C. Roof
Chairman, American Coal Ash Association
Manager, Utility Relations, Boral Material Technologies Inc.

We are excited about the new partnerships we are establishing with other ash interest groups, with the Electric Power Research Institute and especially the upcoming World of Coal Ash. We are developing new publications and continue to provide technical advice to local, state and federal regulators. ACAA's annual "CCP Production and Use Survey" is widely recognized as a thorough and representative depiction of the ash industry in the U.S.

In closing, I think you will find this issue and subsequent issues of *ASH at Work* to be highly informative and thorough in the treatment of CCPs. We look forward to your ongoing participation and thank you for your editorial and advertising support. ❑

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WELCOME TO OUR NEW MAGAZINE: SAME NAME NEW LOOK!

By Dave Goss

Dear readers of Ash at Work: Five years after issuing its last *Ash at Work* newsletter, which was published periodically for 30 years, the American Coal Ash Association is very excited to introduce its new *Ash at Work* magazine. Accentuating the theme of science, applications and sustainability of coal ash in North America, we believe it will truly be a valuable source of information.

It is fitting, perhaps, that a photo of Denver graces our cover. The location of ACAA's office, Denver is a microcosm of what can be found throughout the United States where development of ways to manage and use coal combustion products (CCPs) continues to expand. ACAA member companies in Colorado produce, market and apply CCPs in and from this city. CCPs, such as fly ash (both Class F and Class C), bottom ash and dry FGD sprayer material are used in concrete products, bricks and masonry block, flowable fills, the manufacture of portland cement, agricultural uses, structural fills, waste treatment and in emerging technologies, such as developing new ways to make wallboard and large blocks.

It is exciting to know there is renewed interest in the promotion of coal ash though the Resource Conservation Challenge (RCC) and the Coal Combustion Products Partnership (C2P2). In the future, we will include interviews with notable persons to obtain perspectives from leaders in the regulatory, research and industry arenas.

Dave Goss
ACAA Executive Director

We look forward to your feedback on this new magazine and will very likely ask many of our readers to help us develop articles and information for future issues. Please do not hesitate to contact us directly with your comments. ❑

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For more information about AEP's CCP programs, visit aep.com.

Calendar of Events

Look to the future.

Visit Calendar of Events at WWW.ACAA-USA.ORG to find information about ACAA's upcoming meetings.

7-9 June 2004
Dearborn, Michigan

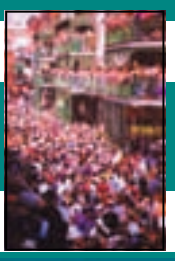
4-6 October, 2004
Denver, Colorado

24-26 January, 2005
San Diego, California

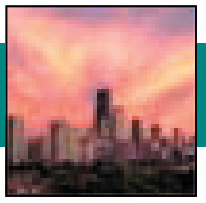
11-15 April, 2005
Lexington, Kentucky

12-14 September, 2005
Atlanta, Georgia

23-25 January, 2006
New Orleans, Louisiana



12-14 June, 2006
Chicago, Illinois



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WHAT ARE CCPs?

By Dave Goss

The terminology, coal combustion products (or CCPs) is both evolutionary and revolutionary. At its root, CCPs refer to residual, nonorganic materials resulting from the burning of coal, or more simply – coal ash. With time, though, the working definition has changed as the concepts behind it's meaning have changed.

The evolution of CCPs is evident from viewing a few examples of previous descriptive terms, such as "power plant waste," "coal combustion waste," "coal combustion byproducts," etc. This evolution is important as it reflects the revolutionary conceptual and technological changes occurring in major CCP-related U.S. and world industries. Impacts have affected mining, solid material engineering, environmental sciences, the power utility industry, as well as creating expanding markets for the beneficial use of CCPs.

For more than a century, the utility industry has generated electricity (a product) from the combustion of coal. As part of this process, other materials are created. Fly ash, bottom ash, boiler slag and various materials from air-emission control systems have been generated as a "byproduct" of generating electricity. Therefore, they were referred to as coal combustion byproducts (or CCBs). But, within the last six to seven years, there has been a wide acceptance that many of these byproducts are able to replace competing materials that are regularly used in commerce. Different types of coal ash and air emission control byproducts can, for example, replace portland cement, sand, gravel, natural gypsum and lime. In some cases, the fly ash or synthetic gypsum improve upon or exceed the requirements of the other products. The CCP industry, recognizing this value, began to use the terminology "coal combustion products." Electric-generating companies produce products at the plant site that need no processing or refinement to be used in commercial applications. Thus, the term "CCPs" has become widely used and recognized by producers, marketers, end users and regulators.

Beginning in 2003, the Environmental Protection Agency acknowledged the value of these materials by creating the "Coal Combustion Products Partnership," or "C2P2." This initiative recognizes that coal ash has many beneficial uses. Through a campaign of public awareness and outreach, the EPA and industry are providing positive reasons to beneficially use CCPs rather than place them into landfills for disposal.

Despite the foregoing discussion, I have yet to definitively answer the question, what are CCPs? There is no single, simple answer. There is, however, a source of information that would be a good place to start. That is on the ACAA Web site at www.acaa-usa.org. This association and the CCP industry realize that depending on the type of coal burned, the coal ash produced and the end use, there are many answers to the question, "What are CCPs?" The addition of air-emission control systems in utility plants has created other products that may be similar in physical appearance or terminology, but completely unlike in performance and utilization. Therefore, ACAA has developed a 36-page glossary of terms that can be found by selecting the tab "What are CCPs?" on its Web site. Even more fundamental information can be found by selecting the tab "Frequently Asked Questions." Within these two sections are answers to questions like, "What Are CCPs?" ""How Much are CCPs Worth?" and "How Much Does it Cost to Dispose of Coal Ash?" There are copies of pamphlets, magazine articles and other information about CCPs. Many of these documents are in a PDF format and can be downloaded at no cost.

Membership in ACAA gives access to an exclusive library of additional documents about CCPs and their many uses. Papers presented at international symposia, sponsored by ACAA, are

accessible to members on the Web site. Resource bulletins, fact sheets, technical publications and special presentations made at ACAA meetings and workshops are available and can be downloaded by members. The information in both the public and member's areas is updated frequently and can answer many questions about CCPs, their characteristics, performance and utilization.

Annually, ACAA conducts a "CCP Production and Use Survey." This survey includes statistical information about the quantities of CCPs produced within the electric utility industry and the uses into which CCPs are placed. The production data is categorized by eight types of material: fly ash, bottom ash, boiler slag, Flue Gas Desulphurization (FGD) gypsum, FGD wet scrubbers, FGD dry scrubbers, FGD Other and Fluidized Bed Combustion (FBC) ash. Under each of these types of CCPs, information is given as to the tons used for such applications as: cement, concrete products, grout, structural fills, wallboard, mineral fillers, agriculture and eight other categories of use. This survey is also found on the Web site and helps answer more about CCPs, what they are and how they are used.

In closing, the answer to the question, "What are CCPs?" is neither simple nor universal. There are almost as many uses for CCPs as one can imagine and similarities and differences between types of coal ash and other "products" are likewise numerous. Many of the answers can be found at www.acaa-usa.org or by becoming a member of the association. Join us to find the real answer to this and many other fascinating questions about coal ash. ❑

THE COAL COMBUSTION PRODUCTS PARTNERSHIP **"C2P2"**

In 2002, the U.S. Environmental Protection Agency began formulating plans to help promote the beneficial use of CCPs. The Agency recognized that in many situations, CCPs could be used in ways that would further national environmental goals.

In 2003, EPA initiated the "Coal Combustion Products Partnership," or "C2P2." This program is intended to help reduce the actual or perceived barriers that limit the beneficial use of CCPs in highway construction. Some of these barriers exist because there is a lack of understanding by end users or state agencies of the potential benefits that CCPs can have. The initial thrust of C2P2 has been to promote increased use of fly ash in concrete. In June 2003, the Federal Highway Administrations (FHWA), in conjunction with the American Coal Ash Association (ACAA) issued a revised edition of the very popular "Fly Ash Facts for Highway Engineers" booklet. This publication describes the use of fly ash in many highway applications, from concrete to road base to structural fill. This edition is the first to be endorsed by the EPA because it supports the goals of C2P2. The use of CCPs helps reduce the production of green house gases, conserves natural resources and helps cut back on the need for landfill space for disposal of coal ash. The booklet also points out that fly ash and other CCPs in large volume uses, such as structural fills, may be affected by technical guidance available from state departments of transportation or highway agencies.

To further support the C2P2 initiative, a series of workshops are planned in 2004. The workshops will be held in San Juan, Puerto Rico (September 30 - October 1); Las Vegas, Nevada (September 14); Austin, Texas (September 16); Atlanta, Georgia (November 16); and Louisville, Kentucky

(November 18). Registration for these workshops will be online at the ACAA Web site, or using information in flyers distributed in the areas of the workshops.

These workshops will combine information from the FHWA, EPA, DOE, ACAA and other sources to provide a comprehensive one-day look at the benefits of using CCPs in concrete paving and highway construction. The workshops will be jointly planned by these organizations and funded, in part, by contributions from the sponsors as well as attendance fees. Speakers with well-known credentials in concrete technology and research will make presentations. Besides discussing the theme of sustainability, speakers will talk about technical and performance aspects of fly ash in concrete and will give specific examples that pertain to the geographic area in which the workshop is being held. It is anticipated that the information in these workshops will provide end users, contractors and regulators with a better understanding of why the use of fly ash and CCPs in highway construction is environmentally and technically sound and may provide economic benefits as well.

