INFLUENCE OF DISEL COMPOSITE FUEL ON THE BASIS OF RICINIC OIL ON INDICATORS OF THE TRACTOR DIESEL OPERATION

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Timeliness: *The relevance of the matter is confirmed by numerous researches of the alternate engine fuel, in particular, from the renewable sources of raw materials (biomass) studied in various regions of the Russian Federation and abroad.*

For obtaining diesel composite fuel as raw materials are attractive oil crops which are not used in the food industry, for example, carthamus, false flax, colza, winter cress, crambe and castor-oil plant.

At the moment the need for the ricinic oil used in military, chemical, machine-building, radio-electronic, printing, paint and varnish, medical, cosmetic and other industries in the Russian Federation grows. As a result of processing of a castor-oil plant fruits by cold press in residual meal or pod there are about 10% of oil which is possible for allocating by processing of meal on technology of extraction with receiving technical ricinic oil with a possibility of application as raw materials for receiving paint and varnish, lubricants and diesel composite fuel.

However viscosity of ricinic oil is 10 times more, than at diesel gas oil therefore it is necessary to apply in mix with low-viscosity components. As additive to ricinic oil can be used mineral oil fuel and bioethanol due to which mixture viscosity considerably decreases, cloud point and crystallizations temperature decreases. [8]

As diesel composite fuel is investigated mixture of ricinic oil (RicO), and summer diesel gas oil according to National State Standard 305-2013. On the basis of the carried-out calculation are defined indexes of a working cycle, dependences on concentration of components of blenderized fuel are shown.

On the basis of the calculation, are determined the working cycle indexes, are shown the dependences on the concentration of the components of the composite fuel. Based on the results of the calculation, the obtained indicators were compared with diesel gas oil.

KEY WORDS: *RICINIC OIL, CASTOR OIL, DIESEL COMPOSITE FUEL, DIESEL, INTERNAL COMBUSTION ENGINE, MIXTURES, POWER, ECONOMY, ALTERNATIVE FUEL, BIOMASS.*

1. INTRODUCTION

One of the main ways of development of agricultural and timber production is the partial transfer to alternative fuels from biomass. This is confirmed by the Decree of the President of the Russian Federation of July 7, 2011 No. 899 on priority areas for the development of science, technology and technics in the Russian Federation. The development of alternative energy and the use of biomass are also taken into account by many international studies and scenarios for the development of energy and industry in general.

According to the innovative scenario for the development of world energy until 2050 as a result of the change in the structure of the global fleet of vehicles, as well as the introduction of strict restrictions on emissions of toxic substances, renewable energy and alternative fuels will develop significantly. [2]

An innovative scenario involves overcoming the crisis of the industrial phase (in its postindustrial or non-industrial form) and the crisis of relations with the environment on the basis of the transition to a new phase of development of the society, economy and energy. [2]

As a consequence of this, the energy sources obtained from biomass will receive a great development already in modern times, they can be applied to the vehicles and tractors without significant upgrades of the existing ICE.

For this reason, is being carried out large-scale international scientific research to diversify energy supply sources that will solve the problem of replacing petroleum fuels, significantly expand the resource base for obtaining motor fuels, facilitate the solution of fuel supply issues for vehicles and fixed installations remote from large settlements, can be achieved reduction of production costs. [3,4]

Biodiesel, methane and diesel composite fuel are preferred as alternative energy sources for automotive vehicles in this period.

Biodiesel as a fuel type has a disadvantage expressed by a low temperature of turbidity and crystallization as a result of which it cannot be applied in northern regions where the ambient temperature reaches over -30 ° C. This type of alternative fuel is more applicable in countries with a warm climate and having smaller reserves of petroleum raw materials than the Russian Federation, such as Brazil, India, Vietnam. [2,6]

Gas-diesel is installed on KamAZ-65115, Scania G340 and NefAZ-5299 buses. But as a result of the insufficient level of gasification of the territory of the Russian Federation, and especially in the rural areas, it is impossible to use methane as an alternative source of energy for tractors in agricultural enterprises and logging enterprises that are remote from the gas pipeline.

Among the preferred types of biofuel applicable to agriculture and forestry is the multicomponent diesel composite fuel produced from the mixing of petroleum diesel fuel and plant oil. [13]

The most studied source of plant raw materials is rape. However, the use of oils from other oilseeds deserves attention. Today, there is a growing need in the Russian Federation for ricin oil in military, chemical, machine-building, radio electronic, printing, paint, medical, cosmetic and other industries. In connection with the current policy on import phase-out and oil demand in the Russian Federation, since the main share of ricinic oil on the market is produced in India. It can be considered that technical ricinic oil is a promising competitor to other plant oils, investigated as components of diesel composite fuel. [14,15,16]

Castor oil plant belongs to the genus of perennial plants of the family of euphorbia. This genus is represented by one species - castor beetle (Ricinus communis), which is subdivided into several subspecies.

