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EFFECT OF ETHANOL-GASOLINE MIXES ON PERFORMANCES IN LAST GENERATION SPARK-IGNITION ENGINES WITHIN THE SPARK-PLUG NO GROUND-ELECTRODES TYPE.

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ABSTRACT

A The objective of this research is to investigate the effect of ethanol-gasoline mixes on the performances of a four-stroke Spark-Ignition engune. Ethanol is observed as an alternative fuel for Spark-Ignition engines and is known for producing blends with gasoline. An experimental investigation was performed on the engine is a four-stroke cycle single-cylinder, engine volume of 124,8 cm^3, port fuel injection, a compression ratio of 9,3:1 ,and a Euro 3 large-size motorcycle fuelled with commercial gasoline with a Research Octane Number (RON) of 95 and gasoline/ethanol mixes G25, G35 and G45 (range of 25%, 35%, and 45%). The experiments were performed utilizing spark plug no ground-electrodes type, varied engine speeds of 4000-9000 rpm. Regulated and unregulated performances and fuel consumption were measured over the carrying out of chassis-dynamometer tests. The combustion analysis, actualized by taking the pressure cycle inside the cylinder, highlights the autoregulation of the engine control unit and guarantees utilize within the same parameters of various tested fuels, with the besides of fuel injection time, which escalates with increasing ethanol percentage. The maximum power, mean effective pressure and efficiency thermal values were obtained with an ethanol-gasoline mix (G45) the position with operated at 7000 rpm. A significant decrease in specific fuel consumption was observed using an ethanol-gasoline mix of G45 (45%)

Key Words : *Ethanol–gasoline mixes, Performance, Spark-Ignition engines and Spark-plug no ground-electrode*

INTRODUCTION

In line with the accretion world inhabitant, industries, vehicles, and apparatus these necessities direct to a rise in the appeal for energy. It is being discovered that there is a restricted count of fossil-based fuels as a sustainable energy source. In the course of both the periods of the production of these fuels and the put on of them, the negative influence on the environment is an important factor and cannot be neglected. Because of these two matters, researchers are focusing on renewable and spotless energy fount. Considering the flow of the global economic crisis, the appeal in alternative fuels is greatly high. Severally, one of the aims of researchers in the enhancement of high efficiency and spotless engines. Alcohol fuels like methanol, and ethanol, etc. Have been emerging as good nominees as reserved fuels for the vehicles equipped with the spark ignition engines because they are fluid and have few physical and combustion properties alike to gasoline [1]. A side from these facts, methanol, and ethanol are created by fermenting and distilling starch crops, such as corn [2]. It also may be established from natural gas, wood, straw gasification of coal, plant stalks, most biomass, garbage, and even combustible waste [3]. Freshly, a new method of gasification by partial oxidation and production of methanol from carbohydrates has been expanded. With this method, methanol can be created from biofuel founts such as rice bran, sawdust, and rice husks [4]. The primary detriment is connected to the lower vapor pressure of bioethanol, which builds a cold start of the engine difficult. Indeed, many researchers have attested an escalate in nitrogen oxide and carbonylic compound emissions advancing from bioethanol/gasoline blend fuels [5][6]. This journal is directed at extending the knowledge of the consequents bioethanol/gasoline fuel blends have when applied in a large displacement motorcycle. This focus emerges from the want to evaluate the effect on the urban air quality of two-wheeler class vehicles when applied as a means of transport in major cities of southern Europe [7][8]. Ethanol Direct Injection plus Gasoline Port Injection (EDI + GPI) is a new technology to harness ethanol fuel more efficiently and effectively in spark-ignition engines than E10 or E85 in the current commerce [9].

Literature review on properties of ethanol as a fuel alternative for Spark-Ignition Engines.

