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SOME SPECIFICATIONS OF DIESEL ENGINE RUNNING ON GASEOUS FUEL

НЕКОТОРЫЕ ОСОБЕННОСТИ ДИЗЕЛЬНОГО ДВИГАТЕЛЯ, РАБОТАЮЩЕГО НА ГАЗООБРАЗНОМ ТОПЛИВЕ

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Abstract. The paper dwells on the effectiveness the transition of diesel transport–energy equipment to the alternative gaseous fuel, as well as its specific design features. There is justified the possibility of the ignition of a gaseous fuel mixture through the assessment of dosing of the explosive charge, and its influence on the functioning of the process of a gas–air mixture combustion.

There are also described the possible positive phenomena, which have sprung during the operation on gaseous fuel.

Аннотация. В работе рассмотрена эффективность перехода дизельного транспортно–энергетического оборудования на альтернативное газообразное топливо, а также его конструкционные особенности. Обосновывается возможность воспламенения газообразной топливной смеси с помощью оценки дозирования взрывного заряда, а также продемонстрировано его влияние на течение процесса сжигания газовоздушной смеси.

Приводятся возможные положительные явления, возникающие во время работы двигателя, а также их преимущества в случае работы на газообразном топливе.

Keywords: explosive charge, gas-air mixture, dosing, exhaust.

Ключевые слова: взрывной заряд, газовоздушная смесь, дозировка, выхлоп.

Among land vehicles and maritime transportation, the most common energy installations are the reciprocationg internal combustion engines. The petroleum–derived liquid fuels with various fractional compositions are used for the operation of them. Heavy–duty vehicles are mostly equipped with diesel engines, in which diesel or fuel oils are used, which are produced from crude oil by substantially complex processing.

Over the past two decades, the specific liquid fuel consumption has reduced as follows: in cargo vehicles — by a factor of 1.7; in maritime transport — 1.8 times; and in river transport — has halved. This has been achieved through the vehicle fleet renewal and due to the use of new high-performance engines. Despite this, the degree of utilization of petroleum products in transport and energy sector is constantly growing. The main reason for this lies in the constantly growing energy consumption and transport services. The shortage of petroleum products is continuously growing because of a decrease of their reserves and their deposit locations in remote areas. At the same time, new deposits are located in areas of difficult access and so on. All this increases the costs of the extraction of petroleum products. The costs of transportation and on the refining of oil are also increasing, and besides, oil is an essential raw material in chemical manufacturing.

The possibility of utilizing natural gas as fuel both in the vehicle engines and the thermal power plants allows for reducing the shortage of diesel fuel, and consequently, for reducing significantly the cost of the energy generated. In addition, natural gas does require any chemical preparation. Mechanical cleaning and removal of drops of moisture are sufficient for use them as fuel for the engines. Accordingly, significant interest is generated by the use of gaseous fuel in the internal combsurtion engines.

Analysis of the consumption of fuels as energy resources shows that in recent years, the share of natural gas has been grwing significantly. This is explained by high properties of its consumption, as well as by its considerably lower cost and equivalent amount of energy in comparison with liquid fuels.

To ensure the increasingly growing amount of energy consumed by transport, which requires cheap and ecologically clean fuel, as well as for the purpose of the more effective use of natural resources, it is necessary to find ways and means to expand the fractional composition as alternative fuels.

One of the means of liquid fuel efficiency is the implementation of a gas–diesel cycle (GDC), that is, the replacement of the main liquid fuel by natural gas in the internal combustion engines, where the mixture ignition is carried out by injecting a small dose of liquid fuel during the induction period. The power of the fuel ignition flame should be considerably higher than in the spark–ignition engines, in order to make it favorable for the effectiveness of a cycle. The use of a gas–diesel cycle allows for reducing the working liquid fuel by 80%, exhaust smoking — by 3–4 times, carbonic oxides — by 86.9%, nitrogen oxides — by 50–60%. The advantage of engine running in a gas–diesel cycle is its capacity to move from gaseous fuel to the consumption of diesel fuel and back again, without engine stop and load removal [1].