Individuals and companies can sign up for C2P2 by going to the EPA Web site at http://www.epa.gov/epaoswer/osw/conserve/c2p2/ and downloading an application form (a registration can also be found on page 12). A complete listing of C2P2 members is found by clicking on "Partners" and interesting "Case Studies" are found on the Web site's home page in the discussion about barrier breaking activities. ❑

COAL COMBUSTION PRODUCTS PARTNERSHIP

Registration Form

The Coal Combustion Products Partnership (C^2P^2) program is a cooperative effort between United States Environmental Protection Agency, American Coal Ash Association, Utility Solid Waste Activities Group, and United States Department of Energy to help promote the beneficial use of Coal Combustion Products (CCPs) and the environmental benefits that result from their use. C^2P^2 will develop resources such as technical assistance publications, workshops, and a Web site. Organizations can participate in C^2P^2 as Champions and/or Leaders:

Champions include generators, marketers, and users of CCPs who, in joining the program, will commit to increasing CCP use or marketing of CCPs.

Leaders include federal agencies, professional groups, research organizations, trade associations, and CCP marketers who, in joining the program, will work with their affiliated organizations to promote greater use and sale of CCPs.

Both Champions and Leaders will be eligible for awards recognizing their activities, particularly documented increases in CCP use.

For more information, visit the C^2P^2 Web site at http://www.epa.gov/epaoswer/osw/conserve/c2p2/.

YES! My organization is ready to join C^2P^2!

Membership Type: ❑ Champion ❑ Leader

Organization: _____

Principal Contact: _____ Title: _____

Address: _____

City: _____ State: _____ Zip: _____

Phone: _____ Fax: _____

E-mail: _____ Web site: _____

Type of Organization (i.e., generator, government, research, etc.): _____

Signature of Senior Official: _____

Print Name: _____

Title: _____

Date: _____

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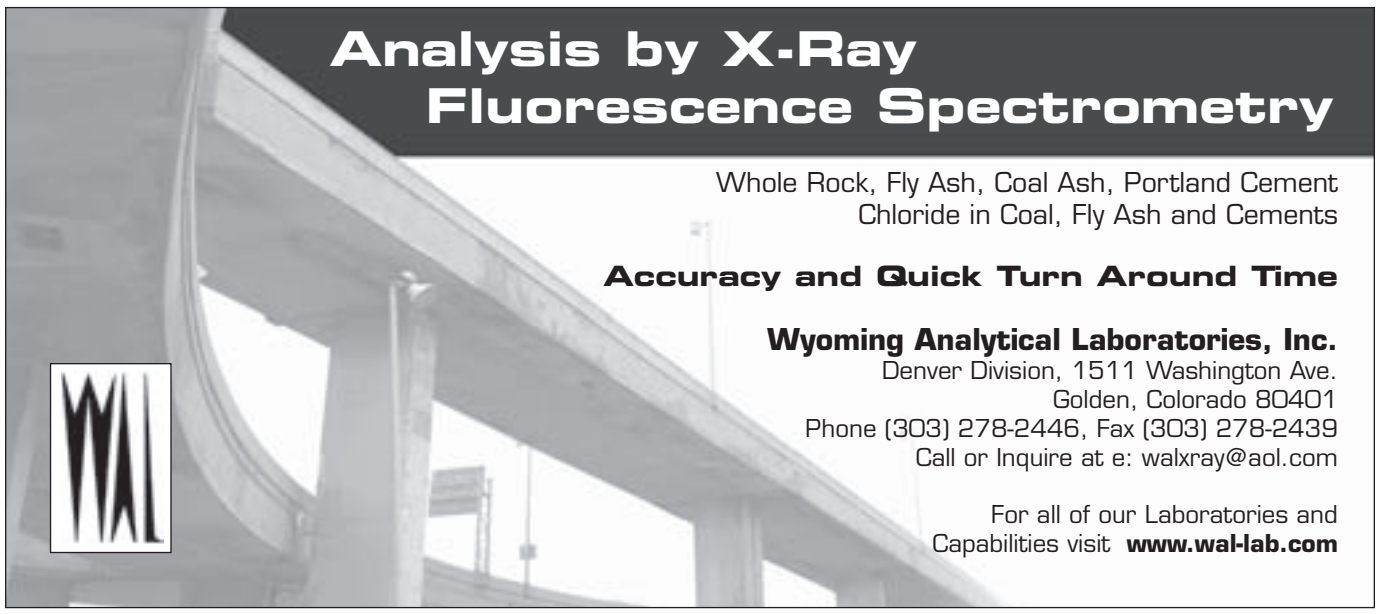
Please fold and mail or fax to C^2P^2 at (703) 308-8686

CCP RESEARCH

The U.S. Department of Energy (DOE) has centralized much of DOE's CCP research and developmental work through the National Energy Technology Laboratory (NETL) in Pittsburgh, Pennsylvania. Several years ago, the DOE recognized the need to encourage increased CCP utilization. The Combustion Byproducts Recycling Consortium (CBRC) was formed to help co-fund research proposals and field studies. It routinely solicits proposals that address priorities in three geographic areas (western, midwestern and eastern). Applicants must include their own cost-share and may, in addition, identify other outside funding sources as part of their proposal. CBRC committees review proposals against regional priorities and national priorities. The CBRC National Steering Committee then recommends specific projects to DOE for final consideration. It is DOE's desire to help enable a goal of 50 percent CCP utilization by the year 2010 through this funding and other byproducts research that DOE supports. This is an aggressive goal, but it states clearly a commitment by DOE to help stakeholders achieve increased usage. DOE has contributed more than $4 million dollars in support of CBRC efforts.

CBRC research projects have looked at a wide variety of topics, including mine applications, the use of CCPs in new processed and formed structural products using ash as filler, in agricultural and land applications, high carbon ash utilization, transportation uses, FGD materials and leaching characteristics of CCPs in disposal setting, even in environments where the material is in direct contact with groundwater. Detailed information on these projects can be found on the CBRC Web site at http://wvwri.nrcce.wvu.edu/programs/cbrc/index.cfm. This government-funded research has been, in many cases, the impetus needed for small companies or individuals to develop new technologies that may hold promise for wide-scale uses across the United States. Additionally, research being conducted in the United States may have direct application in many other countries opening the way for more collaborative international work. ACAA's fall meeting in Denver (October 4-6, 2004) will have a number of presentations that will report on the results of CBRC's research.

DOE is not the only entity providing research and funding. Universities and states conduct much of today's CCP research. A number of organizations have established programs and/or centers of research and support for CCPs. These include the Energy and Environmental Research Center at the University of North Dakota, the Center for Byproduct Utilization at the University of Wisconsin-Milwaukee and the Center for Applied Energy Research at the University of Kentucky. The Ohio State University, Pennsylvania State University, Texas A&M University, Southern Illinois University, West Virginia University and others all have nationally recognized CCP programs and expertise. These organizations look at ash utilization, characteristics, and research activities within their engineering, environmental and technical departments. These partnerships are invaluable to the industry. Mutually supportive research and collaboration will help identify new uses for CCPs and increase overall utilization. ❑



NORTH CAROLINA GROUP DEVELOPS INTEGRATED PLAN FOR COAL ASH USE

Comprehensive, cooperative and cash conscious are terms that aptly describe the character of coal ash development in western North Carolina. Plans are currently underway for a pilot plant to process coal ash generated from a variety of boilers in the state. The facility design aims toward thorough treatment of coal combustion by-product (CCB) mixtures with a target of zero waste. Ash mixtures of any composition will be processed, ranging from high-carbon content to combined fly ash, bottom ash, and slag with modest amounts of unburned carbon.

These byproduct streams will yield a variety of outputs — carbon for reuse; bottom ash suitable for concrete block; high-quality fly ash for cement kilns or redi-mix concrete formulations; and low-density aggregate for lightweight block, structural concrete, and asphalt applications.

As Waste Reduction Partner's chemist Dr. Elaine Marten comments, "For coal ash, this is a complete journey – from womb to tomb to reincarnation; a family of useful coal ash products is the result."

Reduction of another environmentally problematic byproduct stream – organic biosolids from paper mills – is an inherent benefit of this program, since cellulosic biosolids are a part of the low-density aggregate formulation. Additional sources of biosolids can also be used, such as the organic residues from hog waste lagoons, which have, in the past, been environmental concerns for portions of the state. All of these possibilities have successfully been demonstrated in previous experimental work.

The project is a cooperative effort by a consortium of diverse members joined together for a common purpose – to convert North Carolina's coal ash accumulation into useful products. Initial members of the consortium are North Carolina State University's Minerals Research Laboratory (MRL), Waste Reduction Partners (WRP — a non-profit group of retired technical volunteers), public utility representatives, area paper mills, and several other private companies. Membership has evolved further during the intervening three years, and additional interested participants are always welcomed.

Pioneering laboratory work by Dr. Robert Mensah-Biney, senior process engineer at MRL, led to the proposal for the integrated process. By means of froth flotation, carbon is extracted from bottom ash/fly ash mixtures, bottom ash is separated, and the remaining materials are mixed with biosolids to produce green pellets. Pyrolytic conversion of the pellets in a rotary kiln generates low-density aggregate. The design of the process allows use of still-moist ash and biosolid components and, thus, avoids the costly step of predrying the raw materials. Simple process modifications furnish aggregates in a variety of sizes and densities for a multiplicity of final applications.

The breadth of skills and experience represented by the consortium provides a considerable technological toolbox to achieve value-added products of good quality. Of equal importance is the differentiating opportunity offered by the integrated process. Several coal-ash products will be available from the pilot plant, based on the composition of the raw ash stream. This plan offers economic advantages for each specific coal-ash mixture.


