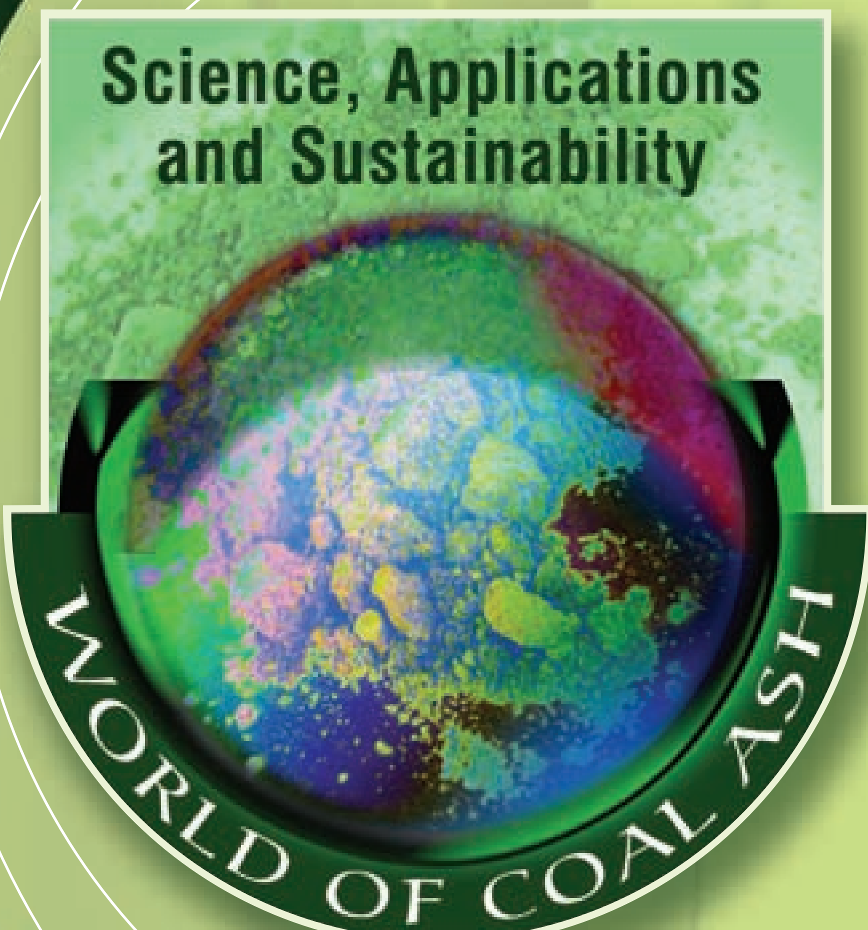
SUMMER/FALL 2005

ASH at work

Application, Science and Sustainability of Coal Ash



C²P² AWARDS

DOE'S MERCURY RESEARCH

COMPUTER MODELING AND CCPS

ACAA MEMBERSHIP LISTINGS

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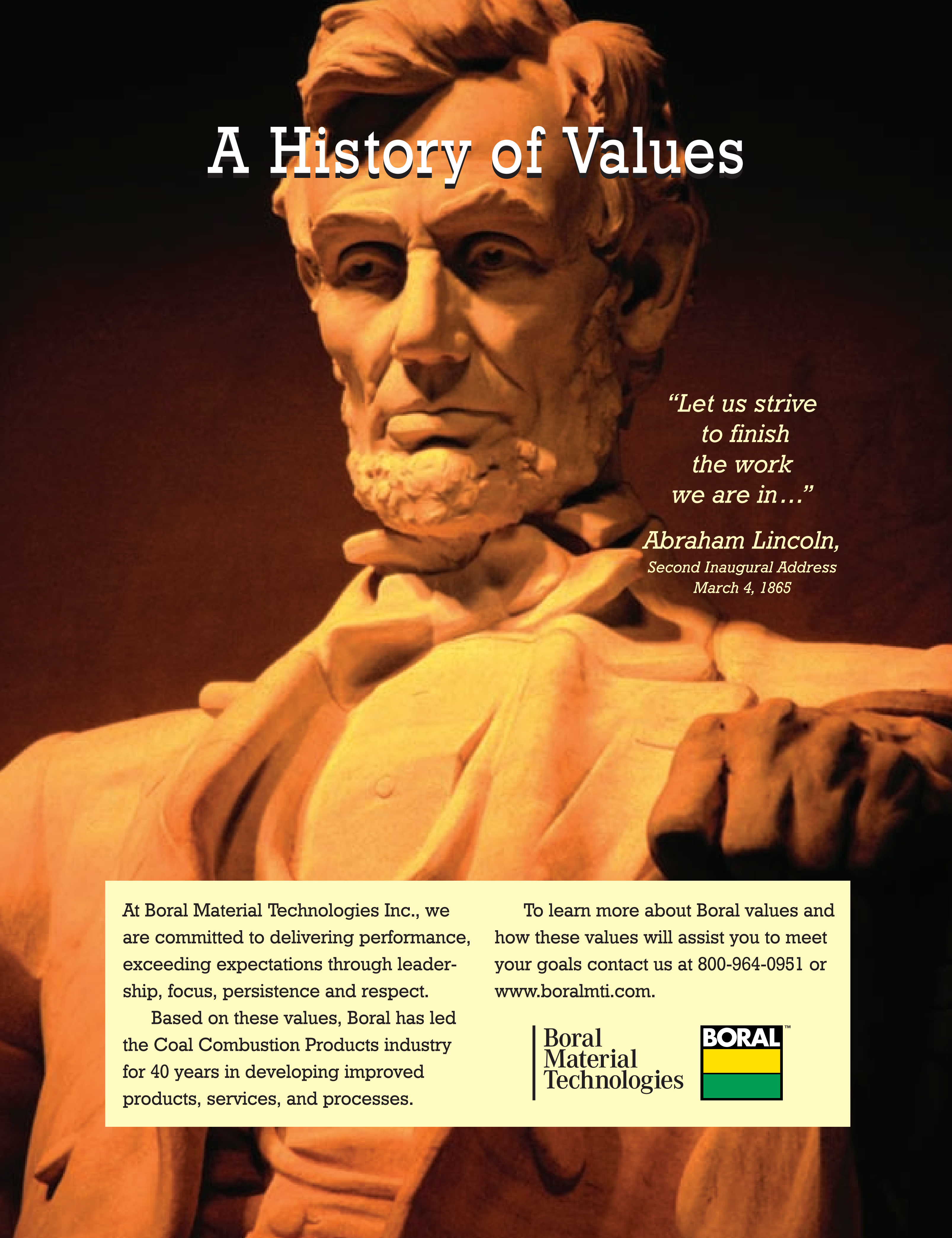
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Abraham Lincoln,
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March 4, 1865
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TABLE OF CONTENTS

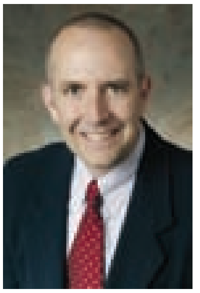
FEATURES

Cover features (clockwise from top left): the logo from the World of Coal Ash; the Lexington History Museum, where the C²P² awards were held; the Lexington Center, where the World of Coal Ash was held.

WHERE THERE IS DEMAND, THERE IS OPPORTUNITY

ACAA creates market demand and creates opportunities for the CCP industry.

By Thomas Jansen



Thomas Jansen, Chairman, American Coal Ash Association, P.E., We Energies, CCP Group Supervising Engineer

The CCP industry is unique in the world of business – it generates large quantities of product regardless of market demand. I've been told that marketing a byproduct is much different than marketing conventionally manufactured products. On the other hand, some experts tell me that many marketing strategies still apply to the CCP industry, and one stands out – create demand and profit from its opportunities.

Demand-driven strategies may be taking the lead as the maturing CCP industry enters a new phase. The supply of CCP often motivates the decisions of producers but there are many recent examples of utilities responding to market demands for supplementary cementitious materials (SCM) and other construction materials. In the last five years there have been increasing numbers of utilities and marketers that beneficiate their fly ash to produce a higher quality SCM. Large, elaborate storage and loading facilities can be seen at many generating stations that now serve construction markets during periods of highest demand. Good quality fly ash is shipped more frequently to serve distant markets that are hungry for SCM for a variety of reasons, including cement shortages, and because more engineers specify fly ash as a way to make better concrete. Bottom ash is being processed and sold as lightweight aggregate. Utilities are investing in equipment and resources to produce high quality gypsum in a synergistic response to manufacturers' investments in modern wallboard plants. And I am sure there will be upcoming announcements of investments to produce other products made from or with large volumes of CCP.

We still have plenty of CCP that is not marketed, and certainly there are limits to current market demand. There are regions of the U.S. where there is an abundance of CCP that does not meet specifications for some end uses or the source is not economically accessible. The oversupply of CCP will be more acute due to increased reliance on new power generation from coal. The U.S. Department of Energy (www.eia.doe.gov/oiaf/aeo/coal.html) projects that coal consumption for electricity generation will increase at an average rate of 1.6% through the year 2025 (that is 1.5 billion tons of coal in 2005 compared to 1.1 billion tons consumed in 2003). Compared to the growth of ash production, the materials from dry scrubbers and wet scrubbers will be our fastest growing and most immediate challenge.

Where will the demand come from for the approximately 75 million tons of CCP that are now disposed of each year, as well as the additionally produced byproducts? Our industry has demonstrated that we can *respond to demand* by researching and developing new technologies, making the necessary investments, and selling CCP to the pockets of existing demand. To keep moving the markets forward, ACAA is the CCP industry's best vehicle to *create demand* through the cooperative efforts of its members and stakeholders. Here are some ways that ACAA and its members can create additional demand:

- Promote CCP use and its benefits through education; networking; public relations; publications and manuals; websites; advertising; and direct marketing to end users and specifiers.
- Jointly promote and research improved *systems* with other industries and organizations. For example, promote greener buildings; greener highways; more durable roads; lighter weight building components; safer fire-rated walls; flowable and self-consolidating backfill and concrete.
- Create or revise specifications, guidelines and standards.
- Produce high-quality products. This can be done by equipment upgrades, improved QC/QA programs, and training plant operators.
- Remove encumbrances to the use of CCP such as excessive regulation and lack of favorable specifications. Customers demand products that are easy to use and available when they need it.
- Sell and use CCP with the goal of long-term growth. All products have limitations. Make sure CCP is used properly and successfully. Referrals and testimonials from satisfied customers are the best means for future sales and long- term growth.
- Price the product to reflect its true value (discounts do not encourage long term demand for a product because it stifles quality improvements, inhibits efficient distribution, and eliminates the added expense of service and technical support). Yes, even ACAA can help with this one by promoting the benefits of CCP, and by helping members and their customers understand the expense of competing materials and systems.
- Use ACAA resources for customer referrals and value-added services.
- Leverage your resources with other ACAA members that have a mutual interest in research, training, education and promotion.

