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NATIONAL-ECONOMY APPLICATION OF DIESEL BIOFUELS

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Abstract. Stocks of fossil fuel oil are exhausted. Explored oil reserves of traditional extraction in the world will last 40-50 years of extraction. Still about the same reserves of oil, that is extracted from shale seams and bituminous sands. In Ukraine, its own oil production accounts for only 20% of its needs. Therefore, it is necessary to find new sources of energy that could replace oil fuels. These resources include biofuels, which can also be used to supply diesel engines. The article analyzes diesel biofuels, which can be replaced by petroleum diesel fuels: dimethyl ether, vegetable oil and biodiesel. It has been established that dimethyl ether has a low heat of combustion, in a result is significant reduction in engine power. Vegetable oil by its properties is significantly different from diesel biofuels. Yes, it has a much higher viscosity, which leads to the formation of larger droplets, which burn significantly worse. And due to the fact that during the shooting, it polymerizes, forming a stable pellicle that covers the nozzles, through which there is spray of fuel in the engine, the latter may break down. Therefore, today, the most suitable biofuel for Ukraine, which can both replace physical and energy indicators with mineral diesel, is methyl ether or biodiesel.

Key words: biofuels, biodiesel, methyl ether, dimethyl ether, vegetable oil.

Introduction

One of the most important problems of humanity is the energy problem. Intensive exploitation of mineral resources led to the depletion of their deposits. Explored reserves of liquid oil on our planet make up 210 billion tons (1240 billion barrels), undiscovered are estimated at 52-260 billion tons (300-1500 billion barrels).

Formulation of problem

At the same time, the world produced about 3.2 billion tons of oil (14.7 billion barrels). And at current rates of consumption and taking into account the dynamics of its growth, proven oil will be enough for about 40-50 years, undiscovered ─ another 10-50 years.It should be noted that in addition to liquid oil, there are also large oil reserves (3700 billion barrels) in the oil sands of Canada and Venezuela. However, to date, an effective technology for the production of liquid petroleum from oil sands has not yet been developed. Under existing technologies for the production of oil from bituminous sands, is required a large amount of fresh water. At the same time, fresh water is already a shortage for humanity, especially in the desert conditions of Alabama. At present, world oil extraction from bituminous sands is about 8.4 million barrels a day. Thus, although the reserves of bituminous sands are huge, extraction of oil from them in the near future (according to current forecasts) will satisfy only a few percent from world needs.

Analysis of recent research results

Ukraine holds fourth place for oil reserves in Europe after Norway, Great Britain and the Netherlands. On its territory there are three oil and gas regions: Western (Lviv, Ivano-Frankivsk, Chernivetska, Zakarpatska regions), East (Poltava, Sumy, Kharkiv and Chernihiv regions) and Southern (Black Sea-Crimean) [1]. As of the end of the twentieth century, potential oil resources of Ukraine were estimated at 1.33 billion tons. Exploration of potential oil resources is 33%, and the degree of production of deposits - 21.6%. However, due to the high energy intensity of production, Ukraine, with its own extraction, supplies only 10-12% of oil [2].

Purpose of research

Therefore, for our country and for the entire world community, the replacement of petroleum fuels with biofuels is urgent. In Ukraine, for the needs of agriculture only about 1.9 million tons of diesel fuel is used annually.

Results of research

One of the substitutes for mineral diesel fuel can be dimethyl ether, which is obtained by processing natural gas and biomass.

Dimethyl ether is a simple ether, which is a colorless gas, chemically inert, with a characteristic smell, which is liquefied under low pressure (in the liquefied form, it

resembles water). When exposed to the atmosphere in a short period, it is completely decomposed into water and carbon dioxide, non-toxic, non-carcinogenic, non-mutagenic. Its usage as a fuel involves the processing of the power system (installation of gas-cylinder equipment, increasing the volume supply of fuel pump, adjusting the mixture, sealing of pipelines).

Dimethyl ether is well sprayed, which results in efficient combustion of fuel. It has a high cetane number (55-60), which reduces the period of ignition and improves combustion. Due to the high content of oxygen (up to 35%), dimethyl ether burns well, which causes a lower level of emissions of solids and nitrogen oxides. Since it contains virtually no sulfur, its oxide emissions are very low. It has good launch characteristics in the cold season. Cost of production of dimethyl ether does not exceed 2/3 of the cost of production of mineral diesel fuel [3].

