CARBON BURN-OUT
at the
WATEREE STATION
of
SOUTH CAROLINA ELECTRIC & GAS

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Summary

The problem of unburned carbon in Class F fly ash has plagued both electric utilities and concrete producers for as long as there has been ash particulate collection. However, as interest in this conference amply demonstrates, the unburned carbon problem is growing both in severity at specific sources and frequency of occurrence. Excessive levels of unburned carbon at many Class F sources preclude those sources from adequately supplying the concrete industry with high-quality pozzolan. Absent this high-value market, the economics of fly ash management for a high-carbon source are unattractive at best.

However, an efficient and economical technology called ***Carbon Burn-Out*** has been developed to reverse this decline in fly ash quality. Close-coupled to an existing power plant, Carbon Burn-Out might be thought of as an 'afterburner' on the power plant. Receiving fly ash from the PC boilers at whatever LOI the boilers happen to be producing, Carbon Burn-Out produces a consistently low-carbon fly ash that fully meets the concrete markets' stringent requirements. Fly ash from Carbon Burn-Out is a high-quality product, and not a 'run-of-plant' byproduct.

Carbon Burn-Out's first commercial application is at South Carolina Electric & Gas' Wateree Station. Design and construction of this Carbon Burn-Out facility is nearly complete and start-up will begin in

late June. This paper reports on the rationale for fly ash beneficiation at Wateree, design features of the Carbon Burn-Out facility, and the way in which Carbon Burn-Out operations and heat recovery are integrated into existing Wateree operations.

Carbon Burn-Out is essentially an improvement on bubbling fluid bed technology. The primary advance has been in the ability to provide the large volume of air required for efficient combustion of the unburned carbon without entraining excessive amounts of ash in the resultant flue gas. Having avoided excessive ash entrainment, Carbon Burn-Out's fluid bed provides nearly ideal combustion conditions for the unburned carbon in ash: long residence time, sufficient oxygen for nearly complete combustion, and temperatures appropriate for efficient combustion but significantly below those at which either NOx formation or changes to the ash structure becomes a concern.

Carbon Burn-Out operates using the unburned carbon in the ash as the sole fuel for the process. Carbon Burn-Out is designed to operate continuously, on the same schedule as the power plant. Following typical boiler operations, start-up fuel is used to bring the ash in the fluid bed up to auto-ignition temperature for the carbon. As that carbon begins to combust, and temperature in the bed continues to increase, the start-up fuel is reduced and then eliminated. A controlled and measured feed of high-carbon ash is then initiated and continued. The Carbon Burn-Out process does not require supplemental fuel for any unburned carbon content above 5.7%.

The primary control parameter is the carbon content of the product ash. Carbon Burn-Out readily produces a product ash at 2% carbon content. The process is designed to combust a fixed amount of carbon per unit of time. The incoming carbon content at Wateree will be quite variable, as is true with most ash sources. The control system will automatically adjust the high-carbon ash feed rate to provide a constant rate of carbon entering the fluid bed.

All of the above described process features and control logic have been extensively developed, tested, and proven at the EPRI-sponsored Carbon Burn-Out pilot plant located in Tampa, FL. This one ton per hour facility has been invaluable is developing appropriate design criteria for large-scale facilities.

As with most other power plants firing Eastern U.S. bituminous coal, those throughout the Carolinas have experienced a deterioration in fly ash quality correlated closely to low-NOx power plant modifications. As several papers in this conference have described, a common side effect of NOx reduction is an increase in unburned carbon. This pervasive problem with fly ash comes simultaneously with a booming construction market demanding a consistently high-quality product. South Carolina Electric & Gas was not satisfied to sit on the sidelines of this market, and also return to disposal as its ash management practice. Extensive technical and economic evaluations were undertaken to select the most appropriate ash beneficiation technology for the Carolina market.

Carbon Burn-Out was selected, and design of *'Carbon Burn-Out -- Wateree'* begun in May 1997. Progress Materials Inc. is providing the facility on a turnkey (design-procure-construct-train-startup) basis. South Carolina Electric & Gas is the owner and the operator.

Maximizing product ash sales revenue is vital for economic success. Southeastern Fly Ash Co., Inc. was chosen as the ash marketer based on reputation within the industry and solid relationships with all the

regional concrete producers. Carbon Burn-Out fly ash is being offered to these producers as a premium product, after years of viewing fly ash as a marginal-quality byproduct. A significant marketing effort to achieve this shift in attitude began early in 1998.

The concrete market demands consistency of supply, in addition to consistency of quality. To provide a year-round supply of high-quality fly ash, Carbon Burn-Out Wateree includes a 14,000 ton product ash storage dome plus a 24 hr dual-scales truck load-out. The concrete producers will then view Wateree fly ash in much the same way they view Portland cement: a high-quality concrete ingredient available every day of the year.

Heat recovery is a very important benefit provided by Carbon Burn-Out. At Wateree, the liberated heat from combustion of unburned carbon is recovered in a heat exchanger, which is an integral part of the Carbon Burn-Out plant. Heat is transferred from both the product ash and from the flue gas to water from the power plant's existing condensate system. This method of heat recovery reduces the extraction steam flow to the low-pressure feed water heaters, thereby increasing the amount of steam available to the turbine-generator. Recovered heat and flue gas from Carbon Burn-Out can be sent to either of the two Wateree boilers. This enables ash beneficiation to continue during plant outages.

The Carbon Burn-Out control system is designed for automatic operation with operator monitoring and manual over-ride capabilities. Controls are carefully designed to avoid situations that might adversely affect power plant operations. Controls will be located adjacent to the fluid bed combustor, in the product load-out scale house, and in Wateree's existing Control Room.

A significant amount of time was spent at Wateree locating the various Carbon Burn-Out plant components for maximum efficiency and minimal operating expense. To minimize the length of heat-recovery ducting and piping, the Carbon Burn-Out combustor, heat exchanger, and particulate control systems have been located within one hundred feet of the two existing boilers. The product ash storage and load-out facility is located six hundred feet from the power plant and is reached from a new access road that avoids power plant traffic patterns.

Carbon Burn-Out provides South Carolina Electric & Gas with the ability to economically produce a high-quality, high-value pozzolan, avoid disposal of ash with excessive levels of unburned carbon, and fully recover the heat contained in that unburned carbon.