

C²P² – Partnership Innovation

John Glenn¹, David C. Goss², John Sager¹

¹ US Environmental Protection Agency, 1200 Pennsylvania Avenue., NW (5306), Washington, DC 20460, ²American Coal Ash Association, 15200 E. Girard Ave., Suite 3050, Aurora, CO 80014-3955

KEYWORDS: sustainability, EPA, partnerships, beneficial reuse

ABSTRACT

In January 2004, the Environmental Protection Agency (EPA) introduced the Coal Combustion Products Partnership, or “C²P².” This initiative is co-sponsored by the Department of Energy (DOE), the Federal Highway Administration (FHWA), the American Coal Ash Association (ACAA) and the Utility Solid Waste Activities Group (USWAG). C²P²'s purpose is to educate the public about the environmental benefits of using coal combustion byproducts, or “CCPs,” help identify actual or perceived barriers to increased use of CCPs and increase the demand for them rather than having them land filled. The use of CCPs conserves natural resources, reduces greenhouse gas emissions and eliminates the need for landfill space. C²P² is an out reach effort by the EPA and co-sponsors to make the general public, end users, contractors, specifiers and regulatory agencies more aware of the environmental, physical, technical and economic aspects of using CCPs.

Although focused initially on highway construction, C²P² is expanding to discuss building design and architectural applications. In 2004, the EPA published a booklet describing the environmental issues associated with CCPs. It contains broad background information on selected beneficial applications. Related workshops were conducted across the nation, which discussed C²P² in the context of using CCPs in concrete, structural fills and highway construction. Speakers from the FHWA, the concrete and ash industries and other organizations discussed the use of CCPs as a sustainable product, one that can increase design performance and a material with physical and economic benefits.

BACKGROUND

Over 50% of the electricity generated in the United States comes from coal-fueled power plants. Coal represents 80% of America's fuel reserves, followed by natural gas (15%) and oil (5%). Over 128 million metric tons of coal combustion products (CCPs) were produced in 2002 and of this amount, approximately 35% (or 45,500,000 metric tons) were used beneficially.

CCPs include fly ash, bottom ash, boiler slag, various flue gas desulfurization (FGD) materials, fluidized bed combustion ash and cenospheres. However, the design of a power plant boiler, the type of coal consumed, the air emission control devices installed (if any), the distance to the marketplace, the cost of disposal and the availability of land for disposal all have an impact on

the use of CCPs. Since the primary product derived from burning coal at a power plant is the generation of electricity, plant managers may care less about the quality of the ash produced than they do about plant operating systems and economics.

Utilities are constantly under scrutiny for their actual or perceived non-compliance to environmental regulations. The installation of scrubbing systems to remove nitrogen oxides (NO_x) and sulfur oxides (SO_x) are continually impacting plant operations, including those related to ash operations. Where a plant, for example, has historically been able to market a large percentage of fly ash into concrete, the installation of some scrubber systems may render the ash totally unsuitable for concrete. The use of dry sodium injection systems, lime spray dryers and various types of wet flue gas desulfurization systems create new challenges and opportunities for ash utilization.

NEW REGULATORY INITIATIVES

In 2002, the US Environmental Protection Agency began formulating plans to help promote the beneficial use of CCPs. The Agency recognized that in many situations, CCPs could be used in ways that would further national environmental goals: the reduction of green house gases, conservation of natural resources and ~~the~~ lessening the need for coal ash landfill space. In 2003, EPA initiated the "Coal Combustion Products Partnership," or "C²P²". This program is intended to help educate the public about the environmental benefits of using coal ash in a variety of ways. For those who already have knowledge about CCPs, the program is also aimed at identifying the actual or perceived barriers that may limit the beneficial use of CCPs in highway and construction applications. With C²P² the sum of these efforts is anticipated to result in an overall increase the use of CCPs. Some of these barriers exist because there is a lack of understanding by end users and government agencies of the potential benefits that CCPs can have.

