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ASH at work

Applications, Science and Sustainability of Coal Ash

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Cover Photo:

In western North Carolina a multi-disciplinary consortium developed commercially viable options for recycling the region's coal ash. Efforts to achieve environmental sustainability contribute to preserving the natural beauty found in such places as the blue ridge mountains (pictured).



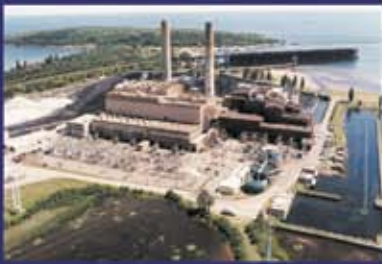


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BENEFICIAL USE WILL CHANGE ... BUT HOW MUCH?

Thomas H. Adams, American Coal Ash Association

“Volatile” would be a perfect adjective to describe 2009 so far. For the American Coal Ash Association the transition to a new executive director would have been enough to keep the officers and staff occupied. However, the tsunami of regulatory activity, never before encountered by this association, has made this transition much more complicated. Fortunately, with Dave Goss available for consultation, and with the support of ACAA leadership and members, we are surviving this tumultuous period. I must admit that getting up to speed with CCP uses, meeting members, learning how the association has been functioning, working to defend beneficial use, getting acquainted with the ACAA staff, participating in WOCA, and managing a relocation effort has kept me off the golf course. In fact, ACAA activities this year resemble the struggles most golfers encounter – just as you get one thing under control, something else seems to fall apart!

The regulatory battle this year has truly been eye opening. President Obama stated early on in his administration that decisions would be driven by scientific data. It appears not everyone working for him got the memo or shares his thoughts. Science is driving some deliberations but it is *politics*. Like any large organization, the Environmental Protection Agency has a diverse workforce that has differing views on issues. With the change in administration this past year, it was clear that federal agencies would be populated with new

leadership that would bring “change” to Washington policies. In the EPA those who are opposed to coal-fired generation have been liberated to take America away from coal to the land of wind and sun (no matter what the cost). Environmental groups, stymied by the previous administration, now have friends in the right places.

On Dec. 22, 2008 the planets aligned to create a threat to the beneficial use of coal combustion products never seen before. Proposed new regulations to be delivered by the end of this year could cripple beneficial use. Under the guise of solving the Kingston containment problem regulations may describe coal ash as a “hazardous waste.” There are many unintended consequences of such a description that we have been attempting to bring to the attention of politicians and regulators. So far we have been disappointed in their willingness to defend and protect beneficial use while addressing the containment problem.

But there is more ... the cancer slope for inorganic arsenic is too low by a factor of 20 times according to some EPA staff! A proposal has been fast tracked on this issue bypassing an established review process. A coalition of trade organizations (including ACAA) has joined together to challenge this proposal. Now I do not profess to have a clue what a cancer slope is but I do know experts say that should this change be enacted virtually every drinking water source and every soil found in the U.S. would fall into the EPA risk

target range. If we were under-regulating inorganic arsenic by this much, shouldn't there be health data to justify the change? Just asking....

Beyond the federal regulatory issues, we are seeing continuing efforts in a variety of states to bring onerous, unnecessary regulation upon CCPs. It is a good thing we have dedicated ACAA member experts to fight these battles.

On a brighter note, the 2009 World of Coal Ash was a great success. I was most impressed with the organization of the event, the exhibits, technical presentations, and social events. The staff at the University of Kentucky's Center for Applied Energy Research and the ACAA staff should be proud of their work especially in a weak economic environment. To make things even harder, the H1N1 flu kept a number of international registrants from becoming attendees. In spite of these challenges the event surpassed previous WOCA records in many categories. It will be tough to top the 2009 WOCA when the 2011 version comes to Denver.

The future of beneficial use is about to change, this much we know. The question is: how much will new disposal regulations impact the ability of the ACAA to maintain and expand beneficial use? No one can answer that question with any degree of accuracy at this time. Let's hope the baby does not disappear with the bath water. ♦



COMMITMENT!

Mark Bryant, Ameren Energy Fuels & Services

When Cortez landed in the new world he ordered the destruction of his ships to ensure the commitment of his men, there could be no turning back. Shortly after Tom Adams accepted the position as executive director, the American Coal Ash Association faced a great challenge to our commitment to the beneficial re-use of CCPs. We all know the events that accelerated committed environmental organizations, political leaders and a new administration to hone in on the future regulatory scheme associated with CCPs and beneficial re-use. But the chain of events to come and the work that would be needed was unprecedented in the history of our organization. There could be no question of or limit to our commitment. We must change the tone of these discussions and protect the beneficial use industry.

Tom took a deep breath and with Dave's unwavering support, off they went to support our members at their time of need in Tennessee, to begin Tom's "trial by fire" into the intricacies of our industry and the vast array of interests our membership envelops. With an experienced staff in Denver behind him and a tool box full of experienced, knowledgeable and engaged industry professionals to support him along the way, the discussions in Washington started to take priority as the calls for managing the CCPs as hazardous continued to rise. We were in the unfamiliar waters of a highly charged political environment. The team work, almost frantic pace and the tireless effort have been amazing to watch. I am confident that these efforts are having a positive impact.

Our association has never lobbied for political action but the need to engage and inform senior administrators at several government agencies, Congress and representatives of affiliate associations for affected industries demanded much more time than ever before. Hosting receptions in Washington to spread the message about the benefits of CCP beneficial uses and why a hazardous label will deal a deadly blow to our industry were our highest priority. We needed to counter the claims of "hazardous" and "toxic" with reasonable and supportable science and open discussion. Tom and the team engaged in discussions with the senior leadership of several leading environmental groups to open and promote a productive effort to find common ground. Tom's most recent meetings between the "end user" industries and key high level EPA representatives which was arranged by ACAA was by all accounts, very effective in outlining the unintended consequences of the "hazardous" stigma.

Working in close concert with our affiliate industry associations we have stayed our path in promoting the many advantages of beneficial reuse of CCPs. The regulatory and statutory process is for others to carry out. But we have all worked hard and been effective individually and collectively as an industry. Our members are diverse with many unique concerns that demand focus and balance. We have asked Tom and his team to stay on the right course and message.

Regardless of the language or the structure, the message received from one segment of our membership, a cross section of

the ash producers, is clear, if "hazardous" attaches to the management of CCPs (products), CCBs (byproducts), or CCWs (wastes) then this perfectly good and valuable material will be withheld from the market and its varied benefits to our society and environment eliminated, the liabilities will be too great. If this becomes the case, "green" jobs and our industry will become the latest causality. We are hopeful that sounder science and minds will prevail as a result of our approach and message. We continue to need your help in reaching out to members of Congress, the White House, your state and regional EPA offices, and local and state DOTs.

Along the way and due in part to relationships that Tom brought to the association, we have found strong demonstrations of support from many organizations such as the National Ready Mixed Concrete Association (NRMCA) and the American Society of Highway and Transportation Officials (AASHTO). It is important that we gather, document and inform EPA, Congress and the White House of the broad support for a management strategy that does not consider CCPs hazardous.

The economy is affecting everyone. We all must be concerned about the value and benefits of membership. In response, Tom and staff have taken to the more frequent use of webinars as a method to reach and update our membership regarding the rapidly changing events in Washington. I think you will agree with me that webinars are a great and cost-effective way to stay up-to-date. Our staff has also asked for help in expanding the list of people both



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“It is important that we gather, document and inform EPA, Congress and the White House of the broad support for a management strategy that does not consider CCPs hazardous.”

within our members' organizations and outside contacts that receive our e-notices, updates and publications so we can spread our message more quickly and effectively. Only your support and constructive feedback can make these efforts a success.

