Comparation Study Performance Diesel Engine Using Biodiesel with Secondary Data

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Abstract. Biodiesel is one of the diesel engine fuels with a mixture of fossil fuels with the addition of vegetable oil fuels. Biodiesel is expected to compete with other fossil fuels. The purpose of this research is to get a trend in the performance of Diesel engines by using biodiesel against fossil fuels so as to obtain the characteristics of biodiesel fuels. Conduct a comparative study of each different type of biodiesel. Get an upward or downward trend in biodiesel fuels against fossil fuels so as to obtain the characteristics of biodiesel fuels. Diesel engine performance that is concerned is torque, power, specific fuel consumption. The best diesel engine performance requirements are torque value, power and specific fuel consumption decreases. The method of data collection is done using secondary data from the results of previous studies that have been published. This research uses palm oil, jatropha curcas oil, calophyllum inophyllum oil, gossypium arboretum oil, brassica napus oil, and hevea brasiliensis oil. The best Diesel engine performance is found in B25 jatropha curcas oil biodiesel with an increase in torque value of 6.49%, an increase in power value of 6.49%, and a decrease in the value of specific fuel consumption by 17.78%.

1. Introduction

The development of fuel oil is being done a lot. The application fuel oil can be using for internal combustion engine. One of the development made by Indonesia is the Diesel engine. Diesel engine is one of the application for internal combustion engine. Combustion that occurs because the air is compres in the cylinder so that the air production with high pressure and high temperature, at the same time in the cylinder occurs spraying fuel so that the combustion process occurs [1]. Biodiesel is one of the alternative fuels for using diesel engine [2]. It is from vegetable oil such as seed from plants. The vegetable oil can be used to meet energy needs as a substitute for fosil. The availability of fosil fuel which is increasingly depleted is one aspect that makes vegetable oil need to be utilized as a substitute for fossil fuels [3]. The study aims to identify the characteristics of biodiesel fuel against fosil fuel and obtain performance diesel engine from each fuel. So as to know the trend of increase or decrease performance Diesel engine. The principle of research expected to contribute to the development Diesel engine. One of the contribute to the development of fuel by conducting research on the performance of Diesel engine with fosils fuel and biodiesel. Diesel engine performance that will be tested is torque, power, and specific fuel consumption. The hypothesis of this study is that when the mixture of biodiesel added to fosil fuel, it will increase torque, power, and decrease specific fuel consumption. This is as a reference to get the best Diesel engine performance by using biodiesel fuel.

2. Method

2.1. Method

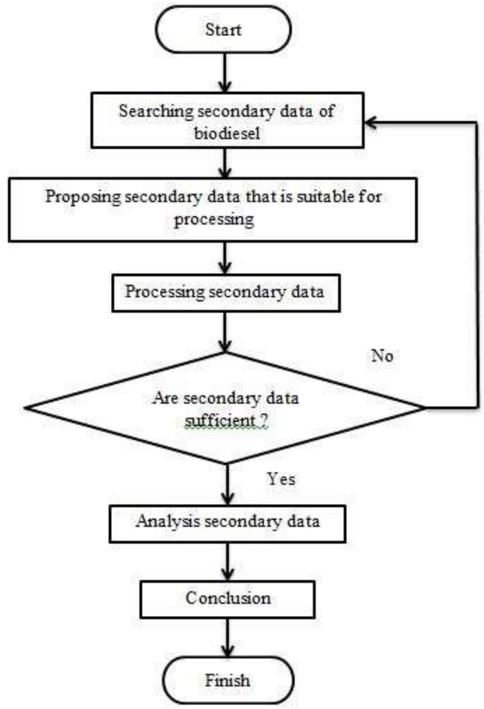

Figure 1. Flowchart

This research using collect data with secondary data. The secondary data is obtained from research results that have been published with journals. The results of secondary data will be compared for each secondary data obtained. Variabel of secondary data using torque, power, and specific fuel consumption. Comparison of secondary data by analyzing the effect of the characteistics of biodiesel against fosil fuel.

3. Results and discussion

There are eight secondary data biodiesel that are used to conduct research performance Diesel engine. Secondary data that has been obtained is the first secondary palm oil data, second secondary palm oil data, third secondary palm oil data, jatropha curcas oil, calophyllum inophyllum oil, gossypium arboretum oil, brassica napus oil, and hevea brasiliensis. Following are the characteristics of each biodiesel.

