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Production & Use Survey Results
6 Questions for Professor Doug Hooton
ACAA Annual Membership Directory
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# Issue 2 • 2021

## Applications, Science, and Sustainability of Coal Ash

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**On the Cover**

As U.S. coal-fueled generation declines, beneficial use markets will increasingly be supplied by ash from non-traditional sources. We look at the path ahead.
As I write these words, ACAA has just held its fall conference and workshop (the latter of which was conducted jointly with the University of Kentucky Center for Applied Energy Research) in French Lick, Indiana. Both events featured a “hybrid” format offering both in-person and virtual attendance—a first for ACAA. Both were very well attended, with over 100 attendees apiece—the vast majority of them in-person.

It is heartening to see such active engagement on the part of the membership. Heading into the new year, the beneficial use industry faces challenges on a number of fronts that will require our focused, coordinated effort going forward:

- While EPA’s near-term focus is clearly on completing several rulemakings related to coal ash disposal, its effort to revise the definition of coal ash beneficial use and regulatory treatment of “piles” staged for beneficial use loom as a concern for the industry. ACAA has repeatedly engaged the agency on these issues—via detailed comment letters and participation in stakeholder meetings. In these forums, we have encouraged EPA to adopt a “resource perspective” to actively encourage the beneficial use of coal combustion products that promote reduced greenhouse gas emissions in support of key Biden Administration climate change policy objectives.

- The change in presidential administrations in 2021 has brought with it many new personnel at the appointee and staff levels who have varying degrees of familiarity with beneficial use issues. Our job is to educate them—a task made all the more challenging by the efforts of environmental groups that see a window of opportunity to re-litigate agency rulings. As always, we have our work cut out for us.

- Last year, two separate bills were introduced in the U.S. House of Representatives that, among other things, seek to prohibit “as open dumping, the use of coal combustion residuals in unencapsulated uses.” A February 2021 letter to EPA signed by 38 House Democrats requested the EPA “prohibit the use of unencapsulated coal ash as structural fill.”

ACAA has conducted educational outreach to industry allies and Congressional offices pointing out that the provisions of the “Clean Future Act” seeking to ban CCP use in unencapsulated applications are unjustified and undermine the legislation’s policy objectives. In briefing materials, ACAA has noted that coal ash beneficial use supports climate change policy goals by conserving natural resources and reducing the need to manufacture cement, resulting in significant reductions in greenhouse gas emissions. Beneficial use of coal ash also supports environmental justice policy goals by significantly reducing the volume of material placed in disposal facilities located in environmental justice communities.

Educating our regulators and legislators is a time-consuming and arduous task under normal circumstances. It is made more challenging by the fact that—with the pandemic an ongoing concern—many agency and Congressional staff have yet to return to their offices. With luck, we will be able to engage with them more directly in the year ahead. Unlike some of our colleagues in government, the ACAA has been “back in the office” for quite some time now. ACAA’s Technical Committee has been in discussions for much of the past year with ASTM Subcommittee C09.24 on Supplementary Cementitious Materials to revise ASTM C618, the specification for fly ash use in concrete. ACAA has proposed language that would permit both bottom ash and harvested ash to be included in the standard and has commissioned a white paper to help support this effort (see Tom Adams’ “Message from the Executive Director” on page 4 for more details).

Elsewhere, ACAA has a full lineup of events scheduled for the upcoming year, including its Winter Membership Meeting in February, WOCA 2022 (jointly sponsored by UK CAER) in May, and the Fall Membership Meeting in October. I look forward to seeing you all in the year ahead and extend my sincere thanks to all of our members who so generously support the Association’s work with their time, labor, and financial resources.

On behalf of the ACAA Executive Committee, I wish you a healthy and prosperous new year.
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The Good News and the Good News

By Thomas H. Adams, ACAA Executive Director

It seems like we have had a tsunami of bad news in recent months. COVID-19 and all its relatives continue to cause turmoil. Masks and vaccinations divide communities and even families. Political division is more pronounced than ever. The economy has wobbled in its recovery from COVID-19 impacts. Employers cannot hire sufficient staff to meet demand. Shortages of computer chips have disrupted new vehicle sales and driven used vehicle prices to unimaginable heights. Inflation is making a comeback. And so on. It seems that good news is one more thing in short supply as we head into the new year.

The American Coal Ash Association (ACAA) has good news to share. The members of our Technical Committee have been engaged in discussions for some months now both within the committee and with ASTM Subcommittee C09.24 on Supplementary Cementitious Materials to revise the specification for fly ash use in concrete, ASTM C618. A number of ideas to revise the specification have been offered for the purpose of increasing the supply of fly ash to close the gap between supply and demand. Recently, the committee was able to come to a consensus. The leadership of C09.24 has encouraged ACAA to make a proposal that can be used to begin the balloting process. ACAA has proposed language that would revise C618 to include language allowing bottom ash to be included in that specification as well as harvested ash. Currently, C618 is silent on both subjects. To support the ACAA proposal and provide rationale for including harvested ash in C618, it was suggested we commission a whitepaper providing a literature review citing research to bolster the ACAA position. ACAA engaged Professor Emeritus Douglas Hooton, University of Toronto, and Professor Michael Thomas, University of New Brunswick, to draft this document. Professors Hooton and Thomas are internationally recognized as experts in supplementary cementitious materials. Funding for this whitepaper is coming from voluntary contributions from ACAA members.

As is the case with most ASTM standards activity, it will take some time to get these revisions through the subcommittee and the main committee, ASTM C09. However, these changes can make a major impact on shrinking the gap between demand and supply of ash suitable for use in concrete. That is the best news we have been able to communicate to the users of fly ash in quite some time.

More good news: ACAA held its fall membership meeting recently along with a workshop co-sponsored by our friends at the Center for Applied Energy Research at the University of Kentucky. The meeting was a hybrid format with in-person and online participation. Over 100 people registered for the in-person option and made the journey to the French Lick Resort, French Lick, Indiana. Another 25 participated virtually. ACAA standing committees reported on their recent activities. The workshop, “Global Trends in Fly Ash Production and Utilization,” offered modules discussing the latest activity in important areas such as pond closure, rare earth extraction, harvesting, current CCP research, standards, and regulation. The keynote address was given by Caryl Pfeiffer, Director, Corporate Fuels & By-Products, at LG&E and Kentucky Utilities. Ms. Pfeiffer’s address, titled “Every Pound Counts,” detailed her company’s approach to extracting value from every pound of coal combustion products generated. It was inspiring to hear what can be done when all departments in a large company are working toward the same goal. Add in exhibitors, two receptions, and good sponsorships and the result was a very productive three days. After waiting 621 days to gather in-person, it was good to be together again. Good news, indeed!
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CCPs and Utility Compliance with the Clean Air Act: Necessity Proves to Be The Mother of Invention

By John Simpson

Throughout much of the history of the beneficial use industry in the United States—now over 50 years—coal combustion and the products it generates (CCPs) have been under intensive regulatory scrutiny. Congress has repeatedly amended the Clean Air Act to tighten standards on power plant emissions governing nitrogen oxide, sulfur, and mercury, while the Environmental Protection Agency (EPA) has continually revisited the issue of whether to regulate CCPs as hazardous waste. Despite myriad changes to coal ash composition as power plants have adopted emission-control strategies in response to new regulations, adoption of innovative technologies and processes to treat CCPs have allowed their usage and marketability to thrive despite predictions by some observers of the industry’s imminent death.

“THE REPORT OF MY DEATH WAS AN EXAGGERATION.”
—MARK TWAIN
Birth of an Industry

Use of electrostatic precipitators to collect fly ash from flue gas dates almost to the inception of pulverized coal’s use as a fuel for steam generating units in the United States. The first precipitator, specified for 90 percent fly ash collection efficiency, entered service in 1923 at Detroit Edison’s Trenton Channel plant, although it would be several years before it would attain that level of operation.¹

By March 1969, The New York Times had reported that a Reading, Pennsylvania, coal plant had been operating for two years with electrostatic precipitators that were able to remove 99.5 percent of fly ash.² Subsequently, the Clean Air Act of 1970 would not only mandate emission control of particulates for coal plants, but would help encourage research and development to improve the technologies to do so. Development by the EPA of New Source Performance Standards for particulate emissions from coal-fueled plants helped spur R&D to improve electrostatic precipitator design, performance, and capacity. As a result, new markets developed for the sale of ash, particularly in the concrete and cement industries, which established new revenue streams for utilities and helped lower their ash disposal costs.³

In the ensuing decade, production of fly ash would more than double, from 26.5 million tons in 1970 to 57.5 million tons by 1979. Beneficial use of fly ash would likewise increase over the same period, from 2.2 million tons (8.3 percent recycling rate) to 10 million tons (17.4 percent recycling rate).⁴ In addition to increased fly ash usage by concrete and cement manufacturers, beneficial use of fly ash in highway construction took off (in 1972 alone, over 2.8 million tons of fly ash was utilized in U.S. road projects following the U.S. Department of Transportation’s sanctioning of this practice).⁵

Clean Air Act Amendments

Action at the federal level would impact coal combustion product markets anew with the passage of the Clean Air Act Amendments (CAA) of 1990. Title IV of the legislation—the “Acid Rain Program”—set forth the goals of reducing annual sulfur dioxide (SO₂) emissions, by 2010, by 10 million tons annually (or roughly

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50 percent) below 1980 levels and lowering nitrogen oxide (NOx) emissions by two million tons annually by the year 2000.\(^6\)

In response to the legislation, coal utilities adopted a variety of sulfur-reduction strategies—chief among them switching to lower-sulfur fuel sources or installing flue gas desulfurization (FGD) devices. Fuel switching to lower-sulfur coal helped boost production from the Power River Basin (PRB) mines in the western U.S., and the resulting ash from PRB coal-fueled units became sought-after by cement manufacturers.\(^7\) Installation of FGD systems—many of which operated at 97 percent efficiency—created vast supplies of a product, FGD (synthetic) gypsum, that has since found widespread application in wallboard manufacturing, agricultural use, and as mine backfill and structural fill. In 2019—the latest year for which data are available—approximately 23 million tons of FGD gypsum was produced in the U.S., of which almost 58 percent was beneficially used.\(^8\)

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To meet the CAAA’s reduced NOx emission mandates, utilities variously employed combustion technologies such as installing low-NOx burners, reburning, and flue gas recirculation, as well as post-combustion technologies, including selective catalytic reduction (SCR) and selective noncatalytic reduction (SNCR). A frequent consequence of the use of low-NOx burners was to increase the levels of residual carbon, and consequently the loss on ignition (LOI), of the resulting fly ash—rendering it potentially unsuitable for use in concrete absent any further treatment. Likewise, one outcome of the use of selective catalytic reduction and selective noncatalytic reduction—which both involve injection of ammonia into the boiler exhaust gas stream to reduce NOX emissions—was the potential for excess deposition of ammonia on fly ash (“ammonia slip”) that could render it unsuitable for beneficial use, such as in concrete, and unsafe for disposal.

The beneficial use industry successfully resolved both issues. A variety of thermal processing technologies now are available to combust the excess carbon from fly ash produced by low-NOx burners, rendering it suitable for beneficial use. In the case of ammonia slip, it can now be treated via the injection of oxidizers, converting the ammonia to harmless compounds and allowing its use in concrete applications (or providing for safer disposal operations). Several all-in-one solutions exist that remove both excess carbon and ammonia from fly ash.

In December 2011, EPA finalized standards for reducing power plants’ emissions of mercury, heavy metals, and acid gases. Many plants—particularly newer, but also a significant percentage of older plants—were already in compliance with the agency’s Mercury and Air Toxics Standards (MATS) by that time due to their use of existing technologies, such as SCR with flue gas desulfurization, activated carbon injection with and without fabric filter, or electrostatic precipitators. However, a number of other plants—comprising approximately 40 percent of the fleet—would require installation of advanced emissions control equipment of one sort or another.

Among the most cost-effective strategies for mercury control compliance was the addition of powdered activated carbon (PAC) to the flue gas stream. However, injection of PAC upstream of the particulate collection systems can result in fly ash quality deterioration, which can interfere with air entrainment in concrete even at low levels. Liquid reagents are now available that passivate the carbon, neutralizing its ability to adsorb air entrainment agents in concrete and restoring the fly ash’s capacity to be used in this high-value application.

**Never Say Die**

The 1970 Clean Air Act and its subsequent amendments have ushered in ever-stricter standards that have boosted emission control performance from a range of stationary and mobile sources. Coal utilities’ compliance with the regulations promulgated under the CAA and its amendments have necessitated the use of a variety of emission-control strategies and technologies, some of which impacted the potential usability and/or disposability of coal combustion products, particularly fly ash. On the other hand, the Act’s sulfur dioxide emission standards helped spur the development of an important and highly marketable coal combustion product: FGD gypsum. Throughout the CAA’s 50-plus years, the CCP beneficial use industry has proven to be remarkably adaptive, developing an array of products and processes to ensure the continuing availability of high-quality CCPs to end users—as well as their safe disposal where required.

Upon the finalization of EPA’s MATS plan, in 2011, the agency announced:

“In EPA’s 40-year history, the Clean Air Act has not impacted power companies’ ability to keep the lights on in communities across the United States.”

Owing in large part to the resourcefulness of the beneficial use industry, much the same could indeed be said of the Act’s impact on fly ash: it has not quashed marketers’ ability to supply vitally needed, high-quality products to communities across the United States.

*John Simpson* is editor of *ASH at Work*. 

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There is little question that U.S. coal-fueled electricity generation—far and away the biggest current source of fly ash—is decreasing and will continue to do so in the coming years. Less certain is the pace at which coal-fueled generators will be retired and thus the impact on supplies of current-production fly ash—particularly for projections beyond the short-to-medium term.

According to the Energy Information Administration (EIA), approximately 28 percent of U.S. coal-fueled electric generation capacity (88.7 GW) has been retired since the coal fleet reached its peak in 2011. Of that total, 48 GW of capacity was retired between 2016 and 2020 alone—a pace that has since slowed, with just 2.7 GW of capacity slated for retirement by the end of 2021.

