Influence of fire extinguishing agents on shock-induced ignition of ammonia and ammonia–hydrogen mixtures

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Development and implementation of new types of fuels is required to reduce emissions of CO_2 and various harmful substances. Ammonia is considered a promising hydrogen carrier that could address the safety concerns associated with the use of hydrogen energy [1]. Due to the poor combustion properties of pure ammonia, the addition of hydrogen may be necessary to ensure operation of engines and power plants. The development of new energy technologies raises questions about the future applicability of fire safety systems currently in use. A recent discovery revealed that halons, widely used as fire extinguishing agents, may, under certain conditions, accelerate the ignition of combustible mixtures [2].

The influence of modern ecologically safe fire extinguishing agent, namely trifluoroiodomethane CF_3I, on shock-induced ignition of ammonia–hydrogen mixtures was experimentally investigated in a shock tube of standard design. Temperature dependencies of ignition delay time were obtained in the range 1020–1950 K at pressures 3.7–5.3 bar. Considerable inhibition of ammonia-hydrogen mixture ignition was observed. A compilation of modern kinetics mechanisms was suggested, enabling the modeling of combustion of ammonia–hydrogen mixtures doped with various halogenated agents. A comparison of experimental and modeled data, along with the results of sensitivity analysis, indicated key underinvestigated reactions of interest such as $CF_3 + O_2 \rightarrow CF_3O + O$.

[1] Kobayashi H, Hayakawa A, Somarathne K and Okafor E 2019 *Proc. Combust. Inst.* **37** 109–33

[2] Drakon A, Eremin A, Matveeva N and Mikheyeva E 2017 *Combust. Flame* **176** 592–8