Figure 2. Characteristics biodiesel and fosil fuels

3.1. Torque

This analysis shows the conditions between speed and torque under different conditions in each secondary data. Torque is the force applied by the crankshaft multiplied by the center of speed. The speedof The piston is related to the process of droplet out by the nozzle. If the fuel experienced as combustion reaction before the piston is at the top dead point, it wil cause the force produced by the piston to be less than optimal.

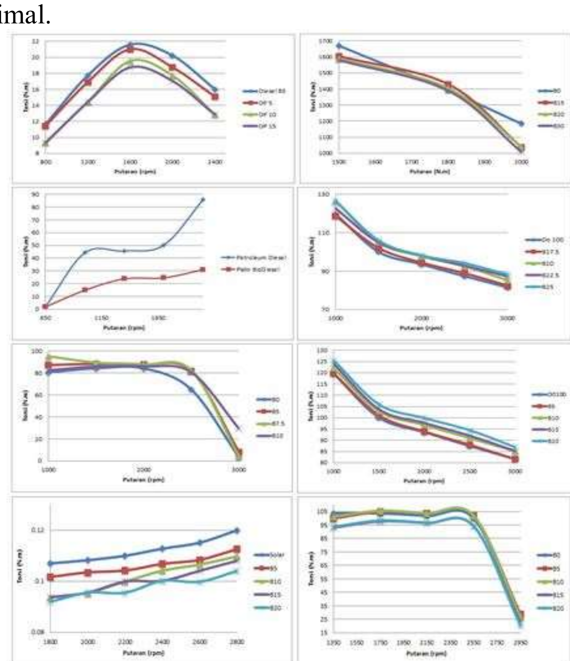

Figure 3. Speed and torque biodiesel

It can be seen in the first secondary biodiesel palm oil data, that the highest torque value is in the fossil fuel Diesel B3 and when the Diesel B3 fuel mixture is added to the biodiesel palm oil will experience a decrease in torque value, the decline in the highest to lowest torque value is biodiesel DP 5 then DP 10 and the lowest DP 15 are at 800 rpm, 1200 rpm, 1600 rpm, 2000 rpm and 2400 rpm. With a decrease in the value of torque at 1600 rpm speed respectively reached 2.64%, 9.45%, and 13.15%.

It can be seen in the second secondary biodiesel palm oil data, that at 1500 rpm and 2000 rpm speedthere is a decrease in the value of biodiesel B15, B20, and B30 to B0 fossil fuels with a decrease in torque value at 2000 rpm by 12.23%, 12.23%, and 14.77%. At 1800 rpm there is a small increase in torque value and tends to be the same for B0 fossil fuels. In B15 and B20 fuels there was an increase of 2.88% and 1.08%. At B30 it has the same torque value as B0.

It can be seen in the third secondary biodiesel palm oil data, that there is a decline in the value of biodiesel palm oil torque against petroleum diesel fossil fuels. The decrease occurred at 650 rpm, 1000 rpm, 1350 rpm, 1700 rpm, and 2050 rpm with a decrease in torque values of 3.63%, 66.35%, 47.85%, 51%, and 63.98%.

It can be seen in jatropha curcas oil, that the torque value at 1000 rpm has a different initial torque value. The torque value of D0 100 is 119,682Nm while B17.5 has a decrease in torque value of 0.819% then an increase in B20 of 5.737% and in B22.5 an increase in torque value of D0 100 does not exceed B20 with a value of 2,459% and in B25 an increase the torque value has the same value as B20 of 5.737%. In the 1500 to 3000 rpm speedas a whole increased along with the addition of a mixture of diesel fuel with jatropha curcas oil not exceeding B25. This can be seen at 3000 rpm speed an increase in B17.5 torque value of 1,081% while in B20 of 4,447% and in B22.5 and B25 also increased in torque values respectively by 6,971% and 8,173%.