Ethanol (C_2H_5OH) is a low cost renewable ecological fuel, and it can be generated biologically by utilizing the fermentation process from a variety of sucrose-containing biomass causes (sugar, sugarcane, beet, fruit, etc.) and starchy biomass sources (corn, potato, milo, rice, etc.). Ethanol is divided into two groups: ‘‘first generation” of ethanol that consists of both ethanol generated from sucrose-including biomass and ethanol produced from starchy biomass with commercial technologies, and ‘‘second generation” of ethanol produced from lignocellulosic biomass (wood, straw, and grasses) with technologies which are below an industrial showing [5]. Density: Density influences fuel atomization quality and combustion efficiency. Ethanol density is higher than gasoline and this induces higher pressure drop and a derivation of fuel mass flow rate included by volumetric-operating pump [10]. Viscosity: Ethanol viscosity is higher than gasoline. This influences the fuel atomization, inducing higher droplet diameters and converting the jet penetration. Consequently, the quality of the combustion process deteriorates and exhaust emission escalates [11]. Heating value: Heating value (net calorific value) of fuel affects the power output of an engine immediately. The heating value of ethanol is around 1/3 times lower than that of gasoline; thus, to reach the same engine power output, more amount fuel is requested for ethanol. This feature represents that the heating value of the ethanol-gasoline blended fuel will lessen with the escalate of the ethanol content [12]. Research Octane Number: Research octane number (RON) of ethanol is higher than gasoline, hence it is described by the capability to resist temperatures and high pressures before detonating. As the efficiency of SI engines relies on the compression ratio (and a fuel with high octane number is mainly convenient for high compression ratios), the utilize of ethanol in a SI engine can rectify energy efficiency [13]. Stoichiometric air/fuel ratio: The stoichiometric air–fuel-ratio of ethanol is 1,6 times reduce than that of gasoline. When ethanol is appended to blended fuel for a SI engine, since the number of air intake remains constant (at fixed engine speed and at fixed throttle valve unveiling), in order to gain the same air/fuel equivalence ratio, the electronic blend control escalates the volume flow rate of ethanol-gasoline mixture, so generating the leaning effect [5]. In fuel-rich conditions, aside from, the leaner effect generated by oxygen content of ethanol changes the air/fuel ratio to stoichiometric worth, then rectifying the combustion process [14]. and many researchers interpreted the intercourses between ethanol-gasoline blended fuels and the exhaust pollutant emissions. All these research clarified that utilize ethanol-gasoline mixed fuels can degrade the exhaust emissions of HC and CO from passenger cars equipped with a spark-ignition engine [12][15][16].

Engine performance on the consequences of ethanol-gasoline mixtures.

In recent years, advances in internal combustion engines (such as the adoption of improved performance lubricants, the common rail, the progress of the control electronics and the utilize of catalytic converters) permitted to degrade greatly both fuel consumption and pollutants emission. These connect certainly steady operation of the engines, however, there is still some way to go with regard to engine cold-starting, the phase in which the environmental performance is not optimal in consequence of low temperature of engine components and lubricants [17] [18]. Partial combustion: In the cold-start phase, engine sections are not still at the operating temperature. In especially, the fuel may condense on the cool walls of the entry manifold and the cylinder. It is, hence, necessary to escalate the supply of fuel to espouse combustion and drivability. The engine then works in terms of rich combustion and therefore the concentration of CO and unburned hydrocarbons to the exhaust intensify [17]. Increased friction: throughout warm-up, lubricant temperature is lower than optimal (100–110^{0}C) and thus their viscosity is higher than ordinary operation condition. This requires higher friction between changing parts and therefore a lower efficiency of the engine [19]. With regard to the consequent of the ethanol-gasoline mixture on the cold start temporary of a SI engine, it is significant to create the ensuing suppositions. As already specified, the Reid Vapor Pressure of ethanol is more inexpensive than that of gasoline, and then the producing lower volatility can make immense cold transient of the engine throughout the warm-up phase. Although, the ethanol-gasoline mixed fuels doesn't have a RVP value that reaches linearly with the percentage of ethanol in the mixs; in fact, with increasing of ethanol content, at first the RVP of the mixed fuel ascents to attain a maximal value at about 15% v/v of ethanol summation, while after, at higher ethanol percentages, the RVP declines [20]. On the contrary, vaporization of ethanol requires twice the energy needed by gasoline, and therefore, this property can influence the minimal starting temperature of SI engines powered with an ethanol-gasoline mix [21]. Hence, higher heat of vaporization of ethanol causes to complications with engine start-up including when a running cold engine, especially throughout winter months, due to the cooling consequent of the air/fuel blend [22][23]. Appealing research analyzed and related the consequent of different ethanol-gasoline mixed fuels (from 10 to 40 vol.% of ethanol) on cold-start extra emissions of a SI engine; the pertinent outcomes shown obviously lower CO and HC cold emissions as compared to the utilize of unleaded gasoline [24].

