Characterization of Kapok Seed Oil as Feedstock to Produce an Alternative Energy of Green Diesel

By Siti Salamah

Characterization of Kapok Seed Oil as Feedstock to Produce an Alternative Energy of Green Diesel

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Abstract. Green Diesel is diesel oil derived from hydrogenated vegetable oils that have better quality than biodiesel, which is in the form of an efficient produce process with no waste and producing less CO_2 than petroleum diesel and biodiesel. There Green Diesel is environmentally friendly. Kapok seed is one of the potential sources of raw materials that can be tan oil resource. Kapok seed produces the Green Diesel. Kapok seed was produced from fruit that has some different characteristics from one tree to the other tree. Therefore, the characteristics of kapok seed must be known. The research was prepared to know the characterization of kapok seed oil by determining the water content, fatty acid, FFA (free fatty acid) and quality of kapok seed oil. The quality of kapok seed oil was tested in the laboratory of Technology Oil Gas and Coal Chemical Engineering Department, Faculty of Engineering University of Gadjah Mada. The results showed brown kapok seed oil. The analysis of kapok seed oil contained several fatty acids; the most dominant was 50.89% linoleic acid, palmitic acid 20.93%, and oleic acid 17.84%. The FFA content was 7.35%. The results quality of oil had Specific Gravity with 0.911 g/ml, Kinematic viscosity 37.29 mm^2/s, and Flash Point 252.3° C and 3° C Pour Point.

Key Words : *kapok seed oil, alternative energy, green diesel*

1 Introduction

The increasing energy needs and the decrease in petroleum energy sources are energy problems to be solved. Biodiesel is one of the alternative solutions to solve the problems of energy needs, by substituting the petroleum diesel with diesel equivalent oil which is processed from vegetable oils such as kapok seed oil, jatropha oil, and others [1]. Biodiesel produced from vegetable oils with a transesterification process known as biodiesel generation 1 (G1). Recently, the used raw material is a product of biodiesel derived from vegetable oils. To refine the weakness of biodiesel on engine compatibility G1 as well as gas emissions, it is necessary to develop biodiesel generation 2 or G2 [2].

Biodiesel G2 is the alkane compound from the result of processing by hydrogenation of vegetable oils that have the similar characterization to diesel fuel. The alkane is the reaction products that were equivalent to diesel oil namely green diesel or biodiesel generation 2 (G2) with a better quality than the G1 biodiesel transesterification results [2]. It is called green diesel because it is environmentally friendly process without wasting the result and emissions generated from burning waste that is smaller than the other diesel [3].

The Green Diesel process removes the oxygen by reaction of hydrogen that produces a pure parraffin product. The primary co–product is propane and the by-products are water and carbon oxides. The green diesel process reaction equation can be written as follows:

$$trigliserida + H_2 \rightarrow green\ diesel + H_20 + CO_2 + Propana$$

From the equation above shows that there is no waste to be processed specifically as a result of the reaction, but it is better quality of Green Diesel from biodiesel. The advantages of Green Diesel or biodiesel G2 are able to achieve a cetane number 70-90 that is much higher than biodiesel G1 achievement which only reaches 50-65, so that the resulting oil can be used directly as a fuel for diesel engines without adding to diesel first and even without making any modification to the machine [3]. The kapok seed is similar to cotton seed, when it is processed to produce oil which is a vegetable oil that would have the potential used as renewable fuel [4]. The kapok seed is for the manufacture of industrial waste fill pillows, bolsters and mattress are one of the vegetable oil properties and fatty acid content similar to palm oil. Thus, kapok seed oil has a good potential to be used as biodiesel G1 [5] and kapok seed oil can be produced for Green Diesel.

