DESIGN & DEVELOPMENT OF BICYCLE FITTED WITH PETROL ENGINE OPERATED ON ETHANOL INJECTION

Prof. M D Harlapur[1], Shriharsha V D[2], Narvekar Nihar[3], Rehmansab B P[4], Gourish Tippannavar[5]

[1] *Asst. Prof & HOD, Department of Mechanical Engineering, REC Hulkoti, Karnataka, India*

[2,3,4,5] *Students, Department of Mechanical Engineering, REC Hulkoti, Karnataka, India*

Abstract - ***Fossil fuels such as oil, gas, and coal have driven the world's economies since the industrial revolution and have released carbon emissions in the process. About 26 billion tons of carbon dioxide is produced every year and this is still increasing. The 1997 Kyoto agreement is the world's only attempt to regulate carbon emissions. Ethanol is a renewable energy and can be made from many raw materials such as sugarcane, molasses, waste biomass materials, corn, sugar beets, and so on by using already improved and demonstrated technologies. The objective of the present work is mainly concerned with determination of maximum possible and optimum replacement of Petrol by petrol–ethanol blends and comparing the performance of petrol engines fuelled with these fuel combinations. Without changing the structure of two-stroke gasoline engine, some blended fuels of different ratios of ethanol and gasoline are used for experimental study of the engine. The effects of different ratios of mixed fuel on the characteristics of the engine, i.e. the output torque, power, fuel consumption rate of the engine, and its exhaust are tested.***

The optimum percentage of ethanol that gives simultaneously better performance and lower emissions when blended with Petrol is determined. The experiments are conducted using 0 per cent, 5 per cent, 10 per cent, 15 per cent and 20 per cent. Use of Ethanol fuels in engines will address Emission norms (Bharat stage 3). The alternative fuel ethanol shows very promising results with respect to efficiency and exhaust of the engine. The main aim of this project is to develop a bicycle powered by petrol engine that is operated on Ethanol-Petrol fuel combinations. As Ethanol fuel is renewable source of energy, hence this will be an eco-friendly one. The cost is estimated to be less than the existing motorcycles. This has to reduce the manpower required for pedaling during elevations.

Keywords: Internal Combustion Engines, renewable fuels, Petrol engines, bicycle, Alcohols, Emission norms, Renewable source, Ethanol, Methanol.

1. INTRODUCTION

While riding bicycle uphill, there comes the need of more man power to ride atop. The person while riding bicycle uphill has to use more force and hence gets exhausted i.e. by pedaling more. The force required is high and it has to be reduced by some form of energy. Hence there is a need to develop a bicycle powered by some energy.

The energy used for this requirement should be an Eco-friendly. Hence an engine which is operated on fuel combustions can be used and the fuel combinations being eco-friendly should be used

1.1 Problem Definition:

The economy of India depends to a large extent on the wheels of transport. The specter of economy ruin due to depleted oil reserves has changed the interest of scientist and research work towards alternative fuels for motor vehicle. Vehicles now in India use petrol and Petrol as fuels majorly for driving motorcycles. These emit hazardous gases like CO, HC, NOx, which are causes for pollution. These gases have to be controlled by some other alternate fuel that controls these emissions and increases the efficiency of converting the combustion energy to power.

Fig – 1 Cars showing the emissions

Fig – 2 Bicycle climbing the road

2. SUMMARY OF LITERATURE REVIEW

A motorized bicycle is a bicycle with an attached motor and transmission used either to power the vehicle unassisted, or to assist with pedaling. Since it always retains both pedals and a discrete connected drive for rider-powered propulsion, the motorized bicycle is in technical terms a true bicycle, or a power-assisted one.

Motorbikes have utilized all variety of engines, from internal-combustion (IC) two-stroke and four-stroke gasoline engines to electric, Petrol, or even steam propulsion. Most motorized bicycles are based or derived from standard general-purpose bicycle frame designs and technologies, although exceptions abound. In addition, modifications to a standard bicycle frame to support motorization may be extensive.

Emission norms and deterioration factors (DF) for 2 and 3 wheelers

Vehicle	Pollutants, g/km	Year 2005		Preferably from year 2008	
		Bharat Stage II		*Bharat Stage III*	
		Norms	DF*	Norms	DF*
2 Wheelers	CO	1.50	1.2	1.0	1.2
	HC + NO_x	1.50	1.2	1.0	1.2
3 Wheelers	CO	2.25	1.2	1.25	1.2
(Petrol)	HC + NO_x	2.00	1.2	1.25	1.2
3 Wheelers	CO	1.00	1.1	0.50	1.1
(Diesel)	HC + NO_x	0.85	1.0	0.50	1.0
	PM	0.10	1.2	0.05	1.2

* Deterioration factors to account for deterioration of devices like catalytic converter.

