

Impact of additives molecular structure on combustion of hydrogen

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My investigation is devoted to elucidation of features of the action of chemically active admixtures on combustion, explosion and detonation of hydrogen-air mixtures, as well as to develop efficient methods for controlling these processes by use of selected small additives.

Advantages of hydrogen as a fuel and energy carrier are well known. Production and use of hydrogen are increased progressively (global annual coefficient is approx 1.15). At the same time, however, application of hydrogen is significantly limited by heightened combustibility of its mixtures with air. Flame propagation in these mixtures easily is transferred to detonation and thus impedes controlling the process when hydrogen is used as a fuel. Until recently chemical methods for controlling gas phase combustion processes of hydrogen and hydrocarbons have been applied on a small scale. Only simple halogenated hydrocarbons (halons) have actually been used as fire extinguishers. These compounds are, however, of limited applicability not only because they are toxic and chemically aggressive toward environment, but also because of their low efficiency of action on combustion. A noticeable influence on combustion is only observed when large amounts of halons are used (up to 20-30%). This makes the use of these compounds expensive and impedes the elucidation of the nature of the action. The low efficiency of halons is one of the main reasons why, when interpreting their influence on combustion, the role of any reaction with the participation of additives is considered to be a factor no more important than, for instance, mixture dilution by the additive or heat capacity changes. Inhibiting action of hydrocarbons on combustion was recently even negated. Such a situation of the problem of chemically controlling combustion is to a great extent a consequence of traditional views on these processes.

My new approach is devoted to elucidation of futures of the action of chemically active admixtures on combustion of hydrogen at conditions important for practice, as well as to develop efficient methods for controlling these processes by use of ecologically clean selected small additives (2-3%) with certain molecular structure. New ecologically clean additives with required characteristics has been suggested, which will effectively control the combustion process, make it more intensive, less intensive or even prevent it.