عنوان مقاله:

Numerical Simulation of Swirl and Methane Equivalence Ratio Effects on Premixed Turbulent Flames and NOx Apparitions

محل انتشار:

دوماهنامه مکانیک سیالات کاربردی, دوره 9, شماره 2 (سال: 1395)

تعداد صفحات اصل مقاله: 12

نویسندگان:

S. Ouali - *Energetic Department, Faculty of Engineering UMBB, Boumerdes, ۳۵۰۰۰, Algeria*

A. H. Bentebbiche - *Energy Systems Laboratory, Faculty of Mechanic, USTHB, Algiers, ۱۶۱۱۱, Algeria*

T. Belmrabet - *Military Polytechnic Academy, EMP, Algiers, ۱۶۰۰۰, Algeria*

خلاصه مقاله:

This paper presents a three dimensional numerical simulation of premixed methane-air low swirl stabilized flames. The computational domain has a simple geometry describing a LBS (low swirl burner) with ۵۰mm of nozzle diameter. RANS Standard κ – ε model to treat turbulence coupled with partially premixed combustion model are used. The purpose is to show the applicability limits and their capacities to predict governing flame parameters by varying swirl intensity and CH۴ mass fraction at the inlet, which shows the optimum operating area of the burner in terms of generated energy and flame stability with a particular interest to thermal NOx apparitions. This work is compared and validated with experimental and LES numerical simulation works available in the literature. Results offered good similarity for all flame studied parameters. Swirl number was varied from ۰.۵ to ۱.۰ to ensure a wide operating range of the burner. From S=۰.۶, we observed the onset of recirculation zones, while for the inert flow the appearance of recirculation zones was observed for S=۰.۹. CH۴ equivalence ratio was increased from ۰.۶ to ۱.۴. That showed apparition of zones with important NOx mass fraction due to the existence of zones with high temperature. Otherwise, the flow field wasn't disturbed in terms of recirculation zones apparitions who remained absent for all cases. Actual investigation works to find equilibrium between the maximum of generated temperature and the minimum of NOx emissions for swirled burners. Used models haven't showed applicability limits, results were clear and precise and offered a significantly gain in computing time and means.

کلمات کلیدی:

Methane, Turbulence, premixed combustion, Recirculation zones, Flame stability, Air, Pollutants, swirl