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Effects Of Bio-Oil - Diesel Blends: The Performance and Emissions of Diesel Engines With Heater on Fuel Blends

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Abstract

The vehicle fuel consumption is increasing. Fossil fuels are running low. Research is needed to reduce the use of fossil fuels. As an alternative, research is carried out on the use of a mixture of bio-oil - diesel fuel in diesel engines. The aim of the research is to increase power, reduce fuel consumption and reduce exhaust emissions from diesel engines. The research method is direct testing on diesel engines with variations in fuel heating by adding a heater to the fuel. Variation of heating materials The fuel used is standard temperature, 40°C, 50°C, and 60°C. The test uses a lamp load with a certain variation to determine power, with a measuring tube to determine certain fuel consumption. Testing using the opacity smoke meter to determine the level of exhaust gas opacity. In this test, In this test it can be concluded that the best condition is B20 at a fuel heating temperature of 40oC, where power has increased, opacity and fuel consumption has decreased, the power can reach 2592,76 watt. Smoke opacity level at 5,4% and 0,088 gr/watt of fuel consumption.

Keywords
bio-oil, heater, engine performance, vehicle's smoke opacity

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INTRODUCTION

The depletion of fossil fuels, rising oil prices from the Russian-Ukrainian war, emerging economies and population growth are contributing to high demand for energy resources, pollution from emissions and global warming. With the increasing demand for fossil energy even though the stock of fossil energy is depleting. So research is needed to add fuel other than fossil energy [1]–[4]. For this reason, several countries are interested in developing alternative non-fossil energy sources for machinery[2]. As an alternative solution to overcome this problem, the addition of biodiesel fuel to diesel fuel is being considered. Problems with the increasing demand for diesel engines. In accordance with the order of the Minister of Energy and Mineral Resources of the Republic of Indonesia No. 25 of 2013, Solar Not mixed with biodiesel, bioethanol or pure vegetable oil [5]. One of the processes used to produce alternative energy fuels is pyrolysis. Pyrolysis can produce charcoal, bio-oil, and gas [[6], [7]. Bio-oil from the pyrolysis process is used as a diesel mixture as fuel for small diesel engines (autoignition). Consequences of using biodiesel Diesel fuel to determine fuel consumption. In previous research, he found that adding 20% biodiesel to diesel fuel provided the best fuel

efficiency. [8], [9]. The bio-oil in this study was produced from the pyrolysis process of Brem waste [7] addition of biodiesel can reduce carbon dioxide CO2 and HC hydrocarbons. Reliable emissions, with a slight increase in nitrogen oxides NOx [10]–[12]. When using biodiesel, the fuel may need to be preheated. The preheating temperature of biodiesel depends on the kinematic viscosity, density, Surface tension is strongly influenced by the physical properties of this fuel The atomization process in the combustion chamber[13].

Previous research, the effect of alcohol additives in biodiesel fuel mixtures on properties such as density, viscosity and flash point were investigated. Biodiesel fuel mixture (B20) was used for characterization compared with 5%, 10% ethanol and methanol [1]. The aim is to investigate the effects of biogas flow and methane concentration on the performance and emissions of CI engines operating in dual-fuel mode[14]. Research about the Performance of Diesel Engine Fueled Diesel Oil with Heated Pure Vegetable Oils [15], Preheated Coconut Oil [5], Heated Coconut Oil [16]. Effect of adding biodiesel to fuel heating and diesel in Mitsubishi L300. diesel engine coverage [17].

This study used bio-oil derived from the pyrolysis process of Brem waste biomass. Where Brem waste becomes waste, which is only for animal feed, garbage etc. The novelty of this research is to use waste to make bio-oil and can be used as a mixture of diesel as diesel fuel. From this research the author wants to examine using diesel fuel mixed with Bio-Oil with a variable mixing Diesel 90% and Bio-Oil 10% or hereinafter referred to as (B10), Solar 85% and Bio-Oil 15% (B15), Diesel 80% and Bio-Oil 20% (B20). which will then be tested on an 815cc single-cylinder Dongfeng diesel engine with a modification of the addition of a fuel heater. In order for the fog to work perfectly and be flammable, it requires a low flash point of the fuel. This will affect fuel consumption, exhaust emissions, and the power of the diesel engine.

