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The Effectiveness of Using Variations in Fuel Against Engine Performance 4 Steps 100 CC with Compression Ratio 8:1

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The Effectiveness of Using Variations in Fuel Against Engine Performance 4 Steps 100 CC with Compression Ratio 8:1

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Abstract. The compression ratio is one of the benchmarks in determining the appropriate fuel RON for motorized vehicles. The use of RON that is not following the manufacturer's specifications can undoubtedly hurt engine performance. The purpose of this study was to analyze the effect of premium, pertalite, Pertamax, and Pertamax turbo fuels on engine performance. This research is experimental research where the object of study used is the Honda Supra X 100cc. The research instruments and equipment used included a dynamometer chassis and a blower as a cooling fan. The engine performance testing method is carried out according to the SAE J1349 standard. Meanwhile, the data analysis technique used descriptive methods. From the results of data analysis obtained from the study, it is concluded that the RON 88 is suitable for 3000-4000 rpm, while RON 90.92.95 is suitable for 4500-7000 rpm, in addition to motors that have a compression ratio of 8:1 they can use RON 90.92.95 without modification to the engine.

Keyword: engine performance; RON; compression rasio; and Honda Supra X 100cc

1. Introduction

Human intellectual development brought us to modern times, while technological developments took us to an era that marked the progress of a country. At this time, the development of technology has reached the era of 4.0, where technology is developing rapidly, both in the information technology (IT) and automotive fields [1,2]. Especially in Indonesia, automotive technology has made significant advances, where every production vehicle is required to comply with the euro 4 standard [3]. This means that every car produced, especially gasoline-engined vehicles, is only allowed to produce Carbon Monoxide (CO) emissions of 1 g/km, Hydrocarbons (HC) of 0.1 g/km, Nitrogen Oxide of 0.08 g/km. Meanwhile, diesel-engined vehicles are only allowed to produce CO2 emissions of 0.50 g/km, HC + NOx 0.30 g/km, NOx 0.25 g/km, and 0.025 g/km Particulate Matter (PM) [4,5].

In Indonesia, this regulation is supported by the Ministry of Environment and Forestry Regulation No. P.20/MENLHK/SETJEN/KUM.1/3/2017 concerning Quality Standards for New Type Motor Vehicle Emissions for Categories M, N, and O [6]. Therefore, what needs to be done to reduce the number of exhaust emissions produced by vehicles is to make the fuel burn entirely. Several technologies that have been applied to support this are the Electronic Fuel Injection (EFI) technology in which the spraying or injection of fuel has been carried out or controlled electronically [7]. Besides, the valve opening regulation is also made electronically through VTEC technology for Honda products [8], VVA for Yamaha products[9], and VVT for Suzuki products [10].

Of the many technologies offered to support this regulation, some Indonesians still choose vehicles with old years. Cars from the 1990s to 2000s still paved the streets. Still fit for use, and relatively cheap tax payments are some of the reasons commonly explained by vehicle owners. Vehicles like this, of course, still use old technology, one of which is like a carburetor. Besides that, the compression ratio ranges from 7-9. The most popular vehicles in Indonesia are motorbikes, and this is of course adjusted to road conditions in big cities where traffic jams often occur, so it is more efficient when used as a means of transportation for people who will work and students who will go to school [11].

One of the vehicles that are currently still in high demand is the Honda supra x 100 cc, where the first generation was produced around 2001-2005, and the fourth generation was produced around 2014 until now. Over time the number of vehicles continues to increase, which of course has an impact on increasing levels of air pollution [12]. Based on data from BPS, it is known that motorized vehicles annually contribute 80% of air pollution in Indonesia [13]. On the other hand, because motorized vehicles are still synonymous with fuel use, of course, it will have an impact on the availability of fossil fuels, even in Indonesia there were several times fuel shortages. Therefore, in the era of President Joko Widodo, a new fuel variant for gasoline-engined vehicles was Pertalite. This is done as part of the government's efforts to reduce scarcity and subsidies for fossil fuels. Besides, it also aims to reduce the level of pollution in Indonesia.

