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PROSPECTS OF USING PETROL AND ALCOHOL MIXTURES BY PISTON INTERNAL COMBUSTION ENGINES

The problem of use of alternative fuels in internal combustion engines (ICE) in recent years is the most relevant in relation to the situation that has arisen in the world to date – a decreasing of reserves and increasing in the price of fossil fuels. The potential of production of ethanol for passenger transport around the world is estimated at about 32 % of the consumed gasoline when using E85 (85 % alcohol) [1]. The possibility of substitution of such a level of traditional fuels draws attention to the problem of the use of renewable resources and the collateral damage to the environment in the form of seizure of agricultural land, pollution of water sources by pesticides, widely used in the production of raw materials for biofuels. One of the important technical requirements related to the use of ethanol in composition of benzoethanol (petrol and alcohol mixture) for ICE, is to increase its aggregate stability. When the temperature drops and increase the amount of water in the benzoethanol fuel occurs its delamination with the formation of two liquid phases. Tendency of the gasoline and alcohol mixtures to separation depends on the petrol composition, water and alcohol content in the composition. With increasing concentration of aromatic compounds in petrol and with increasing alcohol fraction contained in a mixed fuel, its cloud point temperature reduce [1]. The modern system of preparation of mixed fuels are used, as a rule, hydrodynamic, vortex and ultrasonic cavitators. A promising direction of researches is the development of small-dimension hydrodynamic cavitators which enable to maintain the benzoethanol stability on board the vehicle [2]. One of the drawbacks of this type of alternative fuel is its high corrosion activity [3].

This subject of research is one of the basic directions of work of Piston Power Plants Dept. (DPPP) of A.N. Podgorny Institute for Problems in Machinery of NASU (IPMash NASU) [2-5]. The DPPP Laboratory is equipped with the engine test bench (ETB), in which the object of research is the transport piston engine MeMZ-307.1 (automobile, gasoline, four-in-line vertical arrangement of cylinders and liquid cooling) [4, 5]. Given the decline of net calorific value of benzoethanol fuel the engine has been primarily adapted to ensure efficient operation on gasoline and benzoethanol [6]. Adaptation carried out by reprogramming the electronic control unit (ECU) and the change of the characteristic maps, in which the engine is running, depending on the mode (increased length of fuel injection in the study mode, and ignition timing is adjusted interactively using appropriate software). In the ECU was entered additional program to ensure effective operation of the engine on benzoethanol. In this paper carried out comparative studies of characteristics of the MeMZ-307.1 transport engine operating on petrol mark A95 and benzoethanol mark E85 on a ETB. The ETB consists of a motor bench and measuring equipment capable of measuring engines indicators of work and test conditions. ETB includes the DC balancing dynamometer type DS 926-4/V with integrated speed sensor and a weight device for measuring the torque, the motor-generator, thyristor excitation unit, control cabinet, control panel.

On the test modes (maximum torque and nominal power) effective efficiency (η_e) of engine adapted to mark E 85 benzoethanol is higher than not adapted engine as well as of petrol version by 6.6 % and by 6.7 % (on maximum torque mode and nominal mode respectively). Indicators of exhaust gas (EG) emissions of benzoethanol engine is significantly better than indicators of gasoline engine. An exception is the content of nitrogen oxides in EG, which at nominal mode higher for benzoethanol engine than gasoline engine (ETB exhaust system has no car catalytic converter). The values of the air excess factor (α) on the said modes were, respectively, 0.96 and 0.97, and the EG temperature decreased on 54 °C and 93 °C. Excess of benzoethanol E85 consumption compared to gasoline consumption by 35.5 % and 31.5 % for the said modes explained by the difference of the specific heat of combustion, which is 64%. For the most favorable compromise between power, efficiency and toxicity of an engine running on benzoethanol must be coordinated regulation of the ignition timing depending on excess air ratio. Also promising research direction are improving the efficiency of application of benzoethanol in the ICE by the developing a sensor that is integrated into the car standard fuel system, which evaluates the composition of the mixed fuel, and the allows car ECU to choose autonomously the most effective control program (for petrol and benzethanol).

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PROBLEMS OF PARTICULATE MATTER MASS EMISSION IN DIESEL EHXAUST EXPERIMENTAL DETERMINATION

Requirements for the ecological characteristics of diesel vehicles obligatory in the territory of Ukraine, the Russian Federation and the European Union, as fixed legislatively – UNECE Regulation № 49 and № 96 level of EURO III, IV and V respectively [1]. These documents defines a list of normed pollutants in the exhaust gas (EG) of diesel engines, limits for their mass emissions, bench testing methodology and a list of stationary test cycles modes (13 and 8 respectively), is a model of the operation of such vehicles. This sets the method for measuring a mass emissions of particulate matter (PM) – gravimetric and means of its realization – full- or partially-flow tunnels. The high cost of manufactured tunnels, extreme science intensity of their development and the complexity of their certification determine the need to find methods and means for determining the of PM mass emissions, alternative for tunnels and suitable for preliminary and comparative laboratory studies [1].

In Piston Power Plants Dept. of A.N. Podgorny Institute for Mechanical Engineering Problems of NAS of Ukraine developed particulate matter filter (DPF) with new modular unconventional construction for diesel vehicles in operation. Thus its operating characteristics under real operating conditions determined during the bench experimental studies. They were carried out on the engine test bench (ETB), equipped with an autotractor diesel engine D21A1 (2Ch10.5/12), but isn’t equipped with a tunnel [1]. Test programs are based on standardized stationary testing 13 and 8-mode cycles, which are a models of operation of the vehicle [1]. The main operating characteristics of the developed DPF is the efficiency coefficient K_{CE} of cleaning a diesel EG flow from the PM, which defines by the following formula [1]: $K_{CE}(G_{PM}) = (G_{PM.ICE} - G_{PM.DPF}) \cdot 100 / G_{PM.DPF}$, %, where G_{PM} – PM mass emission with diesel EG, kg/h; indexes *ICE* and *DPF* refers to cases of absence and presence of DPF in the exhaust system of a diesel engine. This raises the following problems, the solution of which require the use of appropriate approaches.

The approach to determining of PM mass emissions. It involves direct measurement of EG samples opacity (by Opacimeter INFRAKAR-D) and the volume con-