Once again, I ask for your active involvement and commitment. We anticipate that EPA's draft rule making will be completed and sent to the OMB for interagency review by

Labor Day. Now is the time for all members to act to keep the words “hazardous” and “toxic” where they belong and away from the beneficial use of ash. We must make sure that the voice of reason and science is heard. Please remain active in contacting your congressional representatives and if you need any help, give staff a call.

As always, thanks, and see you in Denver in September. ❖

WASHINGTON NEWS ALERT



American Coal Ash Association

Advancing the management and use of coal combustion products in ways that are environmentally responsible, technically sound, commercially competitive, and more supportive of a sustainable global community.



The American Coal Ash Association has kept members informed of regulatory developments through meetings, phone calls, webinars, news alerts, and via The Phoenix, our member e-newsletter.

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WILL NEW DISPOSAL REGULATIONS UNDO DECADES OF PROGRESS?

By John Ward, John Ward Inc.

Three days before Christmas last year a containment dike at a Tennessee power plant's coal ash disposal facility failed. Approximately 300 acres, several homes, and portions of two nearby rivers were flooded by more than a billion gallons of slurry. Fortunately, no one was injured. But the clean-up costs are estimated to exceed \$1 billion and the incident has touched off a flood of a different kind: unprecedented attention to coal ash disposal by news

media, environmental activists, elected officials and government regulators.

Heeding calls for tougher coal ash disposal regulations, the Environmental Protection Agency has promised to propose new requirements by the end of this year. A crucial question remains, however: Will new disposal regulations undo decades of progress toward using coal ash in safe, environmentally beneficial ways as an alternative to disposal?



In 1980, the Bevill Amendment to RCRA instructed EPA to “conduct a detailed and comprehensive study and submit a report” to Congress on the “adverse effects on human health and the environment, if any, of the disposal and utilization” of coal ash. In both 1988 and 1999, EPA submitted reports to Congress and recommended coal ash should not be regulated as hazardous waste.

A SUPERCHARGED ENVIRONMENT

National news media coverage of the Tennessee incident was ubiquitous following the event and continues. Reports are replete with references to “toxic” and “poisonous” coal ash and have characterized the incident as “100 times larger than the Exxon Valdez oil spill.”

A broad array of environmental activist groups enthusiastically encouraged these media portrayals. Within weeks following the incident, groups released reports with titles such as “DISASTER IN WAITING. Toxic Coal Ash Disposal in Surface Impoundments” and “Waste Deep: Filling Mines with Coal Ash is Profit for Industry but Poison for People.” More than 100 environmental groups petitioned the EPA to regulate coal ash as a hazardous waste.

Congress has also become actively involved. Hearings have been held in several committees of both the Senate and House of Representatives. Press conferences and field visits are occurring regularly. An investigation by the Government Accountability Office was ordered and resolutions were introduced calling for EPA’s expedited review of coal ash disposal regulation.

EPA’S RESPONSE

EPA organized its response around two main efforts. The first was to identify whether any other coal ash disposal sites presented risks of a similar failure. A survey of all coal-fueled power plants was launched and on-site inspections were ordered for some locations.

The second effort is aimed at proposing new coal ash disposal regulations by the end of 2009. For this task, EPA has a number of tools at its disposal within the Resource Conservation and Recovery Act (RCRA) – the primary law governing solid waste regulations in the United States.

A key consideration for EPA will be what sections of RCRA to apply. Subtitle D

pertains to non-hazardous and industrial waste materials and largely delegates enforcement to individual states. Subtitle C pertains to hazardous waste materials and contains more stringent requirements.

DÉJÀ VU? ... OR SOMETHING NEW?

This is not the first time that the “hazardousness” of coal ash has been reviewed by EPA and Congress. In 1980, the Bevill Amendment to RCRA instructed EPA to “conduct a detailed and comprehensive study and submit a report” to Congress on the “adverse effects on human health and the environment, if any, of the disposal and utilization” of coal ash. In both 1988 and 1999, the EPA submitted reports to Congress and recommended that coal ash not be regulated as hazardous waste. In 1993, EPA issued a Regulatory Determination finding regulation as a hazardous waste “unwarranted” and in 2000 issued a Final Regulatory Determination concluding coal ash “do(es) not warrant regulation [as hazardous waste]” and that “the regulatory infrastructure is generally in place at the state level to ensure adequate management of these wastes.”

An effort was launched by environmental activist groups and some members of the Administration in 2000 to regulate coal ash as a hazardous waste, but that effort failed with EPA’s issuance of its Final Regulatory Determination. This time around, however, there are indications that EPA may be rethinking its position.

EPA officials have stated that a Subtitle C hazardous waste designation for coal ash is possible. There has also been ample speculation about a “Contingent C” approach – classifying coal ash as hazardous for disposal, but not hazardous when beneficially used, such as when utilizing coal fly ash in the production of concrete.

THE HAZARD OF HAZARDOUS

The American Coal Ash Association has been vigorously engaged in informing EPA and other policymakers of the dangers of classifying coal ash as “hazardous” in any setting. Over the past three decades, and recently with the cooperation of EPA’s own Coal Combustion Products Partnership program, the beneficial use of coal ash has steadily increased. Today,



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approximately 43 percent of the coal ash generated in the U.S. is recycled rather than disposed.

The ACAA has submitted detailed analyses to EPA officials showing that this environmental success story would be endangered if the agency classifies coal ash as hazardous, even if for the limited purpose of regulating disposal operations. Supply of coal ash for recycling would be restricted as power plants reconsider the potential risks of widely dispersing a material that would otherwise be considered “hazardous.” Demand for coal ash would be harmed by the “hazardous” stigma that could frighten potential users.

Numerous other mining and utility industry groups are also working to encourage development of responsible coal ash disposal regulations that protect the environment without jeopardizing the safe and environmentally beneficial use of coal ash resources. They have been joined by some members of Congress and by numerous state environmental regulators. In fact, at least 21 states and the Association of State and Territorial Solid Waste Management officials have formally urged EPA to adopt a regulation program under RCRA's non-hazardous Subtitle D.

OUR ENVIRONMENT'S AT STAKE

The unintended consequence of calling coal ash “hazardous for disposal” could be the sudden need to dispose of a lot more coal ash. If ash producers are unwilling to sell and ash users are unwilling to buy a material that would be called “hazardous” in any other setting, a number of serious questions arise:

How many hazardous waste landfills would we need to construct to contain the more than 50 million tons of coal ash now beneficially used each year? How many millions of tons of virgin natural resources would have to be mined to replace the coal ash? And how will we replace the nearly 15 million tons of annual greenhouse gas emissions reductions we achieve by replacing cement with fly ash in the production of concrete?

Coal ash disposal standards can and should be addressed without unnecessarily stigmatizing resources with high potential for safe beneficial use. Safe beneficial use should be viewed as a preferred alternative to disposal. ACAA will continue to carry that message as disposal regulations are proposed and debated over the coming months. ♦

For more information on the safe and beneficial use of coal ash, visit www.coalashfacts.org – just one among many channels ACAA is using to spread this important message.

John N. Ward is President of John Ward Inc., a marketing and public affairs consultancy focusing on energy issues related to coal and coal ash. He is a former board member and past president of the American Coal Council. He served on the National Coal Council as appointed by the U.S. Secretary of Energy. John is formerly chairman of the Government Relations Committee of the American Coal Ash Association and is currently assisting ACAA with outreach for coal ash regulations.

