Comparative Study of Performance of Four-Stroke Two Wheeler using Ethanol-Gasoline and Butanol Gasoline Blends

Dr. Ravishankar M K
HOD,
Department of Automobile Engineering,
Malnad College of Engineering,
Hassan, Karnataka, India

Prem Kumar B G
Asst. Professor,
Department of Mechanical Engineering,
Sahyadri College of Engineering and Management,
Mangalore, Karnataka, India

Nithin H S
Research Scholar,
Department of Mechanical Engineering,
NITK Surathkal,
Mangalore,Karnataka, India

***Abstract*: This work deals with the performance study of a two wheeler using ethanol-gasoline and butanol-gasoline blends. In order to obtain its usefulness into practice, the performance was studied on gasoline fuel and also blended with ethanol and butanol fuel and compared. This experiment was conducted on the chassis- dynamometers were speed test, power test, fuel consumption test, and Acceleration test. The results show that the E25, B5 show a comparatively good performance compared with that of pure gasoline in terms of Power and E45, B50 blends show a comparatively good performance compared with that of pure gasoline in terms of Fuel consumption respectively.**

Keywords: Alternative fuels, Ethanol, Butanol, Gasoline-ethanol blends, Gasoline-butanol blends.

1. INTRODUCTION

Alcohols have been suggested as an engine fuel almost since automobile was invented [1]. Ethanol which is a colorless liquid with mild characteristic odor and can be produced from coal, natural gas and biomass, have high octane rating and can be used as one of the realistic alternative fuels. As fuel, it is renewable and having a higher octane rating than gasoline with similar storage and dispensing and can be mixed with conventional fuels (diesel fuel or gasoline) [2]. It is known as the most suited fuel for spark-ignition (SI) engines [3, 4] and can be used in SI engines as pure or by blending with gasoline [4, 5, 6] Ethanol can be blend with gasoline at low concentrations without any modification to be used in SI engine [7]. Ethanol–gasoline blends (gasohol) can be used as fuel in order to substitute some part of gasoline in engine applications. It was reported that using gasoline–ethanol blends including ethanol at low concentrations could improve engine performance and exhaust emissions [7, 8]; such as increasing the octane rating, which is particularly important in unleaded fuel, and reduce carbon monoxide (CO) emissions from the engine. This led the gasohol (a mixture of 10% alcohol with 90% gasoline) to be a commercial fuel in over 35 countries of the World including the USA, Canada and France [9].

Gasohol gain importance within these recent years as alternative fuel due to this high octane number, especially with ethanol which has low carbon [10]. Alternative renewable fuels such as bioethanol-gasoline blended fuels are becoming essential due to increasing oil prices, environmental concerns and their potential to preserve the agricultural activity. Ethanol–gasoline blends which has high octane rating can be used as fuel in order to substitute some part of gasoline in engine applications as it has higher heat of vaporization compared to gasoline, which means that freezes the air allowing more mass to be drawn into the cylinder and increases the power output [11]. Palmer (1986) [12] indicated that 10% ethanol addition increased the engine power output by 5%, and the octane number can be increased by 5% for each 10% ethanol added. Abdel-Rahman and Osman (1997) [13] had tested 10%, 20%, 30% and 40% ethanol of blended fuels in a variable-compression-ratio engine and found that the increase of ethanol content increased the octane number, but decreased the heating value. The properties of ethanol show that it is a clean and green alternative fuel for SI engines. The engine parameters affect the engine performance differently when ethanol is added to gasoline [14]. Using of ethanol blend as a fuel additive to gasoline causes improvement in engine performance and exhaust emissions [15]. Ethanol and n-butanol can be effectively used as oxygenates, which enhance the performance and emission characteristics of SI engine[16]. Addition of oxygenates in gasoline provides better combustion resulting into significant reduction in CO and HC emission. These provides heat addition to actual performance their by increase break thermal efficiency of engine [17].Under various compression ratios of engine, the optimum blend rate was found to be 10% ethanol with 90% gasoline. Later, Hsieh et al (2002) investigated the engine performance and pollutant emission produced by commercial SI engine using ethanol–gasoline blended fuels with various blended E0, E5, E10, E20, and E30 which were classed into its group with ASTM standard analysis. The ‘‘E’’ designates ethanol and the number next to E designates the volume percentage of ethanol in the total fuel blend. The outcomes showed that by increasing the ethanol content, the heating value of the blended fuels was decreased, the octane number of the blended fuels increased while better combustion can be achieved and higher torque output can be acquired.