Dr. Elaine Marten

Those byproduct streams, high in carbon, may benefit most from the carbon separation option and from the separation of the bottom ash. Those clients, with complex mixtures, may be best served by an aggregate, tailored specifically to use raw material of that composition. Carbon separation is not a requirement for producing low-density aggregate from the coal ash mixture. The process allows direct manufacture of the aggregate from carbon-containing residues, since the carbon is burned out during the pyrolytic process.

This all-inclusive approach to processing CCBs was selected after exploring marketing prospects in the western North Carolina region and beyond. There are strong and economically viable markets for the array of products to be generated. Bottom ash is in ample demand for concrete block manufacture, while low-carbon fly ash is attractive for the cement kiln industry. Recovered carbon has use as a fuel source and as a component in steel manufacture. Low-density aggregate is sold to lightweight concrete block producers, redi-mix plants, and specialty concrete formulators.

An attractive location and an available building, relatively close to raw material supply sources, have already been

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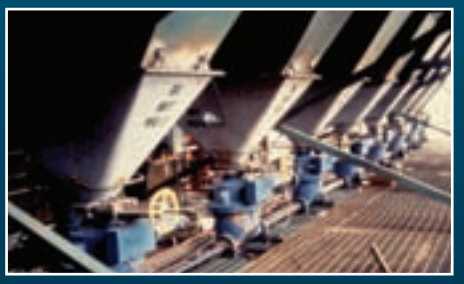

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Dr. Mensah-Biney and Dr. Elaine Marten at the rotary kiln.

identified for the pilot plant. Certain pieces of required equipment are at hand. Other necessary equipment must yet be acquired. The overall purpose of the pilot plant is to give interested CCB stakeholders the ability to develop a specific process from their raw materials, demonstrate the technical and economic feasibility of that process, and provide samples of end products for testing, marketing and sales. Since the pilot plant will be established within a university extension framework, its use will be available at a modest cost to a client for material and process evaluation. If results are enticing, the client may then choose to pursue investments in full-scale CCB processing plants.

In addition to Dr. Mensah-Biney, for the idea inception and process development work, a number of WRP volunteers have played important roles in the project. Terry Albrecht, WRP director, has guided and supported the participation of WRP in the program, and Tom McCullough, retired textile engineer and WRP solid waste group leader, recruited new members of the consortium and oversaw the expansion of the program. The business strategy was devised and the commercialization plan, written by architect Al Keiser. Dr. Elaine Marten, retired chemist, has assisted with laboratory studies, using the low-density aggregate and coal ash to formulate a lightweight asphalt product.

From its very beginning three years ago, this project has been an ensemble effort. Every consortium member needs every other member in the cast. In such a production, there are no scene stealers. Everyone works toward a common goal. The result is a shared success. ❑

For further information, contact Dr. Robert Mensah-Biney at (828) 251-6155, ext. 224 or at mensah@eos.ncsu.edu. Terry Albrecht of Waste Reduction Partners can be reached at (828) 251-6622 or e-mail terry.albrecht@ncmail.net. Dr. Elaine Marten can be reached at (828) 645 3396.

THE EPA AND FUTURE OF CCPs

By Jim Roewer

As the U.S. Environmental Protection Agency (EPA) moves forward in the development of regulations addressing the disposal of coal combustion products (CCPs) and their mine placement – proposals are expected sometime in 2005, with final actions a year later. Some recent developments could either help or hinder that process.

EPA CCP "LISTENING SESSIONS"

On March 2 of this year, EPA announced plans for field hearings to receive comments from interested citizens on CCP mine placement, landfill and surface impoundment disposal. The EPA "listening sessions" took place on March 23 in State College, Pennsylvania; April 13 in Dallas, Texas; April 22, in Vincennes, Indiana; and May 5, in Harrisburg, Pennsylvania, in conjunction with the Office of Surface Mining Forum on Mineplacement.

The environmental special interest groups requested these public meetings to provide themselves with another opportunity to attack coal mining and coal combustion by advocating overly stringent and unnecessarily costly regulation of CCPs. Both USWAG and ACAA testified at these hearings, in addition to representatives of power producers, state regulatory officials, CCP marketers, academia, and environmental groups that favor the use of CCPs to address the environmental damage from coal refuse piles, countering the environmentalists' statements by expressing support for the management and use of CCPs. Our allies made a powerful impression on the EPA officials at the meeting by presenting science-based and policy-based arguments for retaining the nonhazardous regulatory status for CCPs, and underscoring the environmental benefits of CCP mine application.

HOOSIER ENVIRONMENTAL COUNCIL RULEMAKING PETITION

On February 9, 2004, the Hoosier Environmental Council (HEC) and approximately 125 other environmental special interest groups filed a petition with EPA, seeking an immediate ban on the placement or disposal of CCPs into groundwater or surface water, including manmade waterbodies, until EPA promulgates "federally enforceable regulations" under RCRA applicable to "placement, re-use and disposal of coal power plant waste." The petition alleges that mismanagement of CCPs has contaminated groundwater and surface water throughout the United States and that further CCP disposal or mine placement should be halted until EPA completed the rulemaking process. Clearly, the target of the petition is CCP management in ash ponds, but it could also implicate CCP mine placement as well. If EPA were to agree to the petition, the result would be to shut down a large percentage of the industry's CCP disposal capacity, and thus, shut down approximately 40 percent of U.S. coal-fired generation. The call for federally enforceable standards is a thinly veiled reference to regulation under RCRA Subtitle C.

Accordingly, USWAG has urged EPA to deny the petition. In addition, we plan to submit a formal response to the petition, rebutting the allegations made by HEC.

NATIONAL ACADEMY OF SCIENCES STUDY ON MINE PLACEMENT OF CCPS

This past January, Congress passed the Omnibus Budget that included language directing EPA to contract with the National Academy of Sciences (NAS) for an independent study of

Jim Roewer, Executive Director, Utility Solid Waste Group (USWAG)

mine placement of CCPs. USWAG continues to urge EPA to complete its work on mine placement and then provide its work product to the NAS for review. Unfortunately, we understand that EPA management has decided to suspend its work on mine placement and await the results of the NAS study, which is not likely to be issued before early 2006. Thus, EPA action on mine placement now appears to be several years away.

VICTORIES IN PENNSYLVANIA

While the environmental special interest groups have been vocal and active in their campaign against CCPs, coal mining and coal combustion, the ash industry recently achieved notable successes at the direct expense of the environmentalists' interests.

In Pennsylvania, utilities and ash marketers achieved an important win in February 2004 when the Pennsylvania General Assembly's Joint Legislative Air and Water Pollution Control and Conservation Committee (Joint Committee) issued a report rejecting environmental activists' demands for a statewide moratorium on CCP mine placement. The bipartisan legislators, who made up the Joint Committee, unanimously rejected the moratorium and expressed their strong support for the continued use of CCPs for mine reclamation and other beneficial purposes. The report states that the "beneficial use of coal ash, including mine

reclamation, has been well documented and the potential risks have been thoroughly examined and these results have been reported to local, state and federal agencies… coal ash can be effectively and safely used when properly managed. The information also demonstrates the significant economic and environmental benefits coal ash plays in the reclamation activities in the Commonwealth."

Shortly after the Joint Committee report was issued, the Pennsylvania Department of Environmental Protection (DEP) announced another favorable development for mine placement when it issued a final report on the Bark Camp Demonstration Project that concludes that coal ash and dredged material can be used successfully as fill to remove health and safety hazards associated with abandoned mines. Five years of monitoring data demonstrates significant reductions in acid mine drainage, the removal of physical hazards from past mining activities, and the restoration of natural vegetation and habitat. The well-documented success of the Bark Camp Demonstration Project provides another rebuttal to environmental groups' claims that environmental benefits of mine placement have not been proven.

Also, following the release of the Joint Committee's report, the Pennsylvania DEP issued a general use permit to Lehigh Coal and Navigation Co. to reclaim its Springdale Mine in Tamaqua, Pennsylvania, using dredged sediment stabilized with coal fly ash. The permit application had been vigorously opposed by the Army for a Clean Environment, a Tamaqua-based citizen group, that is supported by the Clean Air Task Force. The approval of the general-use permit marks yet another success in the battle over the beneficial use of CCPs and another setback for opponents of CCPs and coal.

THE BATTLE CONTINUES

We can expect the environmental special interest groups to step up their campaign against CCPs, coal mining and coal combustion. USWAG, in conjunction with ACAA, individual utilities and ash marketers will face that challenge and continue to advocate public policies that encourage the sound management of CCPs, and support and expand beneficial use. ❑

USWAG is responsible for addressing solid and hazardous waste issues on behalf of the utility industry. USWAG engages in advocacy pertaining to RCRA, TSCA, CERCLA and HMTA. USWAG's mission is to address the regulation of utility wastes, byproducts and materials in a manner that protects human health and the environment and is consistent with the business needs of its members. USWAG is dedicated to assisting members in the management of wastes and the beneficial use of materials associated with the generation, transmission, or sale of electricity and natural gas. For more information, including USWAG membership opportunities, contact Jim Roewer at jim.roewer@uswag.org or (202) 508-5645.

THE BENEFITS OF USING FLY ASH TO MITIGATE ASR

By Jimmy Knowles

Every day, thousands of architects and engineers allow or require the use of fly ash in concrete for their projects – and sometimes they don't even realize it. In fact, the decision to use fly ash has become so routine that often our industry loses sight of what a good decision it is to use fly ash in concrete.