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TRANSCENDING PORTLAND CEMENT WITH 100 PERCENT FLY ASH CONCRETE

By Doug Cross, Michelle Akin, Jerry Stephens, Eli Cuelh, Western Transportation Institute, Montana State University

Researchers at the Western Transportation Institute at Montana State University (WTI/MSU) in Bozeman have been developing alternative concretes for more than 10 years. One unique aspect of this work is that these alternative concretes are produced with only a high calcium Class C fly ash as the binder, no portland cement. These concretes are very workable in the fresh state. Upon setting they develop excellent short and long-term structural strengths.

The researchers are mostly funded by grants or research contracts. This is true even on the large scale demonstration field projects that have been conducted to date, in which the researchers have had a relatively small part of the project, typically providing mix design services, structural testing and some training of the trades people before field activities begin. This arrangement has worked well,

but to better understand all the nuances related to developing and using a new material, the research team needed to be involved in the whole process, including preparation of specifications and bid documents, contracting the project, and being the project's ultimate owner. Thus, when the opportunity presented itself for WTI to build its own research facility, it was decided that all the concrete on the project would be 100 percent fly ash concrete with traditional mineral aggregates so researchers could experience more of the critical elements/roles involved in introducing a new building material into the construction arena.

In the summer of 2006, WTI began the process of designing Transcend, a new controlled access rural transportation research facility located in Lewistown, Mont. This facility is situated on 230 acres at the Lewistown municipal airport and includes four miles of paved test track

Figure 1. The WTI Transcend research facility is designed for experiments in road ecology, driver safety, infrastructure maintenance and materials, and winter maintenance and effects.

Figure 2. Two buildings contain pumps for snowmaking, while a third is devoted to shop space.



Figure 1



Figure 2

RECYCLING THAT WORKS



In 1973, Phoenix Cement Company began recycling approximately ten thousand tons of raw fly ash per year from the Cholla Power Plant at Joseph City, Arizona for use in the production of ASTM C595 Type IP cement at its Clarkdale, Arizona Cement Plant. Prior to this, 100% of the fly ash and bottom ash produced at the Cholla plant was disposed of in settling ponds.



As demand grew for the benefits of a high quality, consistent fly ash, Phoenix Cement Company installed a fly ash beneficiation facility at Cholla in 1986. This would prove to be the beginning of a construction-based product recycling effort that has grown to include four power plants in New Mexico and Arizona, with multiple products being supplied to the concrete and concrete products industry throughout the Southwest.

Thirty Five years later, nearly ten million tons of Coal Combustion Products (CCP's) have been recovered and marketed by Salt River Materials Group, the commercial marketer of Phoenix Cement Company products, in its Pozzolans business unit. These CCP's are collected from the Cholla Power Plant at Joseph City, Arizona, the Four Corners and San Juan Power Plants near Farmington, New Mexico and the Escalante Generating Station at Prewitt, New Mexico.



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As it turned out, in the course of this project WTI/MSU learned a great deal about how this new material behaves in cold weather.

and a 2.5-acre skid pad. The primary focus of this facility is rural transportation research, accommodating a wide variety of research needs in areas such as road ecology, driver safety, infrastructure maintenance and materials, and winter maintenance and effects. To support the research activities at this facility, it was necessary to construct three buildings (Figure 2). Two of the buildings are for the high and low pressure pumps associated with the snowmaking system at the facility. This system has a 1.3-million-gallon reservoir that feeds water to the snowmaking fan guns along 3,000 feet of paved test track. The third building is a 2,000-square-foot shop. This shop space will be utilized for many things, including a staging area for winter maintenance research projects related to anti-icing and de-icing of roadways.

During the summer of 2008, the plans and specifications for the buildings were complete and the project was ready for bidding. Concrete work consisted of footings, foundation walls for the buildings, and various flatwork around the site. While originally the majority of the concrete work was to be completed by early fall, administrative delays suddenly

meant that the concrete work would occur in cold weather conditions. Until now, WTI investigators focused their efforts on producing this new concrete under reasonable weather conditions, i.e., temperatures above 50°F and rising with minimal wind and no precipitation.

As it turned out, in the course of this project WTI/MSU learned a great deal about how this new material behaves in cold weather. The first pour that occurred Oct. 27, 2008 served four functions. One, it was the first opportunity for the ready-mix company (Casino Creek Concrete, Lewistown, Mont.) to learn and experience first hand the batching process for this material. Two, it educated the trades people on the project regarding best practices for placing and finishing this material. Three, it was the first time this new material was placed using a truck-mounted concrete boom pump. Four, it provided an opportunity to directly compare laboratory and field mixes.

MIX DESIGN, BATCHING AND PLACING

Determining a mix design for this project began by reviewing previous mix designs that have been developed at WTI/MSU.

During the development phase for this project, it was decided that the two most important criteria were workability and 28-day compressive strength. Previous work at WTI/MSU indicated that a mixture with a water to fly ash ratio (w/fa) of 0.24 and a slump ranging between 6 inches and 7.5 inches would be a workable mixture that would develop a strength of at least 4,000 psi at 28 days.

The mix design used for this project consisted of conventional coarse and fine aggregate, fly ash, borax and water, in the proportions shown in Table 1. The resulting concrete resembled conventional portland cement based mixtures except that 100 percent of the portland cement was replaced with a high calcium Class C fly ash from Billings, Mont.. The properties of the JE Corette power plant fly ash are shown in Table 2.

The use of some form of set retarder with this type of concrete is essential. In the absence of any such retarder the concrete will flash set in only a few minutes. Borax, a mineral composed of boron, sodium, oxygen and water, was previously found to be very effective for this purpose. Specifically, 20 Mule Team Borax® (decahydrate borax) was used in this project. This product is a dry powder commercially available as a laundry detergent. Figure 3 shows the borax being loaded into the ready-mix truck. The mix water used was potable water obtained from a public water supply.

Table 1. Proportions for 1 yd³ of Concrete

Mix Design	Water (lb)	Corette Fly Ash (lb)	Coarse Aggregate (lb)	Fine Aggregate (lb)	Borax (lb)
TRANSCEND	267	1116	1785	997	14.51

Table 2. Properties of Corette Fly Ash

Chemical						Physical		
Silicon Dioxide (%)	Aluminum Oxide (%)	Iron Oxide (%)	Sulfur Trioxide (%)	Calcium Oxide (%)	Loss on Ignition (%)	Fineness, Retained on #325 Sieve (%)	Soundness, Autoclave Expansion (%)	Density (g/cm ³)
32.37	17.52	5.34	2.02	28.89	0.23	12.1	0.17	2.72

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The concrete mixtures were made with locally available fine and coarse aggregates that met the requirements of ASTM C-33. The coarse aggregate had a maximum size of .75 inch. The coarse and fine aggregate accounted for 60 percent of the mix volume, while the paste (water and fly ash) made up the remaining 40 percent of the mixture. While this is a paste rich mixture by portland cement concrete standards, it should be noted that the water to fly ash ratio is considerably lower for this concrete than what is typical for portland cement based concretes mixture.

The production of 100 percent fly ash concrete resembles the production of portland cement concrete. As with portland cement concretes, the workability, set time and hardened strength of the material produced can only be assured if prescribed batching and subsequent mixing processes are followed. For this material, the constituents must be added in a prescribed order, and this order is somewhat different from what is typically used to produce portland cement concrete. The basic steps for producing 100 percent fly ash concrete are:

load all coarse aggregate,
fine aggregate, water and borax,
premix for 20 minutes, and then
add all the fly ash.