Chart -1: Emission norms and deterioration factors (DF) for 2 and 3 wheelers

3. DATA COLLECTION

3.1 Companies Involved

1) Golden Eagle Bike - rear-engine (rack-mounted) kit using a belt to drive the rear wheel.
2) Staton-Inc., a motorized bicycle manufacturer.
3) Jiangdu Flying Horse Gasoline Engine Factory Ltd – Electric Bikes SIC Code – 3751 - Motorcycles, Bicycles, and Parts.

Fig -3: Data Collection of motor cycle

Fig -4: Data Collection of motor cycle

3.1 Consumers -

1) Elderly people having difficulty in pedaling.
2) Usage in college or school campus.
3) Environment conscious people.

Patents
1) Bicycle motor control system EP 2394902A1
2) Bicycle with motor CN 102897276 A

Disadvantages:
The available motorbikes have high cost and are not environmentally friendly.
Electric bikes on the other hand have very short range and high battery recharge time.

4. ETHANOL AS AN ALCOHOL:

4.1 Use of alcohols:

1. The level of interest in using alcohol as a motor fuel has followed cycles of fuel shortages and/or low feed-grain prices.
2. There are some disadvantages to using alcohols, particularly methyl and ethyl alcohol. Alcohols may corrode certain materials used in engines.
3. Alcohols burn more completely, thus increasing combustion efficiency.

Advantages of mixing alcohol with gasoline are that alcohol tends to increase the octane rating and reduce carbon monoxide emissions. Ethanol is a renewable energy and can be made from many raw materials such as sugarcane, molasses, waste biomass materials, corn, sugar beets, and so on by using already improved and demonstrated technologies.

4.2 Disadvantages of alcohols:

The use of ethanol in engines causes corrosion problems on the mechanical components, particularly for components made from Al, brass, and Cu. Also ethanol can react with rubber and create jam in the fuel pipe. Adding ethanol to petrol can reduce its lubricity and create wear problems in fuel pump designs.
Ethanol contains soluble and insoluble contaminants. These soluble contaminants, halide ions such as chloride ions, have a large effect on the corrosivity of alcohol fuels. Halide ions increase corrosion in two ways; they chemically attack passivating oxide films on several metals causing pitting corrosion, and they increase the conductivity of the fuel. Increased electrical conductivity promotes electric, galvanic, and ordinary corrosion in the fuel system. Soluble contaminants, such as aluminum hydroxide, itself a product of corrosion by halide ions, clog the fuel system over time.
Ethanol is hygroscopic, meaning it will absorb water vapor directly from the atmosphere. Because absorbed water dilutes the fuel value of the ethanol (although it suppresses engine knock) and may cause phase separation of ethanol-gasoline blends, containers of ethanol fuels must be kept tightly sealed. This high miscibility with water means that ethanol cannot be efficiently shipped through modern pipelines, like liquid hydrocarbons, over long distances. Mechanics also have seen increased cases of damage to small engines, in particular, the carburetor, attributable to the increased water retention by ethanol in fuel.

