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Performance Test of IC Engine with Alternative Fuels

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Abstract:- This study discusses performance and exhaust emissions from spark-ignition engine fueled with ethanol–methanol–gasoline blends. The test results obtained with the use of low content rates of ethanol–methanol blends (3–10 vol.%) in gasoline were compared to ethanol–gasoline blends, methanol–gasoline blends and pure gasoline test results. Combustion and emission characteristics of ethanol, methanol and gasoline and their blends were evaluated. Results showed that when the vehicle was fueled with ethanol–methanol–gasoline blends, the concentrations of CO and UHC (unburnt hydrocarbons) emissions were significantly decreased, compared to the neat gasoline. Methanol–gasoline blends presented the lowest emissions of CO and UHC among all test fuels. Ethanol–gasoline blends showed a moderate emission level between the neat gasoline and ethanol–methanol–gasoline blends, e.g., ethanol–gasoline blends presented lower CO and UHC emissions than those of the neat gasoline but higher emissions than those of the ethanol–methanol–gasoline blends. In addition, the CO and UHC decreased and CO_2 increased when ethanol and/or methanol contents increased in the fuel blends. Furthermore, the effects of blended fuels on engine performance were investigated and results showed that methanol–gasoline blends presents the highest volumetric efficiency and torque; ethanol–gasoline blends provides the highest brake power, while ethanol–methanol–gasoline blends showed a moderate level of volumetric efficiency, torque and brake power between both methanol–gasoline and ethanol–gasoline blends; gasoline, on the other hand, showed the lowest volumetric efficiency, torque and brake power among all test fuels.nox depends on engine condition For diesesel engine we take test on biodiesel ,diesel blend ,and butanol-diesel blend. Biodiesel has reduced carbom monoxide emission but incressed NOx emission .

Keywords:- *DI Diesel Engine, Spiral Manifold, Helical Manifold, Helical-SpiralCombined Manifold, Computational Fluid Dynamics (CFD).*

I. INTRODUCTION

The world in the 21st century presents many critical challenges. One of the most important challenges is the environment. As population increases and the standard of living improves, There is a growing concern that there will be a shortage of energy to heat our homes and power the vehicles on which we so heavily depend. We must also remember the need for clean air, clean water, cleaner burning fuels, and biodegradable, renewable materials. For many years the government and public demanding an increasing in fuel efficiency and reduction in pollutants emission from engine.

The urgent need for alternative fuel is essential to replace the supplement conventional fuels. The root causes for these emissions are non-stoichiometric combustion, dissociation of nitrogen and impurities in the fuel and air. This can be achieved by using plastic extracted fuel since plastic has long polymer chain so its calorific value is more. Due to proper combustion it has low knocking effect and has less emission of exhaust.

There are some other fuel those can full fill the requirement of gasoline such as methnol,natural gas, acetone, diethyle ether, there are lots of research work going on to find out best economical fuel, low consumption add less harmful to environment.Here, we take 5% to 15 % of blend of different fuels mixtures to know about performance characteristics because till 15% we can run engine without any modification.

➢ *Alternative Fuel Mixture For Si Engine[4],[5]*

- Ethanol –petrol blend containing ethanol 5%(E5),10%(E10),15%(E15)
- Methanol –petrol blend containing ethanol 5%(M5),10%(M10),15%(M15)
- benzol –petrol blend containing ethanol 5%(B5),10%(B10),15%(B15)

➢ *Alternative Fuels Mixture For Ci Engine[2],[3]*

- butanol –bio diesel mixture containing butanol 5%(BU5),10%(BU10),15 %(BU15)
- diesel mixture with bio diesel 5%(BI5),10 %(BI10), 15 %(BI15)

SI Engine Fuels [3]

- Fuel has easy air fuel mixture resistance to auto ignition. Oxygen Reactivity resistance :low reactivity, (i.e Octane no),gasoline carbon no =4-12

CI engine fuels[1]

- Fuel has Easy injection with high momentum and good spray formation for efficient mixing of fuel vapor and air Good ignitability: high reactivity(i.e cetane no) Oxygen content Reactivity : high reactivity Cetane Number(CN) Diesel Oil Carbon Number= 15–19

➢ *Experimental Setup*

Engine specification

SPECIFICATION	PETROL ENGINE	DIESEL ENGINE
ENGINE	GREVES	KIRLOSKER
BHP	2.5	5
RPM	3000	1500
FUEL	PETROL & BLENDS	DIESEL & BLENDS
NO. OF CYLINDERS	SINGLE	SINGLE
BORE	70mm	
STROK LENGTH	66.7mm	
STARTING	ROPE & PULLEYSTARING	HANDLE
WORKING CYCLE	OTTOCYCLE	DIESEL CYCLE
METHOD OF COOLING	AIR COOLED	AIR COOLED
METHOD OF IGNITION	SPARK IGNITION	COMPRESED IGNITION
COMPRESSION RATIO		
SPARK PLUG	MICO	NO
CARBURATOR	GREVES	KIRLOSKER
GOVERNOR SYSTEM	MECHANICAL	MECHANICAL