It is well understood from the above literature review that using ethanol in SI engines by blending with gasoline is more practical than using it alone. If ethanol production can meet the demand and the cost of blended fuels can compete with that of conventional gasoline, widespread use of gasoline–ethanol blends can be possible. However, before using these blends in engines, the whole effects on engine must be evaluated. For this reason, the present study is focused on this topic. Here, the effects of ethanol addition to gasoline in various concentrations on engine performance and exhaust emissions are examined by conducting both theoretical and experimental studies.

2. METHODS AND METHODOLOGY

Blending of ethanol and gasoline used for this experiment

Code	% Ethanol	% Gasoline
E5	5	95
E10	10	90
E15	15	85
E20	20	80
E25	25	75
E30	30	70
E35	35	65
E40	40	60
E45	45	55
E50	50	50
E60	60	40
E70	70	30

The ‘‘E’’ designates ethanol and the number next to E designates the volume percentage of ethanol in the total fuel blend.

Code	% Butanol	% Gasoline
B5	5	95
B10	10	90
B15	15	85
B20	20	80
B25	25	75
B30	30	70
B35	35	65
B40	40	60
B45	45	55
B50	50	50
B60	60	40
B70	70	30

The ‘‘B’’ designates Butanol and the number next to B designates the volume percentage of Butanol in the total fuel blend.

2.1 *Experimental Setup*

This work deals with the performance study of two wheeler four strokes Royal Enfield vehicle using ethanol and Butanol as alternative fuel was carried out on chassis dynamometer. Chassis dynamometer is an apparatus where in the road condition can be simulated in lab itself. This can be termed as all weather roads for the test vehicle. Chassis dynamometer is an apparatus which is used at the end of the production line and is designed for testing the two-wheeler coming off the production line. It would work as a comparator stand to identify the performance of a vehicle with respect to standard specification.

3. RESULT AND DISCUSSIONS

3.1 *Power test*

Figure 1.a and 1.b indicate the power in KW against vehicle speed from 40 kmph to 80 kmph available at the wheel and torque in N-m versus vehicle speed from 40 kmph to 80 kmph available at the wheel respectively for the test vehicle running under gasoline and different ethanol-gasoline bends.

Figure 1.c and 1.d shows power in KW against vehicle speed from 40 kmph to 80 kmph available at the wheel and torque in N-m versus vehicle speed from 40 kmph to 80 kmph available at the wheel respectively for the test vehicle running under gasoline and different Butanol-gasoline bends

It is found that the E25 and B5 Ethanol gasoline and Butanol-gasoline blends both gives better power and torque characteristics when compared with that of gasoline, other Ethanol-gasoline and Butanol gasoline blends. Maximum power for gasoline will get as 2.67kW at 70 kmph. For E25 Maximum power and torque will be 2.18 kW 15.4 N-m at 60 kmph and for B5 maximum power and torque will be recorded as 2.13kW at 70 kmph and 15.1 N-m at 50 kmph respectively.

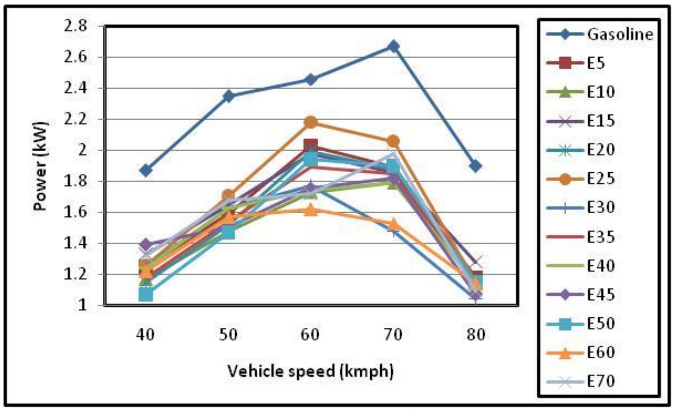

Figure 1.a: Power in kW V/S Speed in kmph for gasoline and Ethanol-gasoline blends.

