

SUMMER • 2006

# ASH **at work**

Application, Science and Sustainability of Coal Ash

## OPTIMAL MIXES

FOR CONCRETE DURABILITY AND  
FOR INDUSTRY COLLABORATION

## POLAND'S CCP MARKET

PROSPECTS RISE WITH EU STATUS

## SERVICE LIFE MODELING

FOR FLY ASH IN CONCRETE

## GEOTECHNICAL APPLICATIONS

OF CCPS IN WISCONSIN

## CHROMIUM VI

IN EUROPEAN LEGISLATION

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### COVER PHOTO:

The breathtaking Reiman Bridge and Milwaukee Art Museum were constructed of concrete made with fly ash. These inspirational structures symbolize our members' dedication to building bridges, engaging diverse groups in ACAA's vision and mission. Photo courtesy Paul Westermann and ACAA Chairman Thomas Jansen of We Energies.



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# BUILDING BRIDGES FROM ANY ANGLE

By Thomas Jansen, We Energies

This is my last Chairman's message to the readers of *Ash at Work* magazine. My two-year term as chairman concluded at the ACAA meeting in Milwaukee, Wisconsin, June 4–6, 2006. It is fitting that my term ended in my hometown for more than obvious reasons—bridges.

ACAA members attending the Milwaukee meeting noticed that some of the streets in downtown Milwaukee are not aligned where they meet at river, and the bridges are on an angle. The original settlement on the east side of the Milwaukee River was known as Juneautown, and the later development on the west side was known as Kilbourntown. The rivalries of the two groups and the parochial interests of the west side leader, Byron Kilbourn, led to some strange urban planning, and ultimately the Bridge War of 1845. Each settlement purposely built their streets in locations where they would not be aligned with their rival's streets on the other side of the river, consequently making it difficult to build bridges to connect the settlements, and according to their rationale, protect their business interests on their side of the river.

For years, the only means to get from one side to the other was by ferry. It was not the most efficient means of commerce; nonetheless, many residents crossed the river for personal and commercial reasons. Finally, in 1840, the Wisconsin legislature required Milwaukee County to build a bridge to connect the



Thomas Jansen, P.E.  
Supervising Engineer – CCP Group  
We Energies  
ACAA Chairman

two areas. Subsequently three more bridges were built in the next three years after the first proved to be convenient. Neglecting the general interests, Kilbourn was outraged and continued to oppose the construction of bridges and made resolutions to remove parts of the bridge on his west side of the river. Some west side settler's worried that this impinged their independence and occasionally vandalized the bridges. On the evening of May 7, 1845, after much inebriated debate in the Kilbourntown taverns, a drunken group of westsiders aimed a canon at the bridge and dropped one of the spans in the river. The conflict escalated when east side vigilantes destroyed other bridges to isolate the westsiders. The violence that ensued demonstrated the absurdity of the conflict and "it became increasingly obvious that Milwaukee needed more access, not less; more settlers, not fewer; more cooperation, not open warfare." The groups reconciled and later that year they agreed to a city charter that was approved in 1846.<sup>1</sup>



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I am pleased to report that ACAA did not have any bridge wars. In fact, in the last few years, we've built more bridges to connect with CCP stakeholders and organizations with mutual interests. Our streets may not always be perfectly aligned, but we made connections that, from any angle, fulfill our mission and help to achieve our goals. One such angle is resource conservation that bridges the interests of ACAA, EPA, the recently established Industrial Resources Council, and the Green Highway Partnership. The ACAA made great strides in building networks, making connections, and promoting CCPs. This magazine continues to generate great interest and growing readership. We now have a monthly e-newsletter that provides relevant, up-to-date information. ACAA recently hired Melissa Burke, a highly skilled and experienced public relations and communications professional. Melissa, teamed with Mike McDonald, will speed up the delivery of promotional literature, workshops, and technical resource bulletins. Our website continues to improve with a photo library and a comprehensive archive of technical literature.

I was extremely fortunate to start my duties with an association that had a strong financial and administrative foundation due to the leadership of my predecessor, Harry Roof. And I have much appreciation for the guidance and encouragement from past chairmen Joel Pattishall and Ted Frady. Joel was partially right when he told me that "you will finally figure out all the

administrative stuff and then your term ends"—well I have yet to figure it all out. Thankfully, I had the pleasure to work with ACAA's dedicated, proficient and energetic staff: Annely Noble, Melissa Burke, Mike MacDonald, who took on a tremendous load with determination, and Dave Goss. They made my job easier, and they made ACAA better. ACAA is very fortunate to have Dave Goss as its executive director. I receive many compliments from our members, from other associations, from customers, and from government agencies that tell me what I now know so well, that Dave is a doer and a leader. Many thanks go to the committee chairs and all the volunteers that worked on projects, made presentations, worked trade shows, wrote technical bulletins, shared resources, and served on committees. Countless thanks to my wife Debbie. And thank you We Energies and my co-workers for letting me serve in this position.

Best wishes to our new chairman, Al Christianson, who ably served as vice-chair during my term, and to Mark Bryant, the new vice-chairman. You have my support.

I am proud of ACAA's accomplishments, because it was a team effort. I am proud of ACAA's members and staff. I am most proud of our cooperation. We are bridge builders. □

*Footnote:*

<sup>1</sup> Historical information and quote from John Gurda, *The Making of Milwaukee*; Published 1999, Milwaukee County Historical Society.

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# EFFECTIVE COMMUNICATIONS IS VITAL

By Dave Goss, American Coal Ash Association

**W**e all realize the importance of being effective communicators. Nevertheless, communications are fraught with subtleties. Depending on your background and experience or cultural perspectives, a message may be interpreted in completely different ways even within the same audience. How does an organization address these complexities when it has both a diverse membership and a varied audience?

One way is to hire a professional, trained in communications and public relations, which is exactly what ACAA has done. Melissa Burke joined our staff on April 10, to serve as the association's communications coordinator. Melissa is accredited in public relations, with a degree in journalism. Her 13 years of industry experience includes more than six years with engineering giant CH2M Hill, headquartered in Denver. Melissa will work closely with the Communications and Marketing Committee, the officers and other volunteers in developing and delivering ACAA's many messages.

In late April, an article appeared in a number of newspapers promoting a new process that will use fly ash to make bricks. The technology, developed by Dr. Henry Liu, is a potential alternative to disposal. Dr. Liu recently received a \$500,000 grant from the National Science Foundation to further study ways to make weather-resistant bricks out of fly ash. He hopes to bring the product to market within two years. The message sounds positive and could make many people aware of a potential new benefit derived from CCPs. The snag, however, is that the reporter chose some less than "comfortable" language for the lead and headline. His introduction states, "Coal-burning power plants spend millions disposing of fly ash, a fine powder loaded with mercury, lead and other toxic chemicals." Following Melissa's advice, ACAA contacted the reporter the day after the articles appeared and complimented him for covering our industry and promoting a new use for fly ash. We offered our resources to him in the future should he wish to write additional articles on other uses for CCPs. We also indicated we could provide him with accurate chemical, environmental and economic data on the many uses for CCPs. Rather than confront him about his choice of terminology and descriptions (which was done separately by other sources) we established a positive working relationship that may pay dividends in the future.