In tropical and subtropical countries, castor oil is grown as a perennial or annual culture, in areas with a temperate climate - only as an annual one.

In crop rotation, castor oil plant is placed after winter wheat, winter barley, maize and leguminous plants. The castor oil plant itself is a good precursor for spring cereals.

The cultivar of castor oil plant Khortitskaya 1 is mid-season, plants of medium height, weakly-violet, laid a dense brush at 8-10 knots. Bole height is 50-70 cm. Khortitskaya 1 is highly resistant to fusarium, adapted for mechanized harvesting. Oil content of seeds is 51-52%. The yield is 1.2-1.5 t / ha. [17]

As a result of processing of the castor oil plant fruit by cold pressing, only 10% of the oil remains in the residual meal, which can be recovered by processing the meal using the technology of extraction or processing of fruits by hot pressing to obtain a technical ricinic oil with the possibility of using it as raw material for the production of paintwork materials and diesel composite fuel.

2. ESTIMATE INDICATORS OF TRACTOR DIESEL ENGINE WORK

To use diesel composite fuel on the basis of ricinic oil, it is necessary to analyze the influence of the constituent components on the economic, power-cycle characteristics of the diesel engine.

Calculation of the D-240 engine was carried out by the methods of Prokopenko R.M., Khorosh A.I., Bashirova R.M. [9,10,11] using three fuel mixtures: RicO + DO, respectively (mixture 1, mixture 2, mixture 3). The results of the studies are presented in Table No. 2.

Is determined the content of the basic substances included in the composition of ricinic oil by the method of Egazaryants C.B, and is calculated the elementary composition of the mixture, which is determined by the content of C, H, O by the formula Mendeleyev D.I. The results of the studies are presented in Table No. 1 [12].

***Table No. 1** - Elementary composition of mixtures.*

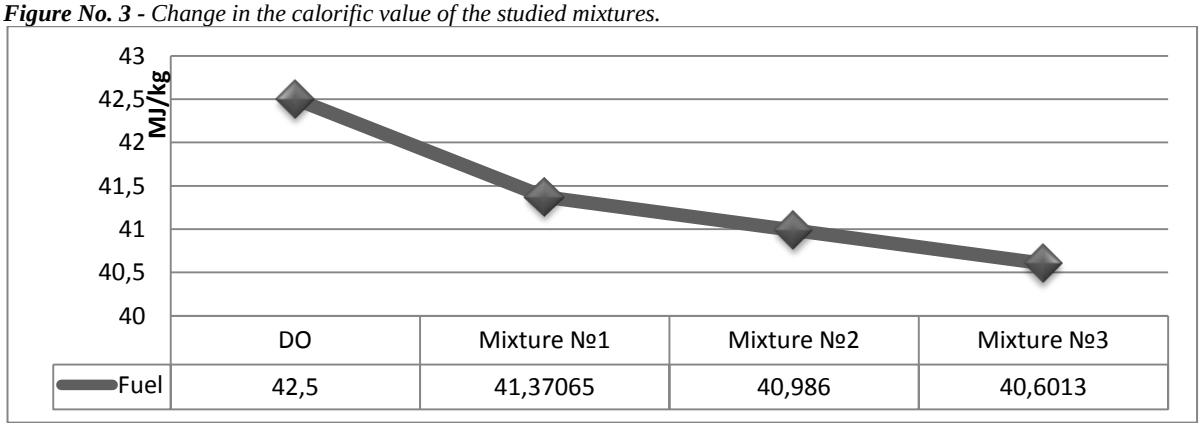
№	Indexes	DO	Mixture 1	Mixture 2	Mixture 3
1.	Carbon C	0,870	0,8495151	0,8426868	0,8358585
2.	Hydrogen H	0,126	0,1239453	0,1232604	0,1225755
3.	Oxygen O	0,004	0,0265396	0,0340528	0,041566

From the obtained data it is possible to single out the primary feature of diesel composite fuel based on ricinic oil, the oxygen content increases which favorably affects the completeness of combustion of the mixture.

