

# **Advanced Multi-Product Coal Utilization By-Product Processing Plant**

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## **ABSTRACT**

The objective of the project is to build a multi-product ash beneficiation plant at Kentucky Utilities 2,200-MW Ghent Generating Station, located in Carroll County, Kentucky. This part of the study includes an investigation of the secondary classification characteristics of the ash feedstock excavated from the lower ash pond at Ghent Station.

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## **EXECUTIVE SUMMARY**

The project area is located in Carroll County, Kentucky, approximately one mile northeast of Ghent, Kentucky. The lower ash pond is situated immediately adjacent to U.S. Highway 42 on the southwest corner of the Ghent power plant site. Disposal of ash into the 120-acre pond began when the Ghent power plant became operational in 1973 and continued over a period of 20 years until the upper ash pond became operational in 1993.

A mobile demonstration plant with a feed rate of 2.5 tph was constructed and operated at the Ghent site. The plant was used to evaluate four different flowsheet configurations for beneficiation the stored ash at Ghent Station as well as to generate several tons each of various processed ash products. The processed ash products were used for performance evaluations in mortar and concrete, as well as process addition in the manufacture of cement clinker. The field work was completed in the second quarter of this calendar year.

Technical activities during the quarter focused on the assessment of dryer types and dryer costs for the project. A market assessment of the products of the project was conducted by Cemex/MRT. This study, still in draft, concluded that the local market conditions did not justify the risks associated with developing and commercializing a new technology, and they recommended that Cemex not participate in Phase 2 of the project.

## **INTRODUCTION**

This project will complete the final design and construction of an ash beneficiation plant that will produce a variety of high quality products including pozzolan, mineral filler, fill sand, and carbon. All of the products from the plant are expected to have value and be marketable. The ash beneficiation process uses a combination of hydraulic classification, spiral concentration and separation, and froth flotation. The advanced coal ash beneficiation processing plant will be built at Kentucky Utility's 2,200 MW Ghent Power Plant in Carrollton, Kentucky. The technology was developed at the University of Kentucky Center for Applied Energy Research (CAER) and is being commercialized by CEMEX Inc. with support from LG&E Energy, Inc., the UK CAER, and the U.S.DoE.

This technical report includes research that was conducted during the third quarter of 2006, which was essentially limited to dryer fuel consideration since field testing was completed during the second quarter. In addition, efforts were expended to secure a new partner for Phase 2 of the project.

## **FIELD DEMONSTRATION TESTING**

### **Dryer Fuel Considerations**

As reported previously, the recommendation of technical representatives from Louisville Dryer Co., Louisville, KY was that the most appropriate thermal drying approach for the UFA product would be indirect drying. This recommendation was based primarily upon the consideration that since the UFA product is so fine ( $d_{50}$  of 3-6  $\mu\text{m}$ ), an entrained flow dryer would require a significant particulate capture system. The recommendation was made for a rotary steam tube dryer using an auxiliary source of heat for steam generation. Using this indirect drying method would be more thermally efficient while minimizing the amount of air passing through the system to significantly simplify the particulate removal system.

Using an entrained flow dryer, fuel sources would be limited to fuels that would not contribute residual carbon to the dried product such as natural gas, liquefied natural gas (LNG), and possibly fuel oil. Using an indirect drier that utilizes steam produced from an external heat source offers the flexibility of using coal and unburned fly ash derived carbon as a fuel source as well.

A comparison of fuel costs is summarized in Table 1. Unit fuel costs were derived from information available from EIA and the comparison of quantities required were calculated based on a 30% moisture filter cake dryer feed and used the thermodynamic consideration that 1100 Btu/lbm are required to evaporate 1 lb of water. As shown in Table 1, drying costs using natural gas at a price of 6 \$/MMBtu were 6.86 \$/ton of dry product while costs for LNG and fuel oil were considerably higher. Fuel cost using coal, even with a price of 65 \$/ton was substantially lower at 2.37 \$/ton of dry product.

An additional benefit of using coal is that unburned can be used as supplemental dryer fuel. To evaluate this scenario, the amount of recovered coarse carbon that would

be available was determined from pilot-scale testing (53 lbs of carbon per ton of UFA product), although drill core results showed that the amount of coarse carbon would be much higher over much of the pond. Nevertheless, as shown in Table 2, the carbon was assumed to contain 40% carbon (dry basis) and dewatered to 30% moisture, values that were again, determined from field testing. The carbon heating value was 5826 Btu/lb (dry basis) of which 2078 Btu/lb would be consumed to evaporate the moisture in the carbon product, leaving a net heating value of 3748 Btu/lb, or 23% of the total heat required in the dryer.

<b>Table 1. Dryer Fuel Comparison</b>				
Fuel Type	Quality	Unit Cost	\$/MM Btu	\$/ton Dry Product
Natural Gas	1000 Btu/ft <sup>3</sup>	6 \$/MMBtu	6.00	6.86
LNG	95,475 Btu/gal	1.10 \$/gal	11.52	10.08
#2 Fuel Oil	135,000 Btu/gal	2 \$/gal	14.80	12.96
Coal	12,000 Btu/lb	65 \$/ton	2.71	2.37
Coal	12,000 Btu/lb	65 \$/ton coal	2.09	1.83
Coarse Carbon	40% Carbon	0 \$/ton carbon		

<b>Table 2. Coarse Carbon Fuel Characteristics</b>	
Carbon Content, dry basis	40.0 %
Heating Value, dry basis	5826 Btu/lb
Moisture Content, wt %	30%
Net Heating Value, as received	3748 Btu/lb

## **Phase 2 Proposal**

As part of the Phase I effort Cemex was to conduct a market assessment of the products of the project. The activity was conducted by Cemex/MRT who would be responsible for marketing the products of the project.

At the end of the period, the project manager for Cemex, Andrew Jackura, informed us that they had chosen not to participate in the second phase of the project based upon the recommendations of Cemex/MRT who concluded that the local market conditions did not justify, in their opinion, the risks associated with developing and introducing a new technology. As of this writing the market assessment was still in draft and will be included in the next technical report.

Efforts will be initiated to enlist another partner for the project in the next quarter.