4.3 Background

The objective of the present work is mainly concerned with determination of maximum possible and optimum replacement of petrol by petrol–ethanol blends and comparing the performance of petrol engines fuelled with these fuel combinations. The effects of different ethanol–petrol blended fuels on the performance, combustion, and emission characteristics of compression ignition engines have been evaluated experimentally and compared.
Ethanol is a quasi-renewable energy source because while the energy is partially generated by using a resource, sunlight, which cannot be depleted, the harvesting process requires vast amounts of energy that typically comes from non-renewable sources. Creation of ethanol starts with photosynthesis causing a feedstock, such as sugar cane or a grain such as maize (corn), to grow. These feed stocks are processed into ethanol. About 5% of the ethanol produced in the world in 2003 was actually a petroleum product. It is made by the catalytic hydration of ethylene with sulfuric acid as the catalyst. It can also be obtained via ethylene or acetylene, from calcium carbide, coal, oil gas, and other sources. Two million tons of petroleum-derived ethanol are produced annually. The principal suppliers are plants in the United States, Europe, and South Africa. Petroleum derived ethanol (synthetic ethanol) is chemically identical to bio-ethanol and can be differentiated only by radiocarbon dating.
Bio-ethanol is usually obtained from the conversion of carbon based feedstock. Agricultural feedstock's are considered renewable because they get energy from the sun using photosynthesis, provided that all minerals required for growth (such as nitrogen and phosphorus) are returned to the land. Ethanol can be produced from a variety of feedstocks such as sugar cane, bagasse, miscanthus, sugar beet, sorghum, grain, switchgrass, barley, hemp, kenaf, potatoes, sweet potatoes, cassava, sunflower, fruit, molasses, corn, stover, grain, wheat, straw, cotton, other biomass, as well as many types of cellulose waste and harvestings, whichever has the best well-to-wheel assessment. Biofuel made from agricultural products (oxygenated by nature) can offer benefits in terms of reduced exhaust emissions and also reduce the world's dependence on oil imports. Moreover, local agricultural industries can be supported and farming incomes enhanced, besides providing a better energy security for many developing countries. Among these, bio-alcohols and vegetable oils or their derived biofuel (methyl or ethyl esters) are considered as very promising fuels. India has rich and abundant resources of both edible and non-edible oil seeds. Non-edible oils from sources such as honge, jatropha, and neem are easily available in many parts of India and are cheap compared to edible oils.
Jatropha curcas is a large shrub or tree commonly found throughout most of the tropical and subtropical regions of the world. Jatropha curcas plant is a drought-resistant, perennial plant living up to 50 years and has capability to grow on marginal soils. It requires very little irrigation and grows in all types of soils. The production of jatropha seeds is about 0.8 kg/m2 per year. The oil content of jatropha seeds ranges from 30 per cent to 40 per cent by weight and the kernel itself ranges from 45 per cent to 60 per cent. Fresh jatropha is a slow drying odorless and colorless oil and it turns yellow after ageing. Honge tree grows mainly in Western India and near Mumbai. The tree

is occasionally seen on roadsides in peninsular India; it is indigenous throughout India from the foothills of the Himalayas down to the south of the Peninsula especially not far from the seacoasts. Karanja trees stand tall, with some trees being over 30m high. Honge trees can grow on moist soil types ranging from stony to sandy to clayey. It does not do well on dry sands but it is highly tolerant to salinity.

Fuel additives are very important, since many of these additives can be added to fuel in order to improve its efficiency and its performance. One of the most important additives to improve fuel performance is oxygenates (oxygen containing organic compounds). Several oxygenates have been used as fuel additives, such as methanol, ethanol, tertiary butyl alcohol and methyl tertiary butyl ether. Ethanol was the first fuel among the alcohols to be used to power vehicles in the 1880s and 1890s. Henry Ford presented it as the fuel of choice for his automobiles during their earliest stages of development.

Presently, ethanol is prospective material for use in automobiles as an alternative to petroleum based fuels. The main reason for advocating ethanol is that it can be manufactured from natural products or waste materials, compared with gasoline, which is produced from non-renewable natural resources. In addition, ethanol shows good anti-knock characteristics. However, economic reasons still limit its usage on a large scale. At the present time and instead of pure ethanol, a blend of ethanol and gasoline is a more attractive fuel with good anti-knock characteristics.

