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Making Biodiesel From Raw Materials CPO (Crude Palm Oil) Trenches With Degumming Method and Analysis Based on SNI 04-7182-2006

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ABSTRACT

Palm oil liquid waste or waste processing CPO (Crude Palm Oil) commonly called CPO (Crude Palm Oil) trenches are very potential to be processed into biodiesel. At the moment, CPO (CPO trenches) processing waste is only considered as waste that pollutes the environment and is not of economic value. If left continuously, palm oil liquid waste that has a pH of 4.2 (acidic) will cause problems for the environment if disposed of directly. One form of utilization of CPO trenches that can be done is by converting it into biodiesel. The manufacture of biodiesel from CPO trenches uses transesterification reactions such as the manufacture of biodiesel in general, with pretreatment to lower the acid figures in the CPO trenches. Biodiesel was obtained later in the analysis of quality standards based on SNI 04-7182-2006 and obtained results that meet the requirements for four parameters, namely the content of FFA samples before the transesterification process is 1.82%. Tan biodiesel content of 0.3055 mg KOH/g. The content of free glycerol is 0.0198% and the total glycerol is 0.0884%.

Keywords: *Biodiesel, CPO Trenches, FFA, TAN, Free Glycerol, Total Glycerol*

1. INTRODUCTION

Fuel is one of the basic needs that can not be separated from the needs of the community. Where the longer the price of fuel is increasing, so it becomes a serious problem in people's lives. Fuels derived from petroleum, coal, natural gas, and others are increasingly scarce. This is due to the increasing population, technological advances, and industrial developments that deplete various energy sources, this is supported by Djamaludin's opinion in 2011 wherein 2008 Indonesia has imported fuel amounting to 153 million BOE (barrel of oil equivalent) = SBM / barrel equivalent oil. Therefore, it takes a thought to get an alternative energy source that is cheap and efficient, and useful for all circles of society.

Efforts can be made to find other sources of energy known as renewable energy. Renewable energy is energy derived from materials found in nature and can be produced in a fast time or will not run out. Undang-Undang No. 30/2007 about energy on article 20 paragraph 4 explain the provision and utilization of new and renewable energy must be improved by the government and local governments following their authority. One type of renewable energy is biodiesel. Biodiesel is one type of fuel produced using vegetable oil or animal fats through the transesterification process or esterification process with the help of alcohol and catalyst (Dharsono & Oktari, 2010). Biodiesel has almost the same characteristics as diesel. Biodiesel can be made from various types of oil such as palm oil, soybeans, sunflowers, peanuts, fence distance, waste cooking oil, and several other types of plant oils. Palm oil liquid waste or waste processing CPO (Crude Palm Oil) commonly called CPO (Crude Palm Oil) trenches, very the potential to be processed into biodiesel.

At the moment, CPO (CPO trenches) processing waste is only considered as waste that pollutes the environment and is not of economic value. If left continuously, palm oil liquid waste that has a pH of 4.2 (acidic) will cause problems for the environment if disposed of directly. According to the Ministry of Environment, the limit of waste dumped into nature is in the pH range of 6-9. Therefore, proper handling is needed so that this trench CPO can be useful and does not cause losses from aspects of human health and the environment. One form of utilization of CPO trenches that can be done is by converting it into biodiesel. The manufacture of biodiesel from CPO trenches uses transesterification reactions such as the manufacture of biodiesel in general, with pretreatment to lower the acid figures in the CPO trenches.

This research was conducted to utilize CPO trenches for biodiesel. Also conducted an analysis based on quality standards SNI 04-7182-2006 to find out the quality of biodiesel obtained.

2. METHODOLOGY

This research is an experimental study that produces quantitative data. Quantitative data produced include FFA (Free Fatty Acid) levels, TAN (Total Acid Number) levels, free glycerol levels, and total glycerol levels.

a. Making Biodiesel from CPO Trenches

Biodiesel making is divided into three stages, namely pretreatment (degumming), esterification stage, transesterification stage, and purification stage.

