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The Effect Of Use Of Roler Size And CVT Spring Variations On Engine Performance

Yuniarto Agus Winoko[1], Aji Irwanda[2]
[1,2] Department of Mechanical Engineering, Malang State Polytechnic
Malang, 65152, Indonesia

*Korespondensi penulis: yuniarto@polinema.ac.id[1], ajiirwanda@gmail.com[2]

Abstract:*The rollers regulate the pulley diameter based on engine speed, and acceleration can be increased by sliding rollers. This research tested torque and fuel consumption (SFC) between sliding rollers and CVT spring variations. The sliding rollers were tested at 10g, 13g and 16g, while the CVT springs were tested at 800 rpm, 1000 rpm and 1500 rpm. The test method uses full throttle opening, with data analyzed using Excel, ANOVA and Minitab. The independent variables are the sliding roller and CVT spring variations, while the fixed variable is 92 Octane fuel. The results of the research are 10g Roller: Highest torque 8.16 Nm at 6000 rpm, lowest 4.09 Nm at 9000 rpm, highest fuel consumption 0, 1256 kg/HP/hour at 9000 rpm, lowest 0.0807 kg/HP/hour at 6500 rpm. Roller 13g: Highest torque 8.77 Nm at 6500 rpm, lowest 4.52 Nm at 9000 rpm, highest fuel consumption 0.1249 kg/HP/hour at 9000 rpm, lowest 0.0804 kg/HP/hour at 5500 rpm . Roller 16g: Highest torque 8.55 Nm at 7500 rpm, lowest 5.40 Nm at 5000 rpm, highest fuel consumption 0.1225 kg/HP/hour at 9000 rpm, lowest 0.0807 kg/HP/hour at 6500 rpm .*

Keywords*: Roller, CVT Spring, Power, Torque, SFC.*

1. INTRODUCTION

Many automatic vehicles use an automatic transmission called Continuously Variable Transmission (CVT) because this system is more efficient than a manual transmission at every vehicle speed. Riders do not need to change the transmission manually, because the engine speed changes automatically, making it suitable for use in urban areas where traffic jams are often encountered. Motorbikes with automatic transmission are very comfortable to use because the transmission shifts smoothly. Apart from that, maintenance is easy, damage detection is fast, and the process of transferring power from the engine to the wheels can be maximized by changing various roller sizes to produce greater pressure on the variator and optimal roller centrifugal force (Fitroh, 2019). The function of the roller in an automatic transmission is to regulate the diameter of the pulley when the engine rotates, thus affecting the mass of the roller. This condition has an impact on the vehicle's ability to accelerate and produce good traction performance. At low speeds, high acceleration capabilities are required (Purwanto, 2019).

A vehicle's traction performance is the ability to accelerate despite obstacles such as rolling resistance, aerodynamic factors, and inclines. Apart from weight, the shape of the roller also affects engine performance, because automatic transmissions (CVT) generally use

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* Yuniarto Agus Winoko, yuniarto@polinema.ac.id

cylindrical rollers (Bagus, 2016). During top rotation, the cylinder roller does not fully rotate so that friction occurs, which causes the roller to wear out quickly and vehicle performance decreases at high speeds. The use of rollers on automatic motorbikes varies in type and size, weight. Changing the size and weight of the roller on an automatic motorbike has two options, namely to increase the initial rotation or top rotation of the engine.

The use of rollers on automatic motorbikes shows variations in type and weight size which can significantly affect engine performance. Rollers are generally used in automatic transmissions (CVT) with a cylindrical shape. When the engine rotates at top speed, the cylinder rollers do not always move fully, producing friction that can affect vehicle performance, especially at high speeds where friction can cause inefficient fuel use and reduced performance. Replacing rollers with different sizes and weights can be done to modify machine performance. For example, using a lighter roller may improve acceleration at early engine speeds, while a heavier roller may be better suited to improving performance at higher engine speeds. This setting allows the driver to optimize the vehicle's traction performance depending on needs and conditions of use, both in urban situations and long-distance travel.

Studypreviously regarding roller diameter was carried out by Fitroh (2019) on the Yamaha Nuovo. This research concluded that at 7000 rpm, the 8 gram roller produces 10.86 Nm of torque, an increase of 9.65% compared to the standard 11 gram roller which produces 8.63 Nm of torque at the same rotation. The highest power is found at 8000 rpm with a roller mass of 8 grams. Another study by AL Ilham et al., (2021) examined the weight of the CVT roller and racing pulley spring on the Yamaha Mio J/GT. The results show that the initial engine has 8.3 HP at 5415 rpm and 14.81 Nm of torque at 3486 rpm. After modification, power increased to 8.4 HP at 4498 rpm and torque increased to 15.08 Nm at 3665 rpm. This shows that changes in power and torque affect vehicle speed.