One of Melissa's tasks will be to identify opportunities to develop stronger relations with representatives of the media, to more accurately promote the goals of our association and



Dave Goss  
ACAA Executive Director

industry. Rather than be confrontational, communications are typically more productive when they are supportive of viewpoints that may not coincide exactly with our own. However, in educating others with differing viewpoints, we can often create allies and new supporters. This is one way to reduce barriers and build collaborative relationships—a positive for all engaged in this industry. □

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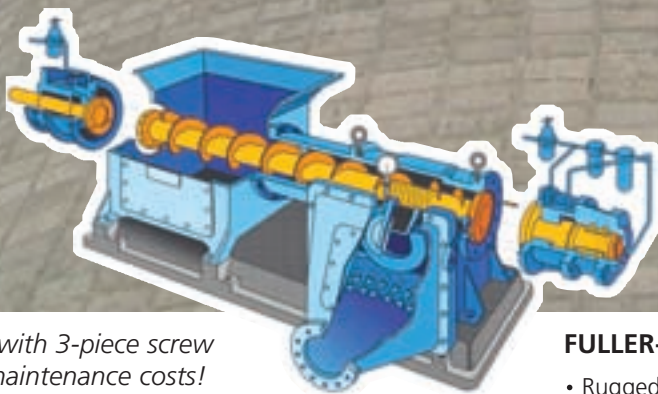
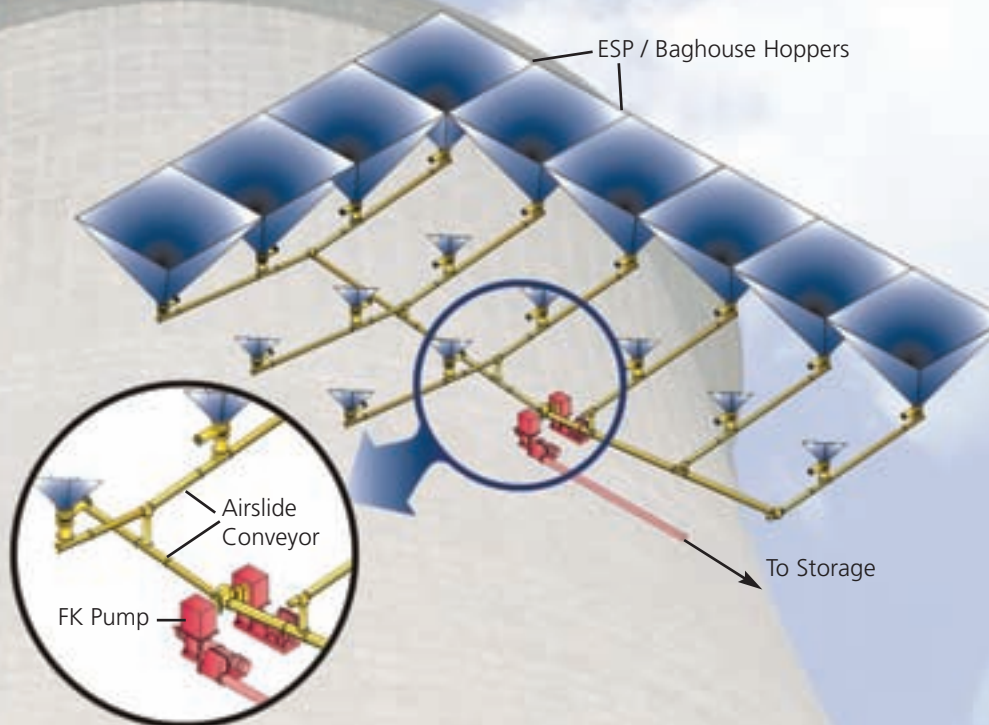
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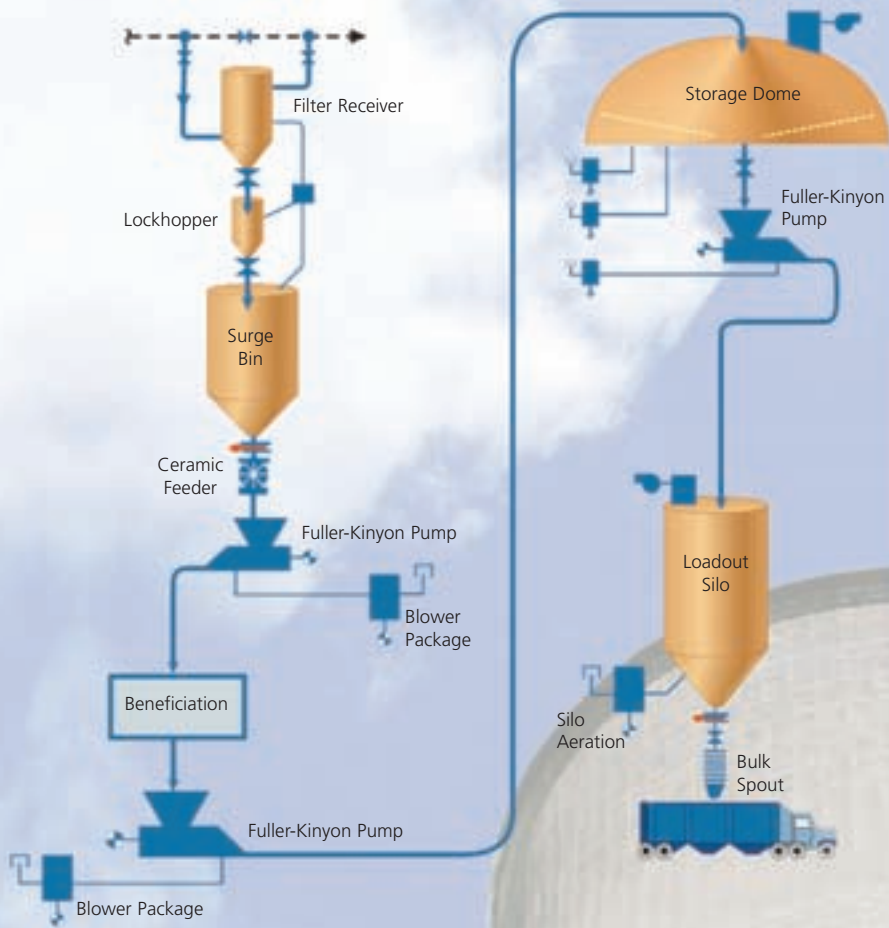
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- Butch Houseknecht, Operations Manager, Separation Technologies, Inc. (STI) Baltimore, Maryland

# OPTIMAL MIXES

## FOR CONCRETE DURABILITY AND FOR INDUSTRY COLLABORATION

By Mike Thomes, Xcel Energy

In its *Guide to Durable Concrete*, ACI Committee 201 defined durability as concrete's "ability to resist weathering action, chemical attack, abrasion, and any other process of deterioration."<sup>1</sup> Such processes include corrosion of reinforcement, freeze-thaw damage, alkali-aggregate reactivity, and carbonation. In each of these cases, liquids and gasses penetrating into the concrete initiate the deterioration. Durability can be enhanced by reducing permeability of the concrete to movement of liquids and gasses into and through the concrete.

If you were to list the most challenging of structures to achieve concrete performance and durability, the "acid test" might be cast-in-place, post-tensioned, outdoor parking ramps in Minnesota. Given Minnesota's dynamic weather variables, these reinforcement-packed structures will be stressed by all the processes of deterioration listed above. Minnesota's weather has the further effect of abbreviating the construction season, thus creating fast-paced construction scheduling and pressure on concrete finishing and curing practices. Unfortunately, the spectrum of ramp structures in Minnesota provides ample evidence of room for improvement in concrete durability and performance.

The Minnesota Concrete Council recognized this construction challenge. The MCC is a non-profit organization created to promote cast-in-place concrete by educating its members on technical practice, sharing the latest scientific investigation and research, and by organizing the efforts of its members. Its membership reflects the design, construction, and support industries associated with reinforced and post-tensioned concrete construction in Minnesota. This broad-based, industry-wide representation suggested MCC was well positioned to study this durability issue and implement strategies. MCC's Technical Committee was aware of the wealth of recent research on "High Performance Concretes," generally involving the incorporation of mineral and chemical admixtures to enhance the durability and strength of the concrete. But there is not a universally standard mix design or proportion for "HPC." Mix proportions for HPC are selected to meet: 1) specified performance criteria, 2) using locally available materials, and 3) good construction practices.

