CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This study aims to form single phase microemulsion biofuels with focusing on the effect of surfactant structure and ethanol/butanol ratio on phase behavior and fuel properties of microemulsion biofuels. Microemulsion biofuel system in this work used palm oil/diesel blends with ethanol and butanol mixture with two types of surfactant (MO and POME) and 1-octanol as a cosurfactant.

From results, conclusions are made as follow:

For the effect of adding butanol, butanol can decrease the amount of surfactant used to formulate single phase microemulsion because butanol has higher hydrophilicity than ethanol. While the use of butanol causes the high kinematic viscosity of microemulsion biofuel because of the higher kinematic viscosity of butanol than that of ethanol. Moreover, at the palm oil/diesel ratio of 50:50 (v/v), the kinematic viscosity of ethanol/butanol blends systems were higher than that of diesel standard. Adjustment of palm oil/diesel ratio (30:70 (v/v)), the kinematic viscosity of microemulsion biofuel can approach to diesel standard. For the droplet size study, the droplet size of ethanol/butanol systems were less than ethanol alone system because butanol has longer chain than that of ethanol. Therefore,iIt has high hydrophobicity (strong binding affinity between butanol and surfactant structure). The heating value of ethanol/butanol systems were higher ethanol alone systems because of higher heating value of butanol than that of ethanol. Therefore, using of butanol need formula adjustment to control the kinematic viscosity.

For the effect of types of surfactant (MO and POME), the amount of surfactant used to formulate single phase microemulsion biofuel of MO and POME systems were similar because of their similar in molecular structures (ester group) and HLB values. The kinematic viscosity of MO and POME systems were not significantly different due to their similar viscosity. For the droplet size study, the droplet size of MO and POME systems were not different. This could be due to their similar binding affinity of surfactant with oil and alcohols.

For the effect of types of palm oil (palm olein and RBDPO), the amount of surfactant used to formulate single phase microemulsion of RBDPO systems were less than that of palm olein systems. Due to the fact that, fatty acids in RBDPO structure can help surfactant to formulate single phase microemulsion. The kinematic viscosities of RBDPO systems were less than that of palm olein systems because the viscosity of RBDPO are lower than palm olein. Note that, the using of RBDPO has limitation due to the wax precipitated in system. For the cloud point and the density measurements, the cloud point and the density of microemulsion biofuels were varied in ranging between diesel and biodiesel (B100).

5.2 Recommendations

The presence of butanol in microemulsion biofuels can decrease the amount of surfactant used to formulate single phase microemulsion. Even though, the kinematic viscosity of the microemulsion system is still higher than that of diesel. The use of butanol needs to be adjusted in proper percentage, otherwise the other components need to be optimized to obtain acceptable fuel property. Moreover, RBDPO systems has limitation due to their property, the wax composition in neat vegetable oil can precipitate when the temperature of the microemulsion biofuels below the melting point of wax component. This problem needs further investigate to avoid the formation of solid fat in microemulsion biofuel with RBDPO systems. Due to the fuel property of the microemulsion biofuels, there are some limitations consist of viscosity and cloud point for utilizing of microemulsion biofuel in diesel engine. However, microemulsion biofuel can be an alternative fuel for small size diesel engine for agricultural application.