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THE EFFECT OF BIOSOLAR AND PERTAMINA DEX ON POWER PERFORMANCE, TORQUE AND DIESEL FUEL CONSUMPTION

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Abstrak — Penggunaan bahan bakar pada mesin sangat berpengaruh terhadap prestasi performa yang dihasilkan mesin, sehingga dari waktu ke waktu ada perbaikan kualitas bahan bakar. Awalnya bahan bakar motor diesel hanya solar, akan tetapi sekarang terdapat biosolar dan pertamina dex. Dengan tujuan untuk mengetahui performa mesin diesel perlu dilakukan pengujian menggunakan pertamina dex dan biosolar. Penelitian ini menggunakan metode eksperimental dengan empat variasi putaran mesin yaitu 1000 rpm, 2000 rpm, 2500 rpm dan 2500 rpm. Alat yang digunakan pada penelitian ini adalah mesin diesel tipe 4JA1, parameter unjuk kerja mesin diesel adalah daya, torsi, dan konsumsi bahan bakar spesifik. Hasil penelitian menunjukkan bahwa prestasi mesin dengan menggunakan bahan bakar pertamina dex lebih unggul dari penggunaan biosolar. Keunggulan pertamina dex yaitu pada torsi pada putaran 2500 rpm sebesar 68,992 Nm, pada parameter daya mengalami kenaikan sebesar 5,246%, sedangkan konsumsi bahan bakar spesifik pertamina dex lebih rendah 0,132% dari pada biosolar.

Kata kunci: Biosolar, Pertamina Dex, Daya, Torsi, Konsumsi Bahan Bakar

Abstract *—Initially, diesel motor fuel was only diesel, but now there are biodiesel and Pertamina Dex. In order to analyze the performance of a diesel engine, it is necessary to test it using Pertamina Dex and Biosolar. This study used an experimental method with four variations of engine speed, namely 1000 rpm, 2000 rpm, 2500 rpm, and 2500 rpm. The tool used in this research is a type 4JA1 diesel engine, the performance parameters of the diesel engine are power, torque, and specific fuel consumption. The results showed that engine performance using Pertamina Dex fuel was superior to that using biodiesel. The superiority of pertamina dex is the torque at 2500 rpm of 68.992 Nm, the power parameter has increased by 5.246%, while the specific fuel consumption of pertamina dex is 0.132% lower than biodiesel.*

Keywords*:* Biosolar, Pertamina Dex, Power, Torque, Spesific Fuel Consumption

I. INTRODUCTION

The heat engine, which uses thermal energy to do mechanical work or transforms thermal energy into mechanical energy, is one of the prime movers that is frequently utilized. While the process of burning fuel produces the energy itself. Heat engines are split into two classes based on how thermal energy is produced, namely internal combustion engines and external combustion engines. Diesel and gasoline motors are examples of combustion engines that burn fuel inside the motor itself such that the resulting combustion gas serves as a working fluid. Diesel engines are a type of internal combustion engine, specifically compression ignition engines, where the fuel is ignited by the high-temperature compressed gas in the cylinder rather than by an ignition device (such as a spark plug). The external combustion engine fuel combustion process occurs outside the engine itself. Diesel engines are frequently seen in cars and other large-capacity, high-power vehicles. This is so that it may be used to move vast amounts of power over great distances.

The effect of the use of biosolar fuel and Pertamina Dex on the performance of single cylinder diesel engines [1-3]. The research results show that the use of fuel greatly affects engine performance, so that from time to time there is an improvement in fuel quality. At first, only diesel fuel was used, now it has developed into biodiesel and Pertamina dex. The results showed that the value, power, torque and fuel consumption when using biodiesel and Pertamina dex were as follows: power for biodiesel 3.3048 kW, Pertamina dex 3.5045 Kw; torque for biodiesel 7.8 Nm, Pertamina dex 8.32 Nm; fuel consumption for biodiesel is 0.353 kg/kW.h, Pertamina dex is 0.314 kg/kW.h; and thermal efficiency for diesel fuel 22.952%, biodiesel 25.09%, and Pertamina dex 27.086%.

