CHAPTER 3

PROPERTIES OF EMULSIFIED OIL

In this chapter, physical and chemical properties of the emulsified oil were considered. The results could be used as information data to evaluate the engine performances and the mass transfer model in the next chapters.

3.1 Emulsified Oil

Effect of the consumption of mixed surfactants on the stability of emulsified oil

Surfactant or emulsifier dosage is one of the most important parameters that directly influence the stability of emulsions. Phase separation is reported in various investigation of surfactant. The relative volume of emulsion containing 10% water contents increased as surfactant concentration increased from 0.2% to 1 % by volume for span 80. Figure 3.1 shows the unstability of the emulsion after blending when used 0.2% vol. of surfactant and the stability of emulsion after blending when used surfactant to 1% vol. were shown in Figure 3.2.

Figure 3.1 The unstability of the emulsion after blending (span 80 2% vol.).

Figure 3.2 The stability of the emulsion after blending (span 80 1% vol.).

In this study, Sorbitan monooleate ($C_{24}H_{44}O_6$) with 1 % by volume was taken as the surfactant. The blending was performed by agitating the mixture of diesel oil, crude palm oil and water with a total volume of 1,000 cc in a tank with an agitator with a speed of 1,500 rpm for 10 minutes. Figure 3.1 shows the structure of emulsified oil and Figure 3.2 shows the stability of the emulsion after blending.

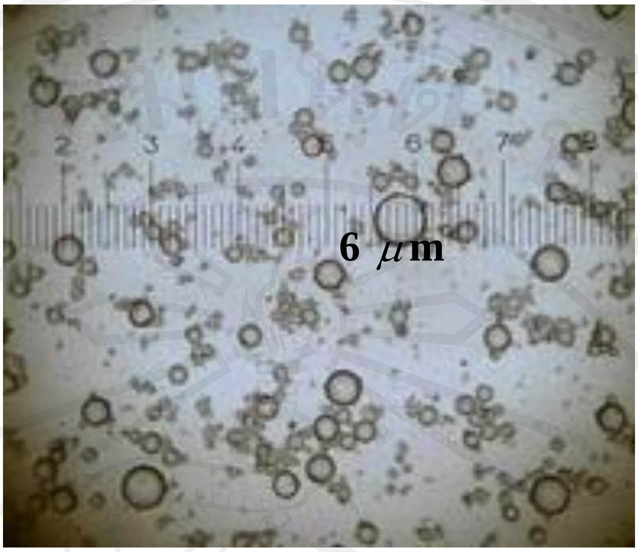

Figure 3.3 The structure of emulsified oil. The magnification of eye piece is 10 x.

a. 0 min left.

b. 20 min left.

c. 1 day left.

Figure 3.4 The stability of the emulsion after blending.

Surfactant was used to merge water with oil in a form of emulsion as shown in Figure 3.3. The water droplets of about 6 micron were coated with small oil droplets. However, there was instability in mixing after a period of time. It could be noted that there were some deposits after time lapse about 20 min. after mixing. Anyhow, the emulsion could be recovered immediately after shaking the mixture. Figure 3.2 shows the stability of the emulsion after blending.

3.2 Properties of the Oil Emulsion

3.2.1 Viscosity

The oil viscosity could be tested by Saybolt Universal Viscometer as shown in Figure 3.5 followed the ASTM D88 standard.

Figure 3.5 Saybolt Viscometer Apparatus.

3.2.2 Flash Point

In our experiments, the flash point of the tested fuels could be determined from a Bomb calorie meter as shown in Figure 3.6 under ASTM D93 Standard.

Figure 3.6 Flash Point Apparatus.

3.2.3 High Heating Value

A Bomb calorie meter as shown in Figure 3.7 was used to determine the higher heating values of the tested fuels under ASTM D 64 standard.

Figure 3.7 Bomb Calorie meter Apparatus.

3.2.4 Boiling Point Temperature (Tbp)

A Automated Distillation Tester Tanaka Model AD-6 as shown in Figure 3.8 was used to determine the boiling point temperature of the tested fuels under ASTM D 86 standard.

