ISSUE 1 • 2017

ASH at work

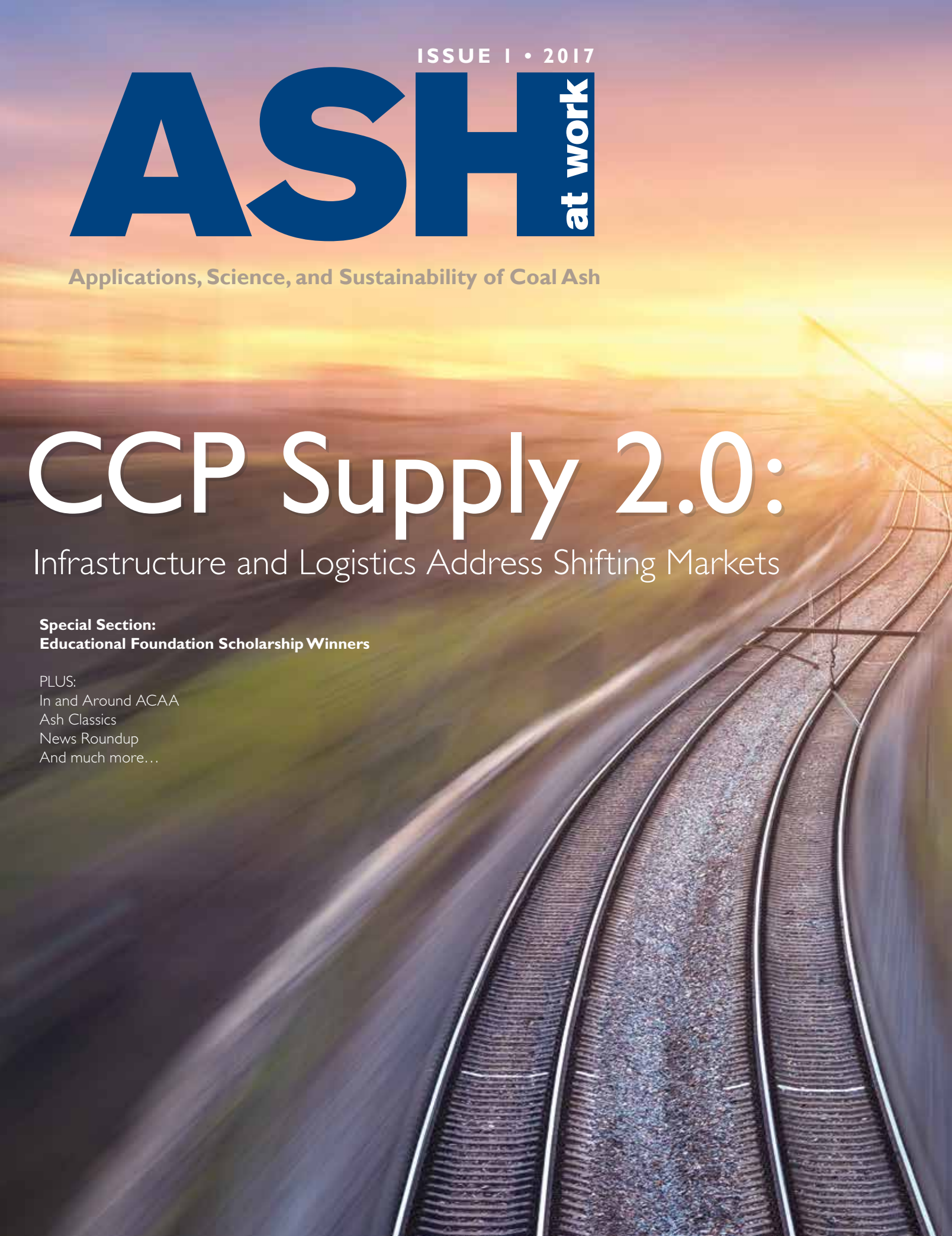
Applications, Science, and Sustainability of Coal Ash

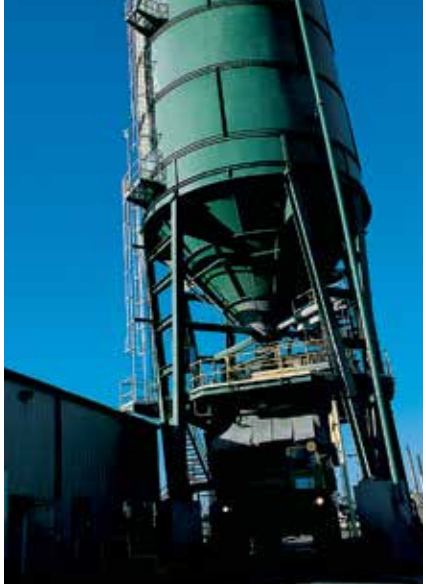
CCP Supply 2.0:

Infrastructure and Logistics Address Shifting Markets

Special Section:
Educational Foundation Scholarship Winners

PLUS:
In and Around ACAA
Ash Classics
News Roundup
And much more…



Powdered

PACT® is a proven, proprietary process for beneficiating fly ash that is contaminated with powdered activated carbon.

Activated

Allows marketing of usually disposed ash because it effectively treats PAC.

Carbon

Can be applied on demand to create a sustainable solution.

Treatment

PACT® is a low cost non-hazardous patented chemical application that can be applied directly to fly ash. Since 2008, BMT has successfully treated approximately 8 million tons of fly ash with this process.

For innovative fly ash solutions, optimum concrete performance, and groundbreaking new products, BMT is the solid choice. With our superior quality products, in depth research, extensive support services, and over 40 years of industry knowledge, BMT is uniquely positioned to help build and sustain your business.

Build something great™ with Boral Material Technologies

To learn more about PACT® or BMT's other technologies, contact us at: 1-800-964-0951 or visit us online at **www.boralflyash.com.**

BORAL®

ISSUE 1 • 2017

ASH at work

Applications, Science, and Sustainability of Coal Ash

TABLE OF CONTENTS

Published for:

ACAA

American Coal Ash Association
38800 Country Club Drive
Farmington Hills, MI 48331
Phone: 1-720-870-7897
Fax: 1-720-870-7889
www.acaa-usa.org
www.FGDProducts.org
www.WWCCP.org

Executive Director
Thomas Adams

Member Liaison
Alyssa Barto

Editor
John Ward

Advertising
Alyssa Barto

Creative Association Management
Publishing Services Manager
Barry M. Bergin

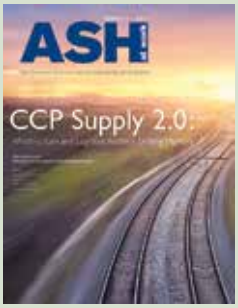
Editors
Carl R. Bischof,
Tiesha Elam, Kaitlyn J. Hinman,
Kelli R. Slayden

Editorial Assistant
Angela R. Matthews

Graphic Designers
Gail L. Tatum,
Susan K. Esper, Ryan M. Jay,
Aimee M. Kahaian

On the Cover

Increased use of rail shipping is one strategy to match supply with growing demand for CCPs.



PLENTY OF ROOM FOR PARTNERS IN COAL ASH

By Charles Price, ACAA Chair

At our winter meeting in Jacksonville, FL, this year, I had the honor and privilege to present the American Coal Ash Association's 2017 Champion Award to one of our many valued "partner organizations." The Center for Applied Energy Research at the University of Kentucky received this year's award in recognition of its decades of research, education, and training on coal ash beneficial use.

ACAA and CAER are especially close partners. Since 2005, our organizations have cosponsored the World of Coal Ash, which has grown to become the flagship event for the international coal combustion product industry. This May, we will gather again in Lexington, KY, for our seventh joint biennial symposium.

Additionally, ACAA and CAER have jointly created the *Coal Combustion and Gasification Products* (CCGP) Journal. The peer-reviewed *CCGP* Journal is designed specifically to communicate coal ash research and emerging new technologies. *CCGP* Journal is free, online, and encompasses the international science and technology of the production, sustainable use, and environmentally sound handling of the by-products of coal combustion and gasification (**http://www.coalcgp-journal.org/**).

Although CAER clearly deserved the Champion Award this year, narrowing the field of ACAA partners to just one organization was exceedingly difficult. In recognizing one longstanding and important partner, I do not want to overlook the contributions made to our industry by numerous associations and allied organizations that assist us in advancing the management and use of coal combustion products in ways that are environmentally responsible, technically sound, commercially competitive, and supportive of a sustainable global community.

ACAA works hard to develop productive working relationships at every link in the coal ash value chain. We coordinate with the organizations that represent people who mine coal, the utilities that consume coal to generate electricity, state and federal environmental regulators, and all of the diverse industries and government agencies that utilize coal combustion products. It's an impressive list of friends and supporters.

In each issue of *ASH at Work,* we profile one of these "Ash Allies." (This issue features the National Mining Association.) We also frequently highlight allies in the magazine's "Six Questions For" feature. (This issue interviews the chair of the American Concrete Pavement Association.) It will take us many years to feature everyone who has helped us.

Great things can happen through these partnerships, which are both informal and formal. One of the most successful formal programs in our industry was the Coal Combustion Products Partnership (also known as the C2P2 Program.) C2P2 was a cooperative effort between U.S. Environmental Protection Agency, American Coal Ash Association, Utility Solid Waste Activities Group, U.S. Department of Energy, Federal Highway Administration, Electric Power Research Institute, and U.S. Department of Agriculture Agricultural Research Service to promote beneficial use of coal ash as an environmentally preferable alternative to disposal. The initiative included three primary activities: a challenge program that attracted participation by more than 200 companies and organizations; various "barrier breaking" activities; and development of CCP utilization workshops.

The C2P2 program was active during the most significant growth period for coal ash beneficial use in history. In 2000, EPA issued a Final Regulatory Determination that coal ash should be regulated under "non-hazardous" RCRA Subtitle D and subsequently initiated the C2P2 program. The results were dramatic. In 2000, beneficial use volume was 32.1 million tons. By 2008, beneficial use volume had climbed to 60.6 million tons.

Following the Kingston coal ash spill in December 2008, EPA commenced a 6-year coal ash disposal rulemaking and terminated the C2P2 program. Beneficial use volumes subsequently declined. (If annual beneficial use from 2009 to 2013 had simply remained level with 2008's use, 26.4 million tons less coal ash would have been deposited in landfills and impoundments.)

I am pleased to report that ACAA has held preliminary discussions with the new EPA administration and several of our former C2P2 partners regarding prospects for reinvigorating the partnership in some form or fashion. Initial reactions have been positive and moving forward with these discussions will be a high priority for ACAA over the coming months.

After all, we can never have too many partners for a cause as important as ours.❖

At Charah, we're known for superior service and solutions. That's exactly what you can expect from the largest privately-held ash management company. We are experts in pond closure, landfill construction, operations and fly ash sales. With 30 years of experience, we have become the industry leader in delivering proven results for beneficial use projects and other innovative solutions. It's time to step up to better service.

For more information, contact us at 877-314-7724 or visit charah.com.

Charah

Service Above All.

A NEW DAY AT EPA

By Thomas H. Adams, ACAA Executive Director

On Friday, February 17, 2017, Scott Pruitt was sworn in as the new Administrator of the U.S. Environmental Protection Agency (EPA). The vote in the U.S. Senate was virtually down party lines as expected. Prior to his nomination to this position, Pruitt had been demonized by environmental activists for his work as Attorney General in Oklahoma. That effort was adopted by Senate Democrats in an attempt to derail his nomination. Opponents of Pruitt knew they did not have the votes to stop his nomination and merely wanted to delay it as long as possible.

President Trump's campaign included many remarks about the need to change the EPA. In his opinion, the agency was over-reaching its authority. The agency was also restraining the economy and job creation by injecting regulatory uncertainty into many issues. The EPA did not engage in serious cost/benefit analysis according to then-candidate Donald J. Trump. Now President Trump has moved to select and install an administrator who agrees with these general positions and will work to change the direction of the agency. So what are some of the radical ideas that Pruitt brings to his new job?

- Administering the laws given by Congress. It is not EPA's role to expand or diminish those laws nor invent authorities not expressly given in statutes.
- Working with states to improve environmental quality, not dictating Washington-knows-best policies.
- Relying on actual scientific data more and theoretical models a lot less when making regulatory decisions.
- Eliminating the sue-and-settle strategy between the EPA and plaintiffs the agency favors. Sue-and-settle enables the creation of new or revised regulation without messy transparency, public hearings, and public comment.
- Needing common sense in EPA regulations. That puddle of water in the parking lot at your office (a.k.a. a bird bath) is just that—a puddle. It is not a navigable water of the United States needing protection under the Clean Water Act.

"President Trump's campaign included many remarks about the need to change the EPA... Now, President Trump has moved to select and install an administrator who agrees with these general positions and will work to change the direction of the agency."

These are just some of the ideas and concepts which Pruitt is bringing to 1200 Pennsylvania Avenue, N.W. One of the first tasks of any agency leader as he/she gets to work is to appoint deputy administrators and assistant administrators. These positions require Senate approval. Pruitt must fill these spots quickly so the work of transforming the agency can begin in earnest. The current 15,000 or so EPA employees are like any other group of citizens in any other workplace. Some support the direction of their company, some do not. Some are happy, some are not. Some do their job, some do not. But they all get paid. This is the reality Pruitt faces as he assumes EPA's top job.

ACAA has recent experience with regulatory uncertainty, sue-and-settle threats, modeling versus science, and so on. Fortunately, we were able to survive and are in the process of rebuilding confidence in the safety and value of our industry. In the coming weeks and months, we will be reaching out to the new administrators at the U.S. EPA to see where we can work cooperatively to advance the beneficial use of coal combustion products. It worked before. It can work again.

PHILLIPS & JORDAN

A Proven Solution

A Proven Solution in Coal Ash Services

pandj.com |

Come visit us at **booths 81 & 83**
at the World of Coal Ash Conference
from May 8th to 11th

POWER | OIL & GAS | WATER RESOURCES | INDUSTRIAL & COMMERCIAL | DISASTER RESPONSE

CCP MARKETING

Unique Industry Depends on Private Investment and Sensible Public Policy for Growth

By John N. Ward

For nearly 20 years, I've had the privilege of visiting Washington DC frequently to educate policymakers and regulators regarding coal combustion products beneficial use. "Coal ash recycling" – the simpler, but technically incorrect descriptor of the industry—is a more complicated enterprise than people assume when they are first exposed to it. To accurately describe the industry and how it works, I find a handful of phrases frequently enter the conversation:

- "This is not your father's commodity business."
- "Ash is like children…"
- "It's all about the logistics."
- "You don't just wake up one morning and decide to recycle coal ash."
- "Public policy matters."

The complexity of the industry is reflected in its very name. Coal ash is defined as the non-combustible mineral portion of coal. (Ash content is one of the characteristics that is specified by coal consumers before they ever buy, much less burn it.) But several distinct types of coal ash are produced when coal is consumed for generating electricity. Fly ash, bottom ash, and boiler slag all have varying characteristics that make them useful for different things. Furthermore, some of the solid materials produced by coal-fueled electricity generation aren't ash at all. Flue gas desulphurization material also known as FGD or synthetic gypsum is produced by power plant emissions control equipment and doesn't originate in the coal. But it is another coal combustion product that can be put to good use.

Coal combustion product uses are even more varied than the types of coal combustion products (refer to Fig. 1). Furthermore, the use of these products is not technically "recycling." Recycling involves taking materials that have already been used and reprocessing them for another use. Coal combustion products have never been used before. What's happening in this industry is the beneficial use of a recovered material.

"THIS IS NOT YOUR FATHER'S COMMODITY BUSINESS."

Consider fly ash – one of the most widely used coal combustion products. It's a powder, like cement. It's sold by the ton, like cement. It's moved and stored like cement. It's used in making concrete, usually replacing a portion of the cement. Must be a commodity like cement, right?

Wrong. Commodities are products that are manufactured (or, in the case of agricultural products, grown) to meet certain specifications. A ton of cement manufactured to a specification on the East Coast is interchangeable with a ton of cement manufactured to the same specification on the West Coast.

Fly ash is not manufactured to a specification. (Specifications for fly ash do exist to guide its use in various products, but power plant operators are in the business of generating electricity, not manufacturing fly ash.) Fly ash characteristics and performance can vary depending on the type of coal that is used, the age and size of the power plant that produces it, and even the operating conditions at individual power plants. As a result, fly ash produced at one power plant may perform differently from the fly ash produced at another power plant just 50 miles away (refer to Fig. 2).

"ASH IS LIKE CHILDREN…"

"…There is no bad ash, just some you need to love a little more than others." The first question most people ask when they find out fly ash is classified as Class C or F is: "Which one is better?" The answer is neither. They simply perform differently, just as fly ash sources within each of those classifications can perform differently based on the factors listed previously.

All fly ashes are capable of producing performance benefits such as improved strength and durability in concrete. Fly ash users adapt to the materials that are available in their area. What ash users need is a supply that is consistent and reliable. How an ash compares to another ash source is less important than whether the ash source being used performs the same this week as it did last week.

In the quest for consistency and reliability, the ash marketing industry has developed a robust array of beneficiation technologies. These technologies can remove excess carbon from fly ash, passivate the effects of carbon that remains in ash, and mitigate the effects of power plant emissions control technologies on the ash. Ash marketers are also increasingly deploying strategies such as blending ashes and other pozzolanic materials in order to create consistent, reliable supplies in various markets.

"IT'S ALL ABOUT THE LOGISTICS."

The fact that coal combustion products are recovered, not manufactured, means the best way to think about the beneficial use industry is as an exercise in logistics, which the dictionary defines as "the detailed coordination of a complex operation involving many people, facilities, or supplies."

On the supply side of beneficial use markets, logistics are complex because the entities making coal combustion products (electric utilities) typically outsource the management of their

American Coal Ash Association
38800 Country Club Drive
Farmington Hills, MI 48331
Email: info@acaa-usa.org
Phone: 720-870-7897
Fax: 720-870-7889
Internet: www.ACAA-USA.org

2015 Coal Combustion Product (CCP) Production & Use Survey Report

Beneficial Utilization versus Production Totals (Short Tons)

2015 CCP Categories	Fly Ash	Bottom Ash	Boiler Slag	FGD Gypsum	FGD Material Wet Scrubbers	FGD Material Dry Scrubbers	FGD Other	FBC Ash	CCP Production / Utilization Totals
Total CCPs Produced by Category	**44,365,587**	**12,010,425**	**2,228,205**	**32,661,536**	**11,313,960**	**1,311,947**	**206,314**	**13,191,460**	**117,289,432**
Total CCPs Used by Category	**24,062,786**	**4,819,205**	**1,866,912**	**17,058,178**	**1,249,438**	**252,849**	**20,697**	**11,723,843**	**61,053,908**
1. Concrete/Concrete Products /Grout	15,737,238	570,092	33,290	409,134	0	0	0	0	16,749,754
2. Blended Cement/ Feed for Clinker	3,629,151	1,130,802	0	1,649,934	0	0	0	0	6,409,887
3. Flowable Fill	107,263	9,106	0	0	0	0	0	0	116,369
4. Structural Fills/Embankments	1,277,356	1,561,531	305,770	1,221,865	100,940	0	0	0	4,467,462
5. Road Base/Sub-base	178,281	311,779	21	0	0	0	0	0	490,081
6. Soil Modification/Stabilization	216,483	66,253	0	8,053	0	0	0	0	290,789
7. Mineral Filler in Asphalt	52,784	0	14,176	0	0	0	11,479	0	78,440
8. Snow and Ice Control	0	527,695	77,935	0	0	0	0	0	605,630
9. Blasting Grit/Roofing Granules	0	184,712	1,400,455	173	0	0	0	0	1,585,340
10. Mining Applications	1,128,682	73,416	0	807,280	0	215,974	0	11,593,760	13,819,113
11. Gypsum Panel Products (formerly Wallboard)	0	28,378	0	11,322,016	973,785	0	0	0	12,324,178
12. Waste Stabilization/Solidification	1,138,078	242	0	0	0	0	9,218	130,083	1,277,621
13. Agriculture	2,409	1,788	0	1,392,693	174,713	0	0	0	1,571,602
14. Aggregate	0	173,472	0	0	0	0	0	0	173,472
15. Oil/Gas Field Services	181,907	0	0	0	0	36,875	0	0	218,782
16. Miscellaneous/Other	413,152	179,940	35,265	247,030	0	0	0	0	875,387

Summary Utilization to Production Rate

CCP Categories	Fly Ash	Bottom Ash	Boiler Slag	FGD Gypsum	FGD Material Wet Scrubbers	FGD Material Dry Scrubbers	FGD Other	FBC Ash	CCP Utilization Total
Totals by CCP Type/Application	24,062,786	4,819,205	1,866,912	17,058,178	1,249,438	252,849	20,697	11,723,843	**61,053,908**
Category Use to Production Rate (%)	**54.24%**	**40.13%**	**83.79%**	**52.23%**	**11.04%**	**19.27%**	**10.03%**	**88.87%**	**52.05%**
2015 Cenospheres Sold (Pounds)	948,787	Data in this survey represents 182 GWs of Name Plate rating of the total industry wide approximate 291 GW capacity based on EIA's July 2016 Electric Power Monthly.							

Notes:
These are estimates for entire U.S. utility and IPP sectors calculated by dividing the survey respondents' data by the portion of the overall industry's coal burn they represent, as reported in the July 2016 EIA Electric Power Monthly (57%).

Fig. 1: Coal Combustion Products 2015 Production and Use Survey SOURCE: American Coal Ash Association

Fig. 2: Fly ash samples from different power plants.
SOURCE: American Coal Ash Association

material to ash marketers who specialize in developing and supplying coal combustion products users. This has the advantage of placing beneficial use in the hands of entities that approach the activity as their primary mission. But those ash marketers have little control over the volume or initial quality of materials the utilities produce.

Supply side logistics are further complicated by geographic and seasonal dislocations in ash production. Coal combustion products are produced at electricity generating stations that tend to be remote from urban markets where most the products are ultimately used. Coal combustion products are also made year-round, while demand for the product tends to be seasonal following construction cycles. The true measurement of ash supply, therefore, is not necessarily how much ash is produced in a year. A more accurate measure of supply is how much can be provided to users on the busiest construction day of the summer.

Demand side logistics also can be complex. For instance, concrete producers are major users of fly ash. But the amount of fly ash that they use is heavily influenced by specifiers – engineers, architects, and government agencies who may never purchase a ton of fly ash directly, but who have enormous influence over how (and how much) fly ash is used in concrete mixtures.

"YOU DON'T JUST WAKE UP ONE MORNING AND DECIDE TO RECYCLE COAL ASH."

Matching supply to demand in such a complex market doesn't happen without significant planning and financial investment. Storage facilities may be needed to collect coal combustion products made in the winter for use in busier summer months. Trucks and trains are needed to move coal combustion products from where they are made to where they are used. Distribution terminals may be needed to stage adequate supplies for individual markets. Beneficiation technologies may be needed to ensure consistent product quality.

The deployment of these investments must be balanced against activities to develop market demand. For instance, if a local market has too little distribution capacity, ash users may be reluctant to increase their use of the resource. (Concrete mix designs are often developed and tested months in advance. Concrete designers are reluctant to commit to higher levels of ash utilization if they are uncertain about ash availability during the time that the resource will be needed.) On the other hand, if ash marketers build too much distribution capacity, markets can become unprofitable and jeopardize the marketers' ability to invest in other places.

Ash marketers must work closely with ash users and specifiers to coordinate supply issues and plan for careful market expansion.

"PUBLIC POLICY MATTERS."