C²P² is part of the larger EPA program known as the Resource Conservation Challenge (RCC). This is a national effort to find innovative, protective ways to conserve our valuable resources and improve public health and the environment. Varieties of industrial materials are included under RCC, including coal ash. Motor oil, cardboard and paper, batteries, consumer electronics and even coffee grounds are also promoted as materials to be reused or recycled rather than simply thrown away. This voluntary program is widely supported and EPA has committed at the highest level to mobilize its institutional resources to bring sustained and focused attention and responsive decision-making to achieving RCC goals.

The initial thrust of C²P² has been to promote increased use of fly ash in concrete. In June 2003, the Federal Highway Administrations (FHWA), in conjunction with the American Coal Ash Association (ACAA) issued a revised edition of the very popular "Fly Ash Facts for Highway Engineers" booklet. This publication describes the use of fly ash in many highway applications, from concrete, to road base to structural fill. This edition is the first to be endorsed by the EPA. It is also available on CD and can be ordered from the American Coal Ash Association and the National Ready Mix Concrete Association.

To further support the C²P² initiative, a series of workshops are planned in 2004. The workshops will be held in Las Vegas, Nevada (September 14); Austin, Texas (September 16); San Juan, Puerto Rico (September 30); Atlanta, Georgia (November 16); and Louisville, Kentucky (November 18). These workshops will combine information from the FHWA, EPA, DOE, ACAA and other sources to provide a comprehensive one-day look at the benefits of using CCPs in concrete paving, highway construction and other applications. The workshops will be jointly planned by these groups and funded, in part, by contributions from the sponsors as well as attendance fees. Well known, credentialed speakers in concrete technology and research will make presentations. Besides discussing the theme of sustainability, speakers will talk about technical and performance aspects of fly ash in concrete and will give specific examples that pertain to the geographic area in which a particular workshop is being held. It is anticipated that the information in these workshops will provide end- users, contractors and regulators a better understanding of why the use of fly ash and CCPs in highway construction is environmentally and technically sound and may provide economic benefits as well.

The EPA's C²P² website (<http://www.epa.gov/c2p2/>) provides the user a number of valuable resources. There is an application form that can be downloaded and completed in order to enroll as a "Leader" or "Champion" of the program. Leaders are organizations such as the American Coal Ash Association, other trade associations, ash marketing firms, universities, researchers, federal agencies and groups that work at getting the C²P² message out. Champions are companies that produce or manage coal ash as well as end-users such as ready-mix companies. Many organizations could fall into either category. There is no cost to join nor are there any specific goals, other than a shared interest in increasing ash utilization. At the time of this writing, approximately 120 organizations have joined C²P² with more joining each month.

Another element of the C²P² website is case studies. These range from relatively brief explanations of projects to technical reports. A partial listing of these case studies include:

- The Lewis & Clark Visitor's Center in Washburn, ND
- Fly ash concrete design in Chicago road structures
- Roller compacted concrete construction at the Olivenhain Dam
- Bottom ash for construction fill sand uses
- High volume fly ash in residential construction
- Water quality conditions associated with the use of coal ash for highway embankments
- Summaries of highway construction projects using coal ash in Georgia, Delaware, Pennsylvania, Michigan, Kansas and North Dakota

The sponsoring C²P² organizations are developing an awards program. This will be similar to the recognitions given by the EPA in their Waste Wise Program. C²P² members will be able to nominate themselves for annual awards for a variety of activities. The following are sample criteria against which applications will be evaluated for special recognition:

- Innovative uses for coal ash including new or existing technologies applied to novel situations.

- Improved ash utilization situations where significant increases in tonnage have occurred or where coal ash has been used in ways that demonstrate an increase in value over previous practices.
- Noteworthy environmental achievement where coal ash usage has supported greenhouse gas reduction, conservation of natural resources and/or the reduced need for landfill space.
- Unusual or particularly effective methods of communicating information about C²P² or coal ash.
- Demonstration of effective partnerships with other groups to improve coal ash utilization or to implement projects or programs.
- New or ongoing research in areas of need to the industry.
- Efforts to increase use or to support C²P² program objectives by federal, state and local Government agencies.