Research by Suhaeri (2018) examined changes in the type of CVT roller on the acceleration and power of a 115cc motorbike. This research found that the use of a sliding CVT roller weighing 9.5 grams (lighter than standard) produces optimal power of 4.45 HP at 7450 rpm. Meanwhile, the use of a sliding roller weighing 11.5 grams (heavier than standard) produces optimal power of 4.54 HP at 7800 rpm, providing better top speed. Overall, these studies show that the weight and type of CVT roller have a significant influence ontorque, power and vehicle performance at various engine speeds.

2. RESEARCH METHODS

This research was conducted at the Malang State Polytechnic Mechanical Engineering Workshop. The research method used is quantitative using an automatic type single cylinder petrol engine by varying the weight of the sliding roller and variations in CVT springs. This research uses the independent variables of sliding rollers with sizes 10gram, 13gram, 16gram and CVT springs with variations of Standard, 1000, 1500 with the dependent variables being power, torque and specific fuel consumption using the control variable rpm 5000, 5500, 6000, 6500, 7000, 7500 , 8000, 8500, 9000.

Power and torque testing is carried out using a dyno test tool. The vehicle is taken to the dyno test, the tachometer probe is attached to the ignition coil cable, and the engine is warmed up to optimal temperature. After all conditions are normal, data collection begins by opening the gas fully until it reaches the specified engine speed limit, then the data is stopped by pressing the stop button. Specific fuel consumption (SFC) testing uses a fuel pump, pressure bar and burette. The volume of incoming fuel is measured over a certain time with a stopwatch.

3. RESULTS AND DISCUSSION

Engine performance includes power, torque, fuel consumption, average effective pressure, efficiency and exhaust emissions. The discussion here is only power, torque and fuel consumption. The power and torque test results are in the form of tables and graphs.

3.1 Power and torque test results

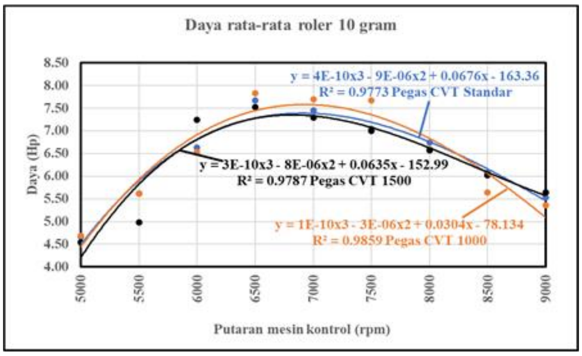

Figure 3.1. The sliding roller testing power is 10 grams

Figure 3.1. H Figure 3.1 shows the relationship of power produced at variations in engine speed from 5000 rpm to 9000 rpm, with a change interval of every 500 rpm. Based on figure 3.1, the standard CVT spring produces a minimum power of 4.66 hp and a maximum power of 7.67 hp. When using the CVT 1000 spring, the minimum power is 4.69 Hp and the maximum power reaches 7.83 Hp, while with the CVT 1500 spring, the minimum power is 4.55 Hp and the maximum power is 7.53 Hp.

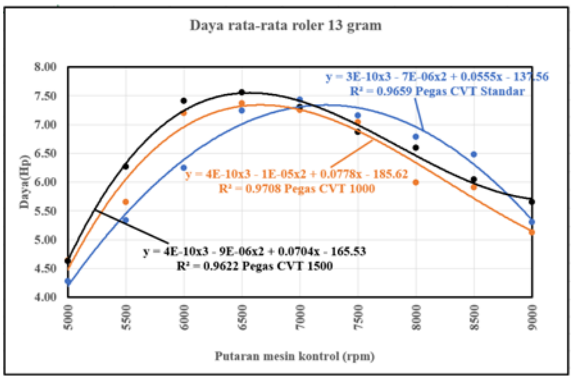

Figure 3.2. The sliding roller testing power is 13 grams

Figure 3.2. Relationship of the power produced at variations in rotation from 5000rpm to 9000rpm, range of rotation changes every 500rpm. Based on Figure 3.2, it appears that the standard CVT spring produces a minimum power of 4.27 HP and a maximum power of 7.43 HP, while the CVT 1000 produces a minimum power of 4.63 HP and a maximum power of 7.36 HP and the CVT 1500 spring produces a minimum power of 4.62 HP and a maximum power of 7.55 HP.

