Mechanisms of accelerated flame propagation in channels

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The article presents the results of a computational and theoretical study of the mechanisms responsible for the acceleration of a gaseous mixture flame in a channel, using the example of mixtures of stoichiometric mixtures of acetylene with oxygen diluted with nitrogen. The modeling was carried out using the non-dissipative "CABARET" method [1] and the reduced scheme of chemical kinetics [2]. Based on detailed numerical modeling in an axisymmetric formulation, the difference in the flame dynamics of mixtures with different proportions of inert diluent is shown. It is established that the presence of an accelerated stage of flame evolution preceding the transition to detonation is consistent with the formation of a vortex flow on the scale of the boundary layer. Analysis of the stability of the boundary layer ahead of the flame front [3], carried out in accordance with linear stability theory, showed that, depending on the activity of the mixture, it is possible to observe both a stable and an unstable scenario of boundary layer evolution. Based on this analysis, a technique was formulated that could be used to determine the critical values of the system parameters that separate one flow evolution regime from another.

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[2] Varatharajan B N and Williams F A 2001 *Combust. Flame* **124**(4) 624–645

[3] Yarkov A V, Kiverin A D and Yakovenko I S 2024 *J. Eng. Phys. Thermophys.* **97** 1751–1759