

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This research aimed to use microemulsion technique for producing biofuel and examined their properties for be an alternative fuel for diesel engine. The microemulsion technique is an alternative application for producing biofuel; it has several advantages. Firstly, preparing different compositions of microemulsion biofuel is simple. Secondly, it yields all raw materials to be biofuel product without any waste or by-product. Moreover, microemulsion biofuel has both economic and environmental benefits because the production of microemulsion biofuel consumes less energy. However, a microemulsion biofuel needs to have a suitable composition; the quantity of the palm oil, the ratio of the alcohol/surfactant and water are all important. Moreover, the fuel's properties and exhaust emissions should also be "friendly" to the environment.

From the phase study, the results showed that the cosurfactant/surfactant ratio (C/S ratio) of 0.5 provided the largest area of microemulsion phase in the pseudo-ternary diagram and gave the maximum solubilization of water (up to 15%). The microemulsion biofuel containing 95% of palm oil, 4.95% of C/S at 0.5, and 0.05% of water by weight was called *MB100*. *MB100* was capable of long-time storage and able to withstand various temperatures 20-70 °C. This composition was selected as *MB100* for the further study on engine running performance and exhaust emissions because the standard of water in a fuel is limited not higher than 0.05%.

The fuel properties of the microemulsion biofuels, *MB100*, *MB20*, and *MB5*, were similar to the fuel properties of the conventional diesel and biodiesel standards. In the performance and emission tests, *MB100*, *MB20* and *MB5* gave good performances and also produced less exhaust emissions, which indicated the microemulsion biofuel were promising to be used as an alternative fuel replacement to the conventional diesel fuel and also friendly to environment.

With regard to the economic feasibility of using refined palm (cooking) oil to produce microemulsion biofuel, the use of palm oil has been close to impossible recently due to lack of palm production in the market that affected the rising of palm oil prices. Refined palm oil cost THB 35-37 per liter from August to October 2007. In December 2007, the cost of refined palm oil rose to THB 47-49. For this reason, the cost to produce biodiesel using microemulsion is higher than the cost to produce conventional diesel. However, since biodiesel is promoted as an alternative fuel by the government, there should be policies that help to expand and manage palm production in order to increase production and control palm oil prices. The approximate cost for producing 1 liter of microemulsion biofuel, MB100, in this research is 43 THB per liter. It seems to be much higher than the petroleum diesel due to all cost are estimated from purchasing price of the lab scale, and overall cost is reliable on palm oil price.

5.2 Recommendations

The use of the microemulsion technique for producing biofuel (i.e., microemulsion biofuel) with refined palm oil is a new approach; in order to make it more applicable, further studies on this new approach and fuel are necessary. Recommendations for further research are as follows:

1. Reductions in exhaust emissions of pollutants, such as NO_x and soot, should be studied in more details, such as by increasing the water content in the microemulsion biofuel.
2. The microemulsion biofuel should be further studied in more details for the combustion behavior in different types of cylinder engine.
3. Increased amounts of alcohol, as the cosurfactant in microemulsion biofuel, should be studied to determine its effects on fuel characteristics.
4. The blends of microemulsion biofuel should be studied to determine the optimum fuel blend ratio for using as an alternative fuel.
5. Other vegetable oils, especially non-edible crops should be investigated for biofuel preparation by this technique.
6. The microemulsion biofuel and its blends should be studied on their effect on engine in long term operation.