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Analysis of O_2 Sensor Troubleshooting on Exhaust Gas Emissions and Fuel Consumption at Piksi Ganesha Indonesia Polytechnic

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Abstract

This research aims to analyze O2 sensor troubleshooting on exhaust emissions and fuel consumption. The research method is comparative. Research steps by analyzing exhaust emissions and fuel consumption without an O2 sensor and with an O2 sensor at idle, 1000, 1500, and 2000 rpm. Research results: 1. comparison of exhaust emissions without O2 sensor and with O2 sensor, namely: idle rotation, CO = 7.41>3.33%, HC = 489 <497%, CO2 = 9.7 <12.5%, O2 = 13.44>0%, 1000 rpm, CO = 7.35>1.52%, HC = 686>538 ppm, CO2 = 9.7>11.8%, O2 = 10.91>2.20%, 1500 rpm, CO= 5.43>1.32%, HC= 666>472 ppm, CO2= 6.7>12.4%, O2= 13.25>4.95%, 2000 rpm, CO= 7.10>0.37%, HC= 499>272 ppm, CO2= 10.1<13.0%, O2= 11.24>9.03. 2. comparison of fuel consumption without o2 sensor and with o2 sensor, namely: idle rotation: 35=35ml, 1000 rpm: 15=15ml, 1500 rpm: 25>15ml, 2000 rpm: 15=15ml.

Keywords*:* Analysis, Troubleshooting, O2 Sensor

Abstrak

Penelitian ini bertujuan untuk menganalisis troubleshooting O2 sensor pada emisi gas buang dan konsumsi bahan bakar. Metode penelitian adalah komparatif. Langkah penelitian dengan cara menganalisis emisi gas buang dan konsumsi bahan bakar tanpa O2 sensor dan dengan O2 sensor pada putaran idle,1000,1500,2000 rpm. Hasil penelitian : 1. perbandingan emisi gas buang tanpa O2 sensor dan dengan O2 sensor yaitu : putaran idle, CO= 7,41>3,33%, HC= 489<497%, CO2= 9,7<12,5%, O2= 13,44>0%, 1000 rpm, CO= 7,35>1,52%, HC= 686>538 ppm, CO2= 9,7>11,8%, O2= 10,91>2,20%, 1500 rpm, CO= 5,43>1,32%, HC= 666>472 ppm, CO2= 6,7>12,4%, O2= 13,25>4,95%, 2000 rpm, CO= 7,10>0,37%, HC= 499>272 ppm, CO2= 10,1<13,0%, O2= 11,24>9,03. 2. perbandingan konsumsi bahan bakar tanpa o2 sensor dan dengan o2 sensor yaitu : putaran idle : 35=35ml, 1000 rpm : 15=15ml, 1500 rpm : 25>15ml, 2000 rpm : 15=15ml.

Kata-kata kunci*: Analisis, Troubleshooting, O2 Sensor*

1. Introduction

Automotive is a science that studies various types of motorized transportation, especially cars and motorbikes [1]. Technological developments in the automotive sector have three priorities, namely, safety, comfort and environmental friendliness [2]. Maintained sensor components will also maintain comfort and safety when driving. The good condition of the O2 sensor on the vehicle will control the exhaust gas emitted by the car so that the emissions produced are environmentally friendly [3]. To obtain exhaust gas emissions that are ecologically friendly, a mixture ratio that is ideal or close to ideal is needed in all operational conditions of the car [4].

Maintenance of engine components must be paid attention to in order to ensure the safety and comfort of drivers [5]. Damage that occurs can cause the vehicle to become uncomfortable when used [6]. Damage to the injector can affect the level of exhaust emissions and fuel consumption because the injector has an important role in regulating the amount of fuel that will be sprayed [7]. The infusion of energy ejected by the injector greatly influences the efficiency and emissions of the car. If the mixture of air and fuel is ideal, then combustion in the combustion chamber can occur perfectly, resulting in more optimal engine performance [8].

Intake manifold damage can affect the level of fuel usage and the level of exhaust emissions [9]. The intake manifold has an important role in creating a perfect mixture of air and fuel so that vehicles with a good intake manifold can reduce the level of fuel use and exhaust emissions [10]. A leaking exhaust can cause higher fuel consumption and can cause the resulting exhaust gas emissions to be unfriendly to the environment [11]. A good exhaust can reduce the level of fuel usage and reduce the levels of exhaust emissions released [12].