At the same time, the essential disadvantage of dimethyl ether, which restrains its application, is the lower heat of combustion (24.8 MJ / kg versus 42.5 MJ / kg in mineral diesel fuel) and lower density, which leads to a significant increase in fuel consumption and decrease engine power. In addition, it has a low kinematic viscosity, which predisposes leakage. Bad lubricating properties of dimethyl ether reduce the inter-repair periods of engines. Since dimethyl ether is a strong solvent for most rubber products, there is a problem of seals. He is a weak drug, which makes the complex operation of cars charged with dimethyl ether in closed volumes (for example, tunnels). Also, dimethyl ether is fire hazard, because its flash temperature is -41°C and the mixture with air is explosive [3].

The cost of producing dimethyl ether from biomass is currently higher than the cost of obtaining it from natural gas, so for Ukraine this substitute for mineral diesel is not relevant.

At present, the development of engines that can work on dimethyl ether, are engaged in the KAMAZ, Volvo, Nissan, and Chinese company - Shanghai Automotive.

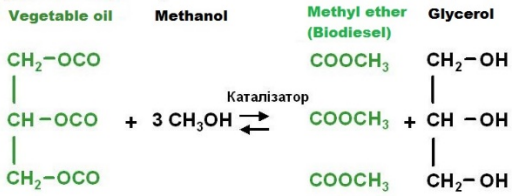
Another substitute for mineral diesel fuel, the raw material for which it is grown in large quantities in Ukraine, is vegetable oil. Even Rudolf Diesel planned that the engines of his design would work on pure vegetable oils, and his first engine, which a prominent designer demonstrated at the International Exhibition in Paris, worked on peanut butter. However, after the death of R. Diesel in 1913, the development of the construction of a diesel engine went towards the use of petroleum fuels. Therefore, despite the fact that the heat of combustion of vegetable oil significantly exceeds this index for dimethyl ether and is approaching the heat of combustion of mineral diesel fuel (37 MJ / kg), its use as a fuel in modern diesel engines will solve many significant problems.

The oil has a high viscosity (more than 90 centistos at a temperature of -10 ° C, while mineral diesel is about 10) [3], which makes it difficult for it to move in the fuel equipment. However, when heating the oil, its viscosity decreases. At the same time, at high temperatures, vegetable oils are prone to polymerization. In other words, the use of vegetable oils as fuel for engines creates a closed circle. To have the necessary fluidity for such oil requires high temperature, and at high temperature, the oil is inclined to form harmful deposits on the nozzles, which prevents the fuel supply to the engine cylinders, as well as pistons and piston rings, which leads to their destruction. Due to the high viscosity of vegetable oil when sprayed in the engine cylinder, coarse droplets are formed, resulting in its incomplete combustion, increased fuel consumption, and engine power decreases. To incomplete combustion also leads to high temperature of flare of vegetable oil (over 350°C, for mineral diesel - 60°C [3]). Cetane number of vegetable oils is low (for rapeseed oil it is 32-36, and for mineral diesel fuel - about 50 [4]), which causes different possibilities of their self-ignition. Vegetable oils pollute the lubricating oils and come into contact with them in a chemical reaction. As a result, a viscous, like a porridge, mass is formed, which can, at the next start, simply disable the engine. As a result, cars have to change oil every 20-25 thousand kilometers. In connection with the above, the direct use of vegetable oils for the propulsion of engines did not find wide practical application.

In some car workshops there is a refit of engines of cars that have already worked out their engine resourse, for work on the processed vegetable oil by reducing its viscosity and more efficient filtration. Improvements in filtration are done by installing an additional filter. Reduce oil viscosity by heating it (passing through the exhaust gas drainage channel) or diluting with mineral diesel. This provides better mixing of oil with air and more complete combustion. But such engines also fail.

If it turns out that it is impossible to use oils effectively in existing engines, then it is necessary to modify either engines or fuel. Both paths are being developed by scientists from around the world. Especially because only in a specially designed engine is possible lower oil consumption compared with mineral diesel fuel. A number of European firms are developing multi-fuel engines working on vegetable oils. There were reports of the development by the American company "Oxypro" of the DFE (Diesel Fuel Extender), whose addition to a small amount of vegetable oil (1: 300) turns it into a complete fuel product for diesel engines [4].

