

Application of the methane-hydrogen fuel compositions (MHFC) for a vehicle with high ecological quality

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The essential part of global fuel resources (30–40% of extracted petroleum) is consumed by a vehicle. While in service of petrol automobiles in an atmosphere the whole spectrum of toxic substances worsening ecological conditions, especially, in the large megapolities is thrown out. For example, in Moscow the share of a vehicle in pollution of atmospheric air achieves about 85%.

The basic negative influence of a vehicle on a condition of an environment of city and health of the population is determined by the low ecological characteristics of automobiles and motor fuel. Basic weight of emissions of harmful substances from a vehicle make: carbon, monoxide, hydrocarbons and nitrogen oxides. However, for health of the population the greatest danger is represented by vehicle emissions of cancerogeneous substances (soot, benzene, lead, 1,3-butadiene) and dangerous organic substances (formaldehyde, acrolein, toluene, xylene).

Russia has joined the Geneva agreement and is obliged to carry out the European norms on emission of harmful substances by a vehicle. A number of steps in this direction is already done, though the backlog from Europe makes 5–8 years. So the special technical rules in Russia establishes the order of introduction in action of the specifications of emissions concerning automobile engineering: an ecological class "EURO-3" — since January 01, 2008; "EURO-4" — since January 01, 2010; "EURO-5" — since January 01, 2014.

Today about 30–40% of petroleum, extracted in the world, is consumed by a vehicle. Russia has about 30% global stocks of natural gas and only about 5% by stocks of petroleum. On our sight the main direction of development of a domestic vehicle consists in increase of a share of natural gas in a general share of consumed motor fuel. Now in Russia the share of gas motor fuel (methane and propane) is estimated no more than 3%.

By expert estimations, the total contribution of lorries and buses of weight more than 3.5 ton to the detriment of an environment makes 87% (at performance by all automobile park of norms EURO-2). Therefore greatest efforts on protection of an environment should be directed just on these groups of a vehicle. The sharp jump of the prices on petroleum motor fuel has become additional important motivation of mass transition of a vehicle on natural gas, development of a network automobile gas refuelling stations (AGRS). Today in Russia about 3 thousand such gas stations. The important aspect of expansion of their network and uses of gas as motor fuel can become regulation of a ratio of the price of petrol / gas. For stimulation of transition on gas fuel such ratio on our sight should be not less than 3:1 for unit of weight of fuel. Now it makes 2:1.

The application on transport a compressed natural gas (CNG) instead of liquid motor fuel (LMF) allows to lower negative influence on an environment in 2–3 times, that is

extremely important, is especial in large cities.

At the same time, the further reduction of emissions requires change, both structure of fuel, and concept of impellent installation.

Perspective improvement of ecological and power parameters of natural gas here is at the expense of the additive of hydrogen. Hydrogen — most effective and ecologically clean fuel. World production of hydrogen today exceeds 550 bln.scm. The unique properties of hydrogen provide an opportunity of increase of efficiency of the engine of internal combustion (ICE) on partial loadings peculiar to movement of the automobile in urban conditions up to 1.5 times in comparison with ICE on petrol. In engines of internal combustion the hydrogen can be used as the basic fuel, and as the additive to traditional hydrocarbons, initiating process of combustion poor fuel-air mixes. In the latter case increase of fuel profitability and sharp reduction of toxic emissions also is reached.

The skilled operation of automobiles on alternative fuel which is carried out in the country and abroad, has shown a great prospects of transition to methane-hydrogen fuel compositions with the contents of hydrogen from 5% up to 10% on weight (20–40% on volume). Thus is sharp (in 2–4 times) is reduced toxicity of emissions, the operational charge of hydrocarbon fuel decreases on 35–40%, and the operational profitability raises on 20–25%.

The transition of a vehicle on natural gas allows to ensure norms EURO-3, and with transition to the new advanced engines — EURO-4. Use of methane-hydrogen fuel compositions (MHFC) at a share of hydrogen not less than 20% on volume even on existing engines is carried out with norms EURO-4, and at increase of a share of hydrogen in a mix till 44–48 of % carry out norms EURO-5. Thus the efficiency of harmful emissions reduction at use MHFC is higher, than at direct use of hydrogen of comparable volume. Business that while substituting, for example, 10% of auto fleet on clean hydrogen (lowering emissions, practically, up to zero) the cumulative effect of emissions decrease of all auto fleet is equal 10%, at use MHFC with the contents of hydrogen 10%mass. to all vehicles of this auto fleet the overall reduction) of emissions of all auto fleet makes 50%, i.e. the efficiency of application of hydrogen grows in 5 times.

As against hydrogen used in fuel elements, where its cleanliness (99,999%) is rigidly regulated, in mixes of a type MHFC of the requirement to cleanliness are not so rigid, as the most part of impurity is components of fuel and is burnt in the basic process of the engine. As against work ICE on natural gas use MHFC allows to work on more "poor" mixes without loss in efficiency of the engine and completeness of combustion of fuel, than the sharp reduction most of toxic emissions NO_x without simultaneous growth of HC emission is achieved. Growing air-fuel ratio of a mix is higher 1,5–1,7 results in reduction of cycle temperature determining formation of NO_x . This effect is shown at simultaneous growth of efficiency, that improves profitability of the engine and its operational characteristics.

The greatest interest the application of MHFC represents for automobiles with combined drive (HYBRID), in which ICE works on constant loading in a range of poor structures of fuel-air mixes at the minimal toxic emission substances and high parameter on fuel profitability. The additive of methane to hydrogen in this case will allow essentially to reduce weight of system of a storage of hydrogen onboard the automobile.

In Russia within the framework of works on nuclear-hydrogen power is developed and the technology of adiabatic conversion метана (ACM), allowing is accepted FASI and RosAtom on the basis of the industrial technologies, processes and catalysts to create effective manufacture MHFC with the contents of hydrogen 44–48%. Gas driven automobiles working on such fuel satisfy to norms EURO-5 at high operational

parameters.