### MCC'S OPTIMUM DURABILITY STUDY

Under the leadership of Mike Ramerth, a principal with the structural engineering firm of Meyer, Borgman, and Johnson

and chair of MCC's technical committee, a task force was assembled to respond to the HPC mix proportion issues listed previously.<sup>2</sup> The task force recognized that the cementitious content, plus the water-cementitious ratio should be as low as reasonable to reduce potential cracking due to drying and thermal shrinkage. But durability is also significantly influenced by properties of the hydrated cement paste. Thus further reductions in concrete permeability and increases in its compressive strength would be assessed via integration of mineral admixtures: slag cement, micro silica, and (of course) fly ash. Both ASTM C 618 Class C and Class F fly ashes are locally available and would be part of the study. The MCC was further motivated by related opportunities for resource conservation and cost control.

Phase one of the MCC's study was to assess results of various HPC mix designs to performance parameters. The task force established the following Performance Specification criteria:

#### Mix Design and Plastic Properties:

- Total cementitious < 658 pounds/cy
- Water- cementitious ratio < 0.42
- Aggregate - well-graded limestone; max. size 1.5 inch
- Air entrained to 6% (+ 1%)

#### Time of Set:

- Measure via ASTM C 403

#### Compressive Strength:

- Measure via ASTM C 39
- Objective:  $f'_c = 3000$  psi @ 30 hours
- $f'_c = 6000$  psi @ 28 days

#### Rapid Chloride Permeability:

- Measure via ASTM C 1202 (Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration)
- Objective: 6 months < 1000 coulombs  
12 months < 500 coulombs

#### Scaling Resistance:

- Measure via ASTM C 672 (Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals)

#### Objective:

- Blended mixes perform equal to or better than control mix using only portland cement



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- 2 – Slight to moderate scaling
- 3 – Moderate scaling (some coarse aggregate visible)
- 4 – Moderate to severe scaling
- 5 – Severe scaling  
(coarse aggregate visible over entire surface)

**Shrinkage:**

- Measure via ASTM C 157 (Length Change of Hardened Hydraulic-Cement Mortar and Concrete)
- Objective: average drying shrinkage length change (6 months) < 0.050%
- No autogenous or plastic shrinkage cracking

The table on the next page summarizes results of 16 cementitious blends tested according to the performance parameters listed above. Color-coding in the table is an attempt to signal whether the performance parameters were accomplished, with the increasingly darker colors suggesting improvement. On balance, it appears that the quaternary blends of 20 percent slag + 20 percent fly ash (either F or C) + 1 percent micro silica show top-notch promise.

In the spring of 2006, MCC will accomplish phase two of its durability study—actual placement of test panels in the field. Test panels will feature the quaternary mixes to verify whether their highly encouraging lab test results translate to the real world. In addition to durability factors, panel placement will also evaluate mixing, placing, finishing and curing requirements. This evaluation will include enlisting the “calibrated backs” of experienced concrete finishers. An important factor in assessing the commercial acceptance of mixes containing relatively fine pozzolans is whether their lack of bleed water and “sticky surface” features create workability problems.

**OPTIMUM DURABILITY?**

Phase one results from MCC’s Optimum Durability study are confirming the increasingly conventional wisdom that HPC blends using fly ash in combination with slag and silica fume interact in a symbiotic way to enhance concrete durability. This corresponds with an opportunity to enhance the value of concrete—and fly ash—for everyone.

**OPTIMUM COLLABORATION?**

Possibly the most gratifying outcome of MCC’s study is that it successfully continues the organization’s mandate of continuing education and solving technical problems of its members. One of the best ways to adopt construction innovations is to enlist the dynamic involvement of leaders in the local market using locally based resources. The MCC has been able to obtain the collaborative involvement of highly qualified and experienced professionals in what is a highly competitive industry. It is exciting to participate with professionals who, on one day will be staring each other down during a bid opening,

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Mix Proportions (number reflects % replacement of cement)			Time of Set (ASTM C 403) hours:minutes	Compressive Strength (ASTM C 39) psi-1Day      psi-28Day		Permeability (ASTM C 1202) Coulombs-6months	Drying Shrinkage (ASTM C 672) %change-6months	Scaling Resistance (ASTM C 157) Rating-50 cycles
Cement Slag Mixes	1	PC (Control)	3:33	3870	7820	1281	-0.050	2
	2	30S	4:30	2495	7650	1066	-0.053	2
	3	30S - 1MS	4:50	2580	6910	606	-0.057	2
	4	30S - 3MS	4:50	2635	9040	620	-0.040	1
Class F Fly Ash Mixes	5	30FA	4:45	2240	7230	366	-0.068	3
	6	30FA - 1MS	4:47	2400	7010	269	-0.048	3
	7	30FA - 3MS	5:15	2300	7980	305	-0.050	2
	8	20FA - 20S	4:37	2470	8825	386	-0.061	2
	9	20FA - 20S - 1MS	4:41	2490	8915	292	-0.061	0
	10	20FA - 20S - 3MS	4:45	2290	8735	263	-0.052	2
Class C Fly Ash Mixes	11	30CA	4:20	2470	7770	590	-0.065	2
	12	30CA - 1MS	4:30	2490	7800	955	-0.065	3
	13	30CA - 3MS	4:40	1995	8093	876	-0.066	2
	14	20CA - 20S	4:05	2150	8900	347	-0.050	3
	15	20CA - 20S - 1MS	4:10	2460	9145	445	-0.050	0
	16	20CA - 20S - 3MS	4:14	2095	9275	313	-0.064	2

Color Key:   Need Improvement  
  OK Results

  Good Performance  
  Yes!

Note: Complete Phase 1 data available  
at [www.mnconcretecouncil.org](http://www.mnconcretecouncil.org)

then the next day could be working collaboratively and enthusiastically to address opportunities to mutually enhance their product.

What an amazing industry! □

<sup>1</sup> ACI Committee 201, "Guide to Durable Concrete (ACI 201.2R-01)," American Concrete Institute, Farmington Hills, MI 2001, pp.2 and 14.

<sup>2</sup> "MCC Optimum Durability Study," Minnesota Concrete Council, St. Paul, MN, Dec. 2005.

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# POLAND'S CCP MARKET PROSPECTS RISE WITH EUROPEAN UNION STATUS

By Agnieszka Myszkowska, Ekotech

Road and highway projects in Poland are on the rise and plentiful. In anticipation of European Union membership, the country enacted a series of reforms categorizing roads and assigning government oversight. The Road Law Act of 2000 established the Office of General Director for National Roads and Motorways (GDDKiA). The GDDKiA has plans to build a nationwide system of highways linking Poland's largest cities with each other and Western Europe by 2009.

While few road projects in Poland currently use Coal Combustion Products, the potential market is huge. Power plant operators are compelled by environmental regulations to find CCP uses. The nation's output is 15 million tons of CCPs a year—6 million tons are brown coal ash and slag. Hundreds of additional tons are available at disposal sites.

Government standards now exist for CCP uses in concrete, stabilization and base course work. Polish company, Ekotech, has identified Pątnów, Bełchatów and Turów as the most suitable plants for binders ideal for road aggregate mixtures. The company has plans to construct facilities at each plant able to process approximately 130,000 tons of ash into binders, expandable to 300,000 tons.


Ekotech studies reveal ash produced at the Pątnów power plant can reach compression strength of 3,626 psi. For highways, the standard value is approximately 1,500 psi. Sand, gravel or slag are added to the binder in various proportions, according to local availability, and adjusted for different road classifications.

The Sochaczew Bypass Project constructed April to August 2003 featured one of Europe's largest applications of silicate aggregate. The aggregate (250,000 tonnes) incorporated bottom ash produced at the EWSA Power Plant in Warsaw. Ekotech managed delivery from plant to project site. They secured administrative approvals for transporting bottom ash from the EWSA plant's landfill. The ash was carefully weighed and transported by truck to the aggregate processing site, where samples were taken to the contractor's laboratory and tested for strength. When temperatures soared in May, water was added to regulate the mixture's humidity. Small amounts of dry Fluidized Bed Combustion fly ash served to further adjust moisture content. Once at the construction site, aggregate was unloaded, weighed again, then spread in layers about a foot deep and compacted. The degree of compaction and bearing capacity were monitored continuously.

