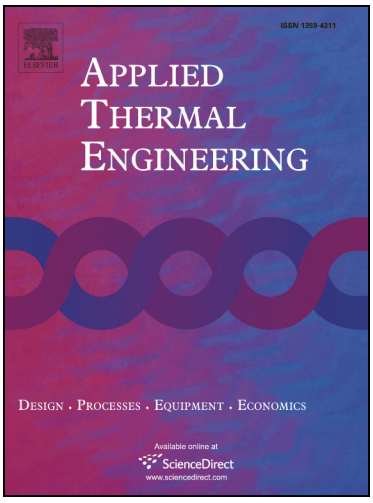

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Simplified numerical modelling of oxy-fuel combustion of pulverized coal in a swirl burner

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Abstract

In this work, a computational fluid dynamics (CFD) modelling has been performed to analyze pulverized coal combustion in a vertical pilot-scale furnace. The furnace with swirl burner is located at the Institute of Heat and Mass Transfer at RWTH Aachen University, where O_2/CO_2 combustion environment was adopted to study pulverized coal combustion experimentally [Toporov et al. Combustion and Flame, 2008]. A two-dimensional axisymmetric domain has been used in this work with a Lagrangian method to track coal particles. Performances of different Reynolds-Averaged-Navier-Stokes (RANS) turbulence models have been investigated. The radiative heat transfer using discrete ordinate (DO) model coupled with variants of weighted-sum-of-grey-gases (WSGGM) methods has been examined. The results obtained by these models have been compared with the experimental data. The DO radiation model with domain based WSGGM and SST k-omega turbulence model showed a very good match with the experimental data among other tested models. The accuracy of predicted results was comparable to LES results available in the literature. It is observed that to get preliminary results the current simplified model is good enough with accuracy comparable to LES modelling. By using this validated model, the influence of combustion environments such as air, oxy-steam (O_2/H_2O) and oxy-RFG (O_2/CO_2) on temperature and NO concentration distribution has been investigated. NO_x produced was least in the oxy-steam environment.

Keywords: Pulverized coal, Swirl burner, CFD, Devolatilization, Oxy-fuel, WSGGM

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