Considerably greater use as a diesel biofuel has found the product of processing vegetable oils and animal fats - a complex of fatty acids, which are called biodiesel. It is obtained by the esterification reaction between fatty acids and alcohols in the presence of a catalyst. As a result, esters of fatty acids and glycerol (raw glycerin) are formed. If ethyl alcohol is used, ethyl ether is formed, in the case of methyl alcohol use methyl methylether. It is also possible to use isopropyl alcohol. As biodiesel production is complicated by ethanol and isopropanol technologies, at the present stage methanol technology is used:



According to density and viscosity, biodiesel is approaching mineral diesel fuel. The small amount of

sulfur in the exhaust (0,001% vs. 0,05% in mineral diesel fuel) does not degrade the lubricating properties of biodiesel. It is known that mineral diesel fuel in the removal of sulfur compounds from it loses its lubricating properties. Biodiesel is characterized by good lubricant performance. This is due to its chemical composition and the content of oxygen in it. In this case, the inter-repair lifetime of the engine increases by about 50%. Biodiesel has good indicators of self-ignition (its cetane number is 51, then in mineral diesel - about 45), which improves engine start. The high flash point (at least 110° C) makes it one of the most fire-fighting fuels. Biodiesel refers to environmental fuels. The amount of emissions of harmful compounds and solids during operation of the engine on biodiesel is reduced by 20-25%, carbon monoxide - by 10-12%, than when working on mineral diesel fuel. Biodiesel does not have an unpleasant benzene odor, and the exhaust of the machine running on it, smells of fried seeds. The carbon dioxide (which is the main greenhouse gas) in the exhaust is exactly as much as is consumed from the atmosphere by the same plants from which the oil is produced. At the same time, one hectare of rape can absorb up to 20 tons of carbon dioxide per season. Biodiesel, digesting the environment, is very quickly biodegradable. Compared with mineral fuels, one liter of which is capable of contaminating 1 million liters of drinking water and causing the death of aquatic flora and fauna, biodiesel does not harm plants or animals when it enters the water. In addition, it is subjected to almost complete biological decomposition: in soil or water, microorganisms for 21 days, 90% recycle biodiesel, within 28 days - by 99%, which suggests minimizing environmental pollution using biodiesel, which is not to say about fuel from oil [3].

However, the use of methyl esters in the form of fuel for diesel engines is associated with certain operational problems that arise as a result of the complexity caused by varying the quality of the esters due to various problems at the stages of obtaining raw materials, the implementation of production technology and storage. First of all, it's an increase in injection pressure of up to 25% when using pure methyl ether as a biofuel, which can negatively affect the reliability of the pumps, as well as somewhat accelerated formation of carbon on the nozzles.

Biodiesel is aggressive with respect to individual sealing materials, in particular rubber products, paints and varnishes, as well as certain non-ferrous metals (aluminum, zinc, copper and their alloys). In most cases, this phenomenon is due to imperfection or simplicity of the process of production of esters (insufficient removal of the catalyst, residues of methanol, lack of neutralization of oils, etc.). Biodiesel has insufficient resistance to low temperatures (below 7-10 ° C). In this case, the viscosity of vegetable fuels increases, in it wax crystals are formed, which block the gas pipes and filters inside the engine. Since methyl ether has the properties of a medium-sized solvent, its application causes the blurring of sediments in the fuel equipment, which results in the filling of fuel filters. In this case, it is necessary to follow the operating instructions for washing systems. By the heat of combustion, biodiesel fuel is inferior to mineral diesel (37.2 MJ / kg in biodiesel versus 42.5 MJ / kg in mineral diesel). Therefore, the power of the engine running on biodiesel is reduced by an average of 7%, and fuel consumption increases by about 5-8%. In addition, biodiesel has a lower oxidation resistance than diesel, which is especially important in the long-term storage of ethers in its pure form. Oxidation can increase the acid number and viscosity, as well as the formation of harmful compounds (resins) that can block fuel filters. Excessive acidity may be due to inconsistent qualitative characteristics of raw materials. Therefore, the esters should not be stored for more than 6 months, otherwise antioxidants should be added. The listed shortcomings are not practical in the application of methyl ether as an impurity to diesel fuel in the amount of 5 to 30% (according to recent studies by Estonian scientists - up to 50%) [4].

The main raw material for biodiesel production, which is grown in Ukraine, is rape. To a lesser extent, sunflower and soybean oil is used.

