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ANALYSIS OF PRODUCTION TECHNOLOGIES AND THE IMPACT OF BIOFUELS ON THE ENGINE'S OPERATION

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The analysis of the technologies of energy consumption in the production of biofuels and assessed the effect of physico-chemical parameters of biofuels on the performance of the diesel engine.

Keywords: vegetable oil, canola, air, oil, dispersion, diesel.

Introduction. Such a petroleum as diesel fuel may be substituted by less expensive (today) type of fuel, and thus environmentally friendly - a methyl ether of oily acid, or "biodiesel" [1,2,7]. The application of process of the esterification for vegetable oil with methyl alcohol made it possible to get methyl esters of oil acicles. These esters were similar in their physical and chemical characteristics to mineral diesel and quite suitable for use as a fuel in internal combustion engines in its pure form. Esters are well mixed with mineral diesel fuel in any proportions. Biodiesel fuel is made from any vegetable oil, rape, sunflower and others. The quality of biodiesel fuel depends primarily on the degree of preparation of vegetable oils. Oil should not contain impurities and water, the finished product should be cleaned more thoroughly.

Problem. The European countries (Germany, Austria, France and others) successfully organized the production of biodiesel from hydrodynamic activated mixture of petroleum diesel from rapeseed oil. In Europe, each year produced it is more than 600 thousand tons of biodiesel using rapeseed oil. The area under cultivation of rape in the world significantly increases, in particular, in Germany they reach 12% of arable land. In Ukraine Due to arisen oil problems, sown area under different types of rape is increasing especially in contaminated soils (Chernobyl regions). The cost of biodiesel based on rapeseed oil mixtures is generally below the market price of petroleum diesel. But even at an equal price, the feasibility of using biodiesel is dictated by environmental requirements. Positive results for the production of biodiesel were received abroad. Over the past 10 years the demand for biodiesel has grown to 2 million tons. Half of this amount is used in Germany where biodiesel is not taxed and costs 0.1 euros/liter less diesel fuel of petroleum origin. On the eve of the global fuel crisis in Ukraine there are objective conditions for the development of manufacturing biodiesel from vegetable oils, primarily in mini-mills in terms of AIC volume 50-100 thousand tons of biodiesel fuel per year. Such contender is Polish company "Man-zoil", which deals with trade in food oils and biodiesel fuel, at this time is building a mini-plant with a production capacity of 150 tons per year in the northwestern part of the country. The Company also appears an intermediary in the market of technical oils for biodiesel [1,2,7].

Analysis of recent research and publications. Biodiesel or biodiesel fuel is an environmentally friendly fuel alternative in respect of the mineral species derived from vegetable oils and used to replace (savings) conventional diesel fuel. The raw material for the manufacture of biodiesel fuel may be different vegetable oils: rape, soybean, peanut, palm, sunflower and olive waste oils (used, for example, in the manufacture of food) and animal fats. From a chemical point biodiesel is the methyl ester. In its manufacture, during esterification, oils and fats react with methanol and sodium hydroxide, which serves as a catalyst, resulting in fatty acids and by-products: glycerin and others. [1,2,3,7].

The purpose of research: Analysis of technologies and energy efficiency of biodiesel in terms of agricultural production. Set the influence of physical and chemical parameters of indicators of biodiesel in diesel and its ecological and performance.

Results. Biodiesel fuel is environmentally friendly type of biofuels derived from fats of vegetable origin and used to replace petroleum diesel fuel (DF). From a chemical point of view, biodiesel is a mixture of methyl (ethyl) esters of saturated and unsaturated fatty acids. In the reaction of transesterification of oils fats react with methyl (ethyl) alcohol in the presence of a catalyst (alkali), resulting in the formation of esters and glycerol phase 56% glycerol, 4% methanol, 13% fatty acids, 8% water, 9% of inorganic salts, 10% esters. Basic physico-chemical properties of fuel diesel engine are shown in table 1.

Table 1. **Physico-chemical properties of fuel diesel engine. [7]**

Physico-chemical properties	Fuel mixtures and derivatives of rapeseed oil (RO)					
	Clear DF	0.7 DF + 0.3 RO	0.5 DF + 0.5 RO	0.3 DF + 0.7 RO	Pure RO	ROME
Density at 20 ° C, kg / m^3	830	856	873	890	916	877
Kinematic viscosity at 20 ° C, mm^2/s	3,8	9,3	16,9	31	75	8
The heat of combustion is lower N.MDzh / kg (MJ / l)	42,5 (35,3)	40,9 (35,0)	39,9 (34,8)	38,9 (34,6)	373 (34,2)	37,8 (33,2)
Cetane number	45	42	41	39	36	48
Auto-ignition temperature, °C	250	-	-	-	318	230
Stoichiometric ratio (air, fuel)	143:1	13,8:1	13,4:1	13,0:1	12,5:1	12,6:1
Content,% wt .: carbon hydrogen oxygen	87,0 12,6 0,4	84,0 12,4 3,6	82,0 12,3 5,7	80,0 12,2 7,8	77,0 12,0 11,0	77,5 12,0 10,5
Sulfur, wt%.	0,20	0,14	0,1	0,06	0,002	0,002
Cokeability 10% of balance, % , by weight.	0,2	-	-	-	0,4	03
The specific carbon content (by Nu) g / MJ	20,5	20,5	20,6	20,6	20,6	20,5