Not only can fly ash make today's concrete construction stronger and more economical, it can also make that concrete last longer, increasing the long-term sustainability of the project. Concrete durability is expected in today's construction and premature deterioration of concrete structures is not tolerated. Unfortunately, nature often conspires against our high expectations and concrete structures intended for a long service life crumble before our eyes.

What causes this premature deterioration of concrete? Well, there can be many causes – and fly ash works to prevent most of them. However, Alkali Silica Reactivity (ASR) is a particularly sinister cause of shortened service life for concrete structures and pavements.

Certain combinations of concrete-making materials will inevitability produce ASR and, like the delayed effect of a ticking time bomb, ASR will ultimately produce the same explosive result, albeit in slow motion (it may take years before the full effects are realized). Fortunately, that internal explosive potential can be defused and diffused by the addition of fly ash.

HOW ASR WORKS

The destructive ASR dynamic is a two-step process. The first step is a chemical reaction that occurs in the presence of water inside the concrete when the alkalis from cement react with any deposits of silica or silicates in the aggregates. The result of this chemical reaction is the formation of ASR gel. This gel is hydrophilic and hygroscopic. That is, it loves water and absorbs as much of it as it can find.

The second step of the process is mechanical expansion. As the ASR gel absorbs water, it swells, causing internal pressures that create microcracks in the concrete. More water penetrates into the concrete through these cracks, which the ASR gel absorbs, expanding further, creating larger cracks, and allowing more water penetration. The cycle then continues. Ultimately, these cracks allow water and other impurities to penetrate deep into the concrete, corroding the reinforcing steel or causing other destructive internal pressures that could result in a premature or even catastrophic failure.

HOW FLY ASH WORKS

Fly ash is comprised mainly of silica (and other reactive glass). However, unlike the deposits of silica in aggregate, fly ash is finely divided and becomes uniformly dispersed through the concrete's cementious paste. The fly ash reacts with the alkalis from the cement, such as calcium hydroxide, and chemically combines with these alkalis to form stable cementious bonds.

This pozzolanic reaction increases the durability of the concrete in two ways. By chemically combining with the alkalis in the cementious paste, the fly ash works to tie up the alkalis, preventing them from reacting with the silica deposits in the aggregates and forming the destructive ASR gel.

Also, as extra-cementious bonds develop between the fly ash and the alkalis in the paste matrix, the permeability of the concrete is reduced. Less water is able to penetrate into the concrete and be absorbed by any ASR gel formations and, therefore, there is less internal stress building up inside the concrete.

ASR MITIGATION STRATEGIES

Most specifying agencies, such as state departments of transportation (DOTs), use fly ash as part of their overall strategy to mitigate the deleterious effects of ASR. Typically, a state DOT will limit the alkali content for cements used in their projects or require a minimum percentage of a finely divided pozzolanic mineral admixture, such as fly ash; sometimes they require a combination of both strategies. *(See table 1: Information excerpted from the Virginia Department of Transportation).*

When using fly ash for ASR mitigation, it is important to note that a certain amount of fly ash is necessary before the benefits of the fly ash are realized. According to research data (ACI Materials Journal/September-October 2002, page 486), there is an initial "pessimum effect" (that is, an increase rather than a decrease in ASR) for many fly ashes at low-dosage rates. The severity of this pessimum effect is directly related to the calcium (CaO) content of the fly ash.

Therefore, higher dosages of high calcium fly ashes are needed in order to overcome this pessimum effect. For instance, CALTRANS considers 15 percent replacement of cement with low calcium

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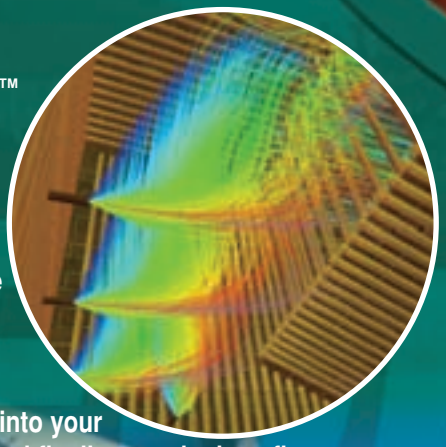

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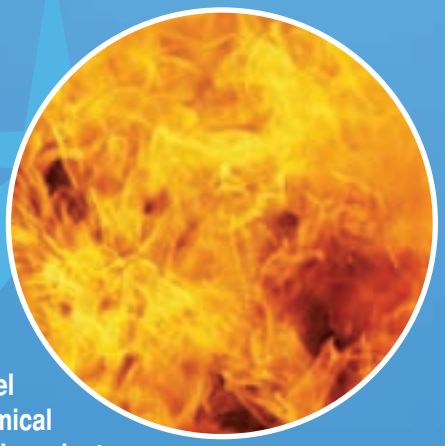

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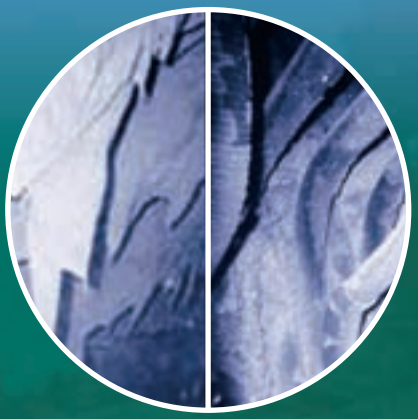

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(less than two percent CaO) Class F fly ash to be enough to mitigate ASR. However, it requires a 25 percent replacement of cement with Class F fly ashes having higher calcium contents (between two and 10 percent CaO).

Unfortunately, many concrete specifications place low-maximum limits on the amount of fly ash that can be used to replace cement. Depending on the calcium content of the fly ash, those low limits may actually increase ASR due to the pessimum effect, especially for Class C fly ashes, which typically contribute additional calcium to the cementious paste matrix, but have less reactive glass tying up the alkalis in the paste. Consequently, specifying agencies seldom recommend Class C fly ash for mitigating ASR.

However, many in the coal ash industry recognize that even high-calcium fly ashes can be effective at mitigating ASR – as long as the fly ash is used at higher replacement rates. The American Coal Ash Association has a task group working on a Resource Bulletin that discusses strategies for how to use fly ash to mitigate ASR, including recommendations for cement replacements using both Class F and Class C fly ashes at various calcium contents.

The many ways in which fly ash works to make concrete more durable, such as ASR mitigation, are some of the "hidden" benefits of using fly ash in concrete. Unfortunately, even those responsible for designing fly ash into their construction projects don't fully appreciate what a good decision it is to specify fly ash. Our mission is to tell them just how well fly ash works to provide a more sustainable future. ❑

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VIRGINIA DEPARTMENT OF TRANSPORTATION

Percent replacement of Cement by weight of Mineral Admixture for ASR Mitigation

Cement Alkali Content	Cement with Class F fly ash
0.46 to 0.60	15%
0.61 to 0.67	20%
0.69 to 0.74	25%
0.76 to 0.82	30%
0.83 to 1.00	35%

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FGD SYNTHETIC GYPSUM QUALITY AND SUPPLY ISSUES FOR WALLBOARD MANUFACTURE

By P.J. Henkels

With the addition of air emission control systems, specifically forced oxidation flue gas desulphurization (FGD) systems, many electric utility company power plants produce significant quantities of synthetic gypsum. This material has a variety of uses, the most common being in the production of wallboard. Successful use of FGD synthetic gypsum in wallboard manufacture depends upon the reliable supply of material that meets established quality agreements. This article discusses wallboard quality and logistic factors relevant to using FGD synthetic gypsum. In many instances, the parameters discussed are equally relevant to the naturally occurring gypsum mineral as well.

GENERAL QUALITY FACTORS

Selected FGD synthetic gypsum quality guidelines are shown in Table 1. These guidelines cover some of the more important, generic parameters for use in wallboard. Other, more detailed specifications will cover those parameters that are specific to the individual source and the wallboard plant.

TABLE 1: SELECTED TYPICAL FGD QUALITY GYPSUM GUIDELINES

Purity ($CaSO_4 \cdot 2H_2O$%, min)	95
Free Moisture (%, max.)	15
Chloride (max. ppm)	120
Total Water Soluble Salts (max. ppm)	600

General quality factors, to be discussed, include product uniformity, purity, free moisture, soluble salts, pH and particle size.

• UNIFORMITY

Uniform quality of the synthetic gypsum is essential in wallboard manufacturing. The process and the finished product properties are tuned to the gypsum's properties. Large fluctuations in this key parameter will make it impossible to efficiently produce a quality-finished product. Consistent high-quality limestone feed and process control of the desulphurization system is essential.

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• PURITY

Gypsum ($CaSO_4 \cdot 2H_2O$) purity is an important attribute for wallboard. The higher the purity, the higher the potential to allow a lower weight board to be produced without sacrificing strength. A purity of 95 percent or more is preferred.

• FREE MOISTURE

Wallboard grade synthetic gypsums are discharged in the form of a wet filter cake from forced oxidation FGD systems. The free or surface moisture of the synthetic gypsum is usually in the range of six to 15 percent. However, lower free moisture is desired because the material is thermally dried before use. Lower moisture content means an associated reduction in energy costs. Additionally, high free moisture creates some difficulties in the physical handling of the material.

• SOLUBLE SALTS

Soluble salt impurities are one of the most important parameters affecting the physical properties of gypsum wallboard. Salts are a common impurity in natural and synthetic gypsum. Salts readily go into solution when the calcined gypsum is mixed with water and other additives to form a slurry during wallboard manufacture. Salts in the gypsum board migrate to the paper — core interface when excess water in the wallboard is kiln dried. These excess salts interrupt the bond between the paper and the wallboard core.

