

# Fire for the future

A new all-British sensing and control system is saving fuel and improving efficiency in boilers and combustion systems. Dr Tom Shelley reports

It is now possible to improve the efficiency of steam raising boiler systems by 10% and there are cases where fuel bills have been cut by 30%, using technology developed by London-based Autoflame. What's more, although developed for industrial boilers, it could be harnessed for steam railway locomotives and other plant.

Autoflame has just won another Queen's Award for Innovation, this time for its Mark 6 Evolution burner management system with level control. Managing director Brendan Kemp explains the challenge: "When there is a demand for more steam, pressure in a boiler decreases, leading to superheated steam bubbles that cause the water level to rise. In a simple system, this turns off the water feed, leading to insufficient water in the boiler and spurious shut-down. Our system instead raises the set level of the water and fuel feed. Then, when normality is restored, the set level goes down."

But there's more. In particular, water level is monitored to an accuracy of 2mm by two capacitance probes of Autoflame's own design and manufacture, with PTFE dielectrics that are towards each end of the boiler – the pair establishing a 'wave signature' that deals with a number of detailed, but important, variables.

## Sophisticated signature

First, breaking bubbles of steam in any boiler precipitate spray that tends to coat the surfaces of conventional level probes, leading to high water level readings. Second, thermal convection currents in the water can result in turbulence. Third, when boilers produce large quantities of steam, it travels over the surface, producing surges. And fourth, if TDS (total dissolved solids) build up, foaming results – also read as an increase in water level.

TDS is kept under control fairly conventionally by monitoring the conductivity of the water, and blowing down and admitting fresh water only when necessary. But Autoflame's system incorporates two key enhancements. First, it compensates for temperature, since conductivity changes by about 2% for each °C, and, second, it compensates for polarisation. The latter it achieves by emitting current in the form of ten 300 microsecond pulses per second, while also measuring build-up of voltage potential above or below 0V in the water.

And there's more: another problem that affects

accuracy of TDS measurement is build-up of scale on the probe. This is countered by designing the water sampling container such that turbulence created during blow-down removes deposits.

Most boiler systems simply blow down at regular intervals, but Kemp makes the point that too frequent blow-downs waste hot water, while too infrequent risk damaging the boiler.

Beyond the sophistication of its level sensing and automation, Autoflame also monitors both ends of combustion, with ultraviolet sensors to monitor flames and others to monitor combustion air and damper positions, plus exhaust gas analysis. Together, these ensure optimum efficiency and minimal nitrogen oxides emissions.

Yes, that's conventional, but the ultraviolet sensors have been tweaked and patented. Each incorporates a stepper motor-driven shutter, so it can check itself for spurious output. Also, software reduces both the voltage and duration of pulses driving the sensor when the flame is at maximum, in order to increase sensor life.

According to Kemp: "If you previously had a system without electronic control, you can expect a 7–10% improvement. If you add a flue gas analyser, you could bump this up 1.5 to 2% more." However, United Fishing Enterprises cut its fuel bill by more than 31% when it turned to Autoflame, while Kikkoman Foods reduced costs at its soya sauce production plant by 3.06 euros per cubic metre of product. Intel has standardised on its systems: cost savings at one site were \$200,000 per annum. **PE**

## Pointers

- A pair of capacitance probes and some software can accurately measure water levels inside a boiler, regardless of waves and surface effects – and anticipate sudden extra steam demands
- Plant operations throughout the process industries and utilities could benefit from better monitoring and control
- Steam locomotives made 13% thermal efficiency at best, but with interest renewed since they run on almost anything – including refuse – advanced controls might tip the balance
- The latest project is the 5AT being led by ex-British Rail consulting engineer David Wardale. Go to <http://www.5at.co.uk>