When using liquid fuel required for the ignition of a gas mixture, the same fuel–injection equipment remains, which ensures the possible operation of engine on both fuels. In this case, the explosive fuel consumption cannot be lower than the diesel fuel consumption at engine idle and during the operation at small rated loads, or it is necessary to design special–purpose fuel–injection equipment, which ensures supply of fuel minimum dose (within 7%). At the same time, when moving from diesel fuel to gaseous fuel, load management, that is, the quality power level control is complicated, which takes place in a diesel engine at the given moment. It is necessary to use such devices, which provide the control of the amount of a gas–air mixture. To that end, very common is the use of the standard injectors, which are required for the operation at engine idle. At the same time, it should be noted that during the operation at idle diesel engine, omission of the ignition in any cylinder is not dangerous, but little cyclic supply of liquid fuel for a gas–diesel cycle is not an indication of the operation of at idle engine. Thus, at this time, the engine may operate at high loads. When omitting the ignition in the cylinder, the unburned gas–air mixture is emitted into an exhaust

manifold that may result in emergency situation, that is why the only condition for the normal operation of such engine when operating in gas–diesel modes in a cylinder is the guaranteed mixture ignition. The standard fuel–injection equipment with little cyclic supply of fuel, as a rule, is unsatisfactory. This is due to instability of cyclic fuel supply in the cylinders over the cycles, as well as due to reduction of the injection pressure, the deterioration of cooling in an atomizing nozzle of injector, their overheating and coking. Combination of these factors causes the deterioration of the ignition and hindering the fuel combustion. The use of the standard fuel–injection equipment, which is regulated by the uniform nominal cyclic supply, brings us to the fact that, during the reduction of load in a cylinder, the non-uniformity of fuel supply reaches its extreme value at idle engine speed, which is linked to the plunger of fuel–injection equipment, and causes the reduction of the effective stroke that in turn, is accompanied by the reduction of the initial pressure of a pressure blower and the operation instability. A subsequent decrease in cyclic supply leads to nondelivery of fuel into the separate cylinders, and the engine is characterized by the operation instability. The minimum value of cyclic supply for most engines, which ensures the required quality of fuel injection and its uniform distribution in the cylinders is limited and it is about 20% of the nominal value [2].

The problem, however, is that during the presence of gas, self-ignition of diesel engine is hindered, and thus, it is necessary to provide a sufficient concentration of a small dose of diesel fuel at one point (in a small volume), where after the self-ignition of diesel fuel, a sufficient amount of energy is released for combustion of a gas–air mixture and the subsequent spread of the flame, which means that it is necessary to create the powerful initial nucleaton site for intensive combustion.

The vehicles gas–diesel engines experience demonstrates that the operating process provides:

- an increase in engine capacity by 3–10%;
- reduction in diesel fuel consumption by 40–60%;
- an increase in diesel engine efficiency by 5–8%;
- reduction in exhaust smoking by 2–3 times;
- extension of service life of engine oil by 2–3 times;
- allows for utilizing completely cylinder capacity;
- allows for developing high engine speed without any additional measures.

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References:

1. Khachiyan, A. S. (2004). On the choice of gas engines for buses in Moscow. *AvtoGazoZapravochnyi kompleks + Alternativnoe toplivo,* (1), 22-24. (in Russian)

2. Sviridov, Yu. B. (1972). Mixture and combustion in diesel engines. *Leningrad, Mashinostroenie,* 224. (in Russian)

Список литературы:

1. Хачиян А. С. О выборе газовых двигателей для автобусов г. Москвы // АвтоГазоЗаправочный комплекс + Альтернативное топливо. 2004. №1 (13). С. 22-24.

2. Свиридов Ю. Б. Смесеобразование и сгорание в дизелях. Л.: Машиностроение, 1972. С. 224.

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