Deviations from this mixing protocol will generally end badly (typically in premature setting of the material).

The one drawback to using borax as a set retarder is the premix time required to get the borax into solution (20 minutes). This premix step creates a logistical challenge for the batch plant on multiple truck concrete pours. Once the premixing of the borax is complete, all the fly ash is added into the truck and continuously mixed or agitated until placement at the job site. One distinct feature of this material is that after initial batching, slump adjustments cannot be done. The addition of mix water beyond what is called for in the mix design will lead to flash set.

In this case, Casino Creek Concrete did a good job batching the fly ash concrete

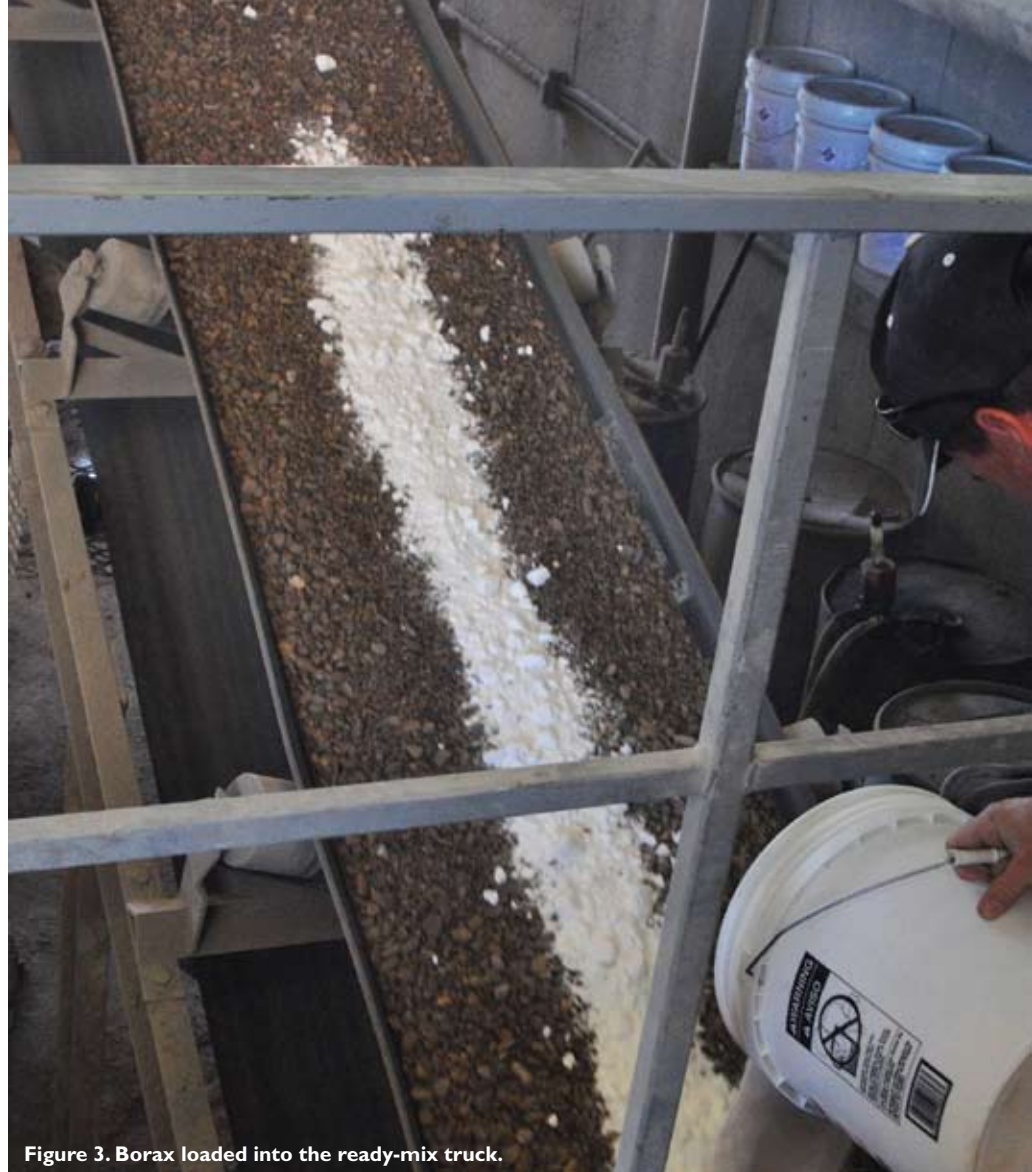


Figure 3. Borax loaded into the ready-mix truck.

following the basic steps. The transit time from the batch plant to the project site was approximately 15 minutes. The concrete arrived at the site with close to the target slump of six to 7.5 inches.

Two different concrete placement techniques were utilized for this project. The footings and foundation walls were pumped using a truck mounted boom pump (Figure 4). The flatwork was all placed using the chutes on the truck. The concrete pump was on hand during the trial pour to allow researchers to investigate the effects of pumping on various properties of the concrete before it was placed in the project buildings. No changes in workability, entrapped air or strength were observed for the concrete pumped during the trial pour this new material was found to pump very well.



Figure 4. Pumping footings and foundation walls using a truck mounted boom pump.

TEMPERATURE EFFECTS ON STRENGTH

As mentioned earlier, the majority of the concrete work for this project was done during cold weather. For cold weather concreting, the American Concrete Institute (ACI) defines cold weather as a period of at least three consecutive days when the air temperature is less than 50°F for more than half of any 24 hour period and the average temperature is less than 40°F. Another important factor is an above-freezing subgrade for concrete slabs. Figure 5 shows the compressive strength profile for all the concrete poured for this project.

The trial pour's 28-day strength exceeded the design requirement of 4,000 psi. The average air temperature for the trial pour was 44°F with a high of 66°F. The first three actual construction pours (shop and pump house footings and foundation walls) all occurred under similar ambient conditions as the trial pour (at slightly above cold weather conditions). For these three pour days, the average temperature was 53°F with high temperatures reaching into the upper 60s. The remaining six pours, however, happened when the conditions were less than optimal (i.e., when cold weather concreting practices should be followed). Figure 6 shows the daily temperature cycles at and immediately after these pours. For these mixtures, the 28-day strengths were substantially below the target values of 4,000 psi, as might be expected in light of the low curing temperatures the concrete experienced. When subjected to temperatures more conducive to curing, and over a longer time span, these concretes still generally came up to strength.

ACI recommends several practices be followed to ensure the strength and durability of concrete placed in cold weather, including controlling the temperatures of the material during mixing, pouring and curing. Mixing temperatures can be controlled by heating the mix water and/or aggregates. Concrete can be protected from freezing by using insulating materials (e.g., blankets, foam and straw), heat, and/or temporary enclosures. For this project, the length of protection was specified as seven days in the bid documents. Furthermore, the temperature should not drop more than 50°F within 24 hours after

Figure 5. Compressive strength profile.