Together we can create demand and profit from the opportunities. ❏

PARTNERSHIPS AND A NEW RESOURCE

By Dave Goss

Joining with other trade associations and government agencies, ACAA continues in its leadership role of increasing national awareness of industrial material recycling. A key part in this role is our participation in two upcoming national conferences. As has been the case since 2002 with the advent of the first Industrial By-products Summit, which was held in Chicago, ACAA is active in the planning of this year's Summit to be held in Philadelphia on November 29-30, 2005. The Summits bring together the public and private sectors to discuss opportunities and barriers to the use of industrial residues, including coal ash, steel and iron slag, foundry sands and other recycled materials.

Another event in which we will be participating later this year is the Green Highway Forum, to be held in College Park, Maryland. Originally intended to address only wetlands, watershed and other land issues related to highway construction, additional sessions on construction and materials, as well as maintenance, have been added. Involvement in this event is integral to ACAA's Green Highway concept, laid out in our recently implemented Strategic Plan.

ACAA is also working closely with the EPA, FHWA, FIRST (Foundry Industry Recycling Starts Today) and other groups to support one of the EPA's solid waste focus areas for 2005, that being the beneficial use of "selected" industrial byproducts, specifically coal ash, foundry sand and recycled concrete aggregate. These partnerships, joint outreach and collaborative activities are assisting federal, state and local government agencies to realize the benefits of reusing coal ash and other materials instead of depleting natural resources. Our efforts also dovetail into the Green Highways event outlined above. We will keep you well informed as these activities progress.

Serving as a resource for the ash industry is both interesting and challenging. The ACAA staff receive 10 to 20 inquiries a week seeking a variety of information. Questions cover wide-ranging topics, such as the physical properties of coal ash, transportation methods and cost, usage projections and technical applications. For this reason, ACAA is continually looking for good reference publications.

I recently had the opportunity to review a new book published by Elsevier Academic Press, titled "Coal Energy Systems" and written by Bruce G. Miller of Penn State's Energy Institute. For an industry novice or a journeyman veteran who might be looking for a basic reference, the book has much to offer. It is well organized, easy to use, contains many well-designed technical diagrams, charts and tables and is a substantive source of industry information. Starting with a fundamental discussion of coal, its roles in society and its impact on the environment, Mr. Miller moves on to cover major U.S. emission and air quality legislative actions influencing the use of coal. Also included are chapters on coal combustion processes, clean coal technologies and various emission control systems. If you are searching for a single reference volume for your library that will enrich and support your understanding of coal, CCPs and the coal-fueled utility industry, you should seriously consider purchasing "Coal Energy Systems". ❑

Dave Goss, ACAA Executive Director

ACAA Mission Statement

The mission of the American Coal Ash Association is to advance the management and use of coal combustion products (CCP) in ways that are environmentally responsible, technically sound and commercially competitive.

ACAA Vision

ACAA will continue to be a world leader in advancing beneficial use of coal combustion products (CCP) and resource conservation through utilization.

ACAA Goals

1. Increase annual utilization of fly ash and bottom ash as a supplementary cementitious material and cement clinker raw feed to 18 million tons by 2010.
2. Increase the annual total beneficial use of CCP to 58 million tons by 2008, and to 64 million tons by 2010 (this is 45 percent and 50 percent respectfully, compared to 2002 survey results).
3. Proactively anticipate, assess and respond to issues that impact the CCP industry.
4. Develop stronger relationships with stakeholders and influencers of CCP utilization and resource conservation.
5. Increase ACAA membership to 100 by 2008, including at least 40 Class U (utility) members. ❑

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ACAA INTERNATIONAL

Calendar of Events

2005 ACAA Fall Meeting, Atlanta, Georgia: September 26-28 Embassy Suites Hotel-Atlanta Buckhead

2006 ACAA Annual Meeting New Orleans, LA: January 30-February 1, Chateau Sonesta Hotel

2006 ACAA Summer Meeting, Milwaukee, WI: June 5-7 Wyndham Milwaukee Center Hotel

Visit Calendar of Events to Locate Upcoming Meetings

www.acaa-usa.org

C²P² AWARDS

The former Fayette County Courthouse, now the Lexington History Museum, hosted the first C²P² ceremony, April 13, 2005.

The first ever Coal Combustion Products Partnership (C²P²) awards ceremony was held on April 13, 2005 in Lexington, Kentucky in conjunction with the World of Coal Ash. At this event, the U.S. Environmental Protection Agency and other co-sponsors recognized thirteen organizations for their environmental and commercial initiatives to increase the use of coal ash. C²P² is a cooperative effort of government agencies and the coal combustion products (CCPs) industry to help promote the beneficial use of CCPs and the environmental benefits which can result from that beneficial use. Award winners were:

GREAT RIVER ENERGY

FIRST PLACE – ENVIRONMENTAL ACHIEVEMENT

Great River Energy spent over $27 million to develop an infrastructure for on-site reclamation of coal ash at its Coal Creek and Stanton Stations in North Dakota. It also developed a highly energy-efficient, aerated concrete product called Flex Crete that will be used in the construction of the National Energy Technology Training and Education Center at Bismarck State College. Since 2003, the company's efforts have resulted in a reduction of greenhouse gas emissions by 525,000 tons.

CHARAH ENVIRONMENTAL INC.

FIRST PLACE – INNOVATION AWARD

Charah Environmental Inc. is finding new ways to bring recycled bottom ash back to the consumer. Instead of using dusty paper concrete bags, the company sells its lightweight, bottom ash concrete in two-handled plastic bags. This innovation helped the company win an agreement with Home Depot, which will purchase 41 million bags of Charah's concrete over the next three years – reusing 1.3 million tons of bottom ash and 160,000 tons of fly ash.

PITTSBURGH MINERAL AND ENVIRONMENTAL TECHNOLOGY INC. (PMET)

HONORABLE MENTION – INNOVATION AWARD

PMET has developed a technology to build brick pavers that use high loss-of-ignition coal ash that would otherwise not be an acceptable substitute for portland cement. As a result, more coal ash can now be reused, preventing the pollution-causing process of making new cement. PMET is currently building a new plant that will make 13.6 million pavers per year and use 67 to 90% less energy than modern high-efficiency brick kilns.

LOWER COLORADO RIVER AUTHORITY: FAYETTE POWER PROJECT

FIRST PLACE – ENHANCED UTILIZATION

The Fayette Power Project has maintained an astounding recycling rate of *over* 100% for all of its coal combustion products. The project's marketing has been so successful, in fact, that the Lower Colorado River Authority has had to dig up its old stockpiles of combustion products just to meet the needs of customers who want to purchase the ash.

XCEL ENERGY AND LAFARGE NORTH AMERICA

HONORABLE MENTION – ENHANCED UTILIZATION

Lafarge N.A. and Xcel were recognized for their enhanced CCP utilization efforts at Tolk and Harrington power stations in the Texas Panhandle area. Their work with the Texas Department of Transportation and other professionals in the area has led to a major increase in the use of coal combustion products the region. Both power stations now recycle 100% of their CCPs, a combined total of more than 500,000 tons per year.

Accepting the 2005 C²P² "Overall Achievement Award" from Mr. Jose Sepulveda, Federal Highway Administration, are (l to r) Ms. Kristine Krause, WE Energies; Mr. Sepulveda; Thomas Jansen, and Robert Meidl, both of WE Energies.

LEWIS AND CLARK FORT MANDAN FOUNDATION

FIRST PLACE – COMMUNICATIONS AND OUTREACH

Attracting thousands of visitors each year, the Lewis and Clark Fort Mandan Foundation is America's premier demonstration project for coal combustion products. The Foundation educates the public about the environmental and economic benefits of coal ash reuse. The structure of the Foundation's Visitors Center is a demonstration of the flexibility of coal combustion products – they are incorporated into nearly all of its major building components.

ASSOCIATION OF CANADIAN INDUSTRIES RECYCLING COAL ASH (CIRCA)

HONORABLE MENTION – COMMUNICATIONS AND OUTREACH

CIRCA is working hard to expand the public's knowledge of coal ash reuse. It has developed educational materials describing the environmental benefits of coal ash in a variety of applications, including use in concrete. CIRCA's efforts have spanned continents – its outreach materials are being used extensively throughout Canada, Europe, Australia, and the United States.

KANSAS CITY POWER AND LIGHT; JACKSON COUNTY, MISSOURI; LAFARGE N.A.; AND THE UNIVERSITY OF MISSOURI – KANSAS CITY

FIRST PLACE – PARTNERSHIP

These four organizations partnered to coordinate a project demonstrating the viability of full-depth, in-place, cold recycling of asphalt. Nearly 22 miles of existing asphalt pavement and base materials were ground up, mixed with 700 tons of Class C coal ash, and re-laid in place. This technique reduced the cost of road repairs by 33%, saving on the cost of hauling away the old pavement and eliminating the need for virgin materials.

ENERGY AND ENVIRONMENTAL RESEARCH CENTER (EERC)

FIRST PLACE – RESEARCH

EERC began studying the potential impact of mercury capture technologies on CCPs in 1998 with an investigation of the possible release of mercury and other toxic elements into the atmosphere and groundwater. Since then, EERC has continued to further our scientific knowledge of coal ash, also studying regulatory and code impediments. In 2001,

Mr. Tom Dunne, Deputy Assistant Administrator of the U. S. Environmental Protection Agency's Office of Solid Waste and Emergency Response, stands with the recipients of the 2005 C²P² "Partnership Award". (l to r) Jack Carson, Lafarge-NA; Catherine Shields, Jackson County, Missouri; Tom Dunne, USEPA; Fred Gustin, Kansas City Power & Light; and Anil Misra, University of Kansas City – Missouri.

it launched the Coal Ash Resource Center website, providing information about coal ash to the public. The site also includes the FIRST SEARCH technical document database and the Buyer's Guide to Coal Ash Containing Products.