Normally, except for government agencies, applicants will be current partners of C²P² and will submit descriptions of their activities that could merit recognition. A panel of reviewers from program sponsors and other organizations will evaluate applicants to determine awards and recognition. The first awards ceremony will be held in conjunction with the World of Coal Ash scheduled for April 11-15, 2005. This international event, jointly planned by the American Coal Ash Association, the Center for Applied Energy Research at the University of Kentucky, the Department of Energy and the Office of Surface Mining will be held in Lexington, Kentucky.

POTENTIAL IMPACTS ON C²P²

The Clean Air Act and Amendments have necessitated electric utilities evaluating ways to change their power plant operations to reduce air emissions, such as SO_x and NO_x. Many companies have installed scrubbing systems that have impacted the type and quality of coal ash produced. In some cases, fly ash has been affected by the addition of low NO_x burners or the additional of systems that add material to the flue gas stream to remove nitrogen and sulfur oxides. These systems have typically increased the amount of unburned carbon remaining in the fly ash, making it unsuitable for use in concrete. Since carbon content is one of the parameters used to determine concrete performance, high carbon ash normally will not meet American Society for testing and Materials (ASTM) standards for concrete use. Other scrubbing methods that add sodium or limestone have had a similar impact on fly ash. Some companies have been forced to dispose of fly ash that, before the installation of scrubber systems or low NO_x burners were marketed for use in concrete.

Another way to address these air emission changes has been fuel switching or blending. Some utilities have changed from local coal sources that produced a predictable type of ash over many years, to new coal sources that have resulted in different types of ash. For example, there are utilities in the eastern and southeastern part of the United States that used bituminous coal from Appalachia or the Illinois Basin since plant startup. However, these same companies may be using bituminous coal from the Uinta Basin in the Central Rockies. Even more common are companies that have switched from eastern coal to sub-bituminous coal from the Powder River Basin. In Texas, some power plants have or are beginning to use (or blend) Powder River Basin coal with local lignite coal. In many cases, markets that had long-term predictable sources for

quality ash are now finding different types of ash or less dependable sources of ash. These changes in fuel sources have resulted in situations where Class F ash is no longer abundant. Instead, Class C ash has become available and its uses may not be fully understood. C2P2 is but one method of providing relevant information to those looking for appropriate uses for new or blended types of ash.

Recently, the EPA provided proposed guidance to US utilities on the need to remove mercury from the flue gases of coal-fueled power plants. Although the total mercury produced by US utilities is estimated to be only 44.7 metric tons annually, the EPA has decided to implement regulations to take effect in 2007. A wide variety of technologies are being explored to address this issue. One method being evaluated by the industry is to inject powder activated carbon (or fly ash high in unburned carbon) into the gas stream, either before the ash collection devices (precipitators or bag house) or after them. If injected before the ash collection system, the mercury will be captured in the fly ash. The potential impact on ash utilization will depend on the mercury capture technology selected and specific plant operations. However, laboratory and field-testing has shown that the potential for captured mercury to be released from the ash and into the environment is minimal. The cost of mercury capture technology varies greatly and could have a significant financial impact on utilities. Depending on the final regulatory requirements, some utilities may simply elect to dispose of ash rather than build systems that may be costly even though they may still permit CCPs to be used. This uncertainty has the potential to impact the C²P² program in the future.

