عنوان مقاله:

Experimental Investigation on the Effects of Swirl on the Exit Turbulent Flow Field of an Unconfined Annular Burner at Isothermal and Reacting Conditions

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خلاصه مقاله:

The objective was to study the effect of change in swirl intensities, S=۰.۴, ۰.۷ & ۱ of the annular swirling flow on the exit flow field of an unconfined annular swirl burner operated at isothermal (only dry air) and reacting flow (premixed methane air mixture) conditions. Reynolds number at the burner's annular exit based on its hydraulic diameter (D) was kept constant at ۴۰۰۰. Exit flow field at isothermal conditions was measured using planar particle image Velocimetry rig and processed using commercial software. The percentage decay in the magnitude of peak value of axial velocity obtained from its radial profile at a height of ۴D from the burner exit with the change in swirl intensity of ۱, ۰.۷, ۰.۴ and ۰ was ۶۵%, ۵۵%, ۴۷.۲% and ۱۳.۵%. The jet spreading angle was ۶.۵o for S=۰, ۸.۴o for S=۰.۴, ۹.۸ for S= ۰.۷ and ۱۴.۲o for S=۱. Recirculation zone was observed only for S=۰.۷ and ۱.۰. The width of the recirculation zone was ۳D (S=۰.۷) and ۳.۴D (S=۱) respectively. The normalized reverse mass flow rates estimated were ۰.۰۲۷ for S = ۰.۷ and ۰.۰۵۸ for S = ۱.۰. The magnitude of turbulence intensities at wake shear layer was much higher than the jet shear layer due to the presence of recirculation zones for S= ۰.۷ and ۱.۰. The integral length scales calculated were varied in the range of ۰.۰۶D ۰.۱۸D for all swirl intensities. Reaction front was identified by deconvoluting the time mean OH* chemiluminescence using Abel inversion method. The flame became shorter and wider with increase in swirl number which was in consonance with the observation of increase in size of recirculation flow in the isothermal flow. The equivalence ratios at which the lean blow out observed were ۰.۵۸, ۰.۶ and ۰.۶۲ for S=۰.۴, ۰.۷ and ۱.

کلمات کلیدی:

Axial swirl generator, Swirling flow, Jet spreading rate, Chemiluminescence, Lean blowout