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STUDY ON THE MIXING COMBUSTION PERFORMANCE OF THE SECONDARY FUEL INJECTION FOR THE AFTERBURNING CHAMBER OF THE RBCC ENGINE

Abstract

Improving the mixing combustion efficiency is one of the urgent technologies for the Rocket-Based Combined Cycle (RBCC) engine. In order to elevate the short-term thrust of the engine, the secondary injection technology is mainly carried out in the afterburning chamber. This study mainly investigates the influence of injection position and injection angle on the mixing combustion performance in the afterburning chamber. The numerical simulations adopt the three-dimensional coupled implicit Reynolds Average Navier-Stokes (RANS) equation with the SST κ-ω uturbulence model. Eddy-Dissipation Concept (EDC) method is served as the combustion model. This research employs orthogonal method to design numerical experiments. The characteristic length of injection position varies between 0.3 and 0.7 with an increment of 0.2, and the injection angle transforms from 45 to 135 with an increment of 45. The consistent wall pressure between the validation model and the experimental data prove that the calculation method utilized in this study is credible. The flow field structure formed in the afterburning chamber reveals the mechanism of the streamwise vortices and the fuel penetration depth. In addition, the laws of fuel mixing efficiency, combustion efficiency, and stagnation pressure loss under different operating conditions are acquired. It is concluded that the smaller characteristic length of the injection position, the higher the mixing combustion efficiency. Meanwhile, as the injection angle increases, the mixed energy loss increases. This study also obtains the mixing performance and energy variation criteria of different cases, which indicates the optimal parameters with the best mixed combustion performance and the weakest energy loss ability. The conclusion can provide references for future investigating the mixing combustion performance of the RBCC engine.