There are two types of rape in the culture: winter and spring. The biological yield of winter rape is about 40-45 c / ha. However, because of the low cold resistance of this crop (in cold, lowsnow winters, rape crops freeze during winter) and significant losses during harvesting (due to seeding of seeds), the average yield of winter rape in Ukraine is 10-12 centners per hectare. In Europe, this figure reaches 25 c / ha. The yield of spring rape does not exceed 6-10 centners per hectare. To reduce the losing of rape, it is recommended to harvest it at high humidity (at night and in the morning) with modern combines. The oil content of rapeseed is 40-45%. Since rapeseed oil is not needed to be waxed (unlike sunflower), it is used mainly for the production of biodiesel. Rapeseed oil can also be used in the food industry. However, rape seeds, like all crosses, contain a significant amount of erucic acid, which adversely affects the cardiovascular system, as well as glucosides that disturb digestion. The oil of these varieties of rape is suitable for the production of biodiesel, but unsuitable for food purposes, and rape oilcake can not be used as a feed for animals. Recently, new low-glucosid varieties of rapeseed (so-called "00" varieties) have appeared, which, however, have a lower 2-3% oil content compared to traditional varieties [5]. Canola is a rape variety – it is genetically modified rape, from which oil with low content of erucic acid is produced. In the Ukrainian language, this word came from English, where it was formed from the first letters of the following phrase: CANADA Oil-Low Acid, or CANOLA [4], [6].

It is estimated that for a complete replacement in the agro-industrial sector of Ukraine of mineral diesel fuel for biodiesel at a sufficiently low yield of rapeseed, it is sufficient to use 10% of arable land for the growing of oilseeds. Considering that it is desirable to use biodiesel in a mixture with mineral diesel fuel, as well as increasing the yield of rape due to adherence to agrotechnology in its cultivation and application of the latest technology in harvesting, these areas will actually decrease in 2-3 times. If we take into account how many fields annually remain untreated in Ukraine we can solve the problem with light oil products. In addition, improve the feed base for livestock through the use of oilcakes. However, the problem is that rape in our country is grown not for processing energy, but for the sale of seeds abroad. Prices

for rape seeds for domestic producers are quite high today, which is a consequence of the interest of foreign producers of biodiesel in obtaining relatively cheap raw materials from Ukraine.

Sunflower is the second most important crop for biodiesel production and the first active area in Ukraine. It has a yield of up to 35 centners per hectare, seed oil content of up to 52-54% [7]. Heavily depletes the soil. It has a significant amount of proteins, making sunflower oilcake a good feed for animals. This is also contributed to the fact that, unlike most oilseeds, sunflower does not contain substances harmful to health. The presence of waxes in sunflower seeds worsens the quality of the oil used to make biodiesel. Therefore, sunflower oil needs to be further cleaned, which leads to an increase in the cost of biodiesel. In addition, the average yield of sunflower seeds in the last ten years has decreased by 1.5 times. The main reason for reducing yields is the violation of the requirements of the culture of agriculture. For Ukraine, the optimal area of crops under sunflower is established - 2.5 million hectares, but in fact in recent years the area of crops is 3-4 million hectares, which naturally, as in the case of rape, causes great damage to soil fertility [4].

Perspective cold-resistant oil crops are also ripe, oilseed raisins, and ferocious. Safflower is not demanding on soil, drought-tolerant, can be grown on salt marshes. Has a prospect of cultivation in the southern arid regions of Ukraine.

However, trends in biodiesel production in Europe are beginning to change gradually, which will surely be reflected in Ukraine. The European deputies intend to limit the role of the first generation biofuels (including biodiesel from vegetable oils) in favor of wind, solar and hydrogen energy and second generation biofuels, in connection with the growing food crisis in the world and significant energy costs in their production. After all, the area of agricultural land occupied by energy crops, quite significant. Rape alone in some European countries accounts for up to 20% of land suitable for cultivation. The first generation biofuel production currently amounts to 15 million tonnes per year [8].

Experts from the consulting company Oil World (Hamburg) predict biodiesel producers to reduce the availability of vegetable oils due to rising prices for it. In addition to the negative trends in the world oil markets, troubles for the producers of the Old World raised the European Commission, which increased the tax on biodiesel from 0.09 to 0.15 euros / liter. [3]. Thus, deprived tax "umbrella" of first generation biofuels has lost its attractiveness for the consumer, as well as for potential investors.

The European Parliament is concerned about the high prices of first-generation biofuels. At present, its production is 3% in the fuel balance of the European Union. Euphorparent now speaks for a more active introduction of second-generation biofuels, which includes biodiesel from waste vegetable oil and algae, since the processing of vegetable oil used in the food industry into biodiesel does not affect the production of food products and solves the problem of its utilization. The most promising source of raw materials for biodiesel production today is algae, which breeds extremely fast, doubling its weight in one day. Some types of algae (mainly Nannochloris and Nannochloropsis) are ideal for biodiesel production due to the high content of lipids (over 50%) and very fast growth rates. They can produce fifteen times more oil per unit area than other oil-bearing plants such as corn or soy. According to estimates from the US Department of Energy, and Green Star Products, one acre (about 0.4 hectares) of land can get 255 liters of soybean oil, 630 liters of canola oil, 2,400 liters of palm oil and 45,000 liters of oil from algae [5].

