



ENVIRONMENTAL & COAL TECHNOLOGY

PROJECT FACTS

UNIVERSITY OF KENTUCKY
CENTER FOR APPLIED ENERGY RESEARCH

PARTICIPANTS

UK Center for Applied
Energy Research
Charah Environmental, Inc.
Eastman Chemical Co
TECO, Inc.

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Environmentally Safe, Large Volume Utilization Applications for Coal Gasification By-Products

The use of coal gasification to produce power or chemicals and fuels will increase in the U.S., due to its inherent energy and environmental efficiencies. The rate of increase is unknown, but even with slow growth, the amount of solid by-products from these technologies will rise from hundreds of thousands to millions of tons per year within the next decade. If the objective of "zero emissions" from this technology is to be realized, the utilization and environmental safety of the solid by-products from gasification technologies in large volume applications must be addressed and developed early.

Our research entailed experiments that used hundreds of tons of materials in practical demonstrations. The research team included: Eastman Chemical and Tampa Electric Co. (TECO), which operate major gasification installations; Charah Environmental Inc., designers and operators of the first successful gasification ash beneficiation plant; and the UK CAER.

Extensive sampling and characterization of by-products produced from both gasifiers was completed to design the beneficiation facilities necessary to produce marketable products such as pozzolan and concrete aggregate.

Samples of gasification by-products produced at Polk Station and Eastman Chemical were obtained, characterized and prepared for utilization studies by screening at the appropriate size fractions where char and vitreous frit distinctly partitioned. Vitreous frit was concentrated in the +20 mesh fraction while char predominated in the -20+100 mesh fraction.

The vitreous frit component derived from each gasifier slag source was evaluated for use as a pozzolan and as an aggregate. Pozzolan testing required grinding the frit to very fine sizes, which required a minimum of 60 kwhr/ton. Fine-ground slag from both gasifiers showed pozzolanic activity in mortar cube testing and met the ASTM C618 strength requirements after only 3 days. Pozzolanic activity was further examined using British Standard 196-5. Neither aggregate showed significant potential for undergoing alkali-silica reactions when used as concrete aggregate with ASTM test method 1260.

Testing was conducted to evaluate the use of the frit product as a component of cement kiln feed. The clinker produced was comprised primarily of the desirable components Ca_3SiO_5 and Ca_2SiO_4 after raw ingredient proportions were adjusted to reduce the amount of free lime in the clinker. A mobile processing plant was designed to produce 100 tons of carbon from Eastman's slag to evaluate its use as recycle fuel. The plant was taken to the site. Two product stockpiles were generated; the frit stockpile contained 5% LOI, while the carbon stockpile contained 62% LOI. The products were used to conduct recycle fuel tests.

A processing plant was designed to separate the slag produced at Eastman into three products. The coarse frit is suitable for use as clinker feed for producing Portland cement. The intermediate-size is enriched in carbon (58-62% C) and may be used as recycle fuel in the gasifier or in a PC boiler. The fines product contains 30-40% C and may also be used as a recycle gasifier fuel, as is done at TECO's Polk Station. However, due to gasifier operating requirements for the production of syngas, this is not feasible at Eastman.