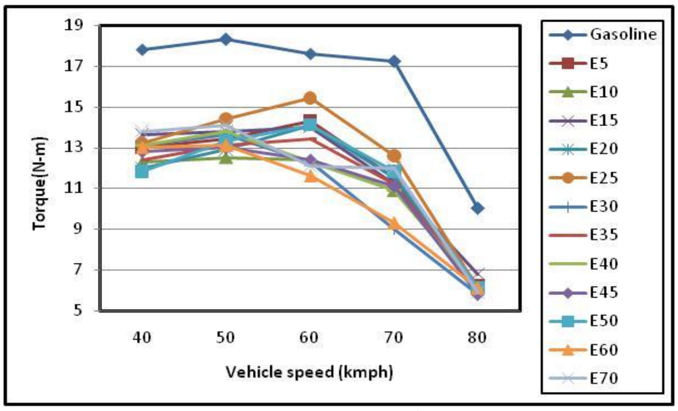

Figure 1.b: Torque in N-m V/S Speed in kmph for gasoline and Ethanol-gasoline blends.

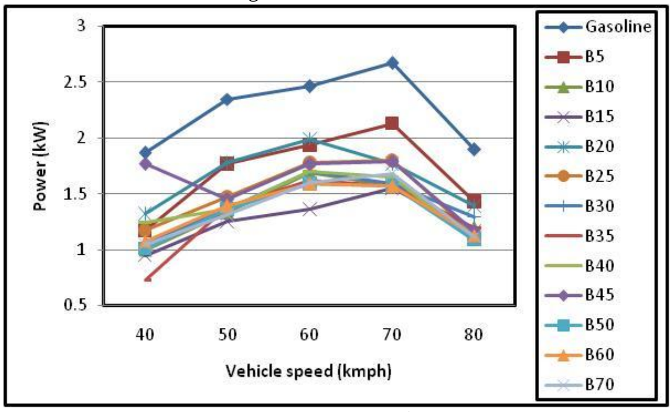

Figure 1.c: Power in kW V/S Speed in kmph for gasoline and Butanol-gasoline blends.

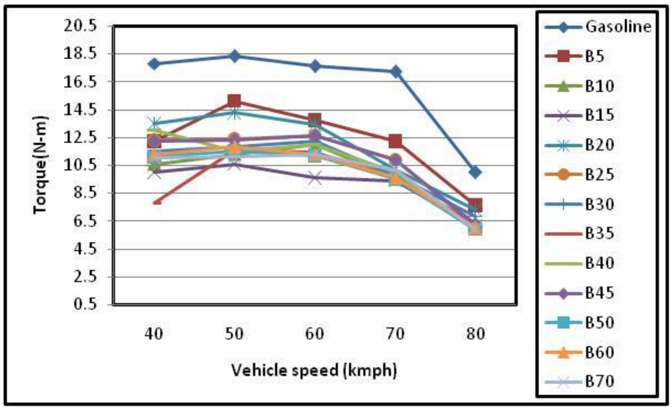

Figure 1.d: Torque in N-m V/S Speed in kmph for gasoline and Butanol-gasoline blends.

3.2 Fuel consumption test

Figure 2.a and 2.b reviles that the fuel consumption characteristics for the test vehicle used. The mileage is better in Ethanol-gasoline compared to other blends of Butanol and Pure gasoline. However it is found that among the Butanol-gasoline blends, B50 have better mileage compared to the other blends it gives the mileage 47.1kmpl at 60 kmph speed and among the Ethanol-gasoline blends, E45 have better mileage compared to the other blends it gives 51.2kmpl at 60 kmph speed.

