By-Products Consortium Awards New Projects

The Combustion By-products Recycling Consortium (CBRC), sponsored by DOE's Office of Fossil Energy through its National Energy Technology Laboratory (NETL), and managed by the West Virginia University Water Research Institute, has been carrying out important R&D projects to identify and examine the potential for new and expanded markets for coal combustion by-products (CCBs). Once viewed negatively, CCBs are now largely regarded as an untapped, recyclable resource with tremendous industrial market potential. Expansion of markets for CCBs will be critical as demand for coal-fired electrical power increases, with corresponding public objections to landfill disposal. Additionally, implementation of new Federal and State air regulations — such as the Clean Air Interstate Rule and the Clean Air Mercury Rule — produces a greater quantity of CCBs with varying characteristics, for which reuse markets must be found.

CCB Applications

Each year, the U.S. electric utility industry generates over 120 million tons of CCBs. Just over half of this amount is fly ash, which is removed from the boiler flue gas via particulate control devices such as electrostatic precipitators (ESPs) or fabric filters. Another quarter of CCBs are the heavier, coarser solids removed from the bottoms of the boilers — bottom ash for boiler slag. The remaining CCBs are flue gas desulfurization (FGD) by-products, most of which are calcium sulfates or calcium sulfites from wet FGD systems that are installed downstream of the particulate control devices. A small but growing percentage of FGD by-products come from dry FGD systems or fluidized bed combustion (FBC) systems that remove sulfur upstream of the particulate control devices. These CCBs are inseparable mixtures of fly ash, bottom ash, and calcium sulfates/sulfites.

Given their different points of origin within the power plant, each CCB has a unique set of physical and chemical properties determining its suitability for specific reuse applications. Finding the proper application requires a thorough knowledge of the CCB properties and the requirements of the potential end-use markets. CCBs must compete in the marketplace against other raw materials; even when reuse is technically feasible, economic factors such as transportation costs often preclude CCB recycling. CCBs that cannot be reused — more than 70 million tons a year in 2004 — must be disposed of in landfills or surface impoundments.

In 2004, approximately 40 percent of CCBs were reused for productive purposes — largely fly ash in Portland cement, and FGD gypsum for wallboard — and CBRC wants to raise that figure to 50% by 2010. To achieve its goals, CRBC will focus on increasing FGD by-product use, while continuing to study the environmental impacts of CUB use and disposal and working to expand the slate of CCB applications.

CBRC Projects

Since its start in 1998, CBRC has funded 42 projects, totaling over $8 million (nearly $4.1 million in Federal funds, and more than $4.4 million in non-Federal cost share). In February 2006, 10 new projects (see table) valued near $2 million were selected by CRBC's National Steering Committee from 52 proposals submitted. Criteria for selection include extent of environmental impacts, long-term economic benefits for producers and end-users, and contribution to CCB technology development. Industry is contributing $687,000 of the total for the current round of projects. Projects range from 1–3 year duration, with values from $40,000 to over $300,000. Among the projects selected are five concrete-related projects, two agricultural projects, one in situ treatment of acid mine drainage, one project on brick manufacturing, and one project on CCB marketing strategies. Awards will be made in yearly increments based upon performance and DOE funding availability.

These projects are expected to build on past successes of the CBRC. Small scale CBRC-sponsored tests for using CCBs in paving pricks, composite wall panels, and foundry sand molds have resulted in commercial projects. Other CBRC technologies, such as fly ash-based sorbents for mercury control from power plant flue gas, have been selected for large-scale field demonstrations. Specifically, CCBs have been used successfully as a structural fill for an airport runway extension, as a safe backfill for reclamation of abandoned mine sites, and as a feedstock for manufacture of products ranging from bricks to telephone poles. Fly ash has been used to replace foundry

sand, and FGD by-products have been employed in the manufacture of countertops, tiles, and other structural materials for the construction industry. Traditionally hard-to-use CCBs such as high-carbon fly ash have been used to fabricate a permeable roadway base material, while "off-spec" (less than wallboard-grade) FGD by-products can be used as soil supplements to boost soybean and alfalfa crop yields or formed into briquettes to help control beach erosion. (note: may be some overlap here) Additionally, technical information generated by CBRC projects has also been used to improve the knowledge base of state and federal agencies when developing police regarding placement of CCBs in mine, quarries, and structural fills.

