ON THE APPLICABILITY OF ZEL'DOVICH ESTIMATES TO THE DETERMINATION OF THE MARKSTEIN LENGTH

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Abstract: A direct comparison of experiments with Zel'dovich computational and theoretical estimates of hydrodynamic and thermal diffusion flame instability by determining the Markstein length is presented. The flame propagation velocity and Markstein length in laminar premixed flames of various fuels were measured at atmospheric pressure and initial temperature of combustible mixtures of 25 and 55 °C by the PIV (Particle Image Velocimetry) method. It was found that at a Lewis number equal to 1 and room temperature, there is a strong quantitative difference between the experimental data and the results of calculation of Markstein length using the Zel'dovich method; however, with an increase in the initial temperature and Lewis number up to $\mathrm{Le} = 1.5$, the calculation results approach the experimental results and at $\mathrm{Le} = 2.5$, they match with the experimental data.

Keywords: flame velocity; PIV; Markstein length

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Figure Captions

Figure 1 Comparison of the dependence of the Markstein length on φ in the methane–air flame: *1* — calculations by Eq. (2); and *2* — data from [7]

Figure 2 Dependence of the calculated (one-dimensional) temperature profile in the flame front (*a*) and Markstein length L_m (signs are the results of the experiment; and line is the result of the calculation according to Eq. (2)) (*b*) on the stoichiometric ratio φ in the methane–air mixture

Figure 3 Dependence of the temperature profile in the flame front (*a*) and the Markstein length L_m (signs are the results of the experiment; and line is the result of the calculation according to Eq. (2)) (*b*) on the stoichiometric ratio φ in the dimethyl ether – air mixture

Figure 4 Dependence of the temperature profile in the flame front (left) and the Markstein length L_m (signs are the results of the experiment; and line is the result of the calculation according to Eq. (2)) (*b*) on the stoichiometric ratio φ in the methyl methacrylate – air mixture

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