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Abstract

The increasing consumpiion of diesel oil results in deplelion of pelroleum supply so *that* biodiesel is made out ofcrude palm oil. The purpose ofthis study was to determine the effect of the production of biodiesel by using Nat)}! catalysts. First, crude palm oil is analyzed for its free fatty acid content. If thefree fatly acid is less than 5%, the Iransesterificalion process can be carried out immediately, if it's more than 5%, the esterification process is carried out first. The esterification process lastsfor 60 minutes temperature of60^{0}C with an acid catalyst H:SO$ then separated and u•ashed. After the washing process, the transesterification process is continued u'irh NaOH catalyst for 30 minutes at 60^{0}C and then the washing process proceeds in order to purify the results. Front the research that has been done, the result of biodiesel has a yield of 87.2866% kinematic viscosity 4.655 mm^2/s. flash point I ICC, pour point I-^{P}C. and density at IS^{O}C of0.875 g/ml.

Ke»vords: biodiesel, crude palm oil, NaOH

1. INTRODUCTION

The continuous use of petroleum results in depleting supply. In Indonesia, the consumption of petroleum, especially diesel oil is increasing. With the increasing need for diesel oil so the produced emissions are increasing as well. To overcome this problem, a new renewable energy form of biodiesel is created. The use of biodiesel is believed to be more environmentally friendly and improves environmental quality bccausc it's easily biodegradable and the released emissions are lower Ihan Lhe ctnissions from burning fossil fuels (Kcntenlejian ESDM Republik Indonesia, 2018).

Crude palm oil is used because of its abundance in Indonesia so that it's possible to be used as a mixture of fuel or a substitute for diesel fuel. Biodiesel can be made with an alkaline catalyst or an acid catalyst. In this case, an alkalinc catalyst was chosen in the form of NaOH rather than KOH because NaOH is more reactive. In order to determine the quality of biodiesel, a sample test was carried out, including density, kinematic viscosity, flash point, and pour point

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Iv•nang Inya, Tunjurtk' Wahyu Wittiyati, Aumsofira Riesty Putriba. PramudltlAdi

ll. LI'I*ERATURE REVIEW

Cmde oil is a vegetable oil obtained from the extraction process of the fruit of the ptxnt F.lacts rtlitjcensi.s. To obtain crude palm oil with good quality, crude palm oil rnuq be furthcr processed by a relining process first so that there ts no deterioration in quality due to hydrotysts and oxidation reactions. Crude palm oil contains triglyccridcs that arc latct reacted '*ith an alcohol to produce biodiesel (Malasan, 2016). The manufacture of biodiesel can be used from scveral raw matenals. such as crude palm oil, sampling oil, jatropha Oil, sunflower oil, and others. According to (Ramos ct al., 2009) crudc palm oil has the advantagc of high cetane numbers. iodine number, and good reaction stability.

Biodiesel is a biofuel Cor diesel engine/ motorbike applications in the form Of Fatty Acid Methyl Fslcrs (FA ME) which is made from vegetablc oil or ammal fat through an esterification/transcstcrification proccss (Kcmcntcrian ESDM Rcpublik Indonesia. 201 S), The level of (ree fatty acids in biodiesel must bc maintained to obtain a bcttcr quality of the biodiesel. The less frec fatty acid content in biodiesel, the better the quality, If the amount of free fatty acids is not controlled, soap will form in thc transcstcrification proccss (Atmojo, 2010).

Biudlcscl an advantage over diesel rucl, najncly 11101 biodicscl is gcnclally liiorc environmentally friendly. The use of 100% of biodiesel reduces CO emissions by then reduces S02 etnission by 100% and reduces HC betwccn 10%-50% oxides. Biodiesel is a fuel that is non-toxic, safe in transportation, and can be degraded naturally, which is more easily extracted by microorganisms (biodegradable). Also, biodiesel has a low smoke number and can eliminate the greenhouse effect, and a high cctanc number value, ranging from 57-62 so that its combustion elliciency is better (Havendri, 2007).

