NOVEL DIAGNOSTICS OF OXY-COAL COMBUSTION IN A SEMI-INDUSTRIAL SCALE FURNACE

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In oxy-coal combustion, a mixture of oxygen and recycled flue gases is used instead of air for fuel oxidation. Consequently, a gas consisting of CO_2 and H_2O is obtained, with a CO_2 concentration ready for sequestration. Flue gases are recycled in order to make up the volume of the missing N_2 and to ensure enough thermal capacity for the subsequent heat transfer operations.
Many studies in literature have been aimed at understanding solid fuel combustion in oxy-fuel conditions, by performing single-particle studies using conventional (e.g. thermogravimetry) analysis. A step further to the knowledge is provided by entrained flow reactors, which allow obtaining data under heating rates and temperatures typical of industrial boilers. However, in entrained flow reactors the burner fluid-dynamics is neglected, which means that the interaction of coal particle and flame with the turbulence cannot be investigated.
The present work aims at employing a relatively simple technique (Optical Diagnostics for Combustion – ODC) developed by ENEA (Giacomazzi et al., 2008), to derive information on coal combustion in air and oxy-fuel conditions by performing experiments in a semi-industrial (3 MW) furnace. The advantage of the proposed diagnostics is the very low intrusiveness which makes it suited for industrial applications.
The technique was found to be capable of monitoring the position of the flame in the furnace; for instance it was observed that the ignition delay is larger in oxy- than in air-fired conditions.
Variation of operating conditions or combustion characteristics were found to be easily detectable by the measuring probes, so that the technique can be potentially used to control and monitor the process.
The correlation of signals taken with more probes was used to evaluate the velocity distribution of coal particles. Such information is hard to be measured experimentally, but may be useful for the validation of numerical models.
The high acquisition rate of the technique allowed the identification of main frequencies for each experimental test. In addition the analysis of the frequency spectra could be used to shed light into the turbulence/flame interaction and thus arguing on the combustion regimes.

References
Giacomazzi, E.; Troiani, G.; Giulietti, E.; Bruschi, E. *Exp. Fluids* **2008**, *44*, 557-564.

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