Government policies also play an important role in encouraging (or occasionally inadvertently discouraging) increased beneficial use of coal combustion products.

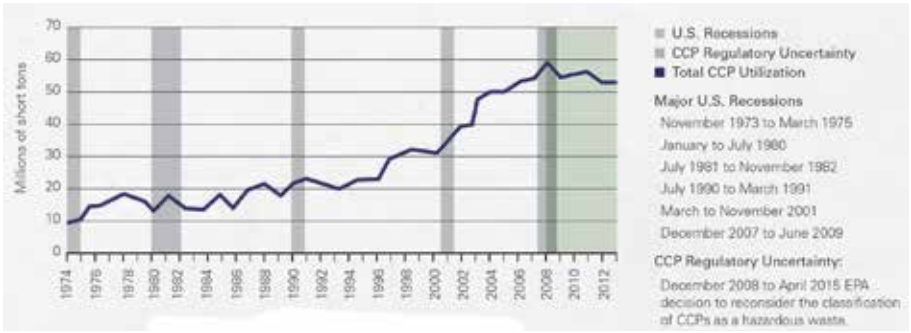


Fig. 3: Coal Combustion Products Utilization History
SOURCE: American Road and Transportation Builders Association analysis of American Coal Ash Association Production and Use Survey data

First of all, government agencies often fill an important role as product specifiers. Federal agencies such as the Federal Highway Administration, Bureau of Reclamation, and Army Corps of Engineers, are influential designers of concrete and other projects that utilize coal combustion products. State highway departments also play key roles in specifying fly ash use in infrastructure projects – one of the largest sectors for coal combustion product beneficial use.

U.S. Environmental Protection Agency policies can also have a major impact on beneficial use – both positive and negative.

For instance, the volume of coal ash utilization stalled between 2009 and 2013 as EPA pursued a protracted rulemaking process that posed the threat of a "hazardous waste" designation for coal ash that is disposed. Even though beneficial use was exempt from the proposed regulation, ash producers, specifiers and users restricted coal ash use in light of the regulatory uncertainty and publicity surrounding EPA's activities. In 2014, EPA began signaling that the "hazardous waste" designation proposal was off the table and in December 2014 finalized coal ash disposal regulations under the non-hazardous section of federal law. Ash utilization began to increase again once regulatory uncertainty was restored. (refer to Fig. 3, which also demonstrates that the 2009-13 performance was not linked to an economic downturn inasmuch as every previous recession saw ash utilization increase as users sought out more economical materials.)

On a positive note, a program led by EPA was in place during the most rapid expansion of coal combustion products beneficial use in history. The Coal Combustion Products Partnership (C2P2 program) was a cooperative effort between EPA, American Coal Ash Association, Utility Solid Waste Activities Group, U.S. Department of Energy, Federal Highway Administration, Electric Power Research Institute, and U.S. Department of Agriculture Agricultural Research Service to promote beneficial use of coal ash as an environmentally preferable alternative to disposal. The initiative included a challenge program, various barrier-breaking activities, and development of coal combustion products utilization workshops. In 2000, when EPA issued a Final Regulatory Determination that coal ash should be regulated under "non-hazardous" RCRA Subtitle D and subsequently initiated the C2P2 program, beneficial use volume was 32.1 million tons. Just eight years later, when the C2P2 program was terminated and EPA initiated the aforementioned ash disposal rulemaking, beneficial use volume had nearly doubled to 60.6 million tons.

THE MORE THINGS CHANGE, THE MORE THEY STAY THE SAME

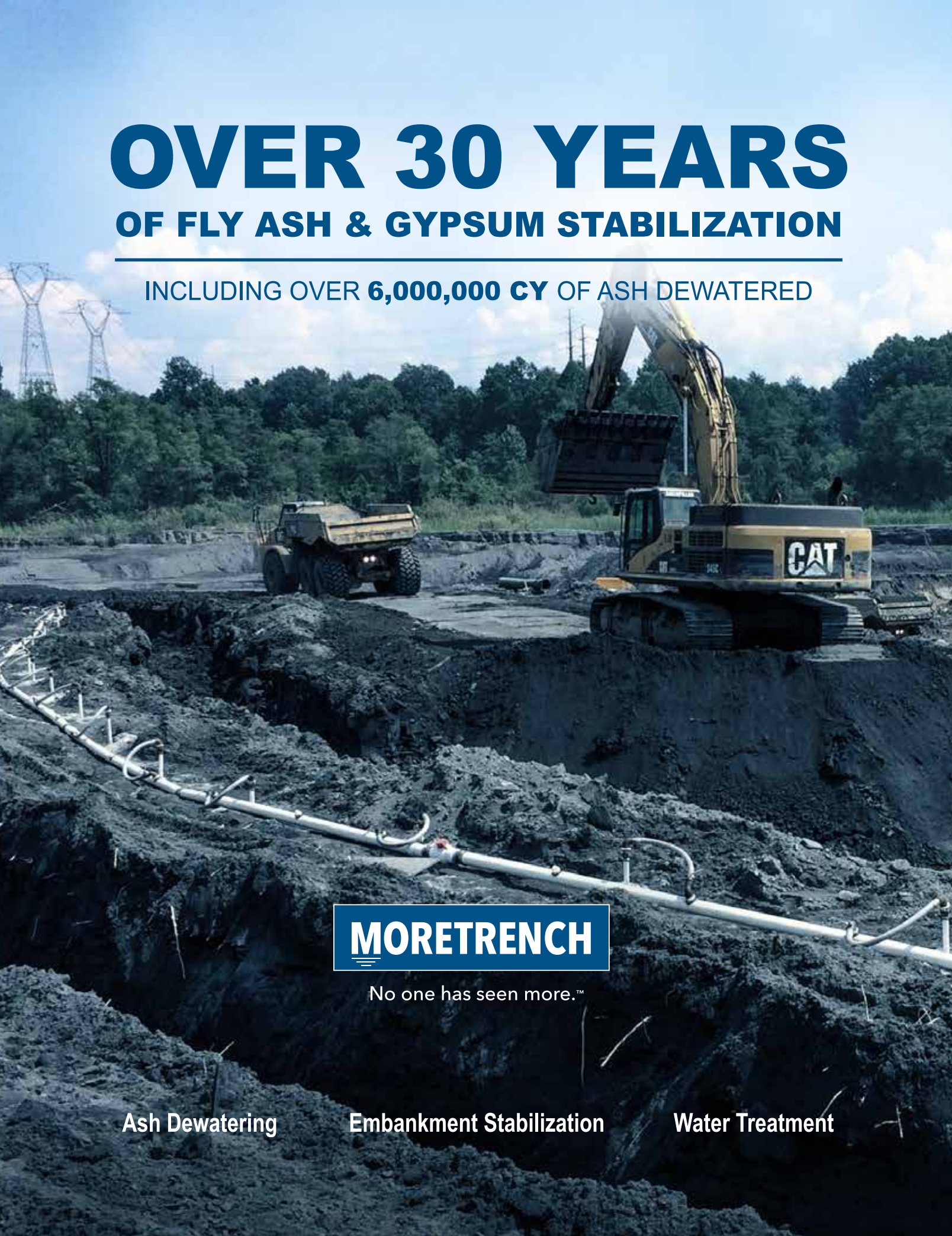
Much has changed in the nearly two decades I have spent in the coal combustion products beneficial use industry. Ash sources that were once perceived as "unmarketable" are now being productively used thanks to beneficiation technologies. Products are moving longer distances to reach their markets. Ash utilization rates once considered "high volume" are now commonplace. Strategies such as blending and ash reclamation that were once considered unfeasible are now preparing to enter the mainstream.

Although the number of coal-fueled power plants has decreased in response to environmental regulations and competition from other energy resources, it's worth noting that we continue to dispose of nearly half of the coal combustion products that are produced annually. A 2015 study by the American Road and Transportation Builders Association that found there will be ample supplies of coal combustion products for beneficial use in the future. The report concluded: "Coal will continue to account for a significant percentage of U.S. electric generation during the next two decades… Even under alternative scenarios of accelerated coal-fueled electric generating unit retirements, CCP production is still expected to exceed overall demand." That means the work of increasing beneficial use is far from complete.

I'm reminded of one of the first visits I made to a concrete producer who used fly ash. I commented on the concrete producer's low rate of ash use and inquired what I could do to persuade him to use more. He responded: "I would love to use more of your product. But first you need to convince me that you won't run me out of supply on the hottest day of the year."

That's one aspect of the beneficial use industry that will never change. Consumers of coal combustion products need supplies that are consistent and reliable. Building the infrastructure to improve supply volume, consistency and reliability requires public policies that incentivize investment in facilities to grow markets sensibly and sustainably. Providing environmental regulatory certainty and avoiding policies that distort supply and demand characteristics of this unique industry will be critical to the continued growth of this great environmental success story. ❖

John N. Ward served as Vice President of Marketing and Government Affairs for coal ash marketer ISG Resources and its successor Headwaters Resources (now part of Boral North America.) Since 2008, he has been an independent consultant to the coal and coal ash industries. He serves as Government Relations Committee Chairman for the American Coal Ash Association.


OVER 30 YEARS
OF FLY ASH & GYPSUM STABILIZATION
INCLUDING OVER 6,000,000 CY OF ASH DEWATERED
CAT
MORETRENCH
No one has seen more.™
Ash Dewatering
Embankment Stabilization
Water Treatment

Editor's Note: "Six Questions for…" is a regular *ASH at Work* feature in which leaders with unique insight affecting the coal ash beneficial use industry are asked to answer six questions.

Lori Tiefenthaler is Senior Director of Marketing for Lehigh Hanson, a major producer of aggregates, cement, concrete, concrete products, and asphalt in the United States and Canada. Lehigh Hanson is part of the Heidelberg Cement Group, a global leader in construction materials. Tiefenthaler was appointed to serve as chairperson of the American Concrete Pavement Association (ACPA) in December 2016. She is the first woman to serve in that position in their 54-year history. Tiefenthaler began her career in the industry working in her family's ready mixed concrete and aggregate business in Iowa. *ASH at Work* asked her about the current states of the cement, concrete, and concrete paving industries.

ASH at Work (AW): You have had a long career in the concrete industry beginning with the family business in Iowa. Did you ever envision rising to a senior management position with one of the world's largest construction materials companies and leading the U.S. concrete paving industry?

Lori Tiefenthaler (LT): I was fortunate that I had excellent mentors and a lot of support along the way. I had the advantage of knowing the career path I wanted to follow, but I know many people do not have the same opportunities to pursue a clear career direction. This is why I feel so passionately about two programs that we believe will increase the diversity in our industry.

We recently launched our "Interns for the Future Program," which we believe is the first for our industry and unique for trade associations. We are seeking highly motivated students for 12-week internships, which we believe will be both a learning and a work experience for the selected interns. Interns will have the opportunity to experience different aspects of the industry, including where technology meets construction, as well as to perform technical or other important projects preparation and presentation skills.

Our goal is to place these interns in our state paving associations throughout the country and at our national headquarters near Chicago, IL.

We are partnering with the Innovative Pavement Research Foundation (IPRF), a 501(c)(3) corporation operated by the ACPA. The IPRF was founded for educational and scientific purposes. The IPRF is accepting 100% tax-deductible contributions toward the program, and our plan is to match ACPA National and ACPA-affiliated Chapter/State affiliates' contributions dollar per dollar to offset the internship expenses for individuals working through the program.

The other program we're very excited about is our Emerging Leaders Group, or ELG. This program recognizes the next generation of leaders within contractor companies and other industry organizations. The ELG consists of ACPA members under 40 years of age who have been identified as future leaders by their employers or other industry professionals, providing them an opportunity to become active participants in ACPA and to shape the future of their Association and industry.

ACPA is encouraging them to participate in the Association at the local and national levels. Participation in the ELG will allow members to exchange ideas on national issues, discuss common experiences and best practices, develop leadership skills, and build a network on a national level. The platform offered by the ELG will poise the next generation to assume leadership roles within their organizations and within their local and national industry associations.

In addition to the mission of developing the next generation of ACPA leadership, the ELG will also provide an immediate opportunity for emerging leaders to bring their voices to the table. Both the Association and its members will benefit through a better understanding of the perspectives of the next generation of leaders.

AW: Your career is marked by a particular interest in concrete paving starting with the Iowa Concrete Paving Association. What intrigues you about the paving business?

LT: Actually, my interest in concrete paving came from a project I worked on my first year out of college when I was managing our family's ready mixed concrete operation. We were the concrete supplier on an Iowa DOT mainline paving project for Cedar Valley Corp (CVC) on the Iowa Highway 71/30 project. We set several records for our company during that project and it was exciting to be a part of orchestrating those changes. I cannot remember the exact concrete mix for that project; however, I do remember that it contained Class C Fly Ash (IDOT C-4-C, the old "cook book" mixes). For the decade of the 1990s, I was fortunate to have worked for the Iowa Concrete Paving Association to promote concrete pavements for city streets, county roads, and runways. What intrigues me most about our industry is the small network of people and passion that continues to evolve our materials, equipment, design and construction technologies.

I have spent my career focused on working hard for my industry. My focus has been on growth in the industry and education on new developments in construction materials, design, and

applications. My passion, focus, and effort has been on a continuous goal of communicating the value of concrete pavements. While I have not focused on diversity or women's issues in my industry, I do strongly believe that my life and work have set a valuable example for women in this field and other male-dominated industries. I believe my work ethic has earned respect among my peers without regard to gender, and that is what will in turn improve our industry as well as open new paths for women who might be interested in this industry, but I remain concerned that there is a limit to what they can do and where they can go in their career.

AW: Fly ash and other supplementary cementitious materials (SCMs) have become more important tools for production of durable, high-performance concrete. In Europe, SCM is blended by the cement producer. In the United States, ready mixed concrete producers have resisted this kind of blending and have continued to blend at the batch plant. Do you see this changing?

LT: This is an interesting question; however, I don't see vast changes in the United States. I work for a company that uses all of the options that you mention. I believe many times these decisions may be based on what is available in the local markets from a quality, consistency, and performance standpoint (composite cements, fly ashes, slag, and other SCMs) and where the most economical storage exists (at the cement facilities or the concrete plants). As mixes change and specifications move more toward performance, we may see the requests for blended products go up in the marketplace due to being able to achieve various outcomes with ternary or even quaternary mixtures.

I also expect we will see changes in some paving concrete mixtures in the future. There is work being done by FHWA, several DOTs, and other agencies, and some of this work is being done in collaboration with industry and the National Concrete Pavement Technology Center, along with universities, including Oklahoma State and Oregon State. Some of these efforts began a few years back when there were some joint deterioration issues in a few Midwestern states, including in the Great Lakes region. Investigation of these issues has revealed important information about deicing pretreatments to concrete, and we need to make some mixture improvements to defend against the damaging processes that some public works agencies believe are critical to vehicle safety. Changing their snow and ice-abatement practices doesn't seem to be an option, so we must look elsewhere.

The good news for the SCMs is that all of them add to the durability of concrete. Preliminary research is showing that in some scenarios, we need to increase the percentages of SCMs beyond where we have been recently and in the past. I would encourage ACPA and ACAA members to get involved and pay attention to the new Pooled Fund Research project getting off the ground this year. It is a large 5-year project, and I am hopeful that industry groups will come to the table with the states to make the field and application portion of this research extremely successful. They are looking at some new tests for workability and durability.

In response to your basic question, however, we also reached out to our close partner NRMCA for a response. It's a good question, but I don't think the situation will change much. According to Karthik Obla, PhD, PE, Vice President, Technical Services at NRMCA, cost savings realized by the concrete producer make it more attractive, as they can purchase SCMs directly. Also, producers have the freedom to develop concrete mixtures at different SCM levels. Prescriptive specifications in the United States makes it essential that they are able to do that.

AW: The ACPA is an important player in the discussion of funding for transportation infrastructure. President Trump campaigned on infusing money into repairing and improving our infrastructure. Is the ACPA confident the President will come through?

LT: We are cautiously optimistic about the possibility of increased funding for the nation's infrastructure. Of course, it remains to be seen what the actual plans will be, as well as what the scope of infrastructure investments will be. Still, we are encouraged by Secretary Elaine Chao's remarks during her confirmation hearing, in which she underscored the problems with the Highway Trust Fund. We're encouraged by the dialogue, and are continuing to work with other transportation-construction allies to continue to advocate for increased and sustainable funding to meet the critical needs of U.S. highways and airports. We also know that the jobs created by construction can help get our economy and GDP moving in a steeper direction, another reason I believe the next 9 months of the new administration will be critical. We need a succinct message and clearly developed solutions and opportunities to support the administration and Congress both inside and outside the beltway. We then need to take this message to our states and home districts for serious discussions.

AW: Sustainability concerns have become very important in the construction industry. What are the most sustainable aspects of concrete paving that engineers need to know in designing pavements?

LT: When we look at concrete pavements and sustainable development, we consider "cradle-to-cradle" sustainability benefits. I like to break this sustainability conversation into four major buckets: materials and resources, design and construction, pavement use (which is the most critical to include), and end of life.

For materials and resources, we need to think about and use all the work of the past 5 years on calculations of our materials environmental impacts. NRMCA has completed two robust rounds of industry-wide environmental product declarations, and this work has help our industry lead the discussion around transparency. SCMs help concrete lower its embodied energy and lengthen the denominator by the increase durability and life we get from concrete. All of our research on optimization of mixtures, the performance engineered mixture studies, and durability work plays a key role here and throughout the life cycle.

For design and construction, the use of the Mechanistic-Emperical Pavement Design Guide (MEPDG) has helped us achieve more predictable pavement design, and it helps eliminate the grossly overdesigned pavements of the past, making our pavements and the materials used more efficient. For example, the use of coal ash and slag for long-life pavements, the use of locally available materials and aggregate optimizations, recycling, and accelerated construction methods all contribute to sustainability.

After a pavement has been constructed and is in service, a highway agency has essentially only one opportunity to enhance sustainability profile—through maintenance, preservation, and restoration activities. These activities include dowel bar retrofits, cross-stitching, full and partial depth repairs, joint and crack resealing, slab stabilization, and diamond grinding, all of which are used to extend the life of the pavement as long as possible while minimizing disruptions and maximizing resource efficiency.

We also look at use-phase benefits, which dwarf the sustainability methods typically seen during construction, as well as restoration and preservation activities. In fact, with the sole exception of the solid waste factor, the impact of the use-phase (traffic in this case) is at least 10 times greater than all other phases. In the past few years, ACPA has had the opportunity afforded to them by the PCA and the RMC-Research Foundation to participate in the Task Forces at the Concrete Sustainability Hub at MIT and we are learning a lot about life-cycle assessment (LCA) and what elements in the use phase matter most and how we can get better measures and models to have robust decision-making tools. We have learned a lot about pavement-vehicle interaction and how concrete benefits on urban freeways especially with heavy loads and high temperatures. MIT models have helped us confirm that both smoothness and deflection matter to the energy savings on roadway use. In this past year, we are starting to see the results of a deeper dive on pavement reflectivity and the environmental savings related to it.

Lastly, at the end of life, the options are very simply to recycle and reuse concrete, either for supporting a concrete overlay, or to take advantage of its 100% recyclability to reuse it in new concrete mixtures or aggregate bases or fill, rip rap, etc.

AW: In your term as chairperson of the ACPA, what are your top priorities?

LT: My first priority in this seat is to work tirelessly and to represent our members to ensure we enable effective advocacy for concrete pavements. We need to stay committed to developing the tools that can assist the states in their successful pursuit of increasing the use of and applications for concrete pavements. One of these tools is a new pavement design program that we are working on collaboratively with the Portland Cement Association and National Ready Mixed Concrete Association.

I also have asked and continue to encourage our members and chapter/state associations to hold project open houses this year because I believe getting people out on the grade around the slipform paving machines inspires people to join our industry and engineers to design and construct with concrete pavements. I'm confident these events will inspire people *and* projects!

We are working diligently on engaging with more robust decision-making by agencies with the employment of asset management systems. We are ready and will employ some new research, developing guidance, and engineering models to be a respected resource for the future.

As I mentioned earlier, we have some very robust plans this year for trying to attract talent. I mentioned the "Interns for the Future Program" and Emerging Leaders Group, which are advancing our diversity goals for the industry.

Later this year, we also plan to embark on a program we call Vision 2040. Vision 2040 will help the industry establish a long-term blueprint for the most critical needs of the concrete pavement industry, as well as our partners in the public sector. Almost two decades ago, we embarked upon a similar venture that outlined some ambitious research, technology transfer, and technology implementation plans that we co-developed with our partners in the industry, public sector, and academia. More than 80% of those plans have been implemented. We're excited about our VISION 2040 plan, and we anticipate some great outcomes.

AW: Thank you, Lori.

Ad Index

Whether it's a clean closure or a cap-in-place, no two ash ponds are exactly the same. Utilities need a partner who offers a customized approach that provides unique solutions to the challenges you face. With Charah, you get the proven experience and expertise to handle every regulatory, engineering and technical issue. Above all, you can count on service that is on time, all the time.

For more information, contact us at 877-314-7724 or visit charah.com.

Charah

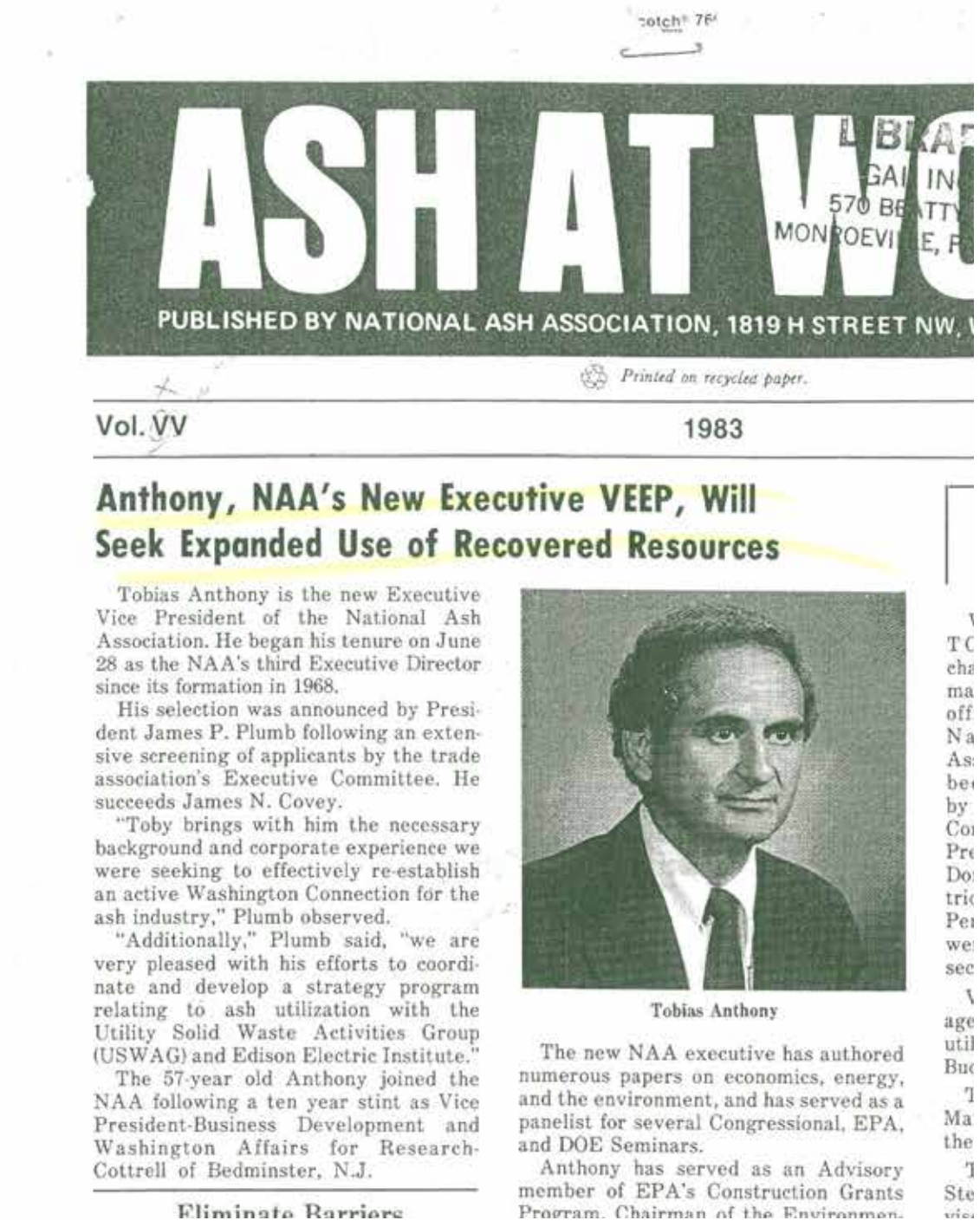
Service Above All.