Table 1:- Engine characteristics

- *Experimental Setup*

Fig 1:- Shows arangement of si engine

Fig 2

Fig 3:- Shows Setup For CI Engine

➢ *Instrumentation*

- Digital RPM Indicator to measure the speed of the engine.
- Digital Temperature Indicator to measure various temperatures.
- Differential manometer to measure the quantity of air sucked into cylinder.
- Burette with manifold to measure the rate of fuel consumption during test.
- ORSAT Apparatus for analysis of Exhaust gas.
- Dynamometer arrangement for calculating torque.

➢ *Theory*

Internal combustion engine needs fuel, ignition and compression in order to run. In a four-stroke engine, the cycle of operation is completed in four strokes of the piston or two revolution of the crankshaft. During the four strokes there are five events to be completed viz., suction, compression, combustion, expansion and exhaust. Each stroke consists of 180degree of crankshaft rotation and hence a four-stroke cycle is completed through 720degreeof crankshaft. The cycle of operation for an ideal four stroke SI engine consist of the following four strokes.

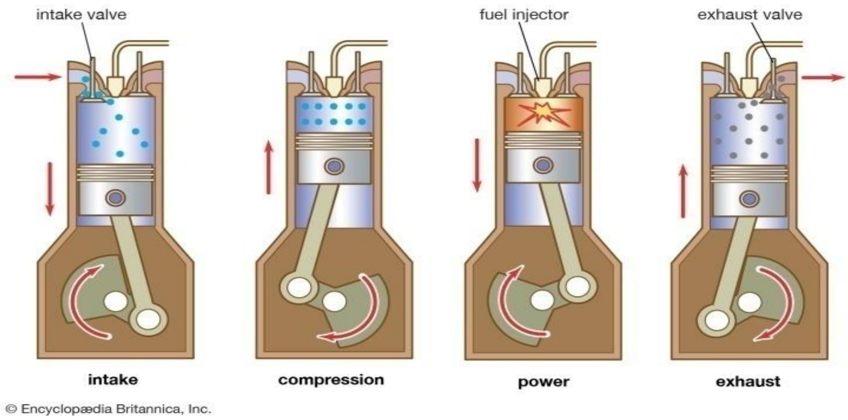

Fig 4:- Shows working of diesel engine

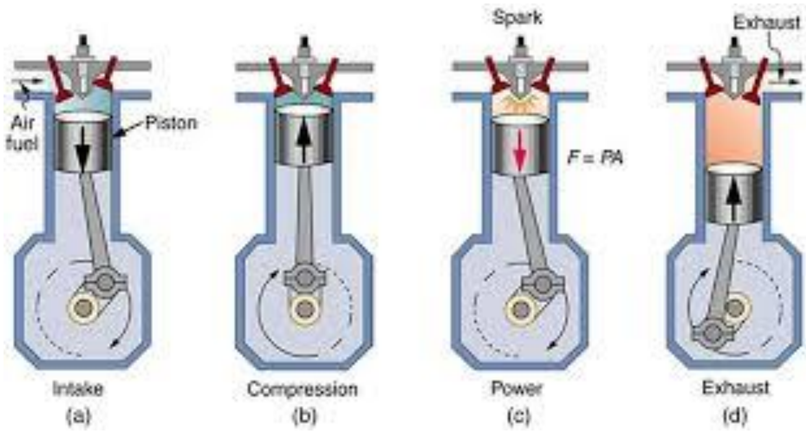

Fig 5:- working of si engine

Calculation

- BRAKE POWER (BP)= 2πNT* 9.81/60000.......kw

Where, T=Torque=W*R.
W=Load from the spring balance in kg.
R=Arm length =20mm
N=RPM of the engine.

- MASS OF FUEL CONSUMED(MFC)=(x*0.72*3600)/(1000*T)….. kg/hr
- For ci engine mfc = x*804/30

Where, X=Burette reading in cc.
0.72=Density of petrol in Gram/cc.
T=time taken in seconds.

- SPECIFIC FUEL CONSUMPTION(SFC)=(MFC/BP) ………………..kg/kWhr

- ACTUAL VOLUME OF AIR SUCKED INTO THE ENGINE CYLINDER(Va)=Cd*A*(2gH).5*3600.m^3/hr

Where=(h/1000)*(dw/da)……meter of water
A=Area of orifice meter=(πd 2 /4)
h=manometer reading in mm.
(dw/da)=density of water =1000kg/m3
Cd=co-efficient of discharge =0.62

- SWEPT VOLUME(VS)=(πd 2 /4)*L*(N/2)*60

Where, d=diameter of bore =70mm
L=length of stroke=66.7mm
N=Speed of the engine in RPM.

