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# Investigation Experimental of the effect of gasoline-ethanol mixtures on consumption and exhaust emissions of engine 110cc DOHC

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**Abstract.** The motorcycle population continues to increase along with population and economic growth. High flexibility is a strong reason for motorcycle enthusiasts. Phenomenon due to adverse effects on environmental health caused by exhaust emissions. Alcohol has properties similar to gasoline. The high octane number is believed to encourage low fuel consumption and environmentally friendly exhaust emissions. This study observes fuel consumption and exhaust emissions of carbon monoxide and the purpose of the 110cc DOHC gasoline engine fueled by gasoline and alcohol-ethanol mixture. Alcohol ethanol used is 5 to 30% at intervals of 5% on a volume basis. Experimental results decrease fuel consumption, CO and HC emissions. This tendency occurs at the addition of 30% ethanol. The highest reduction in fuel consumption is 28.13%, the highest reduction in CO emissions is 83.36% by composition, and the highest reduction in HC emissions is 75.5%.

Keywords: Motorcycle, pollution, emission, ethanol

## 1. Introduction

Motorcycles are the mainstay of the Indonesian people to support mobilization[1]. Motorcycles can serve the wishes of riders on various road terrain. Motorcycles are also easy to modify according to the needs of the rider. The high flexibility of motorcycles makes motorcycle dependence even higher. In line with the exposure of the Central Bureau of Statistics, the volume of motorcycles from 2015 to 2020 increased by 3%. This actualization concerns the stock of fossil fuels and air pollution in Indonesia. The higher the fuel consumption, the higher the air pollution due to the smoke coming out of the motorcycle exhaust duct. To reduce this trend, air pollution is given a limit/threshold through the Regulation of the Minister of the Environment number 23 of 2012. The emission threshold for motorcycles with a capacity of less than 150cc (type L3) such as carbon monoxide (CO) is 2.0 gr/km, HC of 0.8 gr/km, and NOx of 0.15 gr/km.

In line with the threshold outlined in the Regulation of the Minister of the Environment number 23 of 2012, the addition of alcohol by Sanjaya et al. (2019)[2] and Syarifudin et al. (2021)[3] resulted in a 74.2% reduction in CO emissions, and a 46.3% reduction in HC emissions. This research is an effort to reduce air pollution as well as a solution to reduce dependence on fossil fuels. Alcohol was chosen because it has a high octane number, low viscosity, high flash point, and high oxygen content. Experiments conducted by Nithyanandan et al. (2016) [4] also have a good impact on reducing air pollution. Lower HC emissions than pure gasoline. The higher the alcohol ratio, the greater the emission reduction. The oxygen content and octane number in alcohol are the main factors in the tendency to reduce emissions. In addition, the specific fuel consumption is lower than that of pure gasoline.



Ethanol alcohol is easy to find in the community because of the variety of uses and raw materials. Ethanol alcohol with a concentration of 99.9% has a high flash point and a high oxygen content. Ethanol alcohol raw material is easy to obtain and can be pursued on a large scale. Alcoholic ethanol can be produced from liquid waste from sugar production, fermented cassava, corn cobs, rice husks, and the like. According to the publication of Li et al. (2018) [5], ethanol has a high octane number of 100, a heating value of 26.8 MJ/kg, and a viscosity level of 1.08 mm<sup>2</sup>/s. Specifically, these properties are very similar to gasoline fuels. In the article Amirabedi et al. (2019) [6], the addition of ethanol to gasoline fuel reduces the concentration of CO and HC emissions. The higher the ethanol content in gasoline, the specific fuel consumption is lower than pure gasoline. Alcoholic ethanol has a high oxygen content of 34.8% [7]. The impact of these properties can be seen in the graphs of CO and HC emissions produced in the study of Mourad et al. (2020) [8]. CO and HC emissions are lower than without ethanol. This study observes ethanol alcohol as a gasoline fuel mixture. The goal is to reduce dependence on fossil fuel gasoline and reduce air pollution. The ethanol alcohol used is a pure analytical type. The volume of ethanol used is based on a percentage of 5%, 10%, 15%, 20%, 25%, and 30%.