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Performance analysis of diesel engines using pertadex mixed fuel and candlenut seed biodiesel [7]. The results of the investigation showed that compared to utilizing only Pertamina Dex, using a blend of biodiesel reduced the engine's effective power and torque output. Of the three biodiesel blends, the B10 fuel generates the best torque (1,238 Nm) and most useful power (277 watt). All mixtures used more fuel than pure Pertamina Dex gasoline. With a particular fuel consumption of 1197.67 g/kWh, the B30 fuel outperformed the other two biodiesel combinations because it had a higher thermal efficiency than Pertamina DEX alone.

In addition to the condition of a diesel engine, an important component in the combustion process is fuel. In Indonesia, the most frequently used diesel motor fuels are biodiesel and Pertamina Dex which have different properties. Both of these fuels at first glance look the same, but have different characteristics. One of them is the cetane number, where the cetane number of pertamina dex is higher than that of biodiesel. Pertamina Dex is claimed to be suitable for diesel engines with high technology because it has low impurities [6]. The purpose of this research is to get a comparison of the performance of diesel engines with diesel fuel and diesel dex which includes: power, torque, fuel consumption and specific fuel consumption as shaft rotation. The opinion of previous researchers stated that to know the characteristics.

II. METHODS

The tools used in this study were one unit of type 4JA1 diesel engine and a dynamometer, while the materials used in this study used biodiesel and Pertamina dex fuel. This study uses several independent variables, namely variations in rotation, power, torque and Specific Fuel Consumption (SFC) with the dependent variable being Bio Solar and Pertamina Dex (Figure 1).

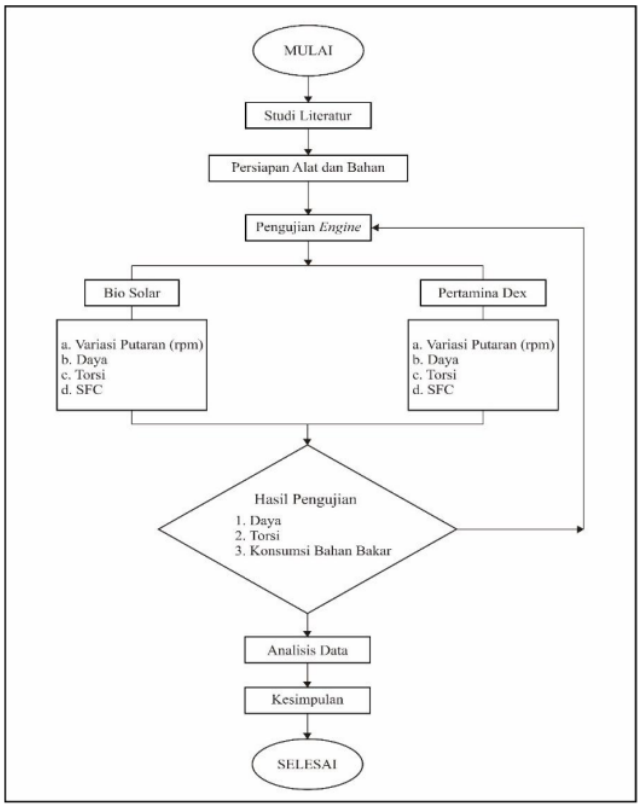

Figure 1. Research Flowchart

III. RESULTS AND DISCUSSION

Tests were carried out using a diesel motor using Biosolar and Pertamina Dex fuel which were carried out at engine shaft rotation of 1000 rpm to 2500 rpm with each increase in engine speed of 500 rpm. At the rotation of the shaft, the fuel usage time (t) is recorded to spend100ccon measuring cup, braking load (m). In this test it aims to determine the performance of the engine produced using Biosolar and Pertamina Dex fuel. The research results are shown in Table 1 and Table 2 below:

Tabel 1. Biosolar Test Results on Engine Performance

BIOSOLAR FUEL								
Machine Rotation	Test	V_f (cc)	m (kg)	t (s)	T (Nm)	P (kW)	mf (kg/m^3)	Sfc (kg/kWh)
1000	1	100	10	117	23,52	2,461	2,507	1,018
	2	100	11	107	25,372	2,655	2,742	1,032
	3	100	14	126	32,928	3,446	2,328	0,675
	Average	100	11,6	116,6	27,273	2,854	2,525	0,908
1500	1	100	19,5	110	45,864	7,200	2,667	0,370
	2	100	18	100	42,336	6,646	2,934	0,441
	3	100	19	53	44,688	7,016	5,535	0,788
	Average	100	18,83	194,3	44,296	6,954	3,712	0,533
2000	1	100	19	66	44,688	9,354	4,445	0,475
	2	100	19	59	44,688	9,354	4,972	0,531
	3	100	20	59	47,04	9,847	4,972	0,504
	Average	100	19,3	61,3	45,472	9,518	4,796	0,503
2500	1	100	19	65	44,688	11,693	4,513	0,385
	2	100	19	65	44,688	11,693	4,513	0,385
	3	100	19,5	59	45,864	12,001	4,972	0,414
	Average	100	19,16	63	45,08	11,795	4,666	0,394

Table 2. Pertamina Dex Test Results on Engine Performance

PERTAMINA FUEL DEX								
Machine Rotation	Test	V_f (cc)	m (kg)	t (s)	T (Nm)	P (kW)	mf (kg/m^3)	Sfc (kg/kWh)
1000	1	100	16	109	37,632	3,938	2,708	0.687
	2	100	15	119	35,28	3,692	2,480	0.671
	3	100	17	110	39,984	4,184	2,683	0.641
	Average	100	16	112.6	37,632	3,938	2,623	0.666
1500	1	100	18	55	42,336	6,646	5,367	0.807
	2	100	21.5	70	50,568	7,939	4,217	0.531
	3	100	22	60	51,744	8.123	4.92	0.605
	Average	100	20.5	61,6	48,216	7,569	4,834	0.647
2000	1	100	25	47	58,8	12.308	6,280	0.510
	2	100	26	43	61,152	12,801	6,685	0.522
	3	100	27	43	63,504	13,293	6,685	0.502
	Average	100	26	43,3	61,152	12,800	6.55	0.511
2500	1	100	28	43	65,856	17,232	6,685	0.387
	2	100	29	76	68,208	17,847	3,884	0.217
	3	100	31	85	72,912	19,061	3,473	0.182
	Average	100	29,3	68	68,992	18,046	4,740	0.262

Figure 2 shows the torque value with engine speed on the biodiesel and Pertamina dex fuel variants. Based on the results of research conducted using Pertamina Dex fuel at 1000 rpm the engine produces a torque value of 37.632 Nm and continues to increase at each engine speed, and at 2500 rpm engine speed the engine is capable of producing a torque of 68.922 Nm. For the use of biodiesel fuel at engine speed of 1000 rpm the torque that the engine is capable of producing is 27.273 Nm and experiencing a significant increase at engine speed of 1500 rpm produces a torque value of 44.296 Nm, at engine speed of 2000 rpm the engine is only able to produce torque of 54.472 Nm and at engine speed 2500 rpm torque generated 45, 08 Nm at 2500 engine speed the torque produced by the engine has decreased. So from the results of the study using two types of fuel, the greatest torque was obtained using Pertamina Dex fuel at 2500 rpm of 68.992 Nm compared to using Biosolar fuel at 2500 rpm only producing a torque of 24.08 Nm.

Engine torque in a vehicle can be interpreted as vehicle acceleration, so that peak torque in a vehicle's engine indicates that maximum engine acceleration is occurring. So that when the driver increases the

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torque to the maximum value, the driver will feel pushed backwards because the vehicle's speed is very fast. Torque also plays a role in the initial movement of the vehicle, in this case the required torque is greater so that the gear box needs assistance in turning the vehicle wheels.