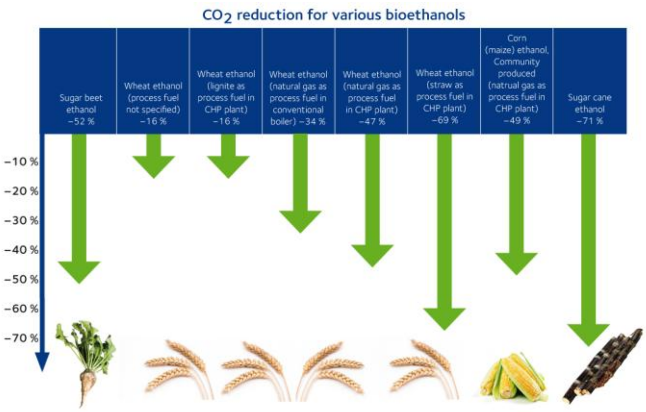

Chart - 2 CO_2 reductions for various bioethanol's

5. EXPERIMENTAL APPARATUS AND PROCEDURE:

5.1 Nomenclature

$(AFR)_{act}$ actual air–fuel ratio of fuel blend
$(AFR)_{st.b}$ stoichiometric air–fuel ratio of fuel blend
$(AFR)_{st.i}$ molar stoichiometric air–fuel ratio of fuel blend
B_p brake power, kW
BSFC brake specific fuel consumption, $kg\,kW^{-1}\,h^{-1}$
$(LHV)_b$ lower heating value of fuel blend, $kJ\,kg^{-1}$
$(LHV)_i$ lower heating value of given component in fuel blend, $kJ\,kg^{-1}$
$\dot{m}_a$ air mass flow rate, $kg\,h^{-1}$
$\dot{m}_f$ mass flow rate of fuel, $kg\,h^{-1}$
N engine speed, rpm
P atmospheric pressure, Pa
Q_f volume flow of fuel, cm^3
Ra air constant, $J\,kg^{-1}\,K^{-1}$
T engine torque, N m
t time required to consume 100 cm^3 of fuel, s
T_a charge temperature at end of induction process, K
T_h temperature difference between charge and engine parts, K
T_0 ambient temperature, K
T_v temperature difference between charge and vapor, K
ΔT total change in charge temperature, K
v_i volume fraction of given component in fuel blend, vol.%
V_s swept volume of engine, m^3

Greek letters

$\eta_{b.th}$ brake thermal efficiency
η_v volumetric efficiency, %
ρ_i density of given component in fuel blend, $g\,cm^{-3}$
ρ_b density of fuel blend, $g\,cm^{-3}$
ϕ equivalence air–fuel ratio

5.2 For petrol ,

Efficiency, η =BP/(m'*CV)
For petrol CV=43000KJ/kg and η=15%
then, m'=(V*ρ)/time
where ρ=790kg/m3.
then time=12.7sec
For blending of 5% ethanol with 95% petrol,
CV=5%(25000)+95%(43000)
Similarly ,time=158secs.
So time increases there is a need for spark retardation.

5.3 Specifications:

Engine	
Displacement (cc)	70
Cylinders	1
Max Power	3.5
Maximum Torque	5
Bore (mm)	46
Stroke (mm)	42
Valves Per Cylinder	2
Fuel Delivery System	Carburetor
Fuel Type	Petrol
Ignition Fly Wheel Magneto 12v, 50w Electronic Ignition	
Spark Plugs (Per Cylinder)	1
Cooling System	Air Cooled

5.4 Engine and equipment

The experiments were conducted on a one cylinder, two stroke spark ignition engine. The engine has a swept volume of 69.799 cm3, a compression ratio of 9:1 and a maximum power of 2.6 Kw at 5000 rpm power and Torque of 5.0 Nm at 3750 rpm.

Fuel consumption was measured by using a calibrated burette and a stopwatch (type Herwins) with an accuracy of 0.2s. The concentrations of the exhaust emissions (CO, CO2 and HC) and air–fuel ratio were measured using a "Sun Gas Analyzer" MGA 1200. The analyzer has a non-dispersive infrared module for CO, CO2 and HC. The sample line tube is fitted to the tailpipe 300 mm away from the exhaust port in order to allow sufficient mixing of the exhaust gases. The MGA automatically requires a 15 min warm up period and then goes into auto-calibration. The concentration of each gas is measured continuously and digitally.

5.5 Fuel

Five different fuel samples were experimentally investigated during this study. Unleaded gasoline and Ethanol, with a purity of 99%, was used in preparing the blends. The unleaded gasoline was blended with ethanol to get 5 test blends ranging from 0% to 20% ethanol with an increment of 5%. The fuel blends were prepared just before starting the experiment to ensure that the fuel mixture is homogenous and to prevent the reaction of ethanol with water vapor. The fuel types properties are shown in Appendix A.

