

BIODIESEL BASED ON ALCOHOL MIXTURES

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Azerbaijan has abundant raw material resources for biodiesel production, one of which is cotton oil. Taking into account the high cost and toxicity of methanol, a mixture of methanol, ethanol, propanol-1, and propanol-2 has been used for the first time in the production of biodiesel. In the presented work, various operational indicators (viscosity, density, ignition temperature, etc.) for biodiesel based on mixtures of cottonseed oil and low-molecular-weight alcohol tested by ASTM standards and also found optimal conditions, comparison of fuels, and biodiesel mixers have been carried out. The results of the research indicate that the obtained fuel mixtures are more efficient and have high performance characteristics. Additionally, by using NMR spectroscopy, the activity problems of alcohol mixtures in the transesterification reaction have been investigated.

Keywords: biodiesel, methanol, ethanol, propanol-1, propanol-2

INTRODUCTION

The high industrialization of the world has led to an increase in the use of mineral fuels. This, in turn, leads to the depletion of those fuel reserves, an increase in the amount of CO₂, SO₂ and other toxic gases in the air, the greenhouse effect, etc., which has led to serious environmental problems. As a result of chemical pollution, the Earth is currently facing problems such as the greenhouse effect, depletion of the ozone layer, acid rain, the reduction of water resources, and others. Our country has implemented many events to address environmental problems and is currently making significant efforts related to the transition to green energy. Azerbaijan's hosting of the UN's COP-29 conference on climate change is a clear indication of the attention our government is dedicating to global environmental issues. Finding alternative fuel sources is very promising for solving these problems. Biodiesel is the most promising alternative fuel for diesel engines because it significantly reduces environmental pollution, is non-toxic and is biodegradable. The main type of reaction in the production of biodiesel is transesterification. A variety of low-molecular-weight alcohols and oils can be used in the process. The use of inedible vegetable and waste oils has increased interest in the production of this type of fuel. The cost of biodiesel depends on feedstocks, geographic region, season, crude oil price, etc. and varies depending on factors [1–7].

As we know, methanol is used in the production of biodiesel. Since the production of methanol is more costly and it is also toxic, its replacement can be considered a relevant issue. Based on this, for the first time, ethanol, propanal-1 and propanol-2 have been used in our research for biodiesel production.

EXPERIMENTAL

Taking into account the reserves of cottonseed oil as a raw material in our country, biodiesel was synthesized on the basis of low molecular-mass alcohols, such as methanol:propanol-1:propanol-2 and ethanol:propanol-1:propanol-2 mixtures. H_2SO_4 was used as a catalyst. The process was carried out with intensive stirring at $75^\circ C$ for 6 hours and after separating the reaction product, it was washed with water at $80^\circ C$. Since an acid catalyst was used in the process, it was easily cleaned, and saponification was not observed. The neutrality of the medium was controlled with litmus paper (Figure 1). Finally, the biodiesel was dried with Na_2SO_4 .

Biodiesel samples were investigated by NMR. Moreover, the participation rate of alcohols in biodiesel production has been determined by using NMR method.

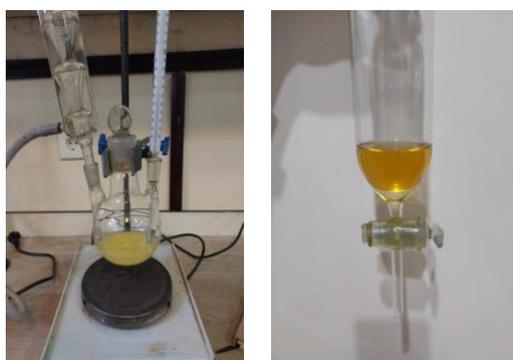


Figure 1. Production and separation of biodiesel.

RESULTS AND DISCUSSION

The reactivity of alcohols in the transesterification process was determined by NMR (Figure 2).



Figure 2. Reactivities of alcohols in the transesterification process.

Also, the operational properties of biodiesel obtained from the alcohol mixture were determined according to ASTM standards. The results are given in the table below:

Table. Some operational properties of diesel and biodiesel samples

Fuel properties	Diesel	Biodiesel (C ₂ H ₅ OH, n-C ₃ H ₇ OH, i-C ₃ H ₇ OH)	Biodiesel (CH ₃ OH, n-C ₃ H ₇ OH, i-C ₃ H ₇ OH)
Viscosity, 20 ^o C	4.99	7.30	7.05
Viscosity, 40 ^o C	3.15	4.72	4.40
Density	0.852	0.876	0.878
Corrosion	2	1	1
Flash point	94 ^o C	157 ^o C	156 ^o C

As shown in the table, the viscosity and density properties of the biodiesel obtained from cotton oil and alcohol mixtures meet the requirements of ASTM standards and corrosion stability is high.

CONCLUSION

Today, the rapid depletion of traditional fuel sources and rapid global climate change in the environment have increased interest in alternative fuels. The situation has led many countries to implement different strategies to develop renewable energy sources. The plan for such explorations includes the synthesis of biodiesel, which is a promising type of fuel for diesel engines. The results of the research indicate that the obtained fuel mixtures are more efficient and have high performance characteristics. The newly prepared biodiesel samples can be used as components for environmentally friendly diesel.

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