EXPERIMENTAL PROCEDURE

Engine.

The primary characteristics of the vehicle applied in the test series are summarized in Table 1. This high-performance motorcycle is outfitted with a four-stroke engine and with a displacement of 124,8 cm^3 and applied spark plug no ground-electrodes type.

Table 1. Technical properties of the experimented vehicle

Engine and displacement (cm^3)	: 4-stroke, 124,8
Fuel system	: PGM-FI (Programmed Fuel Injection)
Cooling system	: Air cooling
CR	: 9,3 : 1
Maximum power (kW)	: 7,40 kW / 8.000 rpm
Weight (kg)	: 106 kg
Coopling	: Multiplate Wet Clutch With Coil Spring
Transmission	: 4 – Speed Manual, Rotary

This vehicle is appropriated with a very efficient electronic fuel injection system, authorizing the control of fuel entering and magnifying catalyst efficiency also in cold transient; the on-board ECU directions the fuel injection approach with the feedback signal from the lambda probe oxygen sensor, that is located in the exhaust pipe. In these situations, the effect of ethanol summation on the pollutant emissions was studied for all. the tested fuels below the main fuel injection [24]. Most modifications identified later connect to the materials and to the configuration of the electrodes. currently, the insulator is generated from sintered alumina. The cathode has a copper core to escalate thermal conductivity; the surface may be blended with silver, gold, and platinum to escalate the resistance to high-temperature corrosion. The anode is subject to high-temperature corrosion by electro-erosion and combustion gases by the spark which carries metal ions in a plasma state. Nickel alloys are especially utilized, even though platinum alloys are detected in high-performance spark plugs [25].

Testing Fuels.

Four testing fuels were applied in the research project. The characteristics of all experimented fuels are presented in Table 2. First fuel (G0) is commercial gasoline with a Research Octane Number (RON) of 95, that is also used as a reference and base fuel for the composition of ethanol-gasoline mixes; the other fuels (G25, G35, G45) are ethanol-gasoline mixes containing 25%, 35% and 45% ethanol v/v, respectively. The ethanol applied for the composition of these mixes is anhydrous. Table 2. visibly indicates that the summation of ethanol to base fuel (G0) escalates the research octane number, viscosity content ,and the heating value of the ethanol-gasoline mixed fuels.

Table 2. Properties of experimented fuels.

fuel	Viscosity (mm^2/s)	Density (g/cm^3)	Low Heating Value (kJ/kg)
G0	0,51	0,722	38729
G25	0,52	0,731	36729
G35	0,55	0,774	34851
G45	0,57	0,791	31099
Reference	ASTMD 445-97	ASTM D-1298	ASTM D-240

Studied ethanol-gasoline mixed fuels with 0%, 5%, 10%, 20%, and 30% ethanol on the performance and emission of a commercial engine (Nissan-Sentra-GA16DE). The researches were accompanied by differing the engine speeds (range of 1000-4000 rpm) and throttle valve opening in the reach of 0% to 100% with 20% accretions. They detected that a higher percentage of ethanol leads to a reduction in the heating value of fuels. The ethanol-gasoline mix supplies a marginal enlargement of torque output and specific consumption, compared to gasoline. Utilizing ethanol-gasoline mixed fuels can significantly confine pollutant emissions of CO and hydrocarbons. Since the ethanol content contains complete combustion, the CO_2 emission is elevated; NO_X emission is not suspended on the ethanol content. By Utilizing an identical engine [12]. Investigated ethanol-gasoline mixed fuels with 35%, and 45% ethanol on the performance of a SI-engine. The researches were attended by differing the engine speeds (range of 4000-10000 rpm) and used to compare in the spark plugs [26].

The Laboratory.

