Optimising combustion with multipoint gas analysis

Supporting the technical and economical aspects of feasibility and implementation
Faster combustion optimisation by shortening test times using a multipoint analyser

Benefits

Operators of coal-fired boilers can face challenges in optimising the performance of their plant. Traditionally, tuning air flows to optimise combustion involved several test-then-adjust cycles, with each test taking around two hours. While such a process can be a slow and time consuming – less-than-optimum flows can reduce combustion efficiency, increase fuel consumption and carbon-in-ash levels, and lead to plant damage.

Solutions

hrl: conducts comprehensive combustion optimisation tests that take less than 15 minutes, rather than traditional sampling methods that can take two hours. The innovative approach uses a multipoint oxygen, carbon-monoxide and nitrous-oxide analyser.

The Multipoint Combustion Diagnostic Analyser (MCDA), designed for tuning air flows into a boiler to optimise combustion, measures the levels of each of the three gases, simultaneously, at 12 points. In combination with the four input-valving system, a total of 48 points can be surveyed in less than 15 minutes. The data-acquisition and analysis software displays concentration profiles (contour plots) of each of the three gases – giving the test engineer a fast overview of the results of the pre-test adjustments to the burner air registers, over-fire air dampers, or ammonia/urea injection system.

hrl: engineers have used a Multipoint Combustion Diagnostic Analyser to:

- identify non-uniform combustion and gas gradients that are the result of poor air-to-coal flow distribution to the burner zone
- diagnose non-uniform over fire air flow distribution, penetration and mixing
- locate and characterise regions of furnace air in-leakage and tramp air
- adjust secondary air to optimise low NOx burners
- determine air leakage levels across air heaters and air in-leakage into the gas pass in air heaters
- determine the best location for station oxygen sensors.

MCDA equipment in use determining combustion gas concentration profiles at a power station

hrl: engineers can use pulverised-fuel flow-measurement equipment, in conjunction with a Multipoint Combustion Diagnostic Analyser, to assist in manual coal-flow balancing to optimise combustion and plant performance.

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Case Study

Optimising burner performance within a power station

The operators of a coal-fired power station installed new low-NOx burners in their plant. As the distribution of fuel to each burner could not be modified, the secondary air needed to be adjusted to optimise combustion.

hrl: used a Multipoint Combustion Diagnostic Analyser (MCDA) to provide the burner manufacturers' engineers with quick results (furnace exit gas concentration contour plots within 15 minutes) achieved from their changes to secondary air distribution. The engineers could identify the problem burners from plots of oxygen, carbon monoxide and nitrous-oxide levels quickly, and make the required adjustments.

The burners were tuned to optimise combustion by balancing nitrous-oxide and carbon monoxide levels with the carbon content of the flyash – all within the time frame specified by the power station owners.

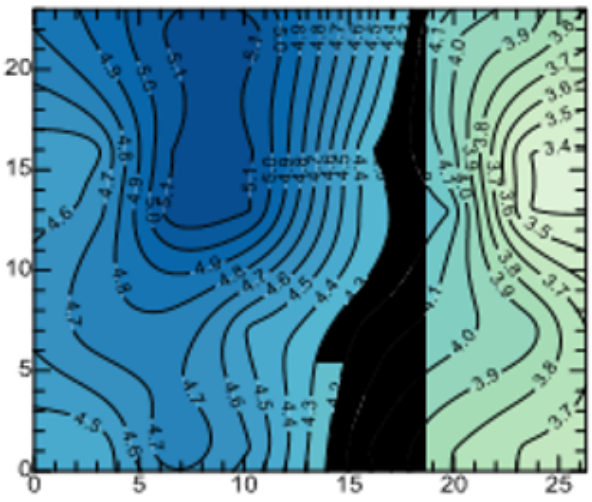
Benefits

By reducing the time taken to complete a survey of the economiser exit from two hours to 15 minutes, a Multipoint Combustion Diagnostic Analyser allows more tuning / test cycles per day than can be achieved with traditional sampling methods.

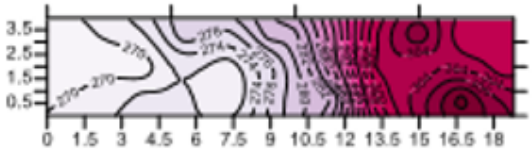
Optimising the combustion gas concentration in coal-fired boilers provides benefits that include:

- increased combustion and boiler efficiency
- reduced fuel consumption
- reduced carbon-in-ash levels
- reduced excess air and flue-gas velocity
- improved furnace temperature and heat-load distribution
- reduced nitrogen-oxide and carbon-dioxide emissions
- improved flame stability through tuned low-nitrous-oxide burners
- reduced risk of excess temperatures due to late combustion
- reduced risk of slagging due to furnace atmosphere conditions
- reduced risk of local oxygen deficient zones and associated corrosion and fouling

Economiser exit grid, contour plot showing Oxygen concentration (%)



Contour plot showing NOx concentration across a duct



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The company's NATA Accredited Laboratories number is 561.

HRL Technology Group's ISO 9001 Quality Management is certified by BSI under certificate FS605116

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