The pretreatment (degumming) stage is done by melting the CPO trenches sample using an electric heater at 60ºC, then added H_2SO_4 as much as 1% (v/v) and heated while stirring at 90ºC for 10 minutes. Furthermore, filtering is done using a fixed bed in the oven at a temperature of 110ºC.

The esterification stage is done using fixed bed samples inserted into the mini reactor, then added 50%(v/v) methanol and 2.5%(v/v) H_2SO_4. The reactor is connected with a condenser and reacted for 3 hours at a temperature of 60-70ºC. Next, separate the upper and lower phases. The upper phase of the FFA analysis is carried out. If the results of the FFA analysis obtained FFA value <5% then the transesterification process can be done.

The purification stage is done by washing the phase of transesterification (Biodiesel) using distilled water (10, 50, and 100 % volume), then drying and filtration. Filtering results analyzed according to SNI 04-7182-2006.

b. Biodiesel Product Analysis (SNI 04-7182-2006)

FFA (Free Fatty Acid) Content Test

A total of 2-5 grams of CPO trenches samples were inserted into the Erlenmeyer 250 mL flask, then added 50 mL ethanol 95% neutral and homogeneous. Furthermore, the pp indicator is added as much as three drops and done with KOH standard solution 0.1 N until the color changes to pink as a review that can last for 15 seconds.

Calculation:

$$FA\ (\%) = \frac{256\ x\ N\ KOH\ x\ V\ KOH}{m\ sample\ x\ 10}$$

Description:

N KOH = Normality of KOH (N)
V KOH = KOH volume required for titration (mL)
m sample = sample mass (gram)

Total Acid Number Test

A total of 20 grams of biodiesel samples were inserted into the Erlenmeyer 250 mL flask, then added 100 mL of titration solvent. Furthermore, pp indicator is added as much as three drops and done with a standard solution KOH-ethanol 0.1 N until the color turns a little pink that can last for 15 seconds.

Calculation:

$$TAN = \frac{56{,}1\ x\ N\ KOH - Ethanol\ x\ V\ KOH}{m\ sample}$$

Description:

N KOH-Ethanol = Normality of KOH-Ethanol Solution (N)
V KOH = KOH volume required for titration (mL)
m sample = sample mass (gram)

Free Glycerol Levels Test

A total of 10 grams of biodiesel samples were inserted into the pumpkin 1000 mL, added chloroform as much as 91 mL. Then, added 500 mL of distilled water and shaken strongly for 30-60 seconds. Spelled with distilled water, shaken, and silenced until a perfectly separate layer. In pipettes as much as 300 mL into the pumpkin Erlenmeyer 500 mL that has been added 2 mL periodic acid, shaken slowly to homogeneous. Then it is closed and stored in a dark place. After 30 minutes the mixture is removed and added 2 mL of KI solution, stored again for 1 minute. Furthermore, it is done with a solution of $Na_2S_2O_3$ 0.01 N until a faint yellow color. After the faint yellow color is added 2 mL starch indicator and continued titration until the right blue color disappears. Also conducted blank analysis without biodiesel samples.

Calculation :

$$Free\ Glycerol\ (\%) = \frac{2{,}302\ x\ ((N\ Na2S2O3)\ x\ (V\ blank - V\ sample)}{m\ sample\ x\ \frac{300}{900}}$$

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Description:
N ($Na_2S_2O_3$) = Normality of $Na_2S_2O_3$ 0.01(N)
V Blanko = Blank volume(mL)
V sample = Sample volume (mL)
m sample = Sample mass (gram)

