On the impossibility of suppressing of methane ignition by the additives of halogenated fire suppressants

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An influence of the additives of iodine-bearing halogenated fire suppressants CF3I and C3F7I on shock-induced ignition of methane–oxygen mixture 6.7%CH4+13.3%O2+Ar at pressures $P = 4.0–6.5$ bar was experimentally investigated. Observed temperature dependencies of induction times have shown that these suppressants, while being effective as inhibitors of hydrogen ignition [1], contrary reduce the ignition delay time in methane similarly to other halogenated compounds studied previously [2]. Performed kinetic analysis indicated that considered fire suppressants are incapable of inhibition of methane autoignition at elevated temperatures due to release of active radical, initiating chain combustion reactions. It is shown that hypothetical suppressant with desired inhibition properties should remain more stable at high temperatures and, at the same time, have more chemically active molecule. Such requirements seem to be rather contradictory. Suggested simplified model of suppressants promotion and inhibiting proves that that more than ten-fold increase of the radicals consuming efficiency would be required to at least compensate promotion effect, and furthermore to noticeably slow down the ignition. Obtained results allowed to conclude that effective chemical inhibition of shock-induced methane autoignition by the halogenated hydrocarbons is unlikely.

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