THE INFLUENCE OF SOME BIOFUEL OPERATING PROPERTIES

Banari Eduard[1], Lupescu Ștefan Constantin[2]*

[1]Technical University of Moldova, Faculty of Industrial Mechanical and Transport Engineering, Department of Transport, Chisinau, Republic of Moldova
[2]Department of Mechanics and Technologies, Stefan cel Mare University of Suceava, 13 University Street, 720229 Suceava, Romania
stefan.lupescu@usv.ro/lupescustefan@ymail.com

Abstract: *The scientific research reflected in this study aimed at determining the operating properties of biodiesel (B100) and biodiesel-diesel blends (B20, B50). The goal was achieved by using the equipment of the Chemotology and Exploitation Materials experimental research laboratory of the Technical University of Moldova. Based on the results presented in this paper, the analysis of the experimental research was carried out, where the operating properties of biodiesel (B100) and biodiesel-diesel mixtures (B20, B50) for fueling compression ignition engines were determined. Therefore, the obtained values of the flash point for biofuels are higher in relation to that of diesel: for B100- by 64 °C, for B50- by 15 °C, for B20- by 3 °C, a fact that serves as proof , that the studied biofuels are more stable in terms of fire safety. At the same time, the values of the freezing temperature indicate the fact that engines powered by biofuels can operate in environmental conditions with temperatures higher than -12 ºC.*

Keywords: *Biofuel, Rapeseed oil, Flash point, Freezing point*

1. Introduction

The current stage of energy development is characterized by the inevitable depletion of the world's oil reserves with a simultaneous increase in energy consumption.

As some specialists in the field estimate, if the consumption of fossil fuels is maintained at the current level, then the reserves of crude oil worldwide will be exhausted approximately by 2060 [3].

It is proposed to develop a Guide on the methodology for the development of Zonal Urban Plans for any territorial administrative unit. The introduction of this guide will allow to ensure the development of Zonal Urban Plans in a more efficient way together with the Local Urban Planning Regulation related to Zonal Urban Plans.The need to use renewable energy sources (SRE) was realized by the leaders of highly developed countries, starting from the 70s-80s of the last century, with the increase in the damage caused to the environment through the pollution of the atmosphere, the waters of the global reserves and the soil. Later, based on this awareness, important measures to improve the ecological and energy situation were stipulated in international policy documents and implemented. The experience already accumulated proves that the use of renewable energy sources and the implementation of various measures regarding the efficiency of energy consumption contribute to reducing the negative impact on our Earth influenced by traditional fuels [1,4,5].

In the context of a growing shortage of energy resources and a significant increase in their costs, measures to save energy resources, by introducing the latest technologies for the conservation and rational use of fuel, become

extremely relevant. Currently, alternative biofuels based on vegetable oils and their derivatives have become more and more widespread.

The most promising alternative fuels are fuels of vegetable origin. Biofuels are fuels that are obtained from renewable sources, especially vegetable oils. Recently, the production of this type of alternative fuel has received significant attention in many countries of the world [2.6].

The analysis of existing sources of information demonstrates that biodiesel is obtained from different raw materials: vegetable oils (palm, from oilseeds - rapeseed, soy, sunflower, etc.), animal fats, residues from the public food sector.

Biodiesel has the ability to reduce dependence on fossil fuels and reduce the volume of pollutant emissions in the exhaust gases of the compression ignition engine.

2. MATERIALS AND METHOD

The physico-chemical properties of the fuel significantly influence the character of the combustion process of the working mixture and the performance of the engine. Thus, following theoretical research on biofuels, these properties were evaluated. The objects of the study were: SUPER DIESEL EURO 5 diesel, biodiesel B100 and biodiesel-diesel mixture (B20 and B50). For these fuels, density, kinematic viscosity, flash point and cloud/freeze temperature were measured.

The methyl ester from rapeseed oil B100 was obtained using the M8-KPB-01 facility, designed and developed by the "Alimentarmaș" Joint Stock Company from Chisinau [7-9]. The fuel blends were prepared from a single batch of diesel and biodiesel, resulting in the following proportions (wt%): 20% biodiesel + 80% diesel (B20), 50% biodiesel + 50% diesel (B50) and pure biodiesel B100.

Determining the cloud point of the tested fuels involves deep cooling and careful visual observation of the change in their state. The temperature at which the first signs of opacity appear in the examined fuel is considered the cloud point of the sample (according to GOST 5066-91 and ISO 3013-74 standards).

To determine the clouding/freezing temperature, a freezer with a cooling temperature of -20 ºC and a thermometer (model TB-3-M1) that measures the temperature in the range of -40…+50 ºC were used. The biofuel and diesel samples, together with the thermometer, were placed in the freezer to establish the cloudiness/freezing temperature. At regular intervals, the reading of the thermometer and the condition of the tested fuels were checked , until the appearance of the first crystals in the biofuels and the observation with the naked eye of their transparency and mobility.

Among the main operating properties of fuels are also those that describe their behavior at low temperatures, being particularly determined by the cloudiness temperature and the freezing temperature. The properties of fuels at low temperatures indicate a reduced ability to pump them through pipelines and operate (supply, drain) in winter. It should also be emphasized that petroleum products do not have a fixed transition temperature between different states of aggregation. As the temperature decreases, certain components gradually become more viscous and less mobile, and some of them separate as precipitates or crystals.

The freezing point determination method involves cooling the tested fuels until they lose their mobility (Fig. 2). The freezing temperature is considered the maximum temperature indicated by the thermometer when the first visible crystals appear in the fuel (according to GOST 5066-91, ISO 3013-74).