METHOD

The research method is direct testing on diesel engines with variations in fuel heating by adding a heater to the fuel. The variation of heating materials the fuel used is standard temperature, 40°C, 50°C, and 60°C. The test uses a lamp load with a certain variation to determine power, with a measuring tube to determine certain fuel consumption. Testing using the opacity smoke-meter to determine the level of exhaust gas opacity.

Test Equipment and Equipment : 1. Fuel Type (The fuel used is pure diesel which produced by PERTAMINA, Bio-Oil from pyrolysis produced by the pyrolysis group)[7], 2. The equipment used in this research is Fuel heater, 3. The test equipment used: Dongfeng S195 brand diesel engine, Tachometer to set diesel engine RPM, Opacity smoke meter to measure exhaust emissions, diesel engine, Load light as a load on the generator diesel engine, Voltmeter to read voltage from generator diesel engine, Tang ampere to read current from engine generator diesel. Experiment by changing the fuel heater with B0, B10, B15, B20

Before testing the diesel engine, testing was carried out with diesel fuel. and power results according to engine specifications. Experiments were conducted at a constant motor speed of 1500 rpm with varying lamp loads of 650, 1300, 1950, and 2600 watts connected to an electric motor rotated by the motor. Each variation in injector pressure he tested three times in five minutes and averaged the results. A measuring cup is used to measure fuel consumption over a period and is measured with a stopwatch. Finally, gas emissions from diesel engines are calculated using smoke meter opacity. The experimental setup is presented in Figure 1.

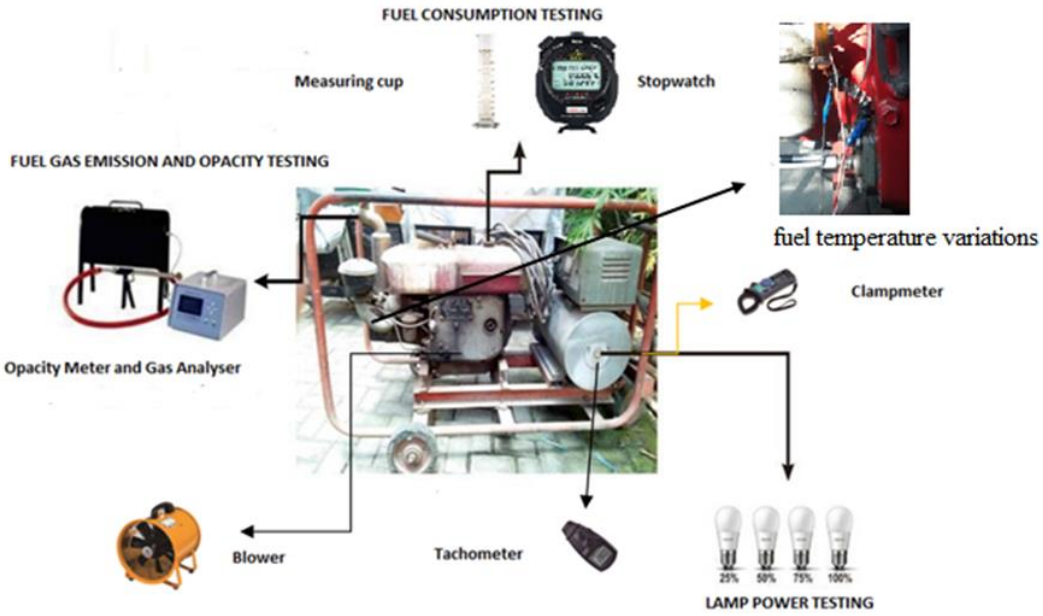

Figure 1. The experimental setup

RESULT AND DISCUSSION

Results

Table 1 shows the data for electrical power test in response to the variation of fuel and heated fuel.

