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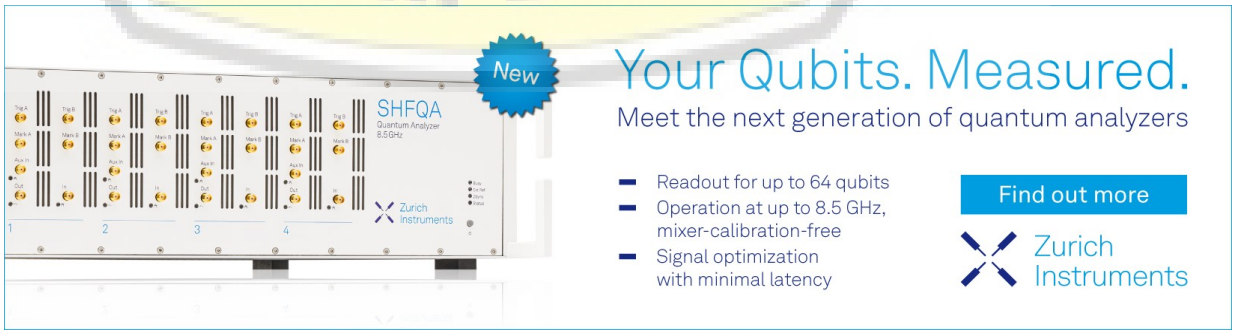

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Heating Ethanol-Gasoline Fuel Mixtures to Improve Performance and Reduce Exhaust Emissions at Gasoline Engine – A Review

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Abstract. Today's dependence on fossil fuels causes shrinkage of fossil fuel in the earth, especially in industrial sector and transportation that is highly depended on petroleum. Industry and transportation agents have changed the use of fossil fuels to alternative fuels such as ethanol fuel. Ethanol continues to be researched and developed to reduce people's dependence on fossil energy. But the use of ethanol fuel cannot be applied a hundred percent in industrial machinery and transportation machinery because the engine that used has a specification for gasoline if we want to use ethanol as an alternate for the main fuel, so it has to changed the components of that engine. Things that could be done at this time is mixes ethanol and gasoline fuel so that the use of gasoline can be minimized without changing the engine components used. This study discusses the effect of a mixture of gasoline and ethanol on a gasoline engine. This study discusses the characteristic of gasoline and ethanol mixture on gasoline engine. This study discusses the characteristic of gasoline and ethanol mixes. This study summarize the result of research in ethanol-gasoline sector since 2008 – 2019 with a special study that covering about the spray characteristic with heating of ethanol-gasoline fuel, octan number and engine performance. The parameters of this study focused on the results of injection spray, torque, power, specific fuel consumption and the effect on emissions products, carbon monoxide, carbon dioxide, hydro carbon and discussed the advantages and disadvantages of a mixture of E0 to E60 gasoline and ethanol fuel in a gasoline engine. It can be seen that the increase of performance and thermal efficiency by adding ethanol fuel mixture to the gasoline engine and reducing exhaust emissions from combustion of ethanol-gasoline. however there is a limit that the ethanol-gasoline mixture if the mixture exceeds the mixture's boundary so it will causes a decrease in engine performance.

INTRODUCTION

The exhaust of motor vehicle is one of the causes of air pollution on earth. It caused by the excessive use of fossil fuel. The transportation industry is began to apply alternative fuels to reduce the value of air pollution to preserve the environment, one of the alternative fuels is ethanol [1]. Ethanol fuels mentioned to reduce air pollution because the ethanol made from plants. But, another problems exsist on motor vehicle that used as different from motor with fosil fuel,the problem happened cause of the motor vehicle technology that used fossil fuel [2].

Nomenclature

SI	Spark Ignition
CO	Carbon Monoxide

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CO_2	Carbon Dioxide
HC	Hydrocarbon
Nox	Nitrogen Oxide
E0	100% Gasoline
E5	5% ethanol with 95% gasoline
E10	10% ethanol with 90% gasoline
E15	15% ethanol with 85% gasoline
E20	20% ethanol with 80% gasoline
E25	25% ethanol with 75% gasoline
E50	50% ethanol with 50% gasoline

ETHANOL AS VEHICLE FUEL

Ethanol fuel has been known as an alternative fuel since 1970 because of the fuel crisis. But fossil fuels still become main fuel to used in vehicles since the internal combustion engines was found [3]. Because the availablity and operation of the engine is quite easy, however the amount of carbon in fossil fuels has a high value and causes high emissions of toxic gases that compared with alternative fuel as ethanol. Especially in the last years, the world has highlighted the environtment problems including air pollution caused by motor vehicle fumes [3][4][5].