ASH CLASSICS

Production and Use—35 Years Back

"Ash Classics" is a recurring feature of **ASH at Work** *that examines the early years of the American Coal Ash Association and its predecessor National Ash Association (NAA), focusing on issues and events that were part of the beneficial use industry's defining years.*

Tracking coal ash production and use is one of the most important activities of the American Coal Ash Association. This edition of ASH at Work *from 1983 shows what the data looked like three-and-a-half decades ago.*



ASH AT WO

PUBLISHED BY NATIONAL ASH ASSOCIATION, 1819 H STREET NW,

Printed on recycled paper.

Vol. VV 1983

Anthony, NAA's New Executive VEEP, Will Seek Expanded Use of Recovered Resources

Tobias Anthony is the new Executive Vice President of the National Ash Association. He began his tenure on June 28 as the NAA's third Executive Director since its formation in 1968.

His selection was announced by President James P. Plumb following an extensive screening of applicants by the trade association's Executive Committee. He succeeds James N. Covey.

"Toby brings with him the necessary background and corporate experience we were seeking to effectively re-establish an active Washington Connection for the ash industry," Plumb observed.

"Additionally," Plumb said, "we are very pleased with his efforts to coordinate and develop a strategy program relating to ash utilization with the Utility Solid Waste Activities Group (USWAG) and Edison Electric Institute."

The 57-year old Anthony joined the NAA following a ten year stint as Vice President-Business Development and Washington Affairs for Research-Cottrell of Bedminster, N.J.

Tobias Anthony

The new NAA executive has authored numerous papers on economics, energy, and the environment, and has served as a panelist for several Congressional, EPA, and DOE Seminars.

Anthony has served as an Advisory member of EPA's Construction Grants Program, Chairman of the Environmen-

Eliminate Barriers

NAA Message Board

Tobias Anthony
Executive Vice President

It is a pleasure for me to be the new Executive Vice President of the National Ash Association (NAA) and to have this opportunity to share my thoughts with you.

My relationship with the electric utility industry extends back some ten years. During that period, I studied the role of the industry particularly as it relates to environmental prerogatives. Those studies revealed to me the nature of the electric industry and the value of its contribution.

I am impressed as to just how essential low cost electric power is to a productive nation. Automation driven by electric power is the key to an industrial, productive nation, and through increases in productivity, future generations are assured a higher standard of living. The cheaper the power, the greater the productivity. All of this brings me to a philosophical point. It is clear that elected officials, particularly in Washington, tend to take utilities for granted, and neglect almost always leans toward disregard. It will be NAA's mission along with other utility associations to change that direction.

One of my goals is to impress upon officials in Washington that utilities produce the fourth most abundant mineral in this country - coal ash. One year's production contains as much aluminum as we produce annually from natural sources. It contains more than 2.5 million tons of lime, and over 12 million tons of ferric oxide. One day, it will be essential and cost-effective to extract those materials while becoming energy independent, and a coal-based economy.

A second goal is to remove impediments to the use of ash and to prevent future unfounded concerns. There are artificial factors in the marketplace which work against the competitive re-use of materials; barriers established by tradition and even biases. We believe these factors work against the needs to a productive nation as natural materials inevitably become depleted. Concurrently, we are addressing concerns over practices designed to reclaim land with ash in an environmentally sound manner. Sound ash-management is the solution to these concerns, just as soil conservation practices have worked well for decades to maintain productive, agricultural land.

In the overall, it is gratifying to be part of a conservation movement of such value to our nation. There is an indigenous marketing and social value in re-using ash to keep it out of landfills while conserving other natural material. In the short lifespan of the NAA, its members have made exceptional progress of benefit and value to the public. I am delighted to join the leadership in accelerating this progress.

ASH PROJECT BECOMES T-SHIRT INSIGNIA—The mine subsidence control project in Fairmont, WV has become emblazoned on a T-Shirt and distributed by the contractor, Nicholson Construction, Co. of Bridgeville, PA, to city officials and others associated with the project. The art work is shown above. To-date the firm has pumped more than 60,000 tons of a fly ash-cement grout mixture into an abandoned mine beneath the city to prevent further subsidence from taking place.

(2)

John Tonkovich Dies At 59, Was An Active NAA Member


John Tonkovich

SHADYSIDE, OH. — John D. Tonkovich, an ardent supporter of the National Ash Association and a well-known contractor, died at his home near here on June 27. He was 59.

His son, Jim, has succeeded him as president of the firm and continues the firm name - John D. Tonkovich & Son, Inc. The company has a contract to remove and sell the power plant ash from Ohio Edison's Burger Station at Powhatan Point.

Known to his friends as "Big John," he worked in concert with the NAA and the Ohio Contractor's Association to get ash approved as a construction aggregate by the Ohio Department of Transportation.

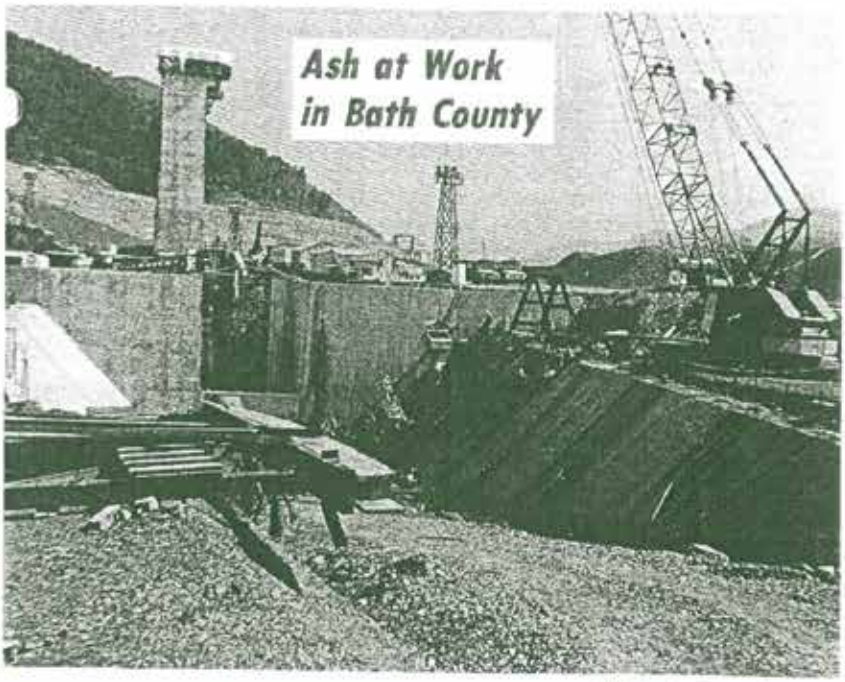
He participated in a demonstration fly ash reclamation project with the U.S. Bureau of Mines on an abandoned coal refuse embankment near his operation which ultimately led to the acceptance of the concept by the U.S. Soil Conservation Service.

Calendar of Events

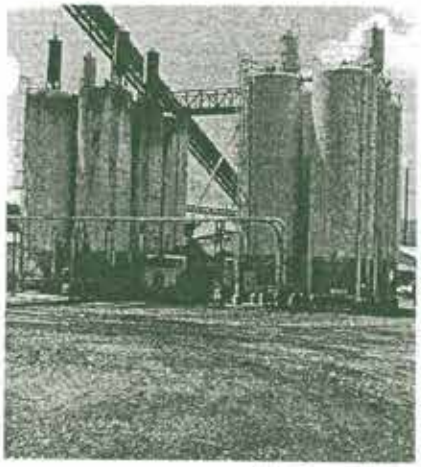
OCTOBER
- 1-4 1983 Annual AASHTO Conference, Denver, CO.
- 19 American Society of Highway Engineers, Altoona Section, Altoona, PA. (Dinner Meeting).

NOVEMBER
- 6-9 Ash Short Course, Technology & Utilization of Power Plant Ash, Louisiana State University, Baton Rouge, LA.
- 12-18 NSGA-NRMCA Short Course in Concrete Aggregates University of Maryland, College Park, MD.
- 15-17 6th International Coal Utilization Exhibition & Conference, Astro Hall, Houston, TX.
- 29-30 Fly Ash Work Shop, Federal Highway Administration, Airport Hilton, DeMoine, IA.

JANUARY
- 15-18 Concrete Industries Exposition sponsored by National Concrete Masonry Association, New Orleans, LA.

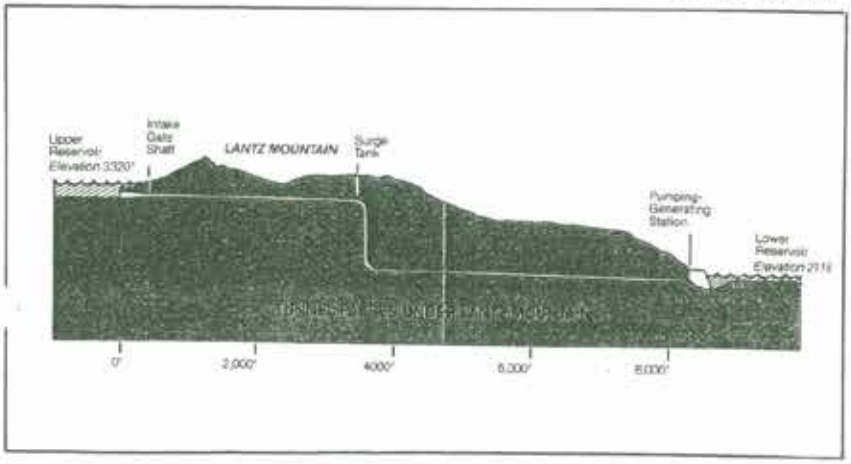


Spillway to Lower Reservoir



Ash, Cement Silos

Cement Batch Plant



(3)

PROJECT DATA

Project Cost - $1.65 billion (est.);

Construction began - March 1977;

Concrete Contractor - Daniel Construction Company, Greenville, S.C.

Generating Capacity - Peak 2,100,000 kw, six 350,000 kw generating units;

Maximum flow of water when generating (per unit) - 5,400 cubic feet per second (cfs), 2,420,000 gallons per minute (gpm);

Energy required to fill upper reservoir power storage - 30,300,000 kwh;

Upper reservoir and dam: surface area - 175 to 265 acres; volume - 13,000 acre-feet (4.2 billion gal.) to 35,500 acre-feet (11.6 billion gal.); depth of water -305′ to 410′; dam - 460′ high and 2,200 feet across; drainage area 2.4 square miles; earth and rock volume - 17 million cubic yards;

Lower reservoir and dam; depth of water with full conservation and empty flood storage pools - 58′ to 118′; dimensions - 135′ high and 2,400′ in length; drainage area - 73.4 square miles; earth and rock fill volume - 3.6 million cubic yards;

Power tunnels; diameter - 28.5′; length and grade - 3,700′ upper section @ 2% grade, 990′ vertical shaft section, 4,800′ lower section @ 2 grade.

Powerhouse - Above ground, concrete with six unit bays, one erection bay (south end), and service bay (west side); Dimensions: 500′ long, 150′ wide, and 200′ high; concrete: 356,000 cubic yards.

Penstocks - 897′ to 1,257′; diameter of six steel -line penstocks - 18′;

Surge shafts - diameter of three units 44′ each, 330′ deep.

Hydro Station Construction Uses 65,000 Tons of Fly Ash

MOUNTAIN GROVE, VA. — Work is about 69 percent complete on what will be the largest single use of fly ash concrete in the eastern United States.

The project is the giant Bath County pumped storage hydroelectric generating station being jointly constructed by Virginia Electric and Power Company and the Allegheny Power System. Vepco initiated work on the $1.65 billion project and APS could possibly own between 40 and 50 percent of the station or its capacity.

Scheduled commercial operation dates for the individual 350,000 KW units begin in May, 1985, with Unit 1 and culminate in April, 1986, with Unit 6.

The station will have the capability to generate up to 2.1 million kilowatts of electrical energy - making it the most powerful pumped storage project in the world to date.

Over 1 million cubic yards of concrete will be utilized in the overall construction program, and virtually every yard being poured contains fly ash. The mix design calls for the use of 65,000 tons of ash.

Applications include the powerhouse, three 28.5′ diameter water tunnels through Lantz Mountain connecting the upper reservoir to the powerhouse, the upper reservoir intake structure, the penstocks and surge shafts, lower dam spillway, and low level outlet works.

MAJOR CONCRETE QUANTITIES

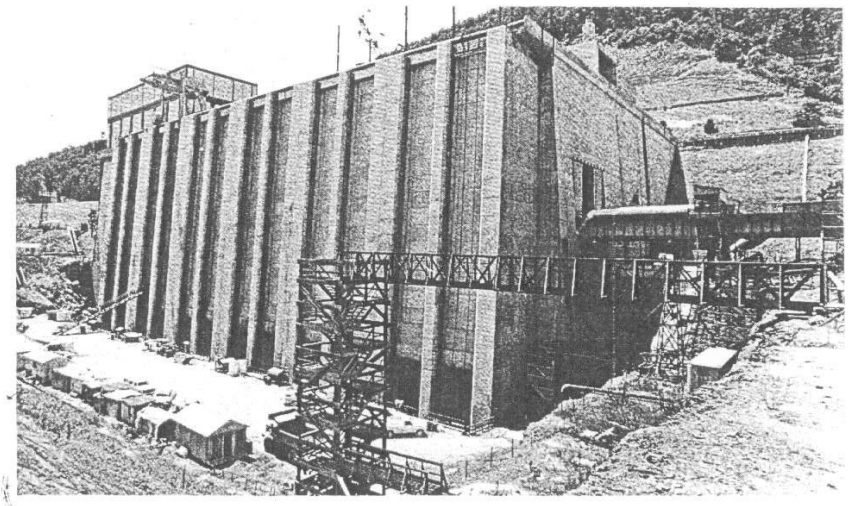
Tunnels (Including penstocks)	405,000 cy
Powerhouse	361,000 cy
Upper Intake	168,000 cy
Lower Spillway	74,000 cy
Low Level Outlet	16,000 cy
	Over 1,000,000 cy

Fly ash for the project is being supplied by American Electric Power Company from their Clinch River and John E. Amos stations at Carbo, Va. and St. Albans, WV, respectively. Several sources of ash were evaluated and tested at the outset, but because of the required quantity of specification material, the AEP ash was selected.

The remoteness of the station, nestled in the rugged mountains near the Virginia-West Virginia border, dictated the use of an on-site batch plant to supply the needed concrete and minimize transportation logistics.

The site selection also enabled Vepco to establish its own on-site quarry to supply approximately 5.5 million tons of limestone aggregate and sand needed for construction and the development of 20 miles of permanent and temporary haul

(4)



Generating Station

roads. The network includes a twisting 3½ mile road up Lantz Mountain on an 8 percent grade to the upper reservoir.

Vepco purchased and installed a 300-cubic-yard-per-hour batch plant as well as 20 agitator wet batch mix trucks, 3 rotary drum mixer trucks, 3 low-boy tractor-trailer units with four 4-cubic-yard-buckets, and 2 flat-bed trailers with three 4-cubic-yard buckets to transport the concrete to the various locations on the job site. Daniel Construction Company actually has the responsibility for operating the plant.

The plant itself, the rotary and the agitator vehicles were insulated to permit the operation of the batch plant on a year-round basis.

Support facilities for the plant included an overhead conveyor system to transfer the aggregate materials from the stockpile, six 140-ton storage silos for the fly ash, and five 190-ton cement silos.

The mix designs for the fly ash concrete vary, depending upon the particular application. For example, 4,000 psi concrete is required in certain areas.

MIX DESIGN FOR 4,000 PSI CONCRETE	
	lbs./c.y.
Cement	340
Fly ash	113
Sand	1,191
Aggregate	
3/4"	635
1½"	635
3"	846
Water	217
Water Reducing Agent - 18.12 oz.	
Air Entraining Agent - As Required	

In early June (1983), the project had a record pour of 20,840 yards of concrete in a single week. Most of the material was utilized in the vertical flow shaft phase of the tunnel construction and the surge tanks. The tanks, measuring 330 feet deep and 44 feet in diameter with 4-foot-thick walls, act as a relief reservoir for the water prior to its 1,000-foot vertical drop into the powerhouse. (See tunnel schematic).

A pumped storage hydroelectric station simply utilizes two large reservoirs - one higher than the other. When power is required to meet customer demands, valves are opened allowing the water from the upper reservoir to fall through the tunnels to drive the massive hydraulic generators in the powerhouse and into the lower reservoir. When the demand drops, the large turbin generators are reversed to become pumps. Electricity from other units on the system is used to recycle the water back to the higher level until needed again.

With all six generating units in operation, water will flow through the tunnels at a rate of 14.5 million gallons per minute to spin the turbines and generate electricity and spill over into the lower reservoir.

When reversed to act as pumps, the turbines can refill the upper reservoir in 13.5 hours - at the rate of 11 million gallons per minute.

No water is consumed during the operation of the pumped storage facility. The only losses are through evaporation from the reservoirs and minor seepage. Once the reservoirs are filled, the normal flow of streams is simply passed through the project.

Besides generating power, the Bath County project will improve flow control in Back Creek and provide a variety of recreation benefits in the area downstream of the lower dam.

Extreme, rapid fluctuations in water levels will preclude the use of the two reservoirs by the general public. Vepc is, however, developing a 325-acr recreational area including two ponds covering about 80 acres for fishing, boating, and swimming. The site will also include camping facilities, picnic areas, and hiking trails.

(5)

Ohio SCS Prescribes Ash To Treat Strip Mine Site

CALDWELL, OH. — Work is nearing completion on the reclamation of a 57-acre abandoned strip mine site near here utilizing fly ash as the primary soil amendment.

The $438,000 project is being administered by the U.S. Soil Conservation Service with funds provided through the Rural Abandoned Mine Program (RAMP). The contractor, Ben Cookson of New Philadelphia, hopes to complete the assigned task by mid-October.

The program involves the total restoration of the property overlooking Duck Creek, where the coal was removed in the 1940's, and was designed by the SCS staff in Columbus headed by State Conservationist Robert Shaw.

Treatment called for the ash to be spread at the rate of 200 tons per acre - a two-inch application - and then mixed into the spoil along with 10-tons of lime utilizing a heavy disc. The 12,000 tons of ash, trucked to the site a distance of 48 miles, is being supplied by American Electric Power Company from an old disposal pond at its now-closed Philo Station.

An Outstanding Example

The seed mixture, including 950 tons of Triple 16 fertilizer, was broadcast over the site from a hydro-seeder truck. The treated area was then covered with three tons of straw per acre to assist in the germination process.

After only 10 days, the first touch of green was evident from the initial seeding. The permanent seeding includes two different mixtures comprising timothy, orchard and switch grass, tall fescue as well as red and yellow sweet clover.

Project Manager Willard Roby said the ash was easy to work into the soil although he admitted it "got a mite dusty when the wind kicked up while machinery was spreading the ash and lime."

Aside from the prescribed treatment of the acid soil, the site work involved the contouring of rocky overburden below the bench with limestone lined drainage ditches along the steep slopes to minimize erosion problems, controlling the runoff water seeping from the high wall, and shaping the bench area.

Roby added it took two dozers working in tandem to move some of the boulders.

Representatives of the National Ash Association, who visited the site on September 22, termed the project an outstanding example of reclamation planning.

Fly Ash Distribution

HERE & THERE

MORGANTOWN, WV. — Thirty undergraduate Civil Engineering students at West Virginia University have enrolled in a Professional Engineering Practice Program for a course in Power Plant Ash Utilization.

Secretary Allan W. Babcock of the National Ash Association is serving as the coordinator and a visiting instructor for the unique program. Other industry participants will include John H. Faber, Faber Associates; Dr. A.M. DeGioia, GAI Consultants; and Dennis L. Kinder, American Electric Power Co.

Dr. Mumtaz Usmen, Acting Chairman of the CE Department, is also actively participating in the course. Subjects being covered by the guest lecturers include ash production, ash management, ash utilization, and ash marketing.

PITTSBURGH, PA. — GAI Consultants, Inc. and Massaro Corporation have announced the formation of a new Utility Waste Management Corporation.

The new firm is designed to provide full service waste disposal and utilization capabilities to the electric utility industry.

GAI has been active as a consultant to the ash industry in both fields for several years.

Mulching Spoil

CRISFIELD, MD. — Researchers at the Cooperative Shellfish Aquaculture & Technology Laboratory here report progress in the development of oyster reefs utilizing fly ash.

A 36% blend of crushed shells added to fly ash plus an addition of 6% hydrated lime have been fabricated into a stable material that could be used in the future construction of such reefs.

Another encouraging aspect of the study indicates "levels of leachates from the mixes are lower than levels of metals that have been found in oysters and in some Chesapeake Bay bottom muds."

(6)

Ash Production Dips to 65.41 Million Tons in '82, Utilization Also Declines

WASHINGTON — Power plant ash production and utilization both dipped to five year lows in 1982, according to figures released by the National Ash Association.

Ash from the power production cycle amounted to 65.41 million tons - the lowest total since 1976 - while usage totaled 13.55 million tons representing an overall percentage of 20.7.

Despite the decline, ash moved into the fourth slot among the most abundant solid minerals ahead of Portland cement and iron ore.

During the same period, the responding electric utilities consumed 585.37 million tons of coal in their coal-fired generating stations.

Individual figures compiled by the NAA included 47.91 million tons of fly ash, 13.13 million tons of bottom ash, and 4.37 million tons of boiler slag.

The corresponding utilization totals for the 12-month span indicated applications, including in-house and external sales, of 7.95 million tons of fly ash (16.6%), 3.63 million tons of bottom ash (27.6%), and 1.97 million tons of boiler slag (45.1%).

Ash industry analysts attribute the decline to four major factors - a substantial reduction in consumption of electrical energy, a slow down in new home starts, a lowering of the ash content of the coal burned by the utility industry to meet emission standard and achieve lower operating costs, and a slow down in highway construction and maintenance.

Also, deferrals in coal conversion decisions and construction programs were contributors.

The same forecasters also predicted an upswing in the two categories when the 1983 figures are compiled.

Perhaps the most revealing statistic in the report was the fact that 51.86 million tons of power plant ash were removed to disposal areas with no utilization. These numbers included 39.96 million tons of fly ash, 9.50 million tons in bottom ash, and 2.40 million tons in boiler slag.

The major volume of ash sold went to cement and concrete products including 2.68 million tons of fly ash, 0.38 million tons in bottom ash, and 0.12 million tons in boiler slag.