Quality and reliability demonstrated by the Sochaczew Bypass Project and others in Poland are fueling national and international interest in CCP utilization. Local, regional and national agencies are in the midst of forming standards and policies; road construction is surging to historic levels; producers are more vigilant than ever in seeking solutions—this market is primed for growth! □

For more information, please contact:  
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# SERVICE LIFE MODELING FOR FLY ASH IN CONCRETE

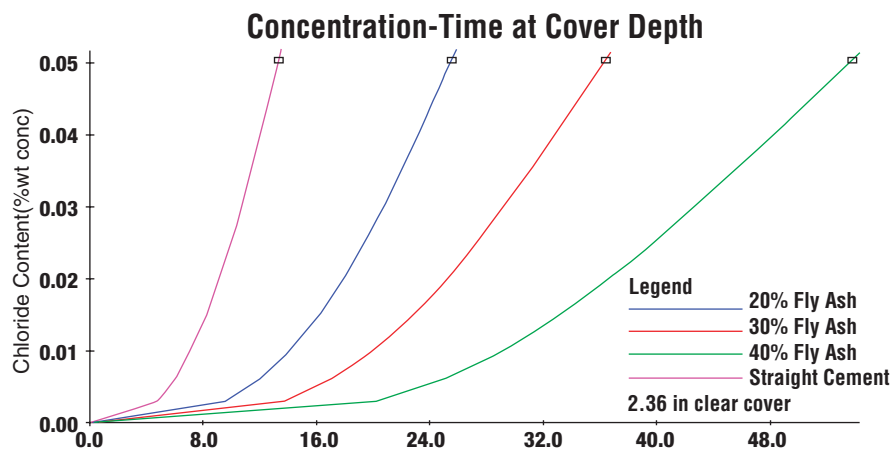
By Kevin Copeland, Boral Material Technologies Inc.

Computer modeling offers fly ash marketers a way to raise awareness and emphasize life cycle, economic and other attributes of fly ash applications. Of particular interest is the ability of concrete to withstand aggressive environments such as deicer salt application, marine exposure, sulfates in soil or groundwater, or aggressive chemicals and alkali silica reaction. Near the coastal areas, concrete experiences particularly aggressive environments in the form of saltwater exposure and spray, as well as sulfate attack. At higher elevations exposure comes from migration of deicing salt ions (i.e. chloride) into bridge decks and graded pavements.

While strength is traditionally a primary design factor for portland cement concrete structures, concrete durability is a much more important to long term service life and serviceability of structures. Because virtually all durability aspects of concrete are improved with a reduction in permeability, the use of fly ash improves concrete durability. In addition, concrete water demand is typically reduced when using fly ash leading to a lower water-cementitious ratio.

These two key properties lead to concrete with a longer life expectancy. Corrosion of reinforcement is slowed dramatically with a reduction in permeability, and concrete resistivity is increased, leading to a slowed corrosion propagation rate. By consuming free lime, fly ash lessens the potential for sulfates from soil and/or groundwater to attack concrete. Finally, fly ash will consume excess alkalis, reducing potential for deleterious alkali silica reaction.

The Life 365 model is one example of a life cycle cost prediction model. It was originally created as an industry standard



model to predict ingress of chloride in structures and mitigation technologies for controlling corrosion. This model allows users to input the actual diffusion data for a given mix design. Users can also select pre-set modifications such as fly ash to produce high performance concrete, or such corrosion inhibitors as stainless steel, epoxy coated reinforcement, or application of sealers or membranes.

## FLY ASH & SERVICE LIFE PREDICTION

When maintained in a saturated condition, or relative humidity exceeding 80 percent, the pozzolanic reaction continues for several months, and fly ash concrete continues to develop a more refined pore structure. It is assumed that no initial drop in diffusivity ( $D_{28}$ ) occurs with the incorporation of fly ash; however, the diffusion decay constant (m-value) increases with increasing fly ash content. A concrete mix water demand reduction of 5 percent is typical for most fly ash sources, and in some cases is conservative. This change in water to cementitious ratio should be incorporated into mix input parameters for Life 365 to better simulate real world use of fly ash in concrete.

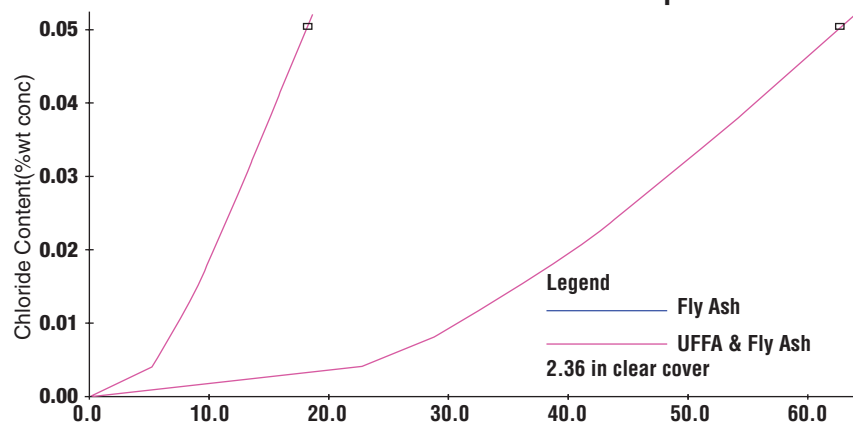
As can be seen in the above figure, the use of fly ash will significantly slow the chloride ingress rate, leading to improved serviceability of structures. The introduction of fly ash at 20 percent replacement of cement extends the predicted time to corrosion from 13 years to 26 years. Likewise, an increase in fly ash content from 20 percent to 40 percent increases the expected time of first repair from 32 years to 60 years.

Structures immediately exposed to aggressive agents, such as offshore bridges and piers in the marine splash zone, require a greater reduction in concrete permeability at early ages. In these cases, prioritization should be given to use of highly reactive pozzolans such as silica fume, ultra fine fly ash, metakaolin, or rice husk ash. The proper combination of these materials with traditional fly ash often leads to synergistic effects in overall protection from ASR, sulfate attack, and corrosion.

As can be seen in the following figure, when concrete is exposed at early age to an aggressive environment, such as a marine splash zone, the use of highly reactive pozzolans proves useful. These materials



Concentration-Time at Cover Depth



are typically higher cost materials and thus the initial cost should be increased accordingly when conducting service life cost calculations. In this case, the inclusion of 8 percent ultra fine fly ash, in conjunction with 30 percent traditional fly ash, increases time to first repair from 24 years to 70 years.

## THE FUTURE OF MODELING

Other more recent computer based service life models attempt to improve on some of the perceived shortcomings of Life 365. One such model, STADIUM, predicts the movement of other ions in addition to chloride, including sulfate, hydroxyl, sodium, potassium, magnesium, and others, as well as several solid phases. The transport mechanism in this model is not limited to diffusion of ions in saturated conditions. One notable feature of STADIUM is its ability to account for movement of ions, and to adjust for coupling due to changes in concentration of various ions. As needed, this model will adjust the amount of predicted ions in solution in keeping with maximum solubilities of the respective compounds.

ACI 365 is close to releasing a state-of-the-art report on the use of Life 365 for service life modeling. Recent improvements to this program include a statistical based approach to predicting service life of chloride-laden structures. Several other service life modeling programs exist, and have been developed and verified to various extents. In coming years, more of these products may be incorporated into structural evaluations, for predicting

serviceability and potential for premature concrete deterioration and cracking.

Regardless of the model used to predict serviceability, the prudent use of fly ash in conjunction with portland cement makes sense. Decades of in place performance have verified the effectiveness of fly ash in improving serviceability in aggressive environments. Depending on the exposure conditions, the optimum combination of cement and fly ash may be determined which yields the required strength and durability performance. To ensure the full life cycle use of a concrete structure based on theoretical or real world exposure, the proper selection of constituent materials is critical.