No Crystal Ball

Personal investors are surely familiar with the regulatory disclosure that “past performance is not necessarily indicative of future results.” Similarly, utility investments in (coal-fueled) power plants are impacted by a range of unpredictable market and non-market factors that can influence plant retirement decisions, including but not limited to:

- Plant operating costs
- The price and availability of competing fuels
- Government policies (federal regulations, state legislation)

Addressing each of these variables in turn:

Plant Operating Costs—According to EIA, 68 percent of U.S. coal fleet retirements since 2011 were plants fueled by bituminous coal—generally smaller, older units than those fueled by subbituminous coal (the other coal rank primarily used in thermal units). In 2019, the delivered price of subbituminous coal was $1.86 per million British thermal units (MMBtu), compared with $2.26/MMBtu for bituminous coal. The lower delivered price for subbituminous coal (owing to more cost-effective mining practices) makes coal plants that use it more economically competitive than bituminous coal-fueled plants. As shown in Figure 1, these more efficient subbituminous plants now comprise a significantly larger proportion of the coal fleet.

Price and Availability of Competing Fuels—The Henry Hub natural gas spot price at this writing is $5.53/MMBtu, double its level of a year ago. In early October 2021, natural gas futures closed at their highest level since December 2008. Credit simple supply and demand: 2021’s unusually hot summer boosted air-conditioning use—and thus gas demand and prices—resulting in less gas being stored for winter.

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UK, where soaring natural gas prices have been coupled with sagging wind generation, coal units scheduled for retirement have been activated to bolster electricity supply. Whether or not a full-blown energy crisis may be headed for the U.S. this winter as some observers have suggested, the threat of one could influence utilities and/or policymakers to preserve more coal capacity than previously anticipated.

**Government Policies**—Enforcement of the Coal Combustion Residuals (CCR) rule has yet to fully play out. According to Firmographs LLC, there are landfills and surface impoundments at approximately 200 utility sites where plant closure dates have yet to be announced. EPA’s determination of how these sites will be treated in any given case could accelerate retirement of the relevant boiler. Further state legislative action, similar to California’s law mandating that all retail sales of electricity by 2045 in the state must derive from carbon-free sources, could likewise speed coal plant retirements.

**Medium-Term Outlook for Coal Plant Retirements**

With the aforementioned qualifiers as background, Firmographs LLC has forecast coal consumption related to U.S. electricity generation, and subsequent fly ash production, for the years 2021-2025. Starting with EIA’s 2020 report data covering these same two areas, Firmographs:

- Examined the announced retirement dates of boilers through 2025;
- Assumed a constant capacity factor for coal units, based on 2020 data, going forward;
- Calculated the amount of fly ash generated by each boiler, assuming constancy of operation based on 2020 data;
- Forecast the coal consumption tonnage and fly ash production of the U.S. coal fleet for each year based on the above data inputs.

Forecasts for U.S. coal consumption and fly ash production are shown in Figures 2 and 3, respectively.

**Utility investments in power plants are impacted by a range of unpredictable market and non-market factors that can influence plant retirement decisions.**

As would be expected, the trendlines for both thermal coal consumption and fly ash production are similar and show a modest decrease year over year during the forecast period. Thermal coal consumption decreases over the period from 433.1 million to 363.6 million short tons (a 16.1 percent decline), while fly ash production decreases from 32.26 million to 27.54 million short tons (a 14.6 percent decline).

The forecast horizon—2021-2025—was chosen due to the relative certainty of the conclusions that could be drawn: the longer the time horizon, the more that any of a number of variables (e.g., regulatory policy, legislation, deviations from historical averages in the price of competing fuels, etc.) can come into play that potentially impact the accuracy of the forecast. A June 2021 analysis published by the National Bureau of Economic Research found that the average time between the announcement of a plant’s retirement and its

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9 Ibid.
actual closing, over the past decade, was three years. Thus, the potential for a plant to be retired by 2025 that, as yet, has not announced plans to do so is also minimized.

**National Production vs. Regional Availability**

Beyond the question of total U.S. fly ash production over a given time period is the issue of where (and when) coal plant shutdowns will occur. The geographical breakdown of plant retirements can impact regional availability of fly ash, as its transportation over long distances can potentially add sufficiently to the delivered cost of the product that it is uneconomical for use by concrete and other manufacturers.

Table 1 lists planned coal plant retirements by NERC region (as reported to the EIA in 2019). The majority of announced retirements are in the Midwest and West, with the median planned retirements in the Midwest occurring sooner (2022) than those in the West (2025). Based solely on these announced retirements—64 percent (on a capacity basis) of which will occur by the end of 2025—NERC regions RFC (Midwest/Mid-Atlantic) and SERC (Southeast) will comprise approximately three-quarters of nationwide coal-generating capacity. The MRO (upper Midwest) will account for under 20 percent, while the NPCC (Northeast), TRE (Texas), and WECC (West) will collectively account for less than 5 percent of coal-generating capacity.

Further complicating the picture of the regional availability of fly ash are the announced plans by at least three coal plants to run only seasonally to improve the economics of their operations—and the potential for additional plants to do so going forward. Two such plants in Minnesota, totaling 1,193 megawatts (MW), have received regulatory approval to operate only during the higher-demand summer and winter months. A third plant in Arizona with 793 MW of capacity will operate

Table 1. Planned Coal Generator Retirements by NERC Region

<table>
<thead>
<tr>
<th>NERC Region</th>
<th>Num Gen</th>
<th>Total Cap (MWs)</th>
<th>Median Planned Retirement Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRO</td>
<td>21</td>
<td>7,438</td>
<td>2022</td>
</tr>
<tr>
<td>NPCC</td>
<td>2</td>
<td>1,055</td>
<td>2020.5</td>
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<tr>
<td>RFC</td>
<td>49</td>
<td>16,376</td>
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<tr>
<td>SERC</td>
<td>28</td>
<td>9,008</td>
<td>2021.5</td>
</tr>
<tr>
<td>TRE</td>
<td>9</td>
<td>6,239</td>
<td>2030</td>
</tr>
<tr>
<td>WECC</td>
<td>28</td>
<td>12,747</td>
<td>2025</td>
</tr>
</tbody>
</table>

Source: National Bureau of Economic Research


11 Ibid, pp. 6-7.


only during the high-demand summer months, starting in 2023.14

**Longer-Term Outlook**

In EIA’s *Annual Energy Outlook 2021*—which includes a forecast of coal-fueled generating capacity retirements through 2050—the agency states, “Most of the coal-fired generating capacity retirements assumed in the [baseline] Reference case occur by 2025.” However, the Reference case includes legislation and regulation current as of September 2020, and so incorporated the EPA’s Affordable Clean Energy rule (viewed by some observers to have offered a modest regulatory reprieve to coal plants), which was subsequently vacated in the United States Court of Appeals for the District of Columbia Circuit in January 2021.15 Thus, EIA’s forecast may underestimate the pace of coal plant closures.

On the other hand, EIA notes in its 2021 Outlook, “Low natural gas prices in the early years of the projection period also contribute to the retirements of coal-fired and nuclear plants because both coal and nuclear generators are less profitable in these years, because natural gas generation generally sets power prices in wholesale electricity markets.”16 Nine months removed from the publication of EIA’s *Outlook*—released in February 2021—U.S. natural gas prices have, in fact, soared.

In any event, EIA’s “worst-case scenario” for the coal-fueled electricity generation sector—a high oil and gas supply environment through 2050—still forecasts a distinct flattening in the rate of decrease in coal-fueled electricity generation over the final 20 years of the forecast (2030-2050). (See Figure 4 on the facing page.) During that period, coal-fueled electricity generation decreases from 90.8 GW to 73.3 GW—for a negative growth rate of just 1.06 percent annually.17

By that time, it is likely that a variety of supplemental fly ash sources—harvested, blended, and/or imported—will have been developed sufficiently to make up for the deficit in fly ash from coal-fueled electricity generators.

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16 Ibid.


*John Simpson is editor of *ASH at Work.*
Since approximately 2008, the electric power industry has undergone a major shift away from coal-fueled electric power plants in favor of those using natural gas or passive power production. This change has resulted in a dramatic reduction in coal fly ash production, diminishing from a high of 72.5 million short tons in 2008 to 36.2 million short tons in 2018. Meanwhile, in 2018 the beneficial use of fly ash in concrete accounted for 12.5 million short tons of the material, which represented over 60 percent of its total beneficial use. Although the total tonnage of fly ash used in concrete has not increased significantly in the past 10 years, the concrete industry’s demand for fly ash, as a percent of the material’s total beneficial use, has increased by nearly 50 percent.

Looking ahead, the utilization of fly ash is expected to increase from 55 percent in 2018 to 90 percent in 2039, with the actual volume of fly ash utilized increasing from 20.1 million short tons to 27.8 million short tons at the end of these respective periods. The demand boost in North America comes from higher demand from the construction industry, increased road construction activities, and highway building; however, fly ash production will continue to fall over the same time frame. The American Coal Ash Association (ACAA) estimates that the average annual production of fly ash in the U.S. will be 32 million short tons by 2039, with the baseline forecast suggesting that fly ash production will fall from 36.2 million short tons in 2018 to 30.8 million short tons in 2039, decreasing at an annualized rate of 0.8 percent over the forecast period.

The falling production of fly ash will largely be driven by the continuing decline in the volume of coal-fueled electricity generation in the U.S. As a result, there will be a widening gap between supply and demand in the coming years, and prices for fly ash are expected to increase as demand outweighs supply. The global fly ash market is expected to grow from $8.5 billion in 2019 to $13.3 billion in 2027, at a compound annual growth rate of 5.8 percent, according to Fortune Business.

The growth in demand for fly ash is due to the increasing demand from the construction and infrastructure sectors as Class F is used as a substitute for portland cement in the production of concrete due to its inherent strengths, lower cost, and environmental benefits. This demand for fly ash will only grow once the recently passed $1.2 trillion infrastructure bill takes effect, which includes $110 billion to be used for the construction of roads and bridges.

Historically, this fly ash has been obtained directly from coal-fueled power plants around the country as it is being produced, but the accelerated rate of decommissioned coal plants is causing regional gaps in the production, supply, quality, and availability of fly ash around the nation. Fly ash from higher-production regions of the nation can be shipped by rail, truck,
and barge to high-demand regions that do not have supply—but it adds costs and time, and supply is not always reliable. Transporting fly ash long distances significantly increases its cost, and the price point of fly ash in most markets does not support these added transportation costs.

This higher demand has resulted in challenges regarding both the decrease in supply and quality of fly ash in some markets, which in turn has caused providers to consider a new source for the fly ash material that provides the performance attributes needed when used in the production of concrete: harvested fly ash. Harvested fly ash is ash that, owing to insufficient market demand at the time of production, was not used as it was produced, but instead was deposited in landfills or impoundments for disposal. Harvested fly ash is now becoming a principal source of fly ash that can provide the same product benefits as production ash to meet the increased demand by the concrete industry.

### The Benefits of Ash Harvesting and How it Works

The benefits of ash harvesting are far-reaching and include:

- Capability to meet growing demand from concrete producers and others
- Lower costs versus using raw virgin materials
- Lower costs for logistics and delivery to markets
- Every ton of ash beneficially used in the production of portland cement saves 0.87 tons of CO2 from entering the atmosphere
- Beneficial use of fly ash provides concrete with higher strength, decreased permeability, increased durability,
A chemical treatment process that mitigates the effects of excess carbon in fly ash when used as a constituent in a concrete mix. This is accomplished by satisfying the absorptive nature of the carbon. It is effective in mitigating natural and activated carbons. The Carbon Blocker™ chemical is applied to the fly ash as it is being loaded at the power plant. The process allows concrete admixtures such as air entraining agents, water reducers, etc. to perform uninhibited from the absorptive nature of carbon. Carbon Blocker™ has proven to be an effective carbon-mitigating solution for more than a decade.

**Capital cost (range):** $400,000 - $600,000

**# Commercial units installed:** 9

**Contact info:** Kevin Foody, 412-225-1110, kfoody@wm.com

**Website:** www.flyashdirect.com

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**Carbon Burn-Out**

**Vendor:** Boral Resources

**Technology type:** Carbon mitigation

**Technology description:** Boral’s Carbon Burn-Out (CBO) is a technology and process in which residual carbon in fly ash is combusted to produce a consistent low-carbon, low loss-on-ignition (LOI), high-quality pozzolan. This fluidized bed thermal treatment process can also remove ammonia from fly ash. The CBO system is available in two configurations: (1) a custom-designed system for integration into an operating power plant to handle all its ash production and reclaim the heating value of the residual carbon in the ash, and (2) a modular stand-alone system consisting of prefabricated unit processes that are designed to beneficiate harvested fly ash. As such, the modular CBO system may be used to beneficiate high-carbon fly ash either directly from the power plant or from fly ash that has been stored in landfills or ponds. The modular CBO system is less expensive and faster to deploy than the traditional customized thermal beneficiation processes. The production capacity of a CBO system can be greatly enhanced by coupling it with RestoreAir® to treat higher residual carbon levels in the ash product.

**Capital cost (range):** The capital cost of thermal technologies depends on the design production capacity, feedstock carbon content, and the desired final carbon contents, as well as site development constraints. The modular configuration is significantly less expensive than the customized systems. RestoreAir® add-on can further significantly improve the cost effectiveness of thermal processes.

**# Commercial units installed:** 4

**Contact info:** Dr. Rafic Minkara, P.E., 770-330-0689, rminkara@boral.com

**Website:** www.flyash.com/products-and-technologies/carbon-burn-out

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**Coomtech Kinetic Turbulent Air Dryer**

**Vendor:** Coomtech Ltd.

**Technology type:** Low energy materials drying

**Technology description:** The Coomtech technology dries powders and granules using managed turbulent airflow, instead of heat, to shear surface moisture from the material. This results in up to 75% less energy consumption than thermal drying. The technology is modular, scaling in multiples of a base unit of 4-6 tph capacity. Feed and receiving stages use off-the-shelf components for reliability and serviceability.
Reduced alkali-silica reactivity, lower heat of hydration, and increased sulfate resistance

Ash harvesting typically falls into two categories:

**Ready-to-Use Ash (Unprocessed Ash)**—In many cases, ash that was previously deposited in landfills or impoundments is good-quality ash. If the ash in these existing impoundments is tested and meets American Society of Testing and Materials (ASTM) C-618 and regulatory specifications, it can be excavated and sold to concrete producers or other manufacturers as-is for beneficial use.