WE INDUSTRIES (WISCONSIN ELECTRIC POWER COMPANY)

OVERALL ACHIEVEMENT

WE Industries received the Overall Achievement Award for its outstanding CCP management efforts over the last twenty years. In 1980, WE Industries land-disposed 95% of its coal ash. Thanks to the new methods it developed – at the cost of millions of dollars – WE Industries now recycles 98% of its coal ash! The technologies the company utilizes to reuse coal ash have been so successful that it is now digging up its old coal ash to be used again. In 2004, WE Industries also won the 2004 Edison Award for its innovation and leadership in expanding the markets for coal combustion products.

Providing opening comments and hosting the ceremony was Mr. Tom Dunne, Deputy Assistant EPA Administrator of the Office of Solid Waste and Emergency Response. He was assisted by Mr. Tom Feeley, Technology Manager for Innovations for Existing Plants. The program featured the U.S. Department of Energy, Office of Fossil Energy, National Energy Technology Laboratory; Mr. Jose Sepulveda, FHWA Division Administrator; Mr. Jim Roewer, Executive Director of Utility Solid Waste Activities Group; and David Goss, Executive Director of ACAA. Mr. Goss was given special recognition for his leadership and support of C²P². More details about the Award Winners can be found at www.epa.gov/epaoswer/osw/conserve/2005news/03-c2p2.htm. ❑

C²P² is a cooperative effort of government agencies and the coal combustion products (CCPs) industry to help promote the beneficial use of CCPs and the environmental benefits which can result from that beneficial use.

ENVIRONMENTAL RELEASE OF MERCURY FROM COAL UTILIZATION BY-PRODUCTS: WILL NEW MERCURY CONTROLS AT POWER PLANTS MAKE A DIFFERENCE?

By William W. Aljoe, Thomas J. Feeley III, Lynn A. Brickett, Karl T. Schroeder, and James T. Murphy

INTRODUCTION

The U.S. Department of Energy's National Energy Technology Laboratory (DOE/NETL) uses the term coal utilization by-products (CUBs) to describe the solid materials produced by the combustion or gasification of coal, such as fly ash, bottom ash, boiler slag, gasifier ash and slag, and flue gas desulfurization (FGD) solids. While the materials are identical to the ones referred to by ACAA as "coal combustion products" (CCPs), DOE/NETL prefers to use the broader term "utilization" rather than "combustion" because coal gasification creates distinctly different types of solid materials than coal combustion.

CUBs are composed primarily of benign mineral components, but also contain trace elements of aluminum, arsenic, boron, cadmium, lead, mercury, and selenium. CUBs from coal-fired power plants are currently categorized as non-hazardous wastes by the U.S. Environmental Protection Agency (EPA) under the Resource Conservation and Recovery Act (RCRA). The continued regulatory categorization of CUBs as a non-hazardous solid waste is obviously an important factor in minimizing the cost of disposal and is critical to CUB marketability for beneficial use applications.

According to EPA estimates in 1999, U.S. power plants burned 786 million tons of coal containing approximately 75 tons of mercury. It is estimated that approximately 48 tons of mercury were emitted to the atmosphere, while the remaining 27 tons, along with 107 million tons of CUBs, were captured by air pollution control devices, such as electrostatic precipitators (ESPs) and FGD systems. Although it is generally assumed that most of the mercury captured in today's pollution control systems resides in the solid by-product materials, recently-issued EPA regulations to reduce mercury from U.S. coal-fired power plants will increase the capture of mercury. This will result in higher concentrations of mercury in CUBs, leading to greater concern over their environmental behavior in both disposal and utilization applications.

DOE/NETL'S CUB RESEARCH PROGRAM

DOE/NETL is conducting a comprehensive research and development program to enhance the environmental performance of coal-based power plants. The goal of the CUB research activity is to increase coal by-product utilization in the United States from current levels of about 35% to 50% by 2010. An important aspect of this research is the examination and testing of mechanisms by which mercury in CUBs could be released to the environment, such as leaching, volatilization, and microbiological transformation. A comprehensive review of DOE/NETL research on the fate of mercury in CUBs was recently published. The focus of this article is DOE/NETL's research on the release of mercury from CUBs produced during full-scale field tests of new technologies that were designed specifically to capture mercury from power plant flue gases and transfer it to the solid CUB materials. Additional information on all DOE/NETL CUB projects can be found online at www.netl.doe.gov/coal/E&WR/cub.

CUB ANALYSIS FROM ACTIVATED CARBON INJECTION MERCURY CONTROL FIELD DEMONSTRATIONS

In 2001 and 2002, under DOE/NETL sponsorship, ADA-ES Inc. and Reaction Engineering International conducted field demonstrations of activated carbon injection (ACI) for mercury control at four coal-fired power plants: Alabama Power's E.C. Gaston, PG&E's Brayton Point, WE Energies' Pleasant Prairie, and PG&E's Salem Harbor. All the plants burned bituminous coal except for Pleasant Prairie, which burned subbituminous coal. Results of leaching tests of the CUBs produced during these field demonstrations are described below.

E.C. Gaston. The particulate collection configuration at the Gaston power plant (Figure 1) was unique because it included both a hot-side ESP for primary particulate collection and a compact hybrid particulate collector (COHPAC) fabric filter baghouse downstream of the ESP. During mercury control testing, activated carbon was injected downstream of the ESP and upstream of the COHPAC to prevent carbon contamination of the ESP ash. Mercury concentrations in the baseline (pre-ACI injection) ash from the COHPAC measured 0.2-2 microgram per gram (µg/g); whereas, at an ACI feed rate of 1.5 lb per million actual cubic feet (lb/MMacf) of flue gas, mercury concentrations in the combined activated carbon/fly ash by-product ranged from 10 to 50 µg/g. Since most of the fly ash was captured in the hot-side ESP, total mercury concentration in the COHPAC by-product was significantly higher than it would be in applications with ACI located upstream of the primary particulate control device.

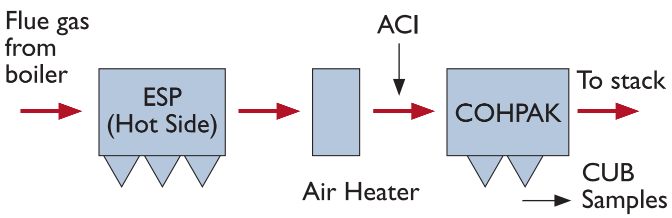

Figure 1. ACI configuration at E. C. Gaston plant

Brayton Point. The Brayton Point particulate collection system was also somewhat atypical because two cold-side ESPs were used in series. Most of the fly ash was collected in the upstream ESP. During mercury control testing, activated carbon was injected between the upstream and downstream ESPs. The baseline ash from both the upstream and downstream ESPs contained 0.2-0.53 µg/g of mercury, whereas, at an ACI feed rate of 10-20 lb/MMacf, the downstream ESP ash contained 0.4-1.4 µg/g of mercury. The reason for the relatively low mercury content of the downstream ESP ash at Brayton Point (compared to the Gaston COHPAC ash) is that most of the mercury in the flue gas was not captured by the activated carbon, but was instead captured by the fly ash in the upstream ESP. Apparently, the unburned carbon in the fly ash was sufficient on its own to achieve a high degree of mercury capture across the upstream ESP, leaving only a small amount to be collected by ACI and the downstream ESP. However, because the mercury captured by the upstream ESP was diluted with the bulk of the ash product, total mercury concentrations in the ash were very low.

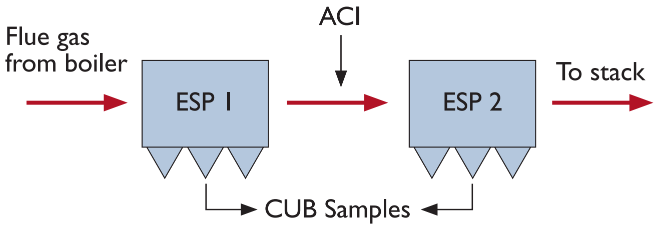

Figure 2. ACI configuration at Brayton Point

Pleasant Prairie and Salem Harbor. The particulate collection systems at Salem Harbor and Pleasant Prairie were more typical of the current fleet of coal-fired power plants in the United States, with one cold-side ESP unit at each plant. However, the specific collection areas (SCA) – the ESP collection plate area divided by flue gas flow rate – at both plants were comparatively large. The SCAs at Pleasant Prairie and Salem Harbor were 468 and 474, respectively, compared to a median of about 300 for all U.S. coal plants, leading to extremely efficient capture of both fly ash and injected sorbent. Baseline ash from the Pleasant Prairie ESP contained less than 0.5 µg/g of mercury; whereas, at an ACI feed rate of 10 lb/MMacf, the ash by-product contained 0.5-5 µg/g of mercury. At Salem Harbor, mercury concentrations ranged from 0.1 to 0.7 µg/g during both baseline and ACI testing conditions (10 lb/MMacf). Like Brayton Point, much of the mercury in the flue gas at Salem Harbor was collected by the carbon in the baseline fly ash, thereby minimizing the addition of mercury to the ash as the result of ACI.

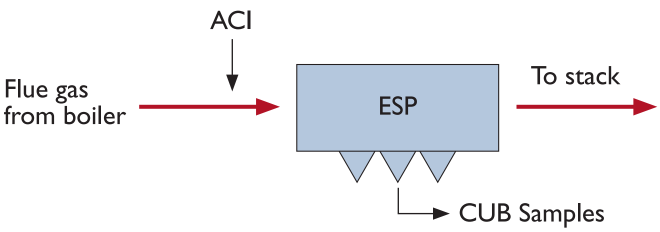

Figure 3. ACI configuration at Pleasant Prairie and Salem Harbor

Leaching Test Descriptions and Results. Leaching analyses were conducted on the combined activated carbon/fly ash by-products collected during ACI tests. Both the standard toxicity characteristic leaching procedure (TCLP) and a synthetic groundwater leaching procedure (SGLP) developed by the University of North Dakota Energy & Environmental Research Center (UNDEERC) were used. The TCLP method was designed to simulate leaching in an unlined sanitary landfill using an acetic acid as the leaching solution. UNDEERC developed the SGLP method to more realistically simulate CUB leaching in typical disposal environments. For the SGLP analysis, deionized water was used as the leaching solution with a 20:1 liquid:solid ratio.

