

Platinum Spark Plug Gap Adjustment to Fuel Consumption and CO Emission at 110cc Engine

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ABSTRACT

One of energy conversion machine is four-stroke engine, that divided into two gasoline engine type and Diesel engine type. In a gasoline engine, the ignition system needs a spark plug. In this research, the researcher used a regular spark plug and platinum spark plug. The regular spark plug is a spark plug that has a heat range which is recommended by factories, and its tip is made from nickel. A platinum spark plug is a spark plug that has a platinum tip at the center electrode. Technically, platinum spark plug specification is over-engineered from a regular spark plug. This research has a purpose to gain data and analyzing the impact of platinum spark plug gap on fuel consumption and exhaust emission at Suzuki Smash 110cc motorcycle. A spark plug gap is needed in order to spark plug can fire up to combust gas mixture in the cylinder. This research method used one-shot experiment design. Variables in this research are spark plug electrode gap, RON 90 and RON 88 gasoline, engine RPM variation, and exhaust gas emission. Data analysis used descriptive analysis that presenting graphics to do the interpretation. The result of this research are: (1) The platinum spark plug and RON 90 fuel can reduce fuel consumption to 5% average, and the optimum gap, around 0,7 – 0,9 mm; (2) Platinum spark plug electrode gap around 0,4 – 1 mm resulting less emission compared to regular spark plug C7HSA at all gap variations. Using platinum spark plug and RON 90 fuel can reduce emission by 7% on average.

Keywords: *Platinum, Fuel Consumption, Exhaust Gas Emission*

1. INTRODUCTION

One of energy conversion machine is four-stroke engine. Four-stroke engine can be divided into two categories, gasoline and diesel engine. In diesel engine, mixed gas combustion is occurred because of the piston's high compression, while, in gasoline engine, mixed gas combustion is occurred because of a fire spark that ignited by a spark plug. Gasoline engine divided into two categories, EFI and carburetor systems.

The spark plug is one of the important components of gasoline engine, because without the spark plug, the combustion process will never happen. Nowadays, in the marketplace, there are three common types of spark plug i.e regular spark plug, platinum spark plug, and iridium spark plug. These three types of spark plug have different workability, because the electrode material of that spark plugs is different.

The platinum spark plug is a spark plug with a platinum material at the tip and has more toughness than a regular spark plug. The platinum spark plug can operate at high load and temperature, it has melting point at 1770° C and it can reducing vehicle emission[1]. The advantage of a platinum spark plug can avoid disturbance

of electrical systems, anti-corrosion metal layer, and platinum tip reducing the ignition voltage, so it can make the engine idle better, cleaner and more efficiently[2].

The spark plug works with way igniting the spark. This spark emitted from high voltage electrical energy across trough electrode gap. This electrode gap can be adjusted, based on the weariness on the electrode tip. If the spark plug has a wide electrode gap, so it needs more voltage[3]. If the spark plug has a narrow electrode gap, so it needs voltages, and if no gap, the spark fire will not be emitted.

In the combustion moment, the engine resulting in Carbon monoxide (CO). Carbon monoxide gas is a gaseous compound that has no odor, no taste, and is colorless[4]. This gas is combined from oxygen and carbon. Generally, carbon monoxide gas is produced from incomplete combustion, such as in an internal combustion engine. These imperfection combustions can be caused by a less than ideal gas mixture, or a very short time combustion process[5].

The last research, has been done to reveal the impact spark plug electrode gap variation on vehicle emission, and exhaust gas emission and fuel consumption, but that

research only measured regular spark plug operating ability. The next research, focusing on comparison every electrode gap (regular, platinum, and iridium) spark plug to HC and CO emission. This research focusing to spark plug gap electrode setting based on the advantage of platinum spark plug and the impact of fuel consumption and exhaust gas emission at four-stroke engine Suzuki Smash 110cc.

2. OBJECTIVES

The objectives of this research explained as follows:

1. To reveal the impact of platinum spark plug electrode gap variation to fuel consumption at Suzuki Smash 110cc motorcycle compared to a regular spark plug.
2. To reveal the impact of platinum spark plug electrode gap variation to exhaust gas emission at Suzuki Smash 110cc motorcycle compared to a regular spark plug

3. METHODOLOGY

This research used an experimental design with one-shot case study approach. This approach can be described as shown in fig. 1:



Figure 1 One-Shot Case Study Design

Where:

- X : Treatment
- O : Observation (measurement)

Variables in this research contain an independent variable, control variable, and dependent variable.