## CONCLUSION

The benefits fly ash provides concrete are becoming more commonly held throughout the concrete industry by owners, engineers, architects, and contractors. In order to capitalize on this enormous benefit, concrete designers need to be more aware of the role fly ash plays, and how service life may be increased with the proper use of fly ash in concrete. While industry associations such as Silica Fume Association, Slag Cement Association, and Corrosion Inhibitors Association are incorporating these models to demonstrate the benefits that their respective products provide to service life, fly ash marketers have not yet united in their efforts to promote their material as a value added product. While fly ash is an obvious choice from a green building perspective, the life cycle benefits should be stressed to owners and designers with help of these programs. □



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# GEOTECHNICAL APPLICATIONS OF CCPS IN WISCONSIN

By Tuncer B. Edil and Craig H. Benson, University of Wisconsin-Madison

**M**any CCPs have desirable properties and leach contaminants at such low concentrations that their use as geo-materials in construction applications should be seriously considered. There also has been a shift in societal attitudes resulting in strong interest in developing beneficial re-use markets for industrial by-products in the context of sustainable development. Ideal applications for CCPs exist in the transportation, construction, and environmental industries, where large volumes of earthen materials and aggregates are used each year. In fact, fly ash, bottom ash, and flue gas desulfurization materials have been or are in the process of being beneficially used as highway construction materials.

We would like to give the gist of our journey through CCP geotechnical applications research with case histories from Wisconsin.

## STH 60 WISCONSIN – STABILIZATION OF SOFT SUBGRADE WITH FLY ASH

Our main effort started with a spark from industry when La Farge North America (Mineral Solutions in those days) and two power companies (Alliant Energy and Xcel Energy) came together to help us establish the University of Wisconsin Consortium for Fly Ash Use in Geotechnical Applications (FAUGA)

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in 1999. While fly ash stabilization of soils was known for many years, it was not used in any Wisconsin state highway projects (except perhaps for demonstration purposes). Designers had numerous questions and concerns about CCP use, and unless they had some solid data in hand they were not going to start using CCPs in constructing or reconstructing expensive state highways. Providing this data became a mission of FAUGA.

Wisconsin has poor subgrade soils covering nearly 60 percent of the state (silts and clays), which are very soft when wet. These soils pose significant construction problems and costs, especially during wet construction seasons. By the time we completed our first demonstration project as part of the reconstruction of Wisconsin State Highway (STH) 60 between Lodi and Prairie du Chien (below), the state engineers and the contractor were convinced that fly ash stabilization is a viable cost-effective option for subgrade stabilization in Wisconsin.



STH 60 near Lodi, Wisconsin: Fly ash is being deposited by special lay-down equipment for mixing with soft subgrade to form a stabilized subbase.



We also used bottom ash as a granular working platform in STH 60 with great success.

We are currently monitoring STH 60, as well as portions of STH 32 and US Highway (USH) 12 where the subgrade was stabilized with fly ash. Long-term performance is being evaluated. Frost impacts to the stabilized layer are being assessed and groundwater monitoring is being conducted. We have been monitoring the stiffness of working platforms used in STH 60 for more than five years. Initially, the fly ash stabilized section had comparable stiffness as a control section constructed using crushed rock; however, since construction, the section stabilized with fly ash has continued to gain stiffness and now is markedly stiffer (about three times) than the control section built with crushed rock.

Since 2000, there have been six state highway projects in which fly ash stabilization using Class C fly ash was adopted. Meanwhile, use in county and city highways, airfields, parking lots, etc., has multiplied. Today, along with the concrete industry, nearly all of the Class C fly ash in Wisconsin is being used in construction. These projects were beneficial because removal and replacement of the soft subgrade with natural crushed rock was avoided. The only material brought in was fly ash (mixed at a rate of 10 percent), allowing use of the native subgrade to build a firm working platform. The fly ash process also saves time, which is crucial when there is small window for construction during a rainy construction season. Once the fly ash mixing and compaction are achieved, there is a sealed surface unaffected by rain.



**USH near Fort Atkinson, Wisconsin: Subgrade being mixed with fly ash placed over it (the red tanker provides additional moisture as needed).**

## ENVIRONMENTAL ASSESSMENT

Unlike natural earthen materials, the potential for pollution by industrial products has to be assessed in the context and environment of a given application. Passage of Wisconsin Administrative Code NR538 Beneficial Use of Industrial By-Products has encouraged beneficial use of industrial by-products and simplified the permitting process. According to NR 538, byproducts are classified into "categories" (Categories 1-5) that define applications where the byproducts can be



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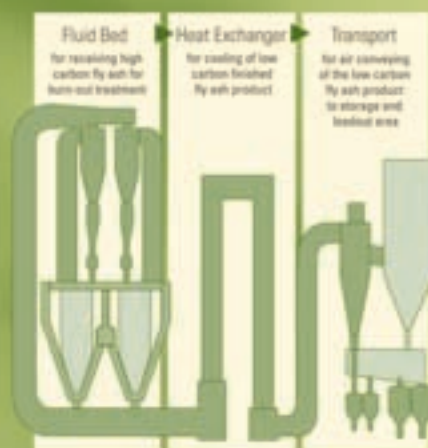


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A - Location  
B - Lysimeter  
Subgrade Prep  
C - Geomem-  
brane liner  
D - Tank

**Construction of pan lysimeter before fly ash stabilized base construction and pavement. Lysimeter collects percolating water through the pavement and fly ash stabilized base for quantity and quality determination.**

used. Byproducts are assigned into categories based on the concentration of potential contaminants from elemental analysis and/or from water leach tests (i.e., ASTM D 3987).

Parallel to our work on stabilization, we have also assessed the leaching characteristics and environmental suitability of wide variety of fly ashes and their mixtures with various soils. We built pan lysimeters under pavements where fly ash was used to monitor the quantity of water percolating from pavement systems and contaminants that may be in the water (photo above). We have currently eight pan lysimeters in pavements in Wisconsin and Minnesota under CCPs (fly ash or bottom ash) along with lysimeters placed beneath control sections without CCPs. To the best of our knowledge, these are the only field leachate collection efforts currently underway in pavement systems where CCPs are used.

A user-friendly computer model (WiscLEACH) was developed to predict the maximum concentration of chemicals in groundwater adjacent to roadways using CCPs for stabilization or in granular layers. Analyses with WiscLEACH showed that in most cases where fly ash is placed above the groundwater table, impacts to groundwater are negligible.

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# CHROMIUM VI IN EUROPEAN LEGISLATION

By Hans-Joachim Feuerborn, VGB Power Tech

As of January 2005, the marketing and use of cement and cement containing preparations is restricted to those with a maximum amount of 2 mg/kg of soluble chromium VI related to the total dry weight of cement. The limit value shall not apply in closed, fully automatic manufacturing processes where skin contact with cement can definitely be excluded. The restriction is based on the European Directive 2003/53/EC. With the directive the limit value of 2 mg/kg was introduced for all cement and cement containing preparations, leaving open the definition of a suitable test method and responsibility for proving the requirement.

Since 1950, it has been well known that chromium VI from cement may cause so-called chromate dermatitis—a serious skin disease, in common parlance also called “bricklayer scabies.” Therefore, national or branch specific regulations were introduced to protect workers who may come into contact with chromium VI containing cement bound mortar and concrete. The general opinion was that only those workers who processed the building material containing cement by hand, who did not pay attention to the warning and safety instruction and who, in general, treated the building material inappropriately, were exposed to increased risk of chromate allergy. In the 1980s, regulations for reduction of the chromate content of cement below 2 mg/kg were introduced in all Scandinavian countries. In Germany, the industry agreed to branch specific regulations for bagged cement and mortars with a limit value of 2 mg/kg, referring to the total

weight of cement for bagged cement and to the total weight of the binder for bagged mortars.

Reduction of chromate content in cement is managed with the addition of iron (II) sulphate, a by-product from Titandioxide production, as a reducing agent. As the effectivity of iron (II) sulphate is reduced if stored at higher temperature and moisture the storage in proper conditions is of great importance for bagged products. Furthermore, to guarantee the reducing potential iron (II) sulphate is added with surplus. Nowadays also tin (II) sulphate, which is not as sensitive to temperature and moisture as iron (II) sulphate, is available as a reducing agent, but at higher cost.