Table 1. ADA-ES leaching test results for ACI ash by-products.

Plant	Sample Location	ACI Rate (lb/Mmacf)	Mercury in Solid (µg/g)	Mercury in Leachate (µg/L)	
			TCLP	SGLP	
Gaston	COHPAC B-Side	1.5	10-50	0.01	BDL[a]
Gaston	COHPAC B-Side	1.5	10-50	N/A[b]	BDL
Gaston	COHPAC B-Side	1.5	10-50	BDL	BDL
Pleasant Prairie	ESP Hopper Composite	10	0.5-5	BDL	BDL
Pleasant Prairie	ESP Hopper Composite	10	0.5-5	BDL	BDL
Pleasant Prairie	ESP Hopper Composite	10	0.5-5	BDL	N/A
Brayton Point	Downstream ESP	0	0.2-0.53	BDL	0.01
Brayton Point	Upstream ESP	0	0.2-0.32	0.02	0.05
Brayton Point	Downstream ESP	10	0.4-1.4	0.07	0.03
Brayton Point	Upstream ESP	10	N/A	0.03	0.01
Brayton Point	Downstream ESP	20	0.4-1.4	BDL	0.01
Brayton Point	Upstream ESP	20	N/A	0.02	0.02
Salem Harbor	ESP Row A	0	0.1-0.7	0.034	BDL
Salem Harbor	ESP Row A	10	0.1-0.7	BDL	BDL
Salem Harbor	ESP Row A	10	0.1-0.7	BDL	BDL

[a]BDL = below detection limit of 0.01 µg/L
[b]N/A = not available.

Table 1 summarizes the leaching test results at the four ACI test plants. For the Gaston and Pleasant Prairie ash samples, the amount of mercury in the leachate was at or below the measurement detection limit of 0.01 microgram per liter (µg/L). For Salem Harbor, only one sample exceeded the detection limit (0.034 µg/L); this sample came from the baseline ash (i.e., no ACI). For Brayton Point, leachate of samples from both the nontreated (upstream) ESP and the ACI-treated (downstream) ESP contained detectable amounts of mercury (0.01-0.07 µg/L). However, no discernable differences in leachate concentrations were found between the upstream and downstream ESPs, or at different levels of ACI injection. This appears to be related to the fact that most of the mercury removal at Brayton Point occurred as the result of high carbon levels in the baseline ash. It should be noted that the leachate mercury concentrations at all four plants were more than an order of magnitude lower than the 0.77 µg/L freshwater criterion continuous concentration and 1.4 µg/L freshwater criterion maximum concentration for mercury under the federal water quality criteria for protection of aquatic life.

Table 2. Mercury concentration in B&W and MTI process samples.

	Mercury (µg/g; dry)	
Process Sample	**Endicott**	**Zimmer**
Coal	0.21	0.15
ESP ash	0.32	0.016
Gypsum	0.70	0.055
FGD slurry	0.76	0.49
FGD fines	38 (by TDT)	13.3

Ash by-product samples from Gaston and Pleasant Prairie were also tested using other leaching procedures for comparison. All of the additional test results were below or equal to the 0.01 µg/L detection limit.

CUB ANALYSIS FROM WET FGD REAGENT MERCURY CONTROL FIELD DEMONSTRATIONS

In 2001, Babcock & Wilcox (B&W) and McDermott Technology Inc. (MTI) carried out joint full-scale field testing of a proprietary liquid reagent to enhance mercury capture in coal-fired power plants equipped with wet FGD systems. The field tests were conducted at two power plants: Michigan South Central Power Agency's 60-MW Endicott Station and Cinergy Corp.'s 1300-MW Zimmer Station. Both plants burn Ohio high-sulfur bituminous coal and use cold-side ESPs for particulate control. Endicott uses a limestone wet FGD system with in-situ forced oxidation, while Zimmer uses a magnesium-enhanced lime wet FGD system with ex-situ forced oxidation. Table 2 presents a summary of the average mercury concentrations for the coal and process by-product stream samples for both Endicott and Zimmer. Although not shown in the data, the majority of liquid stream samples were "nondetects" for mercury (i.e., measuring less than 0.5 µg/L), with a few samples measuring 1-3 µg/L.

B&W and MTI also evaluated the by-product stream samples for their potential to volatilize mercury at elevated temperatures using a thermal dissociation test (TDT) developed by MTI. The TDT method involves the gradual heating of a CUB test sample in an oven while measuring the off-gas mercury

concentration. To represent the temperature-time conditions that FGD by-products are likely to encounter when used as feedstock during the manufacture of wallboard, a temperature of 140°C was held for about 10 minutes in the early portions of the tests. Results of TDTs for Endicott and Zimmer FGD gypsum indicated that only about 3% of the total mercury evolved during the course of the tests occurred at or below 140°C. By contrast, a peak in mercury volatilization occurred at about 250°C (482°F). Since some wallboard manufacturing processes may expose FGD by-products to temperatures between 140°C and 250°C, DOE/NETL is sponsoring additional research to further determine the fate of mercury in wallboard manufacturing facilities. Results from this research are incomplete and are still being evaluated.

One of the significant findings from the B&W and MTI test program was that the mercury in the wet FGD material from both plants was associated primarily with small particle size impurities in the slurry (fines) and was not bound to the larger gypsum particles. Therefore, it may be possible to use particle separation techniques and provide separate landfill disposal of the fines, if necessary, for use in applications where mercury release is a concern.

CUB ANALYSIS FOR MERCURY CONTROL TECHNOLOGY FIELD TESTING IN 2004-2006

As DOE/NETL continues to support the field testing of cost-effective technologies to reduce air emissions of mercury from coal-fired power plants, it will continue to investigate the potential release of mercury from the CUBs produced during these field demonstrations. Toward this end, DOE/NETL issued a competitive solicitation in July 2004 for one or more contractors to conduct independent laboratory analysis of CUBs generated during DOE/NETL's mercury control technology field tests to be conducted at 22 coal-fired power plant units in 2004-2006. The purpose of the solicitation was to ensure accurate and consistent laboratory procedures are used to determine the environmental fate of mercury in CUBs. DOE/NETL expects to award the contract in late spring 2005.

SUMMARY

The following general observations can be drawn from results of field tests that have been carried out thus far to determine whether new technologies for mercury emission control at coal power plants will affect the release of mercury from CUBs:

- There appears to be only minimal potential mercury release to the environment in typical disposal or utilization applications for CUBs generated using ACI control technologies.
- There appears to be only minimal mercury release to the environment in typical disposal and utilization applications for CUBs generated using wet FGD control technologies. The potential release of mercury from wet FGD gypsum during the manufacture of wallboard is still under evaluation.
- The amount of mercury leached from CUB samples tested by DOE/NETL is significantly lower than the federal drinking water standards and water quality criteria for the protection of aquatic life; in many cases, leachate concentrations were below the detection limits of the analytical methods.

DOE/NETL will continue to partner with industry and other key stakeholders in carrying out research to better understand the fate of mercury and other trace elements in the by-products from coal combustion.

ACKNOWLEDGMENTS

This article would not have been possible without the efforts of the DOE/NETL project managers and researchers who provided valuable technical input. In particular, the authors would like to acknowledge the contributions of Ann Kim (retired), Candace Kairies, Carol Cardone, Chuck Miller, and Bob Patton.

Disclaimer: References in this article to any specific commercial product or service are to facilitate understanding and do not imply endorsement by the U.S. Department of Energy. ❑

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A NEW BENEFICIAL USE FOR "UNUSABLE" FLY ASH

By Javed I. Bhatty and John Gajda

INTRODUCTION

Nearly 70 million tons of fly ash are generated annually in the U.S., more than 60% of which is disposed of as "unusable" in landfills because its carbon content is too high or because it is contaminated from processing measures to limit stack emissions. This paper discusses an economic use for much of this "unusable" fly ash as a raw material in cement manufacturing. Demonstrations have produced cements that met applicable standards, and exhibited engineering properties comparable or superior to that of those normally used to produce cement. Cement plants conducting the demonstrations realized several material, operational, fuel, and environmental benefits. The operations were smooth, stable and glitch-free. The fuel consumption declined, and the rate of cement production increased.

Table 1. Oxide Composition of Fly Ash, Shale is also shown for comparison, wt. %

Analyte	Fly Ash A	Fly Ash B	Fly Ash C	Typical Shale
SiO_2	42.95	47.87	52.50	56.53
Al_2O_3	15.46	17.08	21.62	15.06
Fe_2O_3	7.10	8.59	8.53	9.22
CaO	4.47	4.68	3.80	4.00
MgO	1.30	1.21	1.09	1.41
SO_3	0.49	0.21	0.48	0.09
Na_2O	1.88	2.02	1.15	0.12
K_2O	2.50	2.77	2.06	2.71
TiO_2	1.08	1.13	1.03	0.85
L.O.I.* at 950°C	20.83	12.97	6.91	9.51

*L.O.I. = Loss on ignition

OVERVIEW OF CEMENT MANUFACTURE

Portland cement is produced by firing, at high temperatures, a raw feed composed of carefully proportioned lime, silica, alumina, and iron components. These components are derived from naturally occurring materials such as limestone, clay/shale, sand and iron ore. The materials are finely ground, blended in appropriate amounts, and fired in a rotary kiln to form ½- to 1-in. diameter "clinker." The clinker is then pulverized by inter-grinding with about 5% gypsum to make the finished product – cement.

Cement manufacturing is an energy-intensive process. Approximately 80% of the total energy is consumed in the thermal conversion of raw feed into clinker. When used as a raw feed component in cement manufacturing, typical Class F fly ashes with a high concentration of unburned carbon can supplement the fuel. The inclusion of Class C fly ash in cement raw feed could also be beneficial. The lime content of Class C ash would replace a portion of limestone in the raw feed and thus reduce CO_2 emissions.

FLY ASH COMPATIBILITY CRITERIA

WHY FLY ASH?

Fly ash is typically rich in the compounds normally used in the cement manufacturing process. Not only does it provide some of the necessary chemical constituents, but its unburned carbon also provides fuel value. However it is critical that, prior to its use at a cement plant, the fly ash in question be characterized and evaluated for its compatibility with the cement raw feed. Based on the chemical and physical make up of the fly ash, the following criteria for their compatibility with cement raw feed have been outlined and discussed.

