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Improving The Economic And Environmental Performance Of Engines Through The Use Of Alternative Fuels

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ABSTRACT

The rapid depletion of fossil fuels and the steady increase in human energy consumption, leading to environmental pollution, are creating a situation characterized as an energy-environmental degradation. For this reason, extensive research is being conducted to address the problem of reducing the consumption of non-renewable energy sources and pollution of the environment with toxic waste. In such cases, the concept of hydrogen energy, ie the use of hydrogen as a source of energy on a large industrial scale and in road transport, is important. The prospects for the use of hydrogen for automobile engines can be summarized as follows. First of all, environmental friendliness, renewability and unrestricted raw material reserves, as well as unique engine performance; these allow hydrogen to be used without drastic changes to modern engine designs.

KEYWORDS

Hydrogen, ecology, automobile, engine, alcohol, methane, fuel, gasoline, environmental indicators, economic indicators.

INTRODUCTION

Vehicles around the world continue to focus on increasing fuel efficiency and using renewable fuel resources. To achieve these goals and objectives, on July 10, 2020 by the Resolution

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of the President of the Republic of Uzbekistan No. PD-4779 "About additional measures to reduce the dependence of the economy on fuel and energy products by increasing the energy efficiency of the economy and attracting available resources" approved "Roadmap for improving energy efficiency and saving fuel and energy resources in large energy-consuming enterprises of the economy". Paragraph 15 of the Roadmap sets out the task of "developing a long-term national strategy for the development of hydrogen energy".

This decision of the President is aimed at improving the living conditions of the population of the Republic; production of vehicles in accordance with modern requirements; construction of many quality highways; aimed at improving the environmental environment and meeting a number of important requirements [1,2].

THE MAIN FINDINGS AND RESULTS

The internal combustion engines of automobiles are the most important, complex and exhausting unit, and in many ways determine its efficiency, economy and reliability. Increased fuel economy and environmental requirements for internal combustion engines require the use of alternative fuels.

The development process of spark-ignition engines is characterized by an increasing degree of compression, which determines its fuel economy and other performance indicators. This is achieved by changing the design of the combustion chamber, cooling the combustible mixture and organizing its movement in the chamber as needed [3, p. 273].

A specific direction in the development of dead internal combustion engines due to the depletion of standard petroleum-derived fuels is the creation of workflows and engine modifications for the use of fuel-replacing materials.

The development of spark-ignition internal combustion engines is characterized by a gradual increase in the level of compression, which determines its fuel economy and other performance indicators. This is achieved by changing the design of the combustion chamber, cooling the combustible mixture and organizing its movement in the chamber as needed. Figure 1, shows the combustion chamber separating the flame from the torch in the front chamber of internal combustion engines running on gasoline. In such a chamber, the main cavity on the piston α = 1,3...1.4 is filled with a liquid fuel-air mixture that ignites badly from an electric spark. The small-volume auxiliary chamber is connected to the main chamber by means of small-diameter holes, each of which is filled with a condensed mixture supplied from the carburetor. When this mixture ignites, the flames of the burning mixture ignite the charge in the cavity of the piston and at the same time move randomly [4, p. 253].

In an unseparated combustion chamber (Fig. 1, b), the layered mixture is formed when fuel is sprayed through a nozzle into the circulating air in the chamber cavity of the piston. The combustible mixture is ignited either by means of a long-lasting spark discharge or by means of two spark plugs operating simultaneously. This method allows the compression ratio to be

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increased by 3...4 units and the use of mixtures up to α = 1,25...1.3.

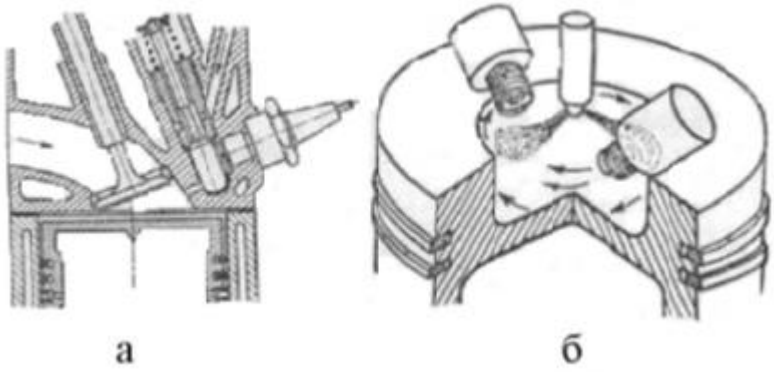

Figure 1. Combustion chambers of internal combustion engines running on gasoline: a) ignition of the torch in the fork chamber; b) burning the charge in layers.

RESULTS AND DISCUSSIONS

Electronic combustion engine control is widely used in gasoline internal combustion engines. This method allows reducing fuel consumption by up to 3...5%. In addition to gases, alcohols and hydrogen are being studied for the use of alternative fuels to replace petroleum-derived fuels. Methyl alcohol (methanol) and ethyl alcohol (ethanol) are bright fuels of the future. The heat of combustion of both alcohols is much lower than that of liquid fuels derived from oil. Their consumption per unit mass per engine is much higher. Therefore, it is necessary to replace the fuel dosing devices of internal combustion engines and increase the capacity of their vessels. The high heat of combustion of alcohols, even when the ambient temperature is positive, causes certain difficulties in starting the engine cold and complicates its operation without overheating. When alcohols burn, acids and salts are formed, which accelerates the wear of parts than when they work on petroleum fuels?