3. Results and discussion

Flash point is the minimum temperature at which, in accordance with GOST 6356-75, ISO 2719:2002 (E) standards and normal atmospheric pressure, fuel vapors can form a mixture with air, capable of igniting on contact with a flame open. This parameter is essential for assessing fire safety during transport, storage and handling of fuels. A high flash

point indicates that the material has a low probability of accidental ignition, being considered a non-hazardous and non-flammable liquid.

The values of the flash point results for the tested fuels are shown in figure 1.

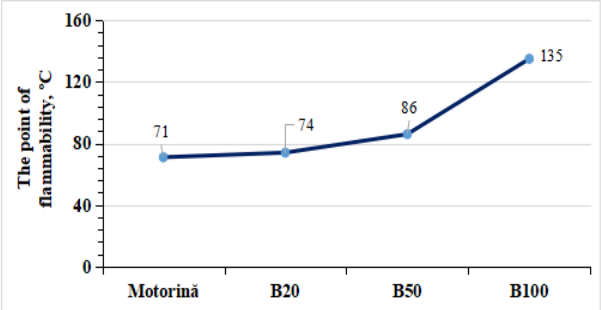

Figure 2. *Flash point values of the tested fuels*

Biodiesel B100 has the highest flash point value (135 ºC) and diesel has the lowest value (71 ºC). In the case of biodiesel and diesel mixtures, it was observed that they have higher ignition temperatures than diesel by 4.23% for B20 and by 21.23% for B50. It is important to note that the flash points of the B20 and B50 blends are further influenced by the corresponding diesel values, indicating a synergistic effect.

Turbulence temperature is the temperature at which the first visible crystals appear in the fuel as it cools. This temperature can cause problems, such as reduced fuel flow through the MAC injection pump, which leads to a decrease in engine power and clogging of filter elements and pipes in the fuel system.

Figure 2. *Establishing the temperature of disturbance/freezing*

Experimental studies (Tab. 1) show that the first crystals appear in mixtures of diesel and biodiesel (B20, B50) at a temperature of -12 ºC, and in the case of biodiesel B100, the crystals become more pronounced at the same temperature, while diesel maintains mobility even at -16 ºC. Thus, it can be observed that the cloudiness temperature of biodiesel is twice higher than that of diesel, according to the value provided by the standard.

The study of the freezing temperature of the fuel samples shows that at the temperature of -16 ºC, the B100 biodiesel showed a significant gelation process, while the B20 and B50 blends became a non-transparent and partially mobile liquid.

Table 1. *Condition of tested fuels after cooling*

Fuel type	**Turbidity temperature, [ºC]**			
	– 9	**– 10.5**	**– 12**	**- 16**
diesel fuel	transparent, mobility	transparent, mobility	mobility	mobility
B20			the appearance of the first crystals	not transparent, inhomogeneous, partially mobile
B50				
B100			increased appearance of crystals	consistent gelation process

The temperature of -12 ºC is considered a signal that biodiesel and its derivatives can no longer be efficiently pumped into the MAC fuel system. Thus, biofuel-powered engines can operate in environmental conditions with temperatures higher than -12 ºC.

4. Conclusion

The experimental research on the exploitation of the energy potential of biodiesel and mixtures formed from biodiesel and diesel, allowed us to formulate the following conclusions:

1. The value of the flash point for biofuels is higher in relation to that of diesel: for B100- by 64 °C, for B50- by 15 °C, for B20- by 3 °C, a fact that serves as proof that biofuels studied

are more stable from the point of view of fire safety.

2. Freezing temperature values do not indicate that biofuel-powered engines can operate in ambient temperatures higher than -12 ºC.

References

1. Caisin, S., et al. Renewable energy sources: Ecological education, Man and the environment, Environmental protection, Education for community development Chisinau, "Bons Offices" Printing House, 2014. - 172 p. ISBN 978-9975-80-816-3.
2. Devyanin, S. N., Vegetable oils and fuels based on them for diesel engines / S. N. Devyanin, V. A. Markov, V. G. Semenov. - M.: Publishing house of Moscow State Agrarian University named after V. P. Goryachkin, 2008. - 340 p.
3. Cohen, S., To Burn Or Not To Burn: When Will We Run Out of Oil? *Interfaith Center for Sustainable Development*, 2022.
4. Fraser, A. and Kirbyshire, A., Supporting governance for climate resilience. Working with political institutions. Working paper 517. - 2017.
5. Hăbășescu, I., et al., Biomass energy: Technologies and technical means. Min. of Agriculture and Food Industry, Academy of Sciences of Moldova, Institute of Agricultural Technology "Mecagro". Chișinău, Bons Offices, 2009, 368 p. ISBN 978-9975-80-301-4.
6. Ivanov, A. A., Evaluation of operational indicators of a machine-tractor unit when working on methanol-rapeseed emulsion. diss. candidate of technical sciences. Tver, 2017, 147 p.
7. Lacusta, I., et al., Technology and equipment for the production biofuel from oily plants. In: *Bulletinul institutului polytechnic din Iași, tomul LVI (LX), FASC. 4B* . Editura Politehnium, 2010, p. 389-394.
8. Sliusarenco, V., Periodic operation plant for biodiesel production. In: Meridian engineering, 2006, no. 2, p. 35-36.
9. Slyusarenko, V., Ganya, G., Lacusta, I., Banari, E., Technological process of biofuel production. In: *Agricultural Science* , UASM, Chisinau, 2010, no. 1, pp. 58-61. ISSN 1857-0003.