Industry promotional efforts will be centered on mass tonnage applications such as structural fills and in coal mine reclamation work while preparing for a resumption of construction activity.

Producers are also being urged to beef up quality control through ash management activities.

Other marketing efforts are being geared toward the increased emphasis on the use of bottom ash in the manufacture of construction products.

NAA

Ash Production Ash Utilization - 1982

	(Million Tons)
I. ANNUAL COAL CONSUMPTION	585.37
II. TOTAL ASH PRODUCED	65.41
III ASH UTILIZED	13.55

	FLY ASH	BOTTOM ASH	BOILER SLAG
1. EXTERNAL UTILIZATION			
a. Cement and concrete products	2.68	.38	.12
b. Structural Fills	.44	.23	.05
c. Road Base	.23	.69	.07
d. Filler in asphalt mix	.10	-0-	.06
e. Snow and ice control	-0-	.67	.79
f. Blasting grit and roofing granules	.07	-0-	.68
g. Grouting	.29	-0-	.0
h. Coal mining applications	.11	-0-	-0-
i. Miscellaneous	.02	.13	.07
TOTAL EXTERNAL UTILIZATION	4.54	2.02	1.79
2. INTERNAL UTILIZATION			
a. Cement and concrete products	.01	-0-	-0-
b. Structural fills	1.89	1.45	.08
c. Road Base	.33	.35	.005
d. Miscellaneous	1.38	.11	.12
TOTAL INTERNAL UTILIZATION	3.41	1.61	.18
3. TOTAL ASH UTILIZED	7.95	3.63	1.97
4. ASH REMOVED TO DISPOSAL AREA AT COMPANY EXPENSE WITH NO UTILIZATION	39.96	9.50	2.40
5. TOTAL ASH PRODUCED	47.91	13.13	4.37

Comparative Results

Ash Produced	1966*	1977**	1978	1979	1980	1981	1982
Fly Ash	17.1	48.5	48.3	57.5	48.31	50.28	47.91
Bottom Ash	8.1	14.1	14.7	12.5	14.45	12.87	13.13
Boiler Slag	.0	5.2	5.1	5.2	3.84	5.18	4.37
TOTAL ASH PRODUCED	25.2	67.8	68.1	75.2	66.40	68.31	65.41
Ash Utilized							
Fly Ash	1.1	6.3	8.4	10.0	8.42	9.41	7.95
Bottom Ash	1.7	4.6	5.0	3.3	4.26	4.07	3.63
Boiler Slag	-0-	3.1	3.0	2.4	1.75	2.93	1.97
TOTAL ASH UTILIZED	3.1	14.0	16.4	15.7	12.43	16.41	13.55
Percent of Ash Utilized							
% Fly Ash	7.9	13.0	17.4	17.4	13.3	19.0	16.6
% Bottom Ash	21.0	32.6	34.0	26.4	29.5	32.0	27.6
% Boiler Slag	.0	60.0	58.8	46.0	48.1	57.0	45.1
PERCENT OF TOTAL ASH UTILIZED	12.1	20.7	24.1	21.0	18.7	24.0	20.7

*First year that data was taken

**1967-1976 data omitted from tatulation because of space limitation

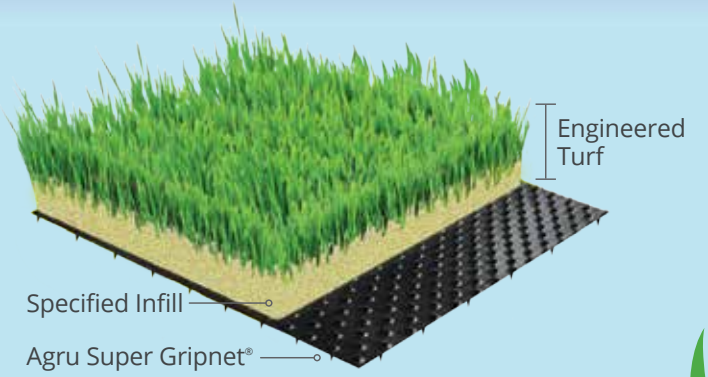
Compiled by the National Ash Association, Inc.•

(7)

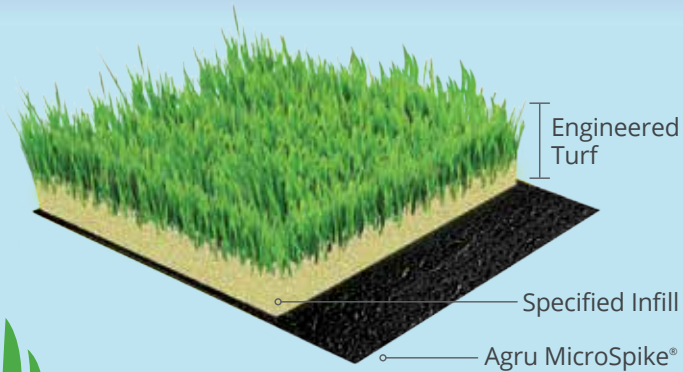
Advanced Engineered Closure System

CCR Rule Compliant Closure System for Impoundments & Landfills

ClosureTurf® with Super Gripnet®



ClosureTurf® with MicroSpike®



ClosureTurf®

900 acres of closure and counting...

54 acre landfill closure in New York

AgruAmerica.com
Chris Eichelberger
ceichelberger@agruamerica.com
330-606-8970 • 800-373-2478

agru america

FLY ASH STORAGE CRITICAL FOR INCREASING USE

By Travis Collins

The recycling goal for coal burning utilities is 100% beneficial use of its coal combustion products. This is often a difficult standard to achieve. Fortunately, industry demand and need for fly ash in concrete has progressed over the last 40 years to the point that "concrete quality" fly ash is an integral product in the manufacture of most, if not all, concrete mixtures produced in the United States. As the demand and cost to use fly ash in concrete has increased, rightfully so have the quality control and supply expectations from the concrete industry risen as well. The recent closures of older generating stations coupled with the installation of various emissions-control methods on other units and the increase in renewable energy sources have all adversely affected the quality and quantity of available fly ash for use in concrete. Consequently, there is increased industry demand on the need for reliable supplies of fly ash for the concrete industry. Because fly ash is produced as a by-product and sold as a quality-assured, integral pozzolan in a concrete mixture, the idea of ash sometimes being available and sometimes not is unacceptable to concrete producers and design engineers. The seasonal nature of the concrete construction industry adds even more pressure during the peak demand months of summer and fall. With peak season demand pressure seemingly increasing every year, the issue of a dedicated fly ash storage in a market or lack thereof becomes a subject all stakeholders—utility, marketer, concrete producer, GC, design engineer, and state DOT—become familiar with when there is a temporary shortage.

Photo 1: National Minerals Corporation's terminal in Cohasset, MN, allows storage of ash produced during winter months for use in the summer construction season

THE CASE FOR STORAGE—EXAMPLE A: CLAY BOSWELL ENERGY CENTER—0 TO 100%

Minnesota Power's Clay Boswell Energy Center (BEC) is a 1025 MW plant located in Cohasset, MN, fueled by Powder River Basin coal. There are four coal-fired units at BEC, with Unit 3 being the second largest at 360 MW. In 2007-2009, Minnesota Power invested in a complete environmental retrofit of Unit 3 to install state-of-the-art emission-control equipment. This retrofit project was nationally recognized for its successful design, implementation, and level of emissions control. Part of this retrofit included segregation of Unit 3, dry collection, and the construction of a 2000 ton fly ash silo for Unit 3 fly ash.

Shortly after the retrofit was complete, technical representatives from National Minerals Corporation (NMC) in conjunction with Minnesota Power began sampling and testing the fly ash produced by Unit 3 to ascertain its characteristics with respect to ASTM C618 for use as a cement replacement. Over the course of 18 months, Minnesota Power and NMC worked together to modify the blend of two PRB coal sources and PAC and ammonia injection rates to find suitable levels for both the plant requirements as well as the effect on the fly ash chemistry.

Ultimately, BEC 3 fly ash has become a consistent, relied-upon Class C fly ash for the local ready mixed, precast, and concrete paving market in Minnesota with NMC cultivating a loyal customer base for 100% of the seasonal production within a 300 mile radius from the plant. However, being located near the Iron Range of Minnesota, the concrete construction season is only May to October, at best. This leaves 7 months of coal burning and fly ash production that could be stored and beneficially reused in concrete.

THE PLAN

After two seasons of successfully marketing BEC 3 fly ash to the concrete industry, representatives of Minnesota Power and NMC began discussing the next steps to further develop the marketing effort of this material to maximize both its beneficial use and revenue potential. NMC offered to purchase land nearby in the city-owned Cohasset Industrial Park and build a 10,000 ton capacity dedicated flat storage terminal for BEC 3 fly ash.

As the plan to build dedicated fly ash storage began to take shape, the saying "the devil is in the details" was very relevant, due to the uncertainty at the time due to the EPA trying to parse the definition of hazardous and non-hazardous as it relates to fly ash. As a result, this question was rightfully in the minds of the Minnesota Pollution Control Agency, the local governing and permitting body, and Minnesota Power. Even though Minnesota Power is committed to seeing encapsulated beneficial reuse of their CCPs, they needed assurance that NMC would be in compliance with all federal and local rulings pertaining to fly ash, storage, emissions, particulates, and groundwater concerns.

Although construction was off-site and was designed and funded by National Minerals Corporation, Minnesota Power's

Photo 2: Construction of the $1.1 billion U.S. Bank Stadium depended on a reliable supply of fly ash for its concrete components

Photo 3: More than 5000 structural precast concrete elements with 28-day minimum strength of 10,000 psi were required for construction of U.S. Bank Stadium

environmental engineering representatives and fuels staff were very involved and helpful to make sure that all state, local, and federal thresholds and permits pertaining to solid waste storage standards were met. They also recognized the long-term benefits a storage building would provide for Boswell Unit 3 fly ash, not to mention the positive economic impact on the city of Cohasset, population 2500. Ultimately, a storage terminal was permitted, constructed, and commissioned in time to store the winter production of BEC 3.

NMC chose to build a 20,000 ft^2, poured-in-place concrete and steel structure, with a concrete floor and a screw conveyor for the loading of trucks. Winter fly ash is hauled in NMC trucks to the Cohasset terminal and pneumatically conveyed into the building. A 6000+ CFM dust collector assures particulate matter emissions far below state and federal thresholds.

WIN-WIN-WIN SOLUTION

It is not often when you can truly present a win-win-win scenario. Minnesota Power is benefitting from the marketing of 100% of Unit 3 fly ash by eliminating the costs associated with landfilling, seeing annual revenues grow through the sales of fly ash year-round and is meeting the company vision of moving Energy Forward through pursuing beneficial reuse opportunities of its CCPs, among other renewable power and recycling initiatives.

As a marketer, building and maintaining dedicated ash storage enables NMC to provide a continuity of supply to its customer base throughout the year. As unplanned outages occur or other unforeseen issues at the power plant happen, NMC is able to assure an uninterrupted supply of fly ash to important concrete projects around the state of Minnesota.

With the closure of older coal-fired plants in this region and the abundant supply of wind energy, historical supply volumes from local power plants are not as easy to predict, causing issues in maintaining a consistent source of fly ash for many concrete producers. Short-notice material changes create havoc with ready mix producers, especially with high-performance, high-strength concrete projects—such as bridge decks, parking ramps, high-rise construction, and main-line concrete paving—where the mixture designs, lab results, and field performance of the concrete are tested and accepted based on the results of a specific set of materials.

U.S. BANK STADIUM

The $1.1 billion U.S. Bank Stadium construction project—home of the 2018 Super Bowl in downtown Minneapolis, MN—fit the definition of a high-performance concrete project where the expectations on all of the concrete materials selected could not be compromised or deviated. BEC 3 fly ash was selected to replace 25% of the cement in all of the precast concrete. The 5000+ structural precast elements (including stadia risers, beams, columns, and walls) for the stadium were produced and erected by Wells Concrete. The production and erection schedule was carefully orchestrated over the course of 2 years. All of the precast mixture designs required a 28-day minimum strength of 10,000 psi. Once the project started, changing materials and thus causing a delay in the project was not an option. Having the ability to guarantee a continuity of supply (that is, a storage terminal) of a consistent source of fly ash despite several scheduled plant outages throughout the project enabled NMC to be the chosen supplier with BEC 3 fly ash to this significant local project—not bad for the market credibility of a material that was still relatively new at the time in the local concrete market.

NOTHING NEW UNDER THE SUN

The idea of building off-site flat storage for fly ash is not a new one in the industry. National Minerals Corporation is one of the ash marketing pioneers that commercialized this concept in 1985 with the construction of a 35,000 ton dedicated flat storage, bulk fly ash terminal located in Eagan, MN. These original buildings were constructed using precast double Ts, incidentally also supplied by Wells Concrete. Although the terminal is under different ownership, the buildings are still in service for the fly ash sources they were initially constructed for over 30 years ago. NMC also constructed a 12,000 ton onsite storage terminal for WE Energies at Pleasant Prairie in 1988 that is still paying dividends for the utility, the current marketer, and ultimately the local concrete industry.

The recent experience and the positive economic impact of building dedicated storage at the Clay Boswell Energy Center is a good example of a utility and a marketer working together to achieve the mutual goal of 100% use of a CCP. NMC has since supplemented the storage building in Cohasset with a 12,000 ton fly ash terminal in Hastings, MN, to further service the off-season production of Minnesota Power and provide a reliable ash supply to their Minneapolis-St. Paul customer base for this material. ❖

Travis Collins is Vice President of National Minerals Corporation. Prior to National Minerals, he spent 18 years in the chemical admixture industry. National Minerals Corporation is a Minnesota-based fly ash marketer that has a long history of ACAA membership and fly ash marketing that dates back to 1975. For more information, please visit www.nmcflyash.com.

Bringing creative solutions to complex challenges

Amec Foster Wheeler's experts understand the complex interactions between air quality control systems, wastewater treatment, ash handling and boiler operation. From planning and construction to operations and retirement, we deliver cost-effective, regulatory compliant solutions to improve productivity, reduce liabilities and increase efficiencies for our power customers.

- twitter.com/amec_fw
- linkedin.com/company/amecfw
- youtube.com/user/amecfw
- facebook.com/amecfw

amec foster wheeler

connected excellence in all we do

Oil, Gas & Chemicals

Power & Process

Environment & Infrastructure

Mining

amecfw.com/ccr

LEVERAGING DATA TO PLAN COAL COMBUSTION PRODUCT SUPPLY

Data forecast models help compile and compare the viability of locations

By Ross Gorman

The SEFA Group has developed a new forecast model to make ash marketing more predictable and efficient. With increasing demand for high-quality fly ash, SEFA applied data analytics to take in-house expertise in fly ash marketing and develop a sophisticated forecasting model. It needed to recognize supply and demand variability, transportation costs, and regional trends. External statistics captured in industry and government data were supplemented with internal data compiled by SEFA, as the company identified key factors to predict evolving shifts in the CCP market.

Using a set of variables to evaluate the estimated future demand for material, SEFA began optimizing the company's future Staged Turbulent Air Reactor (STAR®) plants. They have also used the model to look at more byproduct locations and evaluate expansion at existing locations. SEFA had always used this type of planning but former models were labor-intensive and could require hours or days for a single scenario. SEFA wanted to analyze more factors, and include variable assumptions in the algorithms plus consider multiple scenarios in less time.

WHY THE MODEL WAS DEVELOPED

The SEFA Group leverages technology in every part of their business to provide better service to partners and customers, now and in the future. Like many of their innovations, this analytical tool was developed as a solution to a complex opportunity. Knowing the history of fly ash demand and current state of supply is no longer enough information for future forecasting. Current shifts away from coal to natural gas increasingly effect supply of fly ash from existing sources. Transportation costs figure prominently in marketing the products, and regional demand is dependent on many external factors—geographic, demographic, and governmental.

SEFA needed the ability to look at a variety of scenarios and analyze that impact on their existing plants and planned new plants. The model provided that advantage. Formulas considered different estimates for cement use, growth, and for future replacement rates, based on industry information. Customers of SEFA provided input to determine different replacement ratios expected for cement in ready mix concrete. Actual road mileage and mapping data were integrated to predict how far ash will be transported and to show the transportation component for a given scenario. This provided a more realistic transportation rate than previously used. With increased information and improved and accurate data, the company can now look at how different variables could affect the market feasibility of material for any given source. It can also evaluate critical assumptions and drivers in that feasibility.

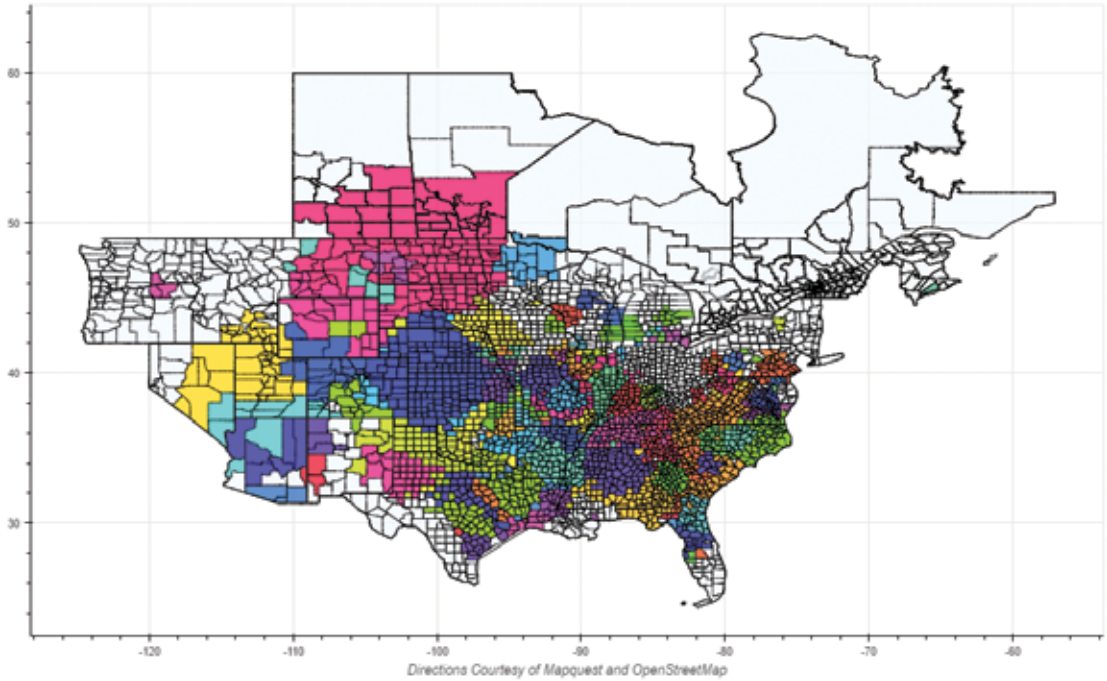


Fig. 1: SEFA's forecasting model enables identifying regional trends in CCP supply and demand

HOW THE MODEL IS USED

SEFA is looking at the demand for fly ash and the distance to all producers in the continental United States and Canada. The new model takes into consideration existing information for population growth and estimated new construction to forecast the future demand for product, factoring in large swings in fly ash production, sudden changes in demand, seasonality, and the competitive impact.

The company can now quantify how adding new plants or new sources would impact existing facilities. For prospective sources, SEFA can quickly look at distance to any location for a more realistic transportation rate, and can look at actual usage to predict the marketing area. Evaluating a wide variety of scenarios, they can now predict real options.

While creating a new planning tool, SEFA is developing visual charts which allow the user to easily drill down and examine the underlying data, trends, patterns, and critical factors behind optional locations. Results generated by the model can be used to generate new data combinations and scenarios. For example, predicting how many loads a day will go out of a potential source leads to considering how those loads could realistically be divided among actual drivers. Factoring in drivers doing one, two, or three loads a day can be used to predict the optimum number of drivers needed while meeting DOT regulations. SEFA can also look at seasonal variations in ash usage for a given source to predict fluctuating fleet size. The model can potentially predict when to schedule outages at STAR plants and manage fly ash storage.

SUMMARY

The company's forecasting method does not replace human decisions or predict outcomes from customer emergencies and service issues which can take priority over cost efficiency. The tool does help resolve those problems more efficiently. Like most algorithm models, it handles trends and consolidates regional volume and resources well, assisting in plant or customer location decisions. It is especially helpful in evaluating the ripple effect of varied assumptions such as transport costs, construction demand, or supply patterns. It still requires judgment on micro or fine detail predictions where the general assumptions may not be as valid for a particular situation.

SEFA's new model enables management to look at large groups of sophisticated data considering 30 or 40 analyses a day, varying complicated assumptions in cement use, population, seasonal supply, customer, and transportation issues. It is easier to discuss the respective assumptions in the model because the results from them may be contrasted easily. The consequence of small or large swings of assumption values can be better understood, helping to prioritize resources and attention. Most important, the focus of the human resource becomes evaluating information and not computing it. Better decisions with partners and customers have emerged from SEFA's use of complex market modeling technologies. ❖

Ross Gorman is a Process Engineer at The SEFA Group with bachelor's and master's degrees in mechanical engineering, and is currently working on his PhD in mechanical engineering, specializing in thermal fluid sciences.

IN & AROUND ACAA

COVINGTON, KY

Approximately 200 people attended the "Midwest Workshop on Current Issues in Ponded Coal Combustion Products," November 1-2, 2016. Jointly sponsored by American Coal Ash Association, University of Kentucky Center for Applied Energy Research, and Electric Power Research Institute, the workshop was the second well-attended event on this topic since U.S. Environmental Protection Agency coal ash disposal regulations were finalized in 2015.

DETROIT, MI

At The Concrete Convention and Exposition – Spring 2017 of the American Concrete Institute, a panel of American Coal Ash Association members made presentations on beneficiation technologies for fly ash. Serving on the panel were (left to right) Hank Keiper, Area Manager, The SEFA Group; Dr. Rafic Minkara, Vice President for Research and Development, Headwaters Resources; Craig Plunk, Director of Technical Services, Boral Material Technologies; Lisa Cooper, Chief Executive Officer, PMI Ash Technologies; Dr. Cesar Constantino, Director of Business Development, Separation Technologies; and Thomas Adams, ACAA Executive Director. The 2-hour session was moderated by Thomas Adams and sponsored by ACI Committee 232, Fly Ash in Concrete.

JACKSONVILLE, FL

American Coal Ash Association's Women's Leadership Forum met during ACAA's Winter Meeting, January 24-25, 2017. The Forum is an informal group of ACAA women whose broad goals are to develop interest and qualifications of women members for ACAA committee leadership and officer positions; to acquaint members with the wide range of energy and building materials careers, and professional organizations and meetings with the goal of opening paths for further career development; and to promote professional interactions and camaraderie among members and women in related fields, including government, energy, building materials, and consulting.

NATIONAL MINERALS CORPORATION

Improved CCP Management & Revenue Return

Assess your needs:
We evaluate the characteristics of the CCPs produced and provide the utility an understanding of the market dynamics and opportunities for greater utilization for specification grade and non-specification grade fly ash.

Improved CCP Utilization & Revenue:
Our utility partners have realized a substantial increase in off-site utilization of fly ash. In addition, NMC has a sales staff dedicated solely to the marketing and utilization of CCPs in concrete and non-concrete applications.

Dedicated Storage:
We currently manage 50,000 tons of fly ash storage in 4 Midwest locations. Over the years NMC has built dedicated storage for over 200,000 tons of fly ash that is still in use today.

