THE ADDITION OF PETROLEUM BENZIN IN MIXING OF CRUDE PALM OIL AND METHANOL ON BIODIESEL PRODUCTION

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ABSTRACT

Research on transesterification of crude palm oil (CPO) using petroleum benzin as solvent has been done. This research aims to determine the optimum concentration of catalyst KOH and NaOH, mole ratio of methanol to oil, volume ratio of solvent to oil, and temperature range of solvent. This research also observes the influence of changing in methanol concentration and levels of palm oil free fatty acids (FFA) on biodiesel production. In this research, transesterification was preceded by esterification for 10 min using sulphuric acid catalyst. The results showed that KOH gave better results than NaOH as catalyst with optimum concentration was 1.75% (w/v). Mole ratio of methanol to palm oil optimum was 6:1, and volume ratio of solvent to palm oil optimum was 2:5. Optimum temperature range of the solvent was 70–90 °C. Decreasing on concentration of methanol, and increasing of free fatty acids (FFA) level gave negative impact on the biodiesel production, more over on transesterification without solvent. The characteristics (phosphor content, density, water content, ash content, carbon residue, energy content and chemical components) of biodiesel which was produced using petroleum benzin relatively similar to biodiesel produced in the normal way (without solvent). Decreasing on concentration of methanol, and increasing on level of free fatty acids (FFA) gave a negative impact on the biodiesel, more over on transesterification without solvent.

***Keywords**: transesterification, CPO, solvent, petroleum benzin*

INTRODUCTION

At last few years the research of alternative fuels is mostly done, and no exception on alternative fuel which was made from raw vegetable oil. Using of vegetable oil as raw material on the manufacture of alternative fuel based on its easy to develop, renewable and have large enough potential energy as fuel for diesel engines [1]. In addition, the fuel derived from vegetable oils have a low gas emissions [2], non-toxic and easily decomposed [3].

One potential source of edible oil and very abundant in our country is palm oil. When compared with other oil sources, the oil has the highest productivity [4]. In association with the provision of alternative energy, the use of vegetable oil directly in fact can cause damage to engine because of high viscosity and low volatility [5]. Manufacture of alternative fuels for diesel oil is usually carried out by transesterification method [6]. Through this method, the vegetable oil is reacted with alcohol to obtain fatty acid alkyl esters [7]. The oil which is processed in this manner then known as biodiesel.

In the development, manufacture of biodiesel from transesterification leads to the involvement of a solvent in the reaction mixture, and it can be reusable by distillation [8]. In their research, Boocock and Gavin [9], using tetrahydrofuran (THF) and methyltersierbuthyleter (MTBE) as a solvent on the transesterification of soybean oil, with NaOH catalyst (1-2 (%-w)). Election of tetrahydrofuran (THF) as solvent by Boocock and Gavin is based on a similarity of boiling point of methanol. While Kovacs, et al. [10] using a fraction of aliphatic hydrocarbons (40-200 °C) on the transesterification of sunflower oil with KOH as catalyst (0.4 (%, w/v)).

Aliphatic hydrocarbon fraction have several advantages if compared with other solvents, namely transesterification and separation took place more quickly, required less alcohol, high conversion, purification of the final product is simpler, and solvent does not react with reactants. The solvent can function as an additive to improve quality of biodiesel [10]. Of course, it would be very interesting if it can also be applied to vegetable oils or other triglyceride sources such as palm oil (CPO).

Aliphatic hydrocarbon fraction is non polar solvent, excellent in dissolving oil (triglyceride), and slightly mix with methanol, but not with glycerin (by product in the production of biodiesel). Based on these properties, of course the petroleum benzin, can also be used as a solvent in the manufacture of biodiesel from palm oil (CPO). In the commercial world, there are several types of petroleum benzin with different

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temperature range i.e. 50-70 °C, 70-90 °C, 80-100 °C and so forth [11]. Petroleum benzin with technical specifications can be obtained through fractional distillation of gasoline [12].