Table 1 Test Data Electric Power with Variations fuel and heated fuel

TEMPERATURE	FUEL	LOAD OF LIGHTS			
		650 watt	1300 watt	1950 watt	2600 watt
STANDART	Diesel Fuel	666,19	1322,25	1943,12	2569,78
	B10	642,32	1312,50	1928,65	2526,67
	B15	668,36	1378,15	1917,44	2563,08
	B20	686,88	1333,00	2038,41	2572,09
TEMPERATURE 40°C	Diesel Fuel	688,88	1341,6	1953,21	2481,36
	B10	692,04	1365,12	1904,22	2475,03
	B15	688,88	1324,08	1940,98	2533,4
	B20	706,32	1350	1968,8	2592,76
TEMPERATURE 50°C	Diesel Fuel	673,62	1362,96	1951,68	2613,96
	B10	725,94	1343,52	1996,62	2514,32
	B15	706,32	1350	1996,62	2582,16
	B20	732,48	1367,28	1979,5	2527,04
TEMPERATURE 60°C	Diesel Fuel	704,14	1302,48	1973,08	2599,52
	B10	677,98	1306,8	1951,68	2563,08
	B15	710,68	1360,8	1974,51	2580,53
	B20	697,6	1343,52	1945,26	2563,08

Electric Power

Figure 2 shows that the comparison of the value of the electric power produced when the diesel motor uses standard heating variations, 40°C, 50°C, and 60°C. There was an increase in power with the addition of bio-oil B10, B15, B20. This is in accordance with Rangga Andi Risokta's research [18].

In the standard parameters, it shows that B20 has a higher power value than B15, B10 and pure diesel at 650, 1300, 1950 and 2600 watt lamp loading conditions. At a temperature of 40°C, it shows that B20 has a higher power value than B15, B10 and pure diesel at 650, 1300, 1950 and 2600 watts of light loading. At temperatures of 50°C and 60°C it shows that B10, B15, B120 have experienced a decrease in power value compared to pure diesel at 650, 1300, 1950 and 2600 watt lamp loading conditions. With these results, heating up to 40oC in fuel can increase the value of engine power by 0.53-5.34% compared to pure diesel at 650, 1300, 1950 and 2600 watts.