Independent variable:

1. Spark plug gap (X1). Spark plug gap variation range: 0.4mm, 0.5mm, 0.6mm, 0.7mm, 0.8mm, 0.9mm, and 1mm.

Moderator variable

1. Engine RPM (X2). Engine RPM variation range: 2000RPM, 2500RPM, 3000RPM, 3500RPM, 4000RPM. This variable has been categorized as moderator variable, because every engine rotation will be affected to fuel consumption, and resulted in emission.

Control variable

1. Fuel type

The fuel used in this research only using RON88 and RON90 gasoline. This research not used mixed fuel type.

2. Measured time

Measured time has conditioned in every 5 minutes.

Dependent variable:

1. Fuel consumption (Y1) in ml/minutes
2. Exhaust gas emission for every fuel type (Y2). This research only measuring CO (carbon monoxide).

The connection between each variable in this research can be shown in figure 2:

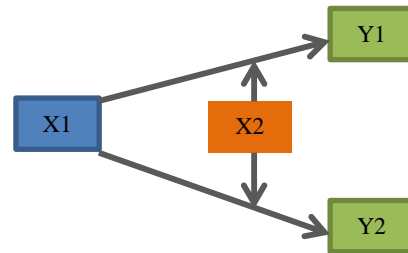


Figure 2 Variables connection

4. RESULT

After collecting data, the result can be shown in table 1 to table 5 as shown:

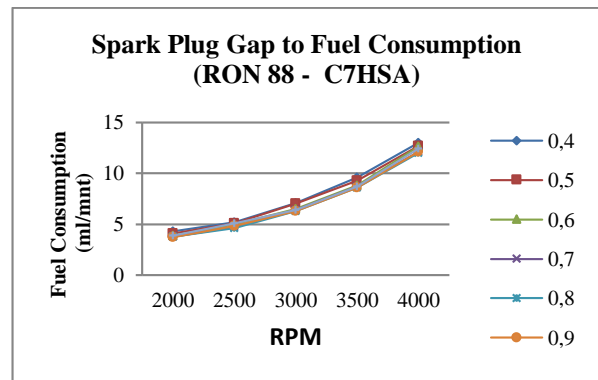


Figure 3 Spark Plug Gap to Fuel Consumption (RON 88 – C7HSA)

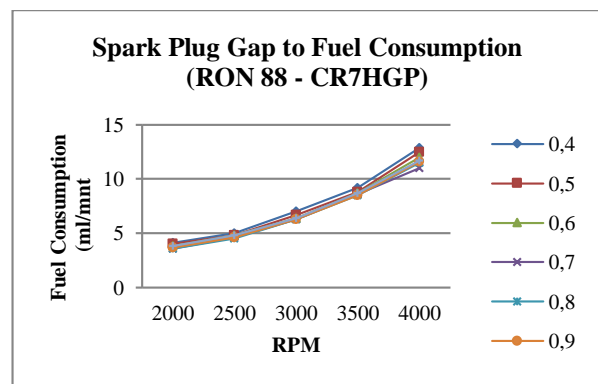


Figure 4 Spark Plug Gap to Fuel Consumption (RON 88 – CR7HGP)

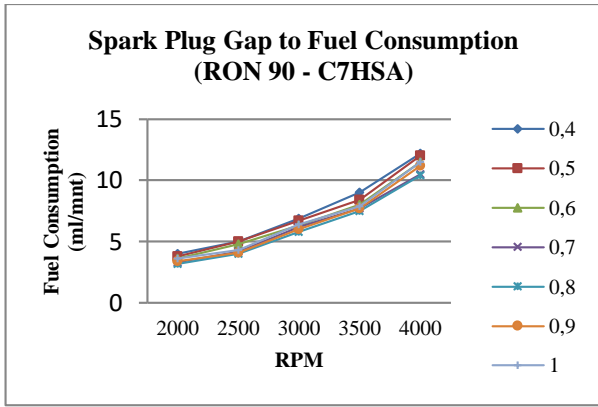


Figure 5 Spark Plug Gap to Fuel Consumption (RON 90 – C7HSA)

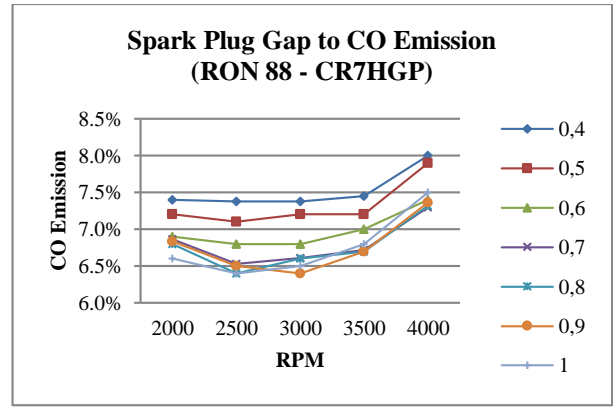


Figure 8 Spark Plug Gap to CO Emission (RON 88 – CR7HGP)

