ABSTRACT

Numerical Simulation of a Natural Gas-Swirl Burner: Influence of Swirl Number on Pollutant Emissions

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Swirl is a technique used to control pollutant emissions from combustion systems. The basic idea is to impart swirl to the air stream. Swirl improves flame stabilization, increases fuel-air mixing, and consequently has a strong influence on flame emissions. The general goal of the current research is the improvement and optimization of the mixing processes between the reactants in such a way to minimize the environmental impact of combustion systems. A non-premixed swirling combustor, operating at natural gas jet Reynolds numbers of 500 and 9000, was simulated with different swirl levels (velocities).

The numerical computations were carried out using the commercially available software package CFDRC. The instantaneous chemistry model was used as the reaction model The CFD simulations were used to characterize the flow, thermal and composition fields in the near-burner, mid-burner and far-burner combustion zones. The analysis showed that the optimal swirl velocities are 2 m/s and 60 m/s for the laminar and turbulent flames, respectively. The CFD results were useful to interpret the effects of swirl in enhancing the mixing rates in the combustion zone as well as in stabilizing the flame**.** The results showed the generation of two recirculating regimes induced by the swirling air stream, which account for such effects.