Comparative Study of Biodiesel Production from PFAD by Ion-Exchange Resin

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Abstract

The 2-step hydrolysis/esterification process is proposed here to replace the conventional 2-step esterification/transesterification process for producing biodiesel from the feedstock containing mainly fatty acid with small portion of triglyceride, as in palm fatty acid distillate (PFAD). The results indicate higher %yield and %purity of methyl ester produced by the proposed process. Moreover, the proposed process can reduce the separation stage after esterification and avoid large amount of salt formed by the acid-base reaction of acid catalyst (from esterificaton stage) and the base catalyst in the transesterification step with higher %yield and purity. In this paper, we also investigate the use of ion-exchange resin catalyst instead of the strong acid catalyst with the aim to make biodiesel production more environmentally friendly.

***Keywords*:** Palm fatty acid distillate; Biodiesel; Hydrolysis; Ion-exchange resin

1. Introduction

It is known that the two-step esterification/transesterification process for producing biodiesel from mixtures of fatty acid and triglyceride is much more complicated than straight transesterification because of the additional separation step. Moreover, large amount of salt is produced from acid-base reaction of the acidic catalyst in esterification with base catalyst used in transesterification. **(Freedman et al., 1984; Jeromin, 1987; Canakci et al, 2001, Boonuan et al., 2008)**. In this work, the feedstock is palm fatty acid distillate (PFAD), which contains very high percentage of FFAs (75-95%). Here, we propose to avoid salt formation from the conventional esterification/transesterification process for producing biodiesel from PFAD by converting all the remaining triglyceride into free fatty acid prior to the reaction. The biodiesel products obtained from the conventional process were compared to those obtained by the new approach. In term of catalyst for esterification process, the advantage of strong acid catalysts is that the catalyst itself is in liquid phase, which can be mixed well with the reaction mass. Whereas the disadvantage of conventional strong acid catalyst is that the process gives rise to problems linked with the corrosive action of reactor. **(Loreto et al., 2005).** Therefore, in this study, the new process was investigated further by using ion-exchange resin as a catalyst to avoid corrosion problem and minimize waste generated from the process.

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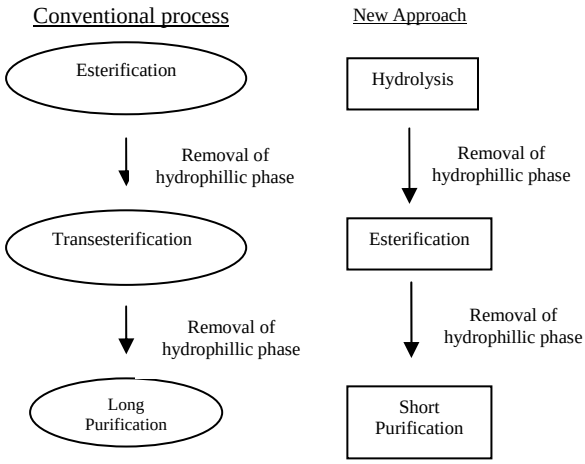
2. Experimental

Raw Material: Palm fatty acid distillate (PFAD) with 75-90% fatty acid was supplied by Patum Vegetable Oil Co, Ltd.

Experiment Scheme:



3. Result and Discussion

From the experiment, the results indicated that the methyl ester produced from the tranesterification/esterification process achieve comparable %purity of methyl ester (more than 97.5 %) However, the new approach can save cost for waste water treatment, which contain large amount of salts and catalyst. However, the new approach, which was purely esterification process, needed additional water removal step during the reaction to shift the reaction equilibrium towards high biodiesel conversion. For the ion-exchange resin catalyst, higher catalyst content led to higher conversion. In this study, without water removal, the maximum conversion obtained from ion-exchange resin with 25 g catalyst/100 ml of PFAD was 70 %.

3. Conclusion

The production of biodiesel from PFAD by a new hydrolysis/esterification process is proposed here to replace the conventional 2-step esterification/tranesterification process. We found the new approach can shorten the production time, minimize soluble and insoluble salts, that create waste treatment problem, and provide higher %yield and %purity of the product. However, the esterification step in the new approach requires more than one esterification step to push the reaction equilibrium towards an acceptable level of acid value. By using ion-exchange resin as catalyst in esterification reaction, we found that the higher ratio of resin:oil provide higher FFA conversion. To reach an exeptable level of FFA conversion, more than one esterification step is needed to shift the reaction equilibrium.

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