

ADVANCED NEAR BURNER FLAME DIAGNOSTICS FOR IGNITION AND STABILITY STUDIES ON FULL SCALE PULVERISED COAL FLAMES

OBJECTIVES

The overall aim of the project is to improve the simulation of the near burner region of flames by CFD models, and to devise techniques whereby ignition processes in the vicinity of the flame holder and the flame structure immediately downstream can be assessed for individual flames in large pulverised coal fired furnaces. Specific project objectives are:

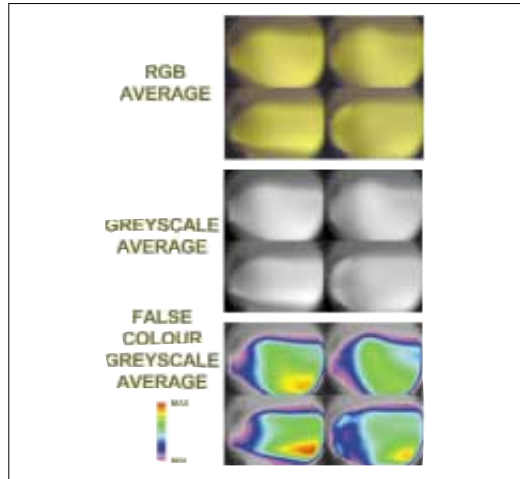
- to establish a technique whereby the near burner region, and in particular the ignition regions of the flame, can be observed and recorded by means of a high-speed video probe
- to demonstrate this technique in plant trials, using existing test activities to assess factors such as the impact of local operating conditions and coal quality on burner stability and near-burner flame structures
- to assess the capability of existing CFD codes to simulate the observed processes occurring in the near burner region (with specialised laboratory coal testing at ICSTM to assess coal properties)
- to investigate the potential differences between single burner and multi-burner furnace performance
- to increase the level of confidence in the use of CFD modelling for the simulation of burners and furnaces
- to develop the equipment and processing methods for industrial use as a specialised diagnostic technique to assist in plant optimisation of individual burners in a multi-burner furnace or in recording the localised flame structures in the near burner region to aid in the development of improved burner designs

SUMMARY

New video probe designs will be developed to allow access to regions of the flame which are not accessible using conventional probing techniques and cannot be viewed from the usual viewing ports. These will use 'standard' video frame rates (25 fps) for longer-term combustion pattern observations and high speed (1000 fps) viewing to visualise flow patterns. The very high temperatures (up to 1500°C), very bright illumination from the flame and high dust levels present technical challenges which must be overcome in video probe designs still small enough to be inserted through narrow passages in the burner.

One particular region of interest is the flame holder, a bluff body stabilisation device on the tip of the pulverised coal feed tube which is a standard feature of all low-NO_x burners. Images showing pulverised coal ignition on the flame holder under different conditions will give burner designers and modellers additional information to contribute to the development of improved low-NO_x burners. The way in which the initial ignition patterns on the flame holder affect combustion downstream in the quarl and the furnace will also be examined using multiple synchronised cameras.

Pseudo-flame images will be generated from CFD predictions by warping data grids to give the same perspective and optical distortion found by calibration in the video camera systems.



Ignition patterns in pulverised coal flames just outside the quarl (Gibbins, J., Lin Y-M, Bowden, S. and Cameron, S., "Video observations of full-size pulverised coal flames", *Comb. Sci. Tech.* 162 (2001) 263-280)

These can then be compared with digitally-processed video images of the actual flames to validate model predictions, giving combustion engineers a novel complementary combination of theoretical and experimental data for hitherto unreachable regions of full-scale pulverised coal flames at a low enough cost for routine industrial use.

COST

The total cost of the project is £131 169 with a contribution of £45 583 from the DTI

DURATION

2½ years – July 2000 to January 2003

CONTRACTOR

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DTI/Pub URN 01/1015