

Influence of Octane Number on the Four-Stroke Petrol Engine Performance

^{1*}Khoiri Rozi, ²Muchammad, ³Gifari Iswandito Dermawan

^{1,2,3}Mechanical Engineering, Diponegoro University, Jl. Prof. H. Soedarto, SH, Tembalang, Semarang 50275, Indonesia

*Corresponding Author's E-mail: khoiri.rozi@yahoo.com

Abstract - This study aims to determine the effect of octane number on the characteristics of a 4-stroke gasoline engine. This study tested 3 types of fuel with octane values RON 90, 92 and 98. The results of this study generally indicate that the higher the octane number of fuel oil will increase the engine performance value. The average engine torque value increased by 13.2% with RON 92 fuel and 38.15% using RON 98. The engine power value increased by 13.1% with RON 92 and 17.8% with RON = 98. The engine specific fuel consumption value decreased by 9.5% with RON 92 and decreased by 22% with RON 98.

Keywords: Power, torque, RON, specific fuel consumption.

I. INTRODUCTION

Over time, oil reserves are decreasing, requiring us to find ways to use this fuel effectively, one of which is by improving the quality of fuel oil (BBM). BBM itself is the most common source of energy used in various fields, from motor vehicles, industrial machines, aircraft to power plants [1]. Fuel oil is most commonly used through the combustion process. Combustion is the process by which chemical energy in the form of chemical bonds in fuel is converted into thermal energy and mechanical energy. This combustion process requires at least two components, namely fuel and oxidizer which is usually oxygen [2]. The octane number in a combustion engine has a very important role for engine characteristics such as thermal efficiency values, peak power and torque, to specific engine fuel consumption [3] [4][5][6][7].

Internal Combustion Engine (ICE) is a machine that works by converting chemical energy into mechanical energy through a series of combustion reactions [8]. This machine works by utilizing the energy released due to the combustion reaction between the fuel and air mixture in the combustion chamber, this combustion process then produces gas with high temperature and pressure so that the gas expands. The result of this gas expansion is what provides piston power that can drive the engine [9]. ICE engines have unique characteristics for each engine, such as engine speed shows how fast the crankshaft rotates in the engine [10], Torque shows the ability of an engine to do work [11], power shows the maximum

energy that can be output by an engine [12], specific fuel consumption shows the fuel consumption required for each power [13]. Thermal efficiency shows the ratio of the power that can be produced by the engine to the amount of energy input into the engine [14].

II. METHODOLOGY

2.1 Method

Research octane number (RON) is a parameter that shows the comparison of the percentage composition of fuel oil, where the fuel ratio consists of n-heptane and iso-octane [15]. This experimental study was conducted to determine the effect of octane number values on engine characteristics [16][17]. The independent variables used are the type of fuel with RON values of 90, 92 and 98. The dependent variables used are Power (P), Torque (M), and sfc. Furthermore, the control variables are engine speed between 1000 rpm to 3400 rpm and engine loading between 1 Nm to 3 Nm.



Figure 1: Engine test

2.2 Equipment and Engine Test

In this study, several equipment was used, including the G.U.N.T Hamburg CT 150 which functions as a test machine [18], then this test machine was placed on the G.U.N.T

Hamburg CT 159 engine stand which functions as a place to place the engine and supporting accessories for engine operations such as the fuel and exhaust gas distribution system 150 [19], the CT 150 test machine was then connected to the G.U.N.T Hamburg HM 365 drive and brake unit via a series of pulleys and v-belts, the HM 365 functions to read engine characteristics such as engine rotational speed and torque produced [20].

