NUMERICAL STUDY OF TURBULENT HOMOGENEOUS COMBUSTION OF METHANE/AIR MIXTURE IN A LOW-EMISSION COMBUSTOR BY REYNOLDS-AVERAGED NAVIER–STOKES AND LARGE EDDY SIMULATION METHODS

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Abstract: A fairly simple and economical method for calculating turbulent homogeneous combustion of methane–air mixture has been developed. The method makes it possible to describe the variations in the average velocity, velocity pulsations, and temperature in a model combustor with high accuracy. When constructing the method, the results of calculations carried out using both the RANS (Reynolds-averaged Navier–Stokes) method (with three turbulence models) and the semidirect LES (large eddy simulation) and DES (detached-eddy simulation) methods were analyzed. Turbulent combustion was simulated using two combustion models for progress variable C. Cooling of the combustion chamber walls was simulated using the convective heat transfer model. The problem was solved using the software package Ansys Fluent 14.5 for perfect compressible gas on two computational grids: 3.7 million and 15.7 million cells of cubic shape. The results of the computational study of turbulent homogeneous combustion in a channel with abrupt expansion, simulating a low-emission combustion chamber, have shown that the LES WALE method with the combustion model for C in the LES variant and nonadiabatic formulation ensures the best agreement with the experimental data.

Keywords: calculation methods; turbulent combustion; combustion chamber

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