In this research, the manufacture of biodiesel using CPO as raw material and petroleum benzin as solvent, a catalyst NaOH or KOH at various concentrations, with variation mole ratio of alcohol (methanol) to oil, the volume ratio of solvent to oil, and temperature range of petroleum benzin. Observations on the variables above are based on the importance of these variables in the transesterification reaction. In this study also examined how the influence of changing methanol concentration and levels of free fatty acids (FFA) of palm on biodiesel production.

EXPERIMENTAL SECTION

Materials

Palm oil from PT. Sinar Mas Group (Tanah Laut, South of Kalimantan), methanol, KOH, NaOH, petroleum benzin (70-90 °C and 80-100 °C), isopropyl alcohol, sulphuric acid, ammonium metavanadate, KH_2PO_4, xylene, ZnO, toluene, all the specifications are p.a. (E. Merck), universal pH paper, distilled water (Laboratory of Mathematics and Natural Science Faculty – University of Lambung Mangkurat).

Instrumentation

A set of glassware, tools reflux, upright mixer, a set of distillation apparatus, thermometer, capillary type viscometer, oven, analytical balance and stop watch, spectrophotometer, gas chromatography-mass spectroscopy (GC-MS), a set of instruments to measure ash content, carbon content, water content, energy content.

Procedure

At first transesterification was aimed for finding the optimum catalyst type and concentration. In this stage the reaction was done by adjusting the reaction in which the other conditions are unchanged. The ratio of moles of alcohol (methanol) to oil was 6:1, volume ratio of solvent to oil was 2:5 and temperature range of petroleum benzin used was 70-90 °C. Based on data obtained through this research, would be known the optimum conditions (what the catalyst and how much the concentration). The optimum conditions were obtained from this step then used for determining the optimum conditions in subsequent step (mole ratio of alcohol (methanol) to oil). So the final optimum conditions that are the result of the overall optimization of reaction condition would be obtained.

Determination of optimum conditions at each stage was conducted on the basis of three parameters, i.e. viscosity, acid number and percent volume of biodiesel produced. On the biodiesel produced with the optimum conditions, in addition to the three above parameters were also carried out further analysis to determine the content of phosphorus (P), ash, carbon, density, energy content, and moisture content, and analyzed with GC-MS (Gas Chromatography-Mass spectroscopy). Analyzes were also performed on biodiesel produced from the reaction without the use of solvents for comparison. Here standards biodiesel for some parameters based on SNI 04-0782-2006 [13] and ASTM D 5761 [8].

The optimum conditions which have been obtained then tested in the manufacture of biodiesel, where the concentration of methanol used is lower and also on the process by which a CPO is used has a higher FFA levels. This is done to find out how the role of solvent in the manufacture of biodiesel with such conditions.

RESULT AND DISCUSSION

Optimization of Catalyst Type and Concentration

Transesterification was conducted in this study using KOH and NaOH as catalyst with various concentrations. Here are the data obtained in this study.

Based on data in Table 2 can be seen that the largest volume of biodiesel was obtained at a catalyst concentration of KOH at 1.75% (w/v). The volume generated was 37.8 mL (75.6% (v/v)) from 50 mL of CPO. While on using of catalysts NaOH with the same concentration, showed relatively small volume i.e. 20.3 mL.

On the use of KOH catalyst with low concentrations it appears that the volume of biodiesel produced is relatively small and continues to increase with increasing up to 1.75%. The low of biodiesel volume is possible as a result of low of methoxy ions which were generated, where methoxy ion is a product of interaction between base catalysts with methanol. So if available metoxy ions are fewer, the fewer biodiesel also be produced.

On the use of catalytic concentration of NaOH which were increased precisely minimize the volume of biodiesel produced. Despite the increasing of base catalyst methoxy number of available ions also increased, but a strong base catalyst like NaOH easily undergo saponification that impact negatively on the stage of separation. Saponification can occur as a result

Table 1. Standard parameters based on ISO and ASTM biodiesel

Standard	Kinematic viscosity (mm^2/s)	Acid number (mg KOH/g)	P levels (mg/L)	Density (g/L)	Levels Ash (%, w/w)	Carbon Residue (%; b/b) (%, W/w)	Water Levels (%; v/v) (%, V/v)	Flash Point (°C)	Pour point (°C)
SNI	2.3 to 6.0	0.8	10 (max)	0.85 to 0.89	0.02 (max)	0.05 (max)	0.05 (max)	100 (min)	18 (max)
ASTM	1.6 to 6.0	0.8	-	-	0:02 (max)	0.05 (Max)	0.05 (max)	130 (min)	-