III. RESULTS AND DISCUSSIONS

3.1 Torque as a function of speed

The torque value test in this study was carried out at engine speed = 1000 rpm to 3400 rpm. Figure 2 shows the results of torque value measurements as a function of engine speed for the three octane numbers tested. From this plot, it can be seen that the engine torque increases from speed = 1000 rpm to reach a maximum value at speed = 2400 rpm. The value decreases again until the engine speed = 3400 rpm. In general, the maximum torque at each engine speed is with RON 98, followed by RON 92 and RON 90. Furthermore, it can also be seen that the increase in torque is significant between fuels with RON 90 and 92 at each rotation. However, on the contrary, the increase in torque between fuel with RON 98 and fuel with RON 92 is relatively small.

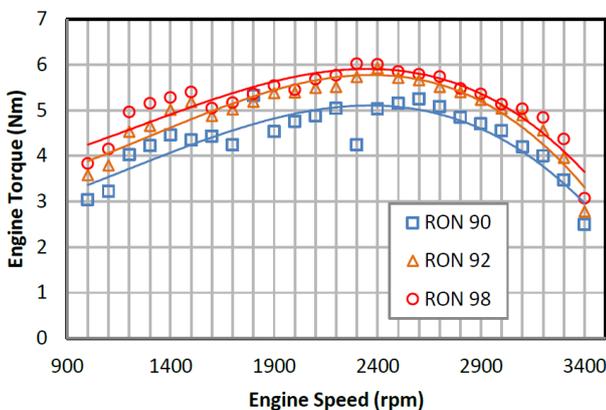


Figure 2: Torque as a function of engine speed (rpm)

3.2 Power as a function of Speed

In this study, engine power was tested at rotation = 1000 rpm to 3400 rpm. The results of engine power testing as a function of rotation are shown in Figure 3. From the plot, it can be found that the engine power characteristic curve shows a relatively high increase in power value from a low rotation of 1000 rpm to a peak power value at an engine rotation of 2900 rpm, then the value decreases again to a peak engine rotation of 3400 rpm. It was again found that the fuel that can produce the highest power value at each rotation is fuel with a RON value of 98, followed by fuel with a RON value of 92

and fuel with a RON value of 90. Furthermore, it can be seen that there is a significant increase in power value between fuel with a RON value of 90 and fuel with a RON value of 92 at each rotation. However, on the contrary, the increase in power between fuel with a RON value of 98 and fuel with a RON value of 92 is relatively small.

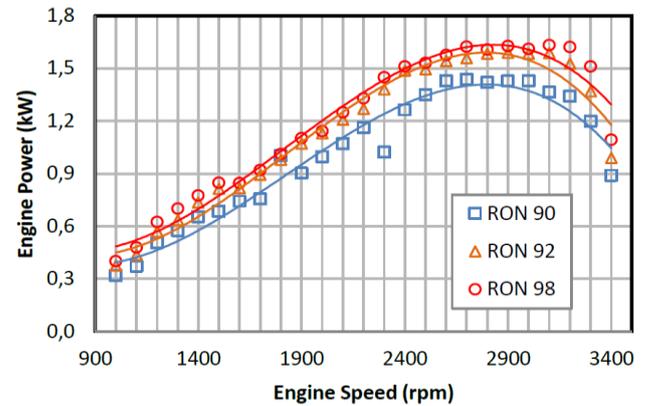


Figure 3: Power as a function of engine speed (rpm)

3.3 Effect of Speed the specific fuel consumption (sfc)

The engine sfc value was tested at engine speed = 1000 - 3400 rpm s. Measurement results of Sfc as a function on the engine speed is plotted in Figure 4. Based on this plot, it shows that the sfc is sloping, with the sfc value decreasing from 1000 rpm to the lowest value between 2200 rpm to 2400 rpm, which then shows an increase back to its peak engine speed at 3400 rpm. Fuel with a RON value of 98 produces the lowest specific fuel consumption value per rotation followed by fuel with a RON value of 92 and fuel with a RON value of 90. At 1000 rpm to 1500 rpm, it was found that the decrease in the specific fuel consumption value of fuel with a RON value of 90 with fuel with a RON value of 92 experienced an insignificant increase, but a significant decrease in the specific fuel consumption value was found when using fuel with a RON value of 98.