CHEMICAL COMPOSITION

The high-carbon fly ashes used in the subject demonstrations were chemically comparable to the constituent(s) that they replaced (Table 1). The LOI content ranged from approximately 7% to 21%. Typical shales contained 9.5%.

DRY VS. WET FLY ASH

Cement plants prefer dry particulate raw materials that are free flowing, easy to handle, and easily blended. Dry fly ash is advantageous because it is easily transportable and blended with the raw mix without pre-processing and grinding. For wet cement plants, the scenario(s) of fly ash use can vary and would require a separate set of evaluations.

PARTICLE SIZE ANALYSIS

For optimal benefit, fly ash must be fine. The fineness provides a large specific surface, which imparts improved reactivity during clinkering. Demonstration materials were finely divided with an average size less than #325 mesh (45 microns).

MINERALOGICAL COMPOSITION

The combinability of fly ash particles with cement raw feed at high temperature (particularly the lime-rich kiln feed)

Figure 1. Fly Ash Transportation Using Pneumatic Trucks

depends upon the glassy nature of the fly ash. The glass enhances reactivity with cement raw materials during clinkering.

THERMAL BEHAVIOR, FUEL VALUE, AND EMISSIONS

Evaluating fly ashes for fuel value and emissions, especially those containing high levels of carbon, is critical for their potential use at cement plants. Differential scanning calorimetry (DSC) is usually employed to check for heat content (Joules/gram degrees centigrade of material), and the presence of any volatiles and other organic compounds. DSC also identifies the behavior of fly ash with temperature, together with the critical thermal points at which any volatile or organic species may release.

COMMERCIAL DEMONSTRATIONS

DEMONSTRATION PARTICIPANTS

CTLGroup, in conjunction with several Midwest cement plants and coal-fired power plants using Illinois coal, performed several commercial demonstrations to consume large volumes of high-carbon fly ash in the manufacturing of cement. As a proof of concept, dry Class F fly ashes from different Illinois power plants were used, with L.O.I. ranging from 6 to 20%.

FLY ASH COLLECTION AND TRANSPORTATION

Using pneumatic transport trucks (Figure 1), nearly 500 tons of high-carbon fly ash were collected from the power plants and transported to the participating cement plants. The blending of the dry fly ash with other raw materials at the cement plant was easy and required no pre-processing.

RAW FEED MIX DESIGN

The chemistry of the limestone and remaining shale limited the addition of fly ash to between 3 and 6% of the raw feed. The use of fly ash, however, replaced a majority of the shale in the normal feed.

CEMENT PLANT OPERATIONS

The two demonstrating cement plants used, respectively, a multi-stage pre-heater and a long dry process (Figure 2). For the pre-heater process, the raw feed was introduced into the top stage of the pre-heaters. Typically, the raw feed moves from one pre-heater stage to the next countercurrent to the flow of the hot flue gases from the rotary kiln. Because of the heat exchange, much of the calcination of the raw feed can occur by the time the feed leaves the final stage of the pre-heaters. For the long dry kiln, the raw feed was directly introduced in the feed end of the kiln, where the material travels forward countercurrent to the hot flue gases. The material undergoes calcination and gradual clinkering as it travels into the kiln towards the firing zone. In both cases, the fly ash-blended raw feed was introduced normally.

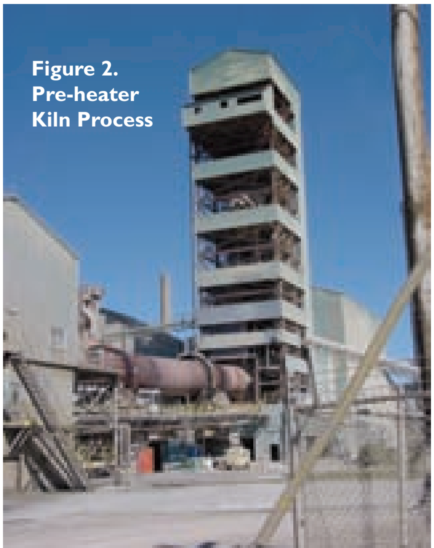

Figure 2. Pre-heater Kiln Process

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- ✓ A natural fit for new generation.
- ✓ With no ash waste stream, our customers have achieved 100% utilization.
- ✓ CBO is not an interim technology, but rather a long-term solution for ash utilization.

Table 2. Operational Parameters Observed During the Demonstrations

Parameters	Observations	Comments	Impact on Operation
Pre-heater Temperature	Temperature rose at lower pre-heater stages	Because of carbon in fly ash	Raw feed calcination improved
Kiln Feed Rate	Feed rate increased	Because of improved fly ash – raw mix reaction Increased calcination due to carbon	Increased production
Burning Zone Temperature (BZT)	BZT increased	Because of residual carbon in fly ash	Potential fuel savings
Fuel Consumption (of purchased fuel)	Fuel reduced	Because of burning residual carbon in fly ash and increased calcination	Fuel saving
Environments	No CO release Stack opacity normal	Because complete consumption of residual carbon	Environmentally safe operation
General Observations	Easy fly ash blending No plugging of process No abnormal temperature profiles	Because of easy blending of fly ash No pre-processing of fly ash	Smooth, successful, and beneficial operation

mineralogical phases such as C_3S (tricalcium silicate), C_2S (dicalcium silicate), C_3A (tricalcium aluminate), and C_4AF (tetra-aluminoferrite). The analyses also indicated the absence of free lime, which is preferred for durable cement. The absence of free lime is attributed to improved reaction of fly ash with lime in the raw mix rendered by the fine and glassy particles of the fly ash.

The microscopical examination of clinker also confirmed the presence and uniform distribution of major clinker phases. Such distribution reflects normal clinkering reaction and uniform transformation of kiln feed to clinker.

CEMENT TESTING

Cements produced from the clinkers made during the demonstrations were tested for compliance with ASTM C 150 for both the chemical and physical properties. Both the demonstration cement and the cement produced before the demonstration conformed to ASTM specifications.[2] Clinker samples collected prior to grinding were also characterized for chemistry and phase mineralogy.

CONCLUSIONS

The commercial-scale demonstrations showed that cement manufacturing can be employed as a high-volume management of discarded fly ashes, especially, high-carbon fly ash. The high-carbon content of the fly ashes provided an additional benefit as a fuel supplement in the energy intensive process thus providing useful energy conservation. It is critical that the fly ash be evaluated for compatibility based on both chemical as well as physical characteristics. Cement produced during the demonstrations was comparable to normally produced cements in chemical and physical properties.

Depending upon the chemical composition of the fly ash and that of the target cement raw mix, using 6% fly ash in U.S. cement manufacturing, can consume more than 9 million tons of fly ash annually. The demonstrations signal the emergence of a new market for "unusable" high-carbon fly ash with tangible material, operational, product, and environmental benefits to both the power generation and cement industries.

ACKNOWLEDGEMENTS

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NOTES

(1) The data on plant operation, production, and product evaluations given here are from one plant, although similar results were observed at the other cement plant.

(2) Extensive pre-testing was done to ensure compatibility with the cement plant material and processes. ❑

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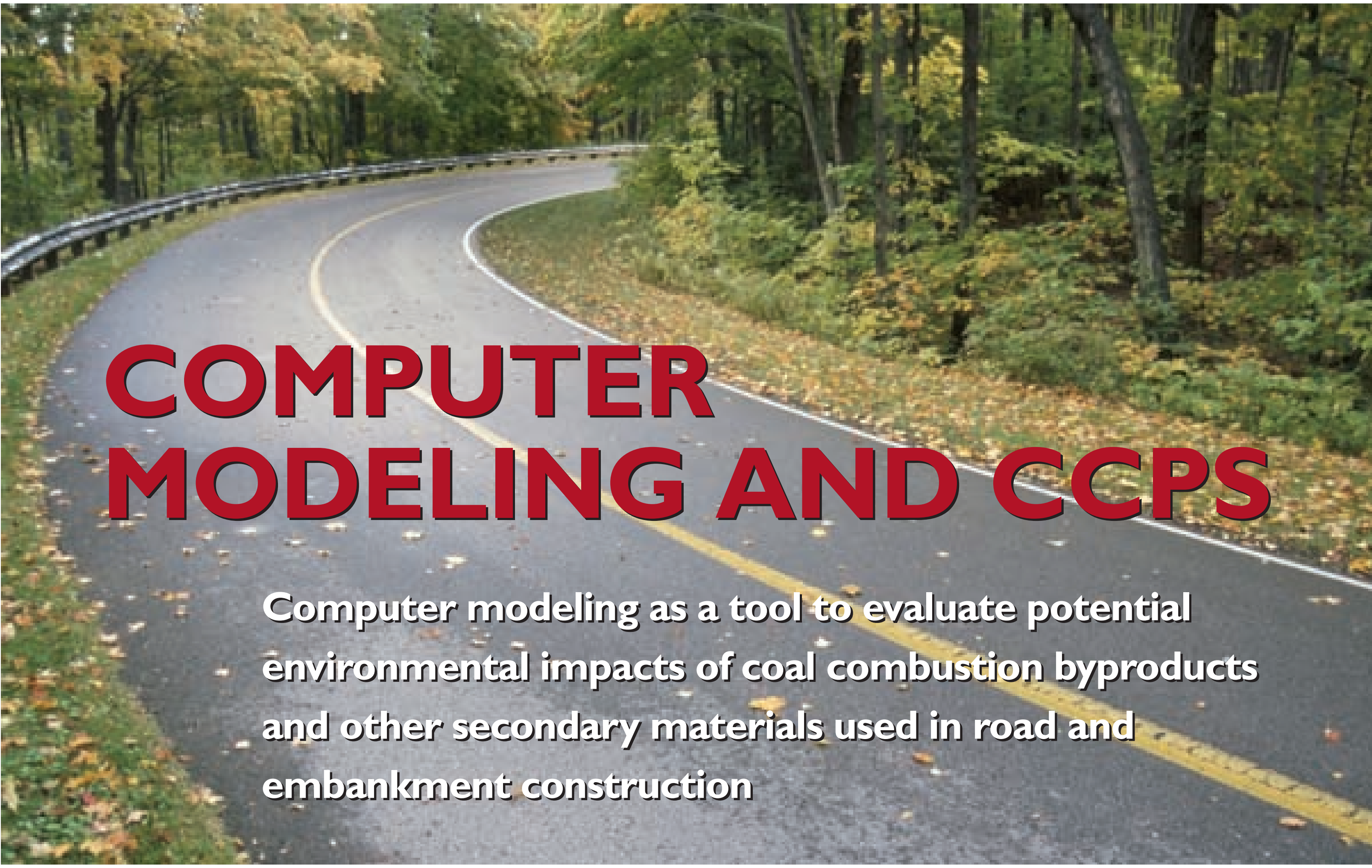

COMPUTER MODELING AND CCPS

Computer modeling as a tool to evaluate potential environmental impacts of coal combustion byproducts and other secondary materials used in road and embankment construction

By Defne Apul, Kevin Gardner, and Taylor Eighmy

INTRODUCTION

There are nearly six million kilometers of roads in the United States. Construction and maintenance of these roadways require approximately 350 million tons of material every year. Embankments provide suitable settings to utilize large volumes of coal fly ash. This potential is not fully explored though, especially when compared to Europe. The Netherlands for example recycles 100% of its coal fly ash and coal bottom ash whereas approximately only 30% of coal fly and bottom ash is reused in the U.S.

