Flame Characterisation in a Multi-burner Heat Recovery Boiler through Digital Imaging and Spectrometry

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Abstract for poster presentation

Fossil fuel fired utility boilers fire a range of fuels under variable operation conditions. This variability in fuel diet and load conditions is linked to various problems in boiler performances, particularly the flame quality which is closely associated with furnace safety, combustion efficiency and pollutant emissions. Reliable flame monitoring is thus critical as the flame can fluctuate significantly in terms of size, shape, location, colour and temperature distribution. For instance, heat recovery water tube boilers are commonly used in industry to recover the energy in the exhaust gas from gas turbines. The boiler is fitted with multiple burners which allow flexibility with tuning of the boiler firing rates depending on process steam demand. It was reported that flame properties in such boilers had a direct impact on the flame stability and pollutant emissions (i.e., NOx and CO). There is, however, no technique available for online monitoring and quantifying the flame properties of individual burners. This has resulted in a lack of understanding in how each burner operates with regard to the overall performance of the boiler, particularly the emissions.

Under the support of the BF2RA and EPSRC, an imaging and spectrometry based instrumentation system is being developed for flame monitoring and emission. Fig 1 shows the block diagram of the system. An optical probe, protected by the air-cooled jacket, transmits the light of flame to the camera house. The light of flame is then split into two beams. The first beam is captured by a camera to provide images for determining the physical parameters of the flame. The second beam is received by a miniature spectrometer for flame spectral analysis. Intelligent computing algorithms are developed for flame monitoring and emission prediction. The system, once fully developed, will be assessed under a range of operation conditions on a heat recovery water tube boiler at a British Sugar's factory. More test results will be presented at the conference.

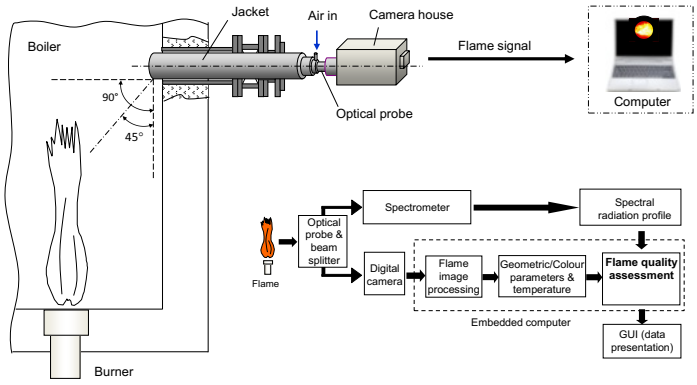

Fig.1 Block diagram of the flame monitoring system

Keywords: Heat recovery boiler, flame, digital imaging, spectrometry, image processing, temperature, emission.

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