Table 2. Results of measurement of volume, viscosity and acid number on optimizing the type and catalyst concentration

Number	Catalyst	Volume of Biodiesel (mL)	Viscosity (mm^2/ s)	Acid Number (mg/g)
1	0.25% KOH	12.5	48.74	7.74
2	0.50% KOH	20.0	46.93	5.72
3	0.75% KOH	22.0	45.15	5.05
4	1.00% KOH	27.0	9.85	1.05
5	1.25% KOH	29.0	7.19	0.52
6	1.50% KOH	33.0	5.97	0.52
7	1.75% KOH	37.8	5.34	0.66
8	2.00% KOH	33.0	6.02	0.68
9	0.25% NaOH	17.0	37.87	3,37
10	0.50% NaOH	25.0	39.82	1.72
11	0,75% NaOH	28.3	6.32	0.57
12	1.00% NaOH	26.0	6.42	0.95
13	1.25% NaOH	25.0	7.85	1.72
14	1.5% NaOH	23.5	7.19	0.48
15	1.75% NaOH	20.3	6.87	1.35

of the interaction between free fatty acids with NaOH. Free fatty acids were resulted from hydrolysis ester (biodiesel) in the presence base catalyst and can also be resulted from free fatty acid which was not complete in esterification stage, given that CPO was used in this study have free fatty acids height levels (4.7%).

The viscosity data shows that in the use of KOH or NaOH catalysts with low concentration resulted in the high viscosity of biodiesel produced. The high viscosity was made possible as an impact of CPO which has not been converted to biodiesel. The viscosity of biodiesel on the use of KOH catalyst ranging from 1% to the top and 0.75% for NaOH has a very large decrease in viscosity. However, based on the value of the viscosity of biodiesel according to ISO standards and ASTM (Table 1), then there are only three concentrations on KOH which meets the standards, i.e. at a concentration of 1.5%, 1.75% and 2.0%. While none of the catalysts NaOH concentration that meets the standards. This case does not mean NaOH can not be used as a catalyst in the manufacture of biodiesel by using this solvent. Viscosities which not meet these standards are made possible by the existence of soap in the biodiesel product. To reduce the content of soap which is still contained in the biodiesel needed laundering more than those done on the use of KOH catalyst.

In addition another important parameter in determining quality of biodiesel is the acid number. In the Table 2 show that in the use of KOH catalyst at a concentration of 1.25% to 2.0% had an acid number value that meets the biodiesel standard, while at other concentrations not meet a predetermined standard, i.e. maximally 0.8 mg KOH/g biodiesel.

Based on the volume of biodiesel, viscosity and acid number which were resulted, a set a condition (type of catalyst and concentration) can be determined, which later can be used in the next testing. On the basis of it all then be decided that the catalyst concentration of 1.75% KOH was an optimum condition in this study.

Optimization of Ratio of Alcohol /Oil

Ratio mole of methanol/oil palm is one factor that can affect the quantity and quality of biodiesel produced. To determine the optimum mole ratio is done by varying the mole ratio of methanol/oil palm, namely 3:1, 4:1, 5:1, 6:1, 7:1, 8:1 and 9:1. All treatments were performed with the same solvent amount i.e. 0.4 part of the volume of CPO. Comparisons were chosen by considering that the mole ratio of methanol/oil palm is a 3:1 stoichiometry, so the comparison would use a larger mole methanol to 9:1 mol ratio. Transesterification reaction is an equilibrium reaction, then with the use of methanol mole larger than stoichiometric can shift the equilibrium to the right, which means will increasing the biodiesel conversion [14]. The use of mole ratio of methanol/different CPO will produce biodiesel with different quantity and quality, as shown in the Table 3.