One of the barriers to beneficial reuse in the highway environment is the concern from leaching of metals from coal combustion products. This concern applies not just to coal ash but to any type of secondary material that can be placed in a road or in an embankment. A material may have excellent engineering properties but if it has metals or other toxic compounds in it, scientists, engineers, regulators, and the public are justifiably concerned with the potential for these chemicals to leach and contaminate the soil and groundwater in large spatial scales, perhaps more easily visualized as 'linear landfills'. Many states often agree that their reasons for not using secondary materials in roads include their worry about potential environmental effect. However, this worry is often a perceived risk that is not necessarily grounded in facts.

Computer modeling is one way to address and evaluate these concerns by allowing us to predict into the future and scientifically determine whether the concerns are justified or perception based. Computer modeling allows us to test 'what if' scenarios and to identify critical beneficial reuse conditions where a concern may be grounded. Availability of predictive methods including computer modeling will potentially lead to more informed decisions with respect to the use of not just coal combustion byproducts but also other secondary materials in roads and embankments including relatively more established ones such as steel slag and some newer materials such as shingles, foundry sand, and contaminated soils. In this article, we present some of the recent advances we have made with respect to modeling contaminant release and transport in the highway environment.

CONTAMINANT LEACHING IN THE EMBANKMENT

An understanding of the hydrology in the highway environment is essential for predicting contaminant release and transport since water is the primary media that transports contaminants. If there is no water, there will be no contaminant leaching. If there is stagnant water there may be leaching and transport of contaminants through 'diffusion', however, this process alone

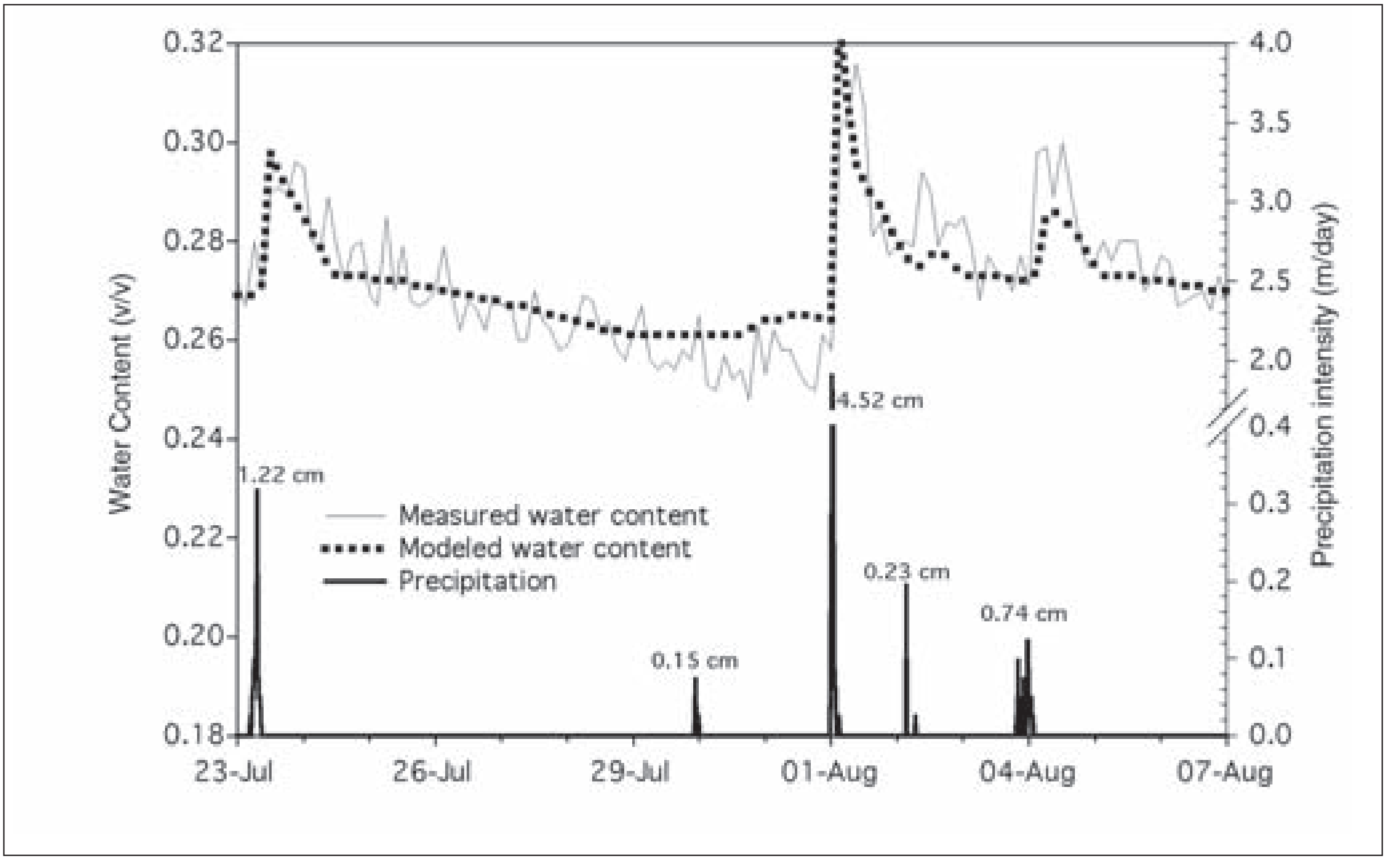

Figure 1: Water content and precipitation intensity in the embankment (taken from Apul et al., 2005)

will be much slower than 'advection' of contaminants which happens when the water is moving as in infiltrating rain water. A powerful model that can handle these complexities is HYDRUS2D which was used in this research.

To predict the hydrology in embankments, we used continuously monitored water content field data from Minnesota from an embankment that did not have coal ash in it. Once we were able to model the hydrology in the Minnesota embankment, we expanded our model to ask the question, what would happen if the embankment in Minnesota had a foot of soil replaced with coal fly ash?

The literature is scarce with respect to information on hydrological conditions in embankments and the hydraulic properties of road construction materials which poses a significant challenge

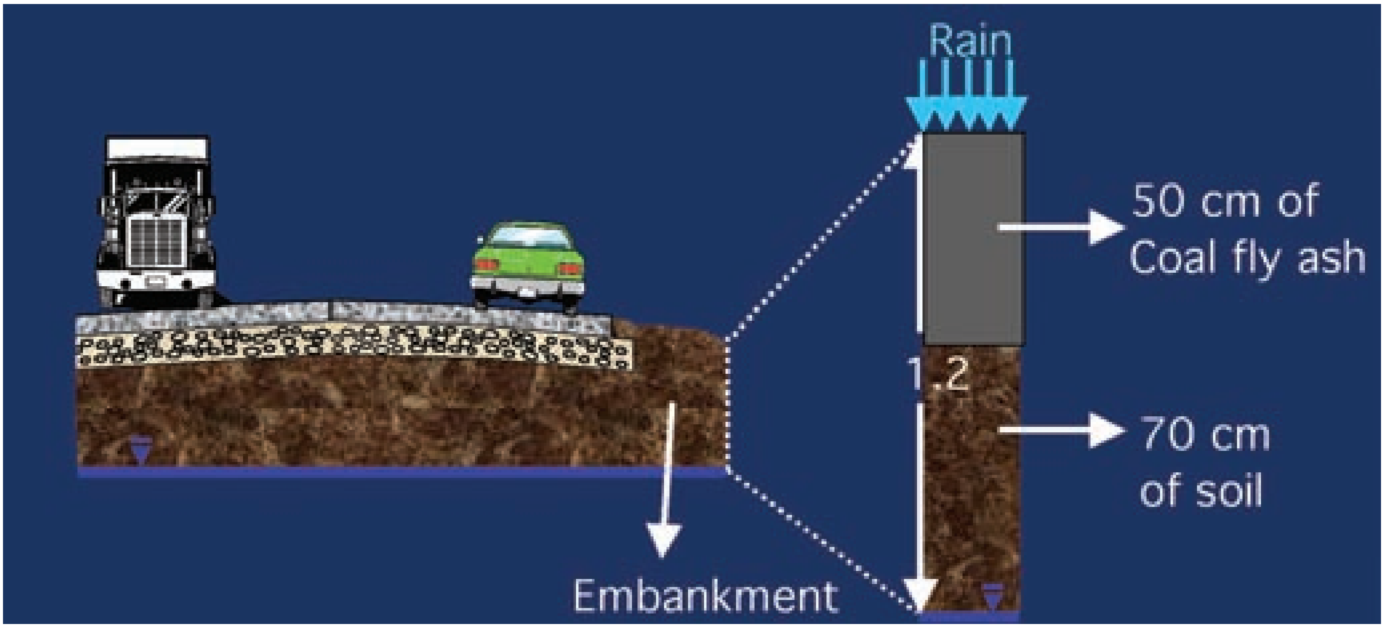

Figure 2: Coal fly ash embankment leaching scenario

towards modeling embankment water movement and contaminant transport. This challenge was overcome by probabilistic calibration of the relevant parameters in collaboration with Dr. Ernst Linder, Ms. Tara Frizzel (from University of New Hampshire), and Ms. Ruth Roberson (from MnDOT). Upon application of a Bayesian Monte Carlo method (further details available in a separate article*) the model output closely predicted field water content measurements in the Minnesota embankment. Figure 1 shows the close match between modeled and field measured water content values in the embankment along with precipitation intensity for a period of 16 days.

