3-D RECONSTRUCTION AND CHARACTERISATION OF OXY-COAL FLAMES ON A 250kW COMBUSTION TEST FACILITY

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Abstract:

Oxy-fuel combustion with CCS (CO2 Capture and Storage) is considered to be one of the most promising technologies to tackle CO2 emission coal fired power generation. However, switching from conventional air-coal to oxy-coal brings a number of technical challenges to plant engineers and operators due to the complicated underlying mechanisms of oxy-coal combustion. Advanced flame monitoring and characterisation techniques can help to achieve an in-depth understanding and subsequent optimisation of oxy-coal combustion processes.

As a result of an EPSRC funded project, an optical tomographic system has been developed for the 3-D (three-dimensional) monitoring and characterisation of oxy-coal flames. The system combines image fibres, CCD cameras and associated computing algorithms, and is capable of acquiring flame images concurrently from eight different directions around the burner, performing the 3-D (three-dimensional) flame grey-level reconstruction, and determining flame characteristic parameters such as size, shape, temperature distribution, and soot concentration. Following extensive tests on a lab-scale oxy-gas fired combustion rig, the system has been scaled up and applied on a 250kW oxy-coal combustion test facility. The 3-D measurements of the characteristic parameters of flame based on its reconstructed model have been undertaken over a wide range of oxy-coal conditions. A multi-functional flame monitoring system has also been used for the 2-D (two-dimensional) temperature measurement and spectral analysis of the flame. The results demonstrate that the digital imaging and tomographic techniques have provided an effective means for the 3-D reconstruction and characterisation of flames under oxy-coal combustion conditions. Future work will focus on the comparisons between the flame data obtained by the imaging systems and that obtained through CFD (Computational Fluid Dynamics) and LES (Large Eddy Simulation) modelling.

Keywords: oxy-coal, flame, CCD camera, tomography, three-dimensional reconstruction, luminosity, temperature

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