***Table No. 2** - Indicators of the working cycle of a diesel engine using mixtures of different concentrations.*

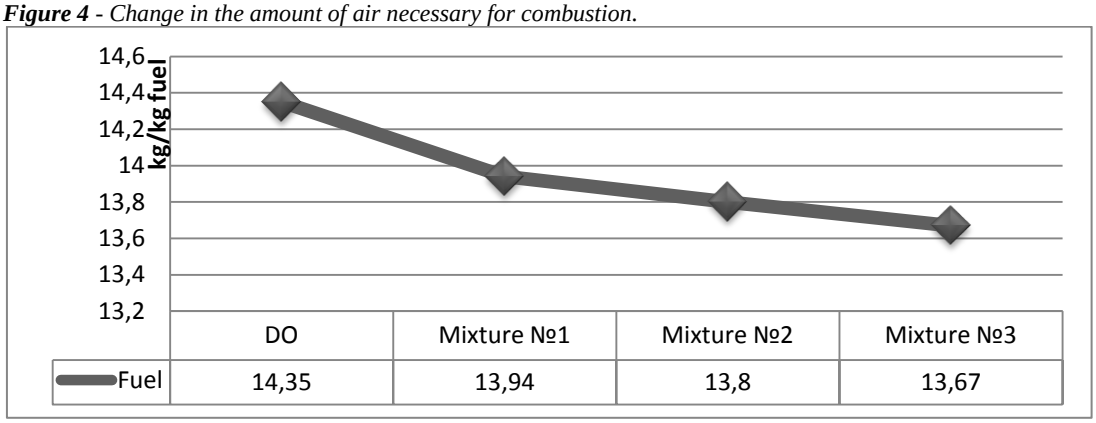
№	Indexes	DO	Mixture 1	Mixture 2	Mixture 3
1	2	3	4	5	6
4.	Heat of fuel combustion, MJ / kg	42,5	41,37065	40,986	40,6013
5.	Theoretical amount of air, kg \ kg of fuel	14.35	13,94	13,80	13,67
6.	Heat of combustion of a inflammable mixture MJ / kg	1.8874	1.8882	1.88876	1.8880
7.	Coefficient of molecular change	1,041	1,04283771	1,04334192	1,043856
8.	Combustion temperature, ^{0}K	2158,0	2168,5	2168	2167,5
9.	Mean effective pressure, MPa	0.7233	0.709635	0.71	0,71035
10.	Effective efficiency	0.363	0,351645	0,3517	0,35174
11.	Effective specific fuel consumption, g \ kW	233,3	247,46	249,74	252,08
12.	Effective power, kW	63,0	61,80	61,83	61,86
13.	Power change,%	-	-1,91	-1,86	-1,81
14.	Change in specific fuel consumption,%	-	+6,07	+7,048	+ 8,05

***Figure No. 3** - Change in the calorific value of the studied mixtures.*



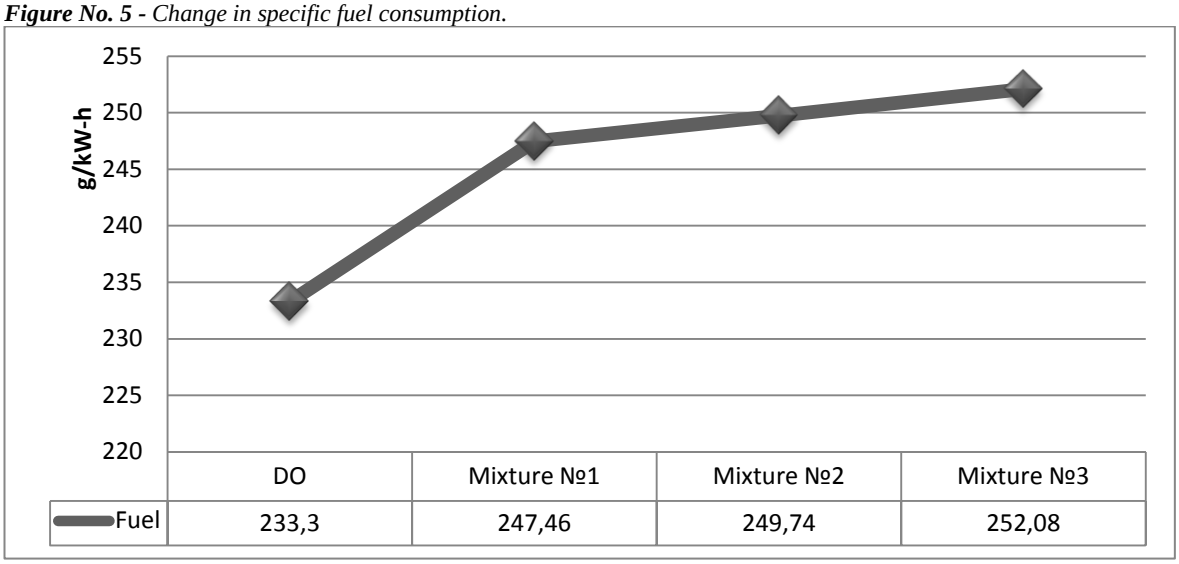
When analyzing the calculations, it is noticed the decrease in the heat of combustion the test mixtures by 2.6% in comparison with diesel fuel. With a change in the oil fraction by 5%, the heat value of combustion changes by an average of 0.93%.