In addition, salts are very hygroscopic. They tend to attract moisture in the critical bond area of the board. For example, on exposure to high moisture from joint finishing and wallpaper products, the drywall paper can detach itself from the core.

Soluble salt content can be controlled by washing the filter cake during the dewatering step in the FGD system.

- **PH**

The pH of the FGD synthetic gypsum needs to be in the neutral range of six to eight. Most additives used in wallboard manufacture are pH sensitive. Deleterious effects of pH outside the neutral include reduced wallboard strength and poor bonding of the paper to the core.

- **PARTICLE SIZE**

Particle sizes for FGD synthetic gypsum range between 20 and 75 microns. Below this range, fine particles will raise the amount of excess water required to form a slurry on the wallboard line. The excess water needs to be dried and will increase wallboard drying costs. In addition, fine particles will lower the bulk density of the material and lead to conveying systems sizing issues. At the supplier's FGD system, fine particles will reduce filter cake washing and dewatering efficiencies. This may lead to higher free moisture and soluble salt impurity content. Larger sizes above 75 microns, on the other hand, will reduce wallboard strength.

LOGISTICAL FACTORS

Synthetic gypsum is delivered to wallboard manufacturing facilities using a variety of transportation systems. Depending on the location of the source, the synthetic gypsum may arrive at the manufacturing plant by conveyor belt, truck, rail car, barge or ship. Other logistic factors that will be discussed include quantity, supply and demand, and storage.

- **TRANSPORTATION**

The economical use of a particular synthetic gypsum at a specific wallboard manufacturing plant is largely dependent on distance and transportation costs. Gypsum is a commodity with high bulk and relatively low value. Due to the volumes of gypsum required for wallboard manufacturing, the cost of transportation is a significant portion of the overall raw material cost. Efficient and economical loading and unloading systems are important factors in handling the material. Some manufacturers have located wallboard plants adjacent to power plants with FGD synthetic gypsum systems to minimize transportation costs.

- **GYPSUM SUPPLY AND DEMAND**

Close coordination is needed between power plants with FGD systems and the wallboard manufacturers to ensure sufficient inventories are available to prevent manufacturing interruptions. Communication between the synthetic gypsum supplier and wallboard manufacturer regarding production volume and scheduled downtime is critical. There may not be alternate sources of synthetic gypsum available during power plant down times.

On the other hand, the utility cannot simply scale back scrubber operations to match reduced production requirements of the wallboard facility. Mutually agreeable strategies need to be developed for handling the excess supply. Ways to handle excess gypsum including moving it to other wallboard manufacturing locations, stockpiling and/or supplying the material to other industries such as agricultural and portland cement manufacture.

- **STORAGE**

Storage capacity at both the synthetic gypsum producer and the wallboard plant is the primary method to buffer swings in supply and demand. Storage facilities should be sized in order to deal with these swings as well as outage situations, transportation delays, etc. Generally, synthetic gypsum should be stored under cover, either in domes, pole barns or open sided, but roofed areas.

SUMMARY AND CONCLUSION

The successful use of synthetic gypsum produced by electric utilities in wallboard manufacture is based on several key factors. These include consistent, high-quality product, good communications and the development of economical transportation and delivery systems.

North American synthetic gypsum producers have demonstrated the ability to use quality product from the electric generating industry for wallboard manufacturing. In the next five to 10 years, it is anticipated that the quantity of available synthetic gypsum will increase significantly. Many power plants are planning to add forced oxidation FGD systems as part of their air emission control improvements. Over the past 20 years, the use of FGD synthetic gypsum for U.S. wallboard manufacturing has grown from negligible amounts to over 8.7 million short tons in 2003. This represents more than 25 percent of the total (32.5 million short tons) of calcined gypsum consumed in the U.S. in 2003. The challenge for the electric utility industry will be to find partnerships with the wallboard and other industries to consume commensurate percentages of the new material being produced. Transportation and logistics factors, as well as competition from other sources, may have a significant impact on the utility industry's ability to see impressive utilization numbers. ❑

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SELF-CEMENTING COAL FLY ASH FOR **GEOTECHNICAL APPLICATIONS**

By Craig Plunk

In the 1970s, with the passage of the Federal Clean Air Act and with further amendments in the 1990s, many coal-fired generating stations, located primarily in the central and mid-western regions of the United States, converted to burning low sulfur sub-bituminous coals. The burning of these low-sulfur coals, in effect, created a new fly ash designated as ASTM Class C that exhibited both cementitious and pozzolanic properties. The self-cementitious properties of the Class C fly ash allow for use in soil-stabilization applications.

Incorporation of Class C fly ash into wet soil to facilitate moisture reduction.

Soil stabilization, as defined in American Society of Testing and Materials (ASTM) D 653 "Standard Terminology relating to Soil, Rock, and Contained Fluids," is a *"chemical or mechanical treatment designed to increase or maintain the stability of a mass of soil or otherwise to improve it's engineering properties."* Soil properties, most often altered, are density, water content, plasticity and strength.

Fly ash, produced from coal from the same source, can have very similar elemental chemical compositions, but very different mineralogies dependent upon the process, operation and combustion characteristics of each specific power station. ASTM C 311 Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete does not distinguish between the various crystalline compounds in which the calcium can exist or determine whether the calcium is in amorphous form. This analysis will only indicate the total calcium oxide concentration in the fly ash. It should be noted that the CaO content reported in a typical ASTM C 618 "Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete" analysis is not free lime, but rather a representation of calcium in oxide form. The compounds of calcium-aluminate and calcium-silicate, present in the Class C ash and the mineralogy, control the self-cementitious behavior of the ash.

Two primary reactions occur when self-cementing fly ash is combined with soil and water. The first is the reaction of the tricalcium silicate (C_3A) present in the fly ash with water. This reaction provides the primary cementation associated with self-cementitious fly ashes. This is a very rapid reaction beginning immediately upon contact with water and concluding in a matter of hours. The second reaction is the pozzolanic reaction, which occurs between the calcium oxide and the siliceous and aluminous materials in the fly ash and soil if present. This is a slow reaction and accounts for a major portion of the strength gains observed beyond 28 days. Typically, hydration reaction retarders are not added to fly ash soil systems to modify or control the C_3A reaction rate. Therefore, the fly ash reaction occurs immediately and must be managed both in the laboratory and with field applications. Because Class C fly ash is self-cementitious, it can be used in stabilization applications as a stand-alone material where performance and economics dictate. The most common applications for Class C fly ash stabilization are:

1. Moisture content control to facilitate densification
2. Mitigation of shrink/ swell in expansive clay soils
3. Strength enhancement of soils

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The use of Class C fly ash to reduce moisture contents in soil was, in many cases, the first use of fly ash in soil applications. The use of fly ash to dry soil is considered to be a modification to the soil properties and not strictly by definition a soil stabilization application. Self-cementing Class C fly ash has proven to be a very effective drying agent. Soil moisture contents can be reduced by as much as 30 percent. Fly ash dries soil by two mechanisms. The C_3A in Class C fly ash is highly reactive. By nature of the reaction between the C_3A and water, water is chemically bound reducing the free moisture content. The second mechanism is by simple dilution. Drying soils with fly ash is often a more cost-effective solution than other options available, such as replacing the wet soil with select drier soils, adding hydrated lime or other materials.

In soils containing volumetrically unstable plastic clays, fluctuations in moisture content can change the soil volume significantly. If this volume change is not controlled, damage due to soil movements can occur to associated structures. Fly ash treatment of clay soils is often a more rapid and economical choice than other treatment options. Fly ash stabilization of clay soils physically cements the soil particles together restricting expansion and contraction of the clay soil, whereas lime treatment is a chemical process, which flocculates and agglomerates the clay. Because the quantity of free lime available in Class C fly ashes is normally below three percent, no significant decrease in the plasticity index is realized. In order to accurately evaluate fly ashes efficacy on treating plastic soil, actual shrink-swell measurements must be made. In general, self-cementing fly ash has been shown to reduce the swell potential of plastic clays by a factor of five to 10.

The use of self-cementitious Class C fly ash has a long and successful history in geotechnical stabilization applications. The treatment of soils with Class C fly ash has a 20-year history of successful use. Stabilization of soils with Class C fly ash has become a widely used option for solving engineering challenges due to weak soils. The fundamental mechanism, by which the fly ash improves the soil, is due to the chemical reactions that occur when the fly ash is mixed with soil and water. The tricalcium aluminate and pozzolanic reactions, that occur, bind the soils grains together into a stable mass-increasing strength and stability. Class C fly ashes, which are deemed unsuitable in concrete applications due to high carbon contents and/or carbon reactivity, can be successfully used in stabilization and modification applications. Class C fly ashes with sulfate contents, between five and 10 percent, have also been successfully used. These high-sulfate fly ashes should be used only after a rigorous and comprehensive field and laboratory investigation has been conducted with the specific materials by a reputable geotechnical engineer. Fly ashes with sulfate contents in excess of 10 percent should not be used in stabilization applications.

As more utilities across the U.S. change their fuel sources, including using PRB coal in areas where it had not been used before, new opportunities will be created for Class C fly ash. For instance, Class C fly ash has become a valuable construction resource that promotes sustainable development initiatives. History of use and long-term performance in geotechnical applications has established Class C fly ash as valuable renewable resource. When the choice is made to use fly ash in geotechnical applications, everyone wins — the designers, the contractors, the traveling public, and the environment. ❑

Mixing and compaction of Class C fly ash-treated soil.

