

Leave well alone

It's both a strength and a weakness that boilers generally operate for years without problems. On the one hand, plant managers are happy, but, on the other, no one knows how much better they could be doing. Brian Tinham reports

Assessing the health and efficiency of your boiler plant is easy, isn't it? Surely, it's just a matter of reading your flue gas probe and ensuring that excess oxygen is around 3%? Well, no. Unfortunately, this is one of those popular misconceptions and the fact is, it's nothing like that simple. Sadly, however, such received 'wisdom' is responsible for some engineers and technicians

failing to get the best out of their equipment – and that may be costing them dearly, in terms of wasted energy and emissions.

As Sharon Kuligowski, managing director of Rochdale, Lancashire-based Dunphy Combustion, quite rightly says, flue gas analysis just looks at the excess oxygen and exhaust stream temperature. These are, of course, important, but they take no account of other plant factors, such as the age or effectiveness of fuel or steam metering equipment, if fitted, or the burner controls, economiser, the boiler itself, or the steam distribution and condensate system (see panel).

"Too many people think that the flue gas result is the same as the boiler system's operating efficiency, but it's certainly not," she insists. "You need to consider the whole plant – everything from the frequency of boiler blowdowns

to burner behaviour and, in particular, cycling – both of which waste energy and stress the plant. There are so many other aspects that can have a serious impact on energy efficiency and what might realistically be achieved."

Clearly, failure to take these into account means you might well be missing a trick. At the very least,

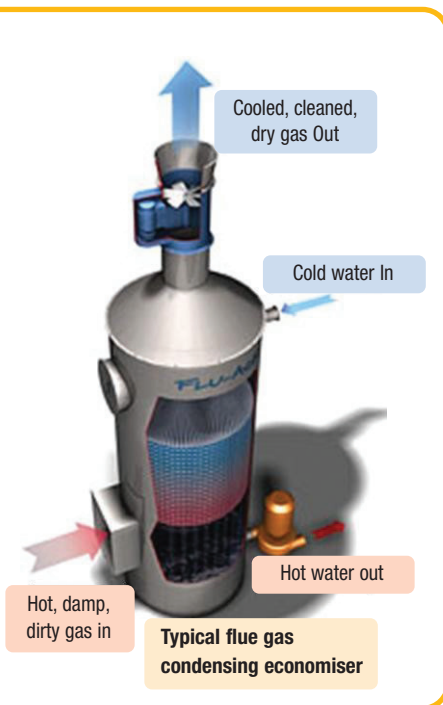


you'll have no insight into appropriate equipment improvements and/or additions – some of which might pay for themselves surprisingly quickly, in terms of fuel savings and waste reduction.

Focusing on burner controls and nailing that excess oxygen assertion, for example, Kuligowski makes the point that the lower the percentage across the boiler turndown range, the less fuel is consumed. "Everyone knows that the fuel-air mix is key, but they don't seem to realise you want stoichiometric combustion. Yes, you need some excess oxygen to prevent carbon monoxide formation, but you want it as low as possible, so you're not wasting energy heating nitrogen, unnecessarily raising the flue gas temperature and increasing NOx emissions. That's why we typically go for 0.4% and then a small margin [of 1–1.5%] for changes in barometric pressure, temperature and calorific value of the fuel."

Right first time

But the point is, such precision is only possible where modern burner management equipment, with up-to-date functionality, has been fitted. For Kuligowski, getting this right starts with fuel and air mixing, and the way oxygen is then managed in response to varying burner load. "Going back a few





Dean Smith


**“You need to consider the whole plant”
Sharon Kuligowski**

recently is our burner head, which is now in its fourth generation, designed to minimise NOx emissions.”

It’s an aside, but so effective is Dunphy’s burner that it surpasses even Switzerland’s notoriously demanding restrictions – 80mg/m³ at 3% oxygen on natural gas or 120mg/m³ for gas oil. That’s impressive – particularly compared to the conventional approach, which harnesses flue gas recirculation, but fails the acid Swiss test.