When the exhaust leaks, the fuel used becomes wasteful, and the resulting exhaust emissions become unfriendly to the environment [13]. Damage to O2 also greatly affects the level of fuel use and the level of exhaust emissions that will be produced. If O2 is damaged, then the emission levels produced by the vehicle cannot be controlled properly so that it can harm the environment [14]. Drivers very rarely notice O2 damage, so when this sensor is damaged, the driver will think that the damage will not affect engine combustion and exhaust emissions in the car.

2. Method

This research uses a comparative method. Comparative research is research that focuses on a group of research subjects and then continues by paying attention to the variables to be studied in the group being compared [15]. The comparative method flow is presented in Figure 1.

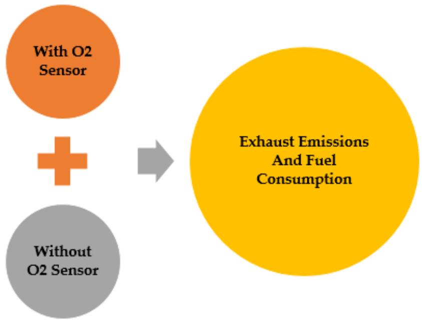

Figure 1. Comparative Method Flow

The tools and materials used include a scanner, gas analyzer, measuring cup, fuel pump, screwdriver +-, pliers, and gloves. The materials used include O2 sensors, petrol, petrol hoses and cables.

3. Results and Discussion

3.1 Results of Analysis of Exhaust Gas Emission Content in 2011 Xenia Xi Cars Without Oxygen Sensors

Table 1. Exhaust Gas Emission Analysis Results Without Oxygen Sensor

rpm	Temperature (°C)	Emission			
		CO (%)	HC (ppm)	CO_2 (%)	O_2 (%)
Idle	> 80 °C	7.41	489	9.7	13.44
1000 rpm	> 80 °C	7.35	686	9.7	10.91
1500 rpm	> 80 °C	5.43	666	6.7	13.25
2000 rpm	> 80 °C	7.10	499	10.1	11.24

Based on Table 1, the results of CO exhaust gas emission analysis without an oxygen sensor are as follows: in the idle position, the CO yield reaches 7.41%, the HC yield reaches 489 ppm, the CO2 yield reaches 9.7%, the O2 yield reaches 13.44%. At 1000 rpm, the CO yield reaches 7.35%, the HC yield reaches 686 ppm, the CO2 yield reaches 9.7%, and the O2 yield reaches 10.91%. At 1500 rpm, the CO yield reaches 5.43%, the HC yield reaches 666 ppm, the CO2 yield reaches 6.7%, and the O2 yield reaches 13.25%. At 2000 rpm, the CO yield reaches 7.10%, the HC yield reaches 499 ppm, the CO2 yield reaches 10.1%, and the O2 yield reaches 11.24%.

CO results increase and decrease at each rpm. The increase and decrease in CO exhaust emissions are presented in **Figure 2**.

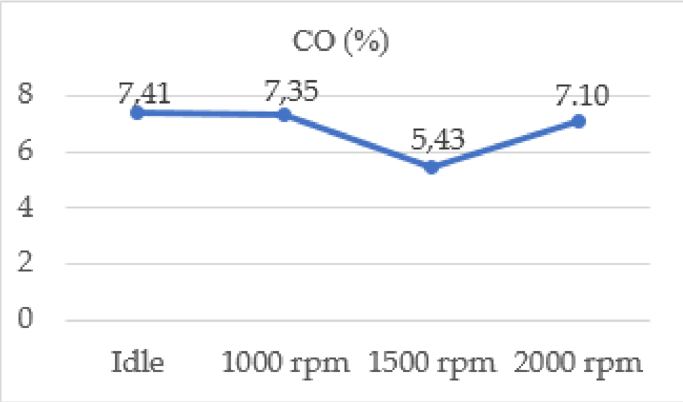

Figure 2. CO Result

When the car engine is in the idle position, the CO output reaches 7.41%. At 1000 rpm, the CO yield reaches 7.35%, so the CO produced at 1000 rpm decreases by 0.6%. At 1500 rpm, the CO yield reached 5.43%, so that the CO produced at 1500 rpm again decreased by 1.92%. At 2000 rpm, the CO yield reached 7.10%, so the CO produced at 2000 rpm increased by 1.67%.

HC (ppm) results without an oxygen sensor increased and decreased. The increase and decrease in HC (ppm) without an oxygen sensor are presented in **Figure 3**.