Material balance of reaction of biodiesel obtaining is: to receive a 1000 kg (1136 liters) of biodiesel required 50 kW thermal energy and 25 kW of electricity, 1040 kg (1143 liters) of rapeseed oil, 144 kg (114 l) 99.8% methanol, 19 kg of potassium hydroxide (88% KOH), 6 kg of auxiliary filter material, 105 kg of

water. With the addition of biodiesel we obtained 200 kg of crude glycerine and 117 kg of water, after purification of biodiesel. Biodiesel can be used in any diesel engine (swirlchamber and precombustion and direct injection); both independently (in adapted engines) and mixed with diesel fuel without making any modifications to the engine [1,6,7]. From rape seed (technical varieties with high erucic acid content of 40-60%) of 1 ha of crops (on average 3 tons) about 1 ton of oil is extracted. Then the oil is subjected to esterification with methyl alcohol which results in approximately 1,000 kg rapeseed oil methyl ester (ROME). Consumables and by-products that are in the production of 1 ton of rapeseed oil methyl ester are shown in table. 2. Preprocessing stage usually involves one of the known physical or chemical processes of refining, which results in cleaning oil from impurities, phosphatides for further trans esterification process, biodiesel fuel (biodiesel) is its end product.

Table 2. **Cost balance of materials and processed products during production of 1 ton of methyl ester [6].**

Consumables and products	Consumption, kg
Rape	3050
Rapeseed oil	1040
Ethanol	144
Potassium hydroxide	19
Filter material	6
Pressed oil cake	1952
Glycerin	200

Technological schemes and energy balance in the production of biological mixed fuel is given in Figure 1. Value of the components of mass balance and energy production per 1 ha of rape seed sowing is shown to yield 2.5 t / ha and oil yield is 30%. In this case, consumption of the sun energy is 36,000 GJ, the cost of technology for growing rape - 15 GJ. The energy intensity of received 2.5 tons of rape seed is 61 GJ, 4.7 tons of rapeseed straw - 64.9 GJ. After extrusion of seeds we obtained 750 kg of oil and energy intensity 29.3 GJ 1750 kg meal with energy intensity 31.7 GJ. On pressing it is consumed 3.4 GJ of energy. To prepare biodiesel mixed fuel (75% rapeseed oil and 25% diesel) it should be 250 kg of diesel with energy intensity 10.5 GJ. The result is 1 ton of mixed fuel with energy intensity 39.8 GJ. Consider the impact of some physico-chemical characteristics of biodiesel, definable by standard EN 14214: 2004, on the parameters of the diesel and its ecological and performance characteristics. Increased compared with diesel fuel density by 10% and kinematic viscosity by 1.5 times contribute to a slight increase (14%) and long range of fuel torch and diameter of droplets of sprayed fuel, which can lead to increased biodiesel falling on the walls of the combustion chamber and the barrel cylinder. Smaller values of coefficient of biodiesel compression lead to an increase of actual angle of fuel injection and maximum pressure in an atomizer. The high cetane number of biodiesel 51 and more helps to reduce period of inflammation delay and less "tough" job engine. The increased almost 3 times, the flash point of biodiesel in closed cup 120 °C or more, provides

high fire safety. Oxygen (10%) in the molecule of methyl ester operates in the following areas. The presence of oxidant directly in the molecule of fuel allows to intensify the process of combustion and provide a high temperature in the cylinder diesel engine, which on the one hand, contributes to the indicator and efficient engine efficiency, and with another - leads to some increase of nitric oxide NO_2 in the exhaust gases [6, 7].