Fly ash soil mixing operation illustrating homogeneity of mixing process.

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For more than 50 years, A.W. Oakes & Son, Inc. has been providing high-quality earthwork construction services. Oakes is very strong in grade control and has dedicated personnel to ensure an accurate final product.

ADA-ES, LLC
8100 SouthPark Way, Unit B-2
Littleton, CO 80120
(303) 734-1727
Fax: (303) 734-0330
Ronda Zivalich
Manager, Chemical Products
rondaz@adaes.com
www.adaes.com
ADA-ES provides innovative proprietary specialty chemicals and injection equipment to the coal-fired boiler industry to enhance the performance of ESPs, improve combustion of PRB coals in cyclone boilers, and capture mercury in ESPs and baghouses.

ACTIVATION Resources International, LLC
407 O'Day Street
Maplewood, MN 55119
(651) 731-3145
Fax: (651) 702-0041
Jan Alboszta, CEO
jan@activationresources.com
www.activationresources.com
ARI's mechanical activation (non-chemical) technology converts FBC fly ash into a cement substitute called Flubet®, replacing 20 percent to 60 percent of Portland cement depending on the application. The technology also reduces the quantity of sorbent used for desulfurization in FBC boilers.

Ameren Energy Fuels and Services Co. (AFS)
1901 Chouteau Ave.
St. Louis, MO 63166
(314) 554-3345
Fax (314) 554-4188
Anthony Konsky,
Ash Management Director
akonsky@ameren.com
www.ameren.com
The AFS ash management team manages more than two million tons of Coal Combustion Products each year from 10 mid-west coal-fired power plants focusing on the increase of CCP utilization while maximizing return.

American Electric Power
P.O. Box 16036
Columbus, OH 43216
(614) 583-7459
Fax: (614) 583-1617
Greg Keenan, CCP Marketing Lead
ghkeenan@aep.com
www.aep.com
American Electric Power, Columbus, Ohio, owns and operates more than 42,000 megawatts of generating capacity and, with five million customers in 11 states, is the largest investor-owned electricity generator in the U.S.,

Ash Recovery Technology, LLC
16490 Chillicothe Road
Chagrin Falls, OH 44023
(440) 543-8357
Fax: (440) 543-6839
Charles Lockert, President
cal.lockert@ashrecovery.com
Ash Recovery Technology provides beneficiation systems for coal combustion fly ash. Solutions are technology independent and may include or combine dry screening, air classification, electrostatic separation, ash re-injection and microwave carbon-in-ash measurement.

Boral Material Technologies Inc. (BMTI)
45 N.E. Loop 410, Ste. 700
San Antonio, TX 78216
(210) 349-4069
Fax: (210) 349-8512
Harry Roof, Manager, Utility Relations
harry.roof@boral.com
www.boralmti.com
BMTI processes and markets more than four million tons of CCPs annually. It leads the CCP industry through development of product innovations, marketing, technology, and CCP transportation and distribution.

Carmeuse Lime Co.
Carmeuse Technical Center
3600 Neville Road
Pittsburgh, PA 15225
(412) 777-0711
Fax: (412) 777-0727
Joel H. Beeghly,
Senior Technical Specialist
Cell phone: (412) 889-5496
joel.beeghly@carmeusena.com
www.carmeuse.com
Carmeuse Lime Co. markets FGD technologies along with means to recover useful FGD by-products. They also promote lime to react with fly ash for use in various construction applications, such as soil stabilization.

Center for Applied Energy Research University of Kentucky
2540 Research Park Dr.
Lexington, KY 40511
(859) 257-0272
Fax: (859) 257-0366
Dr. Tom Robl, Associate Director, Environmental and Coal Technologies Group
robl@caer.uky.edu
www.caer.uky.edu
The Center for Applied Energy Research investigates coal combustion by-product utilization, generating ideas on the use, handling, storage and disposal of CCBs. This group also works on coal cleaning, preparation, pelletization and binding.

Charah, Inc.
Unit M, Suite 100
307 Townepark Circle
Louisville, Ky 40243
(502) 245-1353
Fax: (502) 245-7398
Charles Price, President
cprice@charah.com
www.charah.com
Charah is an ash management business, handling 2.25 million tons of coal combustion by-products annually. With an indepth knowledge of the properties of CCPs, its ash handling capabilities are supplemented by routine development of markets for usable byproducts.

Cinergy Corp.
139 E. Fourth St.
P.O. Box 960
Cincinnati, OH 45201
(513) 287-3336
Fax (513) 419-5525
David Beck , Manager, Byproducts
davidbeck@cinergy.com
www.cinergy.com
Cinergy generates 9,800 megawatts of electricity, producing 6.7 million tons of coal combustion by-products each year. Nearly 2.6 million tons of these byproducts are recycled into many beneficial products and uses.

Combustion Products Management
1541 Alta Drive, Ste 205
Whitehall, PA 18052
(800) 951-5558
Fax: (610) 821-6911
Steve Benza, Senior Vice President.
svashes@aol.com
www.cpmash.com
Combustion Products Management (CPM) provides ash management services nationwide. CPM markets fly ash, bottom ash and cenospheres and specializes in large volume utilization projects that create assets, minimizing plant costs.

Dairyland Power Cooperative
3251 East Avenue South
LaCrosse, WI 54601
(608) 787-1351
Fax: (608) 787-1490
David Lesky, Lead Chemist
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www.dairynet.com
Dairyland provides wholesale electricity to 25 member distribution cooperatives and 20 municipal utilities meeting the needs of more than 500,000 people. It has provided low-cost, reliable electrical energy and services in the upper Midwest for over 62 years.

W. Lee Daniels
Virginia Polytechnic Institute
Department of Crop and
Soil Environmental Sciences
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Blacksburg, VA 24061
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Dr. Daniels specializes in the reclamation of drastically disturbed lands, agricultural and industrial waste management and the prediction of soil and water quality effects. His time includes research into the human impact on soil resources and teaching.

Duke Energy Corporation
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Charlotte, NC 28201
(704) 382-6114
Fax: (704) 382-4014
Tony Mathis, Manager, Fuels and Ash Management
trmathis@duke-energy.com
www.duke-energy.com
Celebrating 100 years of service, Duke Power, a unit of Duke Energy, has approximately 19,900 megawatts of generation and is one of the nation's largest electric utilities providing service for more than two million customers in North and South Carolina.

Dynastone, Ltd.
4806 Avenue C
Corpus Christi, TX 78410
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Fax: (361) 241-8856
Jerry Setliff, President/CEO
jset@setliffcompanies.com
www. dynastone.com
Dynastone and its subsidiaries, Mainland Labs, Ltd., Flowable Fill, Ltd. and JSET, Ltd. develop advanced fly ash use technologies for carbon fixation in ready mix concrete, quick setting materials in controlled placement setting fills, and high volume fly ash concrete (up to 96 percent) replacement of Portland cement in concrete.

Dynegy, Inc.
2828 N. Monroe St.
Decatur, IL 62526
(217) 876-3943
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Joe Kimlinger P.E.,
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www.dynegy.com
Dynegy owns and operates a diverse portfolio of energy assets, which provides electricity, natural gas and natural gas liquids to wholesale customers in the U.S., and retail customers in Illinois.

Energy & Environmental Research Center University of North Dakota
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Debra Pflughoeft-Hassett,
Research Manager
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EERC is a research, development, demonstration, and commercialization facility dedicated to moving promising technologies out of the lab and into the marketplace to produce energy cleanly and efficiently, minimizing environmental impacts and conserving precious natural resources.

Fremont Department of Utilities
400 E. Military
Fremont, NE 68025
(402) 727-2610
Fax: (402) 727-2667
Derril Marshall, General Manager
Fremont, Nebraska Department of Utilities provides electric generation and distribution service along with natural gas, water, sanitary sewer and solid waste disposal services for about 10,000 customers in Fremont and the surrounding area.

Full Circle Solutions, Inc.
665 Molly Lane, Suite 100
(770) 517-7017
Fax: (770) 517-9689
Bob Waldrop, Vice President
bobwaldrop@fullcirclesolutionsinc.com
Full Circle Solutions, Inc. provides coal combustion product management services in the Southeast U.S. to utilities, independent power producers and other industries specializing in construction and agricultural products.

GAI Consultants, Inc.
570 Beatty Road
Monroeville, PA 15146
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Fax (412) 856-4970
Gary F. Brendel, Engineering Manager
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www.gaiconsultants.com
GAI Consultants assists electric power producers develop cost-effective CCP management strategies, including marketing and beneficial use programs; market studies; disposal facility siting, design, and permits; research; and large-tonnage uses for off-spec ash.

Gerald Gambs, P.E.
Consulting Engineer
1725 York Ave. #33C
New York, NY 10128
(212) 427-3982
Mr. Gambs has more than 60 years of experience in mining, fuels and energy programs, to include industrial and educational positions involving coal, uranium, oil and gas; cogeneration; power plant projects; use of fly ash in concrete and concrete products.

Golder Associates Inc.
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Fax: (303) 985-2080
Ron Jorgenson, Senior Consultant
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Golder Associates is a consulting engineering company specializing in ash management, environmental permitting, pipeline design, information management, water quality monitoring, environmental evaluations, geotechnical engineering, hydrologic evaluations, and other earth science applications.

Great River Energy
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Fax: (701) 442-7231
Al Christianson, North Dakota Business Services Representative
achristianson@grenergy.com
www.greatriverenergy.com
Great River Energy, Elk River, is Minnesota's second largest wholesale electricity supplier. As a generation and transmission cooperative, GRE provides wholesale electric service to 28 distribution co-ops with approximately 560,000 members.

