

Production of DMC-biodiesel by alkali heterogeneous catalyst with reduced glycerol by-product

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Abstract

Biodiesel fuel (BDF) has attracted attentions as an alternative fuel for petroleum diesel fuel from the points of resource consumptions and environmental problems caused by the use of fossil fuels. BDF has advantages of renewable, biodegradable and carbon neutral¹⁾. Conventional BDF is produced by transesterification of vegetable oils and methanol. Glycerol is by-produced by this reaction. The amount of glycerol is about 10 wt% of the products. Because glycerol does not dissolve in BDF, it should be removed from the products²⁾.

The BDF production method using DMC instead of methanol has been proposed as an alternative method without producing glycerol. The by-products can be dissolved in oil phase and can be used directly as fuel³⁾. Several methods of transesterification using DMC have been proposed. The supercritical method has disadvantages such as high temperature and high pressure in the operating condition⁴⁾. The lipase method has disadvantages such as high cost of enzyme and low reaction rate⁵⁾. Alkali catalysts are generally used in the conventional methanol-BDF production. However, because the alkali catalysts do not dissolve in the oil phase containing DMC, a large amount of the catalysts is required to obtain high conversion⁶⁾.

We proposed a method using a fine catalyst obtained by dissolving sodium methoxide (NaOCH₃) in methanol and then recrystallizing by adding DMC. In this method, we could dramatically reduce the amount of the catalyst⁷⁾. However, this method requires a methanol removal process under reduced pressure. When the methanol removal process is skipped to simplify the process, a small amount of glycerol is produced. However, it is expected glycerol react with DMC to produce glycerol carbonate.

The purpose of this study is to clarify the reaction conditions to obtain high conversion under mild conditions for the production of DMC-BDF with a small amount of methanol, and with reduced glycerol by-production.

Fig. 1 shows the effect of methanol fraction on triglyceride conversion when the catalyst amount to oil was 0.5 wt%. The values on the horizontal axis indicate the methanol fraction considering the stoichiometric ratio in the reaction. The conversion decreased with decreasing the methanol fraction, and has a minimum value. As the increase in the methanol fraction, most of the catalyst dissolved in the methanol phase, and the amount of the fine solid catalyst in the oil phase decreased. When the fraction of methanol increased further, the conversion increased by the transesterification with methanol.

The effect of the catalyst amount is shown in **Fig. 2**. The conversion when the methanol fraction is 0 indicates the result of the reaction by removing methanol under reduced pressure. The addition of a small amount of methanol increased the conversion, and the required amount of the catalyst could be reduced. As shown in **Fig. 2**, the conversion increased or decreased with increasing the methanol fraction in the region where the fraction of methanol was less than 0.2.

References

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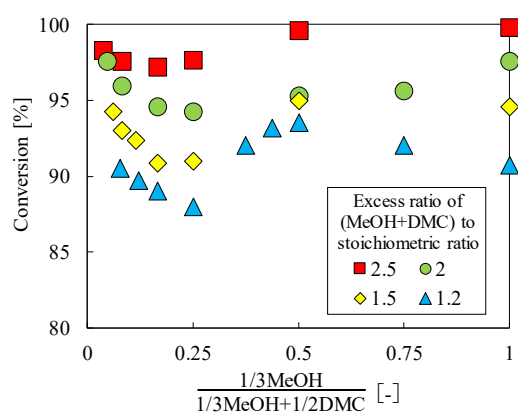


Fig. 1 Effect of methanol fraction on triglyceride conversion (Amount of catalyst = 0.5 wt%)

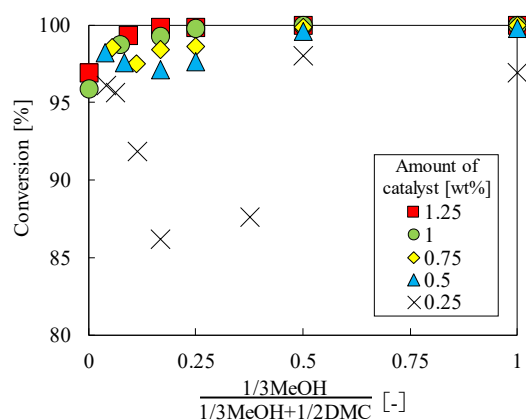


Fig. 2 Effect of methanol fraction on triglyceride conversion (Excess ratio of (MeOH+DMC) to stoichiometric ratio = 2.5)