Appendix A. Fuel specification

Property		Gasoline	Ethanol
Formula (liquid)		C_8H_{18}	C_2H_6O
Molecular weight ($kg\,kmol^{-1}$)		114.15	46.07
Density ($kg\,m^{-3}$)		765	785
Heat of vaporization ($kJ\,kg^{-1}$)		305	840
Specific heat ($kJ\,kg^{-1}\,K^{-1}$)	Liquid	2.4	1.7
	Vapor	2.5	1.93
LHV ($kJ\,kg^{-1}$)		44,000	26,900
Stoichiometric air–fuel ratio		15.13	9.00
Enthalpy of formation ($MJ\,kmol^{-1}$)	Liquid	−259.28	224.10
	Gas	−277.0	−234.6

Chart – 3 showing the Fuel Specifications

The engine was started and allowed to warm up for a period of 20–30 min. The air–fuel ratio was adjusted to yield maximum power on unleaded gasoline. Engine tests were performed at 1000, 2000, 3000 and 4000 rpm engine speed at three-fourth throttle opening position. Before running the engine to a new fuel blend, it was allowed to run for sufficient time to consume the remaining fuel from the previous experiment. For each experiment, three runs were performed to obtain an average value of the experimental data. The variables that were continuously measured include engine rotational speed (rpm), torque, time required to consume 100 cm3 of fuel blend (s), air–fuel ratio, CO, CO2 and HC emissions. The parameters, such as fuel consumption rate, equivalence air–fuel ratio, volumetric efficiency, air consumption, brake power, brake specific fuel consumption, brake thermal efficiency, density, stoichiometric air–fuel ratio and lower heating value (LHV) of the fuel blends, were estimated using the following equations. The fuel consumption is estimated by measuring the fuel consumed per unit time and the calculated values of the density for different fuel blends through Eqns. (1) and (2):

$$\dot{m}_f = \frac{3.6 Q_f \rho_b}{t} \tag{1}$$

$$\rho_b = \sum \rho_i v_i \tag{2}$$

The volumetric efficiency is defined as follows:

$$\eta_v = \frac{\dot{m}_a R a T_0}{30 P V_s N} \tag{3}$$

where

$$\dot{m}_a = (AFR)_{act} \dot{m}_f \tag{4}$$

The equivalence air–fuel ratio is defined as

$$\phi = \frac{(AFR)_{st.b}}{(AFR)_{act}} \tag{5}$$

where

$$(AFR)_{st.b} = \sum (AFR)_{st.i} v_i \tag{6}$$

The brake power is calculated by measuring the engine speed and the engine torque and is given by Eq. (7). The specific fuel consumption is defined as the ratio of the fuel consumption to the brake power, as shown in Eq. (8). The brake thermal efficiency is defined as the ratio of the brake power to the heat input for each blend, as shown in Eq. (9)

$$B_p = \frac{NT}{9549.29} \tag{7}$$

$$BSFC = \frac{\dot{m}_f}{B_p} \tag{8}$$

$$\eta_{b.th} = \frac{3600 B_p}{\dot{m}_f (LHV)_b} \tag{9}$$

where

$$(LHV)_b = \sum \left(\frac{\rho_i v_i}{\rho_b}\right) (LHV)_i \tag{10}$$

6. RESULTS AND DISCUSSION:

The effects of ethanol addition to unleaded gasoline on SI engine performance and exhaust emissions at three-fourth throttle opening at variable engine speeds were investigated. The average changes and the mean of the average changes in the values of the parameters of engine performance and exhaust emissions for all fuel blends and the four different engine speeds obtained from the experimental runs are summarized.

Fuel consumption

The effect of the ethanol–unleaded gasoline blends on the fuel consumption is shown. The increases as the E% increases for all engine speeds. This behavior is attributed to the LHV per unit mass of the ethanol fuel, which is distinctly lower than that of the unleaded gasoline fuel. Therefore, the amount of fuel introduced into the engine cylinder for a given desired fuel energy input has to be greater with the ethanol fuel.

Fig 27, for example, show that at the engine speeds of 1000 and 4000 rpm, the relative increase of is approximately 51% and 29%, respectively. In addition, increases about 2.1 times as the engine speed increases from 1000 to 4000 rpm. This increase in could be explained by the fact that as the engine speed increases, the air velocity increases and the pressure decreases at the carburetor venturi. Consequently, the pressure drop between the pressure at the carburetor venturi and the pressure (atmospheric) inside the float chamber increases, which causes more fuel consumption.