Peak power reaches 7.55 hp at 6500 rpm using CVT 1500 springs. Engine performance reaches maximum because the rollers used match standard sizes, thus providing comfort when used for long distance travel. However, when the engine speed increases, the power value decreases. This decrease is caused by a reduction in the volume of fuel and air when the engine speed increases.

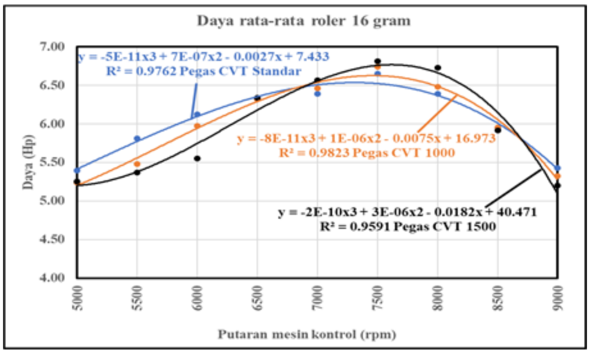

Figure 3.3. The sliding roller testing power is 16 grams

The peak power recorded was 6.81 hp at 7500 rpm using a CVT 1500 spring. However, the power produced did not reach optimal because the rollers used were larger than the standard size, resulting in an increase in the load to press the variator on the roller housing. Figure 3.3 shows the relationship between the power produced at various engine speeds from 5000 rpm to 9000 rpm, with adjustments every 500 rpm. Based on figure 3, the standard CVT spring produces a minimum power of 5.39 hp and a maximum power of 6.65 hp. The use of CVT 1000 springs produces a minimum power of 5.24 Hp and a maximum power of 6.74 Hp, while the CVT 1500 spring achieves a minimum power of 5.25 Hp and a maximum power of 6.81 Hp. This analysis shows that the correct use of CVT rollers and springs can influence engine performance in various engine speed ranges, as well as the importance of choosing components that comply with specifications to achieve maximum performance.

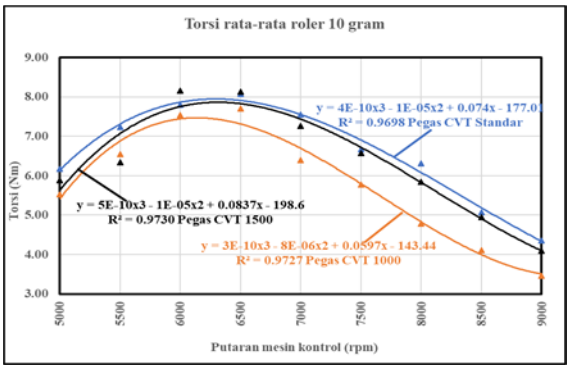

Figure 3.4. The sliding roller testing torque is 10 grams

The relationship between torque produced at variations in engine speed from 5000 rpm to 9000 rpm is analyzed in Figure 3.4, with changes every 500 rpm. Data shows that the standard CVT spring produces a minimum torque of 4.36 hp and a maximum torque of 8.08 hp. The CVT 1000 spring produces a minimum torque of 3.47 Hp and a maximum torque of 7.70 Hp, while the CVT 1500 spring achieves a minimum torque of 4.09 Hp and a maximum torque of 8.16 Hp. The highest torque was recorded at 8.16 Nm at 6000 rpm using a CVT 1500 spring. However, the torque obtained was not optimal due to the use of rollers that were lighter than the standard size, causing an acceleration in pressing the variator on the roller housing and facilitating a faster rise in the v-belt.

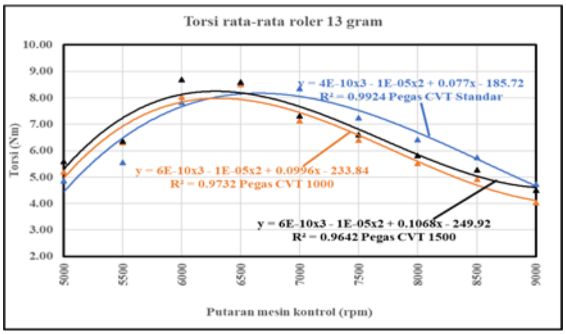

Figure 3.5. The sliding roller testing torque is 13 grams

The highest torque was recorded at 8.70 Nm at 6000 rpm using a CVT 1500 spring. The torque obtained reached optimality because it used rollers with a standard weight size, which resulted in optimal pressure times for the variator on the roller housing. This ensures that engine power is distributed efficiently and optimally.