**Beneficiated Ash (Processed Ash)**—Ash contained in some landfills and impoundments does not currently meet ASTM and regulatory specifications to be directly used in concrete production. Reasons can include its having a loss on ignition (LOI) above 6 percent; minimum concentration of alumina, iron, and silica; or high moisture and high ammonia content. This ash must first be processed or beneficiated to meet specs before it can be beneficially used in the concrete/construction market.

**What Makes for a Good Harvesting Site**

The condition of the ash and potential for reuse in each case is determined through material sampling, physical testing (microscopy, particle size analysis, carbon content, magnetic content, X-ray fluorescence, atomic absorption), chemical analysis, and analysis of the results. Based upon these tests and the analysis, it can be determined whether the previously deposited ash: (1) is good-quality ash that can be sold and reused unprocessed as-is; (2) must first be processed/beneficiated prior to reuse; or (3) is simply not economical for beneficial use due to its chemical makeup or physical location within the landfill or impoundment. This includes assessing the costs of harvesting the ash to pull it from the landfill or impoundment, the costs for processing/beneficiating, if needed, as well as the logistical costs for transporting the ash to concrete producers via truck, rail, or barge.

**Charah Solutions EnviroSource™ Fly Ash Beneficiation to Meet Market Demand**

It is now apparent that meeting the growing demand for fly ash—as well as concrete producers’ requirements for cost-effective, high-quality product—will require the beneficiation of ash stored in existing landfills and impoundments. Charah Solutions’ patented EnviroSource™ fly ash beneficiation technology provides the ash harvesting solution to meet market demand at a significantly lower-cost profile and a much more efficient footprint than other beneficiation/processing technologies. EnviroSource™ technology is a proven thermal process that reduces LOI, ammonia, activated carbon, and environmental controls facilitates deployment within months, not years, at a significantly lower-cost profile than competitive technologies. Capable of handling both current fly ash production or harvested coal ash from a pond or landfill, EnviroSource™ technology is a proven beneficiation process that creates marketable product in support of coal ash initiatives in an environmentally responsible manner.

**Capital cost (range):** The Charah Solutions EnviroSource™ Fly Ash Beneficiation system runs $10 million - $45 million depending upon the number of units needed and scale of project.

**Commercial units installed: 1 (Sulphur, Louisiana)**

**Contact info:** Adam Piacentino, Vice President of Business Development – Sales, 704-650-6727, apiacentino@charah.com

**Website:** www.charah.com

**Harvested Ash Processing and Beneficiation**

**Vendor:** Boral Resources

**Technology type:** Harvested ash processing and beneficiation

**Technology description:** Ash harvesting and beneficiation generally consist of deploying environmentally responsible practices to excavate the ash deposit, then upgrading the material quality using screening, drying, or advanced material processing units to convert the harvested ash into a quality pozzolan for commercial use in concrete. Advanced material processing such as classification, grinding, RestoreAir®, and Carbon Burn-Out can be bolted on to enhance the quality as needed for quality challenging deposits. The ash harvesting/beneficiation system must ensure consistent quality to
yield ASTM C618-quality fly ash suitable for beneficial use in ready-mix concrete and other durable/high-strength applications.

**Capital cost (range):** The capital cost to harvest and beneficiate fly ash is very site specific and highly dependent on the condition and quality of the in-situ deposit as well as other project parameters and constraints. Existing material storage and load facilities can reduce the cost of the project. Site reclamation regulatory timeline, if applicable, and access to landfill for disposal of encountered waste material can also influence the capital cost of the harvesting and beneficiation project.

**# Commercial units installed:** 1

**Contact info:** Dr. Rafic Minkara, P.E., 770-330-0689, rminkara@boral.com

**Website:** www.flyash.com/services/disposed-ash-harvesting-for-beneficial-use

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**Low-Frequency Sonication**

**Vendor:** SonoAsh LLC/SonoAsh Engineered Materials Ltd.

**Technology type:** Carbon reduction, particle size adjustment, calcium reduction, ammonia reduction, sulfur adjustment

**Technology description:** SonoAsh leverages patented low-frequency sound technology to fracture the carbon component from impounded ash and at the same time adjust the particle size and reduce calcium/sulfur/ammonia present to create the desired uniform “manufactured ash” specification. The high carbon component encapsulates a recoverable fraction of the metals present, creating a new condensed ore body for further recovery. SonoAsh partners with utilities and other strategic stakeholders to develop output channel partnerships.

**Capital cost (range):** $6 million - $25 million will process between 10,000 and 50,000 tpy.

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**RAM™ (Reclaimed Ash Management)**

**Vendor:** Ashcor USA Inc.

**Technology type:** Harvested, comingled ash processing and beneficiation

**Technology description:** As an industry leader in fly ash marketing for over 20 years, Ashcor has engineered a commercial solution that transforms the way fly ash is sourced. Our patent-pending Reclaimed Ash Management (RAM™) technology processes previously stored coal ashes (including fly ash comingled with bottom ash) into a high-grade pozzolan for use in concrete. Ashcor can process the entire ash deposit without an ash waste stream and can also address contaminants such as salts and gypsum. Using our RAM™ technology, we are the first ash marketer to manufacture a material from harvested bottom ash and fly ash that meets and exceeds ASTM C618 and CSA A3000 specifications. RAM™ ash offers a consistent average fineness compared to live fly ash sources.

**Capital cost (range):** The capital cost of a RAM™ facility is site specific and highly correlated to desired throughput volume. Additionally, a variety of other factors to be considered include quality of the ash deposit, site characteristics and features (i.e., storage and load-out facilities) and associated regulatory and permitting requirements. RAM™ facilities can be customized to accommodate a wide range of ash deposits, offering a flexible and competitive solution to address ponded and landfilled ash.

**# Commercial units installed:** 3

**Contact info:** Brad MacKenzie, 604-318-8077, brad@sonoash.com

**Website:** www.sonosh.com

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EnviroSource beneficiation technology - how it works
moisture in fly ash, giving utilities the best option for harvesting ash contained in landfills and impoundments that needs to be processed to meet ASTM and regulatory specifications.

Charah Solutions’ EnviroSource technology’s benefits include:

- Increases supply of available fly ash to the market
- Reduces LOI, ammonia, activated carbon, mercury, and other contaminants
- Significantly lower-cost profile than competing beneficiation technologies
- Efficient footprint with self-contained environmental controls
- Can be deployed in months versus years
- Modular design and scalability allow for production of 40,000 to 200,000 tons per year
- Delivered as a portable or stationary system depending on client requirements

With EnviroSource technology, there is no impact on the power plant operation. The technology can be either fully independent or integrated with the operation of the power plant. The process delivers a marketable concrete-grade or cement kiln-friendly product from existing coal fly ash streams.

EnviroSource technology is a four-step process:

1. Exposes high-LOI fly ash to indirect heat in the thermal desorber
2. Separates off-gassed contaminants from solids in a gas reactor

### RestoreAir®

**Vendor:** Boral Resources  
**Technology type:** Carbon passivation  
**Technology description:** RestoreAir® uses a liquid reagent to treat fly ash at the power plant silo, before delivery to customers, to neutralize the impact of powder activated carbons (PACs) or un-burned carbon (UBC) on air entrainment in concrete. The technology uses a low dosage of liquid reagent to passivate the carbon active surfaces and reduce their ability to adsorb air entrainment agents in concrete. Carbon is not removed, but its effect on air entrainment is neutralized. The technology has been successfully demonstrated on Class C and F ashes containing the most common PACs and UBCs. Ash treated by RestoreAir® has been widely accepted by state DOT and concrete producers. The deployment of the technology is complemented by advanced patented analytical tools, such as SorbSensor®, to gain a thorough understanding of adsorption kinetics of PACs and fly ashes.

**Capital cost (range):** RestoreAir® installations at power plants and fly ash terminals are relatively simple. Systems installation costs can range from $250,000 to $500,000 depending on existing load-out silo space availability and integration complexity.

# Commercial units installed: 20

**Contact info:** Dr. Rafic Minkara, P.E., 770-330-0689, rminkara@boral.com  
**Website:** www.flyash.com/products-and-technologies/restoreair

### STAR® Technology

**Vendor:** The SEFA Group  
**Technology type:** Thermal beneficiation resulting in:
- Carbon reduction and mitigation
- Ammonia removal
- Mercury sequestration
- Harvested coal ash drying
- Production and impounded coal ash processing

**Technology description:** STAR® Technology is The SEFA Group’s patented thermal beneficiation process that transforms coal ash into a consistent, high-quality product for recycling into concrete and other industrial applications, providing a permanent solution to remove coal ash from the environment. It was the first technology in the world to process coal ash from ponds on a commercial scale. With a decade of technological advancements, proven market success, and continued growth, SEFA has established STAR® Technology as one of the most advanced and environmentally friendly options available for recycling coal ash.

**Capital cost (range):** The capital cost of a STAR® facility varies significantly based on its production capacity, the extent to which it may tie into a host generating facility, site development characteristics, local construction costs, and a variety of other factors. In SEFA’s experience, the capital cost is often favorable in comparison to the long-term costs of landfilling ash as a waste product.

# Commercial units installed: SEFA operates and maintains six STAR® plants today. Four of those process harvested fly ash.

**Contact info:** Walt LeMaire, CCP Services Business Development, Executive Director, 281-702-6757 (m), wlemaire@sefagroup.com  
**Website:** www.sefagroup.com
3. Removes carbon, ammonia, chlorides, and mercury to generate low-LOI fly ash

4. Removes metals, ammonia, chlorides, and the products of the combustion from the gas stream using its proprietary gas reactor. This process generates a minimal amount of precipitate (less than 30 tons generated for every 200,000 tons of fly ash processed), and the precipitate is returned to the finished product so there is no waste stream.

EnviroSource Technology Results

Results provide a consistent LOI reduction over a wide range of fly ash inputs, reducing the LOI, ammonia, activated carbon, mercury, and other contaminants to meet ASTM and regulatory specifications for sale into the market. The process reduces LOI concentrations by as much as 95 percent and consistently achieves LOI levels below 1 percent for most ash. The technology can also remove 90 percent of the ammonia in the ash.

Ash Harvesting Benefits the Entire Industry and the Environment

In order to meet future demand, ash harvesting is certain to become standard practice across the industry as less production ash is available due to the decline in coal-fueled electricity generation in the U.S. The Environmental Protection Agency’s issuance in 2015 of the Coal Combustion Residuals (CCR) rule, as well as state and local legislation, will also help drive demand for ash harvesting and beneficiation, as much of this legislation dictates the amount of ash that must be beneficiated in closure projects. Ash harvesting will benefit the entire industry by increasing the supply of marketable ash while meeting the price and supply demands of concrete producers across the nation.

Ash harvesting and ash beneficiation also benefit the environment as they conserve our natural resources, including water, decrease landfill disposal, and reduce greenhouse gases—as every ton of ash beneficially used in the production of portland cement saves 0.87 tons of CO2 from entering the atmosphere. Moreover, ash beneficiation plays a vital role at the utility level as utilities work to meet their emissions reduction timeline goals and drive economic and environmental benefits to local communities.

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**EnviroSource Technology Results**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Coal Fly Ash unprocessed result units</th>
<th>Coal Fly Ash processed with EnviroSource result units</th>
<th>Percent reduction result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss on Ignition</td>
<td>16.20 %</td>
<td>1.18 %</td>
<td>92.72 %</td>
</tr>
<tr>
<td>Loss on Ignition</td>
<td>15.50 %</td>
<td>.84 %</td>
<td>94.58 %</td>
</tr>
<tr>
<td>Loss on Ignition</td>
<td>14.70 %</td>
<td>2.50 %</td>
<td>82.99 %</td>
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<tr>
<td>Loss on Ignition</td>
<td>14.53 %</td>
<td>2.10 %</td>
<td>85.55 %</td>
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<tr>
<td>Loss on Ignition</td>
<td>9.81 %</td>
<td>1.10 %</td>
<td>88.90 %</td>
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<tr>
<td>Loss on Ignition</td>
<td>8.30 %</td>
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<td>Loss on Ignition</td>
<td>7.25 %</td>
<td>.15 %</td>
<td>97.93 %</td>
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<td>Loss on Ignition</td>
<td>6.93 %</td>
<td>.30 %</td>
<td>95.42 %</td>
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<tr>
<td>Loss on Ignition</td>
<td>6.05 %</td>
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<td>Loss on Ignition</td>
<td>5.84 %</td>
<td>.17 %</td>
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<td>Loss on Ignition</td>
<td>3.58 %</td>
<td>1.23 %</td>
<td>65.64 %</td>
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<td>Loss on Ignition</td>
<td>1.77 %</td>
<td>.28 %</td>
<td>84.18 %</td>
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<tr>
<td>Average of above samples Loss on Ignition</td>
<td>9.22 %</td>
<td>1.04 %</td>
<td>88.72 %</td>
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</tbody>
</table>

<table>
<thead>
<tr>
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<th>Percent reduction result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen (Ammonia)</td>
<td>353 ppm</td>
<td>32 ppm</td>
<td>90.93 %</td>
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<tr>
<td>Nitrogen (Ammonia)</td>
<td>431 ppm</td>
<td>37 ppm</td>
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<tr>
<td>Nitrogen (Ammonia)</td>
<td>435 ppm</td>
<td>44 ppm</td>
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<td>Nitrogen (Ammonia)</td>
<td>385 ppm</td>
<td>51 ppm</td>
<td>86.75 %</td>
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<tr>
<td>Average of above samples Nitrogen (Ammonia)</td>
<td>401 ppm</td>
<td>41 ppm</td>
<td>89.78 %</td>
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<thead>
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<th>Parameter</th>
<th>Coal Fly Ash unprocessed result units</th>
<th>Coal Fly Ash processed with EnviroSource result units</th>
<th>Percent reduction result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>40600 ppb</td>
<td>&lt;100 ppb</td>
<td>99.75 %</td>
</tr>
<tr>
<td>Mercury</td>
<td>3670 ppb</td>
<td>&lt;100 ppb</td>
<td>99.42 %</td>
</tr>
<tr>
<td>Mercury</td>
<td>4410 ppb</td>
<td>&lt;100 ppb</td>
<td>97.58 %</td>
</tr>
<tr>
<td>Mercury</td>
<td>1380 ppb</td>
<td>&lt;100 ppb</td>
<td>92.75 %</td>
</tr>
<tr>
<td>Mercury</td>
<td>1310 ppb</td>
<td>&lt;100 ppb</td>
<td>92.75 %</td>
</tr>
<tr>
<td>Mercury</td>
<td>1184 ppb</td>
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<td>91.55 %</td>
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<tr>
<td>Mercury</td>
<td>815 ppb</td>
<td>&lt;100 ppb</td>
<td>87.73 %</td>
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<tr>
<td>Average of above samples Mercury</td>
<td>7557 ppb</td>
<td>&lt;100 ppb</td>
<td>99.68 %</td>
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</tbody>
</table>

**Eric Effinger** is Vice President of Operations at Charah Solutions Inc. A registered professional engineer and certified project management professional, he has over 15 years of experience executing and managing large-scale heavy civil construction and utility-related projects throughout the United States. Effinger earned a Bachelor of Science in Civil Engineering Technology from the University of Southern Indiana.
Effective fly ash marketing is all about the strength of your process, your technology and your network. Our proven EnviroSource™ fly ash beneficiation technology, at a lower cost profile than the competition, reduces carbon and other contaminants from your fly ash to make it immediately marketable. And the Charah Solutions MultiSource® materials network delivers a whole new level of results for your fly ash sales. With nearly 40 nationwide locations, we service fly ash demand from a growing customer base that beneficially uses fly ash in sustainable products. Contact us today for more information at 877-314-7724 or visit charah.com.