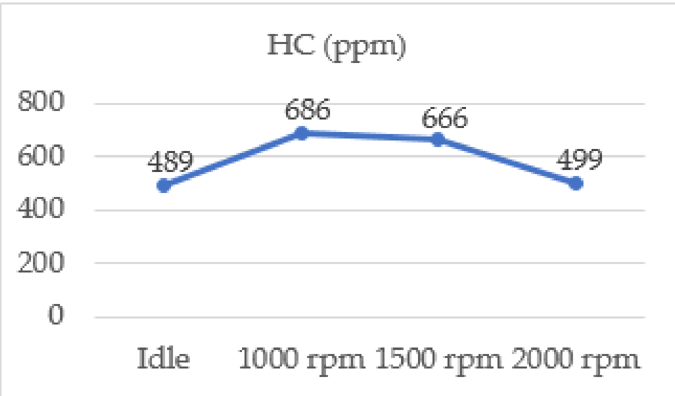

Figure 3. HC Result

In the idle position, the HC results reach 489 ppm. At 1000 rpm, the HC result reaches 686 ppm, so the HC produced at 1000 rpm increases by 197 ppm. At 1500 rpm, the HC result reached 666 ppm, so the HC produced at 1500 rpm decreased by 20 ppm. At 2000 rpm, the HC result reached 499 ppm, so the HC produced at 2000 rpm also decreased by 167 ppm. CO2 results without an oxygen sensor increased and decreased. The increase and decrease in CO2 without an oxygen sensor are presented in **Figure 4.**

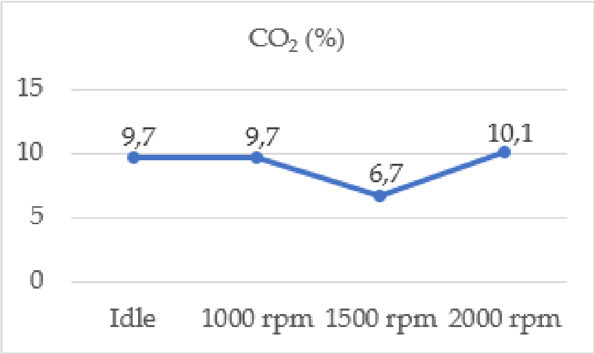

Figure 4. CO_2 Result

In the idle position, the CO2 results reach 9.7%. At 1000 rpm, the CO2 results are similar to the results in the idle position, namely 9.7%. At 1500 rpm, the CO2 yield reaches 6.7%, so the CO2 produced at 1500 rpm decreases by 3.0%. At 2000 rpm, the CO2 yield reaches 10.1%, so the CO2 produced at 2000 rpm increases by 3.4%.

Based on Table 1, CO2 results without an oxygen sensor increased and decreased. The increase and decrease in O2 without an oxygen sensor are presented in **Figure 5**.

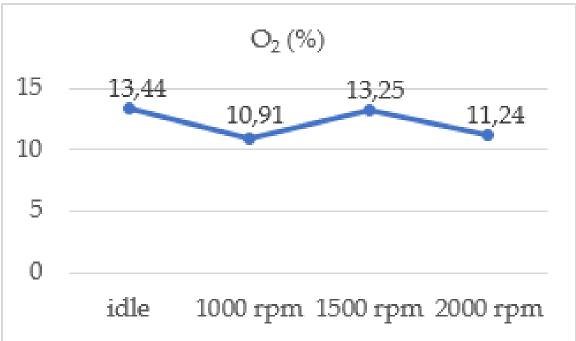

Figure 5. O_2 Result

In the idle position, the O2 results reach 13.44%. At 1000 rpm, the O2 yield reached 10.91%, so that the O2 produced at 1000 rpm decreased by 2.53%. At 1500 rpm, the O2 yield reaches 13.25%, so the O2 produced at 1500 rpm increases by 2.34%. At 2000 rpm, the O2 yield reached 11.24%, so the O2 produced at 2000 rpm again decreased by 2.01%.

3.2 Results of Analysis of Exhaust Gas Emission Content in 2011 Xenia Xi Cars with Oxygen Sensors

Results of exhaust gas emission analysis with oxygen sensor is **Table 2**.