It can be seen in calophyllum inophyllum oil, that the torque value at 1000 rpm to 2500 rpm with B0 fuel to B5 and B7.5 has increased torque value. In B0 fuel has a torque value of 80.7363 N.m whereas in B5 the torque value increases for B0 by 8019% and in B7.5 the torque value increases by 17,983%. On the B10 fuel there was a significant decrease in torque value of 15,795% to the B7.5 fuel. At 3000 rpm rotation the torque value decreased to 2500 rpm which was significant for all fuel mix compositions, the amount of torque value decreased to 94,561%.

It can be seen in gossypium arboretum oil, that the torque value at 1000 rpm to 3000 rpm increases with the addition of the fuel composition. This can be seen at 2500 rpm speed with D0 100 fuel with a torque value of 87,407 Nm then an increase in B5 fuel by 0,673% and in B10, B15, and B20 fuels an increase in torque value to D0 100 is 4.04%, 5,274 % and 8.08%.

It can be seen in brassica napus oil, that at speed of 1800 rpm to 2800 rpm the torque value decreases with the addition of the composition of diesel fuel to canola seed oil. Can be seen at 2800 rpm speed torque value of diesel fuel by 0.12 Nm then decreased torque value on B5 fuel by 6.161% and on B10, B15, and B20 fuels also decreased the torque value of diesel fuel by 8.53%, 9.952 % and 13.27%.

It can be seen in hevea brasiliensis oil, a decrease in the value of torque at B15 and B20 to B0 along with the addition of speed. This can be seen at 2950 rpm speed torque values of B15 and B20 have decreased torque values of 13,508% and 22,379%. In B5 and B10 the torque values increased at 2150 rpm and 2550 by 1,852% and 1,886%.

3.2. Power

This analysis shows the conditions between speed and power under different conditions in each secondary data. Power is the energy output that results from the combustion reaction in the cylinder. The more piston movement in each work cycle can cause the power produced to be increased.

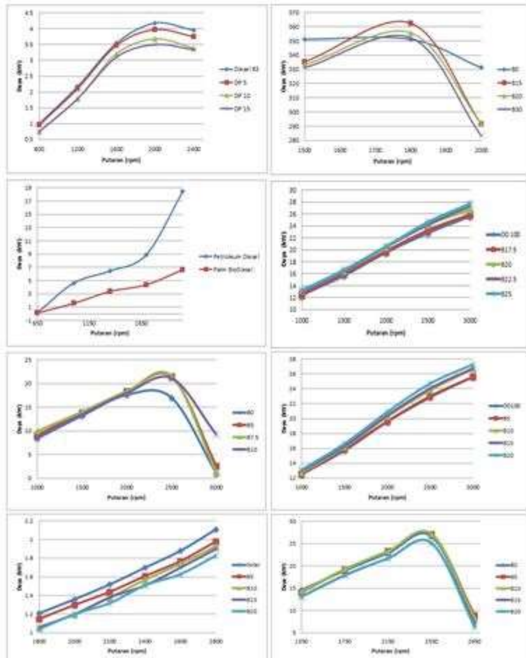

Figure 4. Speed and power biodiesel

It can be seen in the first secondary palm oil data, that there is a decrease in the value of power every addition of a mixture of biodiesel palm oil to Diesel B3 fossil fuels, at 800 rpm, 1200 rpm, 1600 rpm, 1600 rpm, and 2400 rpm. Can be seen in the 2000 rpm speed there was a decrease in the value of biodiesel power DP5, DP 10. And DP 15 by 4.95%, 11.96%, and 16.31%.

It can be seen in the second secondary palm oil data, that at 1500 rpm and 2000 rpm speed there is a decrease in the value of the power against B0 fossil fuels. It can be seen that at 1500 rpm the B15, B20 and B30 power values decrease by 3.89%, 4.79%, and 5.39%. At 1800 rpm, an increase in the value of power to B0 fossil fuels. In fuel B15, B20, and B30 there was an increase of 3.24%, 1.29%, and 0.32%.

It can be seen in the third secondary palm oil data that there is a decrease in the value of the power of biodiesel palm oil against petroleum diesel fossil fuels. The decrease occurred at 650 rpm, 1000 rpm, 1350 rpm, 1700 rpm, and 2050 rpm with a decrease in torque values of 3.63%, 66.35%, 47.85%, 51%, and 63.98%.

