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"Real Time Carbon in Ash for Optimized Control"

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Paper Summary

Due in large part to the low NOx burner modifications required to comply with the CAA, the levels of carbon in Combustion Byproducts at most power plants have increased. The resultant loss in potential energy of this fuel has resulted in increased costs to generate power due to the greater quantity of fuel required to generate the equivalent amount of heat energy. The measurement for this is referred to as Heat Rate. The carbon content also has an effect on the marketability of the ash. Increasing carbon content reduces the value of the flyash byproduct to the point where resale may not be possible. The heat energy and ash sale revenue loss, coupled with the additional strain on ash storage facilities, has resulted in the need to find ways to reverse this negative economic trend for power generating companies. ABB Automation has released for sale, and is currently gaining experience with, an instrument that provides a real time measurement of the carbon content in fly ash (CIA). This instrument enables users to measure real time CIA generation and make operational improvements to recover plant economics.

As with any process measurement, the accuracy of CIA measurement is critical if it is to be used for other than simple indication. In order to accurately measure carbon in ash, a sample of the ash that is truly representative of the homogeneous mixture of ash exiting the furnace must be analyzed. Due to the variations in velocities inherent in exit gas ducts, either point sampling or hopper extraction methods of sampling introduce significant error unless extraordinary means are used to obtain the sample. If the difficulties in obtaining a representative ash sample were not onerous enough, the results of that analysis must be made available real time. Only with accurate information available in real time, can the combustion process be influenced in a manner that results in real CIA control.

The ABB CIA instrument meets both goals for sample accuracy and measurement update time by utilizing a patented method of carbon measurement. The ABB instrument utilizes microwave technology to transmit a signal across the unit backpass. This method permits in situ measurement of the carbon without the need for any type of sample extraction equipment or probe location testing.

The ABB instrument is of robust design. Instrumentation located at the backpass of a furnace must be simple with a minimum of moving parts. The ABB CIA instrument complies with this requirement, as demonstrated by over one year of uninterrupted service at our longest-term installation, with only a requirement for annual maintenance.

Measuring CIA is, however, really only a piece of the CIA control puzzle. Once the CIA status is made available, there must be a means whereby this new process variable is incorporated into continuous control strategies and combustion diagnostics. Data is just now becoming available that indicates that CIA is, indeed, a very good measure of the combustion process. Via traditional control or advanced control techniques, CIA generation can be controlled, when it is measured real time. Additionally, with the proper signal analysis methods, mis-operation of the fuel / air delivery and firing systems that would otherwise be detected only through expensive plant testing can be diagnosed quickly, without effecting unit operation. Analysis is possible either locally or remotely utilizing normal plant operating data.