Table 2. Results of Exhaust Gas Emission Analysis with Oxygen Sensor

Rpm	Temperature (°C)	Emission			
		CO (%)	HC (ppm)	CO_2 (%)	O_2 (%)
Idle	> 80 (°C)	3.33	497	12.5	0.00
1000 rpm	> 80 (°C)	1.52	538	11.8	2.20
1500 rpm	> 80 (°C)	1.32	472	12.4	4.95
2000 rpm	> 80 (°C)	0.37	272	13.0	9.03

Based on Table 2, the results of exhaust gas emission analysis using an oxygen sensor are as follows: idle position CO results reach 3.33%, HC results reach 497 ppm, CO2 results reach 12.5%, and O2 results reach 0.00%. At 1000 rpm, the CO yield reaches 1.52%, the HC yield reaches 538 ppm, the CO2 yield reaches 11.8%, and the O2 yield reaches 2.20%. At 1500 rpm, the CO yield reaches 1.32%, the HC yield reaches 472 ppm, the CO2 yield reaches 12.4%, and the O2 yield reaches 4.95%. At 2000 rpm, the CO yield reaches 0.37%, the HC yield reaches 272 ppm, the CO2 yield reaches 13.0%, and the O2 yield reaches 9.03%.

CO results in exhaust gas emission analysis using an oxygen sensor have increased and decreased. The increases and decreases are presented in Figure 6.

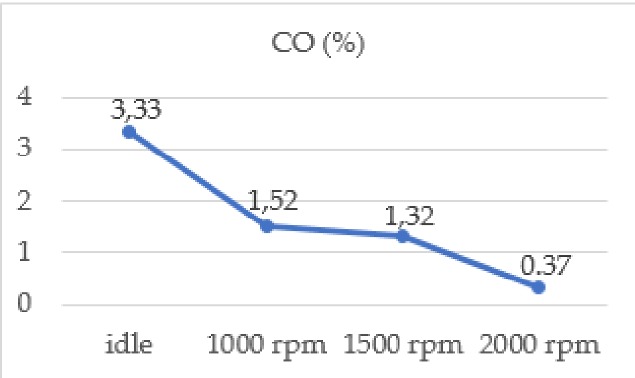

Figure 6. The CO % Result

In the idle position, the CO result reaches 3.33%. At 1000 rpm, the CO yield reaches 1.52%, so the CO produced at 1000 rpm decreases by 1.81%. At 1500 rpm, the CO yield reaches 1.32%, so the CO produced at 1500 rpm decreases by 0.20%. At 2000 rpm, the CO yield reached 0.37%, so that the CO produced at 2000 rpm was again reduced by 0.37%.

Based on Table 2, the HC results in exhaust gas emission analysis using oxygen sensors, which have increased and decreased. The increases and decreases are presented in Figure 7.

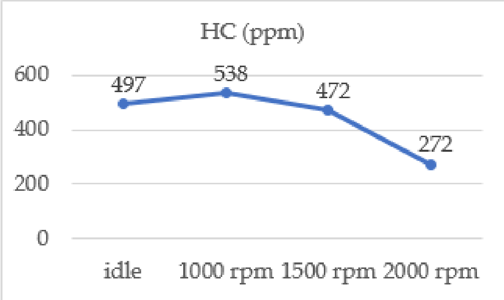

Figure 7. HC Result

In the idle position, the HC results reach 497 ppm. At 1000 rpm, the HC result reaches 538 ppm, so the HC produced at 1000 rpm increases by 41 ppm. At 1500 rpm, the HC result reached 472 ppm, so the HC produced at 1500 rpm decreased by 66 ppm. At 2000 rpm, the HC result reached 272 ppm, so the HC produced at 2000 rpm again decreased by 200 ppm.

The CO_2 results in exhaust gas emission analysis using an oxygen sensor, which has increased and decreased. The increases and decreases are presented in **Figure 8**.

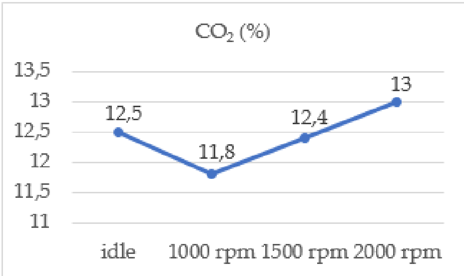

Figure 8. CO_2 Result

In the idle position, the CO2 results reach 12.5%. At 1000 rpm, the CO2 yield reaches 11.8%, so the CO2 produced at 1000 rpm decreases by 0.7%. At 1500 rpm, the CO2 yield reaches 12.4%, so the CO2 produced at 1500 rpm increases by 0.6%. At 2000 rpm, the CO2 yield reaches 13.0%, so the CO2 produced at 2000 rpm increases by 0.6%.