Based on data in Table 3 can be known that in the mole ratio of methanol/CPO from 5:1 to 9:1 the volume of biodiesel which was resulted relatively higher compared with the volume on the other comparison (3:1 and 4:1). While for the viscosity, a comparison ratio of moles of methanol/CPO ranging from 6:1 to 9:1 had meet the standard.

From data of acid number can be seen that the mole ratio of methanol/CPO on 4:1 to 7:1 had meet the standard. At the mole ratio 3:1 the viscosity was still relatively high, and acid number well above the standard

Table 3. Analysis result of biodiesel on variation of mole ratio methanol to CPO

Mole ratio	Volume (mL)	Kinematics viscosity (mm^2/s)	Acid number (mg/g)
3:1	15.0	14.10	6.71
4:1	29.5	7.76	0.61
5:1	38.5	6.60	0.46
6:1	37.8	5.34	0.66
7:1	35.5	4.67	0.71
8:1	39.0	4.72	0.87
9:1	34.0	4.60	1.01

Table 4. Analysis of biodiesel on volume ratio of solvent to CPO

Volume ratio	Volume (mL)	Kinematic viscosity (mm^2/s)	Acid number (mg/g)
0:5	26.2	5.64	0.77
1:5	26.0	5.18	0.55
2:5	37.8	5.34	0.66
3:5	37.5	5.64	0.50
4:5	38.0	6.27	0.61
5:5	36.0	6.36	0.53

Table 5. Results on the optimization of biodiesel analysis solvent temperature range

Petroleum Benzin	Volume (mL)	Viscosity (mm^2/s)	Acid number (mg/g)
70-90 °C	37.8	5.34	0.66
80-100 °C	40.0	6.52	2.52
Mixture (1:1)	29.0	8.07	1.41

for biodiesel. Acid numbers are still relatively high and it was estimated come from palm oil free fatty acids that have not been converted into esters.

Based on data listed in Table 3 it can be concluded that the mole ratio of methanol/CPO optimum at 6:1. At the mole ratio of 5:1, although the volume of biodiesel produced was greater and acid numbers had meet the standards but viscosity was above 6.0 mm^2/s. When compared with some results of research that has been made in connection with optimum mole ratio on biodiesel production, it can be said that the manufacture of biodiesel by the solvent does not change the optimum mole ratio, which generally has been reported by previous researchers.

Optimization of Ratio of Solvent Volume/CPO

Determination of ratio optimum solvent/CPO carried out on the ratio mole methanol/CPO on 6:1. Comparative solvent used was 0:5, 1:5, 2:5, 3:5, 4:5, and 5:5. With different volume of solvents may be an effect on the quantity and quality of biodiesel produced.

In Table 4 it appears that on ratio of 2:5, volume of biodiesel produced began to increase when compared with the volume at the ratio 1:5 and without solvent with volume ratio 0:5. In the table also seemed that the viscosity slightly increased with increasing ratio volume of solvent/CPO. Quite high of viscosity predicted as a result of incomplete on transesterification, where a small portion of CPO is still in the form of triglycerides. With much more solvent in the mixed system nonpolar nature of the mixture also increases. So the interaction between methanol and triglycerides become more difficult. Therefore it is necessary to be known the optimum ratio so that the reaction running well.

In this case it appears that the acid number of biodiesel produced by the solvent has a relatively small amount compared to the biodiesel obtained through without solvent. When compared with the acid number of CPO, it appears that biodiesel produced has an acid number is much lower. Based on data about the volume, viscosity and acid number of biodiesel produced, it can be concluded that the optimum volume ratio of solvent to the production of biodiesel using CPO was 2:5. The principle which is used that fewer solvent would be better. Although at the 1:5 ratio of two parameters namely the viscosity and acid number has meet the standard, but the volume of biodiesel which was resulted far when compared with the volume on the comparison 2:5. However, when compared with the use of other solvents such as THF, then the 2:5 ratios is much smaller.

Optimization of Temperature Range of Petroleum Benzin

In this study, the solvent was used in three different temperature ranges, i.e. 70-90 °C, 80-100 °C and a mixture of both of them with a ratio of 1:1 (v/v). This temperature difference was based on consideration of the differences in chemical components of petroleum benzin. Given this difference is very possible it will affect the solvent properties owned. Here is the data of volume biodiesel obtained as a result of differences in the temperature range used in petroleum benzin.