CCP RESEARCH AND PARTNERSHIPS

The US Department of Energy (DOE) has centralized much of its research and developmental work through the National Energy Technology Laboratory (NETL) in Pittsburgh, Pennsylvania. Several years ago, the DOE recognized the need to encourage increased CCP utilization. Today the Combustion Byproducts Recycling Consortium (CBRC) routinely solicits proposals for DOE funded research related to CCPs. The CBRC is divided into three geographic areas (western, midwestern and eastern) to identify priorities of high interest to those geographic areas. Proposals are reviewed against regional priorities and then against a set of national priorities and recommendations made to DOE to fund research. It is DOE's desire to help enable a goal of 50% CCP utilization by the year 2010 through this research funding. This is an aggressive goal, but it states clearly a commitment by DOE to help stakeholders achieve increased usage.

CBRC research projects have looked at a wide variety of topics, including mine applications, the use of CCPs in new processed and formed structural products using ash as filler, in agricultural and land applications, high carbon ash utilization, transportation uses, FGD materials and leaching characteristics of CCPs in disposal setting, even settings where the material is in direct contact with groundwater. Detailed information on these projects can be found on the CBRC website (<http://cbrc.nrcce.wvu.edu/CBRC>). This government-funded research has been, in many cases, the impetus needed for small companies or individuals to develop new technologies that may hold promise for wide scale uses across the United States. Additionally, research being conducted in the United States may have direct application in many other countries opening the way for more collaborative international work.

DOE is not the only entity providing research and funding. Universities and states conduct much of today's CCP research. A number of universities have established programs and/or centers of research and support for CCPs. The University of North Dakota has established the Energy and Environmental Research Center, the University of Wisconsin-Milwaukee has the Center for Byproduct Utilization and the University of Kentucky has the Center for Applied Energy Research. The Ohio State University, Pennsylvania State University, Texas A&M University, Southern Illinois University and West Virginia University all have nationally recognized CCP programs. These programs look at many uses, characteristics and impacts of CCPs in many settings. Several states have offices within their states that support coal utilization and CCPs use. Notable among these states are Ohio and Illinois. These state programs look not only at mining coal but also at the variety of ways that CCPs can be used within their states for beneficial use. The partnerships that have resulted from state participation have made the introduction of new CCP technology an element of the state's economic growth. Some technology being supported is rather unusual. For example, the State of Ohio has been supporting Energy Industries of Ohio, a small company in Cleveland, in their research for ways to reduce the weight of structural components in the automotive industry using cenospheres and off-specification fly ash. If successful, this may permit the reduction in metals needed for automobile chassis and frames in light trucks and sport utility vehicles. This, in turn, would lead to a reduction of vehicle weight and an increase in fuel economy as well as a new use for ash.

The C²P² program is expected to help increase the awareness of the academic community and the general public of the need for continuing research. Because of regulatory changes, there will be many new opportunities for improved or new technology to assist the coal ash industry. As is often the case, change may be the very impetus needed for new technology to emerge that will permit fly ash and other material to be able to be used in ways previously thought to be impractical.

The formation of partnerships can be one of the most effective ways to induce new technology or promotes specific applications. There are numerous examples where long term community and economic benefits can be derived from local partnerships with public agencies, CCP producers and marketers. The involvement of the EPA and FHWA with C²P² should help local and state government officials realize that CCP use can be environmentally sound and still meet the required performance and design needs for construction projects. Regional partnerships have been created where special issues unique or important to a geographic location can be addressed. The Midwest Coal Ash Association, in Ohio, brings together marketers, producers and Ohio State environmental regulators to discuss applications and uses of CCPs in the state. This communication enhances the understanding and use of CCPs, as they pertain specifically to issues within Ohio. Similarly, the Texas Coal Ash Utilization Group (TCAUG) meets periodically to discuss issues in Texas. However, issues in Ohio or Texas may not be unique making broader geographical relationships important. The Western Region Ash Group includes members from companies, universities and state agencies for the states west of the Mississippi River. This large region has a number of CCP issues that are applicable mainly to the dry, arid part of the US. Some of these issues are not found in the eastern United States. For example, groundwater and leachate questions for CCP use in the eastern US is significantly different than in the West where rainfall and snow melt is often 50% to 80% lower than in eastern and midwestern states.