Roller test bench measurements were executed in the Institut Teknologi Adhi Tama Surabaya (ITATS); the motorcycle under investigation was tested on a single-wheeler chassis dynamometer (SportDyno 3.8—single roller), which simulates vehicle inertia and road load resistance (Fig. 1). The researches were accompanied by differing the engine speeds (range of 4000-9000 rpm). The bench is regulated to procreate the road load requirement and to capacity the exhaust emissions through dynamic speed cycles. By taking this chassis dynamometer, it is too likely to perform experimental tests in unsteady speed mode, unsteady tractive force mode, and unsteady acceleration mode. Moreover, a variable-speed blower, located in front of the vehicle, performed as the cooling wind on the road. A driver's aid presented a speed trace of the driving cycle to ensue with a tolerance of 1000 rpm.

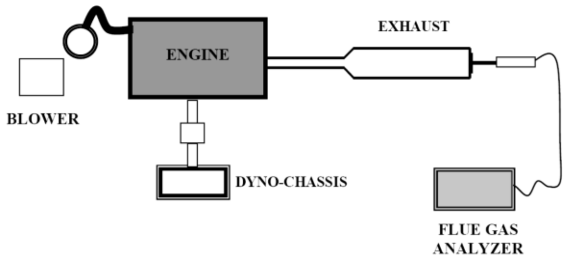

Figure 1. The experimental instrument

RESULT AND DISCUSSION

Figure 2 depicts the effect of G0, G25, G35, and G45 on engine power between 4000 and 9000 rpm engine speed at compression ratios of 9,3:1. In comparison with G0, the power was higher with the blended fuel (G25, G35, and G45) operating in the given speed range. At the compression ratio of 9,3:1, the average augmentation in the engine power as compared with G0 was 18% with a value of 6,98 kW with 7000 rpm engine speed conditions.

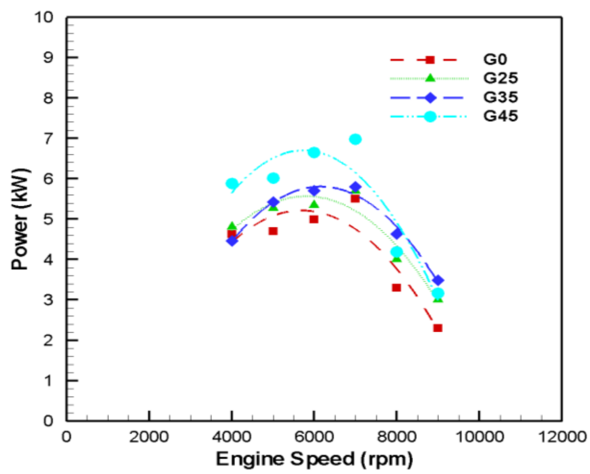

Figure 2. Variation of Power with engine speed

As in Figure 3 with a compression ratio of 9,3:1 for both fuel at high speed, the highest torque and Mean Effective Pressure were discerned. At compression ratios 9,3:1, 55% gasoline and 45% ethanol presented the same torque and Mep at high speed. Conversely, when G45 was applied as a fuel, slightly higher torque and Mep was discerned at compression ratio 9,3:1. At 7000 rpm (G45) displayed a peak Mep of 14% higher in comparison with the gasoline-ethanol blend (G25, 35 and G0).

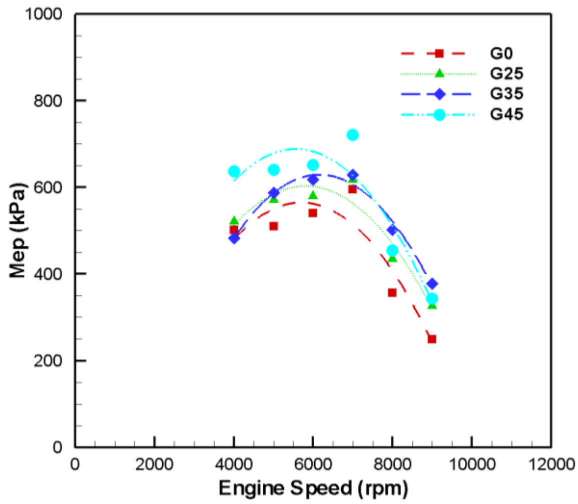

Figure 3. Variation of Mep with engine speed

Figure 4, Investigations were brought for the variation in Sfc of the engine using the mixed fuel (G25, G35, and G45) and G0 with engine speed at a compression ratio of 9,3:1 sequentially. At 9,3:1 compression ratio, the immediate boom in Sfc was witnessed and the values were noted as 10%, 12% and 14% with G25, G35, and G45 respectively. Thus better results were being presented when mixed fuel was used.

