

## ABOUT THE PARAMETERS INFLUENCE ON THE BIODIESEL SYNTHESIS

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The development of the alternative energy segment is becoming the most relevant in the world today. The main influence on this shift in the interest of the scientific community is determined by the importance of the traditional motor fuels environmental component, in particular diesel fuels (DF).

Now, the entire world community is working to reduce exhaust gases emissions when using traditional petroleum fuel [1]. The biocomponents involvement in the diesel fuel composition, for example biodiesel fuel (BioDF) will help significantly in this matter [2].

However, the possibility of BioDF obtaining, with the best physicochemical characteristics, has not been fully studied to date due to the lack of a combined approach to varying the synthesis parameters.

In the course of the work, using the example of obtaining BioDF by the transesterification reaction from sunflower oil, the main significant parameters were varied, such as: catalyst concentration (0.5–2.0 % by oil weight), transesterification reaction time (0.5–2.0 hours), the vegetable oil: ethyl alcohol ratio (1:3–1:12) and the reaction temperature (30–60 °C).

After the BioDF synthesis, the physicochemical and low-temperature characteristics of the product were evaluated (if the product could be separated). Based on the data obtained, an analysis was made of the main synthesis parameters influence on the product quality and quantity.

### **Catalyst concentration**

An increase in the catalyst concentration leads to an increase in the product viscosity and density, which is associated with the formation of saponification products in the catalyst excess presence. However, on the other hand, for BioDF obtained at a catalyst concentration of 2.0 %, a higher yield is observed compared to BioDF obtained at a catalyst concentration of 1.0 %, since an increase in the catalyst mass (up to a certain critical limit) makes it

possible to increase the rate transesterification reactions.

Reducing the catalyst concentration below 1.0 % is inexpedient since the target product yield decreases and the separation of BioDF from the unreacted phase becomes more difficult.

### **Transesterification reaction time**

An increase in the transesterification reaction time from 0.5 to 1.0 h leads to an increase in the target product yield since the reaction proceeds most completely. This trend is accompanied by a decrease in the BioDF viscosity and a slight increase in density. A further increase in the duration of the reaction leads to a decrease in the product conversion due to the saponification products formation.

### **Vegetable oil: ethyl alcohol ratio**

With an increase in the initial reagent's ratio from 1:6 to 1:12, a decrease in the product viscosity and density is observed, as well as a decrease in the BioDF yield. This improvement in physicochemical characteristics is explained by increasing in the oil: ethanol ratio, the chemical equilibrium of the transesterification reaction shifts towards the products. However, at the same time, an increase in the oil: ethanol ratio makes it difficult to separate the products and separate the by-product – glycerol, which leads to a decrease in the BioDF yield.

### **Transesterification reaction temperature**

An increase in the reaction temperature from 30 to 60 °C leads to a significant increase in the product viscosity and density, while the BioDF yield decreased. This is since it is advisable to increase the transesterification reaction temperature up to a certain critical value. Carrying out the reaction at a temperature above the critical one leads to a decrease in the BioDF yield due to increased formation of saponification products and evaporation of the alcohol used.

## References

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## THERMOCHEMICAL AND ULTRASONIC PRETREATED HYDROLYTIC LIGNIN AND POTENTIAL SOURCE AS BIOFUEL ADDITIVE

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In recent decades, the increasing concern on the decreasing of fossil energy resources like oil and has put considerable interest in lignocellulosic material exploitation as a renewable source of biofuels and biochemicals specially in Siberian region.

The studies were carried out according to the state assignment Ministry of Education and Science of the Russian Federation for the project "Development of a set of scientific and technical solutions in the field of creating biofuels and optimal biofuel compositions, providing the possibility of transforming consumed types of energy in accordance with trends in energy efficiency, reducing the carbon footprint of products and using alternative fuels to fossil fuels" (Contract FSRZ- 2021-0012) in the scientific laboratory of biofuel compositions of the Siberian Federal University, created as part of the activities of the Scientific and Educational Center "Yenisei Siberia".

Lignin is a complex polymer compound that is a mixture of aromatic polymers predominantly consisting of phenylpropane monomers. Hydrolytic lignin is formed in quantities of 30–40 % of wood raw materials as the result of hydrolysis under severe thermochemical conditions.

Recently, intensification processes have got significant attention for lignin valorization. Non-conventional technologies such as Ball milling, Ultrasounds (US) and Microwaves (MW) have recently shown promising results in biomass exploitation [1]. Their capacity of generating specific high-energy at a microenvironmental level showed a certain efficiency in pretreatment processes of lignocellulosic material.

This study is focusing on the combination of conventional thermochemical and non-convention-

al ultrasonic pretreatment on the physicochemical characteristics of hydrolytic lignin.

For this purpose we carried different combination of chemical alkaline and cavitation treatment using - an ultrasonic homogenizer Bandelin SONOPULS HD 2200, with an operating frequency of 20 kHz.

- 1 g of a sample of lignin; 100 ml of distilled water; exposure time 15 minutes; exposure power 200 W;
- 1 g of a sample of lignin; 100 ml alkaline solution (8 % sodium hydroxide and 5 % hydrogen peroxide); exposure time 15 minutes; exposure power 200 W;
- 5 g of a sample of lignin; 100 ml alkaline solution (8 % sodium hydroxide and 5 % hydrogen peroxide); processed 12 hours at 110 °C.

Next, the samples were dried at a temperature of 100 °C to a constant weight and used to study the structure and properties of the modified hydrolysis lignin.

The analysis of the different infrared spectrometrogram shows that ultrasonic treatment of hydrolytic lignin for 15 minutes does not lead to significant changes in the structure of hydrolytic lignin. Alkaline treatment in the presence of hydrogen peroxide of hydrolytic lignin at a temperature of 110 °C for 12 hours and ultrasonic treatment for 15 minutes with the introduction of similar concentrations of alkali and hydrogen peroxide during treatment leads to significant changes in the structure of lignin associated with the ongoing processes of condensation of lignin molecules and growth OH groups.