EXPERIMENTAL ANALYSIS OF PULVERIZED COAL COMBUSTION IN A LAMINAR STRAINED BURNER

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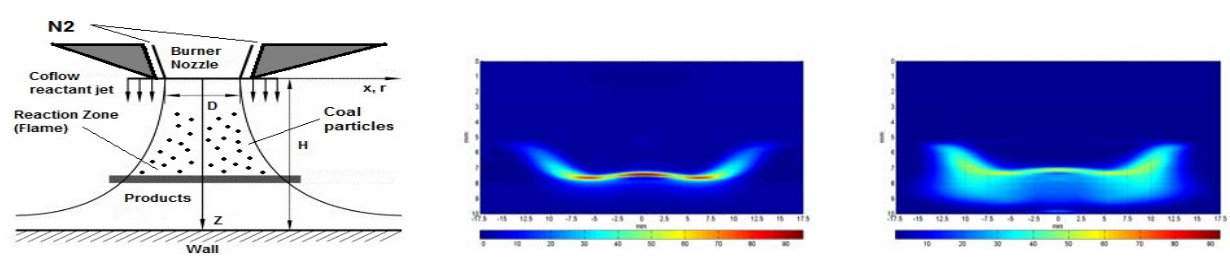
Coal industrial application and thermal conversion processes comprehend a wide spectra in which pulverized coal combustion has generated significant interest since it can achieve process control and performance. Carbon Capture and Storage (CCS) techniques to retrofit conventional industrial processes operating with pulverized coal are also promising approaches. Pulverized coal combustion has been studied now for several decades, but past technology for describing and analyzing coal furnaces and combustors has relied largely on empirical inputs for the complex flow and chemical reactions that occur while more formally treating the heat-transfer effects. Recent technical advances in computational performance and the new and better experimental diagnostics equipment allow us to run more detailed simulations and to characterize more in depth phenomena such as turbulent flows, two-phase flows and reactive flows which have opened new opportunities for describing and modeling such complex combustion systems in greater detail. In order to increase our fundamental knowledge more experimental observations and fundamental modeling has to be performed.
The objective of the present work is to study experimentally the combustion of pulverized coal in a laminar strained burner. This work is a part of an ongoing project treating oxygen-enriched turbulent pulverized coal combustion LES modeling. Here we focus on the understanding of stabilization mechanisms and chemical species fields encountered in coal combustion.
The analysis of pulverized coal combustion in laminar flows will provide important information about the flame chemical structure and its response to different flow parameters. The experimental configuration is shown in Fig. 1(a). A fresh mixture of air, methane and pulverized coal is injected through a convergent jet against a horizontal flat wall to form a stagnation flow. Spontaneous emissions of three different excited stated chemical species: CH*, C2* and OH* are measured in order to analyze the reactive zone of the pulverized coal-methane-air flame. We also employ LIF technique to visualize OH species. Figs. 1a and 1b give typical CH* emission. From the comparison of the CH* emission images we can see straight forward that the localized reaction zone from the methane flame changes to a much wider and continuous reaction zone but always keeping a "maximum intensity" observable reaction zone. PIV technique is also employed to characterize the flow velocity field. The flame front and coal evolution within the flame is analyzed by using spontaneous emission spectroscopy techniques to characterize hot gases composition.



(a) Geometry (b) CH* spontaneous emission (c) CH* spontaneous emission

Figure 1. a) Strained flame, b) Reference gaseous methane-air flame, c) Coal- methane-air flame

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