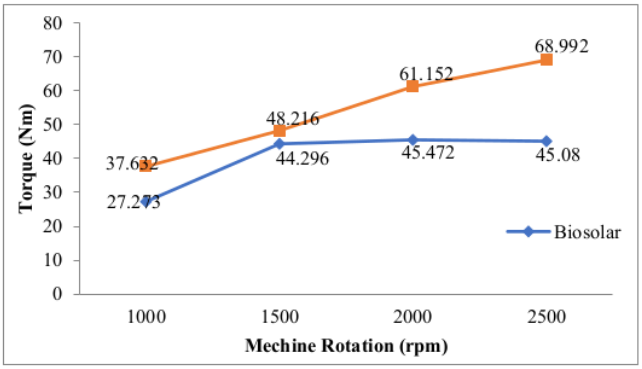

Figure 2. The relationship between torque and engine speed on variants of biodiesel and Pertamina dex fuel

Figure 3 is a comparison of power with engine speed for each type of fuel. In the use of Pertamina dex fuel, the engine can produce the highest power at 2500 rpm engine speed with a value of 18.046 kW from 1000 rpm engine speed to 2500 rpm engine speed. At 1500 rpm the power generated increases to 7.569 kW at 2000 rpm the power generated is 12.8 kW and up to 2500 rpm the highest power generated is 18.046 kW. When using biodiesel fuel, the power generated at 1000 rpm is 2.854 kW at 1500 rpm engine speed, the power generated is 6.954 kW at 2000 rpm, the power generated is 9. 518 and at 2500 rpm the power generated by the engine continues to increase until it is capable of producing a power of 11.795 kW. From the results of the study it can be concluded that as the engine speed increases, the power generated by the engine increases.

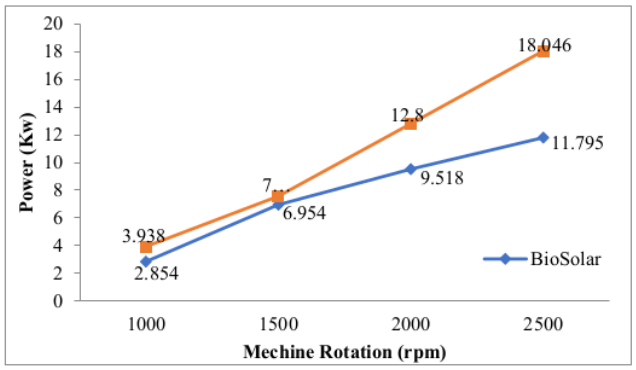

Figure 3. The relationship between power and engine speed on variations of biodiesel fuel and Pertamina dex

Figure 4 explains the effect of the engine speed relationship on the use of specific fuel consumption (SFC). Specific fuel consumption is the amount of fuel used to produce effective power and the lower the value of fuel consumption, the more economical [4]. From the results of the tests carried out, the use of Pertamina Dex fuel at 1000 rpm requires a fuel consumption of 0.666 kg/kWh at 1500 rpm, the required fuel consumption is 0.647 kg/kWh at 2000 rpm, the required fuel consumption is 0.511 kg. /kWh and at 2500 rpm the required fuel consumption is 0.262 kg/kWh, and for the use of biodiesel fuel at 1000 rpm the required fuel consumption is very large 0. 908 kg/kWh at 1500 rpm the required fuel consumption has decreased by 0.647 kg/kWh at 2000 rpm the required fuel consumption is 0.503 kg/kWh and at 2500

rotation the required fuel consumption is 0.394 kg/kWh. So from this study the engine rotation and the use of fuel are very influential on the required fuel consumption.

