

Inefficiency of suppression of methane-oxygen mixtures autoignition by halogenated hydrocarbons

Alexander Drakon¹, Alexander Eremin¹

¹Joint Institute for High Temperatures RAS

An influence of various halogenated hydrocarbons considered as fire suppressants, namely CCl₄, CF₃H, C₂F₄Br₂, CF₃I and C₃F₇I, on shock-induced ignition of diluted stoichiometric methane-oxygen mixtures at temperatures 1100-1900 K was experimentally investigated in a shock tube of a standard design. Ignition delays were measured by registration of the emission of OH radicals. Observed temperature dependencies of induction times indicate that all studied suppressants, while effectively suppressing hydrogen-oxygen mixture autoignition [1], do not show noticeable inhibiting activity at given conditions, but contrary reduce the ignition delay time in methane.

The ignition development in methane-oxygen mixtures was modeled using CHEMKIN software package by GRI-Mech 3.0 mechanism and suggested kinetic schemes of halogenated hydrocarbons pyrolysis and oxidation. Acceleration of ignition development was explained by the release of atomic halogens and active radical during pyrolysis and subsequent initiation of chain reactions of methane combustion. Performed analysis indicated that considered fire suppressants are incapable of inhibition of methane autoignition due to their instability at elevated temperatures and insufficient radical consuming rates. Provided estimations of necessary properties of effective inhibitor allowed concluding that chemical inhibition of methane autoignition by halogenated hydrocarbons is unlikely.

Obtained results should be taken into account during the development and testing of new explosion prevention methods.

1. *Drakon A.V., Eremin A.V. On Relative Effectiveness of Halogenated Hydrocarbons for Suppression of Hydrogen-Oxygen Mixture Autoignition // Combustion Science and Technology, V.190, Iss.3, pp.549-554 (2018).*