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Effects of fuel additive quantity on fuel consumption and CO emissions of a 1.6L gasoline engine fueled with RON97

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ABSTRACT – One of the methods to improve the combustion behavior for internal combustion engines is by introducing fuel additives. However, some additives resulted in higher Brake Specific Fuel Consumption (BSFC) and higher emission of carbon monoxide (CO). The objective of this study is to investigate the effects of fuel additives quantity to the fuel consumption and engine emissions. The tests were carried out at different engine speeds (1500rpm-3000rpm) and constant engine loads of 60Nm by using a 1.6L multi-cylinder four stroke gasoline engine. The additive was blended with gasoline (RON97) in composition of 5, 10 and 15 ml per liter of RON97 accordingly. BSFC and engine emissions were measured using Pro V2 software and MRU AIR gas analyzer respectively. Results showed that gasoline blended with 5ml additive lead to a significant improvement on (BSFC) and lower carbon monoxide (CO) emissions. However, RON97 blended with 10ml/l and 15ml/l additive showed increasing in BSFC compared with 5 ml of additive.

1. INTRODUCTION

With the rapid growth of the automobile industry, there are major concerns involving on the depleting of fossil fuels due to its higher demand in terms of the usages and concerns on reducing vehicle emissions which harmful to health and raise environmental concerns [1-3]. In addition, increasing global concerns especially on greenhouse effect has generate much interest in the green fuel technology and fuel additives that both of them are possible to improve engine performance and emissions simultaneously.

Fuel additive is a compound formulates to enhance the quality of the fuels used in vehicles. The main purpose is to improve the combustion behavior. Types of additives include metal deactivators, corrosion inhibitors, oxygenates and antioxidants [1]. There are several types of fuel additives were formulated with different chemical composition, function and feed-stocks. For instant, certain fuel additives were designed to provide an antioxidant for the engine that helps to minimize the corrosion within the engine components.

This study discusses the findings of the data obtained from the experimental work. It is based on the results obtained such as Brake Specific Fuel Consumption (BSFC) and Carbon Monoxide (CO) emissions.

2. METHODOLOGY

Experimental work is carried out by using a 1.6L multi-cylinder four stroke gasoline engine attached with the dynamometer and fuel measuring system. Engine was operated at constant engine load of 60 Nm with various speeds of 1500-3000 rpm. The experimental work is set up at constant ambient temperature of 33°C and relative humidity of 71%.

During each test condition, the engine was warm up with base fuel to stabilize the engine coolant and oil temperature. The detail of the engine specification is shown in Table 1.

Table 1 Engine specification.

Powertrain Engine and Performance	
Engine	4 Cylinder, DOHC 16V
Injection Type	Fuel system multi-point injection (MPI)
No. of Cylinder	4
Configuration	In-line
Bore (mm)	76
Displacement (mm)	1597
Stroke (mm)	88

The base fuel is RON97 and the test fuels consist of varying amount of fuel additives (5ml, 10ml and 15ml) blended with 1litre of RON97.

The fuel consumption is measured by using fuel measuring system and CO emissions is measured by using Gas analyzer MRU AIR.

3. RESULTS AND DISCUSSION

Figure 1 shows the pattern of fuel consumption (BSFC) for test fuels at various engine speeds and constant engine load (60 Nm). From the graph, as the engine speed increases from 1500 rpm to 3000 rpm, the value of BSFC has gradually decreased. This is due higher air flow rate at higher engine speed resulted in complete mixing process and combustion. Base fuel RON 97 resulted in the highest value of BSFC while RON 97 blended with 5ml of additive resulted in the lowest value of BSFC regardless of engine speed. This value (177.4 g/kWhr) gives a reduction of 15.9% lower than RON97. The additives lead to shorter ignition delay resulted in higher rate of heat release at the early combustion stage which improves the fuel consumption [1]. In fact, fuel additives improved the properties of base fuel such as octane number, viscosity, evaporate rate, surface tension and density that effects the mixing process resulted in complete combustion.

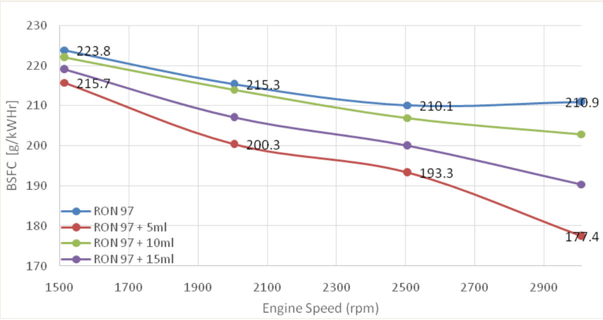

Figure 1 Engine speed Vs BSFC.

Figure 2 shows the pattern of carbon monoxide (CO) emissions for test fuels at various engine speeds with constant engine load (60 Nm). The graph shows a decreasing trend for both the base fuel (RON 97) and the additive blended fuels as the speed increases due to increased air flow rate. Carbon monoxide (CO) is an intermediate product in the combustion and mainly is related to quality of mixture between fuel-air. Base fuel (RON 97) resulted in the highest production of CO while RON 97 blended with 10ml of additive emitted the lowest emissions of CO. The value is 1250 ppm at 3000rpm which is 26.55% lower compared with base fuel RON97 at the same engine test condition. The complete combustion with 10 ml of fuel additive leading to an increase in the burning gas temperature in the cylinders resulted in lower CO emission [3-6].

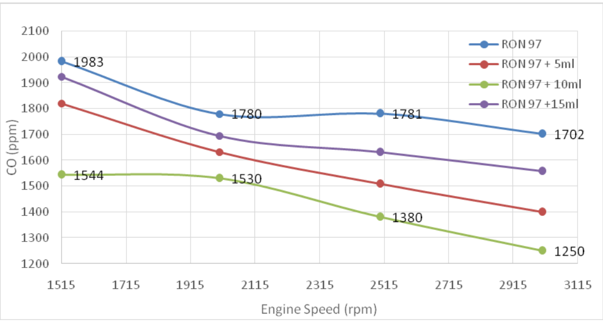

Figure 2 Graph of CO vs engine speed.

4. CONCLUSION

The results clearly showed that increasing the engine speed from 1500 rpm to 3000 rpm resulted in a significant improvement in fuel consumption and CO emissions regardless of additive quantity. The current study also found that when the engine was operating with additional 5 ml of fuel additives resulted in lowest BSFC. However, the additional of 10 ml of fuel resulted in lowest carbon monoxide (CO) emissions.

The overall results show that the engine operating with fuel additive produces improved overall results. It can therefore be assumed that the fuel additive will improved combustion behavior inside the combustion. This can be considered as an enhanced strategy in order to improve fuel consumption and reduce exhaust emissions.

5. ACKNOWLEDGEMENT

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