PROJECT facts

U.S. DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

ENVIRONMENTAL WATER AND RESOURCES

06/2000

PRODUCING LIGHTWEIGHT AGGREGATE FROM COAL GASIFICATION SLAG

PRIMARY PROJECT PARTNER

Praxis Engineers, Inc.
Milpitas, CA

MAIN SITE

Praxis Engineers, Inc.
Milpitas, CA

TOTAL ESTIMATED COST

$828,093

COST SHARING

DOE	$621,070
Non-DOE	$207,023

Description

New coal gasification technologies such as Integrated Gasification Combined Cycle (IGCC) promise to generate electrical power at efficiencies 50% or more above today's power plants, while greatly reducing the air pollution created by acid gases such as sulfur and nitrogen oxides. Gasification can also be used to produce valuable chemical feedstocks from coal.

Gasification processes still produce a large volume of solid by-products, however. Even a relatively small 100-MW plant fired with a typical coal containing 10% ash would generate over 110 tons of slag per day. Large-scale use of coal gasification would create millions of tons of slag per year. Gasifier slag is significantly different from conventional coal fly ash, and may not be accepted in the markets that have been developed for present day coal combustion by-products.

The problem facing the industry is to develop efficient and economical ways to use gasifier slag. Utilization will conserve raw materials, avoid disposal costs, and create new revenues and business opportunities while protecting the environment.

Praxis Engineers, Inc. has developed a patented process for creating lightweight aggregate material from coal gasification slag. The process was developed with funding from the Electric Power Research Institute (EPRI) and Praxis Engineers, and demonstrated through a DOE project, cofunded by EPRI and the Illinois Clean Coal Institute.

Coal gasifier slag is a glassy, granular silicate-rich material produced when molten coal ash is quenched in water. Slag also contains up to 10% unburned carbon in the form of char. Praxis has demonstrated that slag can be used as an aggregate in cement and asphalt concrete, roofing materials, and other applications. Although slag can be used as is for many of these purposes, a simple, low-cost gravity separation of the char particles improves the product significantly.

Even higher value uses are possible with additional processing. Slag can be expanded by heating under controlled conditions to form a lightweight aggregate (LWA) material with a unit weight between 20 and 60 lb/ft^3. Controlled size aggregate can be manufactured by grinding and pelletizing the slag before expansion. Slag lightweight aggregate (SLA) can be used in lightweight concrete products such as roofing tiles and blocks. The lightest slag materials may also serve as an ultralightweight aggregate (ULWA) in insulating concrete. Conventional lightweight aggregates retail for $35 to $40/ton; ULWA retails for $150 to $250/ton.

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Producing Lightweight Aggregate from Coal Gasification Slag

Praxis has performed pilot-scale tests of the process, generating over 10 tons of LWA from slag and slag/clay blends. Gasifier slag can be expanded at temperatures up to 400°F lower than clays or perlite ore typically used to manufacture LWA, lowering costs significantly. Thorough testing indicates no adverse environmental effects associated with SLA products.

Description

The performance of products containing SLA compares favorably with those containing conventional LWA. Applications of SLA in lightweight block, roofing tile, lightweight structural concrete, loose fill insulation, and insulating concrete have been demonstrated. SLA can be used as a complete replacement of conventional aggregates in some applications and as a partial replacement in other products while still meeting industry specifications.

Goal

To ensure the most cost-efficient delivery of electrical power, the U.S. Department of Energy (DOE) is conducting research and development to improve coal combustion by-product (CCB) management. The research program emphasizes characterization and reuse of CCBs to help stimulate markets for new materials such as those produced under the DOE's Clean Coal Technology program. Over the next 5 to 10 years, the program's goals are to develop processes leading to a 100% increase in the current rate of FGD by-product use, a 10% increase in the national rate of overall CCB use, and a 25% increase in the number of CCB applications considered "allowable" under state regulations.

Benefits

- The use of slag will reduce any environmental effects of slag disposal, increase revenues to power producers, and help conserve competing raw materials such as expansive clays and perlite.
- SLA can be produced with lower energy inputs than conventional LWA and without any mining costs.

CONTACT POINTS

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PROJECT PARTNERS

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Milpitas, CA
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Fuller Company
Allentown, PA
(cofunding, pilot plant testing)

Silbrico, Inc.
Hodgkins, IL
(pilot plant testing)

Harvey Concrete Products
Harvey, IL
(block manufacture)

Electric Power Research Institute
Palo Alto, CA
(cofunding)

Illinois Clean Coal Institute
(cofunding)