Chromate in cement, blended cement and concrete originate from ordinary portland cement and possibly fly ash and other compounds used for producing cement and concrete. The chromate content of fly ash is much lower than that of cement and normally the criteria of 2 ppm is met. Nevertheless, the possible contribution of fly ash to soluble chromate in mortar and concrete has to be taken into account. For normal fly ash concrete the requirement is met if a chromate reducing agent is used because the surplus of reducing agent added to the cement reduces also the small amount of chromate coming from fly ash.

A pending question was the missing definition of a test method of chromate in cement containing preparation. Existing test methods for chromate were based on testing powders or mortars with

different water-solid ratios, mixing/extraction times and temperatures of the eluent. In Germany, the test method for analysing the chromate content as defined in the technical regulations for dangerous substances (TRGS) 613, is based on a water-solid ratio of 4-1 with a shaking time of 15 minutes. Other test procedures for waste or soil are based on water-solid ratios of 10-1 or 15-1 with shaking times of one hour in cold water or two hours in boiling water, respectively. Comparative tests showed higher results of chromate content with increasing water-solid ratio. In Denmark, with the Danish standard DS 1020 a test procedure was introduced to test the chromate content of cement by filtration of a freshly produced mortar with a water-cement ratio of 1-1.

In 2003, the Technical Committee 51 of CEN (Comité Européen de Normalisation) CEN/TC 51 “Cement and Building Limes” started work on a European standard for the determination of water-soluble chromium (VI) content of cements. In October 2004 CEN published the draft standard prEN 196-10 “Methods of testing cement - Part 10: Determination of the water-soluble chromium (VI) content of cement.” The test method has drawn heavily on the Danish standard DS 1020 with consideration of existing test methods in France, Germany and the United Kingdom. The test method defined in this standard refers to the filtration of a freshly produced mortar with a water-cement ratio of .5 and the photometric analysis of the filtrate. In addition, a system for the evaluation of compliance of cement is defined. The standard is expected to come into force in 2006. □



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# SYNMAT

# HOW TO USE ACAA'S WEBSITE PUBLICATION LIBRARY

**A**CAA has been working over the past few months to improve both its website photo and publication libraries. The photo library, which now includes more than 500 pictures, gives members the ability to supplement their Power Point presentations and technical papers. Although structurally completed, the photo library will continue to have more materials added. The next effort, the topic of this article, is to grow and enhance the website publication library.

The publication library offers members, at no cost, information search and download options, from over 500 publications. The goals are to increase the number of available publications to 1,800, and to modify the user search options for more efficient and quicker identification. This article begins the process of improving the library function by explaining how to make better use of its search capabilities. Members are asked to contact the staff if they have questions or can offer suggestions for further improving the library.

## WEBSITE PUBLICATION LIBRARY ACCESS

ACAA members accessing the library are required to have an ACAA issued password. Members wanting to add personnel to their organization's access list can do so by simply phoning or emailing ACAA and providing contact information.

Access is gained by first clicking on the "Members" link option on the ACAA website homepage ([www.acaa-usa.org](http://www.acaa-usa.org)). Once the "Welcome Members!" page opens, click the menu option "Library." The resulting window provides for selecting either the Photo Library or the Publication Library. Clicking the Publication Library option results in the window (below) displaying five search option fields and a list of subject categories. The remainder of this article details how to use these options.



## SEARCHING FOR PUBLICATIONS OR TOPICAL INFORMATION

- **Using the Search Option Fields:** Search option fields offer the ability to look for a specific publication by title, several publications by a particular author or organization, and a number of unrelated publications containing references to a single topic. Chart 1 describes how to use each of the search options, to include examples and special comments.
- **Using the Subject Category List:** This option allows the user to more quickly find publications falling into a particular subject area. It will be changed periodically when listed subjects are found to be too general and it is more beneficial to break out the subject into specific subsets. Chart 2 describes instructions for searching, entry examples and comments.

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**Chart 1. Search Option Field Instructions**

Search Option*	Instructions	Example	Comments
<b>Keyword</b>	Enter a single word relating to the topic of interest.	Searching for any reference to “ACAA Meeting,” enter “aca” or “meeting” not “aca meeting.”	Keyword searches find only those words most closely linked with the publication. It offers the fewest search references from which to collect.
<b>Title</b>	Enter a word or words from the title as the words are ordered in the title.	Searching for “Coal Ash Analysis of Powder River Basin Coal,” enter “coal,” or “ash,” or “ash analysis,” or “powder river basin coal,” etc.	From the example, entering “powder river basin ash analysis” will not identify a publication title. The more complete the title entered, the fewer number of related titles from which to choose will appear. Although searching from a limited reference base, as with searching a keyword above, it provides a quicker and greater chance of finding a publication.
<b>Author(s)</b>	Enter the first and/ or the last name of a single author.	Searching for “Jane Smith,” enter “Jane,” or “Jane Smith,” or “Smith.”	If it is known there is more than one author, search by each known author separately until the desired publication appears. If the author is known, this option offers a very good chance of finding the publication in a shorter time.
<b>Source/ Publisher</b>	Enter a word or words comprising the name of the organization responsible for generating the publication.	Searching for a list of ACAA publications, enter “aca,” or “American,” or “American Coal Ash,” etc.	Avoid use of articles and conjunctions, such as “the,” “or,” “and,” etc. Least used of the search options, the results tend to return the most general of listings.
<b>Abstract Text</b>	Enter a single word relating to a general or specific topic located in a number of publications.	Searching for any publications which references “Mercury,” enter “mercury.”	As this search option reviews all provided abstracts, it is the broadest method of search. The content of lengthy abstracts provides information not only on the primary topic of the publication but also peripherally related topics.

**Chart 2. Subject Category List Instructions**

Search Option*	Instructions	Example	Comments
<b>Subject Category</b>	Select a listed category most closely related to the information being sought. Select from the resulting list of publication titles.	Searching for “road base” select “Road and Highway Construction.”	This search option offers a more direct approach to finding information when specific publications are not known.

## OTHER ASH INFORMATION SOURCES

The following is a list of online sites providing varying degrees of ash related information for free and/or a fee.

- American Coal Ash Association- [www.acaa-usa.org](http://www.acaa-usa.org)
- American Coal Council - [www.americancoalcouncil.org](http://www.americancoalcouncil.org)
- American Concrete Institute - [www.aci-int.org/general/home.asp](http://www.aci-int.org/general/home.asp)
- Australian Ash Utilization Association - [www.adaa.asn.au/welcome.htm](http://www.adaa.asn.au/welcome.htm)
- Canadian Industries Recycling Coal Ash (CIRCA) - [www.circainfo.ca](http://www.circainfo.ca)
- Center for Applied Energy Research (CAER) - [www.caer.uky.edu](http://www.caer.uky.edu)
- Center for By-Products Utilization - [www.uwm.edu/Dept/CBU](http://www.uwm.edu/Dept/CBU)
- Center for Energy & Economic Development (CEED) - [www.ceednet.org/ceed](http://www.ceednet.org/ceed)
- Coal Ash Resources Research Consortium - [www.undeerc.org/carrc](http://www.undeerc.org/carrc)
- Coal Combustion Products Partnership (C2P2) - [www.epa.gov/c2p2/index.htm](http://www.epa.gov/c2p2/index.htm)
- European Coal Combustion Products Association (ECOBA)- [www.ecoba.com/index.html](http://www.ecoba.com/index.html)
- Electric Power Research Institute (EPRI) - [my.epri.com/portal/server.pt](http://my.epri.com/portal/server.pt)
- FIRST SEARCH Database – (UND EERC) - [www.undeerc.org/carrc/html/Databases.html](http://www.undeerc.org/carrc/html/Databases.html)