Based on data in Table 5 is shown that there is a difference of biodiesel volume which was produced a result of differences in the temperature range of solvents. Largest volume was obtained on the use of solvent on 80-100 °C, although when compared with the volume of biodiesel for 70-90 °C the difference is not too large. Based on viscosity data which are shown that using those solvent impact on viscosity exceeds the standard for biodiesel, and so also with the solvent mixture.

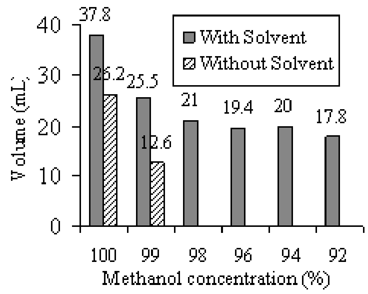

Fig 1. Graph showing the relationship between concentrations of methanol with the volume of biodiesel

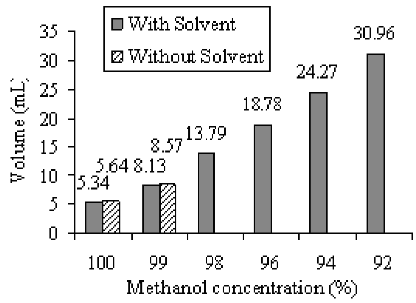

Fig 2. Graph showing the relationship between concentrations of methanol with viscosity

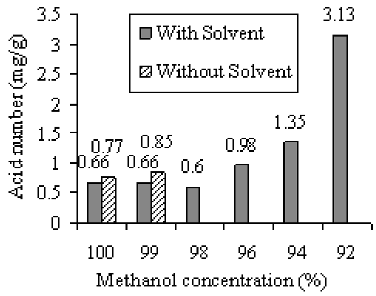

Fig 3. Graph showing the relationship between concentrations of methanol with acid number

In the data of acid number, the value that meet the standard was just biodiesel produced using the solvent petroleum benzin 70-90 °C. While the biodiesel which was produced by the solvent with range 80-100 °C have the highest number acid value. This indicates that the esterification reaction in such conditions is not run well. In petroleum benzin with a high temperature range, the molecular size (chain length) of constituent will become longer than the others. This will have an impact on increasing of nonpolarity properties of solvent. With such condition, interaction between free fatty acid and methanol to be difficult, so that at the end of the reaction of remaining free fatty acids is then measured on determination of acid numbers.

Based on this data above, it has been known that only the biodiesel produced using petroleum benzin 70-90 °C alone that meet quality standards for biodiesel. Therefore in this study had been decided that the optimum temperature range of biodiesel palm oil using solvent is 70-90 °C.

Tests on Different Methanol Concentrations

This testing is necessary to do because in the reality that the methanol used in the manufacture of biodiesel on a large scale is not methanol 100% as used in this study. Through this test will be known how the effect of solvent on the change concentration of methanol level which was used.

On the picture was seen that the decrease in methanol concentration resulted in decrease in volume of biodiesel produced. This decrease was estimated as a result of the saponification process which causes separation of the biodiesel process becomes difficult. Saponification process is a result of interaction between free fatty acids with KOH, where fatty acids can be derived from hydrolysis caused by water or come from CPO on the esterification process. In Fig. 1 also be seen that the volume biodiesel obtained with 99% methanol has a volume equal to the volume of biodiesel which was resulted from reaction without solvent with methanol content of 100%. This indicates that the solvent can reduce the negative impact of water in the manufacture of biodiesel.

This testing is necessary to do given that in the reality that the methanol used in the manufacture of biodiesel on a large scale is not methanol 100% as used in this study. Through this test will be known how the effect of solvent on the change concentration of methanol level which was used.

On the use of methanol with the lower levels (concentration) show the increase in viscosity (Fig. 2). Biodiesel with high viscosity is assumed as a result of incomplete reaction, where triglyceride (has a high viscosity) as a raw material not yet all was converted into esters. The presence of water inhibits the formation of ester reaction.