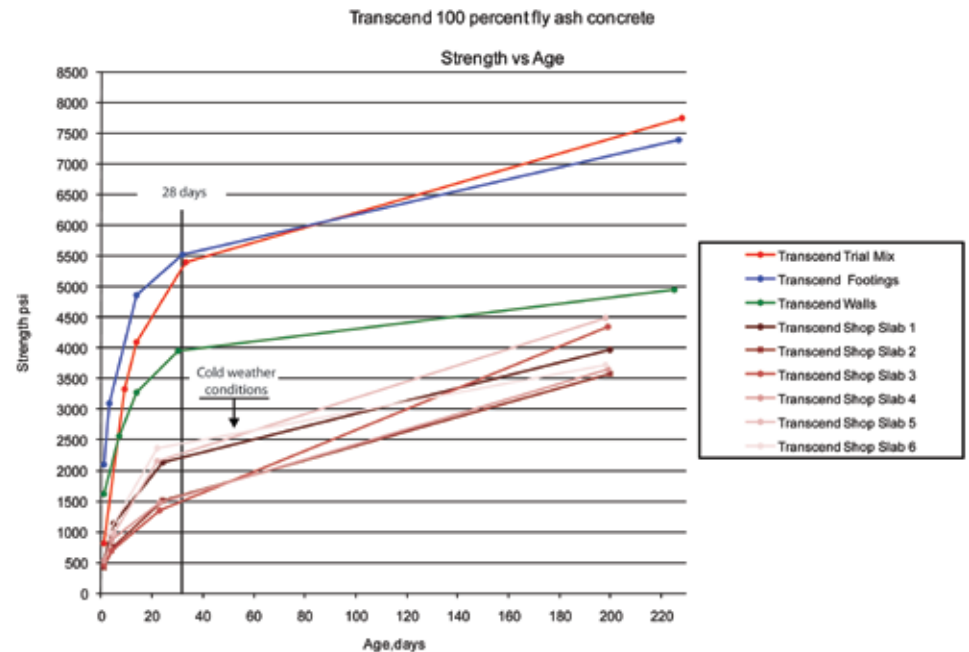
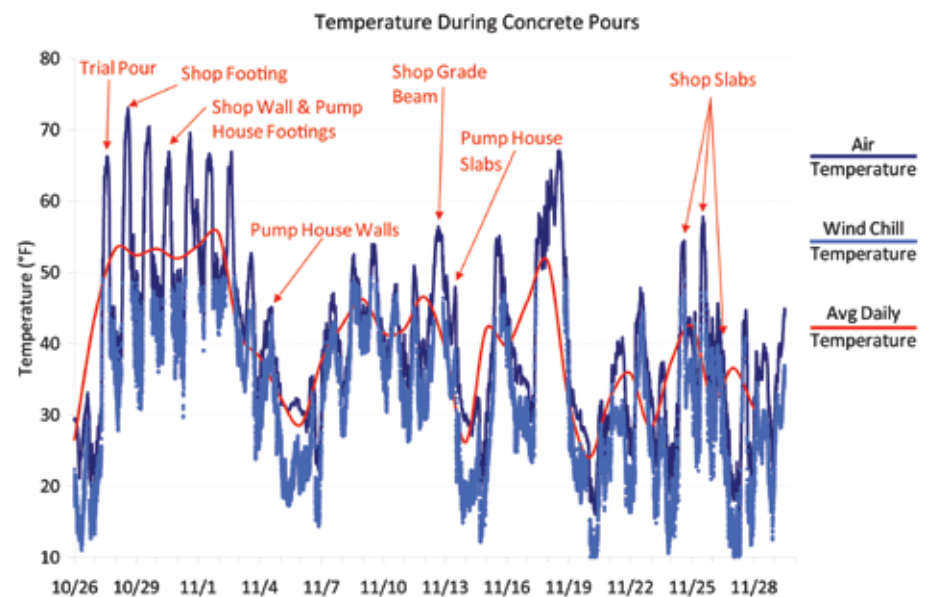


Figure 6. Daily temperature cycles at and immediately after pours.



the protection is removed. Ultimately, cold weather concreting practices were not consistently followed on this project during the construction period. Sometimes ground heaters and insulating blankets were used immediately after the concrete set, but the duration always varied because there were insufficient heaters to protect all the concrete at the same time. However, WTI/MSU found that the concrete gained strength even if this external heat was not applied until days after the

pour. Figure 7 shows some of the precautions the contractor attempted during the cold weather pours (notice the blankets and ground heater unit).

FUTURE WORK

This project has offered WTI/MSU a great opportunity to further characterize 100 percent fly ash concrete. Even though the project suffered delays that pushed the concrete work into the winter, results have turned out relatively well.



Figure 7. Precautions during the cold weather pours.

The facility is now complete and the researchers at WTI/MSU are focusing on completing the durability and strength testing on the samples collected from the project and analyzing data collected from a suite of temperature and strain gauge sensors embedded in the shop building during construction. Large quantities of the aggregate and ash were set aside at the time of the project so that researchers could try to replicate the conditions encountered in the field in the laboratory at MSU. This work will be done in the recently completed Subzero Science and Engineering Research Facility at MSU. This facility has eight state-of-the-art cold rooms with precise temperature control. One of the cold chambers has a structural floor to secure test specimens to and react against while testing. In particular, this cold chamber will be used to replicate the environmental conditions that were experienced last fall during building construction at Transcend. The concretes produced in this effort will also be tested for gas permeability, chloride permeability, and alkali-silica reactivity. Their coefficients of thermal expansion will also be determined. These tests will be carried out on site cast samples, laboratory cast samples, and on core samples removed from the building slabs.

This information will be used to identify possible differences in properties between concretes produced under laboratory versus field conditions. The freeze-thaw testing will happen over the next year and will entail testing two complete sets of samples from each batch of concrete. The results of these tests will be disseminated through this and other publications as the results become available.

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FINAL REMARKS

Acting as more than research consultants on this recent green concrete demonstration project, researchers at WTI/MSU have seen the challenges of introducing a new building material into the construction market from a new perspective, namely that of project owner and manager. And, as everyone knows, in the field things don't always go as planned. Nonetheless, this new fly ash concrete offered acceptable performance under unexpected and adverse conditions in the field. Concrete samples collected during the project will also provide future opportunities to study and understand the performance of this new concrete under field conditions. ♦

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WESTERN NORTH CAROLINA PROGRAM SEPARATES ASH FOR COMMERCIAL, SUSTAINABLE USE

By Elaine Marten, Ph.D., (retired) Waste Reduction Partners

In 2000 retired volunteers from Waste Reduction Partners teamed with North Carolina State University Minerals Research Laboratory (MRL) to study options for separating coal ash for commercial uses in western North Carolina. The program has made a successful transition from bench to pilot scale testing to create "Carolina Ash Products." The work is supported by a consortium of representatives from the power generation, paper mill, byproduct recycling, and concrete block manufacturing industries, as well as a technical manager from the North Carolina Department of Pollution Prevention and Environmental Assistance.

A wet ash pond offered ample, local supply. About 73 percent of the pond's content was low-carbon fly ash, ideal for ready-mix concrete; bottom ash, fit for concrete block manufacture, amounted to about 8 percent; while unburned carbon was recovered at about 5 percent yield and could be burned to give an average of approximately 10,000 Btu/lb. All materials were isolated in multiple drum quantities ample for testing and marketing purposes. Toxicity leaching tests (TCLP) showed that separation processes produced ash free of heavy metal content.

The fly ash had a coarser size distribution than expected, likely because it was excavated from a well-settled section of



Carolina Ash Products team members

the pond after years of storage. Therefore, it would need to be ground before processing to meet the percent fineness requirement for ASTM C-618, a standard industry specification for the use of fly ash in concrete. Additional screening removed coarse particle sizes, which contained minimal carbon, e.g. no greater than 2 percent loss-on-ignition or "LOI." Some parameters were adjusted from laboratory experiments. This demonstrated

the process' flexibility in accommodating various ash compositions from utilities throughout North Carolina.

