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メタデータ	言語: eng 出版者: 公開日: 2021-01-13 キーワード (Ja): キーワード (En): 作成者: MIYAJIMA, Sumire, KAI, Takami, NAKAZATO, Tsutomu メールアドレス: 所属:
URL	http://hdl.handle.net/10232/00031540

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Sumire Miyajima, Takami Kai, Tsutomu Nakazato

ABSTRACT

Biodiesel fuel (BDF) has attracted attention in view of reduction of fossil fuel consumption, effective utilization of resources and environmental problems. Generally, BDF is produced by the transesterification of vegetable oils with methanol over alkaline catalysts such as potassium methoxide. In this reaction, glycerol with a low purity is by-produced and was usually treated as waste. The BDF production method using methyl acetate (MA) instead of methanol has been reported¹⁾. Glycerol is not produced in this reaction, and the produced triacetin can be used as an additive for cosmetics, food industry and gasoline. In addition, because the product is homogeneous and all the components can be used as liquid fuel, it is not necessary to separate the product mixture. Supercritical esterification method¹⁾, biocatalyst method²⁾, and alkaline catalytic method^{3, 4)} have been studied for the BDF production using methyl acetate. Supercritical method requires conditions such as high temperature and high pressure. The biocatalyst method has disadvantages such as high cost. Alkaline catalytic method requires a large amount of catalysts to obtain high conversion. This is because the alkali catalyst does not dissolve in methyl acetate despite, and the reaction proceeds as a heterogeneous system. In this study, recrystallization method was applied to the esterification with methyl acetate. This method was already applied to the esterification with dimethyl carbonate and the reaction rate could be drastically increased⁵⁾. The reaction conditions to obtain high triglyceride conversion and low alkaline catalyst amount were investigated.

Fig. 1(a) and (b) shows the triglyceride conversion after 120 minutes at a temperature of 50°C when the molar fraction of MA in MA and MeOH mixture was changed. The mole ratio of (MA + MeOH) to oil was 4 and 6, and the catalyst amount was 0.25, 0.5, 1.0 wt% to oil. When the mole fraction of MeOH was small and catalyst recrystallization occurred, the conversion was indicated by square symbols. On the other hand, the mole fraction of MeOH was large and all the catalyst dissolved in MeOH, circles were used as symbols.

When all the catalyst dissolved in MeOH, the conversion decreased as the MA ratio increased. The TG conversion at a catalyst amount of 0.25 wt% was low even when the fine catalyst was recrystallized. This is probably because the amount of recrystallized catalyst was not enough for the reaction. When the amount of catalyst exceeded 0.5% by weight, the TG conversion was high even when the molar fraction of MA exceeded 70%. Under these conditions, the catalyst precipitated as fine crystals and dispersed in the oil phase. Therefore, transesterification between MA and oil was promoted. This trend is observed at any molar ratio of (MA + MeOH) to oil, with higher ratios resulting in slightly higher conversions. TG conversion can be dramatically increased by recrystallization methods that produce BDF using methyl acetate.

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Department of Chemical Engineering, Kagoshima University, Kagoshima 890-0065, Japan

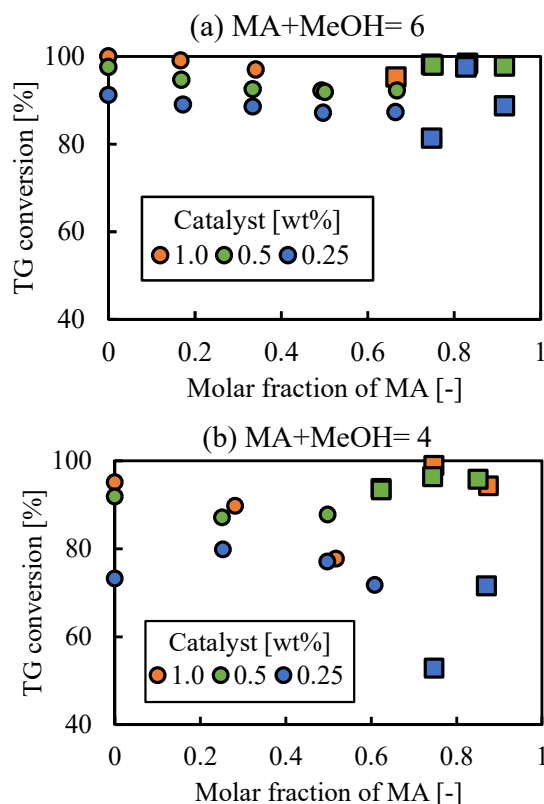


Fig. 1 Effect of molar fraction of methyl acetate on triglyceride conversion