Conclusions

1. Given the exhaustiveness of mineral resources, due to this rise in prices and environmental problems when using them, the urgent need is the gradual replacement of mineral fuels with biofuels.
2. Biofuels for diesel engines can be dimethyl ether, vegetable oil and methyl ether. With the use of dimethyl ether, the engine power is significantly reduced. Vegetable oil by its physical properties significantly differs from mineral diesel, therefore its application on the non-adapted diesel engine can lead to its failure. Today, the most suitable biofuels for Ukraine, which can both replace physical and energy indicators with mineral diesel, are methyl ether, or biodiesel.
3. The cultivation of rape seeds and large volumes for export leads to a decrease in soil fertility, livelihoods of oilcake are lost, and the state's energy independence is not improving.
4. World trends in the development of biodiesel production indicate a change in the priorities in the raw material base of oil suitable for food production, to the oil produced from algae and waste vegetable oil.

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ЗАСТОСУВАННЯ ДИЗЕЛЬНОГО БІОПАЛИВА В НАЦІОНАЛЬНІЙ ЕКОНОМІЦІ

В. М. Поліщук, С. М. Голопура, В. Р. Белецький, Г. Р. Стіранкевич

Анотація. Запаси викопного палива будуть вичерпані. Розвідані запаси нафти з традиційних видобуток в світі буде тривати 40-50 років видобутку. Ще приблизно стільки ж запасів нафти, яка видобувається зі сланцевих пластів і бітумінозні піски. В Україні власного виробництва припадає на нафту лише 20% своїх потреб. Тому необхідно знайти нові джерела енергії, які могли б замінити нафту паливом. Ці ресурси включають біопаливо, яке також може використовуватися для живлення дизельних двигунів. У статті аналізується дизельне біопаливо, яке зможе замінити дизельне паливо нафтове: диметиловий ефір, рослинного масла і біодизельного палива. Було встановлено, що диметиловий ефір має низьку теплоту згоряння, в результаті значне зниження потужності двигуна. Рослинна олія за своїми властивостями істотно відрізняється від дизельного біопалива. Так, він має набагато більш високу в'язкість, що призводить до утворення більш великих крапель, що горять значно гірше. А з-за того, що під час зйомки, воно полімеризується, утворюючи стійку плівку, яка покриває сопла, через які йде розпилення палива в двигуні, то останній може зламатися. Тому, сьогодні, найбільш підходящі біопалива для України, який може замінити фізичні та енергетичні показники з мінеральним дизельним, - це метиловий ефір, або біодизель.

Ключові слова: біопаливо, біодизельне паливо, метиловий ефір, диметиловий ефір, рослинна олія.

ПРИМЕНЕНИЕ ДИЗЕЛЬНОГО БИОТОПЛИВА В НАЦИОНАЛЬНОЙ ЭКОНОМИКЕ

В. Н. Полищук, С. М. Голопура, В. Р. Белецкий, Г. Р. Стиранкевич

Аннотация. Запасы ископаемого топлива будут исчерпаны. Разведанные запасы нефти из традиционных добыча в мире будет длиться 40-50 лет добычи. Еще примерно столько же запасов нефти, которая добывается из сланцевых пластов и битуминозные пески. В Украине собственного производства приходится на нефть только 20% своих потребностей. Поэтому необходимо найти новые источники энергии, которые могли бы заменить нефть топливом. Эти ресурсы включают биотопливо, которое также может использоваться для питания дизельных двигателей. В статье анализируется дизельное биотопливо, которое сможет заменить нефтяное дизельное топливо: диметиловый эфир, растительного масла и биодизельного топлива. Было установлено, что диметиловый эфир имеет низкую теплоту сгорания, в результате значительное снижение мощности двигателя. Растительное масло по своим свойствам существенно отличается от дизельного биотоплива. Да, он имеет гораздо более высокую вязкость, что приводит к образованию более крупных капель, которые горят значительно хуже. А из-за того, что во время съемки, оно полимеризуется, образуя устойчивую пленку, которая покрывает сопла, через которые идет распыление топлива в двигателе, то последний может сломаться. Поэтому, сегодня, наиболее подходящие биотоплива для Украины, который может как заменить физические и энергетические показатели с минеральным дизельным, это метиловый эфир, или биодизель.

Ключевые слова: биотопливо, биодизельное топливо, метиловый эфир, диметиловый эфир, растительное масло.