Lightweight aggregate (LWA) was produced in scaled up quantities, combining raw ash with paper mill biosolids and a tiny amount of binder. The ash biosolids mixtures were compressed in pelletizing or briquetting equipment then fired in batches in various high-temperature

furnaces. Results from testing for Standard Specification for LWA for Structural Concrete (ASTM C-330) gave a 28-day compressive strength of more than 4,900 psi. Additional testing to meet ASTM requirements for toxicity leaching residues (TCLP) showed no heavy metals above regulatory levels. Likewise, the standard test for staining materials (ASTM C-461-98) showed no stain. Resistance to degradation (LA Abrasion) (ASTM C-131-03) showed an abrasion loss of 29 percent. Loose density was less than 50 pounds per cubic foot. The same quality LWA could also be made from fractions of the separation mixture outside concrete product specifications, plus biosolids and binder. This conversion accomplished the original aim to process all the raw ash into usable products with a near-quantitative mass balance. It further demonstrated the wide latitude and flexibility of the process.

The remaining 10 percent of ash unsuitable for ready-mix or concrete block applications was blended with industrial byproducts to make stepping stones. The mixture contains 85 percent byproduct, including western North Carolina feldspar (mining), acrylic resins (paints), and a small amount of portland cement. The attractive, 12-inch-square stepping stones were cast and hardened in a variety of colors, performed well in outdoor use tests, and are lightweight for easy handling. This application requires more development work to optimize a process for commercial manufacture.

A preliminary market feasibility study was carried out by a specialist in mineral processing and manufacture of industrial ceramics. This investigation included discussions with high-volume consumers of the ash isolation products in mass produced building materials. Interviews with members of university departments, specializing



in coal ash research, also contributed valuable insights into commercialization plans. The concept to be validated was the design of a plant for separation of the ash components on a manufacturing scale – bottom ash, fly ash, and carbon – and for carrying out the stages of LWA preparation. Conclusions from the data collected in this study all pointed toward establishing a viable business. Ash from the western part of North Carolina would support a substantial manufacturing facility, which could be sited in proximity to the ash supplies. The technical results from this extensive development work will be made available to any business interested in starting up. ♦

For more information, contact Robert Mensah-Biney at (828) 251-6155, ext. 224 or mensah@eos.ncsu.edu; Terry Albrecht of Waste Reduction Partners at (828) 251-7475 or terry.albrecht@ncmail.net; or Elaine Marten at (828) 645-3396 or email marhoff4@buncombe.main.nc.us.

Elaine Marten, Ph.D. Waste Reduction Partners retired volunteer, and Robert Mensah-Biney, Ph.D., NCSU Minerals Research Laboratory, lead scientist. The photo was taken in the pilot plant of the Minerals Research Laboratory in Asheville, N.C., by Terry Albrecht, Director of Waste Reduction Partners, September 2005.



Marten displays stepping stones containing a blend of fly ash and industrial byproducts from western North Carolina.

This conversion accomplished the original aim to process all the raw ash into usable products with a near-quantitative mass balance.

REVISING THE COAL COMBUSTION BYPRODUCT REGULATIONS IN VIRGINIA

By Melissa Porterfield, Virginia Department of Environmental Quality

Public concerns over coal combustion byproducts (CCB) have compelled Virginia to form an advisory panel that will decide whether to change CCB regulations (9VCA20-85-10). The director of the Virginia Department of Environmental Quality (VDEQ) selects stakeholders who voluntarily respond to a notice issued by the agency seeking members for an advisory panel. The CCB Regulatory Advisory Panel (RAP) represents industry, academia, local government, another state agency and environmental groups. The American Coal Ash Association's executive director, Tom Adams, and consultant, Dave Goss, serve on the panel.

The RAP's goal is to reach consensus, defined by VDEQ as "a willingness of each member of the RAP to be able to say that he or she can live with the decisions reached and recommendations made and will not actively work against them outside of the process." The entire process for revising a regulation typically takes 18 months and as part of this process VDEQ gathers key information, including technical expertise from academia and diverse perspectives on how regulations could impact a range of stakeholders. Panel members may become very passionate about their specific point of view, which leads to some lively discussions. However, bringing together those with differing viewpoints achieves greater understanding and sometimes a compromise everyone can agree with is found.

Ultimately, the VDEQ wants regulations that are clear and easy to understand, enforceable, and protective of the environment. The agency considers the risks and benefits associated with specific activities, the financial impact of regulations on industries and



**"I wish that there were meetings like this going on in every state concerning the regulation of coal combustion byproducts."
– Tom Adams, ACAA Executive Director**

small businesses, and regulations' impact on farm and forest land preservation. Less intrusive, less costly alternatives may achieve a regulation's purpose.

The CCB RAP has discussed changing site operations to minimize impacts to the environment and wildlife, and how to close sites once they are filled. Brainstorming has led to creative and innovative ways to regulate. Ultimately,

agency management makes the final decisions based upon recommendations, concerns and viewpoints of the RAP.

The VDEQ has received positive feedback about using RAPs when developing and revising regulations.

"I wish that there were meetings like this going on in every state concerning the regulation of coal combustion byproducts," said Adams after participating in the CCB RAP in Virginia.

The process VDEQ uses to develop regulations has proven beneficial to all stakeholders involved. In the end, all stakeholders may not be 100 percent satisfied with the regulatory language, but they can say they have had ample opportunity to explain their views and have been involved in the process. ♦



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The diagram at the top of the page illustrates a fly ash recycling process. It features several grey shapes: a large inverted triangle on the left, a vertical rectangle in the center, and a horizontal rectangle on the right. Arrows indicate the flow of material: one arrow points down from the inverted triangle to the central rectangle, and another points down from the top of the central rectangle to the horizontal rectangle. A label 'Fluidized bed' is positioned below the central rectangle. The background of the top section is a light grey with a grid pattern.

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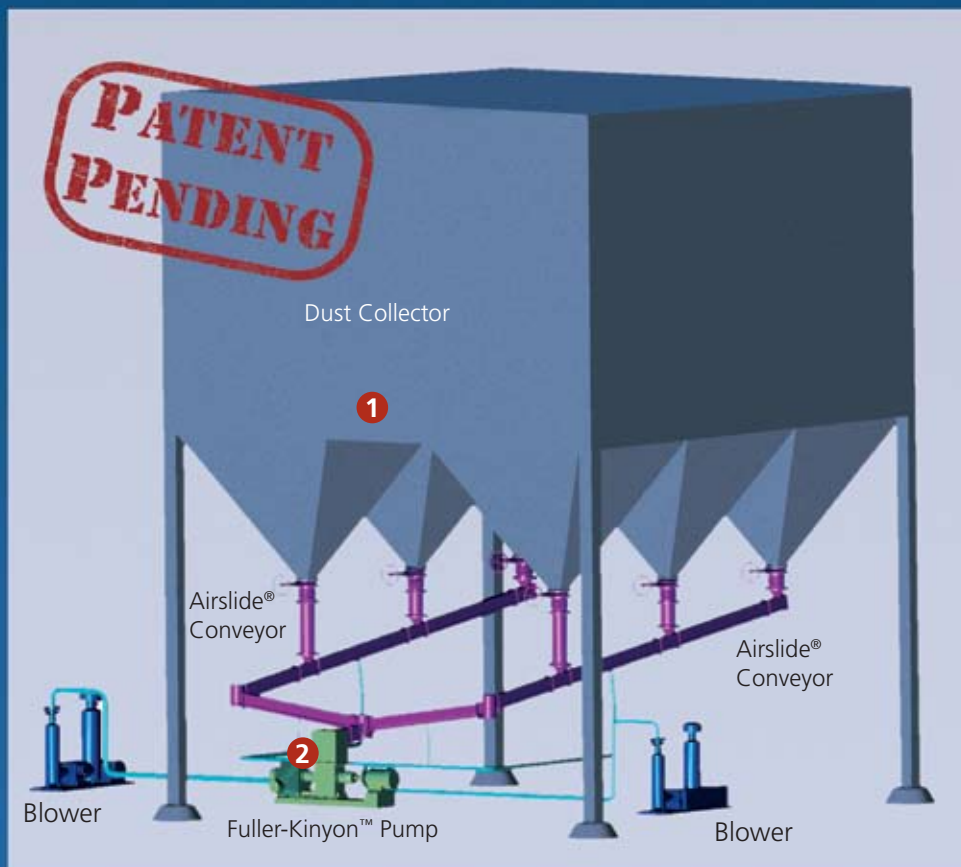
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A WISCONSIN FIRST TURNS HIGHWAY PROJECT GREEN