Holcim (US) Inc.
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Ann Arbor, MI 48108
(734) 821-7043
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Barry Descheneaux, Manager,
Product Support and Development
barry.descheneaux@holcim.com
www.holcim.com
Holcim (US) Inc. is a wholly owned subsidiary of Holcim Ltd., and is one of the largest suppliers of Portland and blended cements and related mineral components in the United States.

Indianapolis Power & Light Co. (IPL)
PO Box 436
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Petersburg, IN 47567
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Jeffrey Jenkins, Environmental Coordinator
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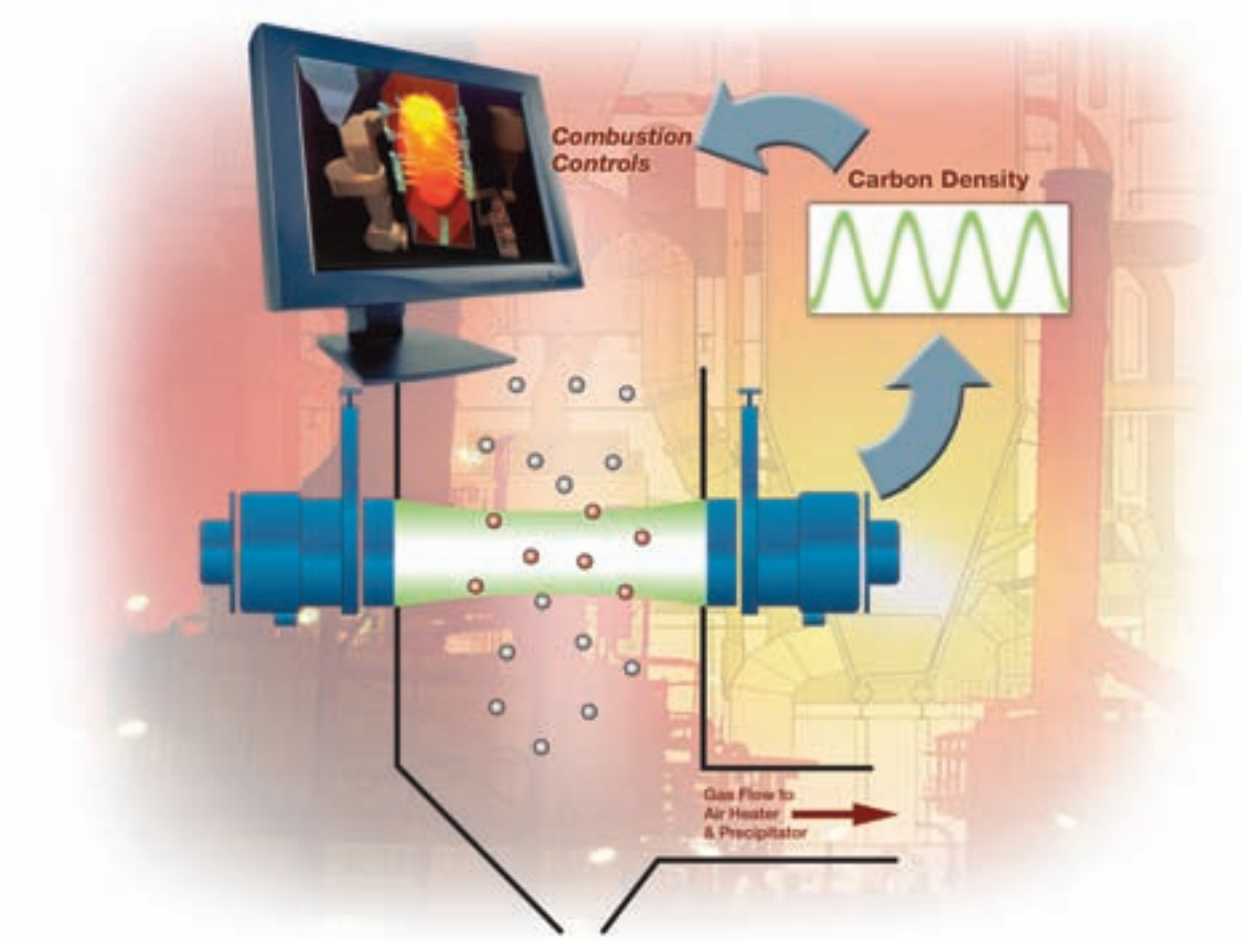
www.ipalco.com
IPL provides retail electric service to more than 440,000 residential, commercial and industrial customers in Indianapolis, as well as portions of other Central Indiana communities surrounding Marion County.

Let ABB turn your Ash into Cash...



Real Time!

The ABB Carbon in Ash Monitor represents the most advanced technology available today for monitoring unburned carbon content in flyash. This patented ***Real* Time**, non-extractive, non-sampling, in-situ monitoring system incorporates advanced microwave technology for continuous, reliable, accurate measurement of carbon.

More than that – ABB's power plant automation experts can integrate the Carbon in Ash Monitor into closed loop control algorithms that will reduce generation costs and increase ash sales through improved combustion.

By employing the ABB solution, environmentally conscious utilities can now regularly produce higher quality, low carbon flyash that has significant commercial value. A typical power plant can annually return upwards of $1Million through enhanced coal combustion and flyash sales.

Don't wait, contact our experts and see how ABB can turn your Ash into Cash today!

For more information visit our website at
www.abb.com/powergeneration
or call 860-285-6870

ABB

ISG Resources, Inc.
10653 South River Front Parkway,
Suite 300
South Jordan, UT 84095
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John Ward, Vice President
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www.flyash.com
ISG Resources is the nation's largest manager and marketer of coal combustion products. ISG markets CCPs for traditional applications, manufactures CCP-based products, and develops technologies to improve CCP quality.

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Kansas City Power & Light Company is a leading regulated provider of electricity in the Midwest. Its parent company is Great Plains Energy Incorporated (NYSE:GXP) of Kansas City, MO.

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Fax: (816) 251-2195
Shrief Kabis, Regional Product Manager-Ash
Shrief.kabis@lafarge-na.com
www.lafargecorp.com
Lafarge NA is the largest diversified construction materials company and supplier of cement, fly ash, slag, aggregates and concrete, and other materials for residential, commercial, institutional and public works construction in the United States and Canada.

LB Industrial Systems, LLC
12508 Jones-Maltsberger Road
San Antonio, TX 78216
(210) 344-2009
Fax: (210) 344-1121
Robert Lister, President
rlister@lbindustrialsystems.com
Web site is under construction.
LB is a customer-focused design/build company providing systems and services for ash conveying, processing and storage needs. It has over 20 years of project and O&M experience, domestic and international.

LG&E Energy Corp.
220 West Main Street, 4th Flr.
Louisville, KY 40202
(502) 627-3154
Fax: (502) 627-2194
Kenneth Tapp, By-products Coordinator
Kenny.tapp@lgeenergy.com
www.lgeenergy.com
LG&E is a diversified energy services company located in Louisville, Kentucky serving 840,000 electricity customers in Kentucky and Virginia with a generating capacity of 7,300 megawatts.

LMS Environmental Contracting, Inc.
6515 W. 500 N.
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(812) 273-5740
Fax: (812) 273-1651
Tom Kuhn, Director, Business Development
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LMS's primary business is heavy construction. Expertise includes landfill development and closure, coal mine reclamation, coal ash handling, industrial site development, dredging, road construction and overburden removal.

Macawber Engineering Inc.
Mike Crawley, CEO
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Maryville, TN 37801
(865) 984-5286
Fax: (865) 977-4131
mcrawley@macawber.com
www.macawber.com
Since 1977, Macawber has focused its efforts on developing and manufacturing systems and special valves for the low velocity pneumatic transfer of abrasive and hot materials such as fly ash from various areas of any type of steam plant.

McDonald Farms Enterprises, Inc.
7247 East County Line Road
Longmont, CO 80501
(303) 772-4577
Fax: (303) 442-5706
Randall McDonald, General Manager
Mcfarms3@aol.com
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McDonald Farms Enterprises is a diversified construction and transportation company. It provides construction, ash management, dredging, waste removal, emergency clean up and container roll-off services.

Mineral Resource Technologies – A CEMEX Company
2700 Research Forest Drive, Suite 150
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Fax (281) 362-1809
Mike Silvertooth, Business Development Manager
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www.mrtus.com
Mineral Resource Technologies, Inc. (MRT), a subsidiary of CEMEX, Inc. is one of the fastest growing providers of CCPs in the U.S. and a leading service provider to the utility industry for CCP management services.

Mirant Mid-Atlantic
8711 Westphalia Road
Upper Marlboro, MD 20774
(301) 669-8035
Fax: (301) 669-8222
Patrick Miglio, Group Leader, ES&H Compliance Services
Patrick.miglio@mirant.com
Mirant, Mid-Atlantic (Chalk Point Station)–formerly owned by PEPCO. Chalk Point Station is the largest generating station in Maryland. Located on the Patuxent River, Units 1 and 2 produce approximately 683 megawatts of coal-fueled generation.

Dr. Barzin Mobasher, Ph.D., P.E.
Associate Professor of Civil and Environmental Engineering
Cement Composites Research Group
Department of Civil and Environmental Engineering
Arizona State University
MC 5306, B-ERC, Rm. 463
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Dr. Mobasher is involved with research in areas of blended cements and high-performance concrete, experimental and theoretical formulations addressing fresh and long-term properties such as rheology, setting, workability, strength, fracture and durability.

