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INVESTIGATION OF THE SYNTHESIS PARAMETERS INFLUENCE ON THE PRODUCT YIELD AND CHARACTERISTICS OF THE PRODUCED BIODIESEL FUELS

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Relevance of work

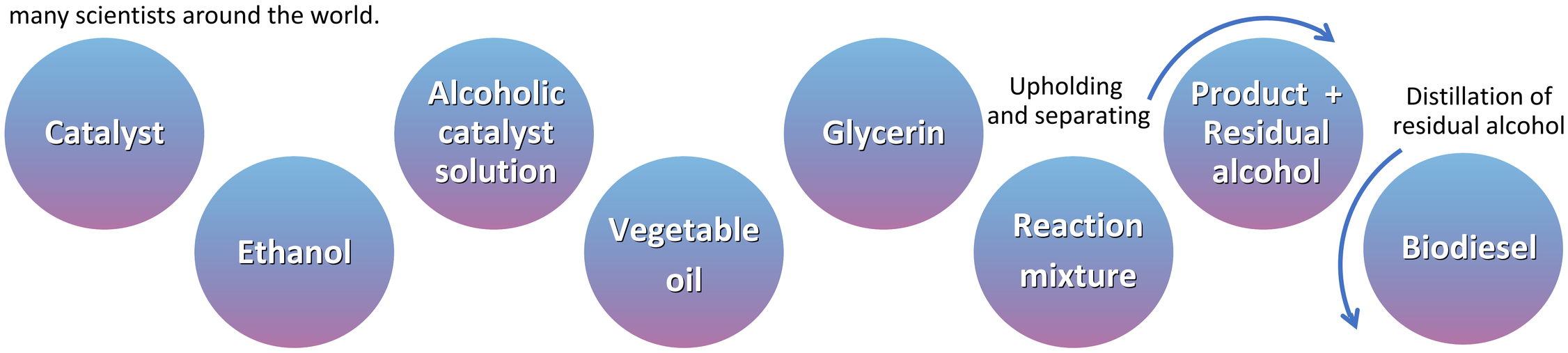
Over the past century, human consumption of energy, such as oil and gas, has increased by several times, while the natural resources are being run low, whereas the demand for various motor fuels is constantly increasing. In addition, ecological issues regarding the burning of petroleum fuels are being in hot discussion [1, 2]. In this vein, the issue targeted at finding alternative energy sources and fuels, which will be renewable and environmentally friendly, is one of the most relevant challenges in our age.

Varying the catalyst concentration			
0,5 % mas.	1,0 % mas.	2,0 % mas.	3,0 % mas.
Constant parameters • The temperature 45 °C; • The ratio of oil: alcohol 1:6; • Reaction time 1 hour			

The most prospective among the alternative fuels is biodiesel. Biodiesel is a mixture of fatty acids monoalkyl esters (most often methyl or ethyl) obtained from transesterification reaction of renewable biological resources, such as vegetable oils, animal fats, algae, etc [3].

Transesterification reaction parameters

The characteristics of the synthesized target product – biodiesel – depend on many parameters: a feedstock type, a ratio of source reagents and their chemical composition, purity of source reagents, water content in feedstock, conditions in which a reaction is conducted (temperature, reaction time), a catalyst type, and etc. Thus, the parameters affecting the biodiesel synthesis remain under high attention of many scientists around the world.



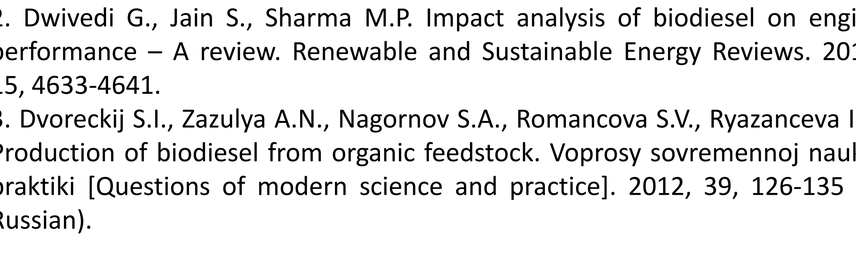
Picture 1 - Schematic diagram of the of biodiesel fuel synthesis

Results and discussions

As a feedstock for the biodiesel synthesis, widely available unrefined sunflower oil was used. The main physicochemical characteristics of the obtained products are presented in Table 1. The biodiesel yields at various catalyst concentrations are presented in Table 2.

Table 1 – Characteristics of the obtained biodiesel

Characteristic	Synthesis 1	Synthesis 2	Synthesis 3	Synthesis 4
Catalyst concentration, % wt.	0.5	1.0	2.0	3.0
Dynamic viscosity at 40 °C, mPa·s	4.758	8,648	7.092	6.943
Kinematic viscosity at 40 °C, mm^2/s	5.437	9,815	8.009	7.865



As can be seen the products obtained at the catalyst concentration of 0.5 wt % is characterized by the lowest density and viscosity. The products obtained at a catalyst concentration of 1.0 %wt. characterized by highest viscosity, which is associated with a intermediates high yield and with the impossibility of a product mixture clear separation. The product obtained at a catalyst concentration of 2.0 %wt. characterized by highest density.

Table 2 – Biodiesel yields at various catalyst concentrations

Characteristic	Synthesis 1	Synthesis 2	Synthesis 3	Synthesis 4
Catalyst concentration, %wt.	0.5	1.0	2.0	3.0
Initial components mass, g	511.7	513.5	517.2	520.9
End product mass, g	32.6	402.1	499.1	102.6
Yield, %wt.	6.4	78.3	96.5	19.7

As seen from Table 2, the feedstock conversion increases with increasing the catalyst concentration, however, to a certain limit. At the catalyst concentration of 3.0 %wt. the biodiesel yield decreases harshly, in addition, significant soap formation is observed, which complicates the products separation.

Conclusion

Varying the catalyst concentration in the transesterification reaction determines the quality and yield of the resulting biodiesel fuel. The study showed that for the biodiesel fuel synthesis from sunflower oil from the viewpoint of physicochemical characteristics and biodiesel yield, the optimal catalyst concentration is 2.0 wt%. by oil weight.

References

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