NUMERICAL SIMULATION OF UNSTABLE REGIMES OF METHANE–AIR MIXTURE PREMIXED COMBUSTION IN LOW-EMISSION COMBUSTION CHAMBER

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Abstract: One of the possible cases of simple for realization and computationally inexpensive methodology for simulating the three-dimensional unsteady turbulent flow with premixed combustion of methane–air mixture in the model low-emission combustion chamber based on Large Eddy Simulation (LES) is proposed. Typical geometrical sizes of combustion chamber elements, operational regime parameters, turbulence level, and flame-front stabilization method are close to those of full-sized industry combustion chambers. For the description of turbulent flow, LES with WALE (Wall-Adapting Local Eddy-simulation) subgrid-scale model was used. As for the turbulent combustion model, a differential equation for combustion efficiency C and Zimont model in LES modification were applied. The methodology allows one to simulate unsteady flow regimes with premixed combustion with and without flashback phenomena for different operational regime parameters of the combustion chamber. Operational regimes are modeled by the variation of boundary conditions at the inlet section of combustion chamber. The possible reason for the regime with a high amplitude of flame-front fluctuations, related with vortex transport from the inlet section of combustion chamber to hot zone, is analyzed. Calculation results obtained for the rearward facing step burner and experimental data of other authors are compared.

Keywords: unstable regime; turbulent combustion; combustion chambers; LES

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