ZoloBOSS and Parametric Tuning

TECHNICAL NOTE

Problem

From combustion tuners and consultants to performance engineers and control room operators, ensuring optimum boiler operation is a key to success. Many tools are available, but until now, none of them provided real-time combustion information. Both O_2 probes in the back-pass and continuous emission monitoring systems (CEMS) on the stack average total combustion outputs and give no indication of specific combustion problem areas. High velocity thermocouple (HVT) probes and extractive gas sampling are limited to a one-time campaign basis and the data begins aging as soon as the campaign is complete. Furthermore, extractive gas sampling in the combustion zone is inherently inaccurate as the chemical reactions, such as $O_2 + 2\,CO \rightarrow 2\,CO_2$, are too fast to be quenched by the probe. The limited nature of these measurements means boiler tuners have to guess at the effect of boiler changes, or iteratively try many changes to achieve a desired result.

Solution

The Zolo*BOSS™* provides real-time, spatially accurate information for the combustion zone and convective pass of the boiler. This information provides feedback to boiler tuners regarding the effect of changes made to boiler inputs. Boiler tuners make overall changes as well as asymmetric changes to boiler inputs with the goal of understanding the magnitude and direction of the change on the boiler. The Zolo*BOSS* gives them these answers in real-time.

Case Study: Parametric Testing at Jim Bridger Plant, PacifiCorp, Rock Springs, Wyoming.

Performance Consulting Services (PCS) of Montrose, Colorado completed a study at the Jim Bridger plant using the Zolo*BOSS* to document changes in the boiler. NO_x emissions and slagging are two primary concerns for this 578 MW T-fired boiler. The study focused on understanding the effects of various boiler parameters on combustion, in particular fireball position and furnace exit gas temperature (FEGT).

JIM BRIDGER STATION DATA

Boiler Manufacturer	Alstom
Burner Configuration	Tangentially Fired
Capacity	578 MW
Coal Type	Mine Mouth

figure 1a. O_2 plot, -20° tilts

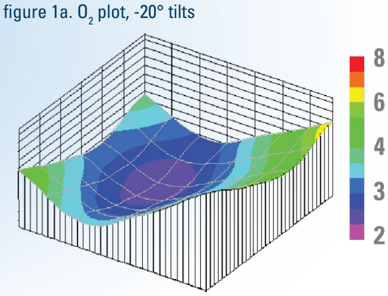
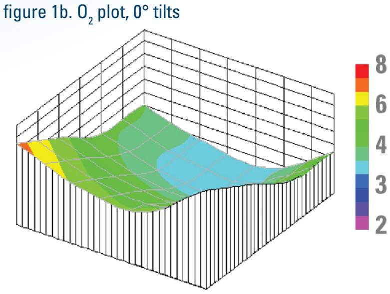


figure 1b. O_2 plot, 0° tilts



ADJUSTING BURNER TILTS

O_2 at the HSOFA with all burner tilts at 20° (top) and all burners at 0° (bottom). The fireball shifted to the rear of the boiler and average O_2 increased .

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figure 2a. O_2 plot, negative tilts

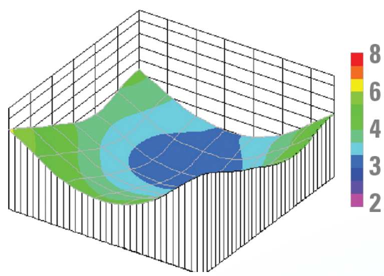
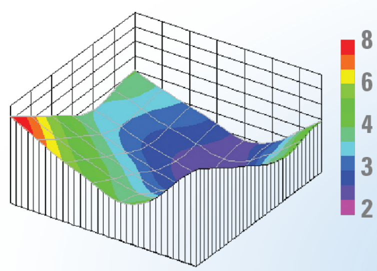


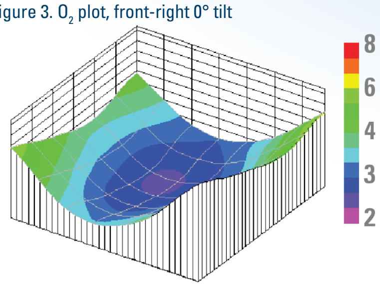
figure 2b. O_2 plot, front-left 0° tilt



MOVING THE FIREBALL

All tilts negative (top). After the left and front corners moved to 0° tilt (bottom), the fireball moves toward the furnace center.

figure 3. O_2 plot, front-right 0° tilt



CENTERING THE FIREBALL

Returning the front left corner to 0° and moving front-right tilts to 0° centers combustion without effecting average temperature.

High and low separated over-fire air (HSOFA and LSOFA) tilts were adjusted to discover the effect on temperature, O_2, and CO. A baseline test was performed with HSOFA at -20° and LSOFA at -10°. Figure 1a shows O_2 just above the HSOFA as measured by the Zolo*BOSS*. With both SOFA tilts raised to 0° the O_2 distribution changes dramatically as shown in figure 1b. The fireball has shifted to the rear of the boiler and average O_2 is increased. In addition, average temperature measured by the Zolo*BOSS* on this plane increased from 2519 °F to 2573 °F.

PCS also made asymmetric changes to discover their impact on combustion. Figure 2a depicts O_2 distribution with all tilts negative. The fireball is centered left to right and slightly nearer to the back wall. In figure 2b the L/HSOFA tilts in front-left corner were moved to 0° and the fireball moved to the back of the furnace. Here, O_2 levels have dropped below 2% and low O_2 concentration reduces the ash fusion temperature and results in increased slagging. Figure 3 shows front-left tilts returned to normal, and front-right tilts moved to 0°. This setting results in a more centered fireball even when compared to the nominally symmetric tilt settings, which, in turn results in reduced slag. While the average temperature in all three cases remains nearly constant, fireball position and distribution changes with every adjustment and the Zolo*BOSS* displays the change in real-time.

Benefits

A well-centered fireball provides better thermal transfer and less slagging from low O_2. These examples provide just two individual combustion tests that a boiler tuner can complete quickly and accurately. With enough characterization, made possible by the rapid feedback the Zolo*BOSS* provides, the boiler tuner can provide control room operators with guidelines that enable them to maintain optimum performance even as conditions change.

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