Ethanol Properties

Ethanol has a different high ignition temperature from fossil fuels so that ethanol has a spesificatiokn of a high compression ratio for about 11-14, it different from gasoline fuel which has compression between 9-10.5. In gasoline has 7 carbon atoms which causes high emission, while ethanol only has 2 carbon atoms which produces this fuel with a little emissions [3].

TABLE 1. Physical properties of ethanol and Gasoline

Properties	Ethanol	Gasoline
Molecular formula	C_2H_5OH	C_7H_{17}
Molecular weight	46 kg/kmole	100-110 kg/kmole
Density	785 kg/m^3	720-780 kg/m^3
Latent heat of vaporization	904 kJ/kg	350 kJ/kg
Calorific value	26800 kJ/kg	43850 kJ/kg
Stoichiometric air/fuel ratio	9.0	14.6
Octane number	106-110	91-96

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EFFECT ON ENGINE PERFORMANCE

Heating isnone of the treatments which is conducted on mixture of ethanol and gasoline fuels, in this case the researches conducted research of ethanol and gasoline fuels one of them by heating, this was applied on two-wheeled vehicles.[6]

Performance on the yamaha vega 2009

In this study the fuel used was E0%, E5%, E10%, E15%, E20%, E25% and E30%, the data collection was done in 2 ways that are by non-heating and heating, on heating there are 3 kinds of treatments that are with one pipe, two pipes and three pipes this is done in order to determine the maximum fuel heating using how many pipes, the following results from the study:

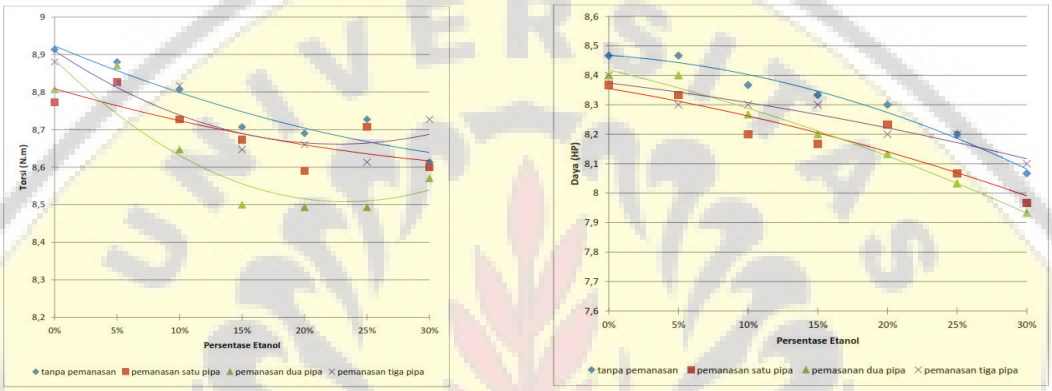

FIGURE 1. The effect of heating fuel on the performance of the yamaha vega 2009

At E0% fuel the highest torque is at unheated fuel with a torque value of 8.913 Nm, For E5% fuel with a value of 8.8 Nm without heating fuel, E10% Fuel at a value of 8,817 Nm with three pipes heating, E15% with value of 8.707 Nm without heating fuel, E20% With a value of 8.69 Nm without heating fuel. E25% with a value of 8,727 N.m without Fuel Heater and E30% with a value of 8,727 N.m with three pipes heating. While at the highest power fuel E0% - E20% without heating the fuel while at E25% and E30% the highest power obtained by heating 3 pipes with each value of 8.2 HP and 8.1 HP [7][8].

Performance on the CB 150 R

In this study the fuel used was E100% with 3 variations of heat treatment temperature used ie 60°C,70°C and 80°C while the vehicle rpm was determined to be 5000,6000 and 7000 RPM, so the test was carried out by heating the fuel to a temperature of 50°C,70°C and 80°C at each specified RPM.