Total Glycerol Levels Test

A total of 10 grams of biodiesel samples were inserted into the Erlenmeyer flask sharpened 250 mL, added 100 mL of alcoholic KOH solution, in saponification by heating the mixture above the electric heater connected to the condenser, and simmered for 30 minutes. After 30 minutes, the condenser is released and transferred the contents of the Erlenmeyer flask into a 1000 mL mustard flask containing 91 mL of chloroform and 25 mL of glacial acetic acid. Then it is covered and shaken firmly until the two layers split perfectly. Pickpocket each 6 mL of periodic acid solution into the Erlenmeyer 250 mL flask and prepare blanks with 50 mL of distilled water and 6 mL of periodic acid. Then, 100 mL of aquatic solution is piped into the Erlenmeyer 250 mL flask containing 6 mL of periodic acid, closed, and stored in a dark place for 30 minutes. After 30 minutes the mixture is removed, 3 mL of KI solution is added and stored again for 1 minute. Furthermore, it is done with a solution of $Na_2S_2O_3$ 0.01 N until a faint yellow color. After the faint yellow color is added 2 mL starch indicator and continued titration until the right blue color disappears. Also done blank analysis in the same way.
Calculation :

$$Gliserol\ Total\ (\%) = \frac{2{,}302\ x\ ((N\ Na2S2O3)\ x\ (V\ blank - V\ sample)}{m\ sample\ x\ \frac{100}{900}}$$

Description :
N (Na2S2O3) = Normality of $Na_2S_2O_3$ 0.01(N)
V Blanko = Blank volume (mL)
V sampel = Sample volume (mL)
m sampel = Sample mass (gram)

3. RESULT AND DISCUSSION

Results

The following is the result of the analysis of FFA (Free Fatty Acid) CPO trenches :

Type of Analysis	Result	Unit	Standard	Test Method
FFA (*Free Fatty Acid*)	1, 82	%	<5	AOCS Cd 3-63

The following is the result of the analysis of Total Acid Number, Free Glycerol levels, and Total Glycerol levels CPO trenches :

Type of Analysis	Result	Unit	Standard	Test Method
Kadar TAN (%)	0,3055	mg KOH/g	Max. 0,8	ASTM D 664
Gliserol Bebas (%)	0,0198	% (massa)	Max. 0,02	AOCS Ca 14-56
Gliserol Total (%)	0,0884	% (massa)	Max. 0,24	AOCS Ca 14-56

Discussion

Biodiesel is one of the alternative diesel fuels derived from renewable biological sources and has a characteristic resemblance to diesel. Biodiesel is made by converting oil (triglycerides) into alkyl esters through the transesterification process.

The raw material used in the manufacture of biodiesel is CPO trenches. CPO trenches which are waste from palm oil production or CPO can cause pollution if this waste disposal is done incorrectly.

The process of pretreatment and esterification reaction in the CPO trenches sample is carried out before the transesterification process. The pretreatment stage is degumming. Degumming is done to remove the sap contained in the raw materials, while esterification is done to lower the levels of free fatty acids or FFA (Free Fatty Acid) in a generally high trench CPO. This esterification reaction reacts between free fatty acids contained in raw materials and methanol using acid catalysts. The catalyst used is sulfuric acid (H_2SO_4). In the reaction product formed methyl esters and water. The water produced from this reaction product must be separated before proceeding to the next stage.

After that, the FFA content test was conducted on the sample. FFA (Free Fatty Acid) is one of the analyses used to show the amount of free fatty acids contained in oils or fats. The manufacture of biodiesel from CPO trenches containing FFA >5% must go through 2 stages of the reaction, namely esterification reaction and transesterification reaction. Before going through the transesterification reaction, the esterification result must be perceived to have an FFA rate of <5%.

Based on the results of the experiment, the FFA rate was obtained at 1.82% so that it can be directly followed up to the transesterification reaction. This result is quite good because if the FFA level is too high then the KOH catalyst of the transesterification reaction will tend to react with free fatty acids to form soap, so the desired methyl ester (biodiesel) will be difficult to produce. So it is expected that after the esterification process will be obtained FFA results <5%, because the smaller the FFA content in the sample, the less likely there will be a reaction between free fatty acids and KOH.

The next stage is the transesterification stage which is the stage where the process of converting triglycerides in CPO trenches into methyl esters. The transesterification process reacts alcohol with oil (triglycerides) to quality the three chains of the ester group of each branch of triglycerides. This reaction requires heating and base catalysts to achieve the degree of conversion of CPO trenches into products consisting of biodiesel and glycerol. The base catalyst used in this experiment was KOH.

