of sodium hydroxide was 6.5 gm. for sample A, B and 9.1 gm. for sample C.

The catalyst alcohol solution obtained by dissolving sodium hydroxide in ethyl alcohol with a mass of 138.0 gm. was added to the preheated feedstock. The synthesis was continued for one hour [1].

Glycerol, weighing 92.9 gm., was added to the obtained mixture for more efficient separation of BD from glycerol. BD was obtained by settling the resulting mixture in a separation funnel during the day.

Twenty-four hours later, the upper separated phase was selected as the target phase.

Further, unreacted ethyl alcohol was extracted from the obtained target product on a rotary evaporator under vacuum at 49.0 °C for one hour. Using the above-mentioned methodology, BD was obtained from 3 different samples of waste sunflower oil.

The fuel yield by oil for sample A was 97.4 wt. %, sample B was 94.6 wt. %, and sample C was 48.9 wt. %.

Table 1 shows the physico-chemical characteristics of the obtained BD and waste oil samples.

Figure 1 allows a visual comparison of the samples obtained.

Thus, the amount of catalyst directly affects the quality of BD when it is obtained from waste oil. Waste oils have a more acidic environment compared to fresh oils, which can be explained by the formation of fatty acids due to the oxidation of vegetable oil during their use.

**Table 1.** Physico-chemical characteristics of samples

| Sample | Density at 20 °C, gm/cm$^3$ | Kinematic viscosity at 20 °C, mm$^2$/s |
|---|---|---|
| A | 0.9210 | 53.044 |
| B | 0.9181 | 48.669 |
| C | 0.8826 | 8.7453 |
| Feedstock of sample A | 0.9206 | 84.971 |
| Feedstock of sample B | 0.9200 | 81.284 |
| Feedstock of sample C | 0,9200 | 88.353 |


**Fig. 1.** *Visual comparison of the obtained samples*

The unsatisfactory performance of samples A, B is due to incomplete conversion of oil into fatty acid ethyl esters, due to neutralisation of the alkaline catalyst by the acidic medium.

## References


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# SELECTING THE OPTIMAL COMMERCIAL DEPRESSANT


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Diesel fuel (DF) is widely distributed in the territory of the Russian Federation and it is used as fuel for various types of transport and technic. In regions of the country with colder climates, DF is necessary for the stable engines with low-temperature properties, which correspond to the data presented in [1]. The most effective and cost-efficient way to achieve these properties is adding depressant additives to the fuel composition. However, different depressant have different effects on the low-temperature properties of DF, which is related to the composition of the fuel itself or the depressant and the specific way in which the components in it interact. As a result, it is necessary to choose the optimal depressant for a particular DF sample.

The purpose of this work is to select the optimal commercial depressant for the DF sample under study.

During this work, mixtures of the DF samples were prepared with the addition of various commercial depressants. The concentration of the depressants corresponds to the manufacturer's recommendations (Table 1).

Next, the cold filter plugging point (CFPP) of the original sample of DF and the resulting mixtures was determined. CFPP was determines according to the methodology described in [2]. The resulting data are shown in the Table 2.

Based on the Table 2, it can be seen that the CFPP of the DF sample corresponds to the summer grade of commercial DF, according to [1]. When depressant R1 was added, the DF grade not change. When depressants B1, C1, M1 and X were added to the DF sample, an improvement in CFPP observed, which increase in the DF grade from summer to off-season. When depressants D1, T1 and V were added to the DF sample, an improvement in CFPP observed, which increase in the DF grade from summer to winter.

Thus, it can be concluded that the D1 depressant gives the most significant improvement in the CFPP value, as the change in the CFPP relative to the sample of DF without depressant is 20 °C. And the lowest efficiency is for depressant R1 (change in CFPP is 4 °C).

**Table 1.** Recommended depressant concentrations

| Depressant marking | Depressant concentration, ml (per 100 ml of fuel) |
|---|---|
| B1 | 0.46 |
| C1 | 0.20 |
| D1 | 0.62 |
| M1 | 0.34 |
| R1 | 0.10 |
| T1 | 0.38 |
| V | 0.20 |
| X | 0.54 |

**Table 2.** CFPP of the DF sample and its mixtures with depressant

| DF and its mixtures | CFPP, °C |
|---|---|
| Without depressant | –10 |
| B1 | –20 |
| C1 | –19 |
| D1 | –30 |
| M1 | –23 |
| R1 | –14 |
| T1 | –29 |
| V | –25 |
| X | –21 |

## References

1. *USS 305-2013. Diesel fuel. Technical conditions. [Electronic resource] – URL: https://internet-law.ru/gosts/gost/56269/ – Date application 12.02.2024.*
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