Oral session preferred

Flame monitoring and characterisation through digital imaging and spectrometry

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Fossil fuel fired boilers are often required to work under variable operation conditions. The variability in fuel diet and load conditions result in various problems in boiler performances. A methodology based on digital imaging and spectrometric techniques is proposed for flame monitoring and characterisation on utility boilers. The system developed consists of an optical probe/water jacket, a digital camera, a spectrometer covering a spectral range from 200nm to 900nm and an embedded computer with associated application software. Computer algorithms are established to determine flame characteristic parameters, including size, shape, temperature and spectral distributions. The spontaneous emissions of flame radicals (e.g., CH*and C_2*) and alkali elements such as Sodium (Na) and Potassium (K) are characterised and their relationships with the combustion inputs (e.g., fuel, air-to-fuel ratio) and pollutant emissions (e.g., NO_x) are studied. The methodology proposed are examined on a gas-fired heat recovery boiler under different operation conditions. The results obtained suggest there exist close correlations between flame parameters computed and boiler operation conditions. In particular, flame radicals (CH* and C_2*) and their ratio show a close relationship with the air-to-fuel ratio. The spectral intensities of Na (589nm) and K (767nm) also illustrate a strong link to the type of fuel. Current work focuses on quantifying the relationship between the flame parameters and the boiler operation conditions and establishing a computational model for online prediction of emissions from flame characteristic parameters.