EnviroSource Benefits:
- Reduces LOI, ammonia and activated carbon
- Significantly lower cost profile than competitive technologies
- Efficient footprint with self-contained environmental controls
- Deployed in months versus years
- Modular design and scalability
- Delivered as a portable or stationary system
- Reduces utilities’ need for landfill and ponds disposal
- Can be installed at operating power plants, non-operating power plants or off-site
Where will future ash supplies come from?

Global Ash Trade Could Help Fill Regional Supply-Demand Gaps

By John Ward

Renewable sources overtook fossil fuels in Europe’s electricity supply mix for the first time in 2020, as EU member nations continued scaling back their reliance on coal-powered generation. Since 2016, coal-fueled generation has declined by roughly half in the 27-member union—tightening supplies of coal combustion products to the construction and other sectors throughout the region. In the U.S., meanwhile, 2020 saw renewables surpass coal in the electricity mix for the first time.

Against this backdrop, two of Europe’s premier conferences—ASHTRANS and EUROCOALASH, held this past fall in Copenhagen, Denmark, and Thessaloniki, Greece, respectively—explored a wide range of topics pertaining to the evolving global coal ash market: ash import/export potential, harvesting, natural pozzolans as a substitute for fly ash, beneficiation technologies, ash blending, and many others.

While there is no “silver bullet” for meeting looming ash supply shortfalls in countries/regions that are moving away from coal-powered electricity—all of the above will doubtless play a role—booming ash production volumes in Asian markets, in particular, urge a closer look at how ash imports.exports may evolve to address regional supply shortages.

Unlike trade in many mineral ores, agricultural goods, and manufactured products, there is no firm data on the global trade of coal combustion products. The European Coal Combustion Products Association (ECOBA) estimates that, over the past decade, an average of 2-3 million metric tons of coal ash have been shipped annually cross-border to serve EU markets. Industry observers have judged the global coal ash trade to be more than twice that volume, at a minimum of 6 million tons annually.

Markets for coal and coal combustion products are increasingly dynamic, however. While the U.S. and Western Europe are reducing their reliance on coal, Asian markets are more than making up for the deficit. (The International Energy

Current Major Fly Ash Flows

Europe:
Still some domestic volumes available. East Europe to West Europe flows growing

North America:
Domestic volume in the Mid-West and Central part of US. Imports of India Ash found in Florida and Gulf of Mexico. Bulk shipment to California and Florida

Aus/NZ:
FA available inland in Aus. Coastal cities import FA from India. NZ has small imports from India

Africa: FA imported for projects

Source: EP Power Minerals

2 Ibid.
Agency projects that coal-fueled power generation reached an all-time high in 2021 and forecasts global coal demand will continue growing to an all-time high by 2024. Below is a brief roundup of some of the top emerging coal ash producing/exporting countries.

**Turkey**—One of the leading ash-exporting countries, Turkey boasts ash supply from both current-production plants and beneficiation. With stable production expected for the next decade, it is positioned to serve markets in Europe and on the U.S. East Coast.

**India**—Possessing the third-largest coal-power generating capacity globally, India produced 226 million tons of ash in 2019-2020. Even with an 83% utilization rate, 38 million tons of current-production ash was potentially available for export that year alone to markets worldwide.

**Vietnam**—Currently with 31 operating coal plants, Vietnam is planning to bring an additional 20 plants online by 2030. With low levels of local utilization, ash is already being exported—primarily to neighboring Southeast Asian markets, including Cambodia and Laos.

**China**—Far and away the world’s largest consumer of thermal coal, with approximately 1,400 plants, China produces several hundred million tons of coal ash annually, much of which is not beneficially used.

**South Korea**—Currently operates approximately 60 coal power plants. While the country plans to shutter some of its older units, eight new coal plants are under construction with a combined capacity of 7.5 GW, all of which are scheduled to come online by 2025.

**Economic and Environmental Aspects of Coal Ash Trade**

While annual global production of coal combustion products, at an estimated 1.2 billion metric tons9, remains robust, and utilization rates leave plenty of surplus ash, a range of logistical and other factors can and do inhibit international trade. Among these potential obstacles are, variously, a lack of storage on the import or export end; insufficient capacity of load and discharge facilities; availability, flexibility, and reliability of carriers (rail, road, and/or water); unsuitable ash quality; and environmental regulations or legal restrictions pertaining to ash importation.

Even assuming that the aforementioned factors do not present an immediate barrier to import/export of ash in a given instance, the decision as to whether to import ash is likely to come down to its delivered price. The greater the distance between ash supply and destination—and the more modes of transport involved—the higher the shipping costs will be. As coal ash is essentially a lower-margin product, such costs can render coal ash importation uneconomical.

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And while much of the impetus for the use of coal ash is for the environmental benefits it can convey—particularly as a substitute for portland cement in concrete—there are also sustainability issues related to the trade of ash long distances. Specifically, the very shipment of ash itself involves the release of greenhouse gas emissions by the carriers used to transport it.

A 2019 study modeling the environmental impacts of importing fly ash into the UK from Germany and China for use as a cement replacement in concrete—compared with the impacts of using locally harvested landfill ash in concrete and no ash at all—attempted to assess the relative merits of each approach. The study concluded that the environmental burden of transporting fly ash from China to the UK would outweigh the environmental benefits of using it to replace ordinary portland cement. The more sustainable alternative was determined to be recovery of locally landfilled fly ash (using a dry-processing technique). The second-best alternative was judged to be importing fly ash from a country within Europe.\(^{10}\)

**Looking Ahead**

Large-volume coal markets, particularly India and China, are projected to produce vast surplus volumes of coal ash well into the next decade. But dramatic growth in coal ash trade will require solving logistical and supply chain challenges to make import and export more practical and economical—particularly if it is to compete for market share with ash harvesting in countries that have significant deposits of landfilled and ponded ash. Investments in infrastructure such as silos and terminals will be necessary, as will technologies to beneficiate ash to U.S./European-specification quality.

A host of factors will likely determine how quickly and the extent to which such investments are made. However, as environmental considerations continue to drive public policy around the world, pressure to increase the use of recycled materials in concrete construction that carry low embedded energy is likely to boost growth in the global ash trade.

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**Coming in early 2022...**

The ACAA Educational Foundation will soon announce the opening of applications for its 2022 scholarship program!

Information on the application process will be posted on the ACAA website, [www.acaa-usa.org](http://www.acaa-usa.org), and in *The Phoenix* newsletter.

Scholarship awards range from $1,500 to $5,000 and are available to graduate and undergraduate students with an interest in the management and beneficial use of coal combustion products.

*Stay tuned for more details!*
At WM, our focus is to recover and generate value from materials. We work closely with customers to help solve every challenge the right way.

WM understands your need for fly ash recycling, treatment, and disposal. As part of each customer’s project solution, we focus on making a positive environmental and economic impact.

THE WM WAY:

Putting our customers at the center of everything we do, WM works alongside you to develop solutions that save time and money by balancing efficiency and effectiveness.

Safety at WM is a core value without compromise; we employ a human performance approach that revolves around working together as a system - safely. The right way is our way of working.

Understanding that your needs are unique and ever evolving, we customer tailor our comprehensive range of sustainable solutions to optimally serve your needs.

Our customers are regularly faced with strict state and federal compliance regulations. WM has gained a solid understanding of these regulations by walking in your shoes every day as owners and operators of more than 700 industrial facilities. We’ll devise a strategy to help you tackle them head-on.

By offering unparalleled stability and industry experience, our customers are fully supported throughout long-term relationships.

Our innovative company culture cultivates a deep-rooted drive to find new, improved ways to safely excavate and harvest ash.

Become a part of WM’s ongoing effort towards always working for a sustainable tomorrow. Contact us today at info@flyashdirect.com to discuss how we can improve your current project.
The continuing retirement of coal-fueled electric generating plants in the United States, coupled with rising demand for fly ash, demonstrate the need for the development of new sources of supplementary cementitious materials (SCMs). Harvested ash, blends, natural pozzolans, and imports represent emerging sources that can help fill the potential supply-demand gap. Key to successfully incorporating these alternative supply sources—particularly for use in high-value products such as concrete—will be updating specifications to reflect this emerging market reality and provide end users with confidence in the quality of these products.

ACAA is taking a lead role in helping guide revisions to SCM specifications in the U.S. (Canada has already amended the CSA A3001 specification, “Cementitious Materials for Use in Concrete.” See sidebar below.) Led by its Technical Committee, ACAA is working with standards bodies to update guidance and specifications relating to the utilization of bottom ash and harvested ash in concrete and the adoption of performance- rather than prescriptive-based requirements for the use of SCMs in concrete, among other initiatives. Below is a partial round-up of activities in these areas over the past year.

- Utilizing voluntary financial contributions from member companies, ACAA has retained the services of two internationally recognized experts on supplementary cementitious materials to develop a white paper on harvested coal combustion products. That white paper was used in subcommittee discussions in December 2021 and ballot items are now being prepared to revise ASTM C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolans for Use in Concrete. The proposed revisions would recognize ground bottom ash and harvested ash for the first time.

Subcommittee discussions also revealed several topics of interest to the concrete community, and ACAA is now moving to expand the white paper to address these additional issues. To support the expanded scope of work, the

Amendment to Canadian Standard Underscores Changing Fly Ash Landscape

On May 28, 2021, CSA Group released a notable amendment to the CSA A3001 specification, Cementitious Materials for Use in Concrete. The revised standard allows for the inclusion of harvested and processed bottom ash with fly ash for use in concrete, provided the physical and chemical requirements of the standard are met. The implications of this change for the industry are significant because it allows for the entire deposit of ashes in ponds or landfills to be utilized, while providing opportunities for additional supplies of fly ash for the concrete industry.

When developing the changes to the standard, risks versus benefits of including bottom ash were considered. With the benefits being numerous and compelling, the standard was revised. A key outcome of the revision was that harvested ash was included in the standard without creating new classifications for fly ash. The harvested ash, which may contain comingled ground bottom ash, can be classified as either Class C or F fly ash depending on the chemical properties of the processed ash.

Driving Forces

The fly ash industry is undergoing a fundamental repositioning. In Canada, coal-fueled power plants are currently being retired or converted to natural gas at accelerating rates. As natural gas is quickly becoming the predominant generation source, a rapid decline in reliable ash production is occurring now. Despite select conversions to dual-fuel units, which can burn gas or coal, there are substantial economic incentives to minimize coal use. Given these incentives, converted units are unlikely to generate a meaningful or reliable ash supply.

If specification-developing bodies fail to adapt to this changing landscape in the fly ash industry, in addition to supply and demand imbalances, there could be further implications to industries and the public sector. As longstanding sources
disappear, fly ash users may switch to remaining sources, some of which could be of lesser quality. Switching sources, and ultimately the elimination of fly ash altogether, would require redevelopment of mix designs and concrete specifications, often a costly and time-consuming process. More profoundly, if the concrete industry fails to embrace emerging sources of supplementary cementitious materials such as ground bottom ash and harvested ash, a shortage of fly ash will result in greater quantities of portland cement in designs, resulting in rising construction costs. A lack of fly ash may result in infrastructure durability concerns, which would have a direct correlation to accelerated greenhouse gas emissions and carbon costs.

**Inclusion of Ground Bottom Ash in CSA Standard**

As the shift away from coal-fueled power generation continues, shortages in fresh fly ash supply must be addressed. In many regions throughout Canada and the U.S., there are thousands of ponded or landfilled deposits comprised of fly ash comingled with bottom ash. The revised CSA standard allows for the harvesting and processing of the ash in these deposits, classifying them as Class C or F fly ash without requiring new fly ash classifications to be developed.

The amendment to the CSA A3001 specification illustrates the fundamental importance of acknowledging the shifting landscape and mounting pressures on the fly ash and coal-fueled generation industries. This revised standard positions Canada to be a leader in the future of ash beneficiation—a future that is in every sense here today.

—Information on the revised CSA A3001 specification was submitted by ACAA member ASHCOR.
ACAA Educational Foundation Board of Directors voted to contribute $10,000 in additional funding to the project. The Educational Foundation’s financial support is in addition to generous contributions already received from ASHCOR, Boral Resources, Charah Solutions, Fly Ash Direct, Great River Energy, Green Cement, John Ward Inc., Salt River Materials Group, The SEFA Group, Separation Technologies, and Southern Company.

