JET THRUST OF A PULSE DETONATION COMBUSTOR DURING COMBUSTION OF OXYGEN-ENRICHED HEPTANE/AIR MIXTURES

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Abstract: Dynamics of reactive thrust of a small-size pulse detonation combustor (PDC) is studied taking into account the influence of various factors determining the course of the operation process of the setup (mixture composition, oxygen content in the mixture, combustion wave velocity, setup heating rate, and presence of nozzle and nozzle geometry). It is shown that the dynamics of thrust corresponds on the whole to the dynamics of propagation of the combustion wave along the tube, since the velocity of the outflow of the combustion products outward is directly related to the wave velocity. The achievement of a steady thermal regime of the setup provides the most favorable thrust effect for a given mixture composition (with $\phi = const$, $[O_2/\text{air}] = const$) and a nozzle. Addition of oxygen to heptane–air mixture affects the PDC thrust but this dependence has a nonlinear character: the maximum thrust is reached during the detonation mode ($D \geq 2000$ m/s) in lean mixtures ($\phi = 0.75$–0.8) with oxygen content $[O_2/\text{air}] = 1.2$–1.6. Using the nozzle makes it possible to significantly increase the thrust of the pulse detonation device with the correct selection of its geometry and apex angle.

Keywords: jet thrust; oxygen-to-air ratio; combustion wave velocity; nozzle apex angle; equivalent ratio

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