Premium fuel has a research octane number (RON) value of 88, while pertalite is 90. For new motorbikes with a compression ratio of 9 or more, of course, there will be no problems with the motorcycle. However, for vehicles with a compression ratio below 9, it will undoubtedly affect vehicle performance. A decrease in compression can occur in an engine, due to several factors: inadequate maintenance by the owner, oil change is not according to standards, how to operate the vehicle that is not according to the manual, supra 100 cc standard ratio is 9; 1 but due to lack of maintenance by the owner, an oil change is not following the standard, usage is not by the manual, resulting in a decrease in the compression ratio down to 8; 1. From the description above, the writer wants to research the effect of premium fuel use, pertalite, Pertamax, and Pertamax turbo on the performance of the old type motorcycle engine, namely the Honda Supra X 100cc which has a compression ratio below 9.

2. Literature Review

In the internal combustion motor cycle, several factors influence the occurrence of complete combustion. These factors include (1) octane number and (2) compression ratio.

2.1. Octane number

The octane number or better known as the research octane number (RON) is a standard measure of the performance of a spark internal combustion engine. The octane number is not an indicator of the energy content stored in the fuel, but a measure of the propensity of the fuel to burn in a controlled manner [14]. In general, the gasoline engine works by relying on combustion from the mixture of air and fuel, which is then compressed at the end of the compression stroke using spark plugs [15]. Higher RON makes the fuel more resistant to compression or difficult to burn [16]. However, the use of RON that is higher than the engine spec will hurt vehicle performance between thermal efficiency, fuel consumption, carbon monoxide, and hydrocarbon emissions [17].

Rashid (2019), in his research results explained that RON 97 offers high performance and efficiency in all operating conditions from low speed to high speed [18]. Moreover, it is shown to be environmentally friendly, as far as octane ratings are concerned with its energy potential [19]. In line with these results, Mohammad (2004) also proved that fuel with RON 95 provides higher engine performance for all part load conditions in the speed range. RON 95 produces an average brake torque of 4.4% higher, brake power, effective pressure compared to RON97 [20]

2.2. Compression ratio

The compression ratio is one of the most essential points that affect engine performance parameters, including thermal efficiency, a heat transfer rate of output power, etc. [21]. he effect of varying the compression ratio has more impact on performance, emissions, and combustion parameters [22,23]. Increasing the compression ratio on the Spark ignition motor will affect increasing the octane number of the fuel [24]. Zheng (2009), through the results of his research stated that the compression ratio of an engine affects engine performance, combustion, and emissions. Besides that, the compression ratio also affects the duration of combustion [25].

3. Research method

This study uses a Honda Supra 100 CC motorcycle, before data collection using the dynamometerr chassis, the researchers first collected data by testing the compression ratio using a compression tester with a fully open throttle valve method. After the compression measurement is complete, the researcher removes the fuel hose that flows from the fuel tank to the float chamber, and removes the remaining fuel in the float chamber, the fuel hose leading to the float chamber is replaced by the fuel pipe from the burette. After the remaining fuel in the float chamber is exhausted, the float chamber is filled with fuel that is flowed from the burette with the aim of measuring the amount of fuel consumption. The measuring instrument is operated after which the engine is also operated, measurements are made starting from 3000 rpm to 7000 rpm.

To obtain valid and accurate research data, the engine performance testing method is carried out based on the SAE J1349 standard, namely the Engine Power Test Code-Spark Ignition and Compression Ignition-Net Power Rating [26]. Data analysis using descriptive method. Descriptive method is used to analyze data by describing the data that has been collected to analyze data by describing the collected data as it is and presented through tables and graphs [27].

Figure 1. Research Instruments.

The specifications of the instruments used in this study can be seen in Table 1.

Table 1. Research Instrument Specifications

Criteria	Specification
Inertia Chassis Dynamometer	Rextro Pro – Dyno
Fan	Krisbow EF – 50S

4. Results and Discussions

4.1. Results

The table shown below presents the results of taking engine performance data on a Honda Supra X 100 CC motorcycle with variations of RON 88, 90, 92, and 98. Tests are carried out by increasing engine speed (accessories) with full load starting from 3000 rpm to up to 9000 rpm.

