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CHARACTERISTICS AND CONSUMPTION OF FUEL OIL SOLAR OIL WITH HAZELNUT OIL IN DIESEL MOTOR

Muhammad Nurtanto[1], Sulaeman Deni Ramdani[1], & Soffan Nurhaji[1]
[1]Mechanical Engineering Education, Faculty of Teacher Training and Education,
University of Sultan Ageng Tirtayasa
Ciwaru Raya St., No. 25, Serang, Banten, 42117
mnurtanto23@untirta.ac.id

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ABSTRACT

This study aims to determine the characteristics of fuel (diesel oil, walnut oil and sesame oil), the characteristics of the fuel mixture and knowing the amount of fuel consumption with a variation of the engine rotation. Measurements were made using 898 analyzer stargas. Data were analyzed descriptively by describing in graphic and measurable phenomenon. The test results found that: (1) the characteristics of hazelnut oil, sesame oil meets the characteristics of the fuel; (2) a mixture of diesel fuel to 80% with 10% of hazelnut oil and sesame oil 10% yield better characteristics; and (3) the fuel consumption of the engine rev 1600 rpm, 2000 rpm and 2300 rpm is more stable on a mixture of diesel fuel to 80% with hazelnut oil 10% and sesame oil 10% each SFC obtained as follows 0.279882, 0.288938 and 0.281213.

Keywords: *diesel oil, fuel characteristics, fuel consumption, hazelnut oil, sesame oil*.

INTRODUCTION

The number of transportation each year has increased. This condition has an impact on the fuel consumption required, while the assumption of fuel needs used gradually decreased. As a result, fuel prices have increased and the quality of fuel is declining. These problems need to find solutions either in the form of alternative energy or energy replacement.

The main fuel of diesel motor is diesel oil. Solar is the result of processing from petroleum, which is used as fuel substitute for gasoline. Energy alternatives with proper oil characteristics are pecan oil and sesame oil through the extraction process. Extraction process can be done mechanically and dissolve (Ketaren, 1986). The hazelnut is one of the agricultural products containing oil (Siswani and Kristianingrum, 2006). Oil content in candlenut seeds is high, ie 55 - 66% of the seed weight (Arlena, Suharto, and Susatlo, 2009). The hazelnut oil contained in the seeds also has many benefits, such as paint, varnish, soap, medicine, cosmetics and fuel, Arlena, Suharto and Jessica (2010). Sesame oil as an alternative energy bio diesel. The yield of sesame oil ranges from 35-50% Weiss (1971) in Sunanto (2002), meaning it is classified as high oil content.

Diesel motor is a power plant that serves to convert the heat energy content or heat of

fuel into mechanical power (Sukoco and Zaenal Arifin, 2009: 14). Meanwhile, according to the Directorate of Vocational Secondary Education (2004: 6) states that a diesel motor is called a compression ignition engine due to ignition of the fuel caused by the temperature of compressed air in the combustion chamber. The required fuel requirements have different characteristics than other types of fuels, so testing is required to obtain the appropriate characteristics.

The objectives of this study were (1) to know the characteristics of pure diesel oil, sesame oil and sesame oil before mixing, (2) to know the characteristics after mixing with a certain ratio, and (3) the influence of fuel consumption with the ratio of fuel mixture to rotation engines on diesel motors.

MATERIALS

The raw materials used in this study are pure diesel oil, pure hazelnut oil and pure sesame oil obtained from the extraction. While the equipment used such as burette, stop watch, and 4JA1L diesel motor - 4 cylinder inline. Tests of fuel characteristics that include specific graphics, kinematic viscosity, flash point, and pour point are done at the Gajah Mada University Petroleum Gas and Coal Technology Laboratory.

This research is using experimental method. Experimental research methods can be interpreted as research methods used to look for the effect of certain treatment against others in controlled conditions (Sugiyono, 2013: 107). This research used experimental treatment design by subject that is several variations of treatment consecutively to the same subject group. The mean for the group is subjected to certain treatment and then the measurements are taken to determine specific fuel consumption (SFC) and exhaust gas emission levels in each different fuel mixture variation. The treatment in this research is pure diesel oil with kemiri oil and sesame oil (as subject) with mixture of fuel such as: (1) diesel oil 90% with kemiri oil and sesame oil 5% each; and (2) diesel oil 80% with sesame oil and sesame oil 10% each and variation of engine speed taken is 1600 rpm, 2000 rpm, and 2300 rpm.

