CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

This research work was to study combustion and emissions of crude palm oil-diesel emulsion having compositions of 5, 10 and 15 % by volume of crude palm oil and 2, 4, 6, 8 and 10 % of water. Sorbitan mono-oleate (span 80) 1 % vol. was taken as an emulsifier. The study was separated into 3 parts. The first one was a study on the physical and chemical properties of the emulsified oils such as density, heating value, flash point and viscosity. The heating value of diesel oil was maximum at 46,600 kJ/kg while the minimum was at 38,533 kJ/kg for diesel oil/CPO/water of 75/15/10 emulsions. The viscosity of diesel with CPO was higher than that of diesel oil but when it was blended with water, the viscosity was reduced. The flash point temperature was higher with the water content in the emulsified oil.

In the second part, the emulsified oils were used as fuels in a single cylinder diesel engine. The engine torque and the brake power were found to be less with the compositions of crude palm oil and water than those with the diesel oil. The specific fuel consumptions of the emulsified oil were higher with the compositions of crude palm oil and water but less emissions such as CO and NOx were found compared with those of diesel oil. The soot was less for the emulsified oil. With the engine test over 200 h, the wear effects on some engine parts when the fuel is diesel/CPO/water at 90/5/5 composition. It could be seen that the wears of this components were similar to those of diesel oil.

The last part was to develop a single droplet combustion mass transfer model to predict mass transfer rate of emulsified oil at various compositions. Experimental tests were carried out with combustion of oil film on a brass sphere having a diameter of 5 cm. It could be seen that the diesel oil could be burnt easily compared with the diesel oil blended with palm oil then the combustion rate of the fuel was highest for the pure diesel oil. When there was water blended in the oil, the continuous firing was more difficult with the composition of water since some part of combustion heat was used to evaporate water in the fuel. It could be noted that the predicted fuel consumption rate from the mass transfer model agreed well with those from the experimental data. The maximum error was less than 7 %. The difference between the combustion rate from experiments compare with predicted from mass transfer theory, because unknown the exact physics of the Schmidt number of water vapor in the air and the flow of oil drops during the experiment.

As the increase of water percentage in the oil composition, the mass transfer rate was less due to the less of heating value and high flash point. The model was also developed for predicting engine performance such as engine brake power. The deviation was less than 8 %from the measured values.

7.2 Recommendations for Further Studies

7.1 Other vegetable oils such as Tung oil and Jatropha oil should be used to blend with fossil fuel oil at suitable compositions to satisfy the heating value and the viscosity for fuel of the combustor either that in boiler or low speed diesel engine, including the greenhouse gas reduction. The low speed engine and boiler are devices that are simple and easy to maintenance.

7.2 Long- term operation of engine with emulsified oil from various vegetable oils should be carried out to investigate the engine performance and engine component wears. A mixture of water make an impact in the long term operation.