As a result of not complete reaction that occurs was showed by high viscosity and also shown by the high acid number. Numbers of acid produced from biodiesel using methanol with high water content was also high as shown in Fig. 3. Therefore, the water content of biodiesel is an important thing to note, because it will have a negative impact. So, necessary to reduce the water content of methanol before being used in the manufacture of biodiesel.

Testing on FFA with higher level

Testing on biodiesel producing use solvent method also performed on CPO with high free fatty acids (FFA) level. On Fig. 4 it appears that increased levels of free fatty acids resulting a decrease in the volume

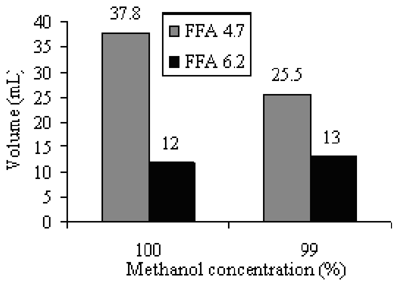

Fig 4. Graph showing the relationship between concentrations of methanol by volume biodiesel derived of CPO with different levels of FFA

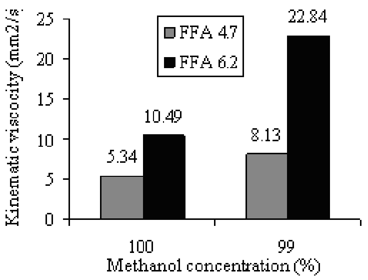

Fig 5. Graph showing the relationship between concentrations of methanol with viscosity biodiesel originated from CPO with different levels FFA different

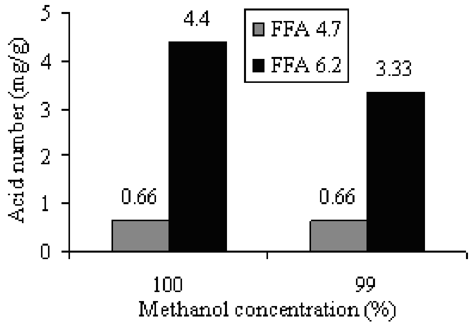

Fig 6. Graph showing the relationship between concentrations of methanol with the acid number, derived from CPO with different levels of FFA

Table 6. Results of analysis of density, ash, residues carbon, water content and energy content

Method	Analysis					
	P (mg/L)	Density (g/mL)	Ash (%w/w)	Carbon residue (%w/w)	Water (%v/v)	Energy Cal./g
With Solvent	5.6	0.902	0.008	0.05	0.1	9515
Without Solvent	9.1	0.899	0.004	0.01	0.1	9585

of biodiesel produced. This volume decline as result of the difficulty of separation process due to of soap formed in the reaction with the raw materials with high fatty acid content.

In addition to decreasing the volume of biodiesel produced, an increase in FFA levels also resulted in increased viscosity as shown in Fig. 5. Increased viscosity is predicted as a result of the soap which was formed by reaction of saponification of the FFA.

Elevated levels of FFA also followed with elevated of acid number of biodiesel. This is reasonable because of the nature fatty acid also be measured on determining the acid number. In Fig. 6 also be seen that using palm oil with high free fatty acid content, resulted the acid number of biodiesel produced is also high and did not meet the standards biodiesel.

The presence of free fatty acids in high level can resulted the using of large amounts of catalyst, so catalyst efficiency decreases. In addition, the presence of free fatty acid resulted formation of soap by saponification reaction. While water can cause hydrolysis reaction on triglycerides and methyl esters (biodiesel) to form free fatty acids. Free fatty acids produced are then able to interrupt the reaction as explained above. Soap is produced, can cause the emulsion of methyl esters and glycerol or between methyl ester and water in the washing process, so that the methyl ester is more difficult to be separated. Besides that the soap will increase the viscosity of methyl esters [15].

Phosphor Content Analysis, Density, Water Content, Ash Content, Residue Carbon and Energy Content

The phosphorus content in biodiesel is one important parameter in determining the quality of biodiesel. In this study, phosphorus content determined by spectrophotometer as complexes of fosfomolibdad of colored blue. The measurement results of both biodiesel produced from the optimum conditions using a solvent and biodiesel produced without the use of solvents (for comparison) is given in Table 6.