RESULT

Characteristics of Pecan Oil, Sesame Oil and Pure Solar Oil

The hazelnut oil and sesame oil are extracted to be used as a fuel oil mixture.

a. The results of the characteristics of hazelnut oil

The content obtained by candlenut oil based on laboratory results as follows:

Table 1. Pure Kemiri Pure Laboratory Test Results

Test Type	Result	Units	Methods
Specific Gravity at 60/60 ^{0}F	0,9227	-	ASTM D 1298
Kinematic Viscosity 40 ^{0}C	31,874	mm^2/s	ASTM D 445
Flash Point PM.cc.	241	^{0}C	ASTM D 93
Pour Point	0	^{0}C	ASTM D 97

b. The results of the characteristics of sesame oil

The content obtained by sesame oil based on laboratory results, as follows:

Table 2. Pure Sesame Oil Laboratory Test Result

Test Type	Result	Units	Methods
Specific Gravity at 60/60 ^{0}F	0,9157	-	ASTM D 1298
Kinematic Viscosity 40 ^{0}C	40,26	mm^2/s	ASTM D 445
Flash Point PM.cc.	255	^{0}C	ASTM D 93
Pour Point	9	^{0}C	ASTM D 97

b. The results of research from the characteristics of diesel oil

The content obtained by pure diesel oil based on laboratory results, as follows:

Table 3. Pure Solar Petroleum Laboratory Test Results

Test Type	Result	Units	Methods
Specific Gravity at 60/60 ^{0}F	0,852	-	ASTM D 1298
Kinematic Viscosity 40 ^{0}C	4,24	mm^2/s	ASTM D 445
Flash Point PM.cc.	75,0	^{0}C	ASTM D 93
Pour Point	10	^{0}C	ASTM D 97

Based on the above data it is found that the specific gravity at 60/60 0F that the hazelnut oil and sesame oil on the diesel oil are 0.9227 and 0.9157. Likewise for kinematic viscosity 40 0C results obtained higher than diesel oil 31.874 mm2 / s and 40.26 mm2 / s. for flash point PM.cc. the values obtained by candlenut oil and sesame oil on diesel oil are 241 0C and 225 0C. While the pour point of diesel oil is higher that is 10 0C.

Characteristics of Pecan Oil, Sesame Oil and Solar Oil

a. Mixed diesel oil 90% with 5% kemiri oil and 5% sesame oil

At volume of 300 ml, 270 ml diesel oil, kemiri oil and sesame oil each 15 ml mixed into one. This is done to see the characteristics of the mixture with pure diesel oil. The content obtained from the mixture is based on laboratory results as follows:

Table 4. Fuel Mixed Laboratory Test Results (90% diesel oil with 5% kemiri oil and 5% sesame oil)

Test Type	Result	Units	Methods
Specific Gravity at 60/60 ^{0}F	0,8617	-	ASTM D 1298
Kinematic Viscosity 40 ^{0}C	4,992	mm^2/s	ASTM D 445
Flash Point PM.cc.	79,0	^{0}C	ASTM D 93
Pour Point	12	^{0}C	ASTM D 97

a. 80% diesel oil mixture with 10% hazelnut oil and 10% sesame oil

At 300 ml volume, 240 ml diesel oil, sesame oil and sesame oil each 30 ml are mixed together. This is done to see the characteristics of the mixture with pure diesel oil. The content obtained from the mixture is based on laboratory results as follows:

Table 5. Fuel Mixed Laboratory Test Results (80% diesel oil with 10% hazelnut oil and 10% sesame oil)

Test Type	Result	Units	Methods
Specific Gravity at 60/60 ^{0}F	0,8677	-	ASTM D 1298
Kinematic Viscosity 40 ^{0}C	6,354	mm^2/s	ASTM D 445
Flash Point PM.cc.	84,0	^{0}C	ASTM D 93
Pour Point	6	^{0}C	ASTM D 97