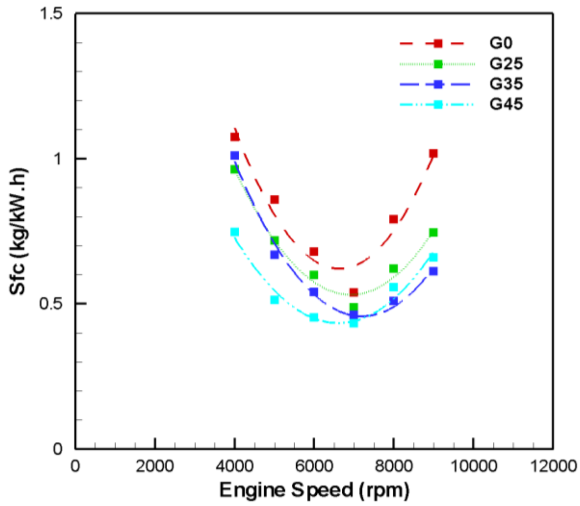

Figure 4. Variation of Sfc with engine speed

As in Figure 5, ethanol summation to gasoline presented an increase in the thermal efficiency. G0, G25, G35, and G45 produced the best results and operating at 7000 rpm the thermal efficiency was detected to be 15%. As compared with sole fuel thermal efficiency was observed to be on the higher side for all mixes as being recorded by experimental results.

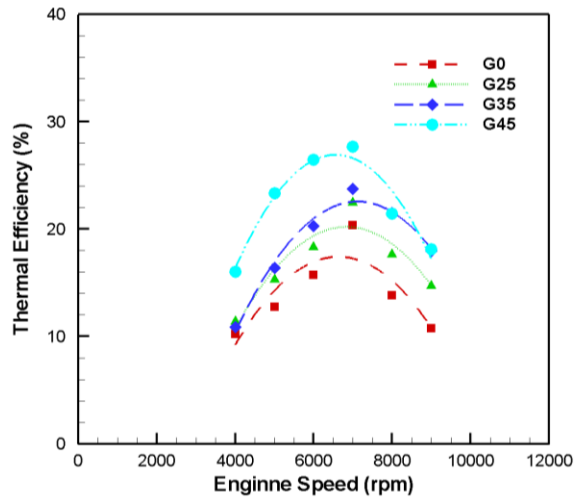

Figure 5. Variation of Thermal Efficiency with engine speed

CONCLUSION AND SUGGESTION

The present research considered the performance characteristics of the single-cylinder internal combustion engine. The emphasis was set on the engine is a four-stroke cycle single-cylinder, engine volume of 124,8 cm3, port fuel injection, a compression ratio of 9,3:1, and commercial gasoline with a Research Octane Number (RON) of 95 and gasoline/ethanol blends G25, G35, and G45 (range of 25%, 35%, and 45%). The following conclusions were drawn:

1. Ethanol-gasoline is a very good candidate as an engine fuel.
2. Appropriate variations in the combustion chamber together with better cooling mechanisms, spark plug no ground-electrodes would escalate the possibility of utilizing gasoline/ethanol mixes across a wider operating range.
3. Maximum power, mean effective pressure and thermal efficiency values were obtained at an ethanol-gasoline mix (G45) the position operated at with a value of 6,98 kW, 720,82 kPa and 27.69% with 7000 rpm engine speed conditions.

At various powers, spark ignition systems can be given different results with gasoline/ethanol mixes and different spark plug electrodes. The fuel mixes , and spark plug electrodes mainly affect the engine performance parameters. Consequently, all of them is a factor affecting the performance of the engine depending on the engine structure (volume, ignition system, compression ratio, number of cylinder, etc.). On this issue should be considered in future studies.

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