Several researches on kapok seed in making biodiesel from cotton seed oil prepared by non-catalytic SCF conditions that was carried out by Demirbas [4]. Performed by Salamah, Ahtawan , Hendra, utilization of kapok seed is as industrial waste kapok to make an alternative biodiesel fuel [5]. The researcher has [1] characterized the rubber seed oil and the decrease of the FFA value (Free Fatty Acid) as an introduction to produce alternative biodiesel fuels. SNARE [6] researched an overview of catalytic Pd on active carbon support with a saturated production of the next generation biodiesel from natural oil. The renewable production fuels Green Diesel from vegetable oil (palm oil and soybean oil) [3]. This research will be carried out the characterization of kapok seed oil to determine the chemical properties (the water content, fatty acid, FFA and quality of kapok seed oil) as the introduction of Green Diesel production so it could increase the value of kapok seed that has been wasted.

Kapuk Seed Oil

One of the materials forming potential of biodiesel is kapok seed oil. Kapok seed oil is derived from the seeds of kapok and kapuk contains in the fruit that produces fibers, cotton for example are used as raw material manufacturing industry home contents pillow, bolters, and mattress. Kapok seeds as a by-product are rarely used or simply discarded as waste and are sometimes fed to feedstock. Kapuk seed is pressed to obtain the oil. The one of kapok seeds beneficial is that it can be potential feedstock of Green Diesel which has more economic value [4]. Kapok seed is similar to cotton seed, when it is processed to produce oil which is a vegetable oil that would have the potential used as renewable fuel.

Each kapok seed has its own characteristics. The characteristics include of water content, fatty acid, Free Faty Acid (FFA), specific gravity, viscosity kinematic, Flash Point, Pour Point so any raw materials are necessary to be researched. This research is intended to give knowledge about the characteristics of kapok seed oil as a feedstock to produce Green Diesel in order to increase the effective used and economic value of kapok seed, especially for kapok industry that has waste or animal feed.

2 Experimental

2.1 Determination of Water Content

The water content determined with heating the oven. Kapok Seed was weight then heated in oven about two hours at 110^0 C. The sample cooled until it reached a steady of temperature room, then wait for the sample weight until it got constant. The water content contained in kapok seed with comparison weight before and after heated.

2.2 Analysis of Fatty Acid Content of Kapok Seed Oil

Kapok seed oil was produced from pressing seed gum. The oil was analyzed by using GC-MS (Gas Chromatography - Mass Pec) in the laboratory of Organic Chemistry, Faculty of Mathematics and Natural Sciences, University of Gadjah Mada Indonesia.

2.3 Analysis of Free Fatty Acid (FFA)

Kapok seed oil weight was 10-20 grams. Neutral alcohol 96% was added and then heated in a water bath 10 minutes while stirring and cooling with a closed back cooling. After cooled and then titrated with 0.1 N KOH used the indicator which was red phenolphtalein until the proper of the solution guava red cooler. FFA is determined by the formula:
Determination of FFA value
The Acid value was calculated using the formula:

$$\% \text{ FFA} = \frac{A \times N \times Mr}{G \times 10}$$

A : amount of ml KOH for titration
N : normality of KOH
G : weight of sample (gram)
Mr : weight molecule relatif of fatty acid dominant

2.4 Quality Test of Kapuk Seed Oil

Kapok seed oil which was used for the manufacture of Green Diesel quality was tested to meet the standards quality of the oil, since it was necessary to check the

quality results of Green Diesel product. Green Diesel was acquired in the end of the phase accordance with the specifications established by the Government of Green Diesel.

3 Result and Discussion

3.1 Water Content

Based on the result of water content that obtained in the kapuk seed was 4,07 %. The water content contained in the kapok seed was still normal. According Sunanto (1994) water content in 100 grams of material is 7 grams (7 %) [5].

kapuk seed used researched are in figure 1 as follows:

Figure 1 Kapok seed

3.2 Analysis of Fatty Acid

The analysis of fatty acid content in kapok seed oil was analyzed by Gas Cromatography Maspec (GC-MS). The results of the analysis by GC-MS are in Figure 2 as follows:

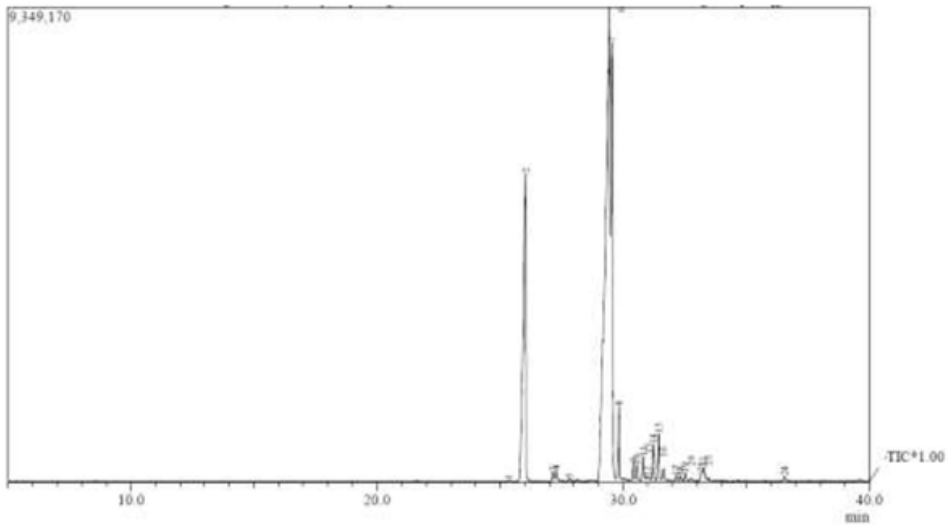

Figure 2 GC-MS chromatograms of cotton seed oil

The data from GC-MS analysis results in getting the most predominant fatty acids were linoleic acid (located on the graph line 6 of 50,89 %, followed by other fatty acids content of 20,93% and 17,84% (peak number 7), such as palmitic acid and oleic acid. The fatty acid content of the seed cotton oil with a molecular weight of 294 was the data that could be calculated from the levels of FFA (free fatty acid) of kapok seed oil.

3.3 The analysis FFA kapok seed oil

The FFA content of kapok seed oil obtained FFA value of 7.35%. This value was relatively high. Considerably from the manufacture of Green Diesel, it should not be lowered due to the decrease in its FFA. Because of the decreased of FFA using H2SO4 catalyst (PA) concentrated will cause corrosive to the reactor. Oil with FFA 7.35 will be manufactured to produce the green diesel.

3.4 The quality of kapok seed oil

The brown kapuk seed oil quality was tested in the laboratory of Oil Gas Technology and Coal Chemical Engineering Department, Faculty of Engineering, University of Gadjah Mada, Yogyakarta, Indonesia.
Oil content quality test results can be seen in Table 1 below:

Table 1 Test results of the kapok seed oil quality

No.	Type of test	Unit	Result Test	Methods of test
1	Specific Gravity at 60/60 ^{0}F	gr/ml	0.911	ASTM D 1298
2	Viscosity Kinematic at 40 ^{0}C	mm^2/s	37.29	IKU/5.4/TK-02
3	Flash Point PM.c.c	^{0}C	252.5	IKU/5.4/TK-03
4	Pour Point	^{0}C	3	IKU/5.4/TK-04

The test results demonstrated the quality of cotton seed oil that can be used for the manufacturing of Green Diesel. Furthermore, these physical properties results showed that the kapok seed oil has properties same with jatropa oil [7] which could be used for the production of Green Diesel feedstock.

4 Conclusion

From the result of the research, the researchers could draw conclusion as follows:

1. The kapok seed oil feedstock has 4.07% water content. The FFA value of kapok seed oil is 7.35%. The kapok seed oil contained several fatty acids, the most dominant was 50.89% linoleic acid, The characteristics of kapok seed oil has been appropriated with the characteristics of vegetable oil which can be used for the Green Diesel production.
2. The kapok seed oil is as well as the vegetable oil quality which is ready to be processed.

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