CRITICAL CONDITIONS FOR BURNER STABILIZED METHANE-AIR FLAMES AT NORMAL AND ELEVATED PRESSURE *

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In this work, the boundaries of burner stabilized methane-air flames stability are found experimentally at different pressure in range from 1 to 4 bar. This paper is the continuation of the work [1]. In particular, the thermal-diffusive oscillations of flame are investigated and critical mass flow rate M_{cr} where pulsations occur and corresponding frequency are measured by analyzing the OH* chemiluminescence signal. Also the mass flow rate M_b at which flame blows-off is determined. That allows us to find the laminar velocity at elevated pressure experimentally and compare it to numerical calculations.

To obtain experimental data, the high-pressure chamber shown in Figure 1(a) was constructed. The flat porous burner equipped with cooling and automatic ignition systems is placed in chamber. Along the perimeter of the burner's porous media the nitrogen is supplied to cut the diffusive flame. Also for this purpose, a nitrogen atmosphere is created initially in chamber. Fresh gases (CH_4, air, N_2) are supplied through mass flow controllers Bronkhorst. To observe and detect the flame pulsations and blowing-off the chamber has illuminators. To obtain the OH* chemiluminescence signal the PMT is used. Elevated pressure is maintained by pressure regulator Bronkhorst.

The boundary of pulsations was found for ϕ in range from 0.9 to 1.35 and boundary of blowing-off for ϕ in range from 0.6 to 1.4 of methane-air flames for different pressure P = 1, 2, 4 bar. Results are shown in Figure 1(b). Dashed lines shows the boundary of blowing-off, solid lines shows the beginning of the oscillations. For every pressure (black, blue, red is P = 1, 2, 4 bar correspondingly) the flame between this lines is flat and stable.

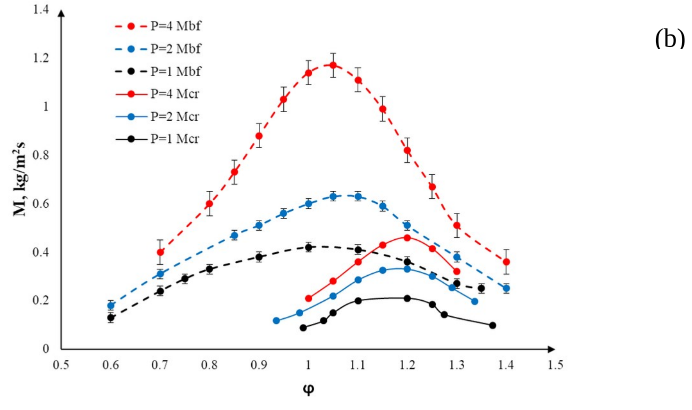

Fig.1. Flat porous burner in the high pressure chamber, cooling system, ignition system (a), experimental dependency of Mcr and Mb on equivalence ratio for P = 1, 2, 4 bar (b).

Obtained data is very important for verification of detailed mechanisms. Mass flow rate of blowing-off allows to find the flame laminar velocity experimentally. Critical mass flow rate and corresponding frequency allow to compare different numerical models due to high accuracy of the obtained data.

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