Table 2. Power and Torque Test Results Data

RPM	Power (HP)				Torque (N.m)			
	RON 88	RON 90	RON 92	RON 98	RON 88	RON 90	RON 92	RON 98
3000	0.70	0.60	0.70	0.73	1.61	1.43	1.66	1.75
3500	3.20	3.27	3.13	3.20	6.50	6.57	6.33	6.50
4000	3.50	3.53	3.53	3.60	6.18	6.44	6.29	6.42
4500	3.83	4.07	4.00	4.10	6.06	6.35	6.32	6.45
5000	4.43	4.50	4.57	4.63	6.25	6.38	6.48	6.57
5500	4.87	5.17	5.07	5.17	6.27	6.62	6.49	6.66
6000	5.23	5.40	5.47	5.60	6.16	6.41	6.44	6.62
6500	5.27	5.57	5.67	5.77	5.75	6.09	6.13	6.26
7000	5.23	5.63	5.60	5.90	5.28	5.70	5.67	5.95
7500	4.93	5.43	5.50	5.73	4.67	5.12	5.17	5.39
8000	4.47	4.90	5.10	5.37	3.95	4.31	4.51	4.75
8500	4.13	4.47	4.73	5.10	3.45	3.71	3.91	4.23
9000	3.80	4.17	4.20	4.83	3.02	3.31	3.30	3.86

Table 2 shows the results of testing the power and torque of a Honda Supra X 100 CC motorcycle at each engine speed. If the data in the table is displayed in graphical form, it is shown in Figures 2 and 3.

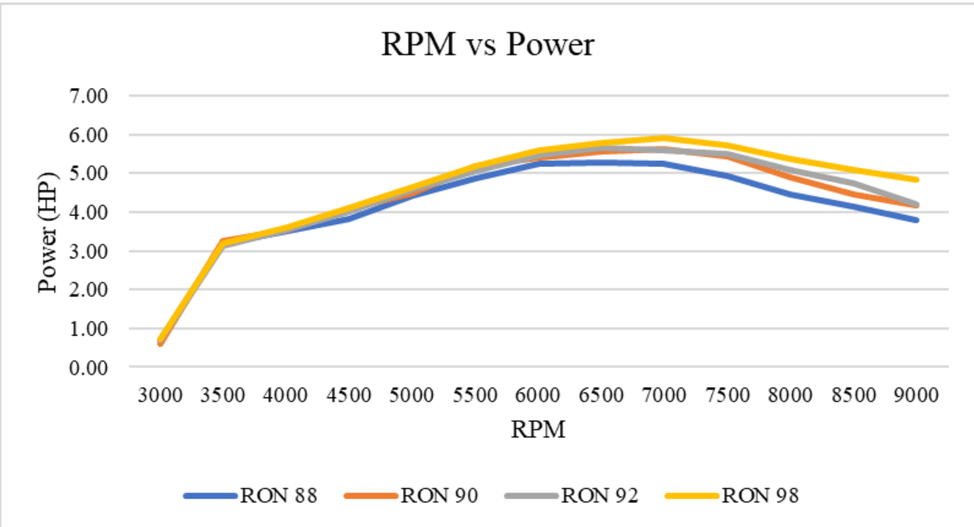

Figure 2. RPM test results with power.

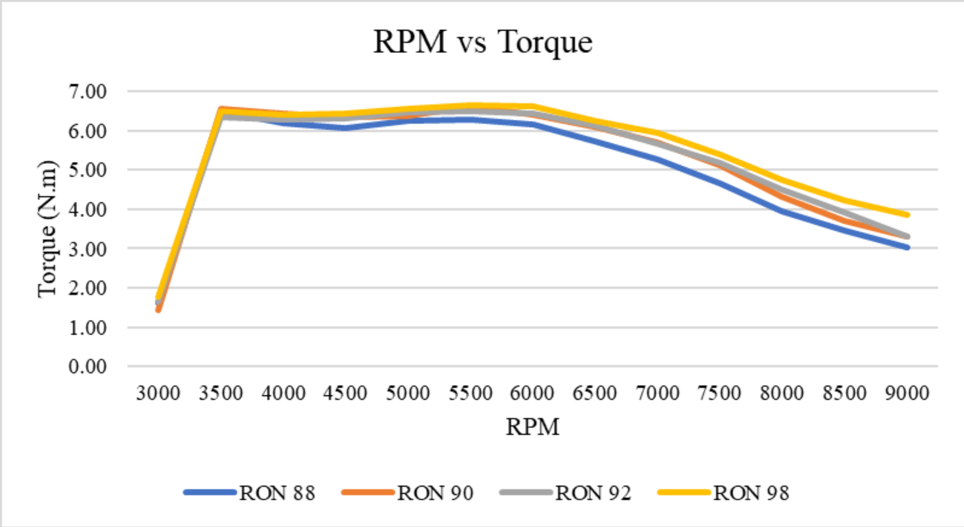

Figure 3. RPM test results with torque..

