The 29th International Symposium on Chemical Engineering, December 2-3, 2016,
Sheraton Grande Ocean Resort, Miyazaki, Japan

Biodiesel production from canola oil with DMC to reduce by-produced glycerol

Yuka Higashi[1], Takami Kai[1], Tsutomu Nakazato[1], Saki Kobaru[2]

Abstract

Some methods of glycerol free biodiesel production which used dimethyl carbonate (DMC) instead of methanol has been reported[1)]. Several methods of transesterification using DMC have been proposed[2, 3)]. When conventional alkali catalysts were used, it is required a large amount of catalysts or a high ratio of DMC to oils[4)] to achieve high conversion. The objective of this study is to reduce the amount of by-produced glycerol. For that purpose, the DMC-BDF production by the recrystallization of sodium methoxide catalyst[5)] is utilized. In this study, the methanol removal process is removed, and the amounts of methanol and the catalyst are reduced.

The conversion reached its maximum value after 60 min from the start of reaction independent of temperature. Although the initial reaction rate was increased with temperature, the conversion after 2 h was more than 80% for all temperature levels. Therefore, the effect of the amount of catalyst on the conversion was studied at relatively low temperature, 65°C. The added methanol molar ratio was 0.38. The effect of the amount of catalyst on the conversion is in **Fig. 1**. The conversion and FAME yield were above 80% and 60%, respectively when the amount of catalyst was above 0.35 wt%. Then the effect of the amount of methanol on the conversion was investigated. The conversion after 2 h reaction was showed in **Fig. 2**. The broken line is the calculated conversion of triglycerol reacted with methanol by the assumption that all the added methanol reacted with triglycerol. The conversion was below 1% without methanol addition. In contrast, the conversion increased drastically by adding methanol when the amount of catalyst was above 0.35 wt%. However, the conversion was not affected by the excessive quantity of methanol to dissolve catalyst completely. As the result, it is considered that the reaction rate was enhanced and high conversion can be obtained in the homogeneous system by adding minimum necessary amount of methanol on these reaction conditions. When the amount of catalyst was 0.35 wt%, the maximum conversion was below 85% even if the molar ratio of methanol to oil was 1.0. Judging from the results shown in Figs. 1 and 2, more than 0.5 wt% of the catalyst are necessary to obtain the conversion over 90%.

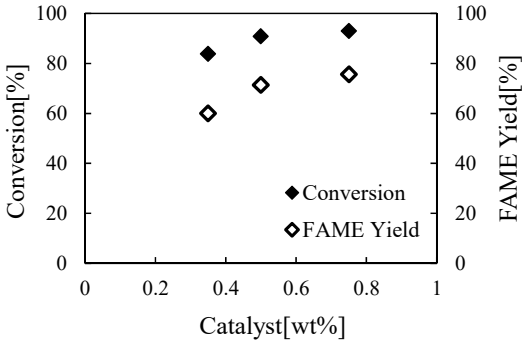

Fig. 1 Effect of amount of catalyst on the conversion and FAME yield

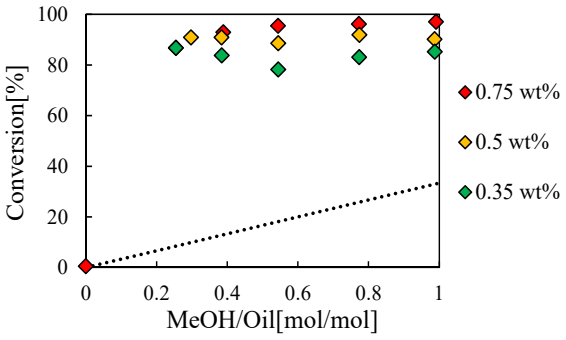

Fig. 2 Effect of molar ratio of MeOH to oil on the conversion after 2 h at 65°C

References

1) Fabbri, D., V. Bevoni, M. Notari, F. Rivetti, *Fuel*, **86**, 690–697 (2007)
2) Ang. G. T., K. T. Tan, K. T. Lee., *Renew. Sustain. Energy Rev*, **31**, 61–70 (2014)
3) Tan. K. T., K. T. Lee, A. R. Mohamed, *Fuel*, **89**, 3833–3839 (2010)
4) Zhang, L., B. Sheng, Z. Xin, Q. Liu, S. Sun, *Bioresourse Technol*., **101**, 8144–8150 (2010)
5) Kai, T., G. L. Mak, S. Wada, T. Nakazato, H. Takanashi, Y. Uemura, *Bioresource Technol*., **163**, 360–363 (2014)

[1] Dept. of Chem. Eng., Kagoshima University, Kagoshima 890-0065, Japan
[2] Technical Sec., Grad. School of Sci. and Eng., Kagoshima University, Kagoshima 890-0065, Japan