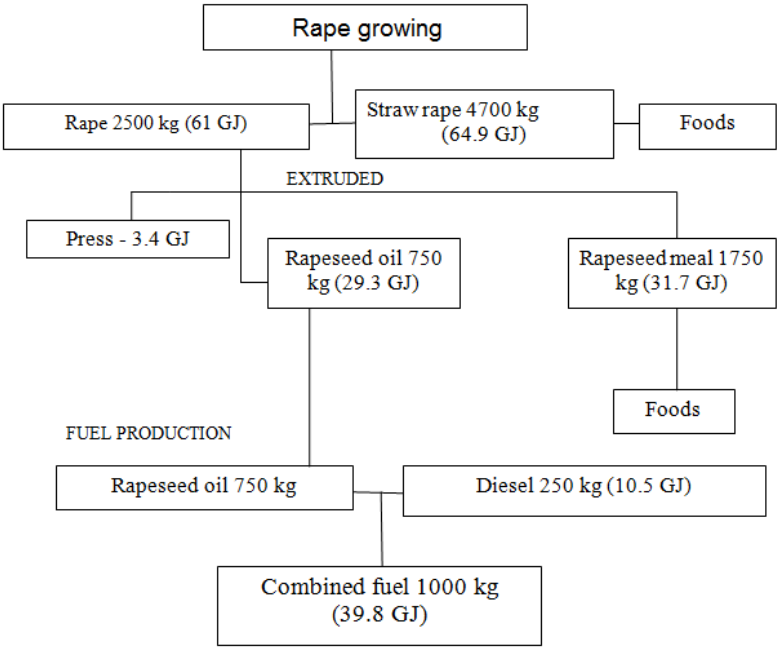

Fig. 1. The balance of power and weight in the production of biological fuel mixed with 1 hectare.

Less carbon fate (-77%) in the molecule of biodiesel leads to the reduction of its NCV by 13-15% and increase the hours and specific effective fuel consumption. To maintain the rated engine parameters when switching to biodiesel fuel equipment requires adjustment (focusing of rail of high pressure fuel pump re-establish to the increase of cyclic fuel presentation) [6,7]. The use of biodiesel allows reduction of harmful emissions from exhaust gases. For diesel engines with vortex chamber (precombustion) and direct injection of reduction respectively is: C - 12 (10)% SnNm - 35 (10)%, RM (solids) - 36 (24)%, soot - 50 (52) % [6,7]. Slight increase in emissions NO_2 can be offset by series of measures: reducing the actual angle of fuel injection, exhaust gas recirculation.

When using diesel engines on biodiesel must pay attention to the following. Before operating the engine on biodiesel filter of coarse and fine clean of fuel must be washed. Because of the increased aggressiveness of biodiesel fuel hoses should be replaced and gaskets are made of a material resistant to biofuel and thorough removal of biodiesel that gets on coatings. In some cases, it is needed more frequent replacement of engine oil due to the potential dilution of biodiesel entering into the crankcase. Perhaps a slight increase in noise and smoke during cold starting at low temperatures requires the use of depressor additives. It is necessary to control the water content in biodiesel (due to its large water absorption) to avoid the risk of microbial growth, formation of peroxides and the

corrosive effects of water, including the elements of fuel system [6,7]. When using biodiesel the effective efficiency of the engine decreases. The ratio of diesel fuel and biodiesel consumption is inversely proportional to their net calorific value and effective efficiency of the engine at the corresponding fuel type [6,7]. When complete combustion of fuel in the cylinder the maximum of effective efficiency of the engine will be determined by the actual ratio of net calorific value of biodiesel and diesel fuel. It was found that while working on biodiesel the dynamics of tractor engine generally deteriorates. The object for experimental studies [6,7]. AIT has served as a part of the tractor HTZ-221 with dual tires "23.1 Y26, central clutch SP-16 and two cultivators KPS-4 with eight harrows BZTS-1.0. These laboratory and field studies were conducted on cultivation of plowed fields. Experimental field was smashed in two scoring areas with length of 250 m each. Working speed of unit was limited by power capabilities of the tractor and the dynamics of its vertical vibrations. During the research process there were recorded: the passage by unit of record area, density of soil in track, time of the tractor working of width of MTA; height difference of level of fuel in the measuring tank before and after the experiment [6, 7]. The work of cultivator unit for two measurements was controlled by time and motion observations. During a measurement tractor engine worked at DF, and during the second – at a mixture of DF and RO at 50:50. Both measurements were carried out during the operation of the unit in the same field. As the results of operational and technological assessment, showed performance units when the engine tractor at the DF, and the biodiesel is almost identical. The resulting difference of these indicators is statistically insignificant. Almost identical are other operational - and technical indicators, except for specific fuel consumption. When the engine was on biodiesel they were by 2.75% over [6.7].

Conclusions. Biodiesel can be used in conventional internal combustion engines, either alone or in a mixture with conventional diesel fuel without change in the design of the engine. With almost the same with mineral diesel fuel energy potential, biodiesel has a number of advantages:

- it is nontoxic, contains almost no sulfur and carcinogenic benzene;
- decompose under natural conditions (about as well as sugar);
- provides a significant reduction in harmful emissions into the atmosphere by burning;
- increases cetane fuel and its lubricating ability, which significantly increases the life of the engine;
- has not high ignition temperature (100 °C), making it relatively safe to use;
- its source is renewable resources.

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АНАЛИЗ ТЕХНОЛОГИЙ ПРОИЗВОДСТВА И ВЛИЯНИЯ БИОТОПЛИВА НА РАБОТУ ДИЗЕЛЯ

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Ключевые слова: растительное масло, рапс, эфир, нефть, диспергирования, дизельное топливо.

Резюме

Выполнен анализ технологий с позиции энергозатрат при производстве биотоплива и оценено влияние физико-химических показателей биотоплива на эксплуатационные характеристики дизеля.

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Summary

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