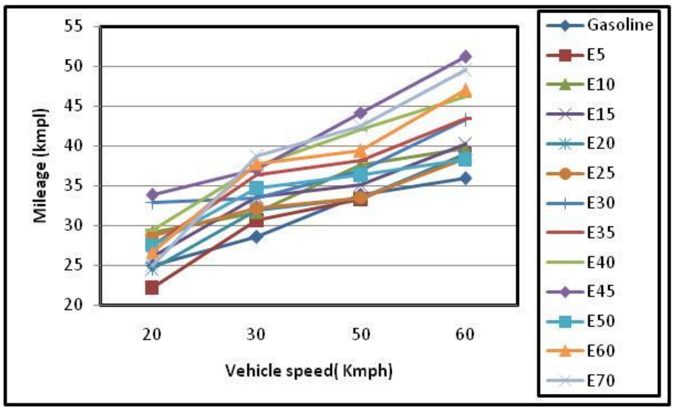

Figure 2.a: Fuel consumption V/s Speed in kmph for gasoline and Ethanol-gasoline blends.

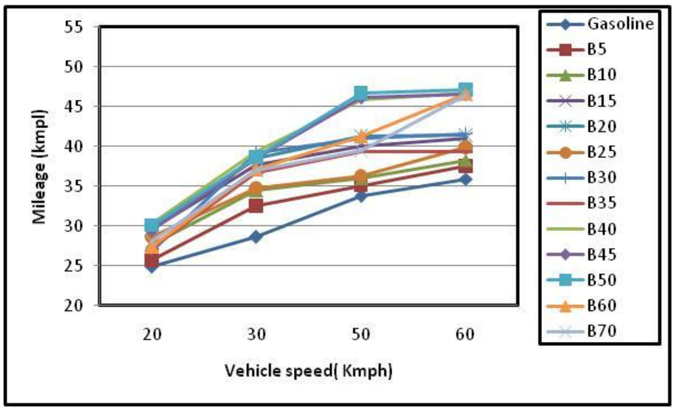

Figure 2.b: Fuel consumption V/s Speed in kmph for gasoline and Butanol-gasoline blends.

3.3 Acceleration test

Figure 3.a and 3.b indicates the time for acceleration from 1-50 kmph and 1-60 kmph for gasoline, ethanol-gasoline and butanol gasoline blends for the vehicle. It is found that acceleration time is less for E35 in both the case. E35 will take 3.2 sec and 4.2 sec for accelerate form 1-50 kmph and 1-60 kmph respectively. Figure 3.c and 3.d indicates the time for acceleration from 1-50 kmph and 1-60 kmph for gasoline and Butanol-gasoline blends for the vehicle. It is found that acceleration time is less for B60 and B50 respectively. B60 will take 3.5 sec for accelerate form 1-50 kmph and B50 will take 4.5 sec for accelerate form 1-60 kmph respectively. This may be due to the fact that we have increases torque and power characteristics at these blends.