MAXIMIZING THE BENEFICIAL USE OPPORTUNITIES FOR COAL ASH PRODUCTS

844-454-5400 - www.nmcflyash.com

COAL FLY ASH REGULATIONS SPUR QUESTIONS OVER DUST EMISSIONS AND WASTEWATER CONTROL

By Derek Schussele

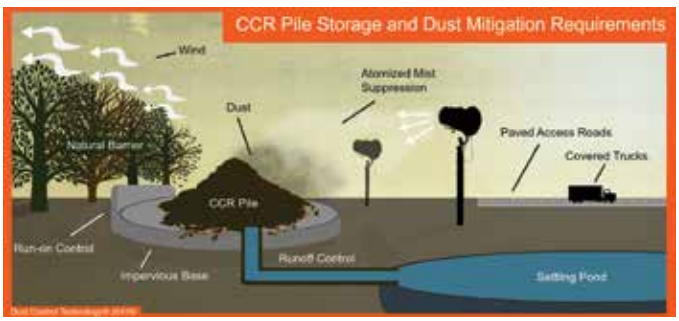
In recent years, incidents of leakage or breaching of surface impoundments have inspired changes in fly ash storage regulations with regards to containment of settling ponds used for the storage of coal combustion residuals (CCRs) including fly ash, bottom ash, boiler slag, and flue gas desulfurization materials.

The Environmental Protection Agency (EPA) Rule "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities"[1] appears to be aimed directly at coal-burning generators. Instead of settling ponds, the EPA is now requiring CCR-producing companies to transition to dry storage, with very stringent rules regarding location and treatment.

Fly ash producers transitioning to new dry storage strategies are discovering that compliance with one regulation can have them bumping up against air quality and wastewater standards. Monitored by extremely sensitive technology, testing for airborne particulates and runoff has shown that timeworn dust suppression methods such as industrial sprinklers are no longer sufficient to maintain compliance with the current federal, state, and local regulation of fugitive dust and wastewater.

CCR REGULATION

Authors of the EPA Final Rule now mandate operators of sites to have "'Cradle-to-grave' management, subject to requirements for composite liners, groundwater monitoring, structural stability standards, corrective actions, closure/post-closure care and financial assurance."



For outdoor storage, the EPA Final Rule requires an impervious base with both run-on and runoff control leading to a lined settling pond.

The Final Rule further requires that owners and operators create a CCR Fugitive Dust Control Plan that gives clear instructions as to how they plan to mitigate fugitive dust emissions from their locations. EPA examples of appropriate control measures include operational changes such as reducing fall distances at material drop points, covering trucks, enforcing reduced vehicle speed limits, and reducing or halting operations during high-wind events. Other measures could involve structural changes to the facility, paving and sweeping roads, or locating the CCR inside of an enclosure or partial enclosure.

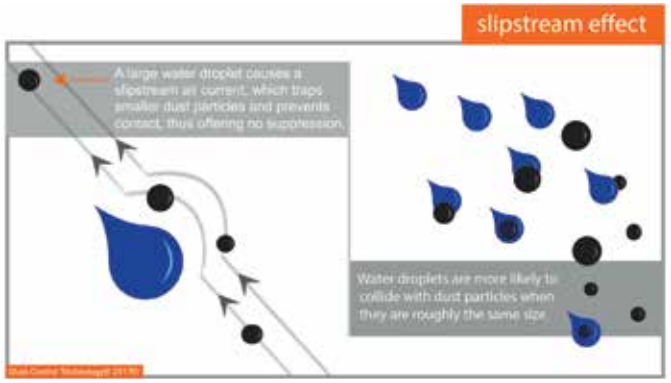
For outdoor storage, the EPA Final Rule restricts the placement of CCR storage piles to an impervious base with both run-on and run-off control leading to a lined settling pond. The agency suggests using wind barriers, compaction and/or vegetative shields, applying a daily cover, and operating a water spray or fogging system.

FUGITIVE DUST

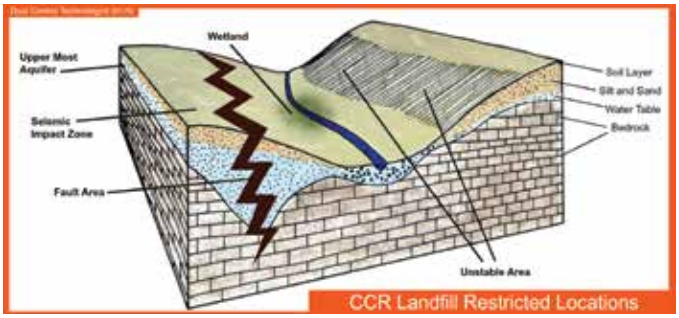
Dust particles that are 200 microns (μm) or smaller are often able to linger in the air and travel on naturally occurring atmospheric currents. At around 100 μm, these particles are considered inhalable—able to irritate the nose and throat. (For perspective, a human hair usually ranges between 50 and 75 μm in diameter.[2]) Dust monitors generally test for PM-10—particulate matter 10 μm in diameter.

Wind naturally comes to mind as a main cause of fugitive dust, but it's only part of the problem. In most operations, the greatest amount of fugitive dust is caused by disruption from loading, offloading, conveying, and transport of fly ash. For this reason, attempts to control dust only via surface suppression are largely ineffective. Surface suppression from industrial sprinklers create droplets approximately 200 to 10,000 μm in size. Large droplets are unsuccessful against airborne dust particles, due to a phenomenon known as the "slipstream effect."

A slipstream is created when a solid mass moves swiftly through the air. Like air moving around an airplane wing and keeping the craft aloft, a slipstream also travels around a large falling water droplet. Smaller dust particles can get caught in this slipstream and be directed away from the droplet, remaining airborne. The greatest chance for a collision between droplets and dust particles (the basis for



Atomized mist suppresses dust more effectively than sprinklers and spray bars, creating smaller droplets that avoid the slipstream effect.



Preventing runoff is a critical element of dust control.

this type of dust control) occurs when the two are about the same size.

Developed in the last decade, atomized mist technology avoids the slipstream effect, producing millions of tiny droplets that are roughly 50 to 200 µm in diameter. Small enough to travel on air currents and producing virtually no slipstream, the droplets collide with particles and use their combined mass to drag them to the ground.

Available in a wide range of sizes, some equipment designs can cover massive areas. For example, the largest DustBoss® design features a specialized barrel with a powerful 60 hp industrial fan on one side and a misting ring on the other. A 10 hp (7.5 kW) booster pump sends pressurized water through the circular manifold, which is fitted with atomizing nozzles. The nozzles fracture the water into an engineered mist, throwing millions of tiny droplets in a cone-shaped plume that can reach up to 100 m (328 ft), covering approximately 280,000 ft^2 (31,000 m^2) of area when using a 359-degree oscillator.

WASTEWATER RUNOFF

The EPA's Final Rule restricts the placement of CCR storage piles away from an aquifer, wetland, seismic impact zone, fault area, or unstable soil. This makes the volume of runoff from dust suppression technology an even more important consideration. Generally using between 165 and 500 gal./min,[3] industrial sprinklers can fill two to three Olympic-sized swimming pools (approx. 2.4 to 3.6 million gal.) every week of operation. Atomized mist is able to deliver a fraction of the water volume, with even the largest designs putting out less than 40 GPM.

The lower water use of an atomized mist system helps prevent over-saturation and runoff, drastically reducing wastewater.

Atomized mist is one of the only technologies that can deliver effective control of both surface dust and airborne particles.

Atomized misting units can be tower-mounted for even greater range and more precise aiming.

This improved water control allows operators to better maintain compliance with local, state, and federal regulations and restrictions.

MODERN METHODS

Some managers are achieving a lower cost of operation by using less water and fewer maintenance hours spent controlling airborne dust and runoff. Engineered mist offers superior surface suppression and effectively addresses airborne fugitive dust, both during disruptive operations and after the fly ash has been consigned in a landfill. Requiring far less water than industrial sprinklers, wastewater from atomized mist can be more easily managed according to federal, state, and local requirements.

The implication of a shift to dry storage may be a hit to profits in the short term, but could yield lower costs and a better relationship with regulators and surrounding communities over the long run. ❖

Derek Schussele is a Dust Management Specialist for Dust Control Technology.

REFERENCES

1. EPA, "Hazardous and Solid Waste Management System; Disposal Of Coal Combustion Residuals From Electric Utilities," U.S. Environmental Protection Agency, 40 CFR Parts 257 and 261 [EPA-HQ-RCRA-2009-0640; FRL-9149-4] RIN-2050-AE81, Washington, DC, Dec. 2014.

2. "Particles: Size Makes All the Difference," National Institute of Environmental Health Services, Research Triangle Park, NC, 2006.

3. Harrison, K., "Factors to Consider in Selecting a Farm Irrigation System," University of Georgia, College of Agricultural and Environmental Sciences, Athens, GA, 2012, http://extension.uga.edu/publications/detail.cfm?number=B882#high pressure.

KEY ROLE OF LEACHATE DATA IN EVALUATING CCP BENEFICIAL USE

By Ari S. Lewis, Eric M. Dubé, and Andrew Bittner

In the spring of 2016, the U.S. Environmental Protection Agency (US EPA) published guidance that describes a general methodology for evaluating the beneficial use of non-hazardous industrial secondary materials, which includes coal combustion products (CCPs) (US EPA 2016a). This methodology is intended for those performing or reviewing beneficial use evaluations and other stakeholders, including state and local governments, the regulated community, and the public. In addition, US EPA has also published a compendium of resources (for example, publicly available guidance documents, statistical methods, health-based benchmarks, and fate and transport models) which was developed to assist a user in implementing the Agency's beneficial use methodology (US EPA 2016b). It is noteworthy that the guidance was designed to address the beneficial use of any non-hazardous "secondary material"; thus, some of the information in the guidance is not relevant to the beneficial use of CCPs, and other parts of the guidance lack details that would better support a robust risk evaluation of the beneficial use of CCPs.

The general risk evaluation process for the beneficial use of non-hazardous secondary materials consists of four iterative steps:

1. **Existing Evaluations:** Using existing assessments to infer potential risks associated with a proposed beneficial use project;
2. **Comparison to Analogous Products:** Comparing potential risks from an analogous material application to the proposed beneficial use;
3. **Screening Analysis:** Comparing potential exposures to constituents from a proposed beneficial use application to appropriate health and environmental benchmarks; and
4. **Risk Modeling:** Quantifying potential human health and environmental risks from estimated exposures to constituents from a beneficial use application.

US EPA's guidance is clear that all possible exposure pathways throughout a product's life cycle are within the scope of the assessment (for example, inhalation exposure to fugitive dust during construction, the product's service life, and disposal of the product). As a result, there are many important issues that should be considered when performing a beneficial use evaluation. A key consideration is the nature and extent of the available leachate data. Leachate data is important for a beneficial use evaluation because it is essential for evaluating the potential migration of CCP constituents to groundwater for construction projects, especially when such projects intersect the water table.

Although US EPA acknowledges the leaching to groundwater pathway, the Agency devotes surprising little discussion in its guidance to the nature and extent of water samples and/or leachate data that would be needed to adequately characterize potential risk from this pathway. In the first step of its beneficial use risk evaluation methodology, US EPA guidance advises the user to rely preferentially on existing data and assessments. The substantial body of existing information on CCP chemical composition and associated leachate may be of little value for many beneficial use assessments involving CCP. This is because the guidance is clear that CCP materials cannot be evaluated in isolation and that assessment of "environmental release" must consider how factors such as time, temperature, pressure, pH, precipitation, and characteristics of the surrounding media affect leaching potential and constituent transport (US EPA 2016b). This means that an existing assessment would need to have appropriately captured all of these factors to reliably infer the potential risk of the proposed beneficial use. Additionally, US EPA points out that if the beneficial use assessment is relying on existing data, there needs to be enough detail on sampling and analytical methodology to be able to judge the quality of the data. Finding such an existing assessment that is robust and adequately representative of a proposed beneficial use involving CCP will likely be

difficult, particularly when the surrounding environment is an important predictor of chemical constituent leaching and transport behavior. It is noteworthy, however, that while a dataset related to a specific use may be hard to come by, many of the general characteristics associated with the behavior of leachate under different environmental factors are well characterized in the literature and may be helpful for bridging and understanding key factors, uncertainties, and limitations in a beneficial use evaluation.

If identifying an existing assessment is not feasible, the next step in US EPA's beneficial use risk evaluation approach involves comparing the proposed beneficial use to an analogous material used for the same application. The guidance is fairly detailed on the type of information that needs to be considered to ensure that an "apples to apples" comparison is being made between the proposed beneficial use and the analogous product(s). In particular, the guidance emphasizes the issue of interaction with the surrounding environment—that is, how CCP and analogous materials may interact with the surrounding environment differently and the implications of these differences. The guidance further raises issues related to the appropriate comparison of disparate datasets and the type of statistical comparisons that may be appropriate. In particular, the guidance notes, "Whether comparing stressor levels at the point of exposure or some surrogate, it is critical that comparisons consider the entire distribution of potential values, rather than individual data points" (US EPA 2016b). Comparing distributions of values can potentially be complicated, especially if the data for the analogous material are from different studies. In their compendium of resources, US EPA points to more general resources on statistical techniques that facilitate reliable conclusions (US EPA 2016b). Overall, however, as with the use of existing assessments, the nature and extent of the data needed to reach a reliable conclusion that the potential risk of a proposed beneficial use involving CCP will pose comparable or lower risks than the use of analogous materials present a rather formidable challenge.

Given the "stars that need to align" to be able to rely on existing assessments or analogous product comparisons, it seems likely that new data on planned beneficial use applications will need to be generated to conduct the screening analysis and/or risk modeling steps outlined in US EPA's risk evaluation process. In fact, even for analogous product comparisons, it is likely that data on the proposed CCP beneficial use will need to be generated. Figure 1 is adapted from US EPA's general risk evaluation process (US EPA 2016a) and focuses on the steps that would be involved in a groundwater evaluation in which CCP is beneficially used as part of a construction project and performing an evaluation using an existing assessment or an analogous product is not possible. As demonstrated in Fig. 1, if the concentration of a constituent in leachate is below its corresponding health-based benchmark, then the risk assessment portion of the beneficial use evaluation process is complete and a user of the methodology can move to the final phase of the process, Final Characterization. If a constituent is not eliminated in this initial screening step, the evaluation can move to the Refined Assessment/Risk Modeling step, in which a simple screening-level fate and transport model can first be used to predict an exposure point concentration for a receptor based on the leachate data and other environmental factors. More sophisticated modeling can also be used as necessary. US EPA provides recommendations and descriptions for screening level and more complex fate and transport models in its compendium of resources (US EPA 2016b). As part of the Risk Modeling step of the beneficial use evaluation process, risk assessment procedures can be used after the refined environmental modeling to further refine the analysis and calculate acceptable risk estimates for constituents that exceeded their benchmarks. Thus, refined environmental and risk modeling may be needed to reach the finish line (Final Characterization) and can be used to determine whether the potential risks to human health or the environment associated with a proposed CCP beneficial use are acceptable (that is, below US EPA's target risk levels) and whether the beneficial use "is appropriate as proposed" (US EPA 2016a).

As noted in Fig. 1, leachate data are at the center of US EPA's methodology for beneficial use risk evaluations when CCP is being analyzed for beneficial use. Surprisingly, US EPA provides little helpful guidance on the topic of leachate data generation and its subsequent assessment. For example, US EPA provides only a limited discussion in its beneficial use evaluation guidance of how to best design a sampling program that speaks to the sufficiency and representativeness of the data to adequately characterize risk. Thus, it may be prudent to ensure that any authority overseeing a beneficial use evaluation finds the proposed leachate study plan acceptable before resources are committed to the study.

In its compendium of resources document, US EPA discusses comparing media concentrations at the "point of release" to health-based benchmarks, noting that "If exposures at the point of release are found to be below all levels of concern as defined by the selected screening benchmarks, then no further evaluation is warranted for that particular exposure route" (US EPA 2016b). Although there is some mention that this type of comparison is appropriate for direct contact pathways (for example, incidental ingestion by workers), the comparison of leachate data to health-based benchmarks is not specifically mentioned. This screening step, however, is likely to be essential for the evaluation of beneficial use projects with CCP because it is possible that many constituents in such applications can be screened out based on comparison of constituents in leachate data to appropriate health-based benchmarks. That is, it would not be necessary to model constituent transport to estimate concentrations of a constituent the receptor may be exposed to if leachate concentrations of the constituent are already below the appropriate screening benchmarks. The challenge would be ensuring that the modeled constituent leachate concentrations are representative of those that would be present under real-world conditions.

For both the Screening Analysis and the Refined Assessment/Risk Modeling steps of a beneficial use evaluation, US EPA is not prescriptive regarding leachate analytical methods and instead refers the reader to an appendix with information related to

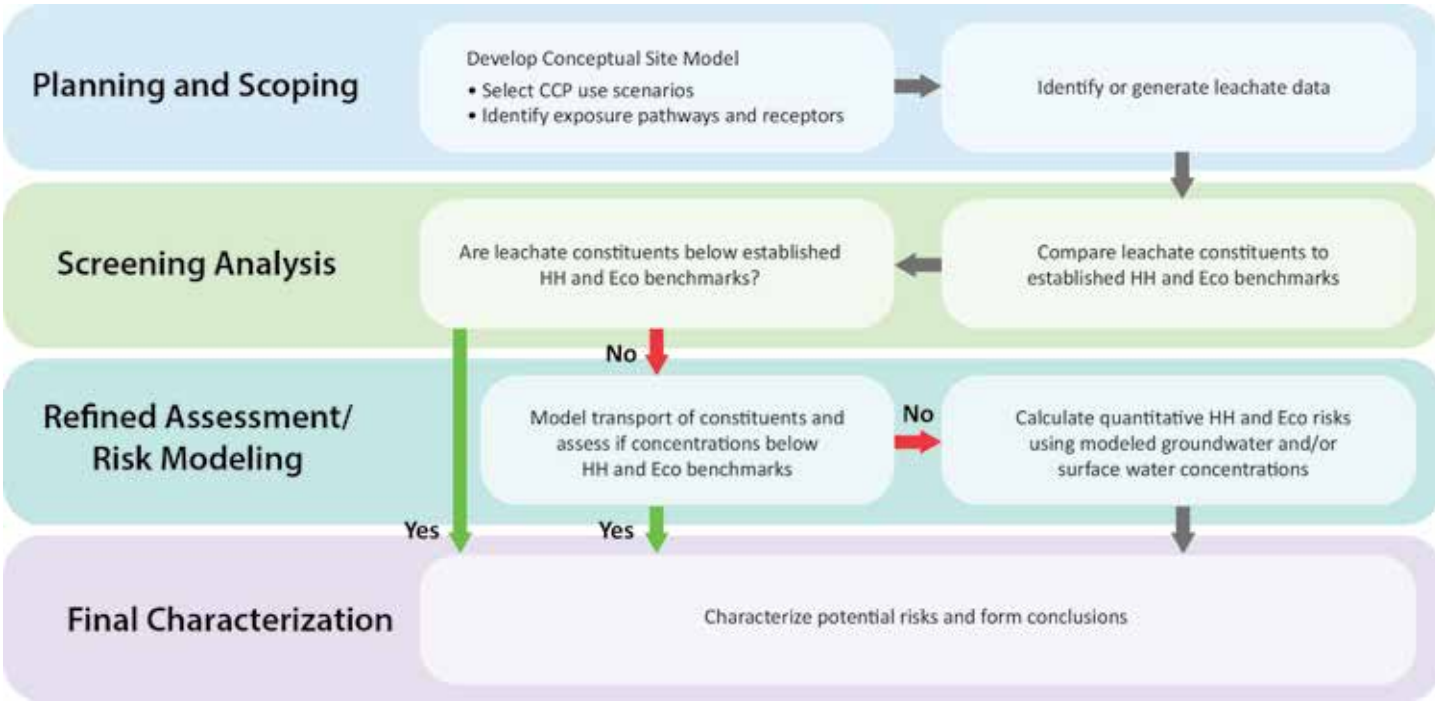


Fig. 1: Proposed beneficial use evaluation approach for CCP impact to groundwater (Notes: HH = human health; Eco = ecological)

the toxicity characteristic leaching procedure (TCLP), synthetic precipitation leaching procedure (SPLP), and Leaching Environmental Assessment Framework (LEAF) test methods (US EPA 2016b). US EPA does not make any formal recommendations on how and when to use certain methods, even though throughout the guidance documents, the Agency clearly emphasizes understanding constituent fate and transport over an extended timeframe and over a wide range of possible environmental conditions. The lack of any specific recommendation for a leachate testing procedure in the US EPA guidance is noteworthy, given the recent research investment US EPA has made into the development of the LEAF testing program, which was specifically designed to characterize leachate behavior over a wide range of environmental conditions (US EPA 2016b). Instead of advocating for broad-based analytical testing, US EPA simply states:

"There is an opportunity during planning and scoping to manage uncertainty through the selection of analytical methods that will either minimize it or deliberately bias it in a known, protective direction. The most suitable methods may not always be the most sophisticated. The added complexity of some methods might not add value when less complex methods are sufficient, and may actually exacerbate the amount of uncertainty present in the evaluation" (US EPA 2016a).

While useful, US EPA's beneficial use evaluation guidance is deliberately generic, offering significant flexibility in how risks from CCP beneficial uses can be evaluated. Given the lack of clear direction from the Agency and the complex task at hand, it will be incumbent on those conducting such evaluations to design leachate sampling and analysis plans that meet the goal of characterizing real-world scenarios without introducing data that characterizes implausible scenarios. ❖

REFERENCES

US EPA, 2016a, "Methodology for Evaluating Beneficial Uses of Industrial Non-Hazardous Secondary Materials," EPA 530-R-16-011, Office of Land and Emergency Management, Office of Resource Conservation and Recovery, Washington, DC, 15 pp.

US EPA, 2016b, "Beneficial Use Compendium: A Collection of Resources and Tools to Support Beneficial Use of Evaluation," EPA 530-R-16-009, Office of Land and Emergency Management, Office of Resource Conservation and Recovery, Washington, DC, 138 pp.

Ari S. Lewis is Principal at Gradient, located in Cambridge, MA, with expertise in toxicology and risk assessment. She has worked extensively on evaluating the potential risks associated with coal combustion products, both from disposal and beneficial use applications. Before joining Gradient, Lewis received her MS from Cornell University, Ithaca, NY, where she studied arsenic toxicity.

Eric M. Dubé is a Senior Environmental Health Scientist at Gradient with over 20 years of experience in health risk assessment for hazardous waste sites, food safety, pesticide and chemical registration, and regulatory analysis. Prior to Gradient, Dubé worked in the biotechnology industry and earned an MPH at Johns Hopkins University, Baltimore, MD.

Andrew Bittner is a Principal Scientist at Gradient and a licensed professional engineer. Bittner is an expert in the fate and transport of contaminants in the environment and has worked on a variety of projects involving groundwater and surface water modeling of coal combustion product constituents. Bittner received his master's degree from the Massachusetts Institute of Technology, Cambridge, MA, and his bachelor's degrees from the University of Michigan, Ann Arbor, MI.

WE HAVE YOUR ASH COVERED

Vegetative Establishment
Sustainable Final Cover

Erosion Control and
Dust Suppression

Moisture Management
for Ash Transport

Be confident in your CCR compliance with proven solutions from Profile Products

Profile Products has helped utilities and energy producers around the globe successfully reduce their environmental liabilities while decreasing the time, labor and cost of CCR reclamation methods. A broad range of products, techniques and expertise in coal ash management has established our proven record of success on some of the toughest CCR challenges. We've worked on a long list of projects with companies that include: Tennessee Valley Authority, Duke Energy, Progress Energy, American Electric Power and others. Why take chances? Put our expertise and experience to work for you.

