

## CHAPTER V

### CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 Conclusions

The KOH/ZrO<sub>2</sub> and KOH/mordenite heterogeneous basic catalysts were used as solid catalysts for biodiesel production in a fixed-bed reactor. The optimum condition for KOH/ZrO<sub>2</sub>, 6 hours of reaction time and 40–50 mesh of catalyst size, yielded 95.29 wt% of methyl ester content. On the other hand, the KOH/mordenite provided the 94.54 wt% within 4 hours of reaction time and the same optimum catalyst size. As for comparison, KOH/ZrO<sub>2</sub> gave a high percentage of biodiesel content, whereas the KOH/mordenite gave higher reusability of the catalyst. The regeneration of catalyst using acetone did not improve the catalytic activity. However, it made the modification of the catalyst surface. In addition, biodiesel production in a fixed-bed reactor is a new technological process, suitable for the industrial scale, having many advantages such as easy separation of catalyst and products.

#### 5.2 Recommendations

The regeneration of heterogeneous catalyst requires further study. It is recommended to examine the appropriate method that could clean the spent catalyst in order to give higher methyl ester content. Finding the new type of heterogeneous catalyst with high stability and low-cost is another attractive study.

For the process of biodiesel production, it is very interesting to up-scale the size of fixed-bed reactor or operating at the industrial condition. Moreover, the new method that could extend the contact time between the reactant and the catalyst is also interesting, for example, the reduction of feed flow rate, the higher amount of catalyst, and the longer of catalyst bed.