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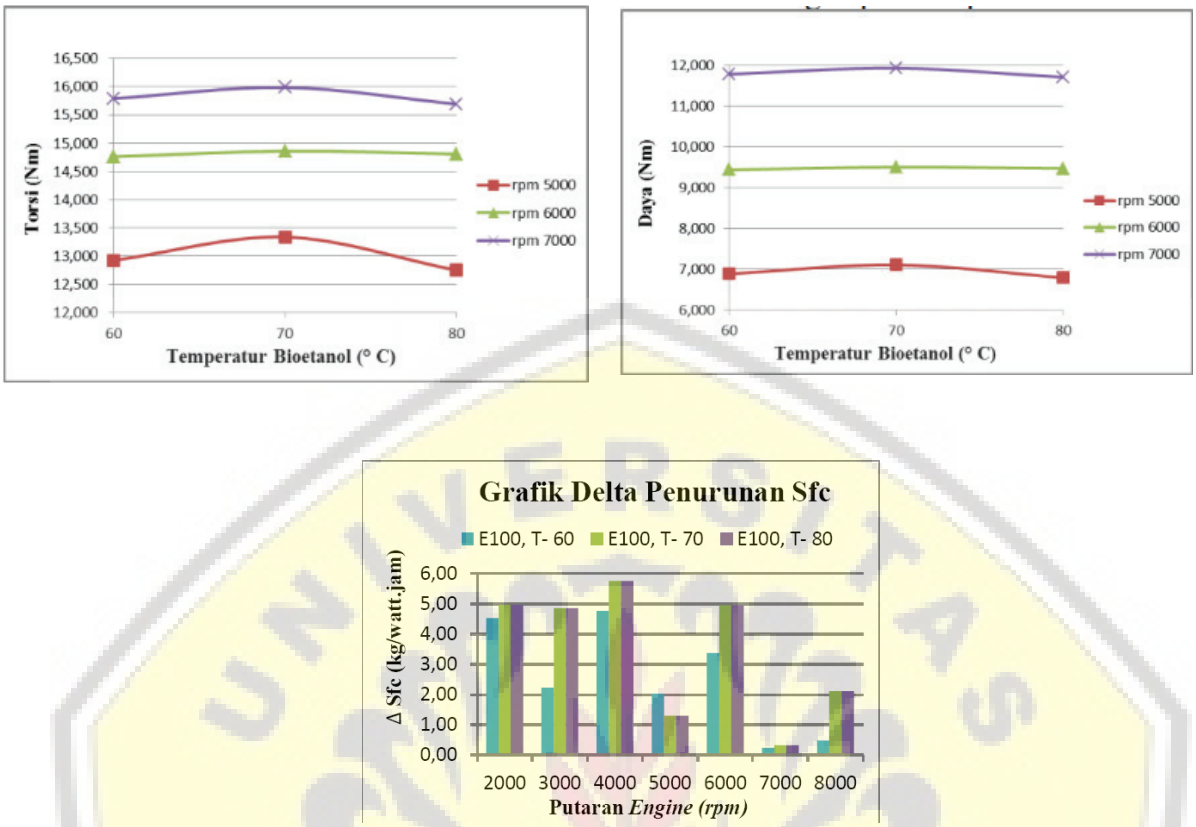

FIGURE 2. The effect of heating fuel on CBR 150 performance

The results of the torque above, it can be concluded that the temperature of 70 °C has the highest value in each RPMs that determined the highest torque at RPM 7000 with a value 16 N.m while the power has the same thing, that is the highest value on 70 °C with highest power is 12HP. On fuel consumption E100% the lowest fuel consumption is 7000 rpm with all heating processes 60 °C, 70 °C dan 80 °C [9][10].

ENGINE EMISSION

The use of ethanol as a mixture of gasoline fuels can reduce the value of emissions including hydro carbon, carbon monoxide, carbon dioxide, nitrogen oxide, In this case ethanol have important role in saving earth with reduce motor vehicle emission, following the result of applying the ethanol mixture to motor vehicles.[11]

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Carbon Monoxide and Carbon Dioxide (CO_2)