It can be seen in jatropha curcas oil, that 1000 rpm speed has a different power value, this is in accordance with the conditions of the previous torque value. The power value of D0 100 is 12.53 kW while B17.5 has a decrease in power value of 0.819% then an increase in B20 of 5.737% and in B22.5 an increase in power value of D0 100 does not exceed B20 with a value of 2,459% and at B25% increase in power value equal to B20 of 5,737%. In the 1500 to 3000 rpm speed as a whole increased along with the addition of a mixture of diesel fuel with jatropha curcas oil not exceeding B25. This can be seen at 3000 rpm speed an increase in the value of B17.5 by 1,081% while in B20 by 4,447% and in B22.5 and B25 also increased in power values respectively by 6,971% and 8,173%.

It can be seen in calophyllum inophyllum oil, that the power value at 1000 rpm to 2500 rpm with B0, B5 and B7.5 fuels has increased power value, this is in accordance with the torque value condition which has been analyzed previously. In B0 fuel has a power value of 8.45 kW while in B5 the power value has an increase in B0 of 8,019% and in B7.5 the power value has increased by 17,983%. On the B10 fuel there was a significant decrease in power value of 15,795% to the B7.5 fuel. At 3000 rpm speed the power value decreased to 2500 rpm for all fuel mixture compositions, the decrease in power value was up to 94,561%.

It can be seen in gossypium arboretum oil, that an increase in the value of power along with the addition of the fuel mixture. At 2000 rpm speed with D0 100 fossil fuel has a power value of 19.59 kW, then an

increase in torque value of 0.314% on B5 fuel and on B10, B15, and B20 fuels has increased power value to D0 100 by 3.354%, 4,402% and 6,708%.
It can be seen in brassica napus oil, that at 1800 rpm up to 2800 rpm the power value decreases along with the addition of brassica napus oil fuel mixture. Can be seen at 2400 rpm, diesel fuel has a power value of 1.7 kW then has a decrease in power value at B5 by 5,294% and on B10, B15 and B20 fuels has decreased to 7,647%, 11,176%, and diesel fuel 11,176%.
It can be seen in hevea brasiliensis oil, that there is a decrease in the value of power at B15 and B20 to B0 along with the addition of speed. This can be seen at 2950 rpm speed of the power value of B0 of 8.15 kW and then a decrease in the value of the power of B15 and B20 fuel by 13,508% and 22,379%. In the fuel B5 and B10 increased the value of the power of diesel fuel at 2150 rpm and 2550 by 1,852% and 1,886%.

3.3. Specific Fuel Consumption

This analysis shows the condition speed with specific fuel consumption under different conditions in each secondary data. Specific fuel consumption is an indicator that states the size of fuel spent on an engine at a certain time.