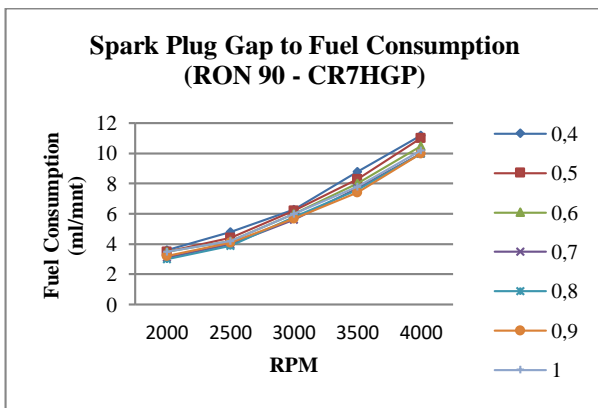


Figure 6 Spark Plug Gap to Fuel Consumption (RON 90 – CR7HGP)

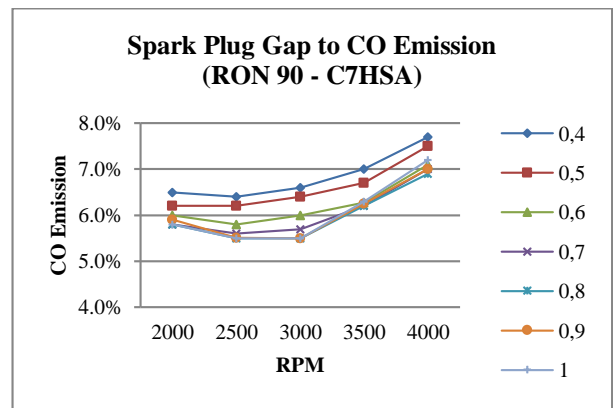


Figure 9 Spark Plug Gap to CO Emission (RON 90– C7HSA)

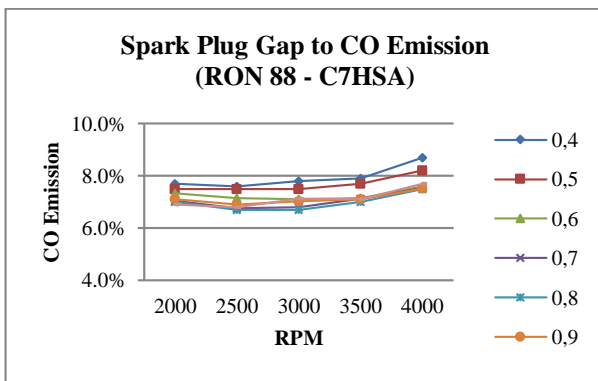


Figure 7 Spark Plug Gap to CO Emission (RON 88 – C7HSA)

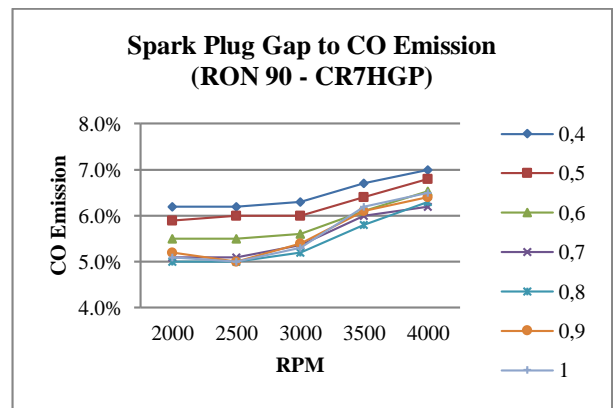


Figure 10 Spark Plug Gap to CO Emission (RON 90– CR7HGP)

5. DISCUSSION

According to Figure 3 to 6 shows that fuel consumption not significantly different, for regular spark plug as well as a platinum spark plug. However, fuel consumption when using platinum spark plug CR7HGP is lower in every RPM and spark plug gap, than regular spark plug C7HSA. At the gaining data process, the motorcycle in steady condition, without carrying any load.

RON 88 gasoline fuel type, is one of gasoline type that has octane number 88 (RON 88). Comparing with RON 90 gasoline, CO emission that result from RON 88 gasoline in every spark plug gap variation is relatively higher than CO emission result from RON 90 gasoline. That because the fuel which has a high octane number, has tended to avoid detonation[6]. The fuel which has high octane number will be combusted perfectly, so the CO emission exhaust gas is lower than RON 88 gasoline type, for the same electrode gap variation.