Figure 3.5 shows the relationship between torque produced at various engine speeds from 5000 rpm to 9000 rpm, with changes every 500 rpm. Data shows that standard CVT springs produce a minimum torque of 4.74 hp and a maximum torque of 8.57 hp. The CVT 1000 spring produces a minimum torque of 4.04 Hp and a maximum torque of 8.50 Hp, while the CVT 1500 spring achieves a minimum torque of 4.52 Hp and a maximum torque of 8.70 Hp. This analysis confirms that selecting CVT rollers and springs that comply with standard specifications can influence engine performance in various engine rotation conditions, as well as the importance of adjusting components to achieve optimal efficiency in using engine power.

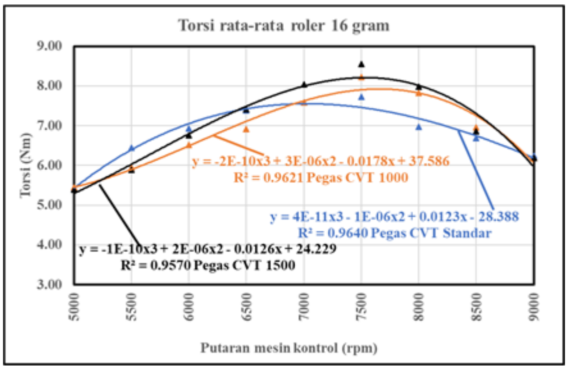

Figure 3.6. The sliding roller testing torque is 16 grams

The highest torque recorded was 8.55 Nm at 7500 rpm engine speed using a CVT 1500 spring. The torque obtained was not optimal because the roller size was too heavy compared to standard, which resulted in pressing the variator on the roller housing for longer and slowing down the rise of the v-belt. Figure 3.6 shows the relationship between torque produced at variations in engine speed from 5000 rpm to 9000 rpm, with a range of rotation changes every 500 rpm. Data from the figure indicates that the standard CVT spring produces a minimum torque of 5.43 Hp and a maximum torque of 7.73 Hp. The CVT 1000 spring produces a minimum torque of 5.45 HP and a maximum torque of 8.23 HP, while the CVT 1500 spring registers a minimum torque of 5.40 HP and a maximum torque of 8.55 HP.

This confirms that the use of CVT rollers and springs that comply with standard specifications is very important to ensure optimal engine performance in producing torque at various engine speeds.

4. RESULTS AND DISCUSION

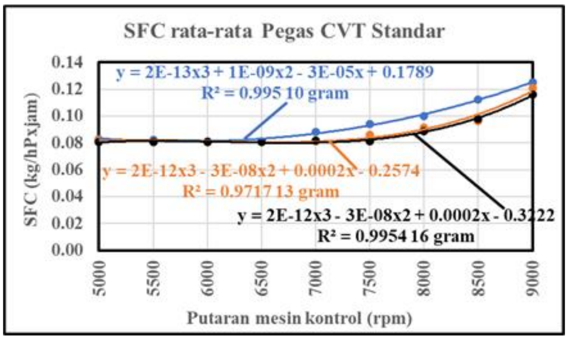

Figure 4.1. Standard CVT spring sfc testing

The highest fuel consumption reaches 0.1252 kg/hPxhour at 9000 rpm using a 10 gram sliding roller and standard CVT spring. The use of a smaller than standard roller accelerates the pressure on the variator in the roller housing, makes it easier to raise the v-belt, but causes engine performance to reach peak point too early. Figure 4.1 displays the Specific Fuel Consumption (SFC) relationship resulting from variations in engine speed from 5000 rpm to 9000 rpm, with changes in rotation every 500 rpm. Based on this figure, a 10 gram sliding roller produces a minimum SFC of 0.0811 kg/hPxhour and a maximum SFC of 0.1252 kg/hPxhour. The 13 gram slide roller recorded a minimum SFC of 0.0806 kg/hPxhour and a maximum SFC of 0.1207 kg/hPxhour, while the 16 gram slide roller achieved a minimum SFC of 0.0807 kg/hPxhour and a maximum SFC of 0.1158 kg/hPxhour. This analysis shows that the choice of different sliding rollers can influence engine fuel consumption, with the 10 gram sliding roller showing a tendency to have higher fuel consumption at high engine speeds compared to other sliding rollers.

