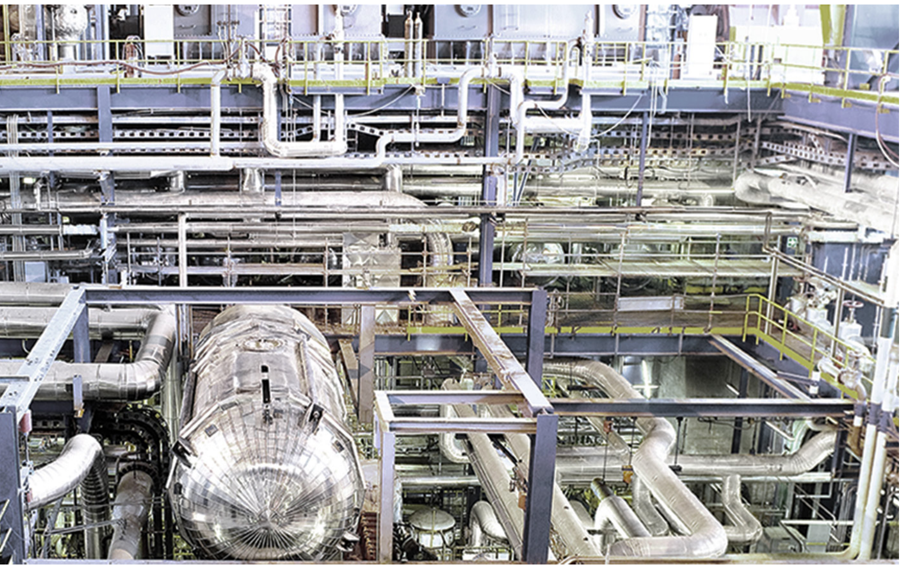
ABB MEASUREMENT & ANALYTICS | APPLICATION NOTE

Analytical measurement

AZ40 O_2 and COe analyzer in coal-fired power plant



Accurate combustion gas measurement in coal-fired power plant applications.

Measurement made easy

Coal-fired power plant

Introduction

The need for carbon monoxide equivalent (COe) monitoring in coal-fired power plants is increasing dramatically. A shift towards heat rate efficiency is occurring within the coal-fired boiler community. Increased competitiveness in electricity rates combined with indications of future limits expected by the EPA are driving the need to actively measure COe in order to improve combustion efficiency and minimize CO.

The localized concentration of COe present in the boiler directly relates to heat rate / efficiency, total fuel consumption, LOI, localized slagging and fouling. By effectively measuring COe and O_2, plant engineers and operators can ensure optimal combustion that results in reduced fuel costs, reduced maintenance and reduction of NOx.

The impact of optimized combustion on plant economics is quite substantial. Improvement in BTU output per kWh (heat rate) is directly linked to a reduction in fuel costs. Some utilities have seen dramatic savings ranging from 60,000 to 2,000,000 USD per unit annually by optimizing their combustion process.

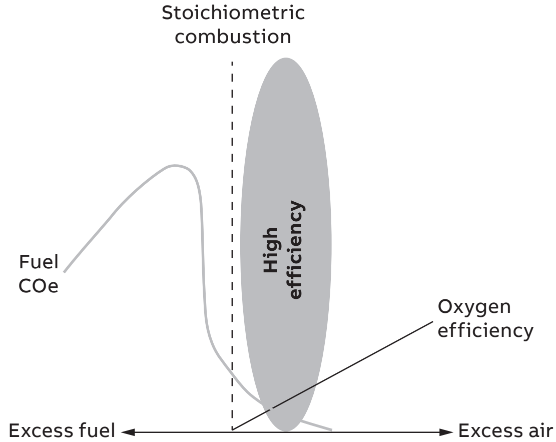


Figure 1 Combustion efficiency

The challenge

One of the common problems that create opportunities for improvement is insufficient combustion air in the furnace. Most large utility boilers use oxygen analyzers installed at the boiler economizer exit gas ducts. Because of the age of the boilers and the reduced frequency of overhauls, many boilers have significant air in-leakage between the furnace exit and the oxygen analyzers. Any air that seeps into the furnace post-combustion does not take part in combustion, yet it registers on the oxygen analyzers as 'excess oxygen'.

CO events (areas of poor combustion) are most often localized and occur in pockets throughout the boiler. The best way to identify the cause of these pockets is by developing a spatial grid across the unit.

As indicated in Figure 2, the furnace produces discrete process zones of flue gas created by the stream pattern. A combustion stream remains intact and separate from other combustion streams as a result of being compressed by the walls of the furnace and by adjacent combustion streams. Some diffusion (mixing) between streams may occur in slow-moving regions, but overall, their high velocity keeps the combustion streams intact. Evaluating the combustion gas composition from each burner offers the only way to optimize overall combustion conditions.

All of these factors contribute to produce a non-uniform combustion pattern throughout the boiler.