## 2. Metodelogy

Tests were carried out at 2000, 3000, and 4000 rpm engine operations. The engine that is used as an operational capacity is 110 cc with a carburized fuel system (Table 1).

Table 1. Specifications of automatic motorcycle 108cc

No.	Parameter	Specification
1	Engine capacity	108 cc
2	Machine Type	4 Stroke, SOHC
3	Bore x Stroke	50x55 mm
4	Rasio compression	10,7 : 1
5	Maximum Power	8,99 kW @ 8.000 rpm
6	Maximum Torque	0,86 N.m @ 6500 rpm
7	Fuel System	22" Carburetor Venturi Cylinder
8	Cooling System	Water Cooling, Air Cooling
9	Clutch System	Automatic, centrifugal, dry type
10	Ignition System	DC-CDI, Battery

Gasoline and alcohol-ethanol fuel were prepared according to the volume specified in Table 2. To determine the percentage of carbonmonoxide and hydrocarbon emissions, the stargass 898 ATC smoke meter was used. Meanwhile, to determine fuel consumption, a buret and a stopwatch are used to measure the volume and flow time.

Table 2. Fuel properties

No.	Fuel properties	Premium	Ethanol
1	Octane number	90	100
2	Calorific value (MJ/kg)	43,4	26,8
3	Density (kg/m <sup>3</sup> )	715-765	790
4	Kinematic viscosity at 25°C (mm <sup>2</sup> /s)	0,4	1,3
5	Oxygen content (wt.%)	0	21,6

Table 3. Fuel volume

No.	fuel code	Fuel volume (ml)	
		Gasoline	Ethanol
1	G100	1000	0
2	GE5	950	50
3	GE10	900	100
4	GE15	850	150
5	GE20	800	200

6	GE25	750	250
7	GE30	700	300

### 3. Result and Discussion

#### 3.1. Fuel consumption of gasoline engine fueled 110cc DOHC by Gasoline-ethanol

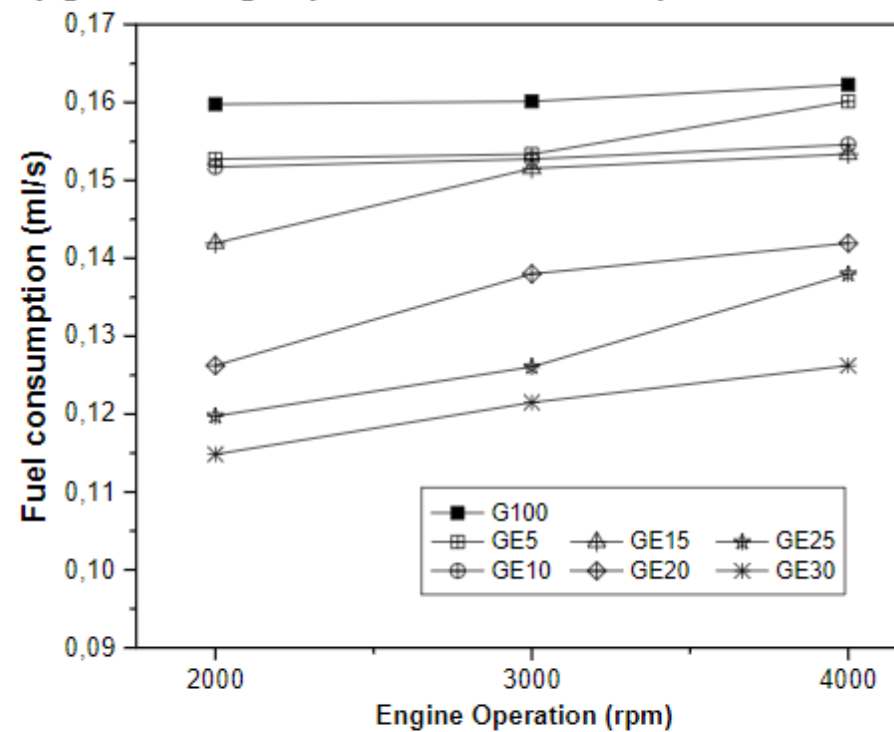


Figure 1. Fuel consumption of gasoline engine 110cc DOHC fuel by Gasoline-ethanol

