CHAPTER V

CONCLUSION

The goal of this research was to synthesize monoester as a potential lubricating base oil from palm oil, which was mainly a triglyceride of palmitic acid and oleic acid.

This research was studied in two ways of the reaction. The first way was consisted of two distinct processes : transesterification and hydrogenation. Then the hydrogenated butyl ester, with the bast viscosity index was chosen to blended with lubricating base oil (150SN). The second way was consists of transesterification and the 2-ethylhexyl ester,with the lower pour point was finally refined through hydroxylation.

Transesterification process was synthesize monoester from palm oil by reaction with an alcohol, such as 2-ethyl-1-hexanol, cyclohexanol, 1-hexanol, and 1-butanol, using concentrated sulfulic acid as a catalyst.

Table 5-1 is a summary of the optimum condition for the tranesterification reaction of palm oil with an alcohol. Table 5-2 is a summary of the physical and chemical properties of the monoester products.

Table 5-1 : The optimum condition for the tranesterification reaction of palm oil with an alcohol

Parameter / Alcohol	Reaction Temperature(^{O}C)	Reaction Time (hr)	yield (%)
1-Butanol	80	1	92.57
1-Hexanol	80	1.30	90.57
Cyclohexanol	90	3.30	91.17
2-ethyl-1-hexanol	80	1	93.62

Table 5-2 : The physical and chemical properties of palm oil and monoester products

Properties	Palm oil	Butyl Ester	Hexyl Ester	cyclohexyl Ester	2-ethylhexyl ester
Color, ASTM	1.0	L2	L2.5	2.5	2
Pour Point, ^{O}C	+12	-6	-6	-6	-12
Kinematic Viscosity					
@ 40 ^{O}C	40.26	6.04	7.12	11.99	7.85
@ 100 ^{O}C	8.37	2.26	2.40	3.29	2.46
Viscosity Index	190.48	197.06	183.86	154.44	152.46
Flas point, ^{O}C	314	215	230	232	240
Oxidation Point, ^{O}C	360.9	295	307	316.4	306.5
Oxidative Compounds, %wt	37.37	10.96	7.15	13.26	9.36

Hydrogenation process was operated in a batch reactor under hydrogen pressure. The used catalyst contained 3%wt of platinum supported on alumina. The optimum condition for hydrogenation was shown in table 5-3. Table 5-4 is a summary of the physical and chemical properties of the monoester products.

Table 5-3 : The optimum condition for hydrogenation reaction of monoesters

Parameter / Monoester	Reaction Temperature (^{O}C)	Reaction Time (hr)	Reaction Pressure (psi)	Catalyst concentration (%)	yield (%)
Butyl Ester	100	1.5	120	4	98.57
Hexyl Ester	100	1.5	120	4	97.35
Cyclohexyl Ester	100	2.0	120	4	97.65
2-ethylhexyl Ester	100	2.0	120	4	98.73

Table 5-4 : The physical and chemical properties of lubricating base oil (150 SN) and hydrogenated products

Properties	Hydrogenate Butyl Ester	Hydrogenat eHexyl Ester	Hydrogenate Cyclohexyl Ester	Hydrogenate 2-ethylhexyl ester
Color, ASTM	L1.5	L2	L2.5	1.5
Pour Point, ^{O}C	+6	+6	+9	+3
Kinematic Viscosity				
@ 40 ^{O}C	6.77	8.04	13.56	9.24
@ 100 ^{O}C	2.31	2.58	3.48	2.75
Viscosity Index	181.84	170.30	149.03	156.39
Flas point, ^{O}C	213	226	227	238
Oxidation Point, ^{O}C	286.7	285	280.7	287.4
Oxidative Compounds, %wt	7.63	7.83	9.86	5.92

From this study, it could be concluded that the main compositions of hydrogenated esters were hydrogenated esters of palmitate and hydrogenated esters of stearate.

The results from table 5-4 indicated that physical and chemical properties of hydrogenated ester products which performed at the optimum condition were as follow : color was 1.5 to L2.5, pour point was +3 to +9 ^{O}C, VI was 156.39 to 181.84, flash point was 213 to 238 ^{O}C, oxidation point was 280.4 to 287.4 ^{O}C, and oxidative compounds was 5.92 to 9.86%wt. This product had high VI and also good thermal and oxidation stability but viscosity was too low and pour point was too high.

This studied chose the hydrogenated butyl ester, which had the bast viscosity index, to blended with lubricating base oil (150SN) and varied percent composition of hydrogenated butyl ester from 3%wt to 30%wt. The physical and chemical properties of blended products were as follow : color was 0.5 to L1.0, pour point was -9 to +3 ^{O}C, and VI was 103.858 to 134.94. Flash point of hydrogenated butyl ester 24%wt was 230^{O}C, oxidation point was 313.2 ^{O}C, and oxidation compounds were 17.61%wt.

Up to this point, the hydrogenated butyl ester products could be used as VI improver for lubricating base oil (150SN) and the bast ratio of hydrogenated butyl ester products was 21-24%wt of lubricating base oil (150SN).

The second way chose the 2-ethylhexyl ester, which had the lower pour point, to be finally refined through hydroxylation. The physical and chemical properties of the product were as follow : color was 0.5, pour point was -3 ^{O}C, VI was 154.770, flash point was 242 ^{O}C, oxidation point was 309.5 ^{O}C, and oxidation compounds were 8.22%wt.

Up to this point, 2-ethylhexyl ester from hydroxylation could be used as a lubricating base oil becuase of its high viscosity index, low pour point, and good thermal and oxidation stability.