Biodiesel production can be done in two stages, namely the esterificatton and transestenfication reaction. The esterification reaction is carried out when the Free Fatty Acids (FFA) content ic more than This reaction aims to reduce levels of FFA. Esterification is a reaction of free fatty acids and methanol to produce fatty acid methyl ceter« or biodie«el with water impurities. Esterification reactions usually use acid catalysts, including sulfuric acid, phosphoric acid, and hydrochloric acid. Based on previous research literature studies, the esterification process that has been carried out by (Laila and Ok(avia, 2017), (Wahyuni et al., 2011), (Devi et al., 2015), and (Hastuti et al., 2015) used an acid catalyst in the form of 112S04 with a temperature between 500-65vc and a decrease in frec fatty acids ranging from 2.45%-11 ,3%.

Trunseslerificuliun is a process Illdl reacts triglycerides Willi alcohol, usually in fortn of methanol, by using an alkaline catalyst to produce FAME (biodiesel) and glycerol. An alkaline catalyst is used because the transcstcrification reaction rate will proceed way faster than the acid catalyst, The alkaline catalyst is chosen because of the ability to catalyze reactions at low temperature and atmospheric pressure, high conversion with minimal time, and it's widely available and economical. Based on previous research literature studies, the process of produce biodiesel that has been carried out using crude palm oil a.s raw materials by (Ristianingsih et al., 2015) with 1% NaOil catalyst and a ratio of oil and alcohol (1:3) reacted for I hour at a temperature of 6.VC obtained a yield of 65.38%, the kinematic viscosity of 4.459 mm^2!s, a flashpoint of 81.5ØC, and pour point or 15 ^{0}C. as well as research conducted by (l (amid and Yusuf, 2002) using grams of NaOII catalyst with a ratio of oil and alcohol (1:5) reacted for I hour at 60^{0}C obtained a yield of 82 46%, the kinematic viscosity of 6 mm^2/s. the flashpoint of 160 ^{0}C, and pour point of 9 ^{0}C. Also. the transestcrificati011 process to produce FAME with raw materials other than crude palm oil such

as used cooking oil was curried out by (Leung and Guo, 2006) using 1.1% NaOH calaiy.sl with a ratio of oil and alcohol (1:7) reacted for 19 minutes at 60^0C obtained a yield of 88.8%, (Demirbas, 2009) using a KOII catalyst as much as 6% witll a ratio 1:9 for 2 hours at 87^0C obtained a yicld of 87%. meanwhile (Zheng et al., 2006) used a 4) ,8% H2SOa catalyst with a ratio I :245 for 4 hours at 70"C, the yield 99%.