By James R. Rosenmerkel, Rosenmerkel Engineering

For 50 years Milwaukee's State Trunk Highway 100 has served as a main arterial connecting the north, west and southern parts of town. In the early '80s it was upgraded from two to six lanes, but has largely survived without major construction – until now.

The Wisconsin Department of Transportation (WisDOT) is reconstructing about two miles of STH 100 between Interstate 43 and Green Bay Road. Among the project's challenges was how to address the inconsistency of clay soils comprising the highway's subbase.

Design consultant, AECOM developed cost/performance models to analyze options, including reclaiming the existing pavement, undercutting and backfilling, and fly ash stabilization (FAS).

Costs were comparable, but fly ash came out ahead with faster construction times and the best environmental advantages. WisDOT had recent familiarity with this option's merits in pavement construction thanks to workshops by Lafarge, which also targeted area consulting firms including AECOM. Though some were apprehensive, WisDOT went with the FAS option, and established plans and specs – making

it the first major arterial highway in the state to use fly ash for the subbase.

The project was let in 2009, with six bidders competing. Trierweiler Construction and Supply, the prime and paving contractor was the successful low bidder. Other subcontractors included: Tri-County Paving for mixing/blending the fly ash with the clay soils; American Road Reclaimers for hauling and spreading the fly ash prior to blending; Musson Brothers for reclaiming, crushing existing pavement, and

Above: Constructing first major highway arterial in Wisconsin with a fly ash subbase.



Breaking and removing the concrete pavement for STH 100's base course.

placing the new base course; and Lafarge North America for furnishing the fly ash from the We Energies Oak Creek plant.

Basic quantities for the FAS were 91,028 yd.² of subgrade stabilization and 5,730 tons of Class C fly ash delivered and spread. WisDOT has adopted the two-part pay bid for this method. While both

items are required, the two-part allows for variation in both ash and treated area. On the bid basis, the fly ash application rate is approximately 125 lbs./yd².

Before work began, WisDOT held a meeting to confirm each contractor was clear about their mission. Often the blending contractor also provides

compaction, grading and finishing operations. Questions were resolved in advance regarding sequencing, protecting loose fly ash from disruption, finishing, lag time for the next operation, traffic on FAS materials, and a host of others issues.

Work began with breaking/removing the concrete pavement, hauling it to a crushing site at the west end of the project for conversion to base course, remodeling the storm sewer system, modifying utilities as needed, and preparing the subgrade for stabilizing. Fly ash deliveries began in early June and the stabilizing began. As the work progressed, minor adjustments were made to the blend's water content, pulverizer speed, compaction procedures and final grading. Production rates were 800-900 yds.²/hr. for the complete process. The DOT soils unit was on site and was pleased with the results. Densities determined by nuclear testing were commonly 95 percent to 100 percent of Proctor and moisture contents fell within 1 percent of optimum.

Cross traffic was accommodated, utility work was completed on time, and

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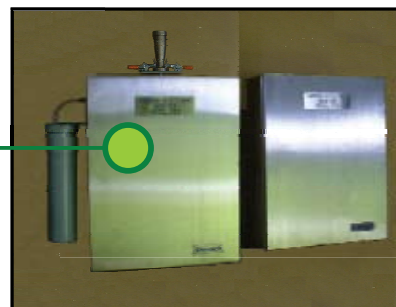
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construction of the new base course began immediately after the FAS process was complete. Base course construction can begin the day after the FAS is complete.

Following proven protocols is critical for FAS. To be confident in the mix design, a geotechnical engineer should provide the application rate and optimum moisture for the soils based on Proctor tests. The fly ash is spread on subgrade soil at the design rate. The pulverizer follows immediately with water supplied by a water truck tied directly to the pulverizer with a hose to mix the materials to the 12-inch depth and design moisture content. Proper moisture content control is crucial to performance. Immediately after mixing is complete, initial compaction follows with a 20-ton vibratory padfoot roller, usually 2 to 3 passes. Final grading follows that and, to complete the operation, the grade is rolled with a smooth drum roller in STATIC mode so as not to disrupt the hydration. After that the next operation in the sequence can begin. Rain on the new surface will not cause problems, in fact it will supplement the hydration process.

At this writing, the project's first phase of paving was nearly complete. A conversation with the project manager/inspector Tony Minto indicates that the FAS subgrade was a huge success. He mentioned there were no disturbances or soft spots in the subgrade as the base course was completed and that during paving all the concrete trucks traveled on the newly constructed base with no displacements or deflections. He seemed very pleased.

The Trierweiler project manager, Joe Matchey, has stated that he had never seen such a successful method. This was his first experience with fly ash, but he will definitely support its use on future projects. Even with non-uniform soils, the stabilized subgrade performed extraordinarily well from his point of view. That view seems to be shared by all parties involved. Expectations are that the second phase will perform even better with new experience.

WisDOT has advanced in the realm of "green" highway initiatives. This is the first specified, fully reclaim/recycle project on



A pulverizer is tied to the water truck.

a major arterial project. It should be a model for future majors in the state. And with highway funds in an abysmal state in Wisconsin, the success of this project should lead to more of its kind. Cost savings, preservation of natural resources and reusing materials already paid for by tax dollars are significant advantages. ♦

James R. Rosenmerkel, P.E. is a consultant to Lafarge North America. He can be reached at jbrosie@sbcglobal.net 262-547-2585. Mr. Catalanotte can be reached at 414-235-6109. Joe Matchey can be reached at 715-305-5403. Bruce Barnes (WisDOT) can be reached at 262-548-5892.

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INSURANCE COVERAGE FOR COAL ASH LIABILITIES

By David L. Elkind, Dickstein Shapiro LLP

President Obama recently proposed a 37 percent increase in the U.S. Environmental Protection Agency's (EPA) budget. One area of increased EPA involvement that may result in significant environmental liabilities for companies involves coal ash contamination. Although EPA previously concluded that coal ash did not warrant regulation under federal law, the agency is taking a second look.

Two recent events have prompted EPA's interest. The first was the Tennessee Valley Authority (TVA) coal ash slurry spill on Dec. 22, 2008, when an earthen dike broke at a 40-acre waste retention pond, releasing 1.1 billion gallons of coal ash slurry. In May, EPA signed a consent order with the TVA to oversee the cleanup. Coal ash may contain metals that at various concentration levels are considered hazardous substances under the federal Superfund law. On March 9, 2009 EPA also sent information request letters related to the stability of surface impoundments containing coal ash to 162 facilities and 61 utilities.

The second event was this year's release of a complete 2002 EPA report that purportedly shows a much higher cancer risk for people living near areas where coal ash has been impounded. This has prompted several environmental groups to petition EPA to regulate coal ash.