Figure 1 presents the results of testing the fuel consumption of a gasoline engine 110cc DOHC with Gasoline-ethanol fuel. The fuel consumption of the gasoline engine 110cc DOHC looks lower when there is a concentration of ethanol. The higher the ethanol concentration, the lower the fuel consumption. The high oxygen content supports a complete combustion process [9]. The high octane number in ethanol optimizes the fuel compression process and optimizes ignition delay so that peak combustion is achieved optimally [10]. The lowest fuel consumption occurred in the GE30 fuel test of 0.11 ml/s at 2000rpm. Meanwhile, the highest fuel consumption occurred in the G100 fuel test of 0.162ml/s at 4000rpm rotation. Analysts, the decrease in fuel consumption is highest for GE30 fuel of 28.13%.

#### 3.2. CO emission of gasoline engine 110cc DOHC fueled by Gasoline-ethanol

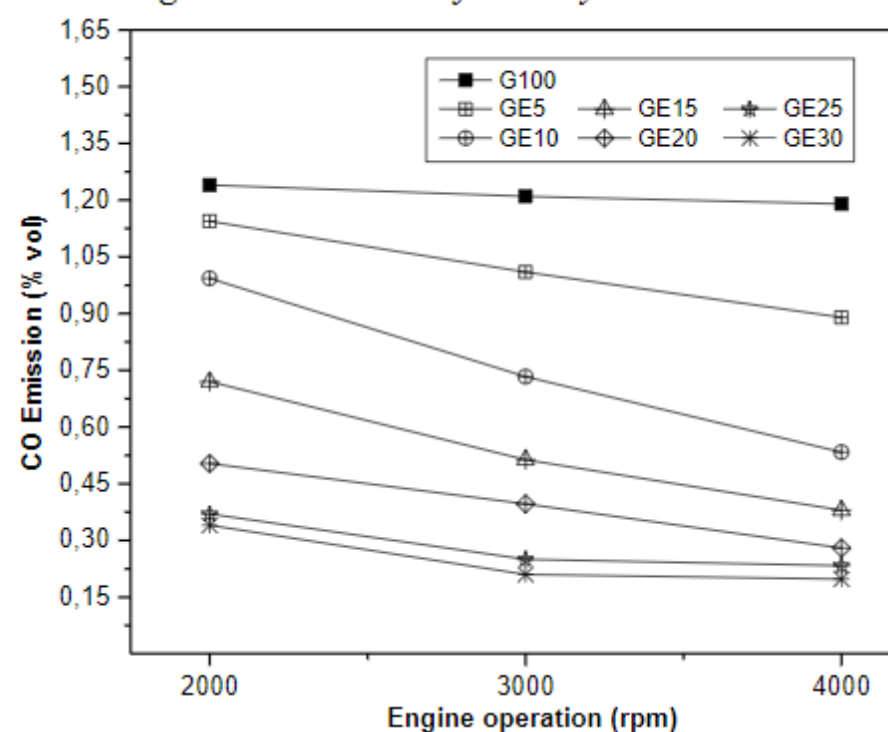


Figure 2. CO emission of gasoline engine 110cc DOHC fuel by Gasoline-ethanol



Figure 2 presents the Hydrocarbon (HC) emission of a gasoline engine 110cc DOHC fuel by Gasoline-ethanol. The increase in engine speed results in decreased CO emissions measured in the Gas Analyzer display. The higher the ethanol content in gasoline, the lower the CO emission. The presence of oxygen in ethanol reduces the formation of CO emissions due to complete combustion [11]. The oxygen content in ethanol has an impact on increasing the ability of the injection pump spray [2], [12]. The lowest CO emission occurred in the G30 fuel test of 0.198% vol at 4000 rpm. While the highest CO emissions occurred in the G100 fuel test of 1.24% vol at 2000 rpm. Analysts, the highest reduction in CO emissions occurred in GE30 fuel of 84.03% at 4000 rpm.

