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Production of Biodiesel without By-Produced Glycerol from Transesterification of Canola Oils

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Abstract

Biodiesel is produced by transesterification of fats and methanol. This fuel has attracted researchers' attention for the reduction of fossil fuel consumption. However, glycerol is by-produced during the reaction. Since the methyl ester phase and glycerol phase mutually cannot solve each other, methyl esters can be separated using difference in specific gravity. The amount of the by-produced glycerol has inevitably increased with the increase of the biodiesel production. Consequently, the overproduction of glycerol has lowered the price of purified glycerol. Previously, some studies proved that the replacement of methanol with dimethyl carbonate (DMC) formed no glycerol [1]. Some of the studies using alkali catalysts required excessive amount of catalyst and dimethyl carbonate [2]. We modified the method of catalyst preparation when sodium methoxide was used in our pervious study [3]. In this study, we investigated better method to improve the efficiency of the reaction. In the investigation, we realized some details happening during reaction, and this may help to improve efficiency of the reaction under mild condition in future.

For this study canola oil and DMC as reactant, and sodium methoxide ($NaOCH_3$) as a heterogeneous catalyst were used. Reaction was performed in a round-bottomed glass flask and a Teflon tube reactor. To enhance the catalytic activity, we have prepared the catalyst by crystallization [3]. Samples were analyzed using high-performed liquid chromatography.

The wave of ultrasonic could shake the radiated molecules. So in theoretically, preparing $NaOCH_3$ catalyst under ultrasonic environment may avoid catalyst grow bigger during recrystallization process. However, in the experiment under ultrasonic environment, any improvement was not observed, and the conversion was the same with the result of our pervious study.

When reaction performed in round-bottomed glass flask, DMC will evaporate into the gas phase even under the boiling point (90 °C). This caused the decrease in DMC concentration in the liquid phase, and the reduction of triglyceride conversion. To decrease evaporation of DMC during reaction, at initial stage of reaction set in lower temperature by temperature controller. The experimental result shows that those conversion was around 90–92%, compare these with pervious study in same condition, it had a bit improvement around 2–3%.

We used a tubular reactor to completely avoid evaporation of DMC. The length of the tube was 10 m. A round-bottomed glass flask was used as a reactant reservoir. The reactant mixture containing catalyst was supplied by a micro tube pump. Conversion of the product was around 72%. The low conversion caused by duration of heating was too short and laminar flow made agglomerated catalyst stick together after reaction. Analysis of the brownish part in the tube by HPLC showed that this phase contained the high concentration of glycerol dicarbonate. The product is considered to be the material which reduced $NaOCH_3$ catalyst activity and caused the catalyst agglomeration.

References

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