For a free on-site analysis and recommendations or a Lunch and Learn seminar, call 800-508-8681. Visit www.profileproducts.com for more information.

Profile®

Solutions for your Environment™

BRIDGING THE GAP BETWEEN REGIONAL SUPPLY AND NATIONAL DEMAND THROUGH CHARAH'S MULTISOURCE℠

By Scott Ziegler

For concrete producers around the globe, fly ash provides the valuable advantages of added strength, durability, increased workability, and improved finished product quality. For coal-fired utilities, the sales and marketing of fly ash for concrete products and other applications eliminates the need to dispose of fly ash in landfills. And for our environment, fly ash sales and marketing significantly reduces the overall carbon footprint and conserves our natural resources by replacing materials that would otherwise have to be mined, processed, and/or produced for these products.

However, as an increasing number of coal-burning power plants are idled due to regulations and/or economic factors, along with alternative energy sources, the supply of fly ash has decreased and shifted to a much more regionalized supply. Bridging the gap between a regional supply source and demand for fly ash beyond that specific region can be a delicate game of logistics and feasibly for utilities and their marketers.

THE OUTLOOK: FLY ASH SUPPLY VERSUS DEMAND IN THE FUTURE

With regulations and technologies changing the landscape of fly ash supply, a projected increase in fly ash demand is also creating obstacles for suppliers. As Table E-1 (Fig. 1) illustrates, projected fly ash production is anticipated to remain relatively flat over the next 20 years, while the rate of demand for fly ash is projected to increase by 53% over the same time period. Couple that with the retirement or idling of coal-burning plants in the next 20 years and a clear map of undersupplied regions develops. In addition, coal-supply dynamics versus alternate energy sources limits the availability of fly ash to specific areas of the country.

The changing energy supply map creates shifting supply dynamics and an increasing gap between local supply and national demand. Unfortunately, for our nation's fly ash-producing utilities, marketers are filling the supply gap with international imports of fly ash. These competitive imports increase the possibility that our domestic fly ash ends up in the landfill instead of in our customer's products as intended. Bridging that gap eliminates the opportunity for international imports to fill that need.

As our markets change moving forward, the availability of ash at a local level will become increasingly critical as specifiers continue to recognize the benefits of incorporating fly ash into product mixture designs while also recognizing gaps in the future availability of the material. Specifiers want to make sure that the specifications they are setting forth can be met and that a continuous supply is available. Therefore, when specifying fly ash, the available supply (beyond that which is produced) at the local level is very important.

For marketers, being able to demonstrate a knowledge of the supply/demand map and the feasibility of delivering the material to market will allow for a balancing of the market.

DELIVERING SOLUTIONS: FROM SOURCE TO THE MARKET

Fly ash marketers have two customers: the utility partner and the end user. Utility partners want to keep ash from being landfilled while end users need to feel comfortable with the supply of that material. Our job as marketers is to provide a solution between supply and demand.

The inability to reach under-supplied markets results in the landfilling of otherwise usable fly ash. International imports of fly ash from both Europe and the Far East currently help to fill the gap of this supply shortage but also leave our domestic utility partners disposing of ash. Due to subsidies, international imports can seem more economically feasible than the competing logistics of domestic fly ash.

Our industry must respond by figuring out how to think more nationally about fly ash sales and move fly ash to where it is needed. We must work with our utility partners to optimize logistics, storage, and capital investment projects to deliver a complete solution. Utilities need their partners to offer a full-scale solution to their marketable fly ash, including addressing local market shortages, expanding market reach, addressing storage, and optimizing year-round fly ash production.

TABLE E-1: PROJECTED PRODUCTION AND UTILIZATION BY CCP CATEGORY (IN MILLIONS SHORT TONS)				
	VOLUME 2013	PROJECTED VOLUME 2033	PROJECTED TOTAL GROWTH	PROJECTED AVERAGE ANNUAL GROWTH RATE
Production				
Fly Ash	53.4	54.6	2.2%	0.1%
FGD Material	35.2	38.8	10.1%	0.5%
Bottom Ash	14.5	14.7	1.2%	0.1%
Boiler Slag	1.4	0.8	-43.2%	-2.8%
FBC Ash	10.3	11.8	14.5%	0.7%
Total Production	**114.7**	**120.6**	**5.2%**	**0.3%**
Utilization				
Fly Ash	23.3	35.7	53.1%	2.2%
FGD Material	12.9	22.3	72.9%	2.8%
Bottom Ash	5.6	7.2	28.4%	1.3%
Boiler Slag	0.9	0.8	-16.1%	-0.9%
FBC Ash	8.8	10.6	20.2%	-0.9%
Total Utilization	**51.6**	**76.5**	**48.3%**	**2.0%**

Fig. 1: Projected production and use by CCP category (in millions short tons). Source: "American Road and Transportation Builders Association Report, Production and Use of Coal Combustion Products in the US – Historic Market Analysis and Market Forecast Reports," June 2015

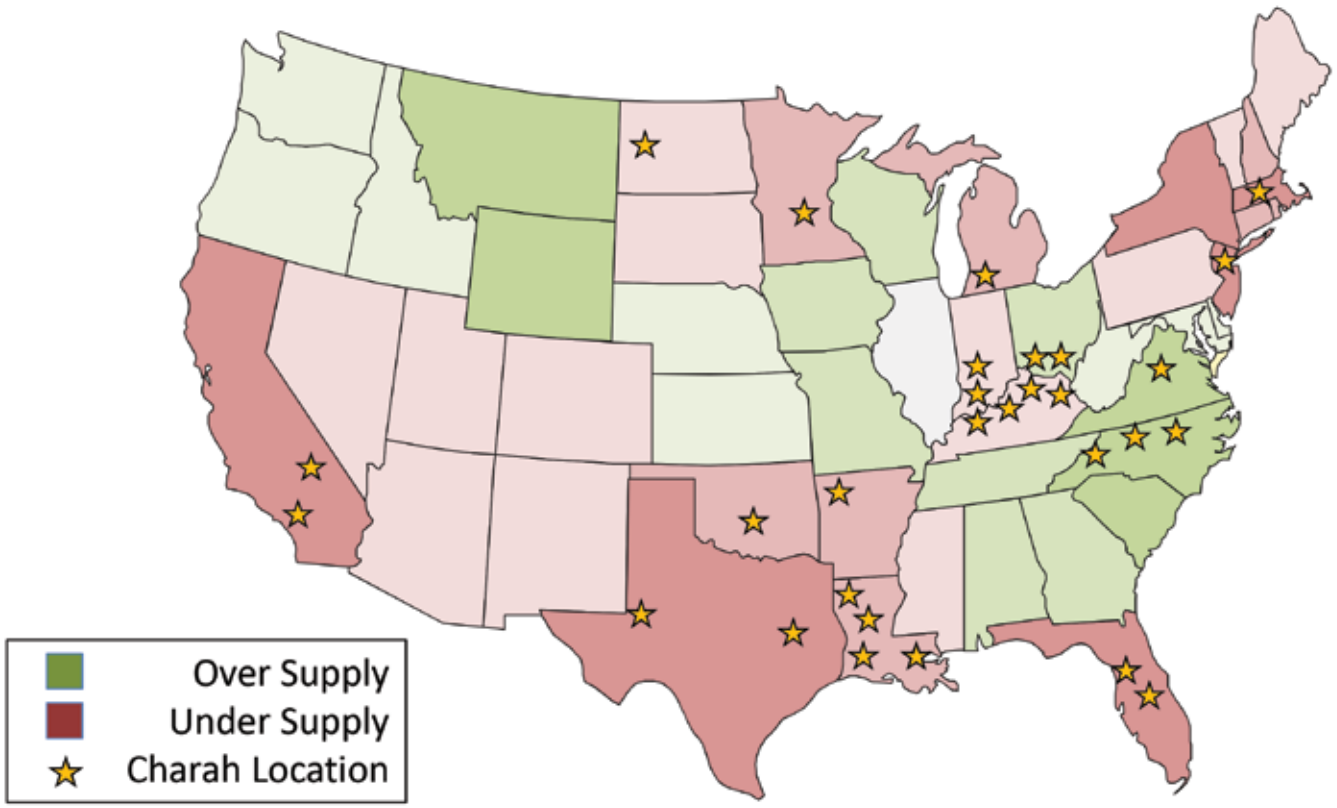


Fig. 2: Ash supply market conditions

MULTISOURCE℠: THE CHARAH APPROACH

Charah is the largest privately held ash management company and one of the recognized industry leaders in coal combustion product (CCP) management for the utility industry with over 30 years of experience. Based on this deep experience, we have developed a new approach to the marketing of CCPs by establishing a unique distribution system of multiple sourcing locations across the country known as MultiSource℠. By leveraging industry supply/consumption data and evaluating industry trends related to supply, demand, and access, we can identify specific geographic areas in which to develop our network of national terminals. These locations are based on serving the market, not delivering one specific source. In the end, these permanent terminals allow for flexibility of supply and commitment to market development.

Multisource℠, Charah's national approach for supplying fly ash, provides a viable solution for our utility partners and a dedication to underserved markets. Our goal is to provide long-term, sustainable solutions to both our utility partners and the markets we supply.

At Charah, we deliver solutions to our utility partners by moving volume out of local markets to their highest and best uses. By developing additional storage capacity, we can help by optimizing availability of material through the seasonality of fly ash supply and demand. This storage option eliminates the need to landfill otherwise usable ash due to weak market demands in the off-season.

Our relationships and experience with the transportation industry help with costing, communication, and planning with regards to the delivery chain. Charah has developed a network of rail, barge, and truck terminals to support the expanding market reach of an otherwise regional supply. For example, our rail terminal in Worcester, MA, supports the New England market, while our LaPlace, LA, barge terminal serves the Southern growth markets. We have developed "direct ship-to" customers and meet project-specific supply plans for large construction projects.

By using the MultiSource℠ system of terminals to move ash to a broader market and investing capital at our partner utilities to allow for greater distribution of ash to the market, Charah is always thinking beyond the local to the national need and delivering that solution. Contact us today to learn more at **www.charah.com**. ❖

Scott Ziegler, Vice President of Ash Sales and Marketing at Charah, LLC, is responsible for Charah's fly ash sales and marketing efforts in existing markets and for developing new markets. He is a Board member of the American Coal Ash Association (ACAA) and a member of the American Coal Council (ACC), the American Institute of Chemical Engineers (AIChE), and the Tampa Port Authority Executive Shippers' Council.

INTELLIGENT SOLUTIONS FOR YOUR CCR MANAGEMENT PROGRAM

TRANS-ASH

With over 50 years experience in heavy construction and CCR management, Trans Ash is prepared to provide state of the art, creative, cost effective, and environmentally acceptable CCR management alternatives.

- **CCR Impoundment Closure**
- **CCR Impoundment Management**
- **CCR Landfill Closure**
- **CCR Landfill Management**
- **Civil Construction**
- **Dredging**
- **Environmental Services**
- **Plant Services**

To learn more, call us at 513.733.4770
or visit us online at transash.com

CAER Chosen for 2017 ACAA Champion Award

The University of Kentucky (UK) Center for Applied Energy Research was selected as the fifth recipient of the American Coal Ash Association Champion Award. Senior Research Engineer Bob Jewell accepted the award at ACAA's 2017 winter meeting on behalf of the Center's Materials Technologies Group.

ACAA established the Champion Award in 2012 to recognize extraordinary contributions to the beneficial use of coal combustion products. The recipient is selected exclusively by the Chair of the ACAA Board of Directors and is known only to the Chair until the moment the presentation is made. The recipient may be an individual or individuals, an institution—private or public, a member of ACAA or a nonmember, living or deceased.

ACAA Chairman Charles Price praised the CAER team for its decades of support for beneficial use of coal combustion products. "Selecting a recipient for the ACAA Champion Award is not easy. Past Chairs of this association will agree that when you start to draft a list of potential recipients the list gets very long very quickly," said Price. "After careful consideration, I have selected an organization that has provided decades of research, education, and training. This organization has had a particular focus on practical solutions which impact markets both today and into the future."

Founded in 1972 with a grant of $400,000 from the Kentucky General Assembly to advance coal use, CAER's multidisciplinary research work extends far beyond the coal ash world as it investigates energy technologies to improve the environment; contributes to technically sound policies related to coal, energy, and the environment; adds to the teaching and instruction aim of UK by educating students from pre-college to postgraduate levels and being involved in labor force development for Kentucky; promotes UK's objective of developing and benefiting from its intellectual property with a balance between the publication of scientific results and patenting; and provides public service through scientific education and its energy-related competencies.

CAER's Materials Technologies Group specializes in developing construction materials from a wide variety of CCPs. The Center has also become a valued strategic partner for ACAA, cosponsoring the international World of Coal Ash conference and symposium since 2005 and, more recently, in development of special topic conferences and creation of the *Coal Combustion and Gasification Products* journal.

Previous ACAA Champion Award Honorees

2012 – John Ward, ACAA Government Relations Committee Chairman
2013 – David Goss, former ACAA Executive Director
2014 – U.S. Representative David B. McKinley
2015 – USDA Agricultural Research Service

CAER Senior Research Engineer Bob Jewell (left) accepts the Champion Award from ACAA Chairman Charles Price, President and CEO of Charah LLC.

Federal Coal Ash Legislation Enacted

Following more than 6 years of effort by a broad coalition of industry groups and public policymakers concerned about coal ash regulation, the United States Congress enacted legislation that changes enforcement authority for U.S. Environmental Protection Agency disposal regulations from citizen lawsuits to states-led permit programs.

Shortly after 1:00 a.m. on Saturday, December 10, 2016, the U.S. Senate voted 78-21 to approve a major water infrastructure package as its final act of the year. That package, which was previously approved by a 360-61 vote in the House of Representatives, contained the coal ash provisions. President Barack Obama later signed the bill.

The path to the coal ash legislation was a long one, featuring multiple House and Senate hearings and several approaches to bills. The first coal ash bill, which was filed in 2010 by then-freshman U.S. Representative David McKinley (R-WV), was a one-paragraph measure prohibiting the U.S. Environmental Protection Agency from regulating coal ash as a "hazardous waste." The House Energy and Commerce Committee took note and worked with Rep. McKinley to craft a larger bill that would have created a complete "non-hazardous" regulatory program patterned after U.S. regulations for municipal solid waste. After the House passed that bill, a series of negotiations with members of the U.S. Senate produced revisions to the bill, which were passed again in the House on several occasions. In 2015, after EPA published its Final Rule for coal ash disposal, the House revised its bill again to incorporate the minimum federal standards established by EPA's rule. The House approved that bill in July 2015. After the last House bill failed to gain traction in the Senate, the Senate Environment and Public Works Committee set about creating a slimmed down bill designed to specifically address the enforcement authority issue. Those provisions were approved by the Senate in September 2016 as part of the Water Resources Development Act (WRDA).

The WRDA bill emerged from weeks of House and Senate conference negotiations rebranded as S. 612 – the Water Infrastructure Improvements for the Nation Act (WIIN.) The

728-page bill contained coal ash regulatory reform language that was modified slightly from language that passed in the Senate's WRDA bill earlier this fall. Changes from the previously passed Senate version included:

- Extending the time period for when EPA must review authorized state programs from 5 years to 12 years;
- Extending the deadline by when EPA must approve a state's programs from 90 days to 180 days to accommodate public notice and comment on a state's application for program approval;
- Changing the authority of states to request EPA review of another state's program to require the requesting states to show "that the soil, groundwater, or surface water of the State is or is likely to be adversely affected";
- Mandating EPA to operate backstop permit programs in states that are not authorized, subject to the availability of appropriations.

States are now expected to enact their own coal ash disposal permit programs, with EPA approving the plans to ensure they are based on the technical standards in the EPA's rule or are "at least as protective" as the federal agency's regulation.

"This new permitting authority fixes the main problems with the [EPA's] recent coal ash regulation ... by removing citizen suits as the sole means of enforcement and allowing states to tailor permit requirements on a case-by-case basis," said a joint statement from Senate Environment and Public Works Committee Chairman Jim Inhofe, (R-OK), and Senators Shelley Moore Capito, (R-WV), Joe Manchin, (D-WV), and John Hoeven, (R-ND). House Energy and Commerce Committee leaders also celebrated completion of the legislation. The milestone was also endorsed by investor-owned electric utilities, the municipal power sector, and rural electric cooperatives.

ACAA Participates in EPA Negotiated Rulemaking

Two American Coal Ash Association representatives were named to a U.S. Environmental Protection Agency panel that is charged with negotiating Chemical Data Reporting (CDR) requirements under the Toxic Substances Control Act (TSCA).

ACAA Technical Committee Chair Rafic Minkara of Headwaters Resources and Danny Gray of Charah LLC will represent ACAA in the process that is expected to take several months to complete. ACAA is one of 12 manufacturing and recycling industry organizations represented on the panel, along with three environmental groups and four representatives of states and American Indian tribes.

In 2016, Congress passed the Frank. R. Lautenberg Chemical Safety for the 21st Century Act, which was the first major update to the TSCA law in nearly three decades. The Act required EPA to initiate a regulatory negotiation specific to CDR reporting requirements for inorganic by-product chemical substances that are subsequently recycled, reused, or reprocessed.

Negotiated rulemaking is a process in which a committee comprised of representatives of stakeholder groups that will significantly be affected by a proposed rule is charged with reaching consensus on the text of a proposed rule.

Under TSCA, EPA requires manufacturers of certain chemical substances included on the TSCA Inventory to report data on chemical manufacturing every 4 years. Some by-products, including coal combustion products, are reportable under CDR. EPA uses information collected under CDR to help assess the potential human health and environmental effects of these chemicals and makes the non-confidential business information that it receives available to the public.

ACAA's participation in the negotiated rulemaking will focus on ensuring that any reporting requirements for coal combustion products do not create unwarranted disincentives for beneficial use.

ACAA Executive Director Receives Dual Honors

American Coal Ash Association Executive Director Thomas H. Adams received prestigious recognition from both the National Ready Mixed Concrete Association (NRMCA) and the American Concrete Institute (ACI).

NRMCA selected Adams to receive its Gaynor Award for 2017. The Richard D. Gaynor Award is presented to an individual who has demonstrated lifetime excellence and commitment on technical initiatives that have benefited the ready mixed concrete industry. It is named for Dick Gaynor, who retired as the Executive Vice President of NRMCA's Engineering Division. The recipient is selected by the NRMCA Research Engineering and Standards Committee.

Adams was also named a Fellow of the American Concrete Institute at The ACI Concrete Convention and Exposition – Spring 2017. The rank of Fellow is awarded to individuals for "outstanding contributions to the production or use of concrete materials, products, and structures in the areas of education, research, development, design, construction, or management." Adams has been a member of ACI since 1977 and has served on numerous technical committees. He joined ACAA as Executive Director in 2009 after working on the staff of the American Concrete Institute following a 30-year career in the ready mixed concrete industry.

Adams has more than 35 years of experience in the industry and has held leadership roles in the Michigan Concrete Association, American Concrete Institute, American Shotcrete Association, and currently at the American Coal Ash Association. He has been an active member of the NRMCA RES Committee since 1980 and is a past Chair of the committee. He has served as a member of the NRMCA Board of Directors.

NRMCA noted that Tom joined ACAA in 2008, just prior to the coal ash spill at a power plant in Kingston, TN. "He worked closely with various stakeholders to prevent the U.S. EPA from promulgating regulations that would designate fly ash and other coal combustion products as hazardous waste," NRMCA wrote. "This would have eliminated the beneficial use of fly ash as an important supplementary cementitious material in concrete for better economy and performance. The initiatives were several pronged, from technical, environmental, regulatory, legislative and legal."

The American Coal Ash Association recently lost two former members whose long service to the association will be remembered.

Rick Hayek, 59, passed away February 4, 2017, in Lancaster, OH. Rick was a former American Coal Ash Association member who retired from American Electric Power. Contributions in memory of Rick may be made to the Paralyzed Veterans of America, 801 18th Street NW, Washington, DC 20006-3517.

From Rick's obituary: "Rick was born in Meadville, PA, on November 13th, 1957, to George and Delores Hayek. He served his country in the United States Air Force, as well as graduated from Ohio University with a Master's in Business Administration. He was a member of the First Baptist Church and was heavily involved with the ministry, serving as a Sunday School Teacher and helping with many other areas as well. Rick loved the outdoors, and was a sportsman. He especially loved hunting golf balls. Rick's love of volleyball was contagious and it was hard to not love the game after playing with or being coached by him. He loved his family and especially loved the light of his day, his granddaughter, Evelyn. Richard was preceded in death by his father, George Hayek; and his sister, Terri Hayek. He is survived by his mother, Delores Hayek; son Ethan(Emily) Hayek; daughter April Hayek; granddaughter, Evelyn Hayek; and brother Russell Hayek; as well as many other loving family members."

Lawrence L. LaBuz, 58, passed away March 1, 2017, at his residence in Danielsville, PA. Larry recently retired after a long and accomplished career at PPL. He served on the Board of Directors of the American Coal Ash Association. Contributions in memory of Larry may be made to the National Parks Conservation Association (NPCA), 777 6th Street NW, Suite 700, Washington, DC 20001.

From Larry's obituary: "Born in Hazleton, he was the son of the late Dr. Eugene LaBuz, M.D. and Margaret (Hanlon) LaBuz. He was a 1976 graduate of Bishop Hafey High School and a 1980 graduate of the University of Notre Dame with a B.S. degree in Civil Engineering where he played trumpet for the Notre Dame Marching Band. Larry was an Eagle Scout and Scoutmaster of Troop 242 in Cherryville, PA where he was a role model for scouts and leaders. His sons followed in his footsteps as Eagle Scouts. Larry was an outdoorsman who enjoyed hiking, backpacking, kayaking, cycling, wildlife photography, and caring for pets. Larry will be remembered for his loving devotion to his family and friends, strengthening family bonds, and his guidance and compassion. Survivors: Larry is survived by his loving and devoted sons and their wives: Dr. Brendon and Alicia LaBuz, Hollidaysburg; Drs. Ryan and Hayat LaBuz, Henderson, NV; Tyler LaBuz, Nazareth; and his cherished granddaughters Sophia and Jenna. Also surviving are his four close brothers and their wives: Eugene and Karen LaBuz, Conyngham; James and Carmella LaBuz, Drums; Thomas and Anne LaBuz, Bloomsburg; Robert and Jeanne LaBuz, Sewell, NJ; and many loving nieces and nephews."

The next edition of *ASH at Work* magazine will be a special edition featuring a recap of World of Coal Ash 2017 and a compendium of coal combustion products case studies.

Descriptions of beneficial use projects are being sought for all types of coal combustion products in as many different applications as possible. Each case study will include the name and location of the project, when it was completed, and a brief description of the coal ash use. Photos and charts are also welcome. Project participants will be recognized in each case study.

For more information on submitting a case study or advertising in this special edition, contact info@acaa-usa.org.

