LAMINAR BURNING VELOCITIES OF ALKANES AT HIGH PRESSURES

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The heat flux method [1] has been used to measure adiabatic burning velocities for a wide range of gaseous and liquid hydrocarbons and oxygenated fuels at atmospheric pressure, e.g. light alkanes and natural gas surrogates [2], gasoline components [3][4], but this method has been rarely used at higher pressures [5]. Adiabatic burning velocity is an important parameter for the design of internal combustion engines. It is therefore important to obtain reliable measurements for liquid components of fuels at pressures higher than atmosphere, closer to that involved in engines.

A new adiabatic burner allowing the measurement of burning velocities at high pressure with the heat flux method has been developed. Experimental measurements of laminar burning velocities of methane were performed in order to validate the experimental setup, and *n*-pentane was studied as the lighter liquid alkane involved in fuels. To our knowledge, it is the first application of this method to a flame of a liquid fuel above atmospheric pressure. Measurements were performed for pressures up to 6 atm at 298 K and at atmospheric pressure for temperatures from 298 to 398 K. Equivalence ratios varied from 0.6 to 1.8 at atmospheric pressure, but only lean and stoichiometric mixtures were studied at elevated pressure because of the limitations of the mass flow controllers. Measurements using the new experimental setup have been made up to 6 atm for methane and burning velocities compare satisfactorily with the data of Goswami et al. [5]. Figure 1 compares the present results to those of the literature. Measurements have then been made in the case of *n*-pentane, a liquid linear alkane representative of those present in gasoline, up to 4.2 atm.

From those measurements, empirical power law correlations have been derived, reproducing the variations of adiabatic burning velocities with temperature and pressure ($S_L = S_{L0}(T/T_0)^{\alpha}(P/P_0)^{\beta}$). They were used to make comparisons with recent literature data involving pressures up to 18 bar for the same reactants but using measurements in constant volume bombs, which are more usually used to measure laminar burning velocities at high temperature or high pressure. Both dependences in temperature and pressure correlate well with the literature data.

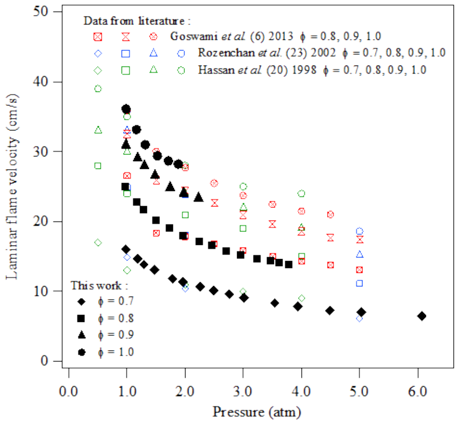

Figure 1: Measurements of methane flame burning velocity at 298 K as a function of pressure for different equivalence ratios

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