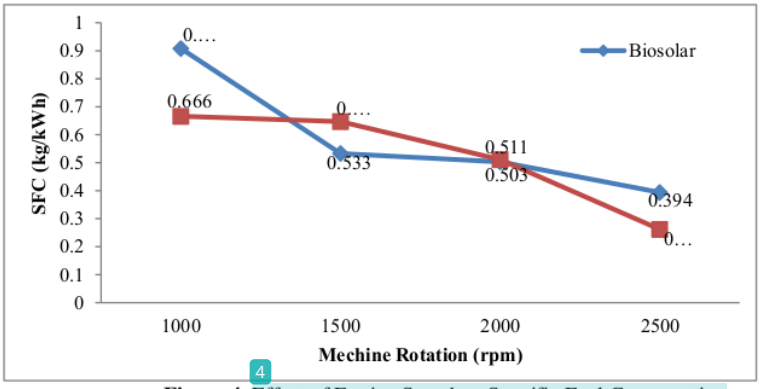

Figure 4. Effect of Engine Speed on Specific Fuel Consumption

Figure 2 explains the relationship between the effect of using specific fuel on the power produced by the engine. The higher the engine speed, the less fuel consumption and the greater the power generated [5]. For the highest material consumption produced at 1000 rpm engine speed with a fuel consumption value of 0.908 kg/kWh capable of producing 2.854 kW of power using Biosolar fuel and for the lowest fuel consumption generated at 2500 rpm rotation using Pertamina Dex fuel, the value fuel consumption of 0.262 kg/kWh which is capable of producing a very high power of 18.046 kW compared to using biodiesel fuel which consumes a fuel consumption of 0.394 kg/kWh is only capable of producing a power of 11.795 kW.

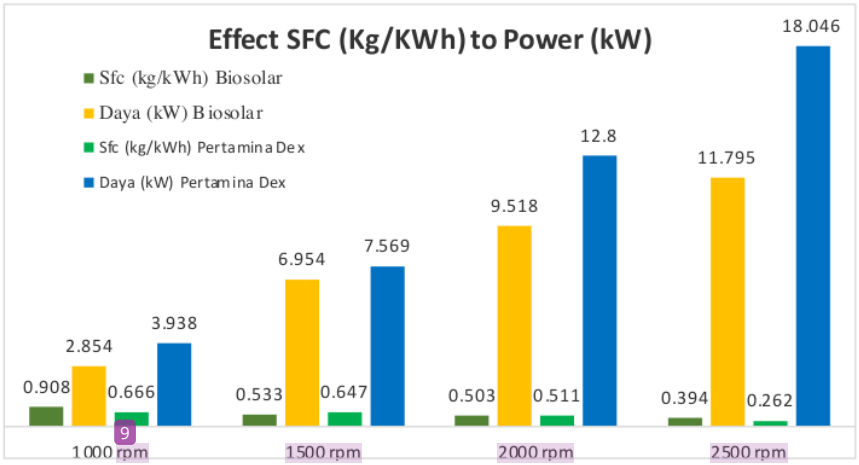

Figure 5. The Effect of Specific Fuel (Sfc) on the Power Generated by the Engine

IV. CONCLUSION

1. Based on the results of testing engine performance, the torque value increased at each engine speed, the highest torque value was obtained in the Pertamina Dex fuel test at 2500 rpm engine speed, which was 68.992 Nm, while testing using biodiesel fuel, the highest torque was produced at 2000 rpm rotation with a value of 45.472 Nm and decreased at 2500 rpm by 0.392%.
2. The power generated by the engine is affected by the engine speed, the higher the engine speed, the greater the power generated. Based on the results of engine performance testing for the use of Pertamina dex fuel, the resulting power increased from 3.631% at 1000 rpm to 1500 rpm to

5.231% at 1500 rpm to 2000 rpm and 5.246% at 2000 rpm to 2500 rpm. For the use of biodiesel fuel, the power generated at 1000 rpm to 1500 rpm produces a power of 4.1%, at 1500 rpm to 2000 rpm the power generated is 2.564%, and at 2000 rpm to 2500 rpm rotation it produces a power of 2.277%. .

3. The specific fuel consumption value obtained from the results of engine performance testing can be concluded that the higher the engine rpm, the lower the required specific fuel consumption value. In this study, the highest fuel consumption value was generated at 1000 rpm rotation using Pertamina dex fuel of 0.666 kg/kWh while for biodiesel fuel it was 0.908 kg/kWh and the lowest fuel consumption value was obtained at 2500 rpm rotation using fuel pertamina dex which shows a fuel consumption value of 0.262 kg/kWh while for the use of biosoar fuel at 2500 rpm requires a fuel consumption of 0.394 kg/kWh which means that for the use of Pertamina dex fuel the required fuel consumption is lower 0,132% than biosolar.

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