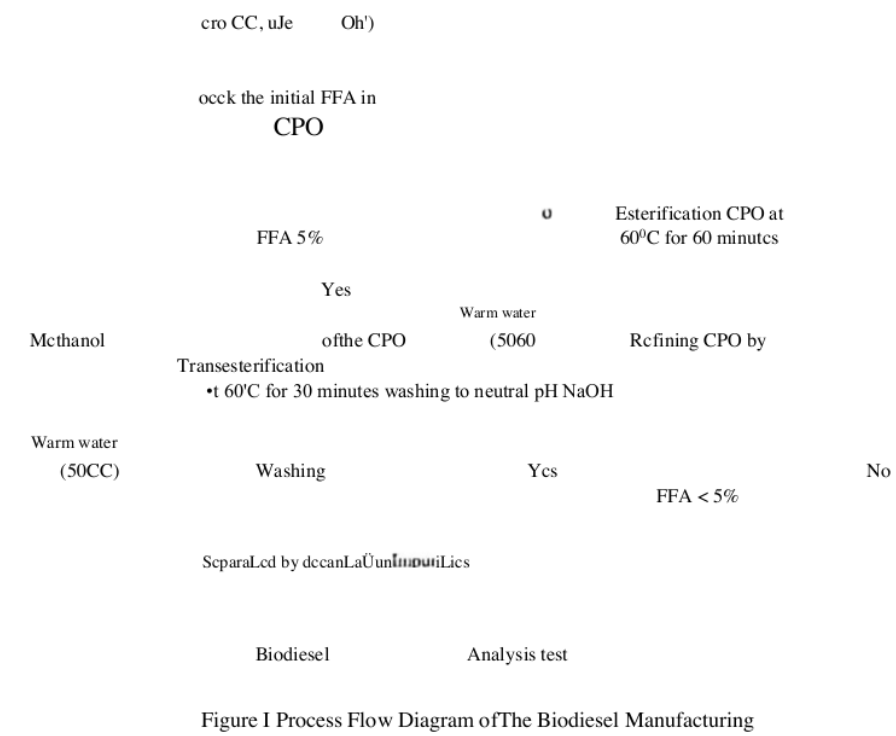

Figure I Process Flow Diagram ofThe Biodiesel Manufacturing

III. R rsr.ARCH METHODOLOGY

111.1 Tools ønd Mato inls Theused tools in this includc Ihrcc ncck ^{e}, roundcd flask, rnagnttic qtrrrcr. ct.lti'.c. heater, thcnnomctct, clamp. 2.^{6} 0 ml Eflcnmcyct. volume pipette, burette. measurjng cup, dtoppcr pipette, separating funnel. Flt mctcr. bcaVcr pycnomctcr. and hydrometct. While the rn.ltcti.l!s used are cmdc palm oil. H_2SO_4, NaOH, methanol, dtstillcd Watct, P P (phenolphthalein), 2nd ethanol 96%,

111.2 Procedure

111.2. I AnalYKis of Frec Vatty Acid

The palm oil is weighed as much as I gram. then roar it into the Erlenmeyer and add i 0 ml oCalc0110i. illen healed utiiii boiling. (lie sample has cool, 3 drops o(iSP indicattor areadded and titrated with 0.1 N NaO!l solution until it tums pink

111.242 Estcrification or Crude Palm Oil

Palm oil is heated in the thrce-ncck rounded flask until reachc• a temperature of 50°Cntc•n a.s much as 1% w/w 112504 with methanol is added with the mole ratio of CPO: methanol is 1:4, Then the reaction is maintained at a fixed temperature of 603C for 60 tninutes under stirring. After the reaction is stopped the mixture is •aashed with warm water at 50^{0}C.

111.2.3 Transestcrification of Crudc Palm Oil

The result of the ecteöfication process that has bccn scraratcd and washed from its impurities is then processed by transesterification using NaOlI t. 1% w/w by weight of 011, mixed with methanol, then added the oil that has been weighed v.ith a mole ratio of CPO: methanol is and reflux for 30 minutes at 60^{0}C.

111.2.4 Separation and Filtering Process

Washing is proceeded by adding warm water at u temperututc of 50^{A}C until pH of thc washing water is neutral. After that, cooled until it is obtained a layer of biodiesel with impurities. The top layer is taken and followed by decantation to ensure the separation of methanol and watcr until biodiesel is reddish yellow.

111.3 Analysis of Biodiesel Characteristics

111.3.1 Yield

Yield is the ratio between the mass / the amount of bicxiiesel produced by the used mass of palm oil. Yield can be calculated using the following equation:

$$\text{Yield} = \frac{\text{the mass of biodiesel}}{\text{mass of crude palm oil}} \times 100\% \qquad (1)$$

111.3.2 Kinematic Viscosity

The kinematic viscosity analysis is carried out by the ASTM D7279-16 standard. This kinematic viscosity test method uses an automatic Houillon 'viscometer. The kinematic viscosity that can be measured by this method ranges from 2 mm^2/s to 2500 mm:js depencLs on the used conslauii lube.

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III.3.3 Flashpoint

Flashpoint analysis is performed by using the ASTM D93-16a standard. This test method uses a Pensky-Martens *closed-cup* and includes a sample of the flashpoint between 40°-370°C. The sample is poured into a clean and dry bowl until the limit mark. After that, the bowl is covered with the lid. A thermometer is attached to the test bowl, then the stirring is performed. The ignition test starts when the sample reaches a certain temperature which is considered to be the flashpoint with the ignition flame brought near the surface of the sample. Repeat the test for every 1°-2°C rise in temperature. Then note the flashpoint.

1!1.1.4 "our Polnt pout point camcd out by A STV test method cnrrtcd out by tilting the t.%c dett•nntned nt a temperature between I '-3 ¹C.