### 3.3. HC emission of petrol engine 110cc DOHC fuel by Gasoline-ethanol

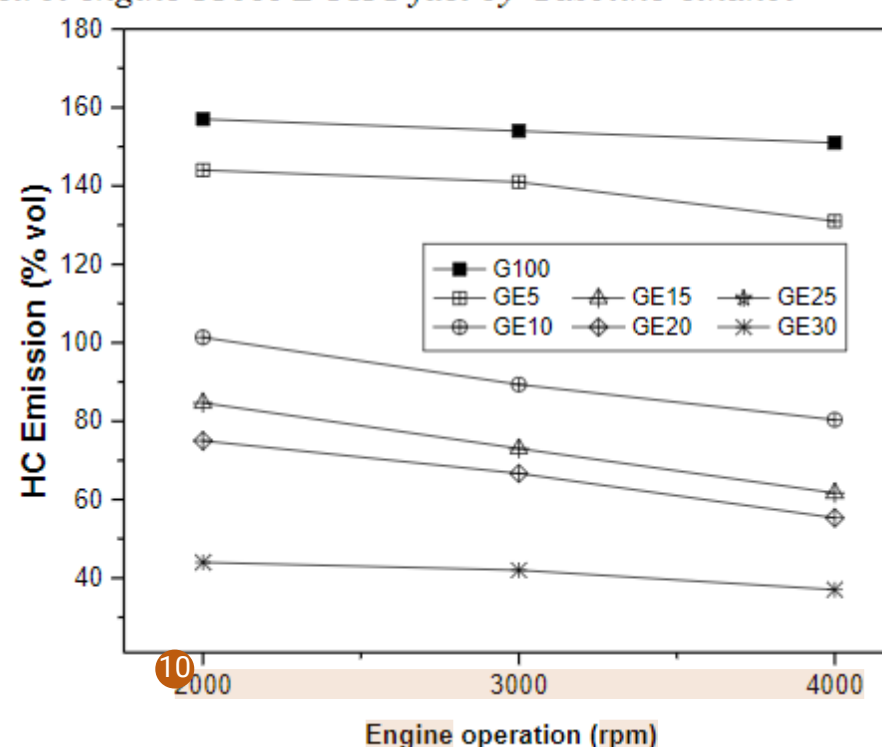


Figure 3. HC emission of gasoline engine 110cc DOHC fuel by Gasoline-ethanol

The Hydrocarbon (HC) emission test of the gasoline engine 110cc DOHC with Gasoline-ethanol fuel is presented in Figure 4. The tendency of the HC emission test looks like the results of the CO emission test. The HC emission of the 110cc DOHC petrol engine fueled by Gasoline-ethanol is lower than without ethanol. The high oxygen content increases the fuel oxidation process thereby suppressing the formation of HC emissions which are read on the Gas Analyzer display [4], [9]. The lowest HC emission measurement occurs in the GE30 fuel consumption of 37%vol at 4000rpm rotation. While the highest HC emission occurs in the G100 fuel consumption of 157% vol at 2000rpm rotation. Analysts, the highest reduction in HC emissions occurred in the GE30 fuel consumption of 76.43% at 4000rpm.

## 4. Conclusion

Ethanol properties such as high oxygen content and high octane number favor it as a gasoline fuel mixture. The use of gasoline-ethanol fuel results in lower fuel consumption, CO emissions, and HC emissions. G30 fuel resulted in the lowest reduction in fuel consumption by 28.13%, the highest reduction in CO emissions by 84.03%, and lower HC emissions by 76.43%.

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