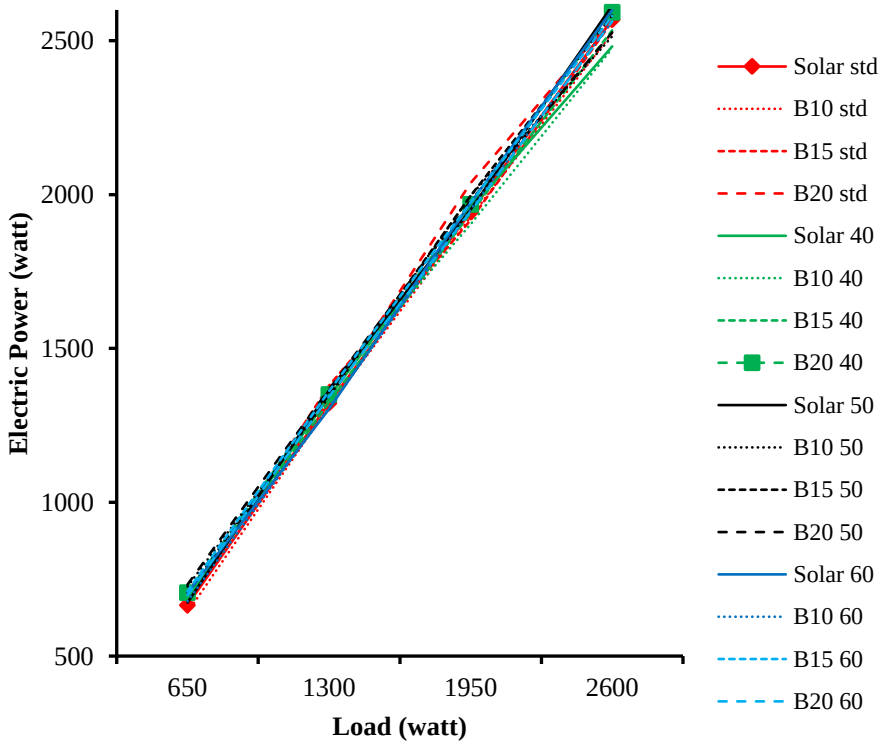

Figure 2. Electric Power with Variations fuel and heated fuel

The blend of biodiesel from waste Brem oil used has more combustion properties better than diesel fuel, namely the viscosity of biodiesel is higher than the viscosity of diesel oil, namely biodiesel has a better lubricating effect than diesel. Higher viscosity makes processing easier to spin with less friction. above and beyond, Biodiesel already contains oxygen in its compounds, so the combustion in the engine approaches the full and more efficient use of the fuel[18].

Opacity

Opacity describes how opaque a gas emission is and whether it is transparent waste. Meaning increases with increasing opacity. Due to exhaust pollutants, the proportion does appear to be an object the greater it is. This particulate, which primarily consists of soot, undergoes a process that can be summed up as thermal decomposition under oxygen-less,

high-temperature conditions, followed by dehydrogenation and oJ polymerization, which results in the formation of intermediate compounds with a lot of carbon, followed by the development of the particle nucleus [19].

In Figure 3. shows that the comparison of the value of the exhaust gas opacity produced when the diesel motor using standard heating variations, 40°C, 50°C, and 60°C. With the addition of bio-oil B10, B15 and B20 there was a decrease in opacity at standard parameters, temperature 40°C, 50°C and 60°C. This is in accordance with research from Moch. Setyadji [18] and Rangga Andi Risokta [19]. Theoretically low opacity could be caused by biodiesel acid containing more easily oxidized or completely flammable fats [18]. This is because the mixing of air and fuel materials that enter the combustion chamber is close to a complete mixture and biodiesel fuel does not contain sulfur, therefore the opacity is removed less and it is less environmentally friendly compared to pure diesel [19].

