INDUSTRY RESEARCH INTO COAL ASH APPLICATIONS CONTINUES
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In the process of making power, coal-fired plants in North America annually produce about 70 million tons of fly ash. This material is an under-utilized resource, with about two-thirds of it relegated to landfill disposal despite numerous beneficial applications in construction, land reclamation, waste management, agriculture, and industrial products.

EPRI continues to conduct studies and publish information to assist utilities in finding beneficial uses for fly ash and in better understanding the properties and specifications of ash required for different applications. Recent work has focused on three key applications: horticulture, flowable fills, and mitigation of alkali-silica reactivity (ASR)-related damage to concrete.

Of the two ashes produced in power production, bottom ash is the coarser, heavier ash fraction that falls to the bottom of the furnace, while fly ash is the lighter fraction carried out of the furnace with the exhaust gases and captured in particulate collectors to prevent its release to the atmosphere. A typical pulverized coal plant produces about 20% bottom ash and 80% fly ash.

Fly ash is categorized into two broad classes based on American Society for Testing and Materials (ASTM) criteria for chemical composition and physical characteristics. The classification corresponds approximately to the rank (type) of the coal. Ashes from sub bituminous and lignite coals are normally designated "Class C," and are sometimes called "high calcium." They contain modest quantities of "free lime" (CaO), making them mildly cementitious when wetted. Ashes from bituminous and anthracite coals are normally designated "Class F," and are sometimes called "low calcium." They generally contain little or no free lime, and only become cementitious after contact with calcium hydroxide and water.

HORTICULTURE

In the U.S. horticultural industry today, the demand for growing media and soil amendments is greater than ever, and many of the materials currently used—including peat moss, processed pine bark, and manure—have drawbacks. EPRI-sponsored studies by the University of Georgia investigated several horticultural applications for mixtures containing coal ash and nutrient-rich materials such as biosolids (high-quality, treated sewage sludge), steer manure, poultry litter, and other animal wastes.

According to EPRI's Ken Ladwig, results showed that the mixtures offered advantages, both botanical and economic, especially for two applications: potting soil and topsoils for sod production. "Because coal ash and biosolids are plentiful and affordable, horticultural

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mixes based on these products offer a cost-effective alternative to commercial products. In addition, the product uses two materials that would otherwise require disposal." It was estimated that these applications have the potential to use more than 8 million tons of ash annually, or about one-tenth of current production.

In a related study, EPRI worked with an Atlanta area power company and wastewater treatment agency to develop a business plan for a hypothetical company producing blended planting mixes and soil amendments. The EPRI study found that the best potential markets for coal ash and biosolid mixtures (in order of decreasing profit margin) are retail garden centers, sports turf industries, landscapers, wholesale greenhouses and nurseries, topsoil blenders, and sod producers. Analyses conducted during the development of the business plan suggest that this business model is applicable to numerous U.S. metropolitan areas.

FLOWABLE FILLS

Flowable fills are mixtures of water, fly ash, and portland cement that flow readily into irregular spaces, are self-leveling, and set to maximum density without compaction or appreciable shrinkage. These mixtures, which are designed to replace conventional backfill materials such as soil, sand, or gravel, have many applications, including backfill for bridge

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COAL ASH APPLICATIONS

Application	Markets	Benefits
Horticulture: potting soil and topsoils	Retail garden centers, sports turf industries, landscapers, wholesale greenhouses and nurseries, topsoil blenders, and sod producers.	Cost-effective alternative to other commercial products, reduced disposal
Flowable fills	Highway construction, building construction	Reduced labor costs, increased speed of backfill, increased soil-bearing capacity, less cracking, faster setting, corrosion resistance
Mitigation of ASR damage	Construction	Increased resistance to ASR, improved strength and durability of concrete

Source: EPRI

BUSINESS BRIEFS

The U.S. Supreme Court has refused to review a lower court ruling that said the **Tennessee Valley Authority** is free to ignore EPA orders to install additional pollution control equipment at its coal-fired plants. The high court's action left uncertain what future enforcement actions, if any, the U.S. government will take against the federally owned electric utility for alleged past violations of the Clean Air Act.

Capstone Turbine has shipped the first beta unit C200, a 200 kW natural gas fueled power system with many of the features of Capstone's 30 kW and 60 kW products, to the University of California, Irvine, where it will provide on-site power. Developed in conjunction with DOE's advanced microturbine system program, commercial plans for the new system will be announced later this year.

Reliant Energy has announced that it will mothball its 882 MW Choctaw County combined-cycle plant in Mississippi until market conditions improve.

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abutments and trenches, fill for embankments and road bases, bedding for slabs and pipes, and fill for abandoned storage tanks and shafts.

EPRI's Ladwig notes that flowable fills have a number of advantages over conventional materials. Because they are placed without compaction equipment or workers in a trench, they reduce labor costs and increase the speed and ease of backfill operations. The fly ash in flowable fill offers increased soil-bearing capacity and prevents post-fill settlement-related cracking. Flowable fills can be used around and under structures that are inaccessible via normal placement methods. Finally, flowable fills can set within 24 hours or less, making them ideal for high-traffic highway applications.

MITIGATION OF ASR-RELATED DAMAGE TO CONCRETE

For decades the concrete construction industry has been plagued by the deleterious chemical reactions that can develop between the siliceous materials in concrete aggregate and the alkali hydroxides in cement. Known as ASR, this phenomenon can lead to premature and severe cracking.

"Using coal ash as a substitute for a portion of the portland cement in concrete can minimize ASR-related damage while increasing the strength of the concrete," Ladwig says. In particular, the reactive silica in power plant fly ash combines with the cement alkalis (that is, NaOH and KOH) more readily than the silica in aggregate. The resulting calcium-alkali-silica "gel" is nonexpansive, unlike the water-absorbing expansive gels produced by conventional alkali-aggregate reactions. As a result, the fly ash increases ASR resistance and improves the concrete's ultimate strength and durability while lowering costs. The optimal proportion of fly ash in the mix varies depending on the fly ash type (Class F or C), its soluble alkali content, fineness, and other factors.