With confidence in our ability to model the hydrology in embankments, the next step focused on adding coal fly ash to the embankment model and analyzing leaching of Cadmium from coal fly ash in a scenario where the precipitation is similar to that in Minnesota and the groundwater table is 1.2 m below the surface (Figure 2). The model was run probabilistically to explicitly incorporate the uncertainty of parameters in the system. We took a probabilistic approach because a single value of model output with no information on the confidence in the output value may not be as valuable. In the probabilistic approach, we can clearly state how much confidence we have in a given output value.

The results for cumulative Cadmium leached in 10 years is shown in Figure 3 and compared to results from a simple model and field data from the literature. Probabilistic results can be interpreted by defining an acceptable level of certainty (i.e. by picking a value on the y-axis). Figure 3 shows that based on the HYDRUS2D model we used, we are 90% certain that the cumulative Cadmium leached in 10 years will not exceed 0.0027 mg/kg. This result is slightly higher than the field data found in the literature for coal fly ash lysimeters (0.00082 mg/kg).

An alternative, simpler model that does not consider the hydrology and spatial scales explicitly is the single equation model that multiplies solubility of the metal with the liquid to solid ratio observed in the field. The simpler model results show that if a low solubility value is used, the results are similar to those obtained from HYDRUS2D model results.

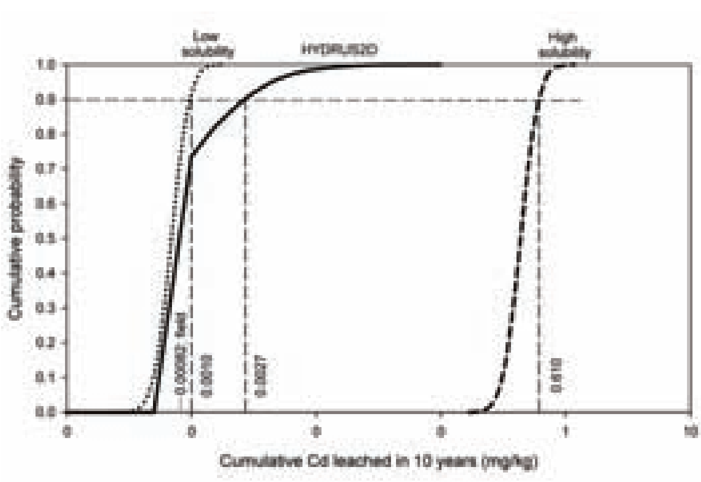

Figure 3: Cumulative probabilities of amount of Cd that may leach in 10 years (taken from Apul et al., 2005)

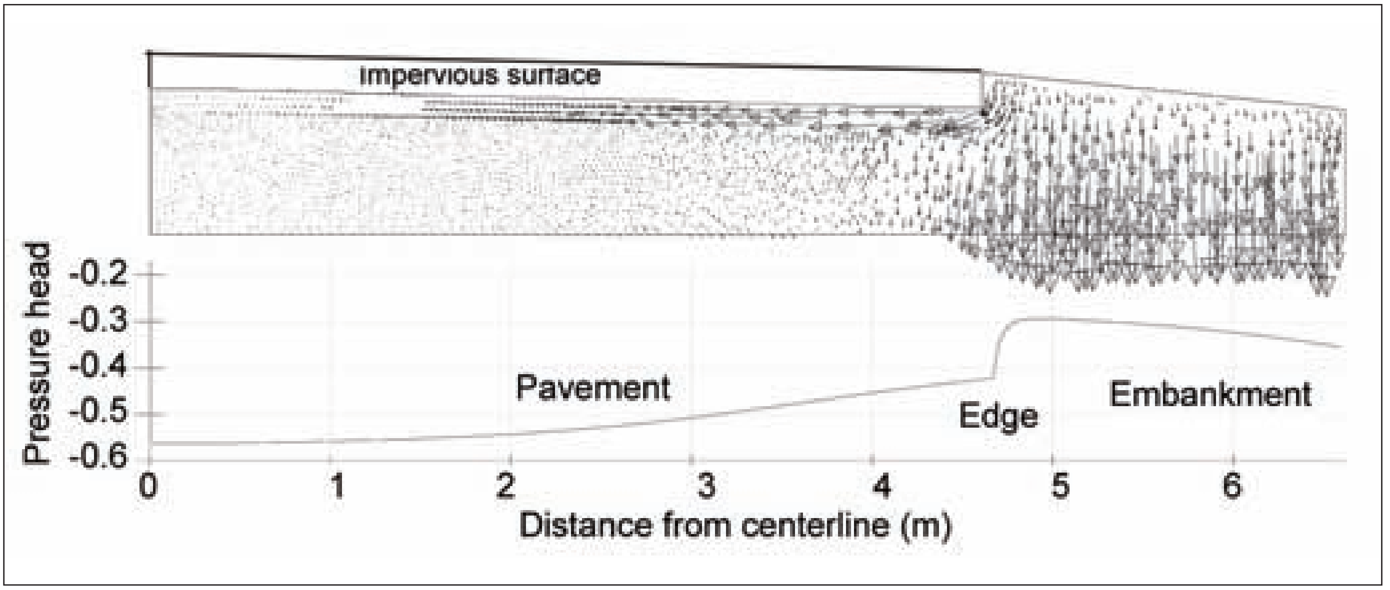

Figure 4: Velocity vectors and pressure head in one half of a cross section of an intact road

However, operating based on the 'precautionary principle' many regulators would tend to use a high solubility value which over predicts leaching of cadmium by two orders of magnitude (0.610 mg/kg). With these findings we propose that the use of HYDRUS2D type of detailed hydrology models is a powerful method for realistically predicting contaminant release, especially when coupled with probability.

CONTAMINANT LEACHING FROM THE BASE LAYER

If we consider the two dimensional cross-section of the highway environment, the hydraulic regimes are even more complicated due to lateral water flow. For example, even when the pavement is completely impervious, there is potential for water to get under the pavement due to differences in the pressure head. Figure 4 shows lateral water movement in half of a cross section of a road where the water getting into the embankment also moves sideways towards the pavement.

Coal bottom ash can be used in the base layer of a road. In evaluating the potential leaching of contaminants from the base layer the condition of the road has to be considered. Contaminant leaching from the base layer in a completely intact pavement, in a completely damaged pavement, and a pavement with only two cracks (or joints) in it was analyzed (Figure 5). Leaching of both salts and metals were analyzed. The difference between these two types of chemicals is that metals are much less mobile than salts because of their affinity for sorptive sites. While salts are mobilized easily, the public perception for salt contamination is often not so negative, especially considering road salting in cold climates is a standard practice even if

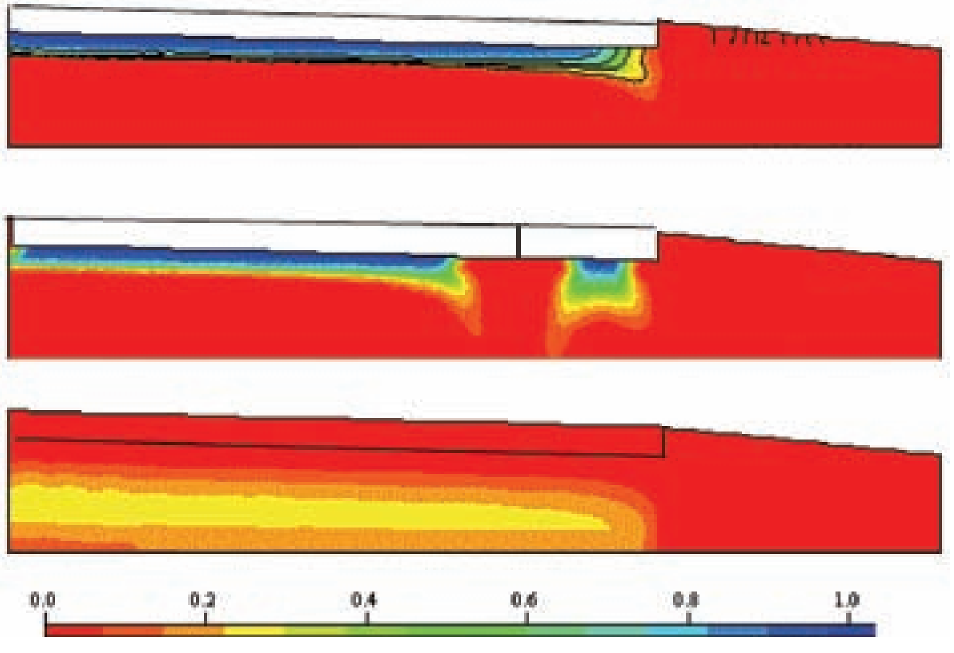

Figure 5: Aqueous concentrations of salts in (one half of) the cross section of an intact road (top), road with two cracks (middle), and completely damaged road (bottom). Concentrations are normalized to initial values. A value of 1 (blue color) indicates that the concentration at that given point is equal to the initial concentration in the base layer. Results are for after 12 months in Minnesota climate. Rectangle box (in white or blue) represent the surface layer; the base layer with secondary material lies immediately below it.

Table 1: Summary of two dimensional simulations for contaminant leaching from a road base			
Fraction of initial base layer contaminant mass reaching groundwater in 20 years			
Subgrade type	Contaminant	Completely damaged pavement	Intact pavement
Any type of subgrade	Salt	1 (All mass reaches groundwater in 2 years)	0.04
Clayey subgrade with high organic matter content	Metals with high organic matter and clay subgrade	10^{-22}	10^{-28}
Sandy subgrade	Metals with sandy, less organic matter subgrade	10^{-4}	10^{-10}

the salt fluxes from it may be much higher than any potential release from a secondary road construction material.