111.1.S

Density analysts at 15 °c is performed by uetr.g the AS TN! hydrornctcr. samplc addcd Into 2 measua.-.g cur t'st

inscrlcd into (lic garnplc. Aftct the hydrometer stops note tyc tyc hydrometer

IV. FINDING AND DISCUSSION

Based on thc research that has bccn done, rcrfonncd of the cha.—actcnsttc analysts on the rnanut'acturc ol' Inodicscl from palm oil using a NaOll catalyst includes kinematic viscosity. flaspoint. pour point, and density at 15 °C.

IV.' Yield

In making biodiesel by using a catalyst as much 1 and a pcrtod of transesteriticillion reaction for NO Illinutes, the obtained yield is S 7 te•.ult IS obtained because of the sidc result in the form Of glycerol and the dissolution of durtng thewashing pmcess. In this study. the use of a catalyst was 1.1% more effective than I'tevtous studies conducted in the literature rcvlew and a rcacuon time of 30 rmnutcs sufftcjcnt titnc to react tnglyccrides with alcohol because of the higher conversion.

IV.2 Kine•natic Viscosity

The test result shows the kinematic viscosity at a temperature of 4(FC With the ASTNf 1)7279 standard, the obtained jesult is 4.664 mm:/s based on the S.SI 7182 standard regarding kinematic viscosity biodiesel in the range of 2,3-6 Based on the S.NI 7182 standard. the produced biodicscl is following the standards because it is in the value r•ulge and with a total of l, NaOll culalyst and a ratio of oil and alcohol l: 7, reacted for 30 minutes at 6(fC, the resulting kinematic viscosity is lower than previous research The kinemauc 'åscostty that too high makes it difficult for biodiesel to now on the fuel tank and it cause the injector to work cvcn harder. The number is also influenced by the soap content that IS contained inbiodieselwhere the soap comes fiom the side result of the transesterificauen process, to reduce the produced of the soap formed, the NaOH content nxds to bc reduced as well.

IV.3nasl•poini

} ollowing the tcst standard ASTNI 1)93, the obtained result is I ICC. tushroint of biodiesel is higher compatcd to diesel oil caused by more C atoms The flashpoint relate

to the fucl'q ability to bum and safety in ctorage If thc test rectilts arc compared with the SNI standard, the flashpoint is I in accordance with the standard, because the SNI 7182 standard of minimum flash point for biodiesel is I OO^{O}C.

JV.4 Pour Point

The result of the pour point value for biodiesel is 12^{0}C. The test result is carried out in accordance with lhc ASTM D5950 standard. Tie pour point relates 10 Ille ease of fuel 10 flow from the tank into the combustion chamber or in the case of fuel storage for tropical countries where the average temperature is above 20^{0}C the pour point with a maximum or 12^{0}C is not a problem. Ilowcvcr. if the pourpoint is too high then thc fuci will be difficult to flow and the fuel tends to freeze and require more handling. Meanwhile. based on the SNI 7182 standard, the maximum pour point is 180C so that thc biodiesel meets thc dctcrmincd standards.

IV.5 Density at IS^{O}C

From the test result that has bccn carried out, the density of biodiesel is 0.873 g/ml. For biodiesel density standards arc bctwccn 0.82 to 0.86 g/ml, it can be concluded that the produced biodiesel is not in accordancc with existing slanchrds. high density can cause low combustion of fuci. In addition. the high dcnqity is due to the prc«cncc of side rcsult in the form of glycerol which is stilt Icn in the biodiesel. Another problem cauccd by high density is when biodiesel is blended with diesel fuel. mixture of biodiesel and diesel Will be difficult to be homogcncou.s because of the difference in density that occurs and two layers will be formed.

V. CONCLUSION AND FURTHER RESEARCH

From the results of tests and research that havc been done, the obtained results arc 87.2856% yield, Lanematic viscosity at 40^{c}c of4.664 mm:ts, a flashpoint of 1 10^{0}C, pour point of 12^{0}C, and density at of O.S73 g'rnl. However, the obtained density of biodiesel from research that has bccn carned out is not follo•aång the determined standards. For suggestions, it is bettcr to conduct further research to fix the proh!em of biodiesel den«ity by studying the effect of the amount of catalyst. reaction time, and the addition of additives. With the result obtained from this study, further research will be carried out by mixing diesel oil into B50.

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