Figure 3.8 Automated Distillation Apparatus.

3.3 Experiment Test

In general, the heating value of the blended diesel/CPO was slightly lower than that of the diesel oil. When water was blended, the heating value of the emulsion was less with the percentage of water. The results were shown in Figure 3.9.

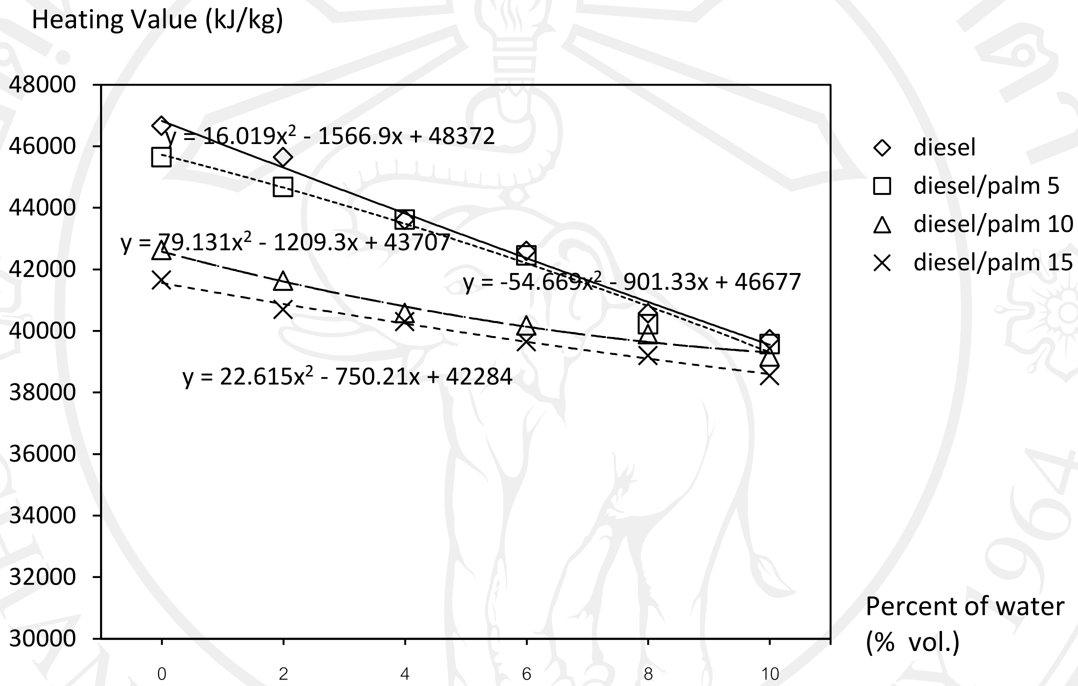

Figure 3.9 Heating values of emulsified oils.

Figure 3.10 shows flash points of different fuels. It could be noted that the flash points of the diesel oil with palm oil and water were similar when the percentage of palm oil was not over 10 %. When the percentage of palm oil was 15 % and that of water was over around 8 %, the flash point was higher than that of diesel oil.