Figure 5 shows that in a period of 12 months in the intact pavement, the salts in the base layer, in coal bottom ash, or any other secondary material do not mobilize much except at the edge of the pavement. In a period of 20 years, only 4% of the initial salt mass in the base layer reaches the groundwater. In a pavement with two cracks, the centerline crack allows very little water in the pavement whereas a shoulder crack will lead to depletion of salts immediately below it. Finally, if the pavement is completely damaged, salts are significantly mobilized in 12 months and in 2.5 years all of the initial mass of salts in the base layer reaches the groundwater (not shown).

A summary of multiple simulation results for a typical Minnesota climate with high groundwater table (3 ft from the surface) sites is given in Table 1. Simulations for metals were conducted for two different subgrade types; one that retards metals significantly (clayey subgrade), and one that doesn't. If the pavement is constructed on a sandy subgrade and is left completely damaged for 20 years, 0.1% of the initial metal concentration will reach the groundwater. However, this scenario is not very likely to happen. The three other scenarios for metals suggest that contamination of groundwater is not expected since fractions as low as 10^{-10} to 10^{-28} are essentially equal to zero.

SUMMARY

Computer modeling of the dynamic hydrological and geochemical conditions in the highway environment can be an instructive tool to assess the contaminant release and transport from coal combustion byproducts and other secondary materials used in roads

Computer modeling of the dynamic hydrological and geochemical conditions in the highway environment can be an instructive tool to assess the contaminant release and transport from coal combustion byproducts and other secondary materials used in roads and embankments.

and embankments. Results from the HYDRUS2D model coupled with an uncertainty analysis suggest that the Cadmium fluxes will be significantly less than the output from simpler models with worst case (high solubility) scenarios. Two dimensional analysis of the leaching from the base layer also suggest that concentrations leaching ground water will not be significant for metals unless the pavement is completely damaged and built on sandy soils. Development and verification of these types of tools may lead the way to more informed decision with respect to beneficial use of coal combustion byproducts and other secondary materials.

ACKNOWLEDGEMENTS

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THE FUTURE OF FGD GYPSUM

By E. Cheri Miller

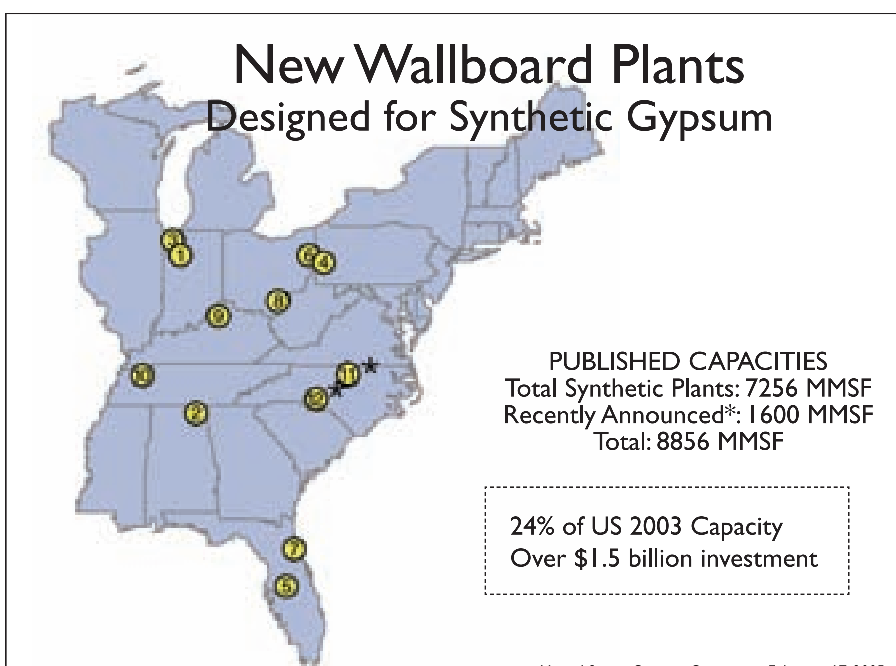
According to ACAA's most recent Coal Combustion Product Production and Use Survey covering calendar year 2003, FGD gypsum is closing the gap with Boiler Slag on percentage utilization. Slag utilization was at almost 96% and FGD gypsum utilization has risen to 70%, but less than 2 million tons of slag are produced annually compared to almost 12 million tons of FGD gypsum. While almost all of this FGD gypsum was utilized as a raw material in gypsum wallboard manufacturing (7.8 million tons), use in cement and concrete products as well as agriculture are steadily growing.

Utilities and wallboard manufacturers have been fortunate that up until now there has been a synergy between the supply and demand for FGD gypsum east of the Mississippi River. Most of the large power plants that have been retrofitted with wet limestone or lime scrubbers that produce FGD gypsum as a byproduct are located in the east, which matched nicely with the recent growth in demand for wallboard products. Virtually all of the 12 newest wallboard plants built or announced since 1995 (Figure 1) have been specifically designed to take advantage of the availability of this raw material. For the most part, these wallboard plants have been located in close proximity to utility sources or on major river systems to take advantage of low cost barge transportation.

However, despite this synergy, only 27% of total gypsum wallboard production in the U.S. utilizes FGD gypsum. Seemingly there is a great opportunity out there to utilize even more FGD gypsum for wallboard, but in reality there may be significant challenges to our industry in expanding use of FGD gypsum in wallboard.

Based on utility projections for sulfur dioxide reduction in response to new regulatory programs, FGD products (including FGD gypsum) production is expected to approach 40 million tons by 2015 and most of the FGD gypsum production will remain in the East or the Midwest, not in key future market growth areas for gypsum wallboard – i.e. the Northeast and West Coast. While the abundant supply of FGD

Synthetic Materials loads FGD gypsum on barge at the Tennessee Valley Authority's Cumberland Fossil Plant for transport to Temple Inland's West Memphis, Arkansas wallboard plant.



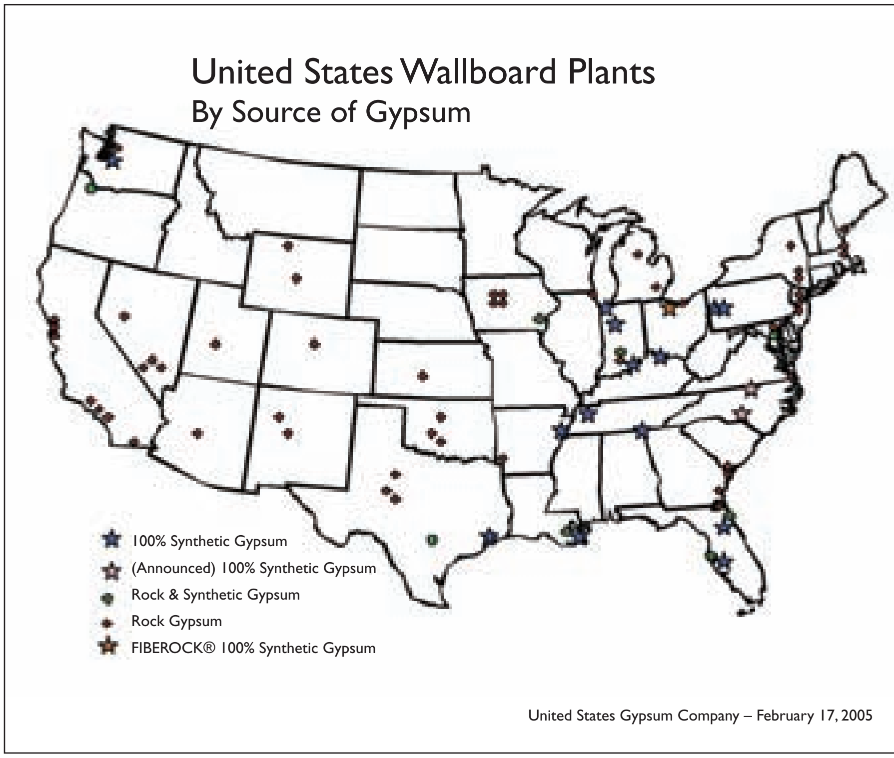
gypsum east of the Mississippi River could make it economical to convert a few more of the older gypsum wallboard plants from natural or “rock” gypsum to FGD gypsum, the material will remain out of reach for the majority of natural gypsum wallboard facilities in the West due to handling and transportation costs (Figure 2).

Based on these considerations, continued growth in FGD gypsum sales will need to take advantage of its suitability for other high volume uses including cement, concrete products and agricultural uses. In 2003 less than 1 million tons of FGD gypsum were sold into these markets, but the potential exists for much larger volumes to be used in these applications.

In addition to the challenges presented by the doubling of FGD gypsum production over the next few years, environmental groups and regulatory agencies concerned with the issue of mercury sequestration and re-release from CCPs will require the utility producers as well as end users (wallboard, cement and agriculture) to prove that FGD gypsum does not present a risk to populations exposed to products containing it.

ACAA is responding to these challenges and to growth in membership representing wallboard manufacturers, FGD gypsum marketing companies and major utilities with scrubbers in their future. The Technical Committee of ACAA has formed an FGD Subcommittee that is beginning to develop Resource Bulletins and Fact Sheets on FGD gypsum. With such broad support from the stakeholders, ACAA will be in the forefront of disseminating the technical information needed to promote the continued growth in FGD gypsum use.

Several members of the FGD Subcommittee and Dave Goss provided information on FGD processes and products in an informal meeting with representatives of the Environmental Protection Agency’s (EPA) Office of Solid Waste and the U.S. Department of Energy’s National Energy Technology Laboratory (DOE NETL) at EPA’s Washington, D.C. office on February 17, 2005. The actual presentations can be viewed on the ACAA website under “Library”. Click on “Library and Meeting/Symposium Presentations”, “ACAA Related Presentations”, then “Presentations to US EPA”. EPA staffers showed a keen interest in the presentations and its potential impact on the industry’s ability to meet CCP utilization goals set for C^2P^2.



There is a great opportunity out there to utilize even more FGD gypsum for wallboard, but in reality there may be significant challenges to our industry in expanding use of FGD gypsum in wallboard.

Anyone interested in participating in the activities of the FGD Subcommittee is encouraged to contact either me (ecmiller@tva.gov) or Jenny Hitch (jhitch@headwaters.com) (preferably via e-mail with all your contact information), and we will put you right to work!

I would like to thank Jessica Marshal and John Gaynor of United States Gypsum Company for providing the figures used in this article. ❑

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The Tennessee Valley Authority’s Cumberland Fossil Plant produces about 1.2 million tons of FGD gypsum annually.

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