- ACAAs Technical Committee is supporting the development of a new Specification for Supplementary Cementitious Materials in Concrete to provide the framework to establish critical quality characteristics that are readily measurable and clearly tied to product performance so that suppliers, specifiers, and purchasers of an SCM can confidently introduce new sources and types of SCMs for use in concrete. This specification focuses on performance rather than prescriptive requirements. It may allow the beneficial use of coal combustion materials that were previously disposed, provided they can deliver a functional benefit in concrete.

- ASTM Subcommittee E50.03 on Beneficial Use is discussing a “New Standard Sampling and Analytical Methods Used in Characterization of CCPs in Storage Units for Beneficial Uses.” A task group led by William Petruzzi, of Verdantas, has been working on a proposed guide to provide a framework for characterizing coal combustion products situated in active or inactive storage units for beneficial use. The guide is intended to serve as a companion document to ASTM E3183-18 Standard Guide for Harvesting Coal Combustion Products Stored in Active and Inactive Storage Units for Beneficial Use.
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Coal Combustion Product Type
Class F Fly Ash

Project Name
ASU Interdisciplinary Science and Technology Building

Project Location
Tempe, Arizona

Project Participants
McCarthy Building Companies, Hanson Aggregates LLC, Thornton Tomasetti, Salt River Materials Group, GCP Applied Technologies, Architekton/Grimshaw, Buro Happold

Project Completion Date
December 2021 (projected)

Project Summary
The Interdisciplinary Science and Technology Building 7 (ISTB7) at Arizona State University (ASU) is intended to serve as a new gateway to the school’s Tempe campus. The 281,000-square-foot building will house research facilities focusing on the sustainability of food, water, and energy. Consistent with the goals of the research that will be carried out within the complex, the building’s designers strove to reduce ISTB7’s carbon footprint by substituting cement with high volumes of Class F fly ash in all of its concrete elements.

High fly ash mixes were used for structural concrete required to achieve a range of strength requirements for elements including slabs on grade, caissons, decks, walls, and columns. Beyond the concrete mix’s strength and sustainability requirements, its use in exposed applications—including stairs, soffits, and flooring—meant it needed to be aesthetically pleasing as well.

In a construction first for Arizona, Buro Happold engineers embedded hollow plastic balls in the concrete—its proprietary “BubbleDeck” system—to reduce both the amount of concrete needed for placement and the weight of each slab. The lower weight of these structural slabs, in turn, allowed for reductions in the weight and size of other weight-bearing elements.

In addition to its advanced concrete technologies, ISTB7 will incorporate a range of other sustainable processes and features designed to minimize its environmental footprint, including treatment and recycling of sewage for use as graywater, use of photovoltaics and sunshades, and incorporation of a five-story atrium biome to filter waste air.
Beneficial Use Case Study
Placement of BAPS Temple Foundation Mat

Coal Combustion Product Type
Fly Ash

Project Name
Placement of BAPS Temple Foundation Mat

Project Location
Robbinsville, New Jersey

Project Participants
Silvi Concrete, Sahara Sand, Riverside Construction Materials, GivenHansco

Project Completion Date
2013

Project Summary
Construction of the BAPS Hindu American Religious Center in Robbinsville, New Jersey, is a multi-stage project that is ongoing. It is being built on a 162-acre site that will house, among other structures, a teaching and recreational facility, a visitor’s center, a youth activity center, and a temple. The final phase is the construction of the Swaminarayan Akshardham Mahamandir, which at approximately 150 feet in height will be the tallest BAPS temple in the world upon its completion.

Project Description
Construction of the Swaminarayan Akshardham Mahamandir, which is expected to take over a decade, involves the importation and assembly by master craftsmen onsite of heavy stone masonry and ornate hand-carved marble statues. The temple is intended to stand for 10,000 years. As such, the project required placement of a foundation durable enough to underpin such a massive and long-lived structure.

Plans called for the placement of a four-foot-deep, 49,000-square-foot foundation—covering more than 1.1 acres. A 50/50 fly ash-to-cement ratio was selected for the mix, which Fairless Hills, Pennsylvania-based Silvi Concrete executed in one continuous 7,200-yard placement.

Owing to the size of the placement and a relative shortage of fly ash in the Northeast at the time of the placement, Silvi stockpiled 55 tractor-trailer loads of fly ash over the course of several weeks in advance of the job, storing it in portable blimps. On the day of the job, the company mustered 106 trucks and utilized three central mix plants—some located as far away as 35 miles—for the 12-hour-long placement. To avoid any risk of running out of water during the placement—which would have meant having to rip out millions of dollars in concrete and rebar and start over—Silvi loaded up an 8,000-gallon water truck to use in an emergency.

Beginning at 5:45 am on October 26, 2013, ready-mix trucks delivered and emptied a full load of concrete at the jobsite every 66 seconds. Keeping to that schedule was critical, as drivers were legally permitted to work only 12 hours per day. To keep the pace up, Silvi arranged to have areas left open between the pumps where mixers could deposit concrete directly into the foundation.

The job, which was completed without interruption, represents the largest placement in the company’s history—and one of the largest in the history of the state of New Jersey. Use of the high-volume fly ash mix allowed the massive concrete foundation mat to cure in 30 days without danger of cracking.
Coal Combustion Product Type
Fly Ash

Project Name
Chandigarh International Airport Terminal

Project Location
Mohali, India

Project Participants
Larsen & Toubro, Sikka Associates Architects, Mehro Consultants, Engineering Services Consultants, Airport Authority of India

Project Completion Date
2015

Project Summary
Rapid growth in the passenger traffic at Chandigarh International Airport—from 69 million in 2004-05 to 188 million in 2014-15—necessitated the construction of a new terminal. From the outset, designers of the new building sought to create a green structure that could serve as a model for future airport construction. The completed 570,000-square-foot terminal incorporates a range of sustainable building technologies, including extensive use of fly ash as a building material, installation of motion/heat sensors to optimally and efficiently adjust air-conditioning levels, and construction of a rooftop 200-kW solar plant to meet the terminal’s major power requirements.

Project Description
Trailing only the U.S. and China, India has the third-largest construction industry in the world. Moreover, the Indian government’s national infrastructure plan promises sustained growth in this sector in the years to come. However, the country’s construction activities come at a high environmental cost—contributing roughly a quarter of the country’s greenhouse gas (GHG) emissions. Production of red bricks alone is estimated to contribute up to 15 percent of the nation’s GHG emissions.

From the very start of the project, designers sought to
maximize the terminal’s sustainability scores, as measured by the Green Rating for Integrated Habitat Assessment (GRIHA), the national rating system for green buildings established by India’s Ministry of New and Renewable Energy. The rating system—India’s equivalent of LEED—places outsized importance on the use of fly ash in the building structure; fully 6 points out of a possible 100 across all criteria are allotted for conserving and demonstrating efficient utilization of resources via the specification of fly ash.

The terminal ultimately incorporated 5.5 million fly ash bricks in its construction. Made from up to 60 percent fly ash, 20–30 percent sand/stone dust, 10 percent lime, and approximately 5 percent gypsum, the bricks—compared to the more commonly used red variety—save clay; do not require baking in kilns, thus saving energy and emissions; use less mortar, thus saving material and labor costs; and are lighter, meaning they reduce dead load and save on transportation costs.

Chandigarh International Airport terminal boasts additional green features, including:

- Passive solar orientation, south-side shading to minimize heat gain, and a rooftop solar plant to generate clean power;
- Two-thirds lower water consumption compared to a GRIHA base case via the installation of low-flow features; and
- Metal and gypsum false ceiling and low-energy flooring materials—both with recycled content.

The terminal building has been awarded a four-star GRIHA rating.
Coal Combustion Product Type
Fly Ash

Project Name
Metolong Dam

Project Location
Maseru, Lesotho

Project Participants
Lafarge South Africa, Ash Resources, Sinohydro, Arcus GIBB, CDM Smith

Project Completion Date
2014

Project Summary
The region surrounding Maseru, capital of the land-locked country of Lesotho in southern Africa, has traditionally suffered from water shortages. That situation has been greatly alleviated with the construction of a 272-foot-high roller compacted concrete dam on the Phuthiatsana River. The Metolong Dam, which reached its full capacity of 51,000 acre feet in 2018, now supplies water for roughly two-thirds of the country’s 2 million people—as well as the country’s textile industry, an important source of employment.

Project Description
The project design called for construction of a 919-foot-long dam estimated to require 431,623 cubic yards of roller compacted concrete (RCC) and 52,300 cubic yards of conventional vibrated concrete (CVC). As with any project involving mass concrete placement, heat of hydration was a potential concern.

Lafarge South Africa proposed usage of its Powercrete Plus CEM II, a low-heat cement that incorporates 15 percent siliceous fly ash and has the ability to be extended further onsite with additional fly ash. After laboratory testing, a mix of Powercrete Plus and DuraPozz siliceous fly ash, from Ash Resources’ Lethabo facility, were used as binder material in both the RCC and CVC mixes. The final formulations used were a 66 percent fly ash blend for the RCC mix and a 52 percent fly ash blend for the CVC mix.

Contractor Sinohydro required Lafarge to maintain an eight-day supply of materials onsite to avoid the possibility of shortages that could interrupt project work. Sinohydro built an onsite batch facility and, over the course of the dam’s construction, routinely oversaw the placement of over 1,000 cubic yards of concrete in a 12-hour shift. In addition to reducing the heat of hydration, use of the high-volume fly ash mixes allowed the company to reduce the cement content from the initial design levels.

The total amount of fly ash incorporated into the construction of the dam is estimated to have been 33,000 tons. Ash Resources delivered a further 4,000 tons of fly ash to ready-mix concrete producers and other contractors for use in the construction of the Metolong Dam and Water Supply Programme’s (MDWSP’s) water treatment works, a raw water reservoir, and segments of several water pipelines.

MDWSP was recognized in 2015 by the Construction Management Association of America for excellence in two separate award categories: Infrastructure and International.
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Stay Safe from Indoor Airborne Hazards

Editor’s Note: As a service to our readers, ASH at Work publishes a recurring series on everyday health and safety topics. We welcome contributions from readers with expertise in health-related issues. Article length should be approximately 500 words. Please submit topic suggestions in advance to John Simpson at johnsimpson@gmail.com.

Americans spend, on average, 90 percent of their life indoors, where concentrations of certain pollutants can range up to five times higher than outdoor concentrations. What’s more, those who are most susceptible to the adverse effects of pollution (the very young, seniors, people with cardiovascular or respiratory disease) tend to spend even more time indoors. Minimizing one’s potential exposure to indoor airborne dangers—and knowing how to react if one is discovered—can be lifesaving.

Indoor airborne hazards can come from a variety of sources—some man-made and others naturally occurring. Following is a list of some of the more common hazards.

**Carbon monoxide** is an odorless, colorless gas that can be fatal if inhaled in high-enough concentrations. Common sources include unvented kerosene and gas space heaters, leaking chimneys and furnaces, gas stoves, generators, and automobile exhaust.
Prevent carbon monoxide poisoning by installing and maintaining carbon monoxide detectors; keeping gas appliances properly adjusted; installing and using an exhaust fan vented to outdoors over gas stoves; opening flues when fireplaces are used; choosing properly sized wood stoves that are certified to meet EPA emission standards; having a trained professional inspect, clean, and tune central heating systems; and not idling a car inside the garage.

**Radon** is a radioactive gas produced by the breakdown of uranium in soil, rock, and water that can be drawn indoors through foundation cracks and cause lung cancer in humans.

Prevent radon from entering your home by contracting with a qualified professional to draw the radon from below the structure and vent it via pipe outside the home, where it is quickly diluted.

**Volatile organic compounds (VOCs)** can irritate the eyes, nose, and throat; cause difficulty breathing and nausea; damage the central nervous system and other organs; and cause cancer. Common sources include paints and lacquers, paint strippers, cleaning supplies, waxes and varnishes, pesticides, moth repellents, air fresheners, and dry-cleaned clothes.

Prevent sickness from VOCs by storing household products that contain chemicals according to manufacturers’ instructions and keeping all such products away from children. Ensure there is proper ventilation when painting, remodeling, or using products that may release VOCs. Never mix products, such as household cleaners, unless directed to do so on the label. Consider purchasing cleaners without VOCs.

**Nitrogen dioxide** (NO₂) is an odorless gas that can irritate the eyes, nose, and throat and cause shortness of breath.

Common sources include appliances that burn fuels such as gas, kerosene, and wood.

Prevent sickness from NO₂ by ensuring all fuel-burning appliances are properly installed, used, and maintained following manufacturers’ instructions. If possible, use fuel-burning appliances that are vented to the outside.

**Molds** can become a problem if spores land on a wet or damp spot and begin growing. Molds produce allergens, irritants, and potentially toxic substances (mycotoxins). Inhalation (or touching) mold or spores can cause allergic reactions in sensitive individuals, such as sneezing, runny nose, red eyes, and a skin rash.

Indoor mold growth should be prevented or controlled by minimizing indoor moisture. If there is mold growth in your home, clean up the mold and fix the water problem. If you suspect the heating/ventilation/air conditioning system is the source, do not run the system and contact a qualified professional to inspect and clean if necessary.

These are just some of the airborne hazards commonly found in the home. Others include bacteria, dust mites, second-hand smoke, and pet dander. If you suspect you have been exposed to an airborne hazard, clear the premises, contact the National Capital Poison Center at 800-222-1222, and arrange for remediation activities as appropriate.

*These materials were adapted from the EPA, Red Cross, Ready.gov, and OSHA.*

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Professor R. Douglas Hooton, Ph.D., P.Eng., is Professor Emeritus, Department of Civil and Mineral Engineering, University of Toronto. He is internationally recognized as an expert in subjects related to concrete durability with emphasis on supplementary cementitious materials (SCMs). Professor Hooton has received numerous awards and recognitions from major technical organizations in Canada, the U.S., and abroad. He retired from his teaching duties in 2021 but is continuing research projects and contributions to the American Concrete Institute, ASTM International, the Canadian Standards Association, and RILEM.

ASH at Work (AW): Your research and teaching have focused on identifying durability problems in concrete structures and mitigation techniques for those problems. What got you interested in this important field of study?