Specific Fuel Consumption Testing Result (SFC) against Round Machine

Specific fuel consumption (SFC) is derived from fuel consumption (mf) divided by power (P) by formulaSFC = $\frac{mf}{P}$ (kg/kW-hours) and *mf* obtained from the formula $mf = \frac{b}{t}.\frac{3600}{1000}.\rho_{bb}$ (kg/hours) which, b is the buret volume in the test of 50 cc, t is the time required for buret buring in seconds (s), and ρ_bb of 0.84 gr / cc. According to Kurdi and Arijanto, 2007: 56 mf values can also be obtained with the formula mf = v / t x ρbb x 3.6 (kg / h). The P value (power) is obtained by using the formula P = (2π.nT) / 60000 (kW) while T is obtained from the formula T = mgI (Nm) where T is the engine torque in Nm, g is the acceleration of gravity of 9.81 m / s2, I is the length of the dynamometer arm of 0.358 mm, is the mass / load measured in kg, and n is the required engine speed in rpm.

a. *Fuel Consumption Test with 90% Solar Fuel Blend with 5% Kemiri Oil and 5% Sesame Oil to Round Machine.*

Test results for specific fuel consumption (SFC) with variations of engine speeds are 1600 rpm, 2000 rpm, and 2500 rpm as follows:

Table 6. Laboratory Test Results of Fuel Consumption with Mixture 90% Solar Oil with Kemiri Oil and Sesame Oil 5% against Round of Machine 1600 rpm, 2000 rpm, and 2500 rpm.

n (Rpm)	m (Kg)	T (Nm)	P (kW)	t (Second)	*mf* (kg/Hours)	SFC (kg/kW-Hours)
1600	33	115,9	19,42627	32,8	4,609756	0,237295
2000	33	115,9	24,28283	21,65	6,983834	0,287604
2500	20	70,24	18,39609	27,9	5,419355	0,294593

In a 90% diesel oil mixture with hazelnut oil and sesame oil 5%, the lowest SFC at 1600 rpm engine speed is 0.237295 kg / kW-hour. The higher the rotation of the resulting SFC engine increases the fuel it needs the more extravagant.

a. Fuel consumption test with 80% solar oil mix with 10% hazelnut oil and 10% sesame oil to engine rotation.

Test results for specific fuel consumption (SFC) with variations of engine speeds are 1600 rpm, 2000 rpm, and 2500 rpm as follows:

Table 7. Laboratory Test Result of Fuel Consumption with Mixture 80% Solar Oil with Pecan Oil and Sesame Oil 10% against Round of Machine 1600 rpm, 2000 rpm, and 2500 rpm.

n (Rpm)	m (Kg)	T (Nm)	P (kW)	t (second)	*mf* (kg/hours)	SFC (kg/kW-hours)
1600	33,25	116,77	19,57344	27,6	5,478261	0,279882
2000	33	115,9	24,28283	21,55	7,016241	0,288938
2500	27	94,823	24,83472	21,65	6,983834	0,281213

In 80% diesel oil mixture with pecan oil and sesame oil 10% respectively, the lowest SFC at 1600 rpm engine speed is 0.279882 kg / kW-hour. The higher the rotation of the resulting SFC engine increases the fuel it needs the more extravagant.

DISCUSSION

Characteristics of Solar Fuel, Hazelnut Oil and Sesame Oil

Laboratory test results based on fuel characteristics can be explained in the inspection type image below.