Based on data in Table 6 can be seen that the biodiesel produced by solvent method has a lower phosphorus content. This is estimated as a result of using petroleum benzin solvents, where by the presence this solvent, the solubility of phosphorus in biodiesel was decreasing. In the process of separation the phosphorus moves easily into the glycerol layer.

Analysis of the density at the biodiesel is one simple analysis to determine whether biodiesel produced meets the standards or not. At relatively high biodiesel density, it can be estimated there are other compounds with higher density such as presence of water. If we compare the density of biodiesel which is produced through the method of solvent with biodiesel

Table 7. Results of analysis flash point and pour point

Method	Analysis	
	Flash point (°C)	Pour point (°C)
With Solvent	150	8
Without Solvent	155	9

Table 8. Results of analysis of biodiesel using GC-MS

Peak Number	Retention time (Min)	Area	% Area	Estimates of chemical compounds
With solvent				
1	18.874	1515670	1.03	Methyl myristate
2	21.135	68997028	47.07	Methyl palmitate
3	22.960	68163510	46.50	Methyl oleate
4	23.160	7243587	5.40	Methyl stearate
Without solvent				
1	18.872	1405182	0.80	Methyl myristate
2	21.143	79053480	44.92	Methyl palmitate
3	22.970	85496704	48.58	Methyl oleate
4	23.165	9132159	5.69	Methyl stearate

produced through without a solvent (commonly used in a generic way), seem that between them is no different. By taking the value two digits behind the decimal, then the value of both are the same, which is 0.90 (g/mL). So that it can be said that through the method of solvent will be produced biodiesel with the same quality biodiesel in the normal way.

Suspicion of the existence of other compounds in the biodiesel which was produced through the presence of solvent or not can be known after the analysis of water content. Levels of both biodiesel in water content was 0.1% (v/v), while based on the ISO and ASTM (Table 1), the water content maximum in biodiesel is 0.05% (v/v). This indicates that the water content of biodiesel should be strived for down again, either by extending the time of evaporation or using a particular material that serves to absorb the water contained in the biodiesel.

In the case of ash content, the both of biodiesel were produced have meet the standards. In other words we can say that with the solvent method, the ash content of biodiesel is still below the maximum limit of 0.02 % (w/w). A slight difference in the ash content may affect the energy content of biodiesel produced.

Meanwhile, from data of energy content was known that calorific value of biodiesel which is produced by presence of solvent is 9515 calories/gram, while biodiesel which is produced without solvents was 9585 calories/gram. However, from those data the differences are not too significant.

From data test of carbon content showed that residual carbon on the method of solvent relative greater if compared with the residue produced on the biodiesel without solvent. However, levels of carbon residue produced are still in the allowable threshold, i.e. a maximum of 0.05 % (w / w).

In the analysis of flash point and pour point can be seen that the biodiesel produced meets ISO and ASTM standards (Table 1). The results showed the value of flash point and pour point for each method is as given in Table 7.

Component Analysis of Biodiesel by GC-MS

Biodiesel which was produced using solvent method on optimum conditions then analyzed with GC-MS. In addition the analysis was also performed on biodiesel produced in a way without solvent as a comparison. Chromatogram analysis showed four major peaks were detected as methyl esters.

CONCLUSION

The optimum condition on transesterification of CPO with the method of solvent (petroleum benzin) was using catalyst KOH 1.75% (w/v) on mole ratio of methanol/CPO was 6:1, volume ratio of solvent/CPO was 2:5 on range of petroleum benzin 70-90 °C. Viscosity and acid number of biodiesel have been produced according to standards ISO and ASTM. In other biodiesel characteristics such as phosphorus levels are relatively lower than the phosphorus of the biodiesel produced with the method without solvent. While on the characteristics of specific gravity and water content is relatively the same. On the characteristics of ash and carbon residue, the method without a solvent gave better results although both are still under limit of maximum value. Result analysis by GC-MS showed that the chemical components of biodiesel, both produced by solvent method or not contain relatively the same compound, namely methyl myristate, methyl palmitate, methyl oleate, and methyl stearate.

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