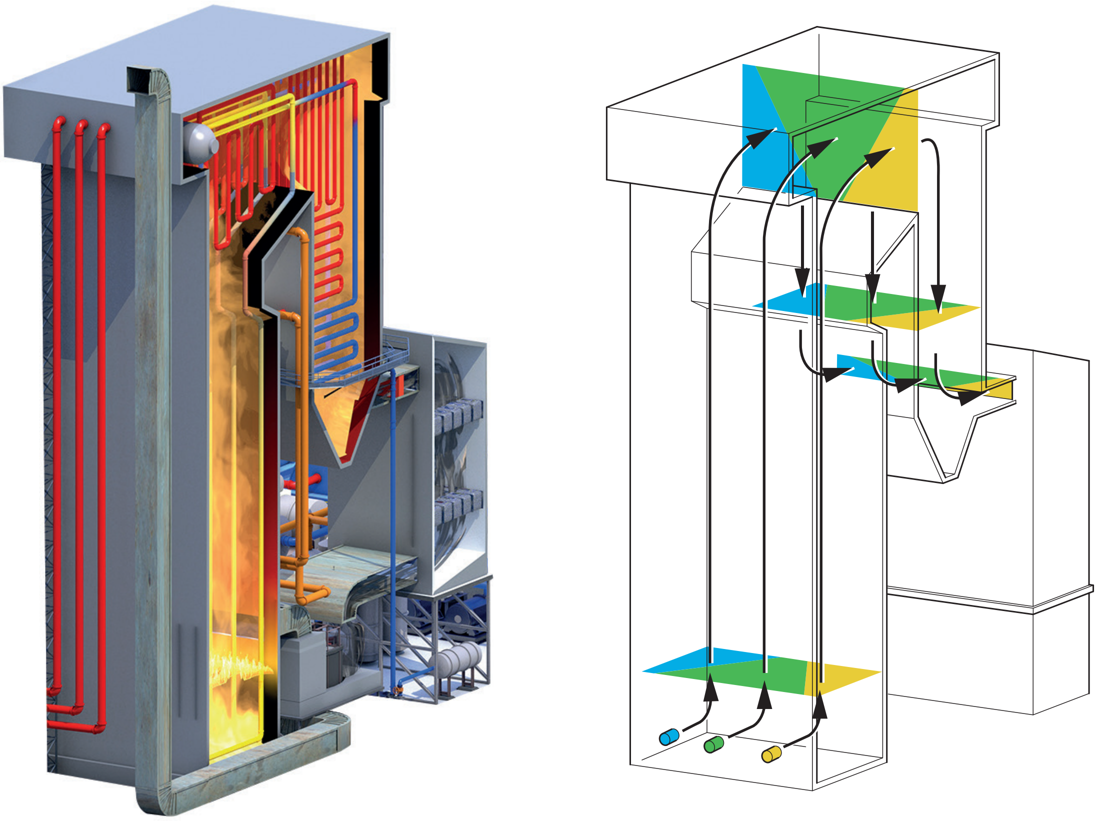


Figure 2 Example of multiple flue gas streams

The solution

Combustion optimization firms incorporate the AZ40 as the centerpiece in a robust and effective combustion optimization solution.

Different strategies are implemented to model boiler inefficiency. These strategies promote the idea of correctly targeted partial grids that identify pockets of high CO and excess air.

By pinpointing the location of poor combustion, the operator can home in on the problematic asset that is leading to the inefficiency and can better utilize the O_2 measurement in order to fine tune the burners to further optimize combustion. Adequately monitoring these area of poor combustion requires a matrix of probes horizontally (sometimes vertically) protruding at different lengths into the furnace (usually from both sides). The object is to extract flue gas samples from multiple points with multiple AZ40 analyzers.

The AZ40 is selected for use in these optimization solution implementations due to its superior accuracy, advanced features and reduced maintenance.

Figure 3 AZ40 probe and transmitter

The AZ40 provides a competitive advantage over other available extractive technologies due to the following:

- **AZ40 has best-in-class accuracy:**
  At ±20 ppm, the AZ40 provides the required resolution to measure the CO present in small pockets that typically represent 150 to 200 ppm concentrations.
- **AZ40 addresses typical extractive plugging issues:**
  AZ40 utilizes a sample flow uni-block that ensures the sample is heated in excess of 204 °C (400 °F) to reduce dew-point plugging. It also features an advanced programmable blowback option that assists in reducing plugging of the probe filter assembly due to particulate accumulation.
- **AZ40 requires minimal maintenance:**
  The AZ40 utilizes orifices to maintain a sample flow rate over extended operating conditions (degraded). Thus calibration is not required over periods of months. These orifices are accessed easily for replacement or cleaning and with the primary and secondary filters many last a year or more. This, coupled with periodic cleaning of the aspirator (which is also easily accessed and cleaned), is the only required routine maintenance.

A robust combustion optimization strategy in conjunction with the ABB AZ40 combustion gas analyzer enables significantly improved combustion. Benefits have been proven to include reduction in LOI, reduction in localized fouling, reduction in boiler excess O_2 and COe (leading to reductions in NOx emissions), improved efficiency, and improved heat rate.

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