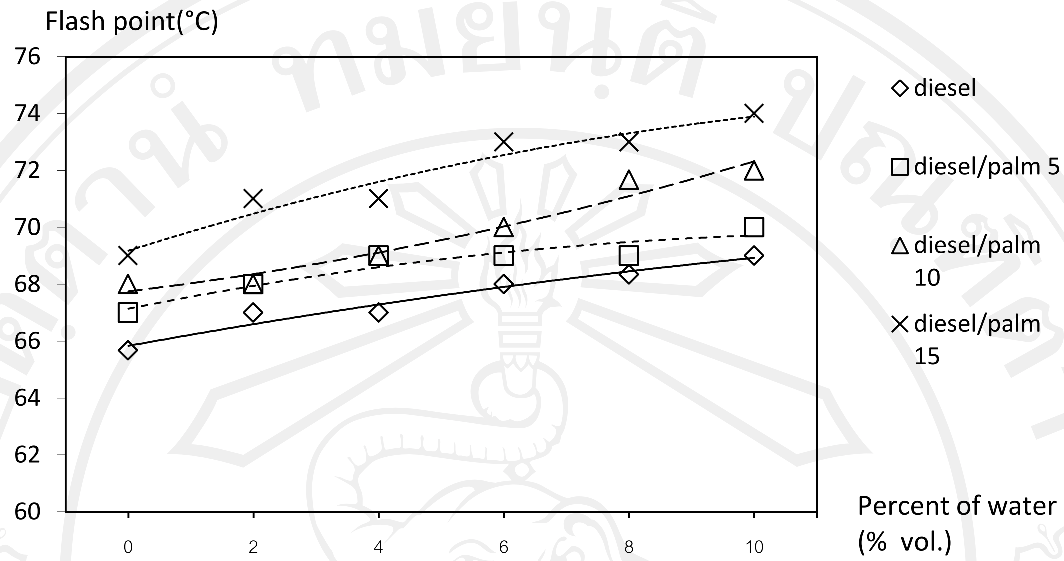

Figure 3.10 Flash point of Emulsified oils.

Figure 3.11 shows the values of viscosities of the blended oils compared with that of diesel oil. The viscosity increased with higher composition of palm oil, but when water was merged with the blended oil in the form of emulsion, the viscosity was less with the higher content of water.

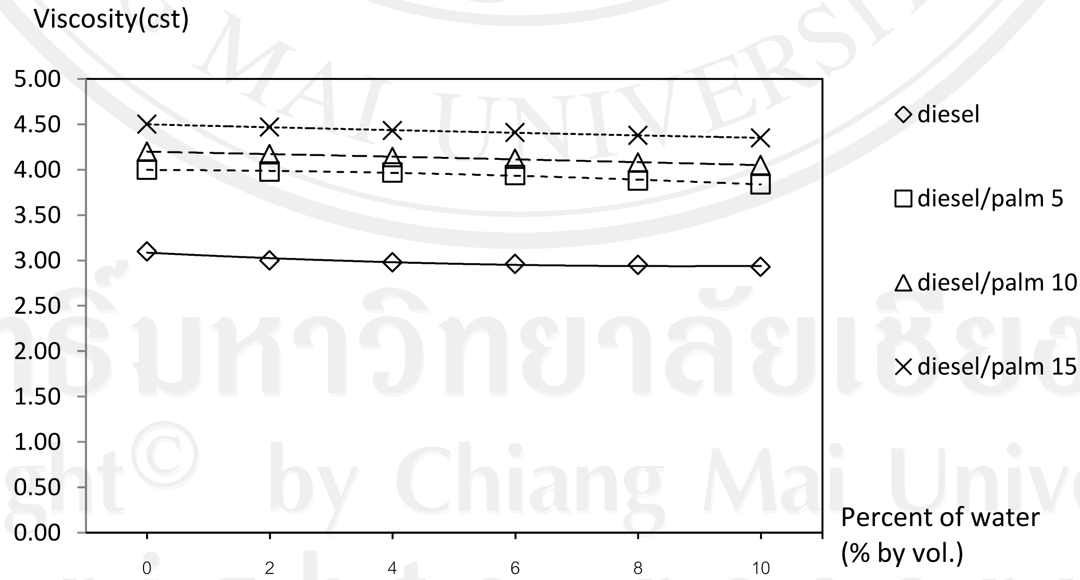

Figure 3.11 Viscosity of Emulsified oils.

Table 3.1 Physical and thermal of oil properties.

Fuel	Heating Value (kJ/kg) ASTM D64	Density (kg/m^3) ASTM D1298	Viscosity (cst @ 40 °C) ASTM D88	Boiling temp. (°C) ASTM D86	Flash point (°C) ASTM D93
Diesel	46,660	826	3.10	275	66
Diesel/CPO/water (90/5/5)	42,749	838	3.96	278	69
Diesel/CPO/water (85/5/10)	40,568	844	3.84	280	70
Diesel/CPO/water (85/10/5)	40,394	842	4.13	284	72
Diesel/Palm/water (80/10/10)	39,160	848	4.05	287	74

Table 3.1 also shows physical and thermal properties of the blended oils at some compositions 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.