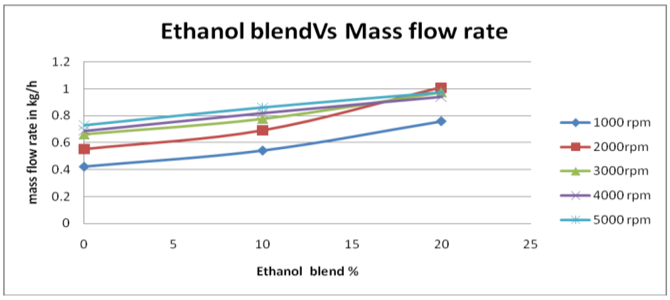

Fig – 5 Variation of Mass flow rate Vs Ethanol blend

6.1 Equivalence air–fuel ratio

The effect of the ethanol–unleaded gasoline blends on the equivalence air–fuel ratio the equivalence air–fuel ratio decreases as the E% increases to 20%. This effect is attributed to two factors: (1) the decrease in the stoichiometric air–fuel ratio of the fuel blends, since the stoichiometric air–fuel ratio of ethanol fuel is usually lower than that of the unleaded gasoline fuel and (2) the increase of actual air–fuel ratio of the blends as a result of the oxygen content in ethanol. For E% exceeding 20%, the behavior is reversed because the actual air–fuel ratio decreases. It is obvious from Fig. 3 that as the engine speed increases to 3000 rpm, decreases, since the amount of air introduced into the engine cylinder increases i.e., the air–fuel ratio increases. This is due to the increase of the amount of air introduced to the engine cylinder (i.e., the actual air–fuel ratio increases). This is due to the increase in the pressure drop from atmospheric pressure to cylinder pressure. Therefore, a greater decrease in the cylinder pressure occurs. With a further increase in the engine speed beyond 3000 rpm, increases, since the air flow into the cylinder, during at least part of the induction process becomes choked. Thus, the amount of air decreases (i.e., the actual air–fuel ratio decreases).

6.2 Volumetric efficiency

There is an increase in the volumetric efficiency as the percentage of ethanol in the fuel blends increases. This is due to the decrease of the charge temperature at the end of the induction process (Ta). This decrease is attributed to the increase in the charge temperature by an amount Th as a result of the heat transfer from the hot engine parts and the residual gases in the charge. At the same time, the charge temperature drops by an amount Tv due to vaporization of the fuel blend in the inlet manifold and engine cylinder. Therefore, the total change in the charge temperature (ΔT) could be expressed by the following simple equation:

$$\Delta T = T_h - T_v \quad \text{and} \quad T_a = T_h + \Delta T$$

As the E% in the fuel blend increases, the volatility and the latent heat of the fuel blend increases. Meanwhile, with increasing volatility and latent heat of the fuel blend, the drop of the charge temperature Tv increases. At the same conditions, the total heat capacity of the charge increases, since the specific heat of the ethanol fuel is higher than that of the unleaded gasoline fuel, and this led to decreases in the drop of the charge temperature Tv. Therefore, increasing the ethanol in the fuel blend has two contradicting effects on Tv. Hence, the value of Tv depends upon which effect is more dominant.

As the quantity of ethanol in the fuel blend increases to 20%, the effect of the increasing volatility and latent heat of the fuel blend is more significant, resulting in Tv increasing. With further increase, the effect of increasing the total heat capacity of the charge is more pronounced, and hence, Tv decreases. For a given engine speed and atmospheric temperature, the difference in temperature between the charge and the hot engine parts and residual gases is constant, i.e., Th ¼ constant. Therefore, Tv changes with E% in the fuel blend as ΔT. This means that Tv changes with the E% in the fuel blends. From the previous discussion, it is clear that as the E% in the fuel blend increases from 0% to 20%, the volumetric efficiency increases due to the ΔT decrease and Tv increase. Conversely, as the E% changes from 15% to 20%, the volumetric efficiency decreases as ΔT increases and Tv decreases. The effect of engine speed on can be also explained from Fig. 4. As the engine speed increases to 3000 rpm, increases, as the amount of air introduced to the engine cylinder increases. Further increase in the engine speed results in a decreasing , where the amount of air decreases as a result of choking in the induction system.

6.3 Brake thermal efficiency

As shown in the figure, decreases as the E% increases. The minimum is recorded with 20% ethanol in the fuel blend for all engine speeds. To discuss the nature of the previous result, it is necessary to discuss the nature of the compression and combustion processes.

The vaporization of fuel continues during the compression stroke. This tends to decrease the temperature of the working charge (i.e., reduces the compression work) and increase the quantity of vapor in the working charge (i.e., increases the compression work). When the latent heat of the fuel used is low, as in the case of unleaded gasoline, the effect of cooling is not sufficient to overcome the effect of additional vapor. Increasing the latent heat of the fuel blend used by increasing the E% increases the effect of cooling (i.e., reduces the compression work).

On the other hand, as E% increases in the fuel blend, the pressure and temperature decrease at the beginning of combustion (i.e., the delay period increases or the crank angle at which maximum pressure is achieved increases).

However, increasing E% increases the air–fuel ratio, i.e., decreases the heat transfer to the cylinder walls (heat losses) due to incomplete combustion, and therefore, increases the value of maximum pressure.
From the previous discussion, it could be concluded that as the E% increases in the fuel blend, the indicated work increases (i.e., increases the indicated efficiency ŋi). Since the mechanical efficiency ŋm is a function of engine speed only, the effect of increasing E% on brake thermal efficiency is the same as that on indicated efficiency

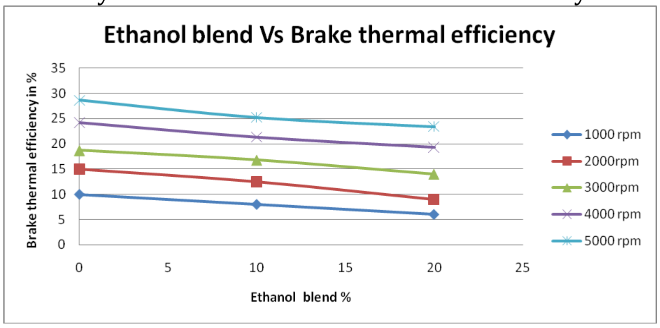

Fig – 6 presents the effect of using ethanol–unleaded gasoline blends on brake thermal efficiency

6.4 Brake torque (T) and brake power (Bp)

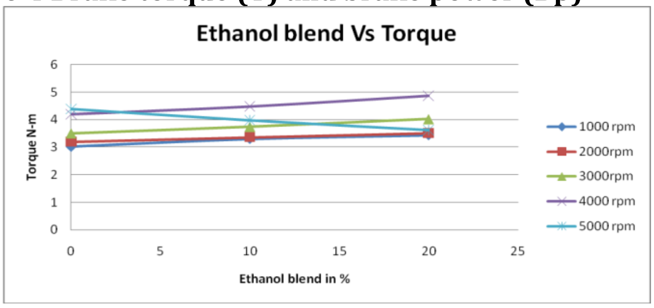

Fig – 7 Variation of Torque Vs Ethanol blend

The effects of ethanol–unleaded gasoline blend on brake torque and brake power is illustrated. It is clear in these two figures that both T and Bp increase as the E% increases for all engine speeds. This increase continues until the E% reaches 20%. This behavior agrees with that of the volumetric and brake thermal efficiencies.

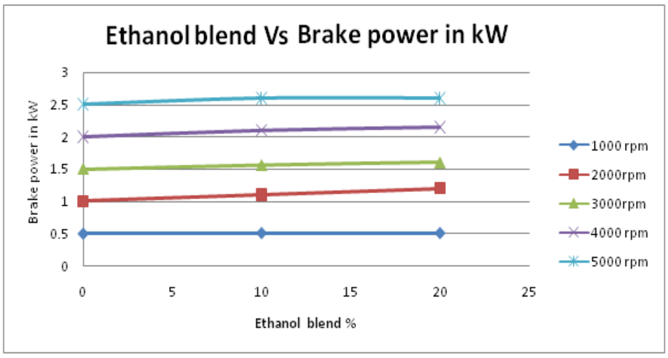

Fig – 8 Variation of Brake power Vs ethanol blend

Generally, the brake torque has a significant dependence on the volumetric efficiency and only a slight dependence on the engine speed. As a consequence, the influence of engine speed on T is similar to its influence on the volumetric efficiency. However, as Eq. (7) shows, the brake power is proportional to the product of the engine torque and speed, which suggests that Bp increases as the engine speed increases.

6.5 Brake specific fuel consumption

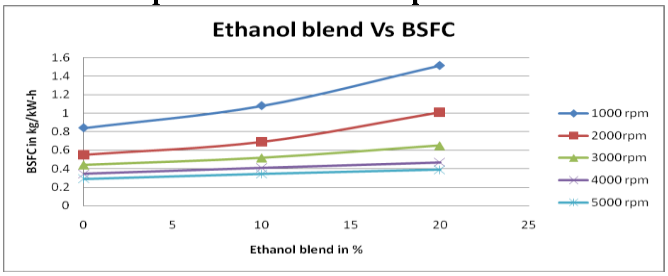

Fig - 9 shows the effect of using ethanol–unleaded gasoline blends on brake specific fuel consumption.

As shown in this figure, the BSFC increases as the E% increases up to 20%. This is a normal consequence of the behavior of the engine brake thermal efficiency shown in Fig. 5. On the other hand, as the engine speed increases to 3000 rpm, the BSFC increase is less. This is due to the increase in and decreases in Ø (Figs. 3 and 5). A further increase in engine speed results in decreasing BSFC, since the decreases and Ø increases.

6.6 Exhaust emissions

Figs. 31-32 show the effect of the E% in the fuel blend on the CO, and HC. From Figs. 9 and 10, it can be seen that as the E% increases to 20%, the CO concentration decrease and HC concentration increases for all engine speeds. This agrees with the behavior shown in Fig. 31. The CO2 concentrations have an opposite behavior when compared to the CO concentrations. This is due to improving the combustion process as a result of the oxygen content in the ethanol fuel.

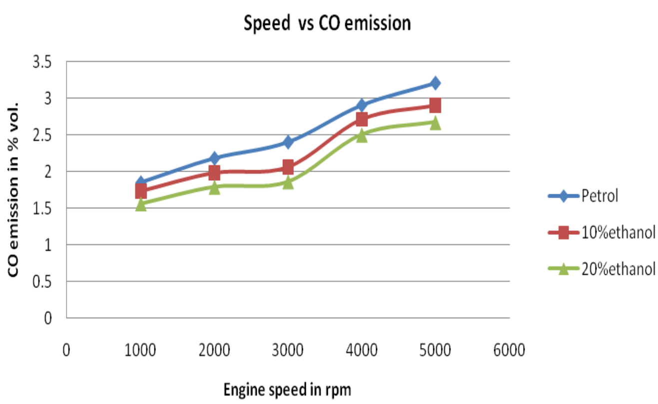

Fig - 10 CO emission Vs Engine speed

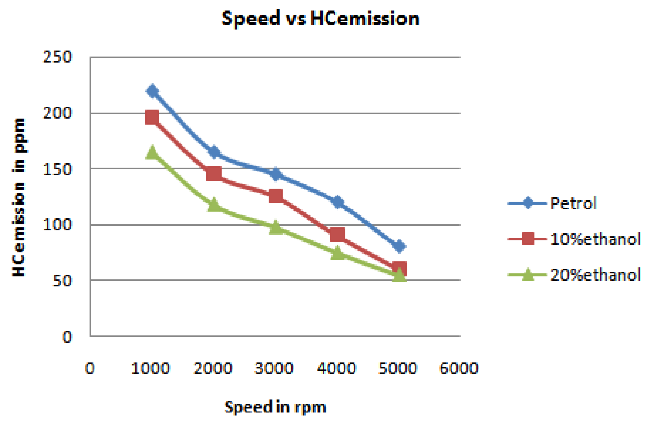

Fig - 11 HC emission Vs. Engine speed

7. CONCLUSIONS

The ethanol as said is one of the clean fuels. The blend with petrol has advantage of emitting lesser emissions as compared with the petrol. Even though the brake thermal efficiency of blends was lesser when compared to petrol, the emissions results are very promising. Thus the

The level of interest in using ethanol as a motor fuel has followed cycles of fuel shortages and/or low feed-grain prices.

Alcohols burn more completely, thus increasing combustion efficiency.

Advantages of mixing ethanol with gasoline are that alcohol tends to increase the octane rating and reduce carbon monoxide emissions.

From the results of the study, the following conclusions can be deduced:

1. Using ethanol as a fuel additive to unleaded gasoline causes an improvement in engine performance and exhaust emissions.
2. Using an ethanol–unleaded gasoline blend leads to a significant reduction in exhaust emissions by about 46.5% and 24.3% of the mean average values of CO2 and HC emission, respectively, for all engine speeds. On the other hand, CO emissions increase by about 7.5%.
4. The 20% ethanol fuel blend gave the best results of the engine performance and exhaust emissions.
5. The addition of 20% ethanol to the unleaded gasoline is achieved in our experiments without any problems during engine operation.

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BIOGRAPHY

Prof. M D Harlapur, working as Assistant professor and Head of Department, in Department of Mechanical Engineering at Rural Engineering College, Hulkoti. He has good sound knowledge in IC Engines and biodiesel.