4.2. Discussions

The use of different RON fuels can certainly affect the engine performance of a vehicle. Figure 1 shows the increase in engine power at various speeds, both at RON 88, 90, 92, and 98. At an engine speed of 3000 to 9000 rpm, fuel with RON 98 produces the highest power when compared to the other three variations of RON, which is 5.9 HP. This power can be generated at an engine speed of 7000 rpm, where there is an increase of 2.3% from the previous engine speed of 6500 rpm, with the power produced is 5.77 HP. Unlike the RON 98, the maximum power gain at RON 92 tends to be lower, which is 5.67 HP. This power is generated at 6500 rpm engine speed, where there is an increase in power by 3.7% from the previous engine speed of 6000 rpm. Furthermore, the power produced by RON 90 becomes the third-lowest power when compared to RON 98 and 92. The maximum power of RON 90 is obtained at 7000 rpm engine speed of 5.63 HP, wherefrom the engine rotation speed (6500 rpm) the power is 5.57 HP or only increases by 1.2%. Then the lowest power in this study was generated by RON 88, where the maximum power generated was 5.27 HP at 6500 rpm engine speed. This power increases not quite significantly when compared to the power generated at the previous speed, where at 6000 rpm the power generated is 5.23 rpm or only an increase of 0.6% from the engine speed of 6500 rpm.

Apart from having an effect on the power consumption of fuel with certain RONs, it also affects the torque generated by the engine. In this case, the increase in torque at each engine speed is shown in Figure 2. Based on the research results obtained from the four variations of the RON, it is known that the highest torque produced by RON 98 is 6.66 N.m. The torque is obtained at 5500 rpm engine speed, which increases by 1.4% from the engine speed of 5000 rpm. The second place, the maximum torque generated by RON 90, which is 6.62 N.m at 5500 rpm engine speed. The torque generated at 5500 rpm engine speed tends to increase by 3.9% when compared to the torque generated at 5000 rpm engine speed. An exciting thing is shown by the RON 88, which can rank third, where this type of fuel is capable of producing higher torque when compared to RON 92. The maximum torque of RON 88 is generated at 3500 rpm engine speed, where the torque can increase significantly when compared to engine speed. previous. Finally, the RON 92, as mentioned earlier, the RON 92 produces the lowest maximum torque when compared to the previous 3 RON variations. RON 92 is capable of producing a maximum torque of 6.49 N.m or only able to increase by 0.3% from the last torque at 5000 rpm rotation. From the data above, the highest power and torque are obtained by using RON 88 fuel at 3000-4000 RPM, but at 4500-7000 rpm the torque and power curve increases. This is because the 88 ron has flammable characteristics.

The motor used for the experiment has a compression ratio of 8:1, the degree of ignition of the standard motor at low speed (1,000 - 3,000 rpm) of fire at 8 - 15 degrees before TDC. At medium to high rotation (4,000 rpm and above), the fire jumps at 25-30 degrees before TDC. At ron 88, the fuel burns at a lower temperature than RON 90.92.95. In line with these results, Zheng et al. (2009), through the results of their research, found that the compression ratio of an engine affects engine performance, combustion, and emissions. Besides that, the compression ratio also affects the duration of combustion [22]. In this case, at 4500-7000 rpm the fuel with RON 88 has the lowest power and torque because at that rotation, the engine temperature increases. Increasing the engine temperature is very useful to help the combustion chamber temperature heating process. Therefore, it is natural for power and torque to increase when both the vehicle uses RON 90, 92, and 98 fuel, even though these vehicles only have a compression ratio of 8:1.

Tangöz et al. (2017), through their research results explain that the compression ratio is one of the essential points that affect engine performance parameters, including thermal efficiency, power, torque, and specific fuel consumption [21]. In line with this explanation, Yadav et al. (2019) suggested that engine performance is greatly influenced by the compression ratio and is directly proportional to the recommended fuel RON [23]. he use of RON that is higher than engine specifications will harm engine performance [17], Besides that, another effect that is caused is an increase in exhaust gas emotions [28].

5. Conclusions

From the data obtained from the research, RON 88 is suitable for 3000-4000 rpm while for RON 90.92.95 it is suitable for 4500-7000 rpm, in addition to motors that have a compression ratio of 8:1 can use materials with RON 90, 92.95 without making engine modifications.

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