Industrial partnerships have also been formed where historically joint cooperation was not as widespread. Ten years ago, the relationship between the ash and the cement industries was less collaborative than it is today. In the past, many cement producers felt that fly ash was a threat to their industry and pointedly avoided the ash industry. Today, many cement producers include fly ash and other CCPs in their menu of products in order to further the overall use of concrete in construction. The “green” movement in the United States and elsewhere has resulted in broader working relationships and active support of both industries by both sectors. Similarly, the ash industry is becoming more involved in associations that promote concrete use, including the Environmental Council of Concrete Organizations (ECCO), American Concrete Institute (ACI), American Concrete Paving Association (ACPA), Portland Cement Association (PCA) and National Ready Mix Concrete Association (NRMCA), to name a few.

As mentioned before, “The World of Coal Ash” will be held in Lexington, Kentucky. This event will combine the bi-annual American Coal Ash Association Symposium, the biannual University of Kentucky Symposium and will include the Department of Energy, the Office of Surface Mining, Federal Highway Administration and Process ORTECH (the FGD organization from Toronto, Canada) as sponsors of the single largest international CCP conference ever held in the US. North American and international participants will find a wide venue of subjects, ranging from sustainability, to science to applications pertaining to CCPs. Other associations and organization will be invited to co-locate their own workshops or meeting during the “World of Coal Ash” so that the combination of resources will offer attendees the broadest perspective.

C²P² strongly urges the formation of partnerships to identify actual or perceived barriers to ash utilization. It is not uncommon to find that the lack of information about coal ash and application techniques is the main reason ash is not considered for a project. By bringing together experts and organizations that have had positive experiences with coal ash use, others may learn of the value of the material. In turn, the results from these new relationships may result in projects and uses that will become case studies. They will, in turn be shared throughout the United States in ways that will further promote usage.

CONCLUSIONS

The C²P² program is an extremely important opportunity for the United States to promote environmental stewardship, while at the same time continuing to provide for the production of reliable energy from America’s extensive coal resources. It was only five years ago that there was a genuine concern that coal ash would be determined by the EPA to be a material requiring management under hazardous waste regulations. Fortunately, and based on more than two decades of research and performance data, the Agency affirmed that coal ash did not require handling as a RCRA Subtitle C hazardous waste. Individual companies and states have demonstrated a long track record of proper management and use, permitting the beneficial use of a large volume of material that otherwise might have to be disposed. The goal is to find further uses for material that is potentially affected by ongoing changes.

The United States CCP industry is in a constant state of change. CCP use is growing and new applications are being found for a variety of materials. On the other hand, there are challenges ahead for producers and end-users. Changes in fuel sources and the addition of air emission controls significantly impact CCP marketing and use. Plants that used to produce high quality ash may have their products removed from the marketplace because of new scrubbing systems or fuel blending. Environmental pressures make land filling a less desirable alternative than beneficial reuse. However, quality issues may force disposal rather than beneficial use. The development of partnerships with regulators, universities, producers, marketers and end-users has helped create new markets. Research continues to find ways to improve ash quality, while at the same time attempting to define the impact of future regulatory changes. Developing technically sound methods of using CCPs in such a changing environment may require the collective agreement of many parties. Sound technical, environmental and operational procedures are necessary to address perceptions and potential objections. Regulatory agencies must be assured that the end-use of altered CCPs is no different than previous uses.

Even though the specific cases may differ in location, quantities and end uses, properly managed applications using CCPs will achieve desired physical, environmental, economic and social results. The industry, working together with other stakeholders is continuing to address change and challenges in positive ways. The opportunity to conserve other materials, to recycle what some consider to be an industrial waste and to benefit from cost savings that can be realized in such uses is important to the United States and many other countries in the world. This is why supporting the Coal Combustion Products Partnership (C²P²) is important, not only to our current population but to future generations.