“We used recirculation until about five years ago, but it increases boiler resistance, because there’s a 7.5–15% dilution of the fuel-air mix,” explains Kuligowski. “So you have to increase the furnace volume and that, in turn, means larger ID [induced draft] fans. It’s a very inefficient and expensive way of mitigating NOx.”

But another key element in any boiler house efficiency drive has to be the control system. “We’ve introduced a touch-screen HMI that brings burner and boiler control together,” she says. “So plant operators really can monitor efficiency and stay in control, seeing real-time totals of fuel, water and electricity consumption, as well as steam output.” And Kuligowski explains that systems are available for everything from small boiler plant to large installations, with fully automatic boiler sequencing and balancing to match changing loads, all under header pressure control.

What’s more, Dunphy’s systems can track the variability of fuel that all plants see, but most ignore. “We use an adaptive trending system that follows the fuel’s calorific value by sensing temperature changes. It learns how much excess oxygen the plant needs and hence our ability to keep the oxygen margin so low.” 

years, boiler control companies used oxygen trim on mechanical linkages that responded, after a fashion, to downstream excess air measurements. But, today, it’s about managing air flow up front – starting by monitoring the fuel-air mix and distribution in the burner and mapping requirements to the boiler load directly.”

Dunphy Combustion’s burner systems, for example, work on an axial, turbine-based airflow mixing system, with a variable speed drive (VSD) providing for digital modulation of overall flow rates, and excess oxygen effectively managed by a rotary damper. “That’s what gives us the precision we need, but it also enables us to work with a turndown of 10:1 on gas, instead of the industry average of 4:1. We’ve had similar configurations for about 10 years. The only major component that’s changed



Measures to improve overall boiler efficiency

If your boiler is more than, say, 15 years’ old, there’s every chance you could benefit from upgrading or even changing the plant – taking advantage of recent advances in boiler and especially burner technology. That’s one of the key action points suggested in guidelines published by The Carbon Trust earlier this year. Others range from carrying out boiler and burner inspection and maintenance, to minimising heat losses by checking (and replacing where necessary) insulation on pipework, valves, flanges and fittings, and – just as important – implementing effective water treatment.

But, if you don’t know your boiler plant efficiency and you want to put a stake in the ground, it’s worth starting by testing, modernising or indeed installing fuel and steam metering equipment. That’s the advice from Sharon Kuligowski, managing director of Dunphy Combustion.

Beyond that, she suggests simply spending half a day in the boiler house, looking out for problems, such as leaks and plant cycling on and off. “Is the equipment sufficient to match the load or is it oversized, because the load has changed over time? Your efficiency might be improved by having the burners reset or you might need to de-rate the boiler and add a better burner system, with a bigger turndown ratio to accommodate load swings.”

Paul Mayoh, industry marketing manager with Spirax Sarco, agrees, noting, for

example, that undersized steam boilers subject to load peaks are at risk of carrying some water over – a situation that might be remedied by fitting an accumulator to increase the effective steam capacity. “It’s an option, rather than installing an extra boiler: there’s no burner cost and it means the existing boiler might run more consistently.”

He also points to the value of reviewing condensate return systems. “For example, it’s better to take flash [steam] out of the high-temperature condensate before it goes into a vented vessel, so that can recover that energy, rather than waste it. You can either put it back into the boiler feed on the high-pressure side of the pump or look for other applications that could use the heat and pass it through a heat exchanger.”

And, in a similar vein, it’s worth considering recovering flue losses from shell type boilers, too, by installing a flue gas condensing economiser, such as those available from Thermal Energy International. This company claims that its systems can increase boiler efficiency to 93%, by capturing the flue gas waste heat in a cold water counter-flow arrangement.

And one final tip: take a look at your steam traps. Installing balanced pressure units, for example, means you can recover not only heat of evaporation from condensate, but also sensible heat – so that discharges have no flash content at all.