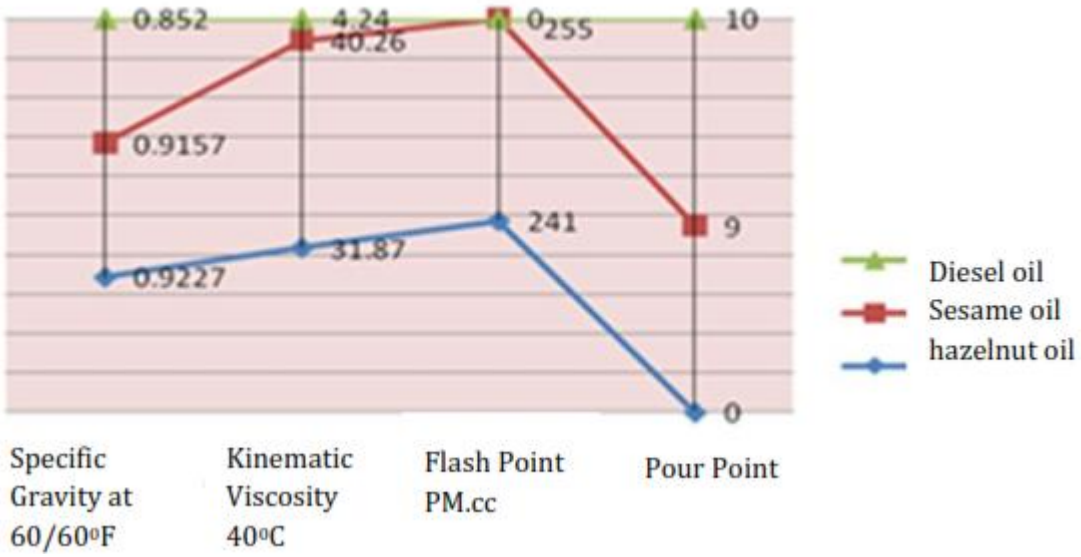

Fig 1. Graph of Characteristics of Fuel Oil of Pecan, Sesame Oil and Solar Oil

Specific graphity (relative density) is the mass ratio of the amount of volume of a substance at a certain temperature to a pure water mass of the same volume at the same temperature or different temperature. specific gravity is expressed by two degrees of temperature, where the first number denotes the temperature of the substance and the second indicates the water temperature. SG at 60/60 0F diesel oil between 0.820 -

0.870 means diesel oil is not contaminated. If less than that number then the oil is contaminated by a heavy fraction substance or contains many compounds naften and aromatics. In the figure graphic figure generated from the hazelnut oil, sesame oil and diesel oil exceeded 0.820 ie 0.9227, 0.9157 and 0.852. these results indicate that specific grafity meets the feasibility of fuel characteristics.

Kinematic Viscosity (viscosity) is a measure of the basic resistance of a liquid to flow or a measure of the magnitude of the inner shear resistance of a liquid body. In general, the higher the drajat API, the smaller the viscosity (Supraptono, 2004: 27). Kinematic viscosity is obtained from the ratio of dynamic viscosity to density. The units for dynamic viscosity are Pa s or Ns / m2 (= 1 Pa s) or kg / ms (= 1 Pa s) or g / cm s (= 0.1 Pa s) or dyne s / cm2 (= 0.1 Pa s) or poise, P (0.1 Pa s) or centiPoise, cP (= 0.01P). The above test results obtained that kemiri oil and sesame oil have a higher viscosity than diesel (4.24) ie (31874) and (40.26). This means that fuel meets the characteristics as fuel.

Flash point PMcc (flash point) is the lowest temperature of a munyak fuel that can cause a flame in an instant if on the surface of fuel oil sprinkled fire (Supraptono, 2004: 28). Flash point is lower then the more volatile and burning. Flash point PMcc from each fuel as follows kemiri oil (241), sesame oil (255) and diesel oil (75.0). These results indicate that the fuel is not volatile and takes time in combustion.

Pour points are the lowest temperatures in which oil fuel can still flow by itself under test conditions. The results of the test showed that the hazelnut oil, sesame oil and diesel oil were 0, 9, and 10, respectively. The result of the test was that the hazelnut oil and sesame oil were under diesel oil. It shows that at 0 and 9 the temperature is still able to flow.

Based on the fuel characteristics, the three oils meet the characteristics as oil for use in the combustion process. However, all three need to be test mixing to know the characteristics after the mixing of these fuels.

Fuel Mixed Characteristics

To see the results of mixed fuel characteristics after mixed into two stages with a mixture of diesel oil 90% and 5% kemiri oil and 5% sesame oil. Phase two is 80% solar oil and 10% hazelnut oil and 10% sesame oil. The results obtained after the test can be seen in the following graph:

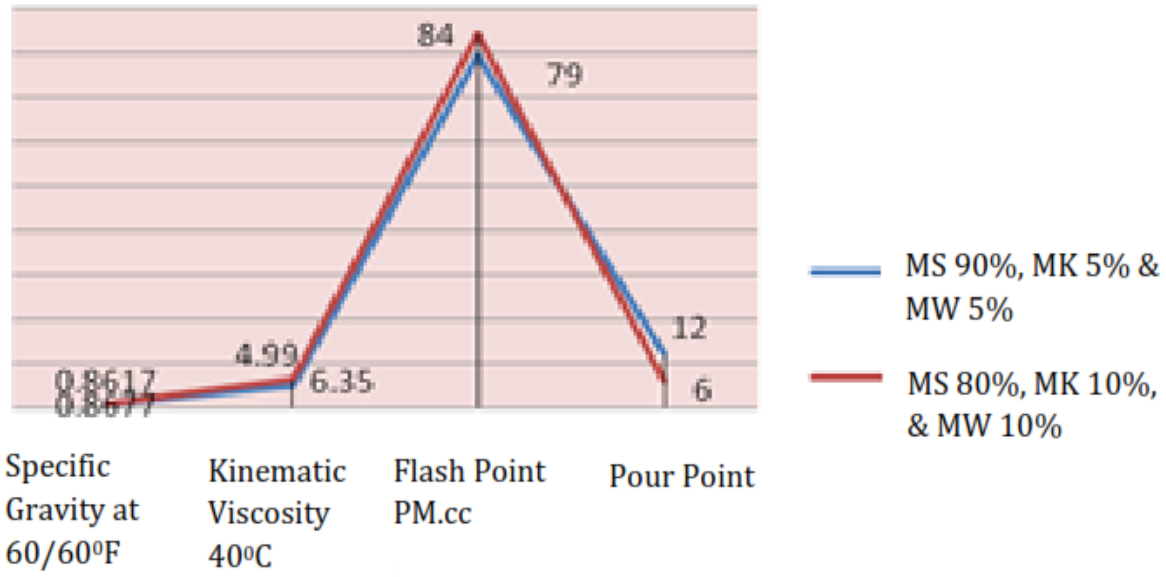

Fig 2. Graph of Solar Oil Mixing Result (MS), Pecan Oil (MK), and Sesame Oil (MW)

Based on the graph above it is found that the second mixture with the percentage of diesel oil 80%, 10% hazelnut oil and 10% sesame oil produce non-contaminated and higher oil that is 0.8677, for a higher viscosity of 6,354 mm2 / s, for flash point in over the standard of 84.0 0C but for the pour point at a temperature of 6 0C still able to drain the oil. It can be concluded that the more mixed percentage of candlenut and sesame oils produce good characteristics.

Fuel Consumption to Round Machine

Mixed fuel consumption needs to be tested against engine speed. The variations of engine speeds tested include 1600 rpm, 2000 rpm, and 2300 rpm. The results of these tests can be observed in the following graphs:

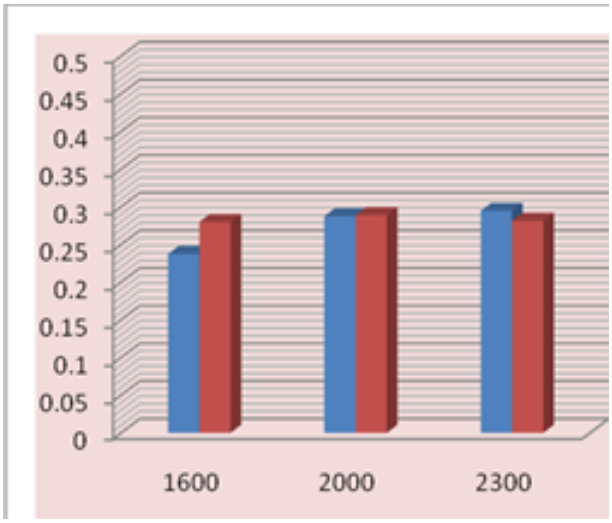

Fig 3. Specific Fuel Consumption Graph (SFC) against Machine Round Variation.

Specific fuel consumption (SFC) generated on 80% petroleum fuel mixture, 10% hazelnut oil and 10% sesame oil, resulted in a more stable engine spin at various turns of 1600 rpm, 2000 rpm and 2300 rpm respectively The SFC is obtained as follows 0.279882, 0.288938, and 0.281213. So it can be concluded that the ratio of mixture of diesel fuel oil with hazelnut oil and sesame oil is higher resulting in a more stable engine speed.

CONCLUSION

The results above can be concluded that:

1. Characteristics of fuel oil kemiri and sesame oil meet the characteristics of oil that can be mixed with diesel fuel to be used as alternative fuel.
2. The fuel characteristics after mixing resulted in the mixing of 80% solar oil with 10% hazelnut oil and 10% sesame oil yielded better characteristics. So further research is required with more mixing.
3. Consumption of fuel using mixing with various variations of a more stable rotation of 80% diesel oil mix, 10% hazelnut oil and 10% sesame oil. The more mixture of pecan oil and the oil of the wax produces a more stable spin.

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