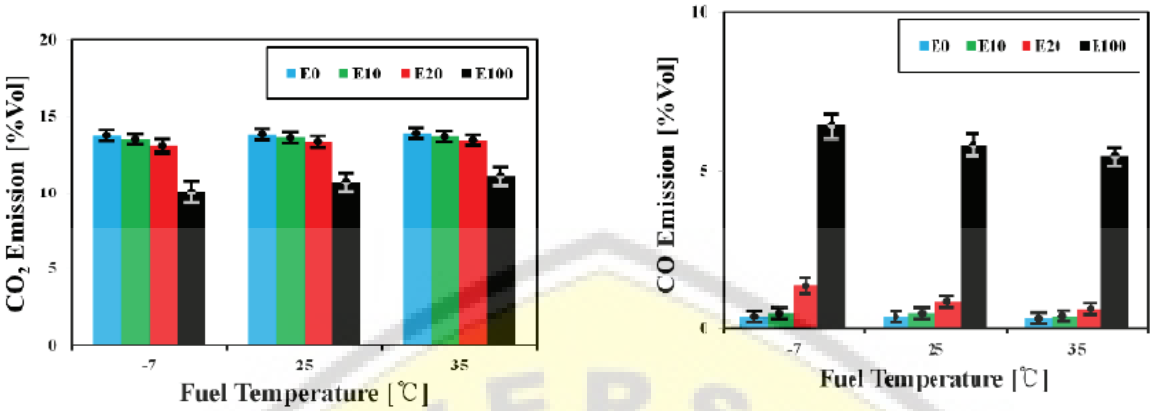

FIGURE 3. The effect of heating fuel on carbon dioxide and carbon monoxide gas emissions

The CO_2 emission gas in the heating process of fuel is very influential, as proven in this test the higher of heating temperature of the E100% ethanol fuel the lower the value of the emissions produced in each heating process [12][13]. It also applies to the mixture of ethanol and gasoline E0%, E10% and E20% CO_2 reduction is very important if the high CO_2 value can damage the ozone layer on the earth [14]. whereas the carbon monoxide gas emissions heating plays a role to reduce the value of carbon monoxide gas emissions so that incomplete combustion can be reduced along with rising heating temperatures as proven on E100% fuel at low temperatures with high value carbon monoxide gas emissions can decrease with increasing heating temperatures on fuel [11][15][16].

Nox and Hidrocarbon

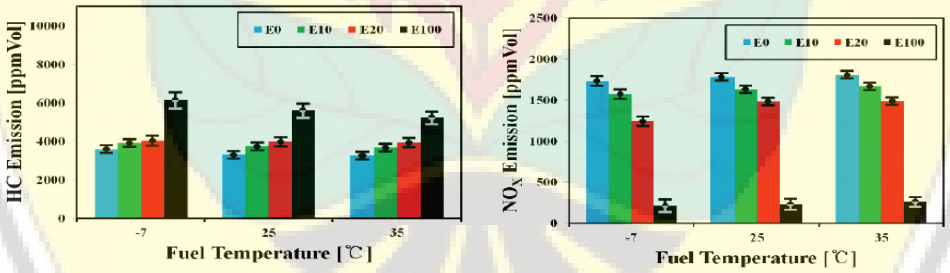

FIGURE 4. The effect of heating fuel on the emissions of hydro oxide and nitrous oxide

Hydro carbon is caused due to incomplete combustion in the combustion chamber on a vehicle, in this case heating is one way to increase the perfect combustion through heating fuel, it is proven that the higher of heating temperature the lower value of hydro carbon produced [17][18]. whereas nitrogen oxides increase when heating the mixture of ethanol and gasoline fuels, because the heating process causes evaporation of ethanol fuel so that the air ratio does not match with the air fuel ratio which causes an increase in nitrous oxide [19][20].

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CONCLUSION

Heating the mixture of ethanol and gasoline fuel causes an increase in performance of motor vehicles although the increase in vehicle performance is not significant that compared to pure gasoline or E0% but this is one good way if using a mixture of ethanol and gasoline without changing the component motor vehicles, but heating fuel too high can reduce performance which will causes detonation in the combustion process. While the heating emissions affect the following exhaust emissions as a result of heating fuel:

1. Vehicle engine torque increases with the heating process but the heating process is too high can decrease the value of the vehicle engine torque.
2. Engine power has increased with the heating process this is due to the increasin value of the torque, so that the power produced is high.
3. Fuel consumption by heating method has a great effect proven at 7000 rounds, fuel consumption is very low if compared with other rounds on fuel E100.
4. Carbon dioxide in the heating process has increased in fuel E100% this is very dangerous because it can damage the ozone layer on the earth. However, this does not happen at E0% - E20% in this fuel mixture have a stable state at the level of carbon dioxide gas emissions.
5. On the E100% fuel, carbon monoxide is very high compared to the mixture of ethanol fuel with gasoline, but in this case heating the fuel is very important because it can reduce the value of carbon monoxide as the temperature of heating increases.
6. The decrease of hydro carbon in E100% fuel is caused by heating, heating is very influential on E100% fuel.
7. Nitrous oxide increases with heating fuel mixture of ethanol with gasoline or pure ethanol because fuels containing water such as ethanol undergo evaporation which results increased value of nitrous oxide.

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