Montana-Dakota Utilities Co.
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Fax: (701) 222-7845
Jason W. Boeckel, Senior Environmental Scientist
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www.montana-dakota.com
Montana-Dakota Utilities Co. distributes natural gas; generates, transmits and distributes electricity; and provides related value-added products and services in the Northern Great Plains.

Dr. Ishwar P. Murarka
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Cupertino, CA 95014
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ishinc@pacbell.net
Dr. Murarka, a consultant to government and electrical utilities, specializes in coal ash research projects involving ground water migration of coal ash constituents emphasizing among others ash related heavy metal contaminants.

Muscatine Power and Water
3205 Cedar St.
Muscatine, Iowa 52761
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Fax 563/262-3315
Don Pauken, Manager, Environmental Affairs
dpauken@mpw.org
www.mpw.org
Muscatine Power and Water, a municipal utility, provides electric, water and communications products and services to the city of Muscatine, Iowa and adjacent areas. Native electric system peak is 149.9 megawatts.

Tarun R. Naik, Ph.D, P.E.
Director, UWM Center for Byproducts Utilization
University of Wisconsin – Milwaukee
College of Engineering and Applied Science
Department of Civil Engineering and Mechanics
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Dr. Naik, with more than 40 years of industry and university experience, specializes in recycling of industrial byproducts and post-consumer wastes, as well as issues related to sustainable development, construction materials, concrete and wood engineering. He has authored over 250 technical papers and reports.

Nebraska Ash Company
1815 "Y" Street (ZIP 68509)
P. O. Box 80268
Lincoln, NE 68501
(402) 434-1777
Fax: (402) 434-1799
L. E. "Tex" Leber, President
www.nebraskaash.com
Nebraska Ash and its wholly owned subsidiary "Plains Pozzolanic" are full-service CCP handling companies which market, store and dispose of fly and bottom ash for coal burning electrical generation stations.

Nebraska Public Power District (NPPD)
402 East State Farm Road
North Platte NE 69101
or
P.O. Box 310
North Platte NE 69103-0310
(308) 535-5327
Fax: (308) 535-5333
Thomas J. Schroeder, Fossil Fuels Manager
tjschro@nppd.com
www.nppd.com
NPPD is a subsidiary of the state of Nebraska that provides power to 91 of Nebraska's 93 counties. Its Gerald Gentlemen and Sheldon generating stations have a capacity of 1,565 MW distributing electricity to nearly 788,000 customers.

Pittsburgh Mineral & Environmental Technology, Inc.
700 Fifth Avenue
New Brighton, PA 15066
(724) 843-5000 ext.11
Fax: (724) 843-5353
William F. Sutton, Executive Vice President
bsutton@pmet-inc.com
www.pmet-inc.com
PMET is a commercial technology development and service company specializing in CCP utilization, waste stream management, and precision analysis. It is dedicated to waste minimization, and the conversion of industrial wastes to safe, usable, and profitable products.

Pozzi-Tech, Inc.
4700 Vestal Parkway East
Vestal, NY 13850
(607) 798-0655
Fax: (607) 770-7956
Terry Watson, President
tewatson@pozzitech.com
www.pozzitech.com
Pozzi-Tech is a full-service CCP management services company. It brings a century of electric utility knowledge and experience together with the provision of quality, timely and cost-efficient options for fuel procurement, logistics and CCP reuse and disposal.

PPL Generation, LLC
Two North Ninth Street
Allentown, PA 18101
(610) 774-4117
Fax: (610) 774-4759
Joel Pattishall, Manager - Ash Operations
jcpattishall@pplweb.com
www.pplweb.com
PPL Generation, LLC controls about 11,500 megawatts of generating capacity in the United States. Its portfolio includes power plants in Arizona, Connecticut, Illinois, Maine, Montana, New York and Pennsylvania.

Progress Energy
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Raleigh, NC 27602
(919)-546-4002
Charlie Hughes, Byproduct Management
charles.hughes2@pgnmail.com
www.progress-energy.com
Progress Energy is a Fortune 250 diversified energy company with more than 24,000 megawatts of generation capacity. The company's holdings include two electric utilities, the subsidiary Progress Materials, as well as other non-regulated operations.

Public Service of New Hampshire
P.O. Box 330
Manchester, NH 03105
(603) 634-2439
Fax: (603) 634-3283
Allan Palmer, Senior Engineer
palmeag@nu.com
www.psnh.com/
Formed in 1926, Public Service of New Hampshire is the Granite state's largest electric utility. It serves more than 447,000 customers throughout the state and generates over 1,110 megawatts.

PSEG Services - Environmental Health and Safety
Paulsboro Resource Recovery Center
243 West Jefferson Street
Gibbstown, NJ 08027
(856) 224-1637
Fax: (856) 224-1574
Thomas Costantino, CHMM, REM, CMIR, Resource Recovery Manager
thomas.costantino@pseg.com
www.pseg.com
PSEG Services Resource Recovery oversees the management of Coal Combustion Products in cement applications and commercially available products, as well as pre-approved beneficial use land reclamation projects.

Rio Bravo
3100 Sparta Court
Lincoln, CA 95648
(916) 645-3383
Fax: (916) 645-9209
George Nowland, Project Manager
gnowland@rbrocklin.com
Rio Bravo, with four California power plants, produces 114 megawatts of electricity. These include two coal-fired cogeneration facilities and two biomass-fired electrical generators. It successfully uses all of its coal combustion products (CCPs) for beneficial use within California.

Salt River Materials Group
8800 E. Chaparral Rd., Ste. 155
Scottsdale, AZ 85250
(480) 850-5757
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Scott Palmer, Market Development Manager
spalmer@srmaterials.com
www.phoenixcement.com
Salt River Materials Group markets a variety of construction materials including normal and lightweight aggregates, the product Phoenix Cement™, Portland and blended cements, and a full line of CCPs in the Southwestern U.S.

Salt River Project (SRP)
P.O. Box 52025
Phoenix, AZ 85072-2025
(602) 236-3824
Fax: (602) 239-3992
M. M. Bailey, Power Generation Consultant
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www.srpnet.com
SRP operates two generating stations, Coronado and Navajo, in northeastern Arizona. Both produce and market an approximate combined total of 880,000 tons of Class F fly ash.

Santee Cooper
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Moncks Corner, SC 29461
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Thomas Edens, Administrator, Combustion Product Utilization
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Santee Cooper, with 2,800 coal-fired megawatts and 1,200 more under construction, is the nation's third largest public utility and serves 1.6 million South Carolinians. It provides CCPs to the cement and concrete industries, as well as synthetic gypsum to agriculture.

Dr. Don Saylak, Ph.D., P.E.
Research Engineer
Texas Transportation Institute & Director of By-product Utilization and Recycling
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Dr. Saylak has over 50 years experience in materials science with publications and patents in the design and evaluation of construction materials including stone, synthetic aggregates, asphalt, plastics and elastomers, sulfur-modified binders and concretes, industrial wastes and byproduct use.

Seminole Electric Cooperative, Inc.
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Tampa, FL 33688-2000
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Fax: (813) 264-7906
Mike Opalinski/Jim Frauen, Director of Environmental and Engineering Services/Manager Environmental Services
info@seminole-electric.com
www.seminole-electric.com
Seminole is a wholesale generation and transmission co-op providing the energy needs of 10 member distributors serving 1.6 million Florida customers. With 1,800 megawatts of capacity, 2003 member coincident peak demand was 4,009 megawatts with sales of 14,956 MWH.

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Tom Cerullo, Northeast Regional Manager
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1440 S. Burgandy Trail
Jacksonville, FL 32259
(904) 710-6029
Fax: (904) 287-1164
Dave Brodhacker, Southeast Regional Manager
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Separation Technologies LLC offers a proven, modular ash beneficiation system that has been in operation over nine years, consistently producing low LOI fly ash, at a relatively low cost of installation.

South Carolina Electric and Gas Co., Inc.
111 Research Drive
Columbia, S.C. 29203
(803) 217-7461
Fax: (803) 933-8064
Ted Frady, Sr. Engineer, Ash Utilization
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www.scana.com
South Carolina Electric and Gas (SCE&G) is an investor-owned, regulated utility, with an electric generating capacity of approximately 5,000 megawatts. SCE&G, based in Columbia, serves more than 500,000 South Carolina electric customers.

Southern Illinois Power Cooperative
11543 Lake of Egypt Road
Marion, IL 62959
(618) 965-1448
Fax: (618) 964-1867
Richard G. Myott, Planning & Environmental Department Manager
SIPC is a generation and transmission cooperative annually burning 1.2 million tons of Illinois coal. SIPC produces cyclone boiler slag, Class F fly ash and calcium sulfite scrubber material, as well as CFB alkaline bed ash and fly ash.

Sphere Services, Inc.
123 Leinart Street, Suite 205
Clinton, TN 37716
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Fax: (865) 463-2491
Tracy L. Wandell, President
Kip Clayton, Coal Products Manager
tlwandell@msn.com
www.sphereservices.com
With more than 16 years of specialized expertise, Sphere Services, Inc. is a marketer of cenospheres. SSI works directly with its clients to develop a business relationship to reduce client costs and increase revenue for their CCPs.

Sunflower Electric Power Corporation
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Jim Carlson, Supervisor of Environment
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Sunflower Electric Power Corporation is an electric cooperative located in Holcomb, Kansas. Holcomb Station has one coal-fired and five gas-fired generation units, with a total generation of 548 megawatts.

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www.synmat.com
Synthetic Materials (Synmat) specializes in the dewatering of synthetic gypsum slurries. Synmat's core competencies include facility design, construction, operation, as well as gypsum cake transportation and marketing.

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