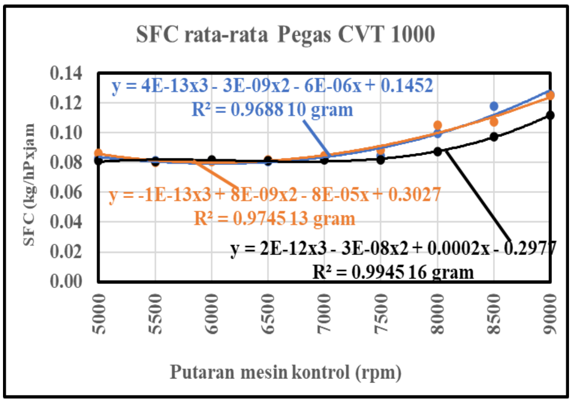

Figure 4.2.CVT 1000 spring sfc testing

The highest fuel consumption reaches 0.1256 kg/hPxhour at 9000 rpm using a 10 gram sliding roller. The use of rollers that are lighter than standard causes faster pressure on the variator in the roller housing and makes it easier to raise the V-belt. This causes the engine to spin faster but requires high fuel consumption. Figure 4.2 shows the relationship between Specific Fuel Consumption (SFC) resulting from variations in engine speed from 5000 rpm to 9000 rpm, with changes in rotation every 500 rpm. Based on this figure, a 10 gram sliding roller produces a minimum SFC of 0.0807 kg/hPxhour and a maximum SFC of 0.1256 kg/hPxhour. The 13 gram slide roller recorded a minimum SFC of 0.0804 kg/hPxhour and a maximum SFC of 0.1249 kg/hPxhour, while the 16 gram slide roller achieved a minimum SFC of 0.0806 kg/hPxhour and a maximum SFC of 0.1120 kg/hPxhour.

This analysis shows that the use of a 10 gram sliding roller, although providing faster engine performance, also contributes to higher fuel consumption at high engine speeds.

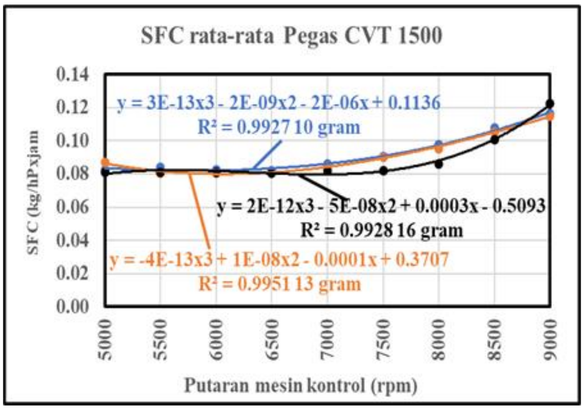

Figure 4.3.CVT 1500 spring sfc testing

The highest fuel consumption is 0.1225 kg/hPxhour at 9000 rpm using a 16 gram sliding roller. The use of rollers that are heavier than standard results in greater pressure on the variator in the roller housing, requiring greater engine power to press it, resulting in higher fuel consumption. Figure 4.3 shows the relationship between Specific Fuel Consumption (SFC) resulting from variations in engine speed from 5000 rpm to 9000 rpm, with changes in rotation every 500 rpm. Based on this figure, a 10 gram sliding roller produces a minimum SFC of 0.0820 kg/hPxhour and a maximum SFC of 0.1165 kg/hPxhour. The 13 gram slide roller recorded a minimum SFC of 0.0802 kg/hPxhour and a maximum SFC of 0.1148 kg/hPxhour, while the 16 gram slide roller achieved a minimum SFC of 0.0807 kg/hPxhour and a maximum SFC of 0.1225 kg/hPxhour. This analysis shows that the use of heavier sliding rollers tends to increase fuel consumption at high engine speeds, as seen with the 16 gram sliding roller recording a higher maximum SFC compared to other sliding rollers.

5. CONCLUSION

The highest power produced is 7.83 hp at 6500 rpm using CVT 1000 springs. The use of rollers that are smaller than standard provides extra comfort in vehicle acceleration. Maximum torque reaches 8.70 Nm at 6000 rpm using CVT 1500 springs. The use of standard heavy rollers ensures that the variator pressing time on the roller housing runs optimally, so that engine power is distributed with maximum efficiency. The highest fuel consumption is 0.1256 kg/hPxhour at 9000 rpm with a sliding roller weighing 10 grams. Selection of rollers below this standard size accelerates the variator's pressure on the roller housing, increasing engine performance with higher rotation speeds, but also causes higher fuel consumption.

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