A COLLABORATIVE PARTNER

BROAD-BASED EXPERIENCE

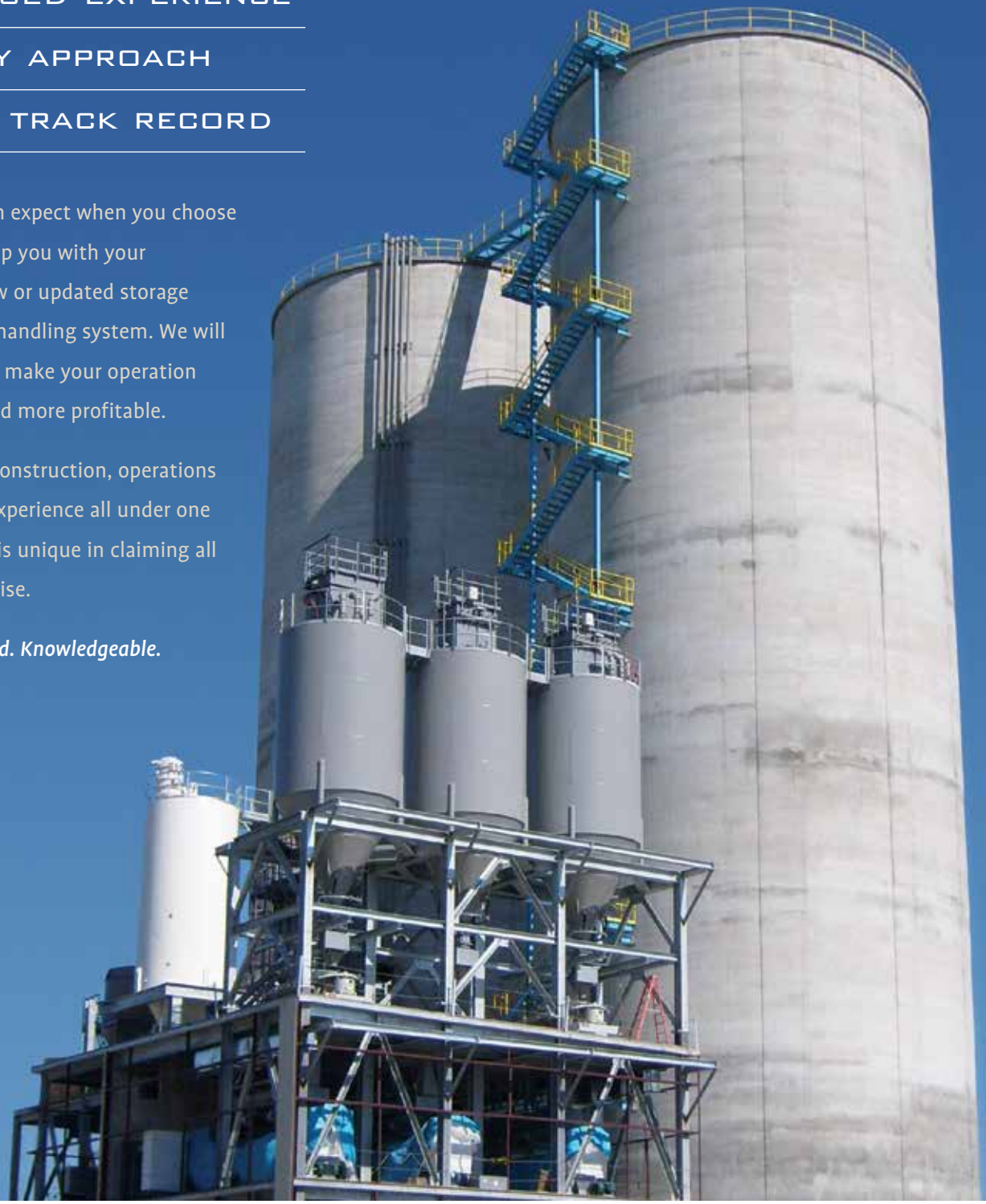
A TURNKEY APPROACH

A PROVEN TRACK RECORD

That's what you can expect when you choose WL Port-Land to help you with your investment in a new or updated storage facility or material handling system. We will partner with you to make your operation more productive and more profitable.

With engineering, construction, operations and maintenance experience all under one roof, WL Port-Land is unique in claiming all four areas of expertise.

Committed. Talented. Knowledgeable.
Let us help you.



WL PORT-LAND
SYSTEMS, INC.

DESIGN / BUILD ENGINEERING RENOVATION

412-344-1408 WWW.WLPORT-LAND.COM 305 MT. LEBANON BLVD. SUITE 400 PITTSBURGH, PA 15234

ACAA EDUCATIONAL FOUNDATION SELECTS 2016-17 SCHOLARSHIP WINNERS

The American Coal Ash Association Educational Foundation awarded $9000 in scholarships to three university students with interests in advancing the sustainable and environmentally responsible use of coal combustion products.

Gang Xu, P.E., a PhD Candidate in civil engineering at Washington State University, Pullman, WA, was selected to receive the $5000 David C. Goss Scholarship. Xu is researching an environmentally friendly pervious concrete using fly ash as the sole binder modified by graphene oxide.

Jenberu Feyyisa, a civil and environmental engineering Graduate Student at the University of North Carolina at Charlotte, Charlotte, NC, was selected to receive the $2500 John Faber Scholarship. Feyyisa is researching an innovative approach to modify ash surface to decrease wettability characteristics and form a water-repellent surface using organosilane chemicals.

Sarah Hodges, a Sophomore studying chemical engineering at the University of Kentucky, Lexington, KY, was selected to receive a $1500 ACAA scholarship. Hodges is engaged in research using ash from the Kingston power plant to create calcium sulfoaluminate cement.

Scholarship application essays by all three of the winners are being published in their entirety in this issue of *ASH at Work*. Fifteen ACAA member volunteers participated in judging the scholarship applications.

The ACAA Educational Foundation Scholarship Program's 2017-2018 program will accept applications from September 1, 2017, through October 15, 2017. Awards will be based on essays, coursework, academic credentials, recommendations, and a demonstrated interest in the use of coal combustion products.

The ACAA Educational Foundation is a financially self-sustaining, not-for-profit organization, which promotes understanding of CCP management and use through communications and outreach initiatives that are aimed at government and industry decision makers and the public. Foundation initiatives consist of awarding university level scholarships, development and distribution of educational materials, financial support for research, and sponsorship of CCP forums. Visit **www.acaa-usa.org/About-ACAA/Educational-Foundation** for more details. ❖

Thank You, Scholarship Judges!

Dawn DeJardin – WEC Energies Group (scholarship committee Chair)
Tristana Duvallet – University of Kentucky, CAER
Dawn Santoianni – Duke Energy
Judy Wilfrom – GHD Services Inc.
John Trast – GEI Consultants
Mark Rokoff – AECOM
Gary Lee – Southern Company
Fred Gustin – Kansas City Power and Light
Mike Schantz – Lhoist North America
Jen Rafferty – Titan America
Travis Collins – National Minerals Corporation
Tim Kyper – DiGioia, Gray & Associates
Peggy Rennick – SCB International
Karen Milligan – Headwaters Construction Materials – SYNMAT
Lisa Cooper – PMI Ash Technologies

ENVIRONMENTALLY FRIENDLY PERVIOUS CONCRETE WITH FLY ASH AS SOLE BINDER MODIFIED BY GRAPHENE OXIDE

By Gang Xu, Ph.D. Candidate, P.E., Department of Civil and Environmental Engineering, Washington State University

ABSTRACT

An environmental friendly pervious concrete will be developed by using fly ashes as the sole binder modified by the graphene oxide (GO). A fly ash-based pervious concrete could not only reduce the demand for portland cement, but also divert the fly ash from waste stream, which otherwise poses a substantial environmental risk. The use of nanotechnology relaxes the restriction on using fly ashes in concrete without sacrificing the performance of concrete. This study also reveals the possible role of GO in the hydration of fly ash and help to achieve enhanced understanding of GO-modified fly ash pervious concrete at the microscopic level.

INTRODUCTION

Pervious concrete is a special type of concrete with a high porosity that allows water from precipitation and other sources to pass through directly (Fig. 1). Approximately ***two million square feet*** of pervious concrete were placed in California in 2014 (Caltrans, 2014). The infiltration effect provided by pervious concrete pavements can not only recharges the groundwater, but also reduce the amounts of total suspended solids, total phosphors, total nitrogen, and metals in the ground water (McCain, 2010).

A typical pervious concrete mix design in the United States. contains portland cement. It is well known that portland cement has some environmental concerns: the high energy consumption and the release of air pollutants (NO_x and SO_2) and greenhouse gases (CO_2) related to mining and manufacture. The annual global production of cement is about ***6.9 billion yd^3***, which has an enormous impact on the environment. In order to make the pervious concrete sustainable, the fly ash has been chosen to fully replace portland cement in the pervious concrete.

Fly ash, a by-product of coal fired power plants (Fig. 2(a)), has been used as a partial portland cement replacement in conventional concretes for years. In 2007, the United States produced ***131 million tons*** of coal ashes. While only 43 percent were used beneficially, nearly 75 million tons were disposed of (American Coal Ash Association, 2008). A 100 percent fly ash pervious concrete could not only reduce the demand for portland cement, but also divert the fly ash from industrial wastes, which could otherwise cause serious environmental problems (Fig. 2(b)).

In order to improve the performance of fly ash-based concrete, graphene oxide (GO) (Fig. 3) was chosen to improve the fly ash-based pervious concrete. Previous research (Lv et al. 2014) indicates that a small amount of graphene oxide can improve the mechanical strength and durability of concrete greatly. This is mainly because GO nanosheets have a high

Fig. 1: Pervious concrete demonstration (Harrison, 2011).

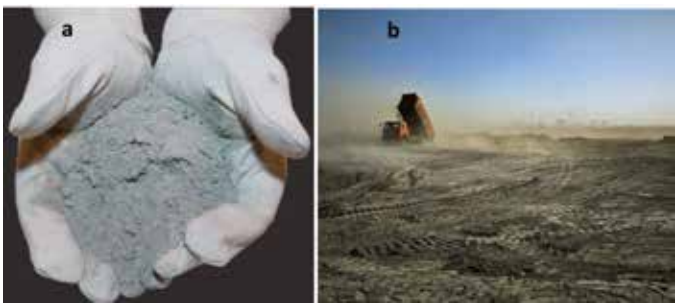


Fig. 2: (a) Fly ashes; and (b) air pollution from fly ash (Dewan, 2008).

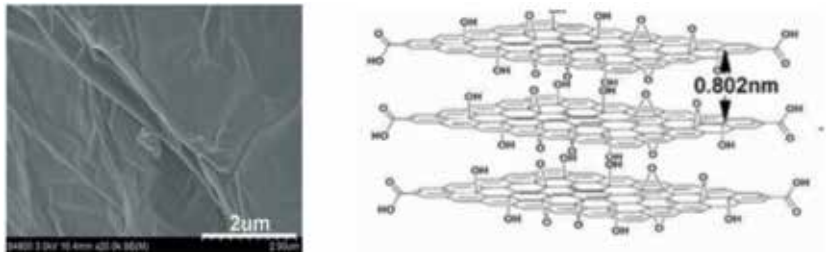


Fig: 3: SEM image of the graphene oxide membrane (Lv et al., 2014)

specific surface area, are strongly hydrophilic, and exhibit ultra-high strength and flexibility.

In this study, fly ashes that are potentially capable of replacing a 100 percent portland cement in the pervious concrete will be identified. Based upon selected fly ashes, an innovative pervious concrete mix design with a pure fly ash paste and GO will be developed. A highly interdisciplinary investigation will be carried out to evaluate the mechanical, chemical and structural performance of 100 percent fly ash pervious concrete with GO, which requires skills and collaborations among material science, structural engineering, environmental engineering and pavement engineering.

Ultimately, this research will develop an environmentally friendly pervious concrete with a pure fly ash paste an GO. The function of GO in fly ash hydration will be studied as well. The research results will not only divert the fly ash from waste stream to value-added application, but also contribute to the knowledge base of GO performance in concrete application.

RESEARCH DESCRIPTION

A. The Idea That Is Being Tested

Fly ash has been used as a partial cement replacement in the concrete for years. However, it is typically used at replacement rate of less than 25 percent due to the lack of understanding of its overall performance. This research is based upon an idea that the carefully selected fly ash will act like a self-cementitious material to create a paste, which forms a thick coating around aggregates and is able to totally replace portland cement in the pervious concrete. Meanwhile, GO-modified fly ash pervious concrete will meet the multidisciplinary requirements, i.e. material science, structural engineering, pavement engineering, and environmental engineering.

B. The Approach and Methodology

This research will be divided into two phases. The Phase I will emphasize on the selection of fly ashes and the interdisciplinary evaluation of a fly ash paste with GO. The research tasks of this phase will include following aspects:

1. Preparation: review literature on properties of fly ashes and GO.
2. Selection: criteria will be developed to identify fly ashes that can potentially be used as a sole binder in the pervious concrete.
3. Interdisciplinary investigation: fundamental engineering properties and the durability of a pure fly ash paste with GO will be investigated. In the field of material science and environmental engineering, scanning electron microscope (SEM) / energy dispersive X-ray spectroscopy (EDS) will be adopted to better understand the microstructure and the elemental composition of fly ash paste with GO.

The Phase II will mainly focus on the interdisciplinary performance of a pervious concrete with a pure fly ash paste. With the proven binding strength and durability of a pure fly ash paste from Phase I, a mix design will be developed with the desired workability, set time, compressive strength and tensile strength. Laboratory tests simulate many years of field services will be conducted to investigate the durability of pervious concrete, which includes evaluations of salt scaling, chloride permeability, freeze-thaw, and clogging.

C. The Anticipated Deliverables

For Phases I and II:

1. A report of literature review will be submitted.
2. Laboratory data from tests will be collected for future researches.
3. Finite element model simulating transport behavior of pervious concrete will be created. This model will provide guidance for the pervious concrete design in parking areas, areas with light traffic, residential streets, pedestrian walkways, greenhouses, etc.
4. Three research papers will be published in professional journals and conference proceedings. ❖

REFERENCES

American Coal Ash Association (2008). "Coal Ash Facts." http://www.coalashfacts.org/.

McCain, G.N., M.J. Suozzo, M.M. Dewoolkar. 2010. "A Laboratory Study on the Effects of Winter Surface Applications on the Hydraulic Conductivity of Porous Concrete Pavements". *Transportation Research Board 2010 Annual Meeting CD-ROM.*

Xie, Ni., S. Mery, Y. Dang, M. Akin and X. Shi, (2014). " Evaluation of pervious concrete mixes in areas subject to snow plow operations and abrasive and salt application". *Report for Nevada Department of Transportation, Research Section.*

Roskos, C.E. (2011). "Building green: development and evaluation of an environmentally friendly concrete". *Thesis of Master of Science submitted for Montana State University, Bozeman, Montana.*

Schaefer, V.R., K. Wang, M.T. Suleiman, and J.T. Kavern. 2006. "Mix Design Development for Pervious Concrete in Cold Weather Climates". *Iowa DOT Final Report No. 2006–01.*

Shenghua Lv, S., Ting, Ji. Liu, and Qi. Zhou. 2014. "Use of graphene oxide nanosheets to regulate the microstructure of hardened cement paste to increase its strength and toughness". *CrystEngComm, 2014, 16, 8508*

ORGANO-SILANE MODIFIED COAL FLY ASH FOR USE AND LEACHATE PROOF DISPOSAL

By Jenberu Feyyisa

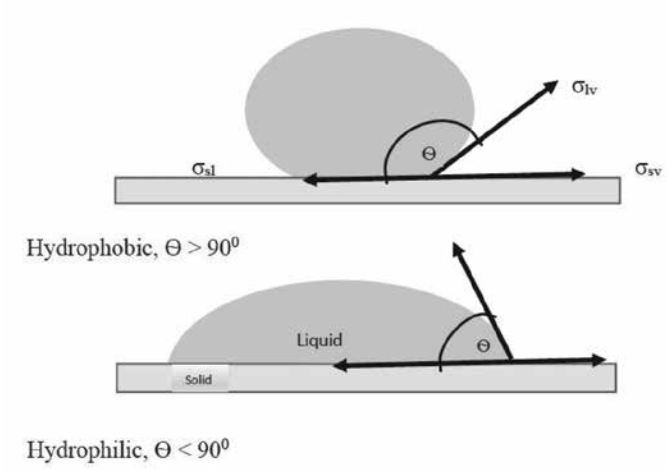


Fig. 1: Contact angle measurement technique on hydrophobic and hydrophilic surfaces.

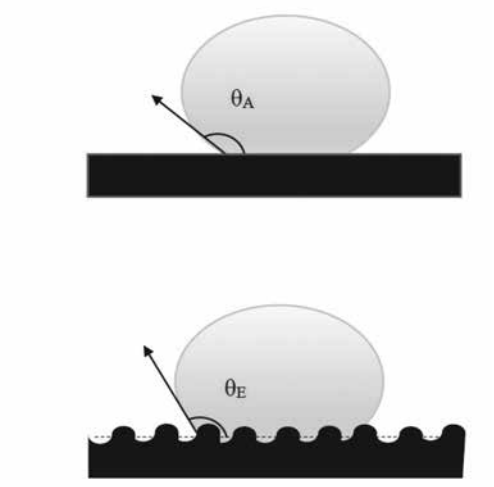


Fig. 2: Observed (θ_A) and intrinsic (θ_E) contact angles on a hypothetical rough surface.

ABSTRACT

Coal combustion products (CCPs) when in contact with water, may have the potential to release leachable constituents of concern, particularly heavy metals. This behavior not only deters the beneficial reuse and applications of CCP but also continues to be the subject of environmental concern at its disposal and surface impoundment sites. These perceived concerns are worsened by the continued growth in the cumulative quantity of generated CCP and the lack of guaranteed safe disposal because of some recently recorded spills from storage basins. Detailed investigations to transform CCP and form leachate proof material not only turns the perceived behavior and environmental concern, it also valorizes and make CCP ubiquitous material for different engineering applications. This research aims to provide an innovative approach to modify CCP surface to avoid its wettability character and form water-repellent surface (hydrophobic) using organo-silane (OS) chemicals.

INTRODUCTION

Beneficial reuse of CCP in a significant volume reduces the quantity of coal fly ash (CFA) sent to landfill or surface impoundment. Some of the main reuse areas of CCP include construction material production, structural fill, and as an additive for waste stabilization and environmental remediation. Detail application procedures and uses can be found in Wu et al. (2014) and Chi and Huang (2014) for cement-based composites; Pei et al. (2015)

Fig. 3:A photograph of (a) Model-260 Goniometer; and (b) FlowTrac II.

for pile stabilization methods; Wang et al. (2008) for adsorption application; Singh and Siddique (2014) and Singh and Siddique (2013) for replacement of sand in concrete production; Jala and Goyal (2006) and Basu et al. (2009) for soil amelioration and agricultural use; van der Merwe et al. (2014) for PVC composite. However; despite all the efforts to reuse, larger quantity of CCP is still sent to land fill. For example, in 2014, out of the 190 million short tons of CCP produced in US, only 47% was recycled (EPA) and the remaining quantity sent to disposal basins, the primary environmental concern associated with CCP. When in contact with water, trace elements contained in its mineralogy leach and transport to the surrounding soil and ground water. Leaching characteristics of trace elements in CCP have been researched and can be found in EPRI (2005). Due to these characteristics, more recent regulations are accelerating the industry trend of CCP handling and the closure of impoundments. The U.S. EPA promulgated new Federal rules (EPA 2015) regarding the management of CCP; likewise, at the state level, North Carolina passed legislation in 2014 (General Assembly 2014) in response to TVA and Dan River breach, respectively. Even though some progress has been made in advancing the beneficial use of CCR, because the EPA recently developed methodology for evaluating encapsulated beneficial uses of CCR, significant effort is still required to eliminate the perceived environmental concerns. One mechanism to eliminate this concern is to treat CCP so that it is water repellent (hydrophobic), thereby preventing infiltration and leachate generation. Recent research has demonstrated promise, for instance Daniels et al. (2009) have presented example on how to stabilize type F CCP through laboratory experiment and demonstrated their results at CCP monofill site. However, their work does not aim at avoiding infiltration that mimics leachate (Feyyisa and Daniels 2016). In circumstances where full control of leachate generation (as in case of CFA) and seepage control is required, the material has to be and remains dry until the infiltration resistance is overcome.

This research, hence, aims at modifying CCP using OS chemicals and identifies measurement technique for fundamental

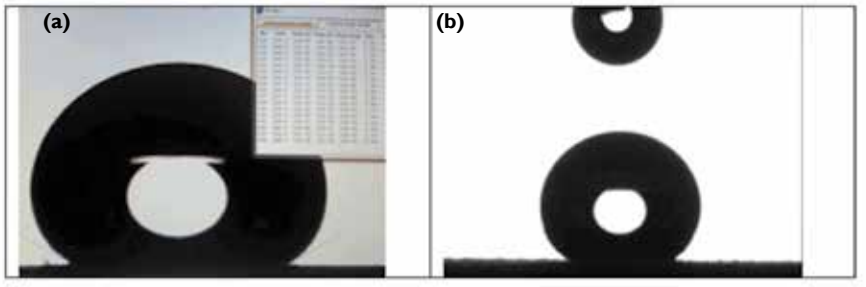


Fig. 4: (a) Example of contact angle measurement; and (b) successive hanging (pendant) drops.

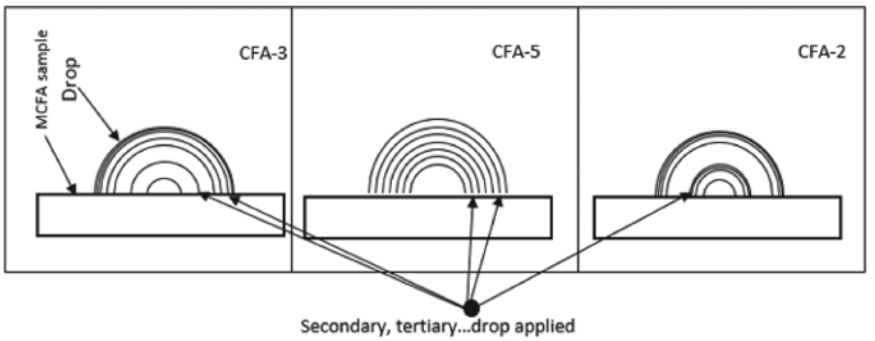


Fig. 5: Different patterns of drop motion on the surfaces of the modified: (a) CFA-3; (b) CFA-6; and (c) CFA-2.