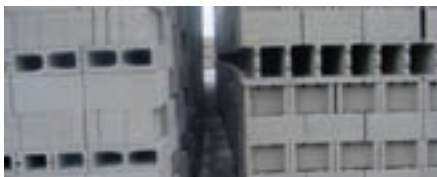




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- Korean Coal Ash Recycling Association - [coalash.or.kr/main.html](http://coalash.or.kr/main.html)
- National Energy Technology Laboratory (NETL) - [www.netl.doe.gov/technologies/coalpower/index.html](http://www.netl.doe.gov/technologies/coalpower/index.html)
- National Ready Mixed Concrete Association - [my.nrmca.org/script-content/PsIndex.cfm](http://my.nrmca.org/script-content/PsIndex.cfm)
- National Research Center for Coal and Energy - West VA University - [www.nrcce.wvu.edu/lab.cfm](http://www.nrcce.wvu.edu/lab.cfm)
- Portland Cement Association - [www.cement.org](http://www.cement.org)
- South African Coal Ash Association - [www.cnci.org.za/sacaa.htm](http://www.cnci.org.za/sacaa.htm)
- The Ohio State University Extension Program "Online" - [ohioline.osu.edu](http://ohioline.osu.edu)
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- U.S. Environmental Protection Agency - [www.epa.gov](http://www.epa.gov)
- U.S. Geological Survey - [www.usgs.gov](http://www.usgs.gov)
- U.S. Green Building Council - [www.usgbc.org](http://www.usgbc.org)
- Utility Solid Waste Advisory Group (USWAG) - [www.uswag.org](http://www.uswag.org)
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*Barzin Mobasher, Assoc. Professor*  
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Ash portfolio consists of sales to ready mix concrete, flowable fill, structural fills and reclamation projects.

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Dean Golden is a retired senior project manager who spent 26 years with the Electric Power Research Institute. In this capacity, he conceived and directed research programs involving the disposal and reuse of CCPs conducted by a range of industry and governmental organizations. He now provides market studies for clients in the area of by-product utilization.

### Don Saylak

Texas A&M University Civil Eng.  
Dept. College Station, TX 77843  
(979) 845-9962  
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Don Saylak, Professor Emeritus  
d-saylak@tamue.edu

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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.

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Gerard Gambs, Consulting Engineer  
Mr. Gambs, has over 60 years 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.

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Ron Jorgenson, Associate  
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jason.boeckel@mdu.com  
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*Mgr, Environmental Affairs*  
dpauken@mpw.org  
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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.

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Fax: (402) 434-1799  
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texl@nebraskaash.com  
Nebraska Ash and its wholly owned subsidiary "Plains Pozzolan" are full service CCP handling companies which market, store and dispose of fly and bottom ash for coal burning electrical generation stations.

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Fax: (308) 535-5333  
*Thomas Schroeder,*  
*Fossil Fuels Manager*  
tjschro@nppd.com  
NPPD is a government-owned, coal-fired electric utility providing power to 91 of Nebraska's 93 counties. Its Gerald Gentlemen and Sheldon generating stations have a capacity of 1505 MW distributing electricity to nearly 788,000 customers.

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pjrvcs@aol.com  
www.pjromano.com  
Peter J Romano is a construction industry marketer and distributor. It incorporates in its project development the beneficial use of industrial by-products, including coal combustion fly ash of various grades and color pigments for concrete construction.

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bsutton@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.

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*Jon Little, Marketing & Community Relations Manager*  
littlej@prpa.org  
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Platte River Power Authority, located in Colorado, is a wholesale electricity generation and transmission company owning and operating its 270 MW coal-fired Rawhide Energy Station.

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*Terry Watson, President*  
tewatson@pozziotech.com  
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(610) 774-4117  
Fax: (610) 774-4759  
*Joel Pattishall,*  
*Manager Coal Combustion Products*  
jcpattishall@pplweb.com  
www.pplweb.com/ppl+generation  
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.

### Prairie State Generating Company LLC

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*Colin Kelly, President*  
colin.m.kelly@peabodyenergy.com  
www.prairiestateenergycampus.com  
Prairie State, currently under construction in southwestern Illinois, will be a 1,500+ MW pulverized coal power plant with an associated 6.5 million ton per year mine-mouth underground coal mine.

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*Ginny Farrow, Manager - By-Products & Reagents, Regulated Fuels*  
ginny.farrow@pgnmail.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 as well as other non-regulated operations.

### Public Service Enterprise Group

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*Albert Fralinger, Manager, Materials Resource Recovery*  
albert.fralinger@pseg.com  
PSEG Services Resource Recovery tests, manages and markets coal combustion products in cement applications and commercially available products, as well as pre-approved beneficial use land reclamation projects.

### Public Service of New Hampshire

780 N. Commercial Street  
P.O. Box 330  
Manchester, NH 03105  
(603) 634-2439  
Fax: (603) 634-3283  
*Allan Palmer, Senior Engineer*  
palmeag@nu.com  
Formed in 1926, Public Service of New Hampshire is the Granite State's largest electric utility, serving more than 447,000 customers throughout the state and able to generate more than 1,110 megawatts.

### Residual Management LLC

224 W. Washington St., 5th Flr.  
Milwaukee, WI 53204  
(414) 647-9434  
Fax: (414) 647-9521  
*Trevor Schuurman,*  
*Director of Marketing*  
ttschuurman@yahoo.com  
Residual Management beneficially reuses off-spec CCP materials. Working with the individual states regulation, Residual Management finds projects that utilize the CCP materials as sub-grade fill on construction sites, in sight and sound berms, or in golf course construction.

### Rio Bravo Jasmin

3100 Thunder Valley 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 MWs 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 Road, Ste. 155  
Scottsdale, AZ 85250  
(480) 850-5757  
Fax: (480) 850-5758  
*Dale Diulus,*  
*VP Coal Combustion Products & Logistics*  
ddiulus@srmaterials.com  
www.srmaterials.com  
Salt River Materials Group markets a variety of construction materials including normal and lightweight aggregates, PHOENIX CEMENT(TM) portland and blended cements, and a full line of CCPs in the Southwestern U.S.

### Santee Cooper

1 Riverwood Drive  
P.O. Box 2946101  
Moncks Corner, SC 29461  
(843) 761-8000  
Fax: (843) 761-4114  
*Thomas Edens, Administrator,*  
*Combustion Product Utilization*  
tedens@santecooper.com  
www.santecooper.com  
Santee Cooper, with 2800 coal fired MWs and 1200 more under construction, is the nation's third largest public utility serving 1.6 million South Carolinians. It provides CCPs to the cement and concrete industries, as well as synthetic gypsum to agriculture.

### Seminole Electric Cooperative, Inc.

P.O. Box 272000  
Tampa, FL 33688  
(813) 739-1213  
Fax: (813) 264-7906  
*James Frauen,*  
*Manager, Environmental Affairs*  
jfrauen@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 1800 MW of capacity, 2003 member coincident peak demand was 4009 MW with sales of 14,956 MWH.

**Separation Technologies LLC**

6071 Catawba Road  
Troutville, VA 24175  
(540) 966-6833  
Fax: (540) 966-1623  
*Randy Dunlap, VP CCPs*  
rdunlap@titanamerica.com  
Separation Technologies is a leader in total CCP management with expertise in marketing, utilization, transportation and landfill management. STI also offers the leading carbon and ammonia removal systems in the industry to customize CCP management processes.

**South Carolina Electric & Gas**

111 Research Drive, K-61  
Columbia, SC 29203  
(803) 217-7461  
Fax: (803) 933-8064  
*Ted Frady, Sr Engineer,*  
*Ash Utilization & Disposal*  
tfrady@scana.com  
South Carolina Electric and Gas (SCE&G) is an investor owned, regulated utility, with an electric generating capacity of approximately 5000 MW. SCE&G, based in Columbia, serves 570,000 South Carolina customers.

**Southern Company**

600 N. 18th St., 14N-8162  
Birmingham, AL 35291  
(205) 257-7135  
Fax: (205) 257-0410  
*Xia Lin,*  
*Fuel Environmental*  
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xia@southernco.com  
www.southernco.com  
Based in Atlanta, Southern Company is one of America's largest generators of electricity. It supplies energy to a 120,000 square-mile service territory spanning most of Georgia and Alabama, southeastern Mississippi, and the panhandle region of Florida.