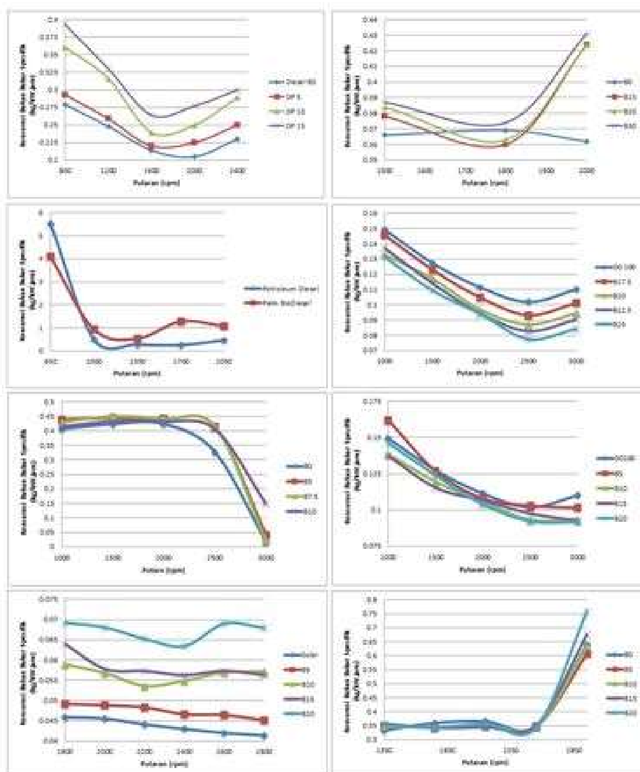

Figure 5. Speed and specific fuel consumption

It can be seen in the first secondary palm oil data, that with each addition of a mixture of palm oil fuel to Diesel B3 fossil fuels, the specific fuel consumption will increase. Increasing the value of specific fuel consumption at DP 5, DP 10 and DP 15 with 800 rpm, 1200 rpm, 1600 rpm, 2000 rpm and 2400 rpm speed. Can be seen at 1600 rpm with an increase in the value of the specific fuel consumption of DP 5, DP 10 and DP 15 fuels of 2.80%, 11.68%, and 23.36%.
It can be seen in the second secondary palm oil data, that at 1500 rpm there is an increase in the value of the specific fuel consumption of B15, B20 and B30 fossil fuels by 3.28%, 4.92%, and 5.74% and at the 2000 rpm speed an increase of 17.13%, 17.13%, 19.06%. At 1800 rpm, there was a significant decrease in the value of specific fuel consumption with B15 and B20 fuels of 2.44% and 1.62%.

It can be seen in the third secondary palm oil data, that at 650 rpm there is a decrease in the value of specific fuel consumption with a decrease of 25.76%. At 1000 rpm, 1350 rpm, 1700 rpm, and 2050 rpm speed an increase in the value of specific fuel consumption was 88.39%, 86.2%, 388.37% and 131.05%. It can be seen in jatropha curcas oil, that in each mixture of fuel composition has decreased the value of specific fuel consumption. Can be seen at 2000 rpm with D0 100 fuel has a specific fuel consumption value of 0.11 kg/kW.hr on B17.5 decreased by 5,933% while on B20 decreased by 13,004% and at B22.5 had a decrease of 15,187% and the last in B25 experienced a decrease in specific fuel consumption by 15,624%.

It can be seen in calophyllum inophyllum oil, that the value of specific fuel consumption is in the condition of speed of 1000 rpm to 3000 rpm has a fluctuating value. In fuel B0 has a value of 0.406 kg/kW.hr while in B5, B7.5 and B10 there was an increase of 7,929%, 5,754% and 2,107%. In fossil fuels B0 has the lowest specific fuel consumption value and has the most stable decrease in the consumption value of specific fuel along with the addition of speed. The decrease in the value of specific fuel consumption occurs at 3000 rpm speed with a percentage decrease in value of 1000 rpm rotation of 95.65%.

It can be seen in gossypium arboretum oil, using D0 100 fuel with a mixture of gossypium arboretum oil. The value of specific fuel consumption tends to decrease to D0 100 fuel. It can be seen that at 2000 rpm there is a decrease in the value of specific fuel consumption at B5 by 3,057% then B10 has decreased by 5.02%, in B15, it has decreased by 4,216% and at B20 decreased by 6,716%.

It can be seen in brassica napus oil, that there is an increase in the value of specific fuel consumption along with the addition of a mixture of brassica napus oil composition to diesel fuel. This can be seen at 2400 rpm speed, diesel fuel has a specific fuel consumption value of 0.043 kg/kW.hr, then an increase in the value of specific fuel consumption at B5 of 8,482%, at B10 of 27,821%, at B15 of 31,025 % and in B20 increased by 47,677%.

It can be seen in hevea brasiliensis oil, that at the initial speed of 1350 rpm an increase in the value of specific fuel consumption with a B0 value of 0.333 kg/kW.hr, then on fuel B5, B10, B15, and B20 amounted to 4,489%, 4,489%, 7,346% and 5,306%. At 1750 rpm to 2950 rpm, it tends to decrease in the value of specific fuel consumption. It can be seen that at 2150 rpm the B0 specific fuel consumption value is 0.366 kg/kW.hr, then the B5, B10, B15, and B20 fuels have a decrease in B0 values of 4,089%, 3,717%, 5,576% and 2,602% .

4. Conclusion

It can be concluded that the highest increase in torque value is in the mixture of fosil fuel with jatropha curcas oil in the composition of B25 with an average increase of 6.49%. The highest increase in power value is in the mixture of fosil fuel with jatropha curcas oil in the composition of B25 with an average increase of 6.49%. The highest decrease in the value of specific fuel consumption was in fosil fuel with jatropha curcas oil mixture in the composition of B25 with an average reduction of 17.78%.

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