Alcohols easily form aqueous solutions and become dehydrated even during storage, a phenomenon that worsens the lubrication of parts and exacerbates their rust damage, so it is necessary to use special oils. It is advisable to use gasoline-alcohol mixtures as a first measure to save oil in internal combustion engines running on gasoline. When a small amount of alcohol is added (up to 5% in methanol and up to 10% in ethanol), there is no need to make any changes to the engine.

Hydrogen is a type of fuel with great prospects for internal combustion engines because it has an inexhaustible raw material base; the combustion heat is very high. The high diffusion coefficient of hydrogen allows the formation of a homogeneous mixture, even when the fuel is transferred to the cylinder in any way, allowing it to be evenly distributed among the cylinders in all operating modes of the engine. At the same time, the use of hydrogen as an engine fuel also has drawbacks. Its production is relatively expensive, and special high-pressure gas cylinders are required

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to use hydrogen in internal combustion engines [5, 6, pp. 12-18; 7, 8, pp. 729-731].

We are conducting research to improve the technical, economic and environmental performance of hydrogen in gasoline-air mixtures in spark-ignition engines. We created our own hydrogen generator (electrolyzer). We carried out verification and testing work for its reliable operation. The schematic diagram of the hydrogen generator is shown in Figure 1. The hydrogen generator is installed in the Lacetti vehicle and is being exploited and tested [9, pp. 65-66; 10].

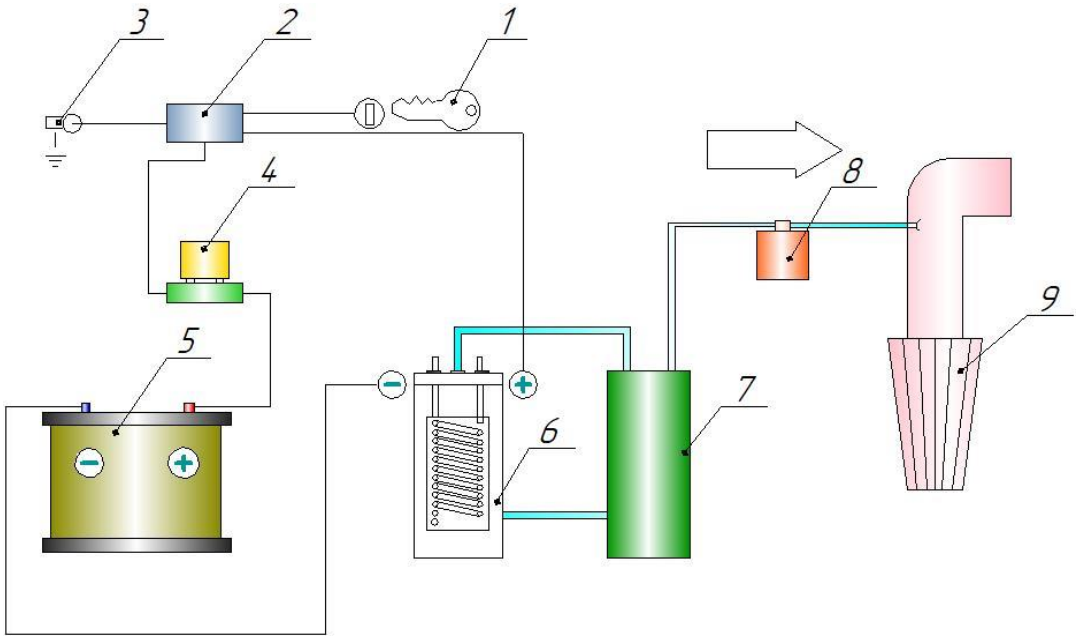

Figure 2. Schematic diagram of a hydrogen generator.

1-switch, 2-relay, 3-mass, 4-fuse, 5-accumulator, 6-NNO generator, 7-reservoir, 8-moisture holder, 9-air filter.

Table 1

Fuel	Average value of fuel consumption	Deviation from the average value	$(x_1 - x)^2$
Gasoline	9.8	-0,1	0,01
	9,24	0,1	0,01

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	9,53	0,1	0,01
When adding hydrogen to the gasoline-air mixture	7,68	-0,2	0,04
	7.41	-0,1	0,04
	7,32	0,2	0,04

According to the test results of the study, gasoline consumption was x = 9.52 liters, and the addition of hydrogen to the gasoline-air mixture consumed x = 7.47 liters of fuel.

Scientific research is being carried out to improve the performance of the car by re-equipping the scientific laboratory and adding hydrogen to the gasoline-air mixture. As a result of scientific research conducted in the operational test of the car, it was possible to reduce fuel savings by up to 20% by adding hydrogen to the gasoline-air mixture.

CONCLUSION

When gasoline-air-hydrogen mixtures are used gradually, it is possible to realize the advantages of using hydrogen even at high compression levels, without unpleasant consequences, by increasing the proportion of hydrogen in them and reducing the load. If such control is set in the idle mode of the engine, it can run on hydrogen even when it is α = 5...6.

The addition of hydrogen to the gasoline-air mixture affects the combustion process, ensuring a complete combustion process, which in turn improves economic and

environmental performance. By adding hydrogen to the gasoline-air mixture, the amount of toxic gases (SO, SO2 and SN) released into the environment as a result of complete combustion of the fuel is reduced by 5-10 times, depending on the engine operating mode. Engine power will be increased by 10%, the performance and dynamics of the car will be improved.

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