Dr. Doug Hooton (DH): During my 3rd year of civil engineering at University of Toronto, back in 1973, one of my professors (R.H. Mills) got me interested in concrete materials. Fly ash was a topic of interest to him because there was a local coal power plant that had high and variable LOI due to its use as a peak load plant. So I undertook several small undergraduate projects on: (a) the impact of carbon on the air entrainment of concrete, (b) a scanning electron microscope study on the morphology and mineralogy of fly ash, and (c) a project that used cycloning to concentrate the iron oxide fraction of fly ash for use as a potential iron source for cement kiln feed (at the time, we met with a local cement producer but they did not see any possibility for use of fly ash as kiln feed—that attitude certainly changed about 15 years later). All that led to seven years of graduate studies in concrete, five years of concrete research for a large power company (which got me involved with standards as well as the durability of all their powerplants and dams), then finally it led to my university career.

AW: What do you regard as the biggest durability issue today?

DH: The single most widespread and expensive concrete durability concern is due to the premature corrosion of steel reinforcement in concrete structures. We know how to prevent that, and fly ash can certainly help improve resistance to corrosion, but it remains a serious issue due to the thousands of bridges and parking garages that were built prior to the adoption of better standards and codes.

AW: Are there bigger threats on the horizon?

DH: I am not sure that there are bigger specific threats, but there are certainly other threats. We know how to deal with concrete corrosion as well as the other durability threats to concrete, including freezing and thawing, sulfate attack, and alkali-silica reaction (ASR), but durability problems still occur due to improper specifications, construction execution, or due to the needed data not being available within the short timelines involved in the construction bidding process. As one example, reliable standard test data for assessing aggregate reactivity of a source takes a year, so unless a quarry/pit owner is proactive and has the needed data, or is forced to by state agency mandates for ongoing ASR testing by all aggregate suppliers, this problem is not going to be solved. Another current threat is due to supply chain problems. Adopting changes to ASTM C618 and AASHTO M295 that will allow use of harvested and co-mingled coal ash in concrete will open up the potential use of up to a billion tons of stockpiled ash and address growing regional fly ash shortages for providing more durable and sustainable concrete, while also reducing power plant landfill volumes.

AW: Does the concrete industry have the necessary organization and support to overcome the major durability challenges we face?

DH: The major concrete materials suppliers and concrete producers have the tools and the knowledge to overcome the durability challenges. Smaller producers in rural areas may not all have the knowledge, but I believe that is changing. But there is resistance by many specifiers to allow new materials or adopt performance specifications that allow alternate concretes for achieving more durable/sustainable concretes. While current materials and concrete durability standards have improved, the industry, especially specifiers, needs to develop

6 Questions for Doug Hooton

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.
and embrace performance standards that allow flexibility in meeting required concrete performance.

**AW:** With Professor Michael Thomas, University of New Brunswick, you recently led the successful effort in Canada to change the CSA specification for fly ash use in concrete to include harvested ash and bottom ash. This change is being well received, according to early reports. Was revising the CSA specification more difficult than you expected?

**DH:** No, this was one of the fastest amendments ever made to the CSA A3001 specification for cementitious materials. In addition to summarizing the literature on harvested ash, including sources co-mingled with bottom ash, it was made clear to the CSA committee that the situation with the impending closure of all coal power plants in Western Canada required immediate action. Given that fly ash is the only major source of supplementary cementitious materials in that region, if these changes had not been adopted, concrete producers would no longer be able to supply concrete that would be resistant to sulfate attack, chloride ingress, and alkali-silica reaction—all big durability concerns in that region. Also, including harvested coal ash did not result in any change to the fly ash classifications, so this did not necessitate any changes in any of the CSA concrete standards that referenced fly ash.

**AW:** When you are not working on concrete durability issues, what do you enjoy in your leisure time?

**DH:** I used to be a drummer and during my high school and university years, I played in several bands, and while I still have my kit, I have not had the time to play in decades. While it may surprise most of your readers, like most of the engineering professors I know, I work seven days a week to keep up with teaching, research commitments, mentoring graduate students, and especially with all my CSA, ACI, ASTM, and RILEM standards activities, and so for me it is mainly, “eat, sleep, concrete.” But on the plus side, until Covid-19, it also involved a lot of global travel (including sabbaticals in Brisbane, Copenhagen, and Berlin). We have a summer place on a lake about five hours north of Toronto that was originally a fishing camp built about 80 years ago. While I do swim, boat, and occasionally have friends up to fish, most of my leisure time up there is working on the old camp, or the garage and sheds or the dock—and with about 14 acres, there are always trees to deal with. But I find this work relaxing and, as the old adage goes, “a change is as good as a rest.” I have always enjoyed fixing and building things—it used to be fixing motorcycles and old British sports cars, but thanks to taking several shop courses in high school, it now mainly involves carpentry, wiring, and plumbing. Lastly, I must admit that I am a long-suffering Toronto Maple Leafs fan.

**AW:** Thank you for all your contributions to our understanding the important role of fly ash and other SCMs. And thank you for taking time to talk with *ASH at Work.*
The National Coal Transportation Association (NCTA) was founded in 1979 to provide education and facilitation for the resolution of coal transportation issues. NCTA is a non-profit corporation comprising electric utilities, coal producers, shippers of coal-related commodities (e.g., limestone and coal combustion products), and entities that produce, repair, and manage all facets of railcar component parts and systems.

NCTA members maintain a significant capital investment in the ownership, leasing, and control of fleets of railcars, which they provide to the railroads in unit trains of up to 150 cars. These fleets represent approximately 45% of the coal cars in service in the eastern U.S. and 90% of the coal cars in service in the western U.S.

While NCTA is an educational entity that does not officially lobby for or against legislation, we actively participate with a position in hearings and rulemaking proceedings of interest to our membership. NCTA fosters relationships with key personnel and departments within the Department of Energy, the Department of Transportation, the Surface Transportation Board, the Federal Railroad Administration, the Association of American Railroads, and with various elected representatives. Our membership advocates for the fair treatment of coal shippers regarding their total cost of service, including the costs of building and maintaining shippers’ facilities.

NCTA’s Committees are the backbone of the Association:

- The Operations and Maintenance (O&M) Committee was founded over 30 years ago to educate utility car owners regarding the technology, design, maintenance, operations, and repair of railcars in unit train service. NCTA members have invested more than $4 billion in railcars and have a large stake in handling, maintaining, and repairing their investment.

- The Eastern and Western Logistics and Planning Committees do much of the heavy lifting to solve problems with respect to the efficient operation of the coal delivery process. Transportation entities such as rail carriers, barge companies, river terminal operators, and export terminal operators are active participants. However, coal producers, electric utilities, industrial consumers of coal, and railcar owners also participate with the shared goal of continuously improving coal transportation and coal handling systems.

- The Educational Foundation Board oversees the NCTA scholarship program, which awards four annual scholarships of $1,500 each. NCTA offers two non-renewable one-year college scholarships and two non-renewable one-year vocational or associate degree program scholarships annually to dependent sons and daughters of full-time employees of NCTA member companies in good standing.

NCTA’s commitment to education extends beyond its membership to the public at large. NCTA’s biweekly digital newsletter, On Track, offers updates on Association news and events, as well as industry goings-on via regular features that keep an “eye on” rivers and ports, rails, PSR, our nation’s capital, coal, and energy developments from the U.S. and abroad. Published semiannually, Coal Transporter magazine shares in-depth information on new technologies, upcoming conferences, Committee activities, Surface Transportation Board proceedings, and coal news of national and international importance. Both publications are publicly available on the NCTA website.

For more information about the NCTA, please visit www.movecoal.org.
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ASH Classics
A Look Back at the Beginnings of the U.S. Coal Ash Industry

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

In a preview of the battles that the industry would continually face over the years, this issue, from 1983, features an “Ash Alert” to NAA members after EPA scheduled hearings to accept public comment on an amendment to redefine the materials that should be classified as hazardous wastes when recycled under Section 3001 of RCRA. NAA would file a brief at the initial hearing stating that power plant ash should not be placed under the hazardous waste umbrella and to do so would jeopardize the marketability of the material.

WASHINGTON—A contract has been awarded to Valley Forge Laboratories for the preparation of supporting background data for proposed guidelines on the “Federal Procurement of Transportation Construction Materials Containing Fly Ash, Bottom Ash, and Boiler Slag.”

The program is being jointly sponsored by the HH&U Committee of EEI’s Utilities Solid Waste Advisory Group and the National Ash Association.

R&U Chairman Robert Miller of Central Illinois Light Company and the NAA’s Dennis Kindler will act as coordinators for the project. Kindler is a research engineer with American Electric Power Service Corporation.

Others serving on the NAA task force with Kinder are: Stephen Bonsen of Pennsylvania Power & Light, Don T. Ward of Baltimore Gas & Electric, Al Mahood of Allegheny Power Service Corp., and Technical Director Roy Auvens.

When developed, the guidelines will be presented to the Environmental Protection Agency for possible implementation under Section 9002 of the Resource Conservation & Recovery Act of 1976 as amended. It is being patterned after recently enacted guidelines calling for consideration of the use of fly ash concrete on all federally funded construction projects.

The overall purpose of the guidelines is to promote the expanded utilization of power plant ash by procuring agencies on subgrade and embankments, subbase, base, and pavement applications.

CONTINUED ON PAGE 2
New NAA Officers

VEPCO OFFICIAL—Charles E. Shelton, who represents Virginia Electric & Power Company on the NAA Board of Directors, is Manager-Fossil & Hydro Operations Support for the Virginia utility. A Registered Professional Engineer, Shelton was employed by the utility shortly after graduation from VPI and held assignments at three generating stations before being named senior staff engineer in 1974. He assumed his present post in 1982.

NEW DIRECTOR—James S. Brunner, general manager for two Consumers Power Company’s fossil-fired generating stations, is the newest member of the NAA's Executive Committee and the Association’s Board of Directors. A registered professional engineer, Brunner is a graduate of Albion College. He joined the company in June 1948 as a junior engineer and assumed his present assignment in April of 1982. He has also attended the University of Michigan and Texas A&M University. In addition to managing the K.C. Cobb and J.R. Whiting stations, and the Grand Rapids Steam Heating Plant, he also directs the utility's travel repair crew.

TVA Celebrates 50th Birthday

CHATTANOOGA, TN—The Tennessee Valley Authority celebrated its 50th birthday on Wednesday, May 18, 1983.

Although more well-known for the 36 dams it operates in Tennessee and Alabama, the TVA also has 10 coal-fired electric generating stations in the two states and is, therefore, a major producer of power plant ash.

The TVA was also of the charter members of the National Ash Association.

New Technical Group Among 9 Committees

WASHINGTON—A Technical Committee is among nine standing committees appointed by President James P. Plumb to serve the membership of the National Ash Association during the coming year.

The objective of the new committee is to develop and maintain a technical support program for the entire ash industry.

Appointees are to provide guidance to Technical Director Roy Aaron and make recommendations to the Executive Committee and Board of Directors on technical activities beneficial to the Association.

Members named to serve with Chairman Aaron include Messers, Al Babcock, Craig Cain, Robert J. Collins, Ronald E. Morrison, and Jack Weber.

Other standing committees, with the first named being the chairman, are:

- Audit - James E. Davis, John Maier, Roger Ophaug;
- Budget & Finance - Donald T. Ward, Gerald Bowdren, Joseph Mullan, Charles E. Shelton, and Charles Tackett;
- Charter & By-Laws - Ronald E. Morrison, Joseph Mullan, Richard Ondreyko;
- Membership - John Dorsett, Stephen T. Benza, Gerald Bowdren, Donald T. Ward;
- Planning - Gerald Bowdren, Don T. Ward, Ronald E. Morrison, John Dorsett, Joe Mullan, Bart Thomas;
- Publications - Al Babcock, Stephen Benza, William Collins and Ron Morrison;
- Staffing - Joe Mullan, Steve Benza, Gerald Bowdren, Craig Cain, Ron Morrison, Don Ward.

REVIEW CONTRACT—Robert Miller (seated), chairman of ERI's Resource, Recovery & Utilization Committee, is shown reviewing the Valley Forge Laboratories contract with other members of the committee at a recent meeting in Washington. They include (left to right) Dennis L. Kinder, American Electric Power Service Corp; Russell Boyd, Envirosource Company; and Stephen Benza, Pennsylvania Power & Light Company. Messers. Kinder and Benza represent the NAA on the joint committee.

NAA, RR&U Join (Continued from Page 1)
Kansas Air National Guard Used Fly Ash To Stabilize Area Around Jet Fuel Tanks

TOPEKA, KA.—Soil stabilization techniques utilizing fly ash enabled the Kansas Air National Guard to save over $400,000 in the renovation of three fuel storage ponds here at Forbes Air Force Base.

Captain Bob Burke of the ANG said the project was completed at a cost of $141,000, representing a substantial savings over the original estimates of $550,000. Hamm Asphalt of Perry was the general contractor.

The Air Force officer is credited with “the foresight in seeing fly ash as a useful alternative to conventional chip and seal methodology and allowing the necessary field tests of the Class C ash.”

IMPERVIOUS BARRIER

The project involved the renovation of existing banks and basins, covering approximately eight acres, as an imperious barrier to resist jet fuel spillage in the event of a tank rupture.

Midwest Fly Ash Co. supplied the 3,600 tons of ash from Kansas Power & Light Company’s Jeffrey Energy Center with Robin Somerville serving as project coordinator. The Jeffrey Center burns sub-bituminous Wyoming coal.

Somerville explained the existing brown clay, gravel, and top soil was mixed with the fly ash at the rate of 20 pounds per square foot. The banks were cut back, the materials mixed with the ash on the basin floor, and then put back in place. An average percent of relative compaction of 101.5 was achieved on the dike slopes.

The percent moisture ranged from 10.1 to 17.6. The optimum moisture was listed at 21.5.

The basin was then scarified to a depth of six inches. The ash was placed in window rows, tilled with the existing soils and water added. The mat was rolled and compacted with a rubber-tired roller with the contractor achieving a percent of relative compaction of 104.8.

GRAIN TRAILERS

The floor was sealed with a CRF:H emulsion at the rate .5 gallons per square yard.

Two modes of transport were used in delivering the ash to the job site including pneumatic tankers and bottom dump grain trailers. Somerville reported the dumps proved to be very successful because the turn around time was essential in completing the project on schedule.