**Southern Illinois Power Cooperative**

11543 Lake of Egypt Road  
Marion, IL 62959  
(618) 964-1448  
Fax: (618) 964-1867  
*Richard Myott,*  
*Planning & Environmental*  
*Department Manager*  
rmyott@sipower.org  
SIPC is a generation & transmission cooperative burning 1.2 million tons per year of Illinois coal. SIPC has cyclone boiler slag, Class F flyash and Calcium Sulfite scrubber sludge as well as CFB alkaline bed ash and flyash available.

**Southern Illinois University**

405 West Grand MC 4623 Southern  
Illinois University at Carbondale  
Carbondale, IL 62901  
(618) 536-5521  
Fax: (618) 453-7346  
*John Mead, Director*  
jmead@siu.edu  
The Coal Research Center established in 1974, provides a substantial coal research, education and service program to stimulate and coordinate innovative efforts to improve the efficiency of coal mining and coal use.

**Sphere One, Inc**

601 Cumberland, Building 32  
Chattanooga, TN 37404  
(423) 629-7160  
Fax: (423) 678-0614  
*Kip Clayton, Materials Manager*  
kclayton@sphereone.net  
www.sphereone.net  
Sphere One, in addition to being an international and domestic provider of lightweight spherical filler composite materials, including cenospheres and microspheres, provides related technical and product information to its customers.

**Sunflower Electric Power Corporation**

2025.75 W. St. John Street  
P.O. Box 1649  
Garden City, KS 67846  
(620) 272-5467  
Fax: (620) 272-5467  
*Jim Carlson,*  
*Supervisor of Environment*  
jcarlson@sunflower.net  
Sunflower Electric Power Corporation is a Cooperative located in Holcomb, Kansas which consists of 1 coal fired and 5 gas-fired generation plants, for a total generation of 548 megawatts.

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### Synthetic Materials

P.O. Box 67245  
244 Old Highway 149  
St. Pete Beach, FL 33736  
(727) 367-0400  
Fax: (727) 367-0402  
*John Glasscock, President*  
jrg@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.

### Tampa Electric Company

TECO Plaza - P.O. Box 111  
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(813) 228-1627  
Fax: (813) 228-1033  
*Elaine Farrington, Account Manager, Combustion Byproducts*  
ehfarrington@tecoenergy.com  
Tampa Electric's nearly 4000 MWs provide electricity to over 635,000 customers in the Tampa Bay, Florida area as well as selling over a million tons of CCPs annually for industrial and construction applications.

### Tarun R. Naik

University of Wisconsin - Milwaukee  
Dept. of Civil Engr. & Mechanics  
P.O. Box 784  
Milwaukee, WI 53201  
(414) 229-6696  
Fax: (414) 229-6958  
*Tarun R. Naik, Professor*  
tarun@uwm.edu  
Dr. Naik, with over 40 years of industry and university experience, specializes in recycling of by-products and issues related to sustainable development, construction materials, concrete, wood and foundation engineering. He has authored over 250 technically related papers.

### Temple-Inland Inc.

540 E. Barton Avenue  
P.O. Box 1270  
West Memphis, AR 72303  
(870) 702-3104  
Fax: (870) 702-3200  
*Bruce Shrader, Plant Manager*  
bruceshrader@templeinland.com  
Temple-Inland Inc. is a Fortune 500, Texas based holding company made up of three core operations - corrugated packaging, forest products and financial services. It is a major manufacturer of residential and commercial building materials including gypsum wallboard.

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ecmiller@tva.gov  
TVA is the nation's largest public power provider and is completely self-financed. TVA provides power to large industries and 158 power distributors that serve 8.3 million consumers in seven southeastern states.

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(614) 688-3408  
Fax: (614) 292-3780  
*Tarunjit Butalia, Research Scientist*  
butalia.1@osu.edu  
The CCPEP, co-sponsored by state and federal agencies, utilities, and trade groups, promotes the knowledge of productive and proper application of CCPs as useful raw materials in highways, construction, mine reclamation, manufacturing, and agricultural uses.

### The SEFA Group

217 Cedar Road  
Lexington, SC 29073  
(803) 520-9000  
Fax: (803) 520-9001  
*Jimmy Knowles, Vice President - Market Development*  
jknowles@sefagroup.com  
The SEFA Group develops and maintains mutually beneficial relationships within the utility and construction industries to maximize the use of coal combustion products in environmentally friendly ways.

### Trans-Ash

617 Shepherd Drive  
P.O. Box 15396  
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*Robert Gerbus, President*  
bgerbus@transash.com  
www.transash.com  
Trans Ash is a leading ash management contractor to the power generation industry. Trans Ash services include: CCP utilization, pond excavation, landfill management, construction and power plant services. Additional services include: bottom ash and boiler slag marketing.

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Lexington, KY 40511  
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Fax: (859) 259-0010  
*John Stencel, President*  
john@triboflow.com  
www.triboflow.com  
Tribo Flow Separations provides solutions for purifying dry, fine-sized powders and for measuring the foam capacities of powders and liquids. Using its gas transport, triboelectric purification (TEP™) technology and automated foam index technique (AFIT™), TFS also offers consulting and services, focused and collaborative R&D, and equipment sales.

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(859) 257-0272  
Fax: (859) 257-0360  
*Thomas Robl, Assoc. Director*  
robl@caer.uky.edu  
The Environmental and Coal Technology Group investigates coal combustion by-product utilization, generating ideas on the utilization, handling, storage and disposal of CCBs. This group also works on coal cleaning, preparation, pelletization and binding.

### University of North Dakota

15 North 23rd Street, Stop 9018  
Grand Forks, ND 58202  
(701) 777-5261  
Fax: (701) 777-5181  
*Debra Pflughoeft-Hassett, Program Manager*  
dphassett@undeerc.org  
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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.

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1375 Euclid Avenue, Suite 600  
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(216) 622-2455  
Fax: (216) 622-2464  
*Steve Putrich, Principal Engineer*  
steven\_putrich@urscorp.com  
www.urscorp.com  
URS Corporation provides engineering consulting to utilities that generate CCPs including ash, scrubber byproducts and gasification byproducts. URS is an expert in the areas of management, disposal and beneficial reuse of CCPs.

### W. Lee Daniels

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Blacksburg, VA 24061  
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Fax: (540) 231-7630  
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Dr. Daniels is a professor at Virginia Polytechnic Institute & State University specializing in land application of industrial and municipal residuals, reclamation of drastically disturbed lands and wetland restoration.

### We Energies

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P.O. Box 2179  
Milwaukee, WI 53203  
(414) 221-2457  
Fax: (414) 221-2022  
*Thomas Jansen, Supervising Engineer - CCP Group*  
thomas.jansen@we-energies.com  
We Energies is a 6000 MW electric and natural gas energy company serving 2.4 million people in Wisconsin and Michigan. An industry leader, it owns patents for ash re-burn, ammonia liberation, electrically conductive concrete, ash alloy, and ash recovery.

### West Virginia Water Research Institute

Evansdale Campus  
NRCCE Bldg. #202  
P.O. Box 6064  
Morgantown, WV 26506  
(304) 293-2867  
Fax: (304) 293-7822  
*Tamara Vandivort, Program Coordinator*  
tvandivo@wvu.edu  
WVWRI serves as a statewide vehicle for performing research related to water issues. It is also the coordinating body for the National Mine Land Reclamation Center, Combustion By-products Recycling Consortium and numerous other technical groups.

### Western Research Institute

365 North 9th Street  
Laramie, WY 82070  
(307) 721-2386  
Fax: (307) 721-2256  
*Alan Bland, Program Manager*  
abland@uwyo.edu  
WRI's programs develop innovative technologies providing technical services to the ash management and utility industries. Projects are in process to develop new, large-volume and niche uses for ash.

### Xcel Energy

1099 18th Street, Ste. 3000  
Denver, CO 80202  
(303) 308-2736  
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*Gerry Zimmerman, Regional Manager*  
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