An EPA official testified before Congress about coal ash on April 30, 2009. EPA is contemplating regulatory activity, with one focus on impoundment integrity as



part of an overall regulatory program. This December, EPA is going to issue proposed regulations for the management of coal ash by electric utilities.

These activities likely will lead to two developments: demands by EPA (or a state environmental authority) that coal ash impoundments or other disposal

areas be remediated, and private party litigation, raising both property damage and personal injury claims. At least one utility has been named in a class action involving alleged contamination from coal ash that was used for mine reclamation.

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Thus, intentionally burying coal ash according to common standards, without knowledge of likely environmental effects, should not defeat coverage in most jurisdictions.

is pursued aggressively and intelligently. A successful pursuit of coverage will require a sound, coordinated effort, and will take time.

The first step is to collect the applicable liability insurance policies. In the TVA example, the contamination was caused by a “burst” event, when the dike broke. The insurance policies at issue that likely are most applicable are the current policies. In a typical environmental matter, however, where coal ash has been deposited at a site for many years, all of the insurance policies, from the initial usage of the site to the present, potentially are implicated. Notice should be provided to all of the insurers. Insurance policies require two types of notice: notice of a claim, and notice of an “occurrence,” which is the cause of the claim. For example, if you have an automobile accident today, that is an “occurrence” that requires notice now. The consequences of late notice depend on the jurisdiction. In most jurisdictions, the insurance company must prove that it was “prejudiced” by the late notice to avoid coverage.

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In a limited number of jurisdictions, however, the insurance company does not have to prove prejudice to avoid coverage if notice is late. The prudent course is to give notice as soon as the possibility of contamination that may result in liability is known.

Insurance companies rarely voluntarily pay coverage for environmental claims. If the insurance company has an exclusion that it believes applies, it may deny coverage. In most situations, the insurance company will reserve its rights and furnish the policyholder with a laundry list of information requests. The policyholder should respond only to those requests that implicate information that is readily available. It should never, without adequate protections in place, produce information that is subject to the attorney-client privilege, as it risks losing the privileged status.

A successful pursuit of insurance coverage for coal ash and other environmental claims often involves a two-phased approach. In the initial phase, the policyholder must assemble

as much information as possible with respect to the claims. Such information is vital both to settle and litigate insurance claims. The policyholder also must assess the value of the claim. This will involve collection of past cost information and projections of likely future costs for the claim. Depending on the result of the legal analysis, the claim should be allocated to the potentially applicable insurance policies.

The other important step that should be taken in the initial phase is to assess the legal strength of the claim. The laws of each state differ with respect to the interpretation of many of the relevant insurance policy issues. There are many important legal issues that are implicated—too numerous to be discussed here—but two are worth mentioning.

The first issue is whether the environmental damage was intentional. Many insurance companies will take the position that the claim is not covered because the act was intentional, but the policyholder has a strong counter-argument. Most courts hold that the unintentional

result of even intentional acts is covered by liability insurance. Thus, intentionally burying coal ash according to common standards, without knowledge of likely environmental effects, should not defeat coverage in most jurisdictions.

The second issue involves the various forms of “pollution exclusions,” which differ depending upon the period of the insurance policy and the company that sold the policy. Each form of the pollution exclusion raises numerous issues, but one common question is whether coal ash constitutes a “pollutant.” Coal ash typically contains many of the same constituents as soil, including trace amounts of metals. The fact that EPA historically has not regulated coal ash as hazardous waste supports the notion that it is not a pollutant. As the EPA’s recent congressional testimony noted, there are many beneficial and even commercial uses of coal ash. In 2007, 56 million tons of coal ash were reused. Coal ash has contributed to the construction of many bridges, and often has been used as a substitute for portland cement in concrete manufacturing, and for land reclamation. The argument may be more difficult to



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The fact that EPA historically has not regulated coal ash as hazardous waste supports the notion that it is not a pollutant.

make, however, if the metals in the coal ash exceed regulatory levels.

Most policyholders will want to negotiate with their insurance companies before considering litigation. One exception to this, however, is where multiple sites are involved in different states, potentially implicating different states' laws. In such a situation, the policyholder should consider filing suit first in the state whose law is more favorable, to bolster an effort to have that state's law apply. In most situations, however, negotiations will be pursued first. The policyholder initially should negotiate with its insurance companies after first obtaining "standstill" agreements that preclude litigation for the length of the agreement and suspend the statute of limitations. The policyholder should limit the duration of the agreement in order to expedite negotiations. If possible, the policyholder also should seek

to obtain the insurance company's[ies'] agreement that the policyholder may sue first if the agreement is terminated. The policyholder must be aggressive and creative, yet patient. Aggressive in vigorously pursuing coverage, and creative, because there are many ways to achieve success. The policyholder may find it easier to negotiate with its current insurer, who will want to renew the coverage, than with an older insurance company, which knows that it will unlikely have further business with the policyholder. Claims should be resolved quickly with an insurance company that may become insolvent. Finally, patience is most important. More than one client has obtained several million dollars in excess of what it anticipated by following counsel's advice not to settle too quickly.

In negotiating with the insurance company, it is preferable first to negotiate a

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confidentiality agreement with respect to the information that is being shared. Policyholders should share site reports and other pertinent information, but should not exchange privileged information. The policyholder should also be reluctant to provide non-public information that may defeat coverage.

The policyholder should approach each insurance company individually, rather than as a group. If negotiations with the current insurer's claims handler become stalled, the policyholder should consider having its risk manager or insurance executive negotiate with the insurance company's underwriter, who will want to retain the business.

If litigation is pursued, the policyholder should bring all of its viable claims in one action. Piecemeal litigation is inefficient, resulting in repetitive discovery, which increases transaction costs. Piecemeal litigation also is much more difficult to settle with insurance companies, who will want to settle all related claims in one negotiation. Moreover, courts dislike piecemeal litigation, and the policyholder runs a risk that the claim with the worst set of



According to the EPA's recent congressional testimony, 56 million tons of coal ash were reused in 2007. Coal ash has contributed to the construction of many bridges, such as this one in Charleston, South Carolina.



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Moreover, courts dislike piecemeal litigation, and the policyholder runs a risk that the claim with the worst set of facts will be the first to reach an appellate court. The old adage that “bad facts make bad law” is particularly apt in the insurance coverage context.

facts will be the first to reach an appellate court. The old adage that “bad facts make bad law” is particularly apt in the insurance coverage context.

Because the goal of any litigation should be to achieve an early settlement, the policyholder's counsel should try to obtain an early trial date and avoid unnecessary discovery disputes in order to maintain that trial date. Many insurance coverage actions are settled on favorable terms only when a trial date is imminent.

Few business disputes are contested today as aggressively as those seeking insurance coverage for environmental claims, and coal ash claims likely will be no exception because millions of dollars are going to be at stake. Although there is no precise cookie-cutter formula for obtaining insurance coverage, the policyholder that develops a coherent strategy early will be in the best position to maximize its

insurance recoveries for such claims. The policyholder must remember that it purchased its liability insurance for valuable premiums to reduce its exposure to such claims, and should not be timid when seeking to obtain coverage. ♦

David L. Elkind joined Dickstein Shapiro LLP as a partner in 1996. His practice primarily is focused on representing policyholders in insurance coverage disputes. In recent years, his practice has included representation of numerous utilities in disputes with their insurance companies over a broad range of claims. He can be contacted at 202-420-3603, or elkindd@dicksteinshapiro.com.



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