A comprehensive study of two interactive parallel premixed methane flames on lean combustion

林河川,鄭藏勝,陳必虔,何俊慶,趙怡欽
Mechanical Engineering
Engineering
tscheng@chu.edu.tw

Abstract

An experimental and numerical investigation is performed on interactive parallel lean pre-mixed methane flames with variable jet spacing, equivalence ratios and inlet speeds issued from twin rectangular slot burners. The flow field and combustion chemical reactions are predicted by detailed numerical simulation with both Skeletal and GRI-v3.0 mechanisms. Numerical results are validated by the flame temperature, height and shape against experimental measurements. When moved closer beyond a threshold jet spacing, these twin flames become interactive and both flames tilt outward in appearance with a wider operational range of lean and velocity conditions. Numerical prediction found that there are three different interacting stages: entrainment, recirculation and reverse flow according to the jet-to-jet spacing and named by their characteristic postflame flowfield between jet burners. For the reverse flow stage, a stagnating flowfield, termed lateral impingement, is generated along the symmetric axis between the flames which is similar but not identical to that found in the counterflow flames. As the jet spacing is reduced, the transition of the postflame flowfield is believed to be the main mechanism to enhance flame stabilization, especially in lean conditions. This reverse flow pattern provides warm and slow postflame flow field and residual OH from main flames to heat and burn the fuel escaping from the flame bases through low temperature burning process. The computational result shows there is a region near the burner rim gathering lots of HO2 and H2O2 which are commonly found in the low temperature combustion. In the other word there is a crucial factor combined with stagnating flow, low dissipating thermal and interacting chemical species to help the flame base to stabilize to burner rim with additional supply of OH from main flames.

Keyword：lean combustion, lateral impingement, stagnating flow and interactive flames.