Real Time Combustion Controller (RTCC)

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Principle and Description

The RTCC is a patented system for controlling the air to fuel ratio of a combustor*. The technology is based on the systematic variation of molecular signatures as the stoichiometry (air/fuel) changes. In practice, the RTCC system (Fig. 1) consists of a sensor, a computer, and facility interface modules.

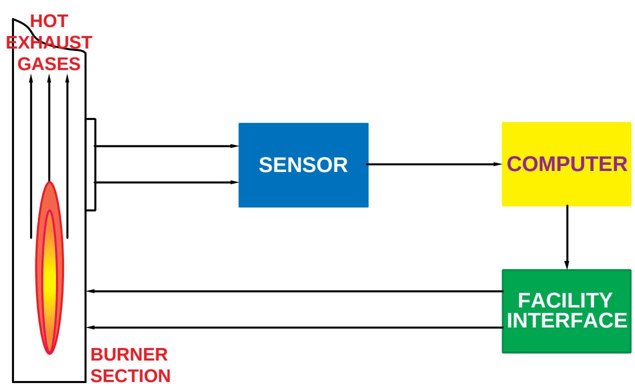

Figure 1. RTCC system schematic.

Advantages

Close control of combustion operations is often required for assuring environmental compliance and for maintaining efficient process economics. Anticipated future regulatory efforts and increases in fuel costs are expected to translate into the need for better burner control, and the RTCC can achieve this objective now.

Measurements for determining the combustion efficiency have relied on extracting a gas sample at the stack and analyzing for CO_2, CO, and O_2.

Problems with these measurements include the long residence times that may be encountered between the source and the stack, air leakage into the facility (correction factors), and the need to sample, condition, and route the gas to as many as three different instruments. QA/QC must be maintained for each instrument, and extensive calibrations may be needed.

Calibration/System Operation

The RTCC is a non-intrusive system capable of measuring the combustion efficiency in as fast as 100 ms. Calibration is accomplished on-line by stepping the air and/or fuel flows over the user-specified stoichiometry range. The operator then enters a stoichiometry value, and the RTCC will change the input flows to achieve the set point. The RTCC contains only one moving part.

Past Performance

Results from experiments on the DIAL 500 kW fuel-oil-fired combustion test stand are shown in Figure 2. Only the fuel oil input to the burner was controlled. Initially the stoichiometry, ϕ, was around one (equivalency) and then set to 0.85, which was maintained until a new set point of 1.0 (Fig. 3) was entered. The time needed for the controller to adapt to the new ϕ values was about 6 seconds. Fluctuations in the ϕ values arise from changes in the air to the combustor, and further control of the air would result in additional stability over that already obtained. Inspection of the data reveals that the RTCC accounts for these minor changes by increasing or decreasing the fuel flow accordingly.

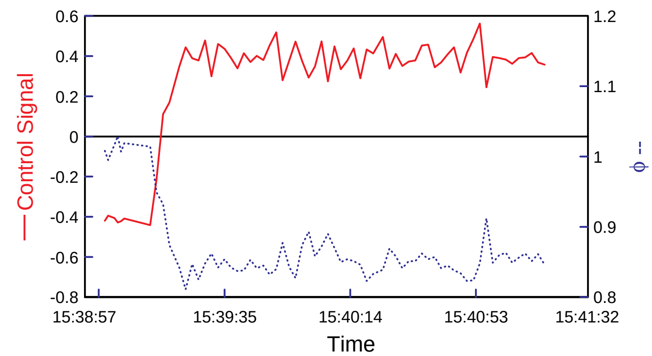

Figure 2. Control from ϕ = 1.0 to ϕ = 0.85.

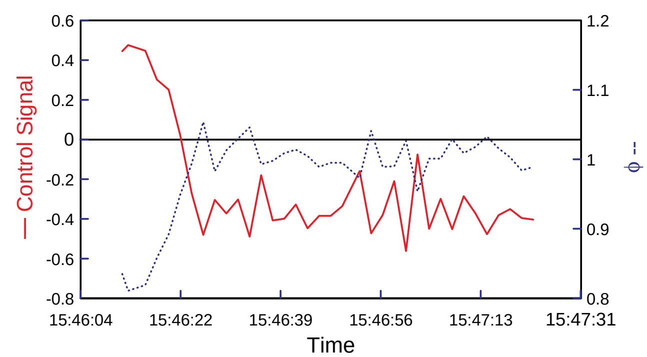

Figure 3. Control from ϕ = 0.82 to ϕ = 1.0.

Applications

The RTCC is expected to be of value for many different fuels including natural gas, fuel oils, and coal. The effect of any particles resident in the process is accounted for from first principles and changes in fuel BTU content, which may alter the control curve, are made insignificant by the rapid, non intrusive, on-line calibration method. The system will have application to chemical, electric power generation, industrial heating, glass making, and environmental processes.

*Lindner, J.S.; Shepard, W.S.; Etheridge, J.A.; Jang, Ping-Rey and Gresham, L.L. *Real Time Combustion Controller.* U.S. Patent No. 5,599,179, February 4, 1997.

Availability

The RTCC is available for licensing. For further information, you may contact:

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