Somerville said it is hoped the project will be a blueprint for similar applications in the Topeka area.

NAA Reps Participate In FHWA Fly Ash Workshop

SHREVEPORT, LA—Five representatives of the National Ash Association participated in a Fly Ash Workshop here June 8-9 for Federal Highway Administration engineers from 17 southern states.

Technical Director Roy Aaron headed the panel that included Claude Brown of Dallas, TX, Gifford-Hill Company; Lou Marcuz of Houston, TX, Ash Management Systems, Inc.; Jim Gunn of Des Plaines, IL, American Fly Ash Company; and Everett Perrien of New Orleans, LA, Middle South Services, Inc.

The opening session included a review of the current use of ash and state-by-state reports on the use of fly ash in soil stabilization, embankment and mineral filler applications as well as a partial replacement for cement in pavements and structural members.

Speakers included Jeffrey Sommerfield of the FHWA in Washington who gave a nationwide overview of ash utilization and Robert Prochaska of FHWA Region 6 who led a discussion on the FHWA position on the use of fly ash under the new Federal Procurement Guidelines.

Others included William Ledbetter of Texas Transportation Institute at Texas A&M University and Sam Thornton of the University of Arkansas.

States represented in the three FHWA regions are Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Arkansas, Louisiana, New Mexico, Oklahoma, Texas, Iowa, Kansas, Missouri, and Nebraska.
$2.1 Million Mine Subsidence Control Project Initiated in Fairmont

Fly Ash/Cement Grout To Be Used

FAIRMONT, WV— Work is underway on a $2.174 million mine subsidence control project here utilizing a fly ash/cement grout to stabilize an 18-acre section of the McCoy Mine where coal removal began in 1894.

The project is being carried out by Nicholson Construction Co. of Pittsburgh, PA, under a contract from the West Virginia Department of Natural Resources. Funds are being provided by the U.S. Office of Surface Mining (OSM) from a trust fund created by a royalty on each ton of coal mined across the nation.

It is expected to take 125,000 tons of fly ash and 15,000 tons of cement to prepare the grout mix to fill the old underground mine workings. The job was designed by OSM Geologist Jesse L. Craft after studying the mine maps and engineering films. The work is expected to stabilize the area and prevent further subsidence from taking place.

Dr. Craft identified the coal as being the Pittsburgh seam. The depth below the surface ranges from about 40 feet near the outcrop to 119 feet at the deepest point.

The ash is being supplied by Monongahela Power Company from its Harrison Power Station and will be trucked to the job site in tarped open-bed dump trucks.

Nicholson designed the grout mixer using a Warman high-solid slurry pump with a capacity of 600 slurry gallons per minute. The pump has a variable speed hydraulic motor (800 to 1,200 rpm) that can be adjusted to travel the distance and elevation the grout has to travel to reach the injection point.

‘Specifications Require Group To Attain Unconfined Compression Strength of 200 PSI’

The game plan calls for the grout to be mixed at a central batch plant and transported to the injection points in a 3,300 foot network of six-inch diameter steel pipe. There are approximately 58 bore holes into the old haulageways including monitoring positions.

Project Manager Lynn Crayne explained the specs require the grout to attain an unconfined compressive strength of 200 psi in 7-days. As designed, the mix will contain an 8:1 ratio of fly ash to cement.

Due to the high pozzolan strength of the fly ash, Crayne said “We may be able to reduce the cement ratio.” Lab tests produced psi’s in the 300 to 475 range in seven days and up to 850 psi in 28 days, he explained.

The Nicholson official stated the mix at the perimeter points will be “considerably stiffer” to prevent “blow outs or leaks at the outcrop.” The barrier grout will be pumped with a 75 to 25 percent ratio of fly ash to cement.

The mixing operation will be directed by Construction Materials, Inc. - a Deloit-Hoy Company, located in Morgantown. A Hetzel mixer has been installed at Fourth and Virginia streets with a rated capacity of 150/180 cubic yards per hour.

“Our goal is to be able to inject 1,200 tons of grout per day,” Crayne stated.

The injection process will be monitored by a TV camera lowered into an adjoining hole about 15 feet from the feed point to insure the fly ash-cement grout has a good flow around obstructions and is filling the mine cavity. The camera, mounted on a swivel head, has a range of about 25 feet with an attached high intensity light. OSM staff will be housed in an above ground trailer to record and document the results.

Subsidence first occurred in the 5 by 6 block area adjoining the city’s Central Business District in September, 1978. Structures affected include 4 churches, 3 banks, U.S. Post Office, Health Department, Board of Education, County Fire/Rescue headquarters, an auto agency, several commercial buildings, as well as many apartment and single family dwellings.

In an order to facilitate the movement of vehicular traffic in the area, the piping will be placed beneath the surface across the main streets. At other intersections asphalt ramps will be placed over the pipe.

Nicholson was selected from among 14 contractors who bid the job. The completion date of the project is November, 1984.

Map of McCoy Mine with Injection Points
The American Coal Ash Association (ACAA) held its fall membership meeting on October 19 and 20 at the French Lick Resort, French Lick, Indiana. The last such event was held in Scottsdale, Arizona in February of 2020, 621 days prior. For the first time in ACAA history, the meeting had a hybrid format. In addition to an in-person attendance option, this event offered a virtual attendance option for those with travel restrictions. A total of 117 people registered for the meeting, with 104 attending in-person and 13 opting for virtual attendance.

The ACAA standing committees reported on recent activities, as is the custom at membership meetings. A special report on recent international coal ash conferences was also part of the event. ACAA Chair of the Board of Directors Steve Benza, Dr. Rafic Minkara, Chair of the Technical Committee, and John Ward, ACAA Communications Consultant, discussed their recent experience at AshTrans in Copenhagen, Denmark. Each member of this panel discussed the advantages of international outreach on coal combustion product issues.

The Women’s Leadership Forum had its customary luncheon meeting and featured a roundtable discussion of issues of mutual interest.

The meeting featured products and services from nine exhibiting companies, including APTIM, Boral Resources, Griffin Dewatering, Keystone Drill Services, The Mouat Company, Mt. Carmel Stabilization, Stantec, Synthetex, and Waste Connections.

Receptions were held on both Tuesday and Wednesday evenings. Both were well attended and lively. Networking was in high gear!

To satisfy the interest in sharing the latest information available on some important beneficial use topics, ACAA teamed up with the Center for Applied Energy Research at the University of Kentucky to co-sponsor a workshop entitled “Global Trends in Fly Ash Production and Utilization.” The workshop began immediately following the ACAA membership meeting and attracted 103 registrations, with 80 of those attending in-person. Topics included The State of Pond Closures, Rare Earth Element Extraction, A Survey of Harvesting Activity, Recent ASTM Activity, Current Beneficial Use Research, and a Regulatory Overview.

A special keynote address was given by Caryl Pfeiffer, Director, Corporate Fuels & By-Products, at LG&E and Kentucky Utilities. Ms. Pfeiffer’s presentation, entitled “Every Found Counts,” described how her company approached CCP beneficial use with the goal of extracting maximum value from every pound of CCP.

The highlight of the membership meeting and workshop had nothing to do with coal ash. Dr. Ivan Diaz, Boral Resources, began his presentation on ASTM activities by proudly announcing that he had just recently become a U.S. citizen. A native of Mexico, Ivan said the journey to citizenship took 15 years to accomplish. Attendees responded with hearty applause to welcome the newest U.S. citizen!

The success of these events would not have been possible without generous financial support from ACAA meeting sponsors Boral Resources, Charah Solutions, Global Containment Solutions, Haley & Aldrich, Hanson Engineering, John Ward Inc., National Minerals, Penta Engineering, SEFA Group, Stantec, Tetra Tech, and Trans Ash. Workshop sponsors included APTIM, Geosyntec Consultants, John Ward Inc., TenCate Geotube, and Waste Management. THANK YOU for making these events special.

The comment heard most frequently during the membership meeting and the workshop was, “it was good to get to see my colleagues in-person once again.”
The Anna Maria Island Workshop series resumed November 10-12, 2021, after taking a pause in 2020 due to the COVID-19 crisis. This workshop was the twenty-first in the series. The invitation-only event brings together approximately 50 content experts to look at the current and future needs and opportunities for the use of cement and concrete. Industry, academia, and government entities are represented at each workshop. The annual event is held in the assembly chamber of the Holmes Beach, Florida, city hall.

The theme for this year’s workshop was infrastructure renewal. With concerns over current infrastructure and the recent investment in repairing and replacing bridges, pavements, and other types of infrastructure, the presentations were very timely—pointing to the technologies that are working, those that are not working, and the research underway to help improve understanding of tools and materials available to build robust and resilient projects.

Fly ash, bottom ash, and harvested materials were included in the presentations and identified as critical materials in building durable concrete structures and pavements. Boyd Clark of the CTL Group described the challenges in selecting the best and most available supplementary cementitious materials (SCM). When fly ash is not available from traditional sources, what are the options and how can they be evaluated? Mr. Clark noted the significant potential from the use of bottom ash and harvesting where feasible. Dr. Ivan Diaz of Boral Resources spoke to the efforts of Boral in developing tools to evaluate pozzolanic reactivity. Andrew Bennett of the Michigan Department of Transportation described current pavement design practice in Michigan and the increasing need for greater supply of fly ash and other SCM to build durable pavements. Pavements in Michigan and other states with freeze/thaw considerations are experiencing premature pavement failure due to changes in the type of deicers used and the manner in which those materials are applied. Mr. Bennett said that one of the mitigation tools to combat this deterioration is the use of higher amounts of SCM in pavement mixtures. Professor Jason Ideker of Oregon State University spoke on updates to techniques to combat alkali-silica reaction in concrete mixtures. While new materials show some promise, the best tool for this purpose continues to be Class F fly ash.

Fly ash was also mentioned in presentations focusing on reducing greenhouse gas emissions resulting from the production of portland cement.

ACAA has been a sponsor of this event for the last 11 years, and our members have been regular speakers. It has proven to be a valuable opportunity to talk to industry experts, researchers, and owners to gain information on their needs, interests, and the solutions available from the use of coal combustion products.
Welcome, New ACAA Members!

**Ash Grove Cement** is a leading North American cement producer. Their parent company, CRH, is a global leader in the construction materials business. They are one of the largest concrete and precast suppliers and rely heavily on CCP products such as fly ash in their manufacturing process. As such, they are interested in the fly ash market and the future of remediated fly ash sites. Please visit www.ashgrove.com for more information.

**Burns & McDonnell** provides full-lifecycle services for coal combustion residuals (CCR) management. The company’s CCR material experience includes a broad range of disposal facility strategy and planning, investigations, studies, designs, groundwater modeling and reporting, permitting, and construction support, including flue gas desulfurization byproduct, fly ash, and bottom ash and slag landfills and ponds. Please visit www.burnsmcd.com for more information.

**Harsco Environmental** is the largest and most comprehensive provider of onsite material processing and environmental services to the global metals industry, with operations at over 130 customer sites across more than 32 countries. Harsco is a technology partner to cleaner, more efficient metal production, providing customers with economically and environmentally viable solutions for the treatment and reuse of production byproducts. Please visit www.harsco-environmental.com for more information.

**Hive Aggregates** is a United Kingdom-based company interested in the potential to harvest fly ash from landfills and process it into a sustainable cement substitute. The company is also working on other projects and opportunities involving the beneficial use of byproducts, including the use of steel making waste and air pollution control residue from power stations. Please visit www.hiveenergy.co.uk/clean-futures/hive-aggregates for more information.

**Nicholson Construction Company** is a nationally renowned geotechnical engineering and construction firm with more than 60 years of experience. Headquartered in Pittsburgh, the company offers proven expertise in the design and installation of deep foundation elements, earth retention systems, and both ground treatment and fly ash containment solutions. Please visit www.nicholsonconstruction.com for more information.
News Roundup

Coal Ash Recycling Rate Increases in 2020

Fifty-nine percent of the coal ash produced in the United States during 2020 was recycled—up from 52 percent in 2019 and the sixth consecutive year that more than half of all the coal ash produced was beneficially used rather than disposed, according to the American Coal Ash Association’s just-released “Production and Use Survey.”

According to the survey, 40.8 million tons of coal combustion products were beneficially used in 2020, a volume approximately level with the previous year. But production of new CCPs declined from 78.6 million tons in 2019 to 69.2 million tons in 2020 as utilities consumed less coal for generating electricity.

The survey also showed that harvested ash is beginning to play a meaningful role in beneficial use activities. Nearly 4 million tons of previously disposed ash was utilized in a variety of beneficial uses in 2020, including coal ash pond closure activities, for cement kiln raw feed, and for gypsum panel manufacturing.

Highlights of CCP production and use in 2020 include:

- Use of coal fly ash in concrete decreased 12 percent to 11.1 million tons. Concrete producers and consumers indicated a desire to use more fly ash, but several regional markets were affected by shifting supply dynamics associated with closures of coal-fueled power plants.

- Use of all coal combustion products in cement production declined 4 percent to 4.8 million tons.

- Utilization of a key “non-ash” coal combustion product posted a modest increase. Synthetic gypsum is a byproduct of flue gas desulfurization units, also known as “scrubbers,” located at coal-fueled power plants. Use of synthetic gypsum in panel products (i.e., wallboard) increased 3 percent to just under 10 million tons.

- Synthetic gypsum use in agricultural applications—in which the gypsum improves soil conditions and prevents harmful runoff of fertilizers—increased 34 percent to 847,704 tons.

- Use of CCPs in pond closure activities increased 44 percent to 3.4 million tons. This activity is driven by utility compliance with coal ash regulations enacted in 2015 that effectively require an end to the practice of wet disposal. Fly ash, bottom ash, and synthetic gypsum were all used in the construction of new permanent disposal facilities.

- Use of CCPs in structural fills continued a multi-year decline in 2020, dropping 52 percent to 816,543 tons.

- Production of boiler slag declined 14 percent, but utilization in the production of blasting grit and roofing granules increased 11 percent to 273,548 tons.

- For the first year in survey history, no cenospheres were reported sold in 2020. The downturn was likely linked to increased closure of disposal ponds from which cenospheres are harvested.