CO% results in exhaust gas emission analysis using oxygen sensors have increased and decreased. The increases and decreases are presented in **Figure 9.**

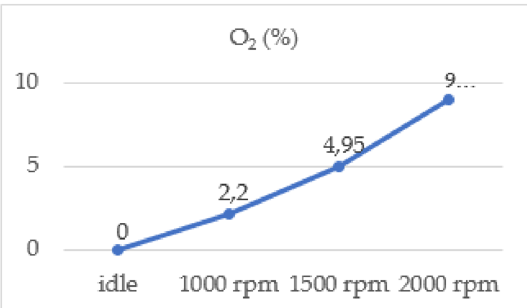

Figure 9. O_2 Result

In the idle position, the O2 result reaches 0.00%. At 1000 rpm, the O2 yield reaches 2.20%, so the O2 produced at 1000 rpm increases by 2.20%. At 1500 rpm, the O2 yield reaches 4.95%, so the O2 produced at 1500 rpm increases by 2.75%. At 2000 rpm, the O2 yield reached 9.03%, so that the O2 made at 2000 rpm increased by 4.08%.

3.3 Results of analysis of fuel consumption in the 2011 Xenia Xi car without an oxygen sensor

Table 3. Fuel Consumption Analysis Results Without Oxygen Sensor

rpm	Temperature (°C)	Times	Test Result
idle	> 80 (°C)	1 minute	35 ml
1000 rpm	> 80 (°C)	1 minute	15 ml
1500 rpm	> 80 (°C)	1 minute	25ml
2000 rpm	> 80 (°C)	1 minute	15 ml

Based on Table 3, the results of fuel consumption analysis without an oxygen sensor are as follows: in the idle position, the fuel consumption results obtained after testing for 1 minute are 35ml; at 1000 rpm, the fuel consumption results obtained after testing for 1 minute are 15ml; at 1500 rpm The fuel consumption results obtained after trying for 1 minute were 25ml, and at 2000 rpm the root material consumption results obtained after trying for 1 minute were 15ml.

The results of the analysis of fuel consumption without an oxygen sensor for 1 minute can be concluded that when the car engine is in the idle position, the resulting fuel consumption is 35ml. At 1000 rpm, fuel consumption decreases by 20ml, so the result obtained is 15ml. At 1500 rpm, fuel consumption increases by 10ml, so the result obtained is 25ml. At 2000 rpm, fuel consumption decreases by 10ml, so the result obtained is 15ml.

3.4 Hasil Results of Analysis Of Fuel Consumption In 2011 Xenia Cars With Oxygen Sensors

Fuel analysis results with oxygen sensor is presented in **Table 4.**

Table 4. Fuel Analysis Results with Oxygen Sensor

rpm	Temperature (°C)	Times	Test Result
Idle	> 80 (°C)	1 minute	35 ml
1000 rpm	> 80 (°C)	1 minute	15 ml
1500 rpm	> 80 (°C)	1 minute	15 ml
2000 rpm	> 80 (°C)	1 minute	15 ml

Based on **Table 4**, the results of fuel analysis with the oxygen sensor are as follows: at idle, the fuel consumption results obtained after testing for 1 minute are 35ml; at 1000 rpm, the fuel consumption results obtained after trying for 1 minute are 15ml; at rpm 1500 fuel consumption results obtained after trying for 1 minute are 15ml, and at 2000 rpm the fuel consumption results obtained after trying for 1 minute are 15ml.

The results of the fuel consumption analysis with the oxygen sensor can be concluded that when the car engine is in the idle position, the fuel consumption results are 35ml; at 1000 rpm, the fuel consumption results are 15ml; at 1500 rpm, the fuel consumption results are 15ml, so the results are the same as the results at 1000 prompt 2000 rpm the fuel consumption results are 15ml, so material consumption is still the same as the results at 1000 and 1500 rpm.

4. Conclusion

Based on the results of exhaust emissions testing, the highest oxygen exhaust emissions without using oxygen sensors at 1000 rpm and the lowest at 1500 rpm. While exhaust emissions using oxygen sensors are highest at 1000 rpm and lowest at 2000 rpm. The results of fuel consumption analysis when using oxygen sensors and without using oxygen sensors have no effect.

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