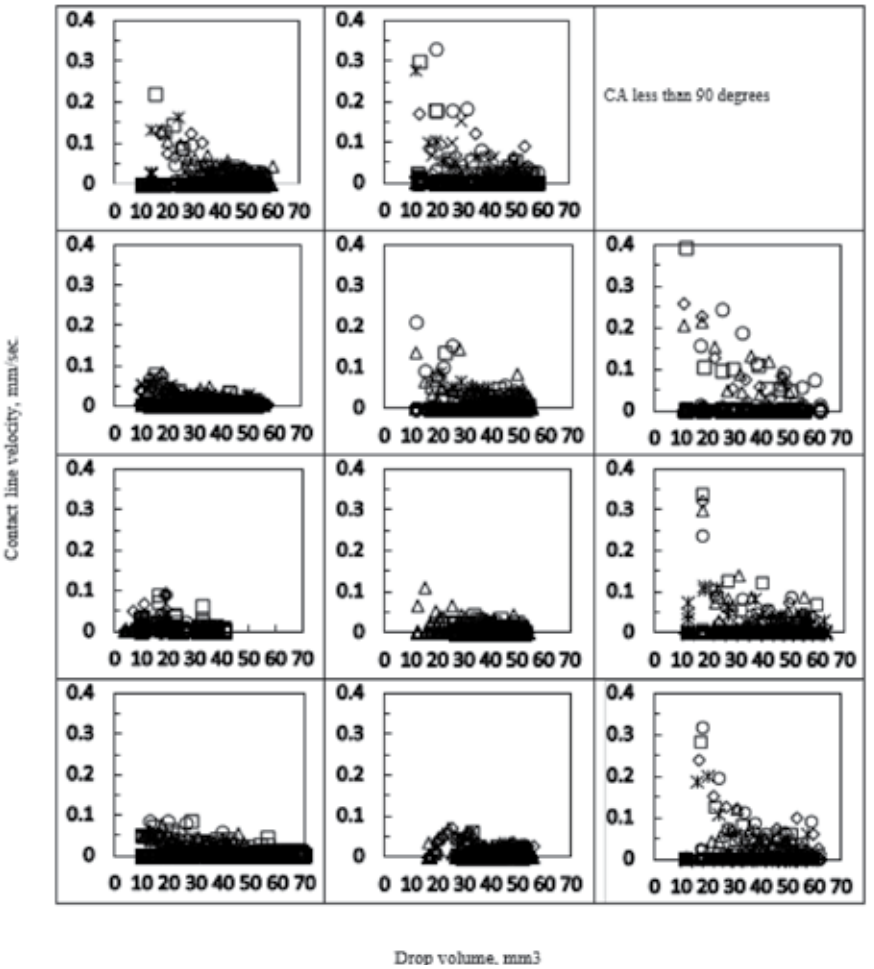


Fig. 6: Example plots of drops sizes at which acceleration assumes zero for MCFA-3 mixed with OS: C-4, C-1, and C-2 in columns 1, 2, and 3 respectively. Rows represent mix ratio used in ascending order top down (usually from 2 to 8 even numbers).

wettability parameters. The degree to which the surface of CCP has been modified to become hydrophobic has been studied through contact angle (CA) and breakthrough pressure (BP) measurements. Thus, accurate measurement of fundamental parameters is a key to identify the resistance of a surfaces to wetting. Despite many efforts to measure accurate CA, its reproducible measurement on solid surfaces still remains the subject of much debate. This study so far has identified properties of the modified CCP and protocols of measurement related to wettability parameters: appropriate (dynamic) measurement technique to measure CA (Feyyisa and Daniels 2016), and details of surface energy property and measurements techniques for five different CCPs with three OS chemicals (under final review (ASCE JMCE)). Accordingly, water repellent property of the treated CCP was significantly changed from its wetting/hydrophilic surface to hydrophobic and super hydrophobic surfaces (CA>150 degrees). In addition, the surface has able to resist an infiltration pressure head up to 10 m, guaranteeing sufficient resistance to imbibition.

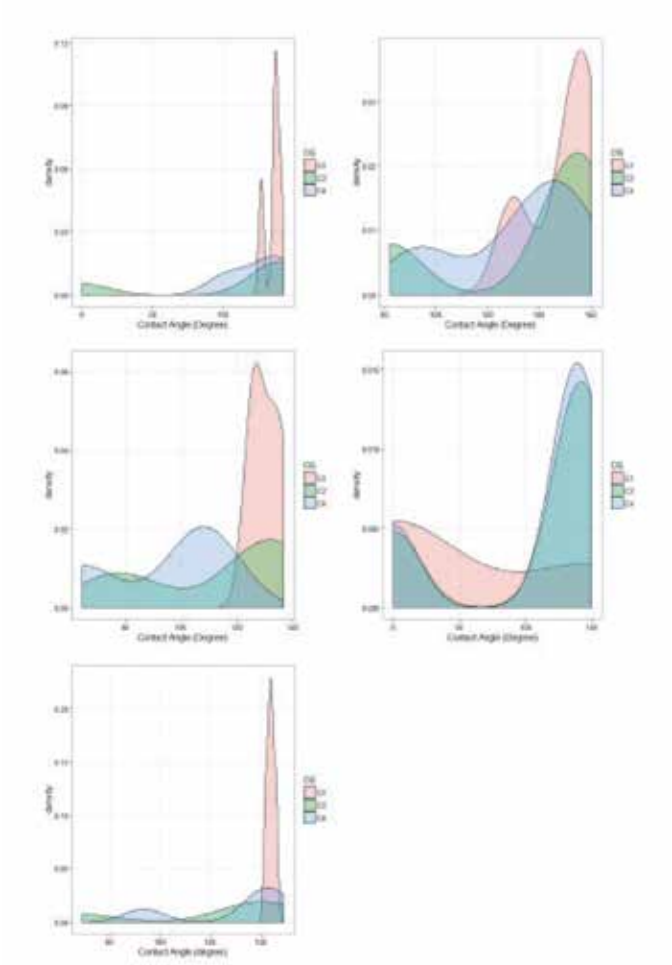


Fig. 7: Probability density distribution range of OS effectiveness to form hydrophobic surfaces. First column for CFA (1-3) and second column for CFA (5 and 6).

Finally, I believe that, the trend of leachate containment from CCP provides solution to not only the management of current and future produced CCP but also to millions and millions of tonnes piled in the past couples of decades across the world. Through applying a thin layer of the modified CCP, infiltration to CCP mass can be prevented, guaranteeing control of heavy metals leaching. Furthermore, this modified CCP can be used in many geo-technical and engineering applications where wetting and imbibition are to be prevented. This study in general seeks to develop a new areas of CCP reuse (leachate proofed applications) and also landfill without serious environmental concern.

RESULTS

For the first time, the surface of different CCP have been modified to reduce wettability using three different OS chemicals. A new protocol and measuring technique for the modified CCP surface has been identified and recommended (Feyyisa and Daniels 2016). Using this technique measured data for five different CFA has been conducted identified and categorized in to three groups and under final review to be published (ASCE JMCE). BP test data has been completed and numerical and statistical modeling with CA measurement has been completed and draft journal paper is underway. This research is also expected to investigate and identify new areas where modified CCP can be reused in geo-technical and engineering applications and guarantees its future disposal at landfills; in other words, leachate proofed.

ACKNOWLEDGMENTS

The authors gratefully thank and acknowledge the financial support provided by the Environmental Research and Education Foundation (EREF). ❖

REFERENCES

Basu, M., Pande, M., Bhadoria, P. B. S., and Mahapatra, S. C. (2009). "Potential fly-ash utilization in agriculture: A global review." *Progress in Natural Science*, 19(10), 1173-1186.

Chi, M., and Huang, R. (2014). "Effect of circulating fluidized bed combustion ash on the properties of roller compacted concrete." *Cement and Concrete Composites*, 45, 148-156.

Daniels, J. L., Hourani, M. S., and Harper, L. S. (2009). "Organo-silane chemistry: A water repellent technology for coal ash and soils." World of Coal Ash (WOCA), Lexington, KY.

EPA, U. (2015). "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule." Federal Register / Vol. 80, (No. 74).

EPRI (2005). "Chemical Constituents in Coal Combustion Product Leachate: Boron." *Department of Environmental Health Sciences*, University of California, Los Angeles, Los Angeles, CA 90095-1772.

Feyyisa, J., and Daniels, J. (2016). "A Dynamic Contact Angle Measurement Technique for Water-Repellent Coal Fly Ash (CFA)." *Geo-Chicago 2016*, American Society of Civil Engineers, 925-938.

General Assembly, N. C. (2014). "SENATE BILL 729." Session 2013.

Jala, S., and Goyal, D. (2006). "Fly ash as a soil ameliorant for improving crop production—a review." *Bioresource Technology*, 97(9), 1136-1147.

Singh, M., and Siddique, R. (2013). "Effect of coal bottom ash as partial replacement of sand on properties of concrete." *Resources, Conservation and Recycling*, 72, 20-32.

Pei, X., Zhang, F., Wu, W., and Liang, S. (2015). "Physicochemical and index properties of loess stabilized with lime and fly ash piles." *Applied Clay Science*, 114, 77-84.

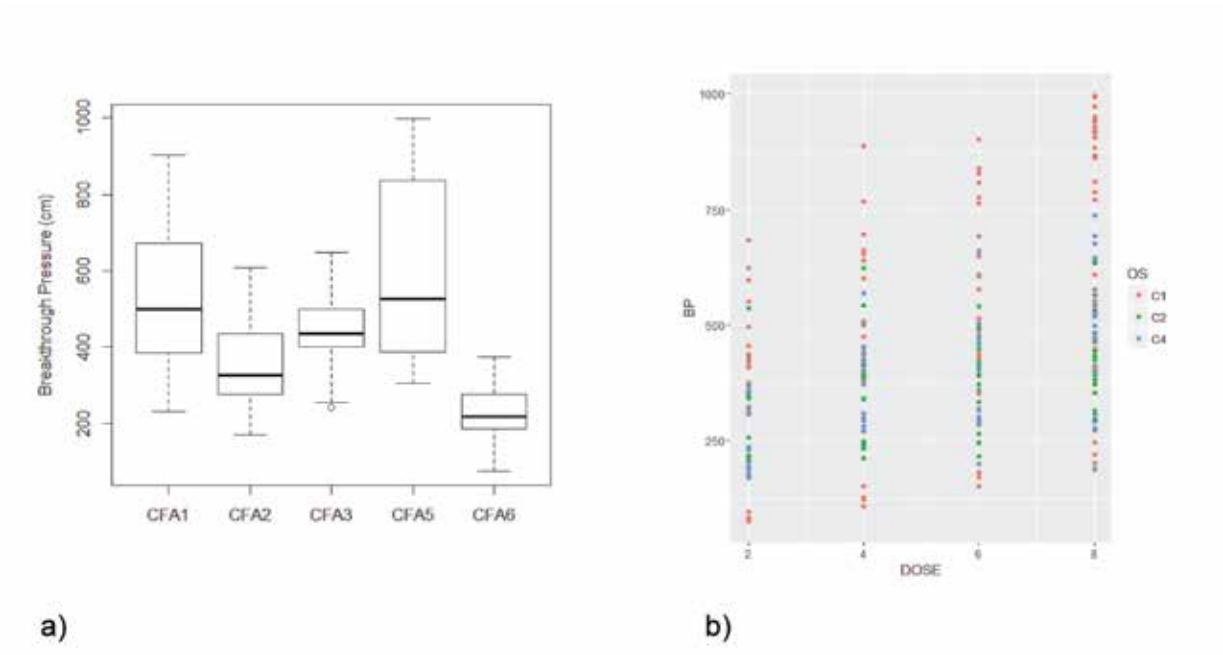


Fig. 8: Relative effectiveness of MCFAs for (a) breakthrough pressure; and (b) organo-silane dose applied.

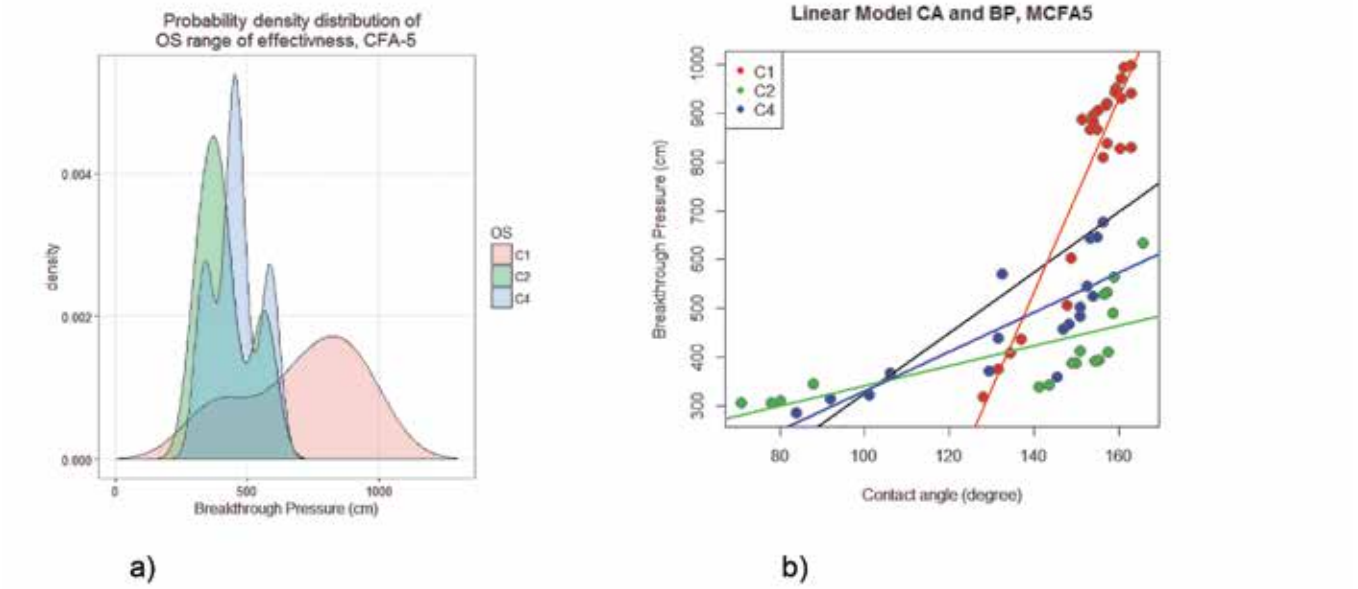


Fig. 9: Example of (a) probability density distribution of breakthrough pressure effectiveness; and (b) linear modeling CA and breakthrough pressure for one of the modified CFA surface.

Singh, M., and Siddique, R. (2014). "Strength properties and micro-structural properties of concrete containing coal bottom ash as partial replacement of fine aggregate." *Construction and Building Materials*, 50, 246-256.

Wang, S., Ma, Q., and Zhu, Z. H. (2008). "Characteristics of coal fly ash and adsorption application." *Fuel*, 87(15–16), 3469-3473.

Wu, T., Chi, M., and Huang, R. (2014). "Characteristics of CFBC fly ash and properties of cement-based composites with CFBC fly ash and coal-fired fly ash." *Construction and Building Materials*, 66, 172-180.

van der Merwe, E. M., Mathebula, C. L., and Prinsloo, L. C. (2014). "Characterization of the surface and physical properties of South African coal fly ash modified by sodium lauryl sulphate (SLS) for applications in PVC composites." *Powder Technology*, 266, 70-78.

COAL ASH CEMENT

By Sarah Hodges

ABSTRACT

The 2008 Kingston, TN spill of coal ash due to dike failure accentuated the need for recycling methods for industrial coal ash. Dr. Tom Robl at the University of Kentucky's Center for Applied Energy Research, CAER, and the Environmental and Coal Technologies (ECT) group analyzed samples of the coal ash from the Kingston spill. It was found to be a viable candidate to be utilized in the creation of CSA, calcium sulfoaluminate cement. With this information, the process of incorporating Kingston ash in CSA cements can begin, in hopes of developing the Kingston ash CSA cement as an environmentally friendly way to progress the infrastructure in rural Appalachia. Several strength and durability tests will be run on the samples comparing standard CSA and portland type 1 cement to the Kingston ash mix.

SOURCE OF CREATION

This research will act as a revitalization of the work started by CAER's ECT group. Though begun in 2009, this research never received funding to continue from the Tennessee Valley Authority and was unable to move beyond the stages of initial analysis of the coal ash samples. However, in order to begin this research, it was key to utilize the information provided from their analysis of the Kingston ash. (Robl et al. 2009)

PREMISES

Coal ash is produced as an industrial byproduct by many power plants such as those utilized by the Tennessee Valley Authority. This byproduct is traditionally unused and stored in landfills or industrial holding ponds. An alternative to placing this coal ash in a landfill or pond could be to utilize the coal ash byproduct in the production of CSA cement. Since the coal ash from the TVA Kingston plant is known to be a viable resource in the creation of CSA cement, the next steps in the process towards industrial utilization of coal ash will be to create small scale CSA batches.

Based on a sample size of 50 gallons from the Kingston site, 5 batches of 10 gallons, the coal ash would be processed entirely into becoming CSA cement with careful attention paid to the consumption of resources and production of byproducts during this process. Batch by batch it will be pertinent to keep track of the machinery used, chemicals consumed, energy consumption of the machinery, and time required to process a single batch; with the intention of maximizing output per processing round (Robl et al. 2009).

Once produced, samples from each batch will be tested against portland type 1 cement, and standard CSA cement to observe any variances caused by the addition of the Kingston ash. Most notably the research will observe if the Kingston ash CSA cement had a noticeable change in the time required for the cement to be processed, for the cement to set, and for the cement to reach the same strength as the standard cement.

ECONOMIC AND ENVIRONMENTAL IMPACT

There are several pillars of economic and environmental impact that this project will touch upon. The first of those is the utilization of the coal ash produced at the TVA plant in Kingston, TN. The previous placement of this coal ash, in a holding dike near the Emory River threatened homes, wildlife, and water supplies (Gang 2013). By removing the coal ash from that area, the immediate environmental threat of the ash will be removed. In addition, future utilization of the coal ash byproduct of the TVA plant will prevent buildup of any coal ash that could result in a similar spillage tragedy at that site.

Utilizing the Kingston ash in CSA cement would also greatly reduce the carbon footprint of creating cement materials. The process of creating CSA cement already decreases the carbon emissions of creating cement by processing at a much lower temperature; adding a recycling component to this energy efficient process will reduce the amount of materials needed to create the cement. Further research will need to be completed in order to determine the exact environmental and economic impact as related to batch size and industrial processing of the coal ash. East Tennessee has the capacity to accommodate processing facilities; by producing the CSA cement in east Tennessee in partnership with TVA, the overall economic impact of utilizing local resources, local workforce, and creating local infrastructure will wholly benefit the local economy. The Kingston TVA plant is only one of hundreds; the coal ash CSA cement recycling process could be reproduced in communities worldwide (Gang 2013). ❖

REFERENCES

Gang, Duane W. "5 Years after Coal-ash Spill, Little Has Changed." USA Today. Gannett, 23 Dec. 2013. Web. 14 Nov. 2016.<http://www.usatoday.com/story/ news/nation/2013/12/22/coal-ash-spill/4143995/>.

Robl, Tom, PH.D., Kevin Henke, Robert Jewell, PH.D., John Wiseman, Kamyar Mahboub, Will Stevens, Adam Peterson, Dave Kajak, Tristana Duvallet, PH.D., Anthoula Ouzounidou, PH.D., and Yongmin Zhou. Processing Characteristics of Kingston Ash: Preliminary Examination. Project Summary. Comp. Jack Groppo, Bob Rathbone, Jim Hower, and Aurora Rubel. Lexington: U of Kentucky Center for Applied Energy Research, 2009. Print.

Thomas, Michael Thomas, Ph.D. "Optomizing the Use of Fly Ash in Concrete." 548. Skokie: Portland Cement Association, 2007. 24.

Thank You

Exhibitors and Sponsors

Exhibitors

AECOM
Agru America, Inc.
Amec Foster Wheeler
American Coal Ash Association (ACAA)
American Excelsior Company
Asian Coal Ash Association
ATC Group Services LLC
Barnard Construction Co., Inc.
Beneficiate: North America
CAPP
Carylon Group
Cascade Drilling
CETCO
CH2M Hill
Charah, LLC
Chesapeake Containment Systems, Inc.
Civil & Environmental Consultants, Inc.
Colorado Lining International
COMANCO Environmental Corporation
ConeTec, Inc.
Consulting Services Incorporated
CQA Solutions, Ltd.
CSI
D'Appolonia Engineering
Dewind One-Pass Trenching, LLC
Directed Technologies Drilling, Inc.
Dome Technology
Domtec International, LLC
Dust Control and Loading Systems
ENTACT
DustMASTER Enviro Systems
Environmental Protection, Inc.
Environmental Specialties International, Inc.
Extreme Plastics Plus
GAI Consultants, Inc.
Geocomp Corporation / GeoTesting Express, Inc.
Geo-Solutions, Inc.
Geo-Synthetics, LLC
Geosyntec Consultants
Geotechnics, Inc.
Golder Associates Inc.
Godwin Pumps - A Xylem brand
Great Lakes Environmental & Infrastructure
Green Techniques, LLC
Griffin Dewatering
GSE Environmental, LLC
Haley & Aldrich
Hanson Professional Services, Inc.
Headwaters Construction Materials
Hull & Associates Inc.
International Lining Technology
J.F. Brennan Company, Inc.
Kelchner
Lancaster Products
Marietta Silos, LLC
Matrix PDM Engineering
MoistTech Corp.
Moretrench
NRT, an OBG Company
Neptune Wash
Orbite Technologies, Inc.
Phillips & Jordan, Inc.
Platipus Anchors Inc.
Profile Products
Pumpaction and Putzmeister
R.B. Jergens Contractors Inc.
Raven Engineered Films
Remedial Construction Services, L.P. (RECON)
Republic Services
S&ME, Inc.
The SEFA Group
Saiia Construction Company, LLC
SCS Engineers
Sevenson Environmental Services, Inc.
Stantec
TenCate Geosynthetics Americas
Tetra Tech
TRC
Trans-Ash, Inc.
United Conveyor Corporation
University of Kentucky Center for Applied Energy Research
University of North Carolina Charlotte
Utter Construction Inc.
Waste Management
Watershed Geo
WL Port-land Systems, Inc.

Sponsors

Platinum - $10,000+

Amec Foster Wheeler
Charah, Inc.
Headwaters Construction Materials
Remedial Construction Services, L.P.
SCS Engineers
The SEFA Group - Attendee Bags and Breakfast Sponsor
Tennessee Valley Authority (TVA) - Wireless Internet

Gold - $6,000+

Arcadis - Massage Chair Sponsor
Boral, Inc.
Global Containment Solutions - Happy Hour Sponsor
Trans Ash, Inc.

Palladium - $3,000+

Agru America, Inc. - Door Hangers
Chesapeake Containment Systems, Inc.
Civil & Environmental Consultants, Inc.
Environmental Specialties International, Inc. - Beverage Break Sponsor
Geosyntec Consultants
Moretrench
Phillips & Jordan, Inc. - Beverage Break and Notebook Sponsor
Ryan Incorporated Central

Silver - $1,500+

The Beaver Excavating Company
ENTACT
HDR

Bronze - $750+

GHD
RPM Solutions
Sevenson Environmental Services, Inc.

Award Sponsors

Midwest Coal Ash Association - MCAA Stipend Award(s) and Student Presentation Awards
American Coal Ash Association - Student Poster Award
University of Kentucky Center for Applied Energy Research - Barton A. Thomas Memorial Award

STAR® TECHNOLOGY turns coal combustion residuals into **environmentally sustainable** materials

Our patented STAR® Technology makes us the country's leader in thermal beneficiation of fly ash. STAR Technology can transform coal ash from surface impoundments or ponds into a consistent, high-quality product for the concrete industry. We provide a permanent solution by removing coal ash from the environment.

STAR® Technology is a stand-alone solution that is cost effective and **eliminates long-term liability.**

We provide a full range of solutions for our Utility Partners

- Byproduct & Beneficiated Ash Marketing
- Ash Beneficiation/Processing
- Ash & Gypsum Transportation Services
- Engineering, Construction & Plant Maintenance Services

844-790-5551

www.**sefagroup**.com

SEFA

America's largest fly ash marketer… …and a whole lot more

You know Headwaters as the only fly ash marketer with operations coast to coast.

Headwaters also brings decades of experience to a wide array of Coal Combustion Products opportunities.

- Synthetic gypsum processing and management *formerly SYNMAT – Synthetic Materials*
- Circulating Fluidized Bed ash management and marketing *formerly LA Ash*
- Comprehensive plant services capabilities, from landfill construction and operations to equipment maintenance and limestone handling
- Innovative solutions for ash quality management, such as RestoreAir® second generation carbon treatment

For your next Coal Combustion Products challenge or opportunity, choose the CCP leader. **Choose Headwaters.**

HW HEADWATERS
CONSTRUCTION MATERIALS

www.flyash.com