ACAA Conducts Congressional Briefing

ACAA representatives on July 15, 2021, participated in a briefing of U.S. House and Senate staff members concerning coal ash beneficial use. Approximately 50 Congressional staff members and representatives of aligned trade associations attended the in-person briefing featuring ACAA Executive Director Thomas Adams and ACAA Government Relations Committee Chairman John Ward. Entitled “Coal Ash 101: Overview of Beneficial Use of Coal Combustion Products,” the hour-long briefing covered the types, characteristics, and history of coal ash; summaries of production and use data; environmental benefits; regulatory history; current trends in ash supply and use; and an overview of current public policy issues.
Educational outreach to policymakers is increasing in response to attacks by environmental groups on certain coal ash beneficial use applications. Section 622 of H.R. 1512, the “CLEAN Future Act,” and H.R. 2396, a separate stand-alone bill entitled the “Ensuring Safe Disposal of Coal Ash Act,” each contain a provision that would “prohibit, as open dumping, the use of coal combustion residuals in unencapsulated uses.”

**Comments on Illinois CCR Disposal Standards Filed**

ACAA on August 6, 2021, submitted comments to the Illinois Pollution Control Board on two subjects left open after the state finalized its coal ash disposal regulations in February.

“Historic [sic], unconsolidated coal ash fills” and “use of temporary storage piles of coal ash” were issues that could have implications for beneficial use, which state regulators said “merited further exploration.” ACAA’s comments urged the Illinois regulators to adopt policies that encourage beneficial use as a preferred alternative to disposal and to resist actions that may inadvertently create barriers to beneficial use.

“CCP beneficial use enjoys a decades-long track record of safe, large-scale utilization in a wide variety of applications,” ACAA’s comments said. “Regulatory scrutiny at the state and federal levels has consistently validated the safety and benefits of CCP beneficial use. CCR disposal regulation can inadvertently erect barriers to beneficial use, however. Regulators must be careful not to use too broad of a brush in defining the practices being regulated and must avoid placing unjustified restrictions or cumbersome reporting requirements on CCP beneficial use.”

The state’s public comment process was marked by a very small response. Other organizations weighing in included Illinois Environmental Regulatory Group (representing industry) and a coalition of environmental groups that included the Prairie River Network and Sierra Club.

**Use of Bottom Ash as a Concrete SCM**

American Concrete Institute Committee 232 on Fly Ash and Bottom Ash in Concrete and Committee 236 on Material Science of Concrete are organizing a joint technical session titled “Use of Bottom Ash as a Concrete SCM” to be held at the ACI Spring 2022 Convention in Orlando, Florida.

The session will focus on the latest research related to use of ground bottom ash as a supplementary cementitious material in concrete. This includes studies on the chemical and physical characteristics of ground bottom ash, its pozzolanic reactivity, and its performance related to fresh, mechanical, and durability properties of concrete mixtures.

**ELG Supplemental Rulemaking Under Development**

U.S. Environmental Protection Agency announced it will conduct a supplemental rulemaking to “strengthen certain discharge limits” in effluent limitation guidelines (ELG) for steam electric power plants. The agency also asked courts to pause litigation over ELG rules finalized in 2020 while the supplemental rulemaking is conducted.

EPA said it undertook a “science-based review” of the 2020 Steam Electric Reconsideration Rule in response to President Biden’s Executive Order 13990 that called for assessment of numerous regulations completed under the Trump administration. EPA said it found opportunities for improvement and that the agency intends to issue a proposed rule for public comment in the fall of 2022. Notably, however, EPA said current ELG regulations—both the 2015 and 2020 rules—will
remain in force while this supplemental rulemaking is developed.

In contrast to the ELG action under the Clean Water Act, coal ash-related solid waste regulations subject to Executive Order 13990 review did not trigger any new rulemaking activity.

With no fanfare, EPA posted the following statement to its “coal ash rule” website: “EPA determined that the most environmentally protective course is to implement the rules. EPA will be addressing the remaining issues remanded back to the Agency regarding the July 2018 rule through the rulemaking process.”
Northern Kentucky Convention Center
Covington, Kentucky

Exhibit Hall Sold Out!

For sponsorship information and to register, please visit: worldofcoalash.org

Please note that those wishing to attend WOCA’s popular “Short Course” must register for the course and the full conference to attend both activities.

Organized by the American Coal Ash Association and The University of Kentucky Center for Applied Energy Research
The American Coal Ash Association was established in 1968 as a trade organization devoted to recycling the materials created when we burn coal to generate electricity. Our members comprise the world’s foremost experts on coal ash (fly ash and bottom ash), and boiler slag, flue gas desulfurization gypsum or “synthetic” gypsum, and other “FGD” materials captured by emissions controls. While other organizations focus on disposal issues, ACAA’s mission is to advance 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.
Coal combustion products—often referred to as “coal ash”—are solid materials produced when coal is burned to generate electricity. There are many good reasons to view coal ash as a resource, rather than a waste. Using it conserves natural resources and saves energy. In many cases, products made with coal ash perform better than products made without it.

As coal continues to produce approximately one-quarter of the electricity generation in the United States, significant volumes of coal ash are produced. Since 1968, the American Coal Ash Association has tracked the production and use of all types of coal ash. These surveys are intended to show broad utilization patterns and ACAAs data have been accepted by industry and numerous government agencies as the best available metrics of beneficial use practices.

Fifty-nine percent of the coal ash produced during 2020 was recycled—increasing from 52 percent in 2019 and marking the sixth consecutive year that more than half of the coal ash produced in the United States was beneficially used rather than disposed. The overall recycling rate had declined over the previous two years from its high of 64 percent in 2017.

American Coal Ash Association’s 2020 “Production and Use Survey” also showed that harvested ash is beginning to play a meaningful role in beneficial use activities. Nearly 4 million tons of previously disposed ash was utilized in a variety of beneficial uses in 2020, including coal ash pond closure activities, for cement kiln raw feed, and for gypsum panel manufacturing.
Fly Ash

Fly ash is a powdery material that is captured by emissions control equipment before it can “fly” up the stack. Mostly comprised of silicas, aluminas and calcium compounds, fly ash has mechanical and chemical properties that make it a valuable ingredient in a wide range of concrete products. Roads, bridges, buildings, concrete blocks and other concrete products commonly contain fly ash.

Concrete made with coal fly ash is stronger and more durable than concrete made with cement alone. By reducing the amount of manufactured cement needed to produce concrete, fly ash accounts for approximately 12 million tons of greenhouse gas emissions reductions each year.

Other major uses for fly ash include constructing structural fills and embankments, waste stabilization and solidification, mine reclamation, and use as raw feed in cement manufacturing.

Bottom Ash

Bottom ash is a heavier, granular material that is collected from the “bottom” of coal-fueled boilers. Bottom ash is often used as an aggregate, replacing sand and gravel. Bottom ash is often used as an ingredient in manufacturing concrete blocks.

Other major uses for bottom ash include constructing structural fills and embankments, mine reclamation, and use as raw feed in cement manufacturing.

Bottom ash can be used in asphalt paving.
Power plants equipped with flue gas desulphurization ("FGD") emissions controls, also known as "scrubbers," create byproducts that include synthetic gypsum. Although this material is not technically "ash" because it is not present in the coal, it is managed and regulated as a coal combustion product.

Scrubbers utilize high-calcium sorbents, such as lime or limestone, to absorb sulfur and other elements from flue gases. Depending on the scrubber configuration, the byproducts vary in consistency from wet sludge to dry powdered material.

Synthetic gypsum is used extensively in the manufacturing of wallboard. A rapidly growing use of synthetic gypsum is in agriculture, where it is used to improve soil conditions and prevent runoff of fertilizers and pesticides.

Other major uses for synthetic gypsum include waste stabilization, mine reclamation, and cement manufacturing.
Other Products and Uses

**Boiler Slag** — is a molten ash collected at the base of older generation boilers that is quenched with water and shatters into black, angular particles having a smooth, glassy appearance. Boiler slag is in high demand for beneficial use as blasting grit and roofing granules, but supplies are decreasing because of the retirement from service of older power plants that produce boiler slag.

**Cenospheres** — are harvested from fly ash and are comprised of microscopic hollow spheres. Cenospheres are strong and lightweight, making them useful as fillers in a wide variety of materials including concrete, paint, plastics and metal composites.

**FBC Ash** — is a category of ash from Fluidized Bed Combustion power plants. These plants reclaim waste coal for fuel and create an ash by-product that is most commonly used to reclaim abandoned surface mines and abate acid mine drainage. Ash from FBC power plants can also be used for waste and soil stabilization.

New Uses on Horizon

New beneficial uses for coal ash are continually under development. Researchers and ash marketers are currently focusing heavily on the potential for harvesting ash that has already been disposed for potential beneficial use. There is also renewed interest in the potential for extracting strategic rare earth minerals from ash for use in electronics manufacturing.
We get it.
Find out how.
Fly ash has become a strategically
important component of producing
durable, sustainable concrete.
We get it.
You need fly ash supplies that
are consistent and reliable.
We get them for you.
At Boral Resources, we have the
resources to get fly ash where you
need it, when you need it.
We are the fly ash
industry's pioneers.

<table>
<thead>
<tr>
<th>2020 CCP Categories</th>
<th>Fly Ash</th>
<th>Bottom Ash</th>
<th>Boiler Slag</th>
<th>FGD Gypsum</th>
<th>FGD Material Wet Scrubbers</th>
<th>FGD Material Dry Scrubbers</th>
<th>FGD Other</th>
<th>FBC Ash</th>
<th>CCP Production / Utilization Totals</th>
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<tr>
<td>Total CCPs Produced by Category</td>
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<td>7,973,554</td>
<td>834,131</td>
<td>17,677,439</td>
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<td>11. Gypsum Panel Products Formerly Wallboard</td>
<td>18,308</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>9,963,467</td>
<td>0</td>
<td>0</td>
<td>9,981,776</td>
<td></td>
</tr>
<tr>
<td>12. Waste Stabilization/Solidification</td>
<td>1,117,551</td>
<td>43,634</td>
<td>0</td>
<td>118,854</td>
<td>0</td>
<td>13,415</td>
<td>0</td>
<td>73,215</td>
<td>1,365,070</td>
</tr>
<tr>
<td>13. Agriculture</td>
<td>0</td>
<td>3,801</td>
<td>0</td>
<td>764,996</td>
<td>76,006</td>
<td>0</td>
<td>0</td>
<td>947,704</td>
<td></td>
</tr>
<tr>
<td>14. Aggregate</td>
<td>1,550</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1,550</td>
<td></td>
</tr>
<tr>
<td>15. Oil/Gas Field Services</td>
<td>64,163</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6,810</td>
<td>0</td>
<td>70,973</td>
<td></td>
</tr>
<tr>
<td>16. CCR Pond Closure Activities</td>
<td>1,585,156</td>
<td>1,026,079</td>
<td>0</td>
<td>537,176</td>
<td>292,553</td>
<td>0</td>
<td>0</td>
<td>3,413,964</td>
<td></td>
</tr>
<tr>
<td>17. Miscellaneous/Other</td>
<td>307,068</td>
<td>75,520</td>
<td>0</td>
<td>92,212</td>
<td>7,186</td>
<td>0</td>
<td>0</td>
<td>482,068</td>
<td></td>
</tr>
</tbody>
</table>

### Summary Utilization to Production Rate

<table>
<thead>
<tr>
<th>CCP Categories</th>
<th>Fly Ash</th>
<th>Bottom Ash</th>
<th>Boiler Slag</th>
<th>FGD Gypsum</th>
<th>FGD Material Wet Scrubbers</th>
<th>FGD Material Dry Scrubbers</th>
<th>FGD Other</th>
<th>FBC Ash</th>
<th>CCP Utilization Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Totals by CCP Type/Application</td>
<td>17,104,493</td>
<td>2,955,653</td>
<td>369,729</td>
<td>13,147,742</td>
<td>292,553</td>
<td>106,256</td>
<td>2,193</td>
<td>6,809,788</td>
<td>46,788,407</td>
</tr>
<tr>
<td>Category Use to Production Rate (%)</td>
<td>64.5%</td>
<td>37.0%</td>
<td>44.3%</td>
<td>74.3%</td>
<td>4.8%</td>
<td>3.7%</td>
<td>5.3%</td>
<td>94.3%</td>
<td>58.98%</td>
</tr>
</tbody>
</table>

2020 Atmospheres Sold (Pounds) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
CCPs Imported in 2020 (Short Tons) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
CCPs Exported in 2020 (Short Tons) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Data in this survey represents 121,741,120 GWh of Name Plate rating of the total industry wide approximate 323,824 GW capacity based on EIA's July 2020 Electric Power Monthly.
Fly ash has become a strategically important component of producing durable, sustainable concrete. **We get it.**

You need fly ash supplies that are consistent and reliable. **We get them for you.**

At Boral Resources, we have the resources to get fly ash where you need it, when you need it. **We are the fly ash industry’s pioneers.**
2021 American Coal Ash Association Membership Directory

These listings are organized into the following five membership categories:
Utility • Marketer • Specialty Marketer • Associate • Individual

Utility

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E-mail: sevans2@ameren.com

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Reagent Procurement & CCP Marketing
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E-mail: jechelbarger@aep.com

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Rob Brown
President

Colorado Springs Utilities
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The SEFA Group began investing in recycling technologies over 20 years ago, as it became evident that evolving environmental requirements would change the availability and quality of fly ash suitable for sale.

Since that time, SEFA has been operating recycling facilities and developed STAR Technology, commercially proven since 2008. As environmental requirements evolve, SEFA will continue to offer services to enhance and improve the processing of commercial quantities of material reclaimed from legacy coal ash impoundments.

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TLC for CCP

No Other Company

offers more experience and capabilities in Coal Combustion Products management and marketing.

No other company cares more about safety and performance in achieving your CCP program goals.

- America’s only coast to coast marketer of fly ash for concrete and concrete products
- 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 limestone handling and equipment maintenance
- Innovative solutions for ash quality management, such as RestoreAir® second generation carbon treatment
- Innovative solutions for ash-based product manufacturing, including light weight aggregate
- The industry’s widest range of technology options for harvesting previously disposed CCPs

For your next Coal Combustion Products challenge, choose the CCP leader.

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