The narrow spark plug electrode gap (0,4 mm), producing the highest CO emission gas, for regular spark plug C7HSA at 8% (80000 ppm), RON 88 gasoline with platinum spark plug CR7HGP at 7,4% (74000 ppm), RON 90 gasoline with regular spark plug C7HSA at 7,5% (75000 ppm) and RON 90 gasoline with platinum spark plug at 6,2% (62000 ppm) at 2000 RPM. This happened because the fire that occurred by a spark plug, tend to smaller at the narrow spark plug electrode gap, than the wider electrode gap, so the CO emission is high. Although using a platinum spark plug and RON 90 gasoline fuel type. The other impact for the narrow spark plug electrode gap is causing high engine temperature.

At the narrow spark plug gap, for example, 0.4mm. This causing more fuel consumption at every RPM. At 2500 RPM, fuel consumption 5.2 ml/mnt (RON 88 gasoline-C7HSA), 5 ml/mnt (RON 88 gasoline-CR7HGP), 5ml/mnt (RON 90 gasoline-C7HSA), 4.8 ml/mnt (RON 90 gasoline-CR7HGP). This occurred because Suzuki Smash 110cc still using conventional fuel system. The fuel intake system, still using a carburetor, where the throttle valve, is opened manually by hand. This is very different from the electronic fuel injection system (EFI).

The widest spark plug gap, in this research set to 1mm, will result less emission than the narrow spark plug gap, but relatively higher than the spark plug gap of 0.8mm at every RPM. This occurred because with a wide spark plug gap, the spark becoming larger, but it can increase the temperature higher, also combustion speed acceleration and pressure in the cylinder[7]. Wide spark plug electrode gap can cause misfire, if not supported with strong firing system, so it can reducing engine power, and more emission[8]. At spark plug gap 1mm, fuel consumption become higher, although at certain RPM, it less emission than the narrow gap. This occurred because at a wide gap, there is any risk of causing misfire, although the spark is larger than the narrow gap.

Based on data gaining, the most optimum spark plug electrode gap to producing fuel efficiency and reducing exhaust gas emission, for low, middle, and high RPM at 0.7 - 0.9 mm. The combustion instability at high RPM occurs because this motorcycle still using a regular firing system, so it needs an upgrade (for example, using a racing coil) so it can resolve the instability combustion at high RPM, for wide spark plug electrode gap adjustment.

There is another factor that affecting fuel consumption and exhaust gas emission, beside spark plug gap, such as: (1) driving/riding habitual, (2) intake and exhaust valve adjustment, (3) vehicle load, (4) road conditions, (5) fuel system, using a carburetor, or electrical fuel injection, (6) exhaust line of motorcycle, (7) engine conditions, (8) power train type, such as manual, CVT, or semi-automatic, (9) exhaust system, such as catalytic converter.

However, at the daily use, the rider open and close the throttle in variative time and depend on riding aggressivity, carrying various load and road route. If the rider needs fuel economy, the rider must be riding very smooth and avoiding traffic road. The rider always inspects and check the spark plug regularly, managing oil condition, tires, and other components to gain more fuel efficiency and low emission.

6. CONCLUSION

The conclusion of this research can be explained:

- 1) There is an impact of platinum spark plug electrode gap variation to fuel consumption of Suzuki Smash 110cc. The usage of a platinum spark plug can make less fuel consumption. The optimum gap between 0.7 to 0.9 mm. At 0.4, 0.5, 0.6, and 1mm made more fuel consumption. Using platinum spark plug and RON 90 fuel can reduce fuel consumption to 5% on average.
- 2) There is an impact of platinum spark plug electrode gap to exhaust gas emission of Suzuki Smash 110cc. Platinum spark plug electrode gap between 0.4 to 1mm producing less emission than regular spark plug C7HSA. Platinum spark plug producing the lowest emission at 2000 to 3000 RPM, at 5.1%, 5% and 5.3% but unstable at 3500 RPM to 4000 RPM. Using platinum spark plug and RON 90 fuel can reduce the emission to 7% on average.

7. RECOMMENDATION

Recommendation from this research:

- 1) Need to do a riding test to gain the data comprehensively between platinum spark plug electrode gap adjustment to fuel consumption. This may get a different result than a lab test.
- 2) Better to do a test with a different motorcycle.
- 3) Need to measure the other compositions of exhaust gas as an impact of platinum spark plug electrode gap adjustment.

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