***Figure 4** - Change in the amount of air necessary for combustion.*



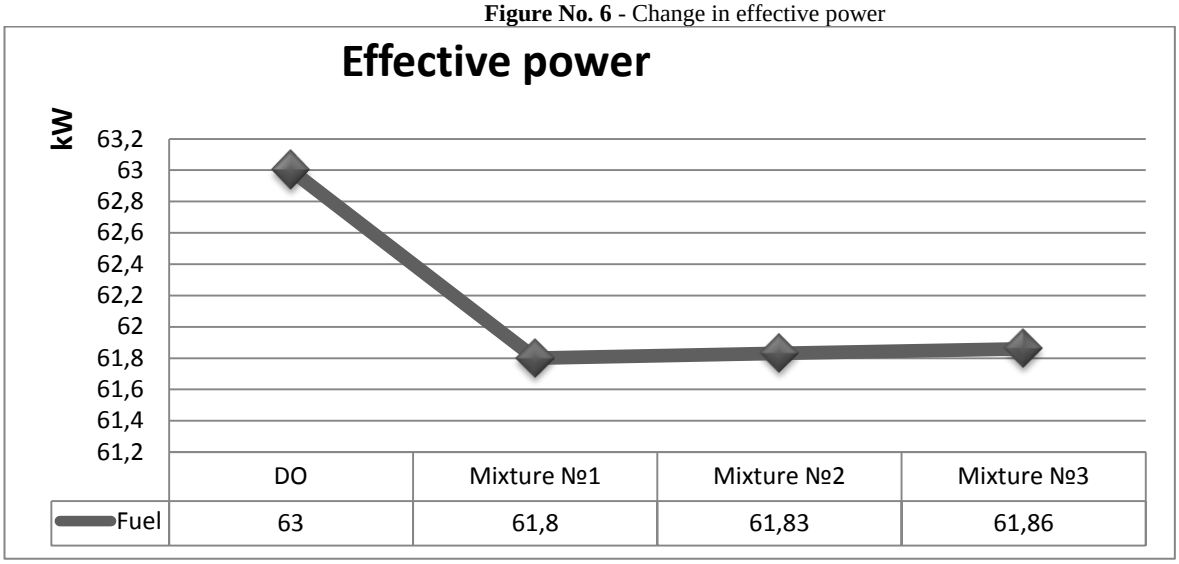
When using mixtures based on ricinic oil, is reduced the required amount of air for combustion of the mixture: according to calculations in comparison with diesel fuel, it decreases by 2.86%, with the required amount of air decreasing as the concentration of oil in the mixture increases. This is due to the high oxygen content according to the elemental composition of $C_3H_5O_3$ ($C_{18}H_{33}O_3$) ricinic oil compared to diesel fuel.

Figure No. 5 *- Change in specific fuel consumption.*



Specific fuel consumption is significantly increased by 6.07% in comparison with diesel fuel, and is revealed regularity: with an increase in the oil concentration for every 5%, the consumption increases by 2.3 g / kWh.

Figure No. 6 - Change in effective power



There is a slight decrease in power compared to the operation of the engine on diesel fuel mixture: an average of 1.86-1.91%, depending on the concentrations of the used components.

3. CAN BE DONE THE FOLLOWING CONCLUSIONS ON THE BASIS OF THE CONDUCTED STUDIES:

1. The required amount of air for combustion of the mixture decreases as increases the concentration of oil in the mixture.

2. There is slight decrease in the power of engine D-240 at 1.86-1.91% when working on diesel composite fuel based on ricinic oil compared to diesel fuel.

3. The economy of the engine deteriorates by 6.07% in comparison with diesel fuel or by an average of 2.3 g / kWh, with an increase in the proportion of oil in the mixture by 5%.

It was found that the heat of combustion of the combustible mixture is relatively small changed, which is associated with a decrease in the number of moles of combustion products. [5.8]

4. CONCLUSION.

Thus, diesel composite fuel based on ricinic oil has the ability to be used on diesel internal combustion engines, according to the calculations, it has similar indicators with mixtures based on rapeseed, mustard, soybean oil.

These studies will be of interest to companies engaged in the production and processing of castor oil in order to reduce fuel costs. But it makes sense to reduce the share of the oil base and increase the environmental friendliness of the ICE to conduct research on the addition of bioethanol.

5. CONFLICT OF INTERESTS.

The author confirms that the presented data do not contain a conflict of interest.

6. GRATITUDES.

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