For further information and the quarterly newsletter, Ashlines, see the CBRC Web site at http://wvwri.nrcce.wvu.edu/programs/cbrc

Title	Objectives	CBRC/ DOE-NETL Funding
Cold In-Place Recycling of Asphalt Pavements Using Self Cementing Fly Ash, Univ. of Missouri.	A demonstration of this fly ash pavement use was conducted in August 2004 on approximately 2.5 miles of low-traffic roadway. Researchers will build upon those results and establish the parameters for engineering design of rehabilitated road pavements with a fly ash-stabilized recycled asphalt base layer.	$24,987
Evaluation of the Durability and Commercial Potential of 100% Fly Ash Concrete, Montana State Univ.	Portland cement is the binder material in traditional concretes for construction applications. Although an excellent performer, Portland cement production is energy-intensive. Researchers will determine the long-term durability and possible economic benefits of using 100% fly ash concrete in construction applications.	$95,900
In Situ Stabilization of Gravel Roads with CCBs, Univ. of Wisconsin	Researchers will test the feasibility of using low-cost, rapid-application, self-cementing CCPs to stabilize deteriorating gravel roads which are estimated to be 1.6 million miles (53%) of all roads in the U.S.	$130,362
Using Class C Fly Ash to Mitigate Alkali-Silica Reactions in Concrete, Univ. of North Dakota	Researchers will evaluate the performance of several Class C fly ashes (>10% CaO) as a means to mitigate alkali-silica reactions (ASR) in concrete.	$150,000
New Technology-Based Approach to Advance Higher Volume Fly Ash Concrete with Acceptable Performance, Nat'l Ready Mixed Concrete Assoc.	Surveys indicate that the average fly ash content in all ready-mixed concrete is only about 10%. Researchers plan novel science-based approaches to address this low percentage by using high fly ash concentrations during warm weather applications for optimal strength gain and setting time.	$199,680
Manufacturing Building Products with Fly Ash and Advanced Coal Combustion, Illinois State Geological Survey	Researchers at the ISGS have been working with the brick industry to develop high-quality, marketable, fired bricks that use high volumes of Class F fly ash as a raw material. Researchers plan to demonstrate the use of CCBs in the production of high-quality fired bricks and innovative autoclaved aerated concrete (AAC) blocks.	$51,000
Field Testing of Arsenic and Mercury Bioavailability Model from Land-Applied CCBs, Tennessee Valley Authority	Researchers will investigate the environmental effects of CCB use, including the potential bioavailability of contaminants to soil organisms, plants, and possibly animals and humans.	$46,000
Community-based Social Marketing: The Tool to Get Target Audiences to Use CCBs, Univ. of Tennessee	Researchers plan to demonstrate the utility of community-based social marketing (CBSM) as a method for implementing sustainable agricultural uses of FGD-gypsum by farmers and develop a model that can be expanded and applied to other CCB markets.	$200,193
Evaluation of CCBs for *In Situ* Treatment of Acid Mine Drainage, CC Environmental, LLC.	Researchers will follow up the investigation of a 1994 alkaline injection technology (AIT) project in an abandoned coal mine in eastern Oklahoma, which has been studied for 11 years. Monitoring is necessary to fully evaluate the treatment effectiveness.	$26,940
National Network of Research and Demonstration Sites for Agricultural and Other Land Application Uses of FGC Products, The Ohio State Univ.	With many electric utilities in the process of bringing new scrubbers on line, the amount of FGD products to be generated in the future in the U.S. will be greatly increased. Researchers propose to establish a national network of sites for research/demonstration of beneficial agricultural and other land application uses of FGD products.	$222,682