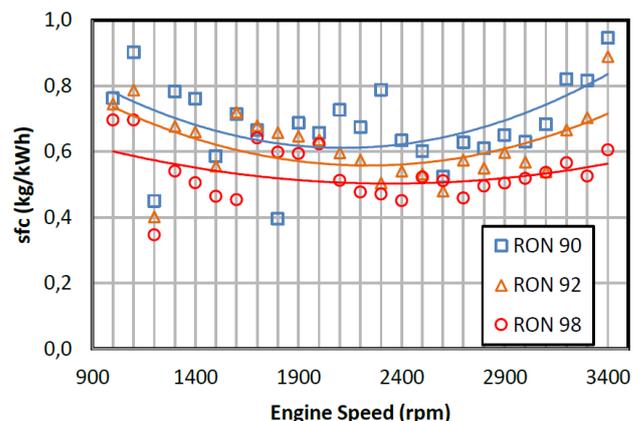


Figure 4: Effects engine speed (rpm) on the sfc

3.4 Effect of Load on specific fuel consumption (sfc)

Effects of the load on the sfc for this study is shown in Figure 5. From this graph, it can be seen that the sfc experienced a significant decrease from a loading of 0.25 Nm to 1.75 Nm, then sloped down to reach the lowest sfc value at a peak loading of 3 Nm. Fuel with a RON value of 98 produced the lowest sfc value, followed by fuel with a RON value of 92 and fuel with a RON value of 90 at each load. At low loads between 0.25 Nm to 1 Nm there was a significant decrease in the specific fuel consumption value between fuel with a RON value of 98 and fuel with a RON value of 92, while the decrease in the specific fuel consumption value between fuel with a RON value of 92 and fuel with a RON value of 90 did not experience a significant decrease in the specific fuel consumption value. At medium to high loads between 1.5 Nm to 3 Nm, the engine's specific fuel consumption value decreases until the difference in specific fuel consumption values between fuel with a RON value of 98, fuel with a RON value of 92 and fuel with a RON value of 90 does not experience a significant difference.

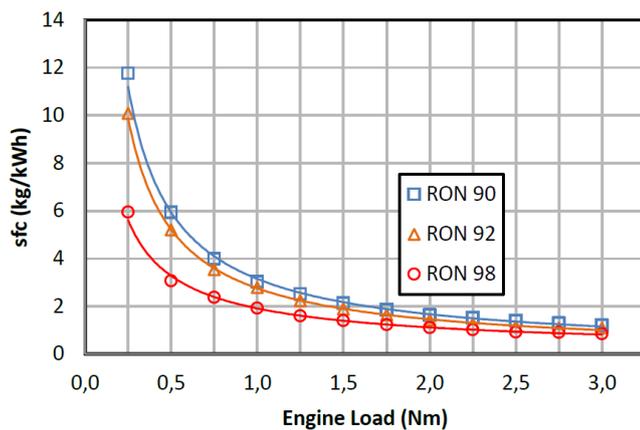


Figure 5: Influences of load on the sfc

IV. CONCLUSION

Based on the analysis of the research that has been done, the following interesting results can be summarized: Torque increases with increasing engine speed and then decreases at high speeds between 2900 rpm and 3400 rpm. The increase in power is relatively steep and reaches its peak at a relatively speed of 2900 rpm and then decreases gradually to 3400 rpm. Specific fuel consumption decreases the sfc value at low speeds of 1000 rpm to 1500 rpm, the lowest sfc value is at 1500 rpm to 2900 rpm and then the value increases again at high speeds, between 2900 rpm and 3400 rpm. Torque and power increase significantly at each rotation. The fuels that produce the highest torque and engine power are RON 98, RON 92 and RON 90. The specific fuel consumption value decreases with each rotation and load, in order the fuels that

can produce the lowest specific fuel consumption value are fuel with a RON 98, fuel with a RON 92 and fuel with a RON 90.

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