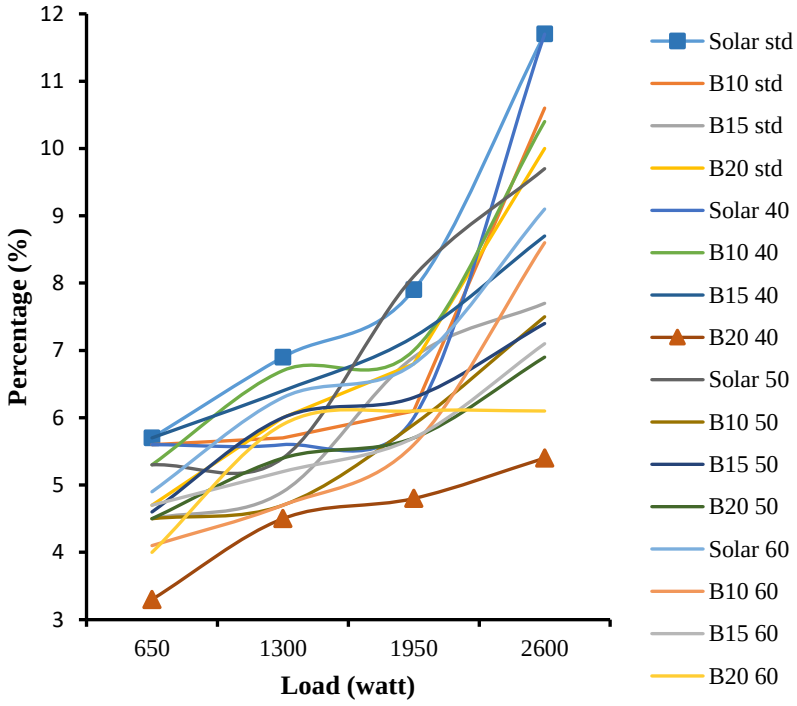

Figure 3. Opacity with Variations fuel and heated fuel

Specific Fuel Consumption

Figure 4 shows that the comparison of the Specific fuel consumption values produced when the diesel motor uses standard heating variations, 40°C, 50°C, and 60°C.

Overall, with a mixture of biodiesel B10, B15, B20 and by heating the fuel to 40°C, 50°C and 60°C, fuel consumption has decreased. The best decrease in fuel consumption is in parameter B20 and a temperature of 40°C. Specifically, in parameter B20, the temperature is 40oC at 2600 rpm which decreases fuel consumption by 9.07% compared to pure diesel with standard parameters, 2600 rpm. These results are in accordance with the research of Rangga andi Risokta [18]. The more blended biodiesel shows lower fuel consumption compared to diesel. That's because the presence of oxygen in vegetable oil results in almost complete combustion in the combustion chamber. Also higher viscosity helps reduce frictional forces resulting in more energy efficient piston manufacture Switching from TDC to TMB and vice versa.

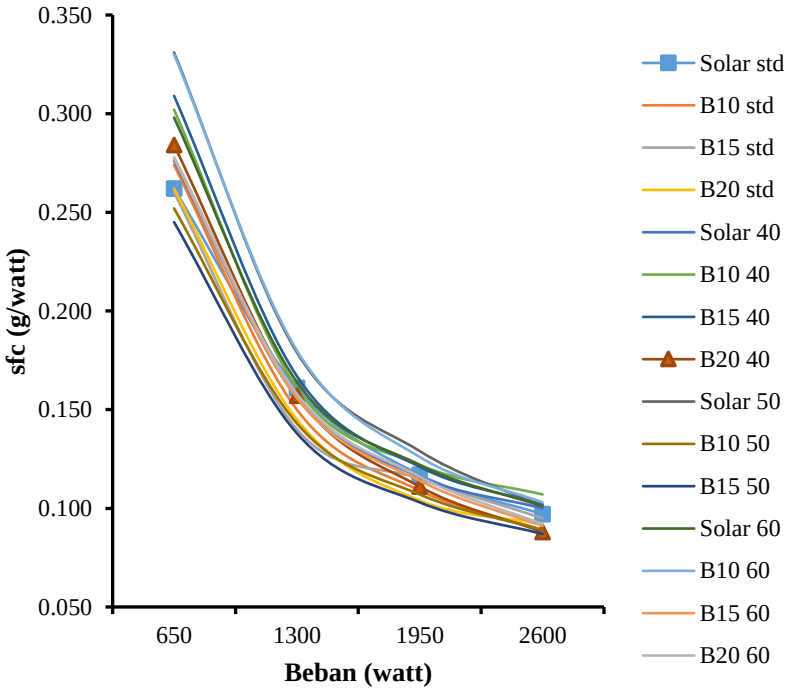

Figure 4. SFC with Variations fuel and heated fuel

CONCLUSIONS AND SUGGESTIONS

Conclusions

Diesel engines can operate using a mixture of Bio-Oil and diesel fuel with a variety of heaters fuel. Use of Bio-Oil fuel mixture and diesel with a variety of fuel heaters affect the performance and opacity of diesel engines.

In this test it can be concluded that the best condition is B20 at a fuel heating temperature of 40^{o}C, where power has increased, opacity and fuel consumption has decreased.

Suggestions

Based on the research conducted, the researchers only focused on B20, therefore in future studies it is hoped that it will be as high as B100

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