After the biodiesel is produced, then the biodiesel purification process is carried out to remove contaminants and the remnants of the reaction result are not needed because it will affect the quality of the biodiesel. The purification process is performed in the form of washing, drying, and filtration. Washing is done to eliminate glycerol resulting from transesterification reactions as a byproduct. These glycerols must be separated as they can affect the quality of biodiesel. The washing process is carried out in a separate funnel using a warm water temperature of 60ºC with 3 repetitions with a percentage of water washing 10%, 50%, and 100% volume.

The drying stage is done to remove the remaining water contained in biodiesel because the water that is still in the biodiesel will affect the quality of combustion in the vehicle engine. The drying process of biodiesel is done by heating biodiesel at a temperature of 100-110ºC. Furthermore, the dried biodiesel is filtered to remove dirt contained in biodiesel.

Once produced pure biodiesel, an analysis of the quality of the product is performed to find out if the biodiesel produced meets the standards. The parameters for biodiesel analysis can be seen in SNI 04-7182-2006. The analysis is :

a. Total Acid Number

TAN or acid number is the amount of free fatty acids and mineral acids neutralized by KOH in one gram of oil, so it can show limits on the amount of acid contained in biodiesel. The unit of TAN is mg KOH/g, and the determination is based on ASTM D 664 test method.

Total Acid Number (TAN) value owned by biodiesel CPO trenches is 0.3055 mg KOH/g. This value is below the maximum limit of SNI 04-7182-2006 for TAN which is 0.8 mg KOH/g. Tan content of biodiesel from CPO trenches is already good because if the total acid in biodiesel is too large then the acid can cause damage to the engine and can result in corrosion. The smaller the TAN number, the less likely it is that the corrosion and damage to the machine will also be smaller.

b. Free Glycerol Levels

Free glycerol is glycerol found in biodiesel samples tested. To remove glycerol from biodiesel is carried out washing with water because glycerol is

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soluble in water. The high value of this parameter can be caused by an imperfect washing process. Determination of this free glycerol using the test method AOCS Ca 14-56, the maximum level of free glycerol is 0.02 with the unit %(mass).

Based on the results of the experiment, biodiesel from this trench CPO has a free glycerol value of 0.0198%. This value still meets SNI 04-7182-2006. The high content of free glycerol can cause damage in the injection system, decreased fuel filter lifetime, and increased corrosion of the fuel tank. The smaller the value of free glycerol, the better the quality of biodiesel because it will reduce the damage to the injection system, reduce the corrosion and not affect the lifetime filter of the fuel filter.

c. Total Glycerol Levels

Total glycerol is a parameter that measures the number of glycerides contained in biodiesel samples (free glycerol and bound glycerol). The provision for determining total glycerol levels is using the AOCS Ca 14-56 test method, the maximum total glycerol content is 0.24 %(mass).

Based on the results of the experiment, biodiesel from this CPO trenches has a total glycerol value of 0.0884%. This value still meets the standards set by SNI 04-7182-2006. High bonded glycerol can cause a decrease in combustion efficiency that contributes to the onset of coke/black smoke in exhaust gases and the onset of deposits in pistons, injectors, and valves. Thus the smaller the total glycerol value, the better the quality of biodiesel because it can efficiently combustion, does not produce black smoke in exhaust gases, and reduces the risk of deposits on pistons, injectors, and valves.

4. CONCLUSION

Based on the results of the analysis of biodiesel products from CPO trenches obtained data, namely the content of FFA samples before the transesterification process is 1.82%. Tan biodiesel content of 0.3055 mg KOH/g. The levels of free glycerol is 0.0198% and the total glycerol is 0.0884%. This indicates that the biodiesel products produced meet SNI 04-7182-2006 because it has a TAN value (max. 0.8 mg KOH/g), free glycerol (max. 0.02%), and total glycerol (max. 0.24%) below the maximum limit set by SNI 04-7182-2006.

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