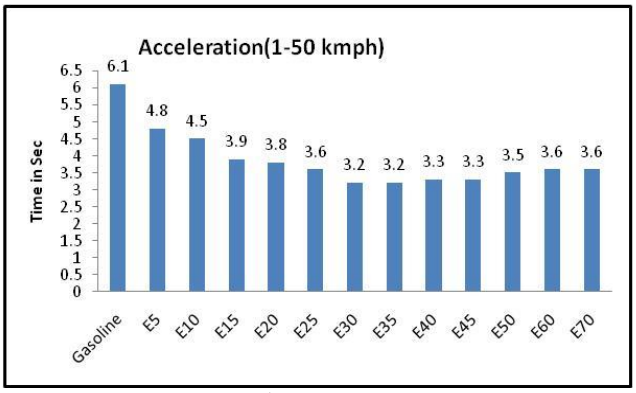

Figure 3.a: Time for acceleration V/s Fuel used

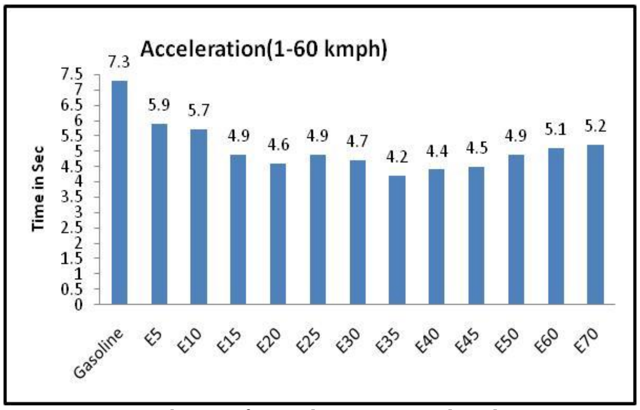

Figure 3.b: Time for acceleration V/s Fuel used

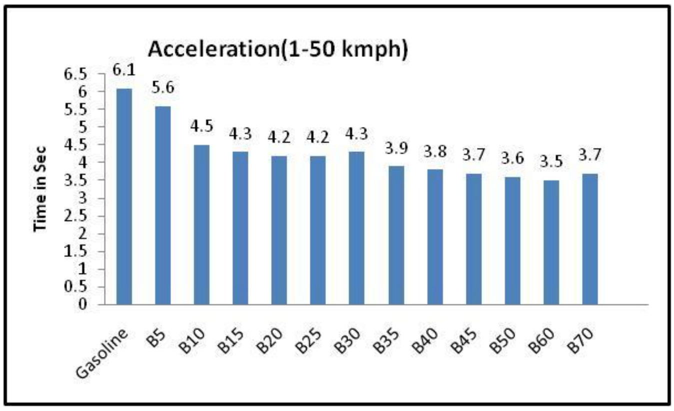

Figure 3.c: Time for acceleration V/s Fuel used

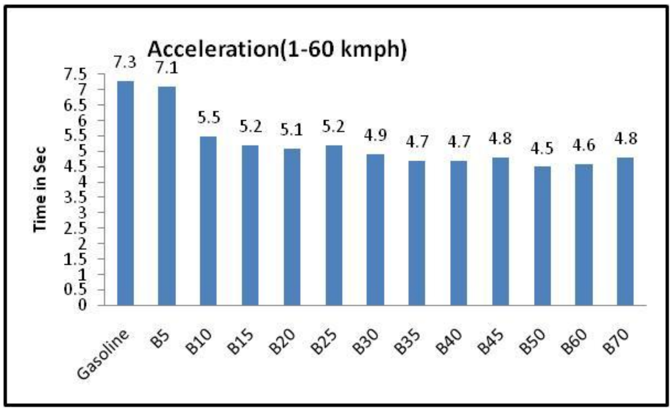

Figure 3.d: Time for acceleration V/s Fuel used

4. CONCLUSION

From the experiments carried out by running the test vehicle on gasoline and different ethanol-gasoline, Butanol-gasoline blends, the following observations can be made

- In terms of torque and power characteristics, the E25 and B5 blends are better for the test vehicle.
- Whereas in terms of better fuel economy the E45 and B50 blends show favorable results when compared to the remaining blends.
- However, in terms of acceleration time E5 and B5 blends showed better results, but gasoline is still better in terms of acceleration time.
- Thus we conclude that, Ethanol and Butanol can be blended with gasoline in percentages equal to E45 and B50 to obtain good result in fuel consumption.

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Author Profile:

Ravishankar.M.K received B.E degree in Automobile Engineering, M.Tech degree in Maintenance Engineering and L.L.B degree from University of Mysore in 1993, 1996 and 2000 respectively. He was awarded the ISTE-GSFC National award 2nd Prize for the Best M.Tech Thesis in Mechanical Engineering for the year 1996. He received Ph.D in Machine Design from Indian Institute of Technology, Madras during 2014. Also he was awarded the National Doctoral Fellowship by AICTE, Govt. of India during 2004 for perceiving Ph.D.

Prem Kumar.B.G received B.E degree in Automobile Engineering, M.Tech degree in Machine Design from Visvesvaraya Technological University in 2010 and 2013 respectively. He has published 3 international journals and 2 international conferences. He is working as an Assistant Professor in Sahyadri college of Engineering, Mangalore.

Nithin.H.S received B.E degree in Automobile Engineering, M.Tech degree in Industrial Automation and Robotics from Visvesvaraya Technological University in 2010 and 2012. Worked as Senior Research Fellow in NITK under Naval Research Board project from May 2013 to December 2013. Current pursuing Ph.D in National Institute of Technology, Surathkal,Karnataka,