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STUDY ON IGNITION AND COMBUSTION CHARACTERISTICS OF GASEOUS OXYGEN/GASEOUS METHANE IGNITER

Abstract

In order to investigate the ignition and combustion characteristics of a gaseous oxygen/gaseous methane torch igniter, a series of numerical simulations and validation experiments were conducted. This igniter has a total mass flow rate of 70g/s and an oxygen/fuel mixture ratio of 1.0 under rated conditions. Considering the difficulty of stable ignition in fuel-rich conditions, an ignition method was adopted that maintains a constant oxygen mass flow rate while initiating methane flow at a low branch mass flow rate, achieving an instantaneous high mixture ratio of 6.7. Meanwhile, both the Eddy Dissipation Concept (EDC) model and the flamelet model were used to analyze these two operating conditions, respectively. Additionally, machine learning techniques were employed to conduct a preliminary predictive analysis of the ignition limit mixture ratio for this type of igniter. The results indicate that this approach effectively allows the igniter to ignite and transition to rated conditions. Compared to the EDC model, the flamelet model based on rapid reaction theory predicts a flame front closer to the injector faceplate with a shorter flame length and demonstrates more accurate combustion chamber pressure prediction performance. Both models yield similar high-temperature regions. By combining numerical simulations with experimental data, machine learning techniques provide additional avenues for predicting the ignition limit performance of the igniter.