- VOLUMETRIC EFFICIENCY ηv=(Va/Vs)*100%
- BRAKE THERMAL OR OVERALL EFFICIENCY ηbth=(Bp*100)/(MFC*Cv)….%

Where, Cv=Calorific value of Petrol =45800…KJ/Kg & Diesel45500....KJ/KG
BP=Brake power in KW.

II. RESULT & ANALYSIS

➢ *Mass fuel consumption (MFC)*

✓ At 5% blend methanol and petrol has nearly equal MFC.
✓ With increase in load MFC will increase.
✓ Benzol and Ethanol has nearly equal values.
✓ At no load condition all fuel has nearly equal value.

- Fuel consumption is slightly more than petrol when it blended. Due to the blending RPM will increase and hence BP will increase so it consumes more fuel
- Mas fuel cosumption in kg /hr

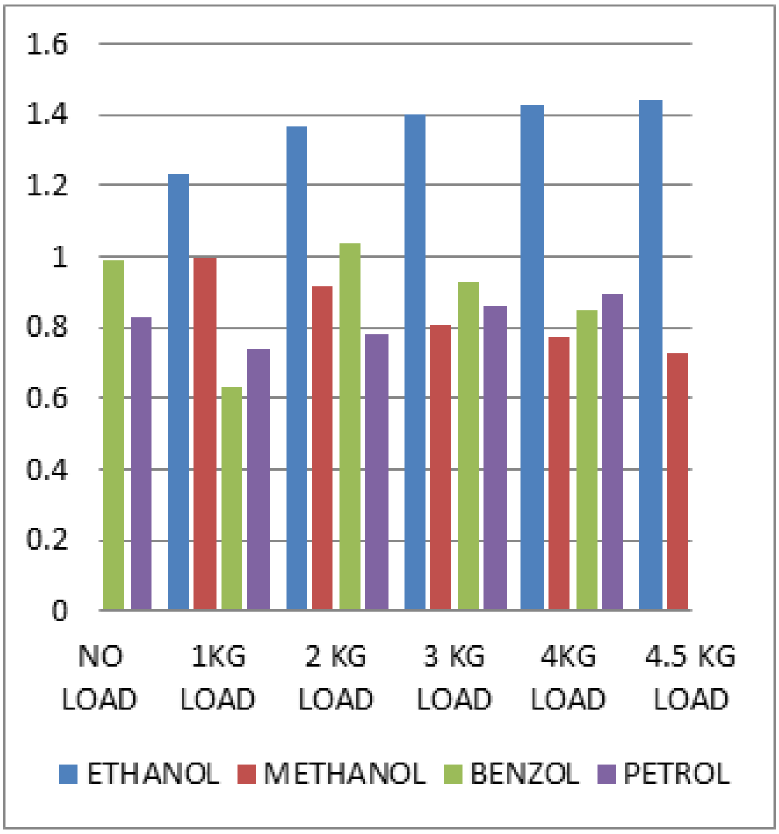

Fig 6:- (MFC VS LOAD FO 5% BLEND)

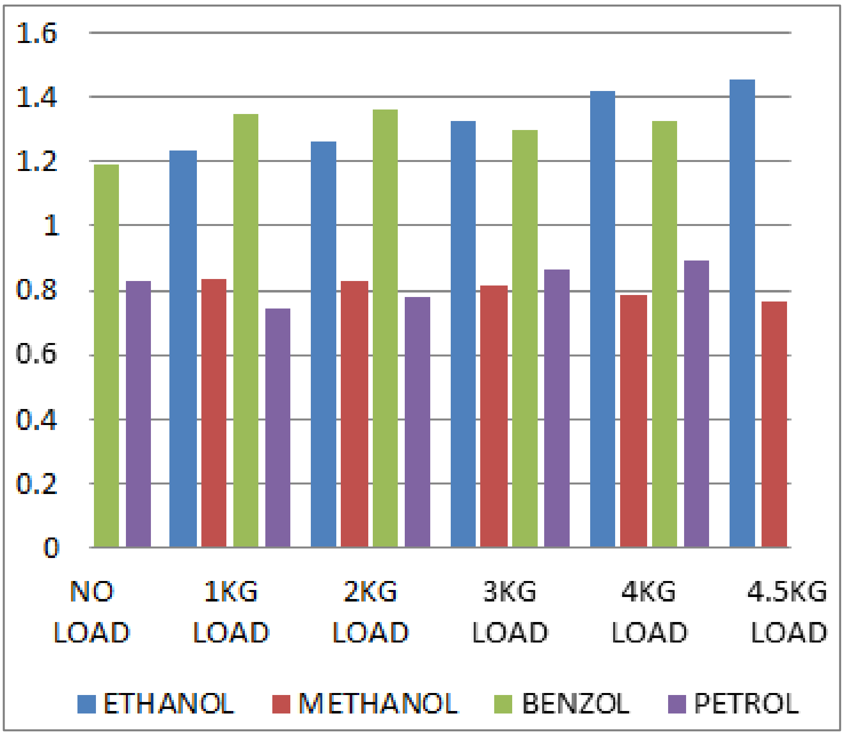

Fig 7:- MFC VS LOAD FOR 10% LOAD

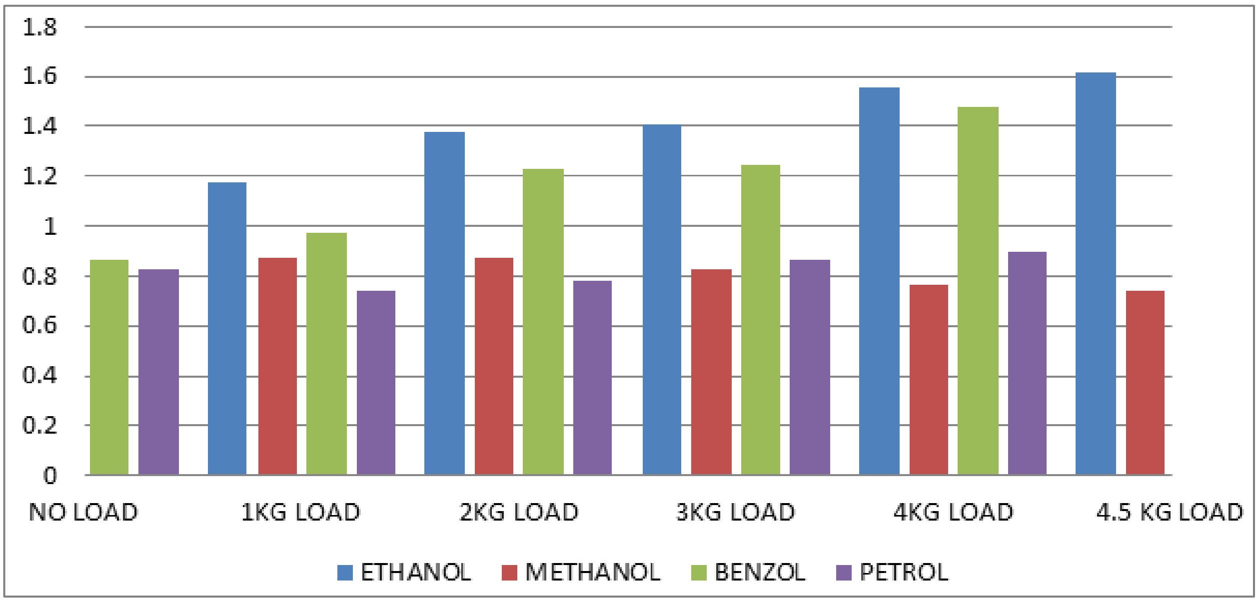

Fig 8:- (MFC VS LOAD FOR 15% LOAD)

❖ *Specific Fuel Consumption*

Specific fuel consumption means fuel consumed per unit power output. according to our analysis we found SFC for blended fuel is slightly more than petrol. At higher load SFC of blended fuel is less.
SFC in gm/ W hr

- *Ethanol:-*

✓ For E5 and E10 SFC is nearly same
✓ E15 has slightly different value
✓ Upto 3kg load SFC of petrol is less than blended fuel then after petrol has higher value of SFC. So at higher load blending has good impact on SFC.

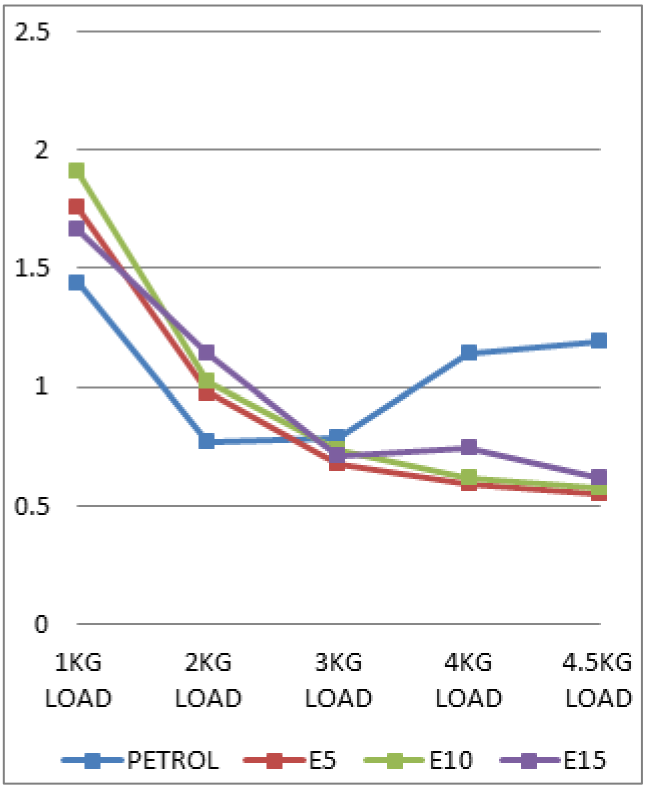

Fig 9:- sfc (gm/Whr) vs load for ethanol

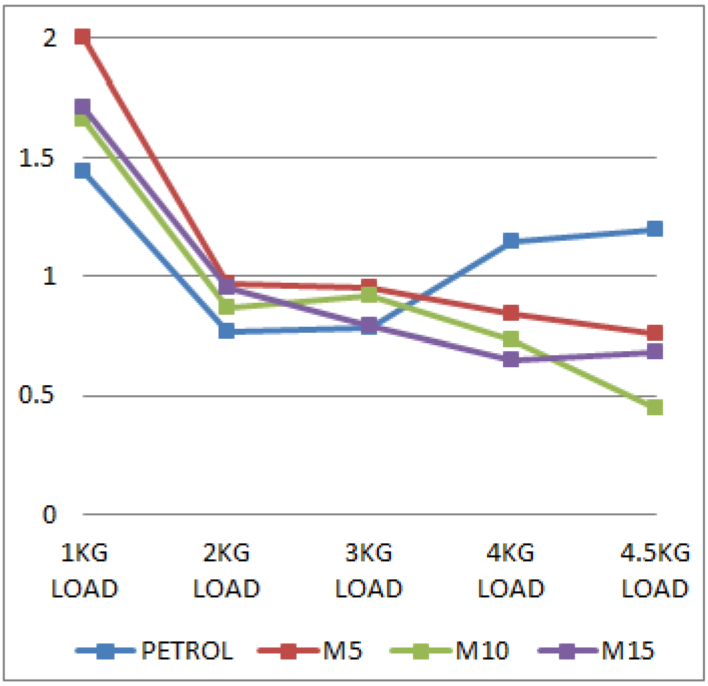

Fig 10:- sfc (gm/Whr) vs load methanol

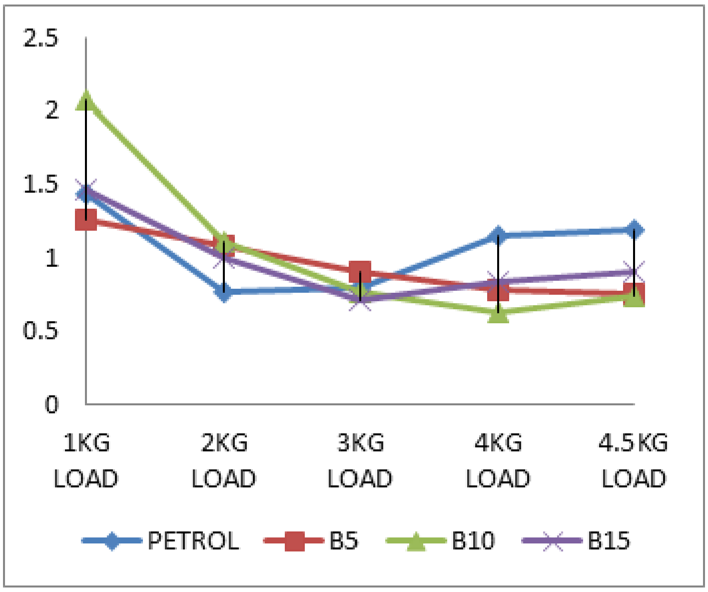

Fig 11:- sfc (gm/Whr) vs load for benzol

- *Methanol*
- ✓ The value of SFC for M5 is slightly different from M10 and M15.
- ✓ The values are nearly equal to Ethanol.
- ✓ Upto 3kg load SFC of petrol is less than blended fuel then after petrol has higher value of SFC. So at higher load blending has good impact on SFC.

- *Benzol*
- ✓ Among all three blend condition Benzol Petrol has nearly equal value of SFC.
- ✓ As like Petrol its value is less up to 3 kg then it increases with increase of load.
- ✓ There is significantly change of values with the mixture strength for same load.

➢ *Emission analysis*

Carbon dioxide(co2)

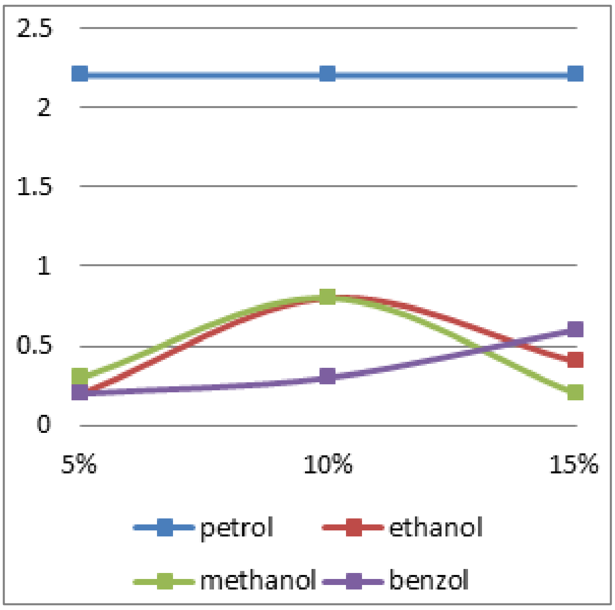

Fig 12:- Emission oif co2

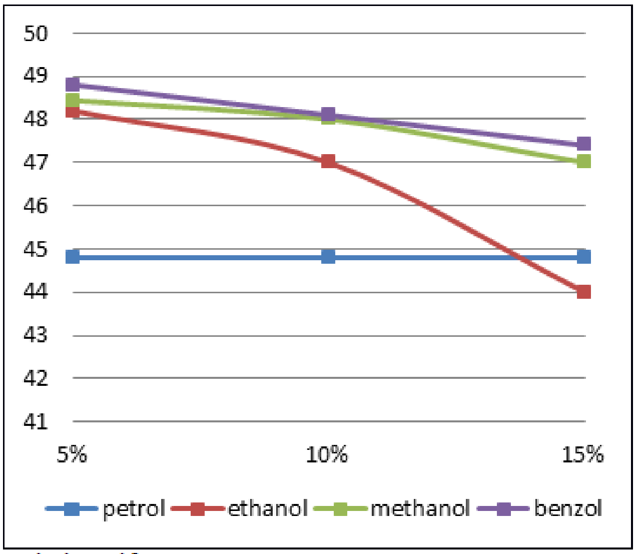

Fig 13:- Emission of oxygen

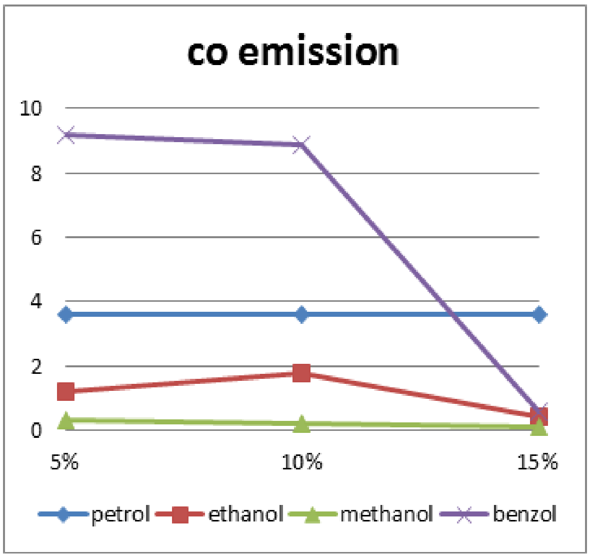

Fig 14:- Shows emission of co of blend with petrol

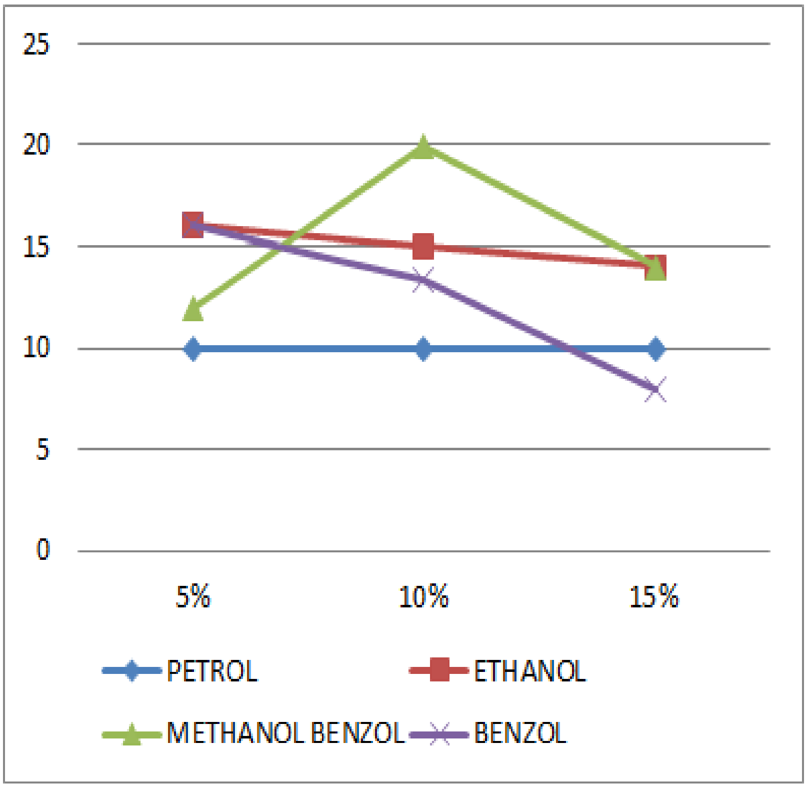

Fig 15:- Shows blend vs brake thermal efficiency (ηb

➢ *Oxygen*
- For benzol oxygen output is highest among all.
- Methanol has slightely more value then ethanol
- Petrol has least value.
- For all blending condition with increase in strength Oxygen content get decrease.

➢ *Carbon Dioxide*
- For benzol with increase in strength CO2 content will increase.
- At 10% blend both methanol and ethanol has highest value CO2 emission.
- At 10% both ethanol and methanol has nearly equal value of CO2 emission.
- Petrol has highest CO2 emission.

➢ *Carbon Monoxid*
- After blending with benzol there is drasticaly change of CO emission.
- For benzol with increase in mixture strength CO emission will decreases.
- For ethanol at 10% blend CO emission is more.
- Methanol has very less CO emission and it gradually decrease with increase in strength

➢ *Brake Thermal Eficiency*
- After blending break thermal will increase significantly.
- For both ethanol and benzol BTE will decrease slightly with increase in strength of the blend.
- At 10% Methanol blend it has highest BTE
- For most of the cases ethanol has better value of BTE

- *For Ci Engine*

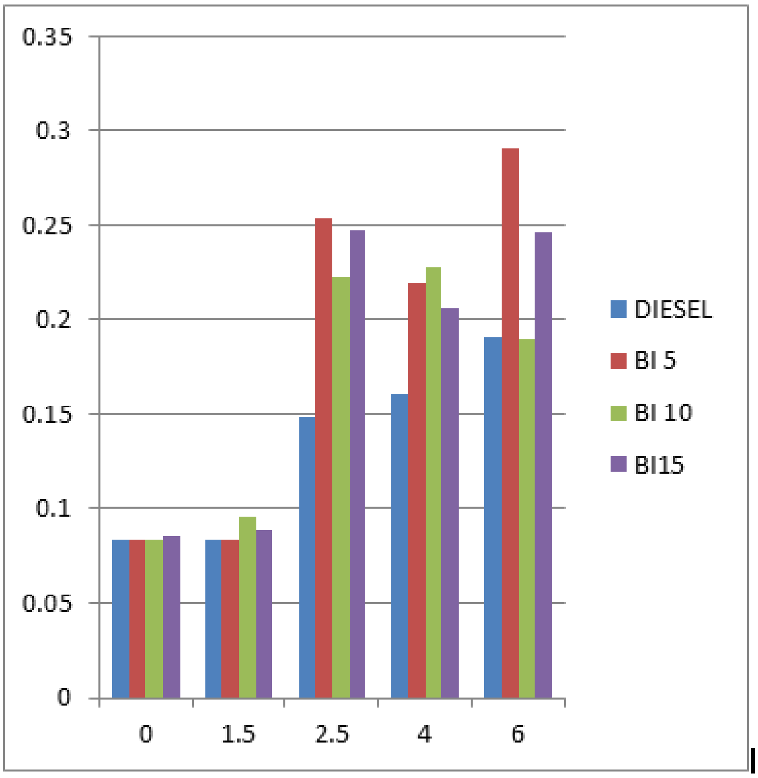

Fig 16:- MFC VS LOAD FOR BIODIESEL BLEND WITH bio diesel(JATHROPHA OIL) fig 8

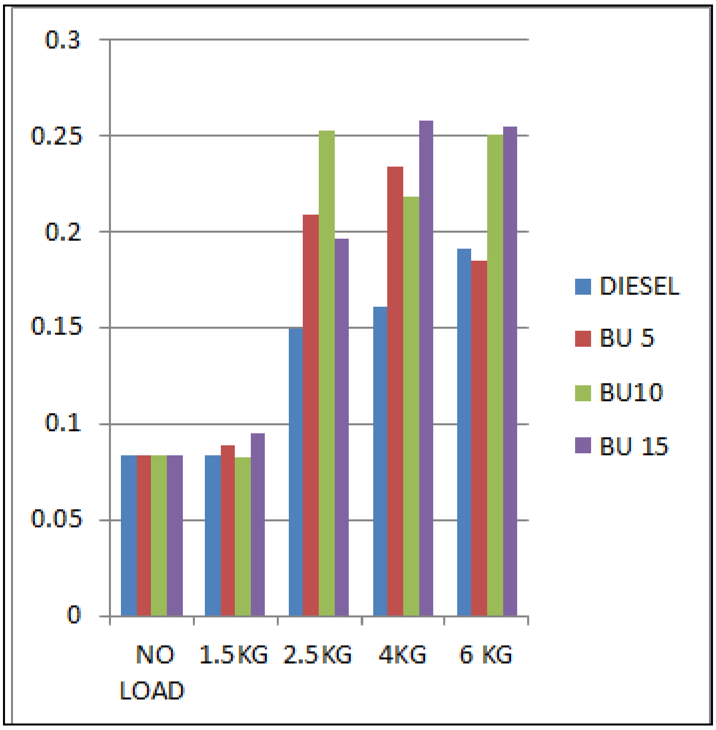

Fig 17:- MFC vs load for butanol blend & diesel

- *mass fuel consumption vs load*
  At 5% blend till 1.5 kg load has nearly equal MFC.

- ✓ With increase in load MFC will increase.
- ✓ diesel and biodiesel blend has nearly equal values.
- ✓ At no load condition all fuel has nearly equal value.

- Fuel consumption is slightly more than petrol when it blended. Due to the blending RPM will increase and hence BP will increase so it consumes more fuel
- Mas fuel cosumption in kg /hr

❖ *Specific Fuel Consumption Vs Load*

- Till 1.5 kg load sfc will nearly equal after that sfc increase with load.
- Biodiesel 10% blend has nearly equal value of diesel .
- Bio diesel 10 % is perfect for diesel engine

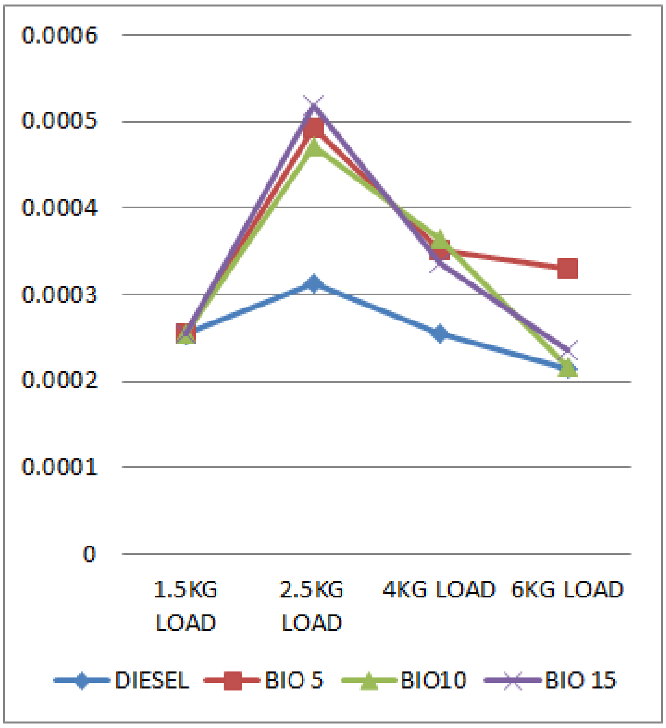

Fig 18:- sfc vs load of different blend

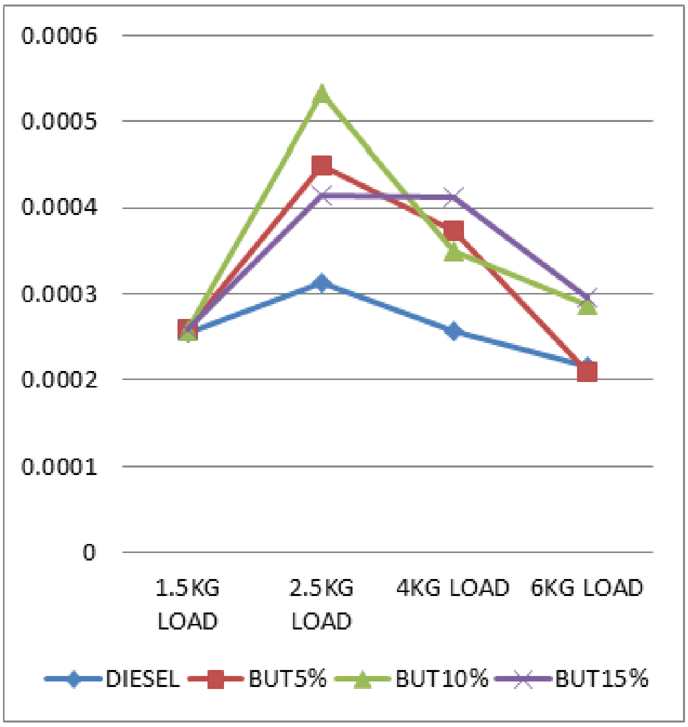

Fig 19:- sfc vs load of different blend of butane of bio diesel

➢ *Brake thermal efficiency vs blend*

