The expansion coefficients and propagation speeds of *n*-butane-air mixtures in enclosures

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Together with the normal burning velocity, the propagation speed is an important feature of a flammable mixture and a significant parameter in respect to the rates of fuel oxidation to products and heat generation. The propagation speed of a flame is necessary for predicting the flame blow-off and flash-back, or assessing the risk factors which may arise in operating chemical reactors or mine galleries where flammable mixtures may be formed.

In the present research, the flame propagation in *n*-butane-air mixtures (2.6-5.5 vol%) was investigated at room temperature and various initial pressures (0.5-1.5 bar). The experimental measurements were done in two different small-scale enclosures (a sphere and a cylinder) with central ignition. The propagation speeds were determined using the adiabatic model of flame propagation which uses the expansion coefficients along with the normal burning velocities obtained from the pressure increase in the incipient stage of flame propagation. The expansion coefficients were computed from thermodynamic data as the ratio of burnt and unburnt gas volumes assuming the equilibrium is reached in the flame front. These parameters were compared with those obtained from alternative relationships proposed in literature for situations when no equilibrium calculations are possible (e.g., flammable gases with complex composition). The experimental propagation speeds are compared with computed ones, obtained from normal burning velocities delivered by kinetic modeling made using a dedicated computing package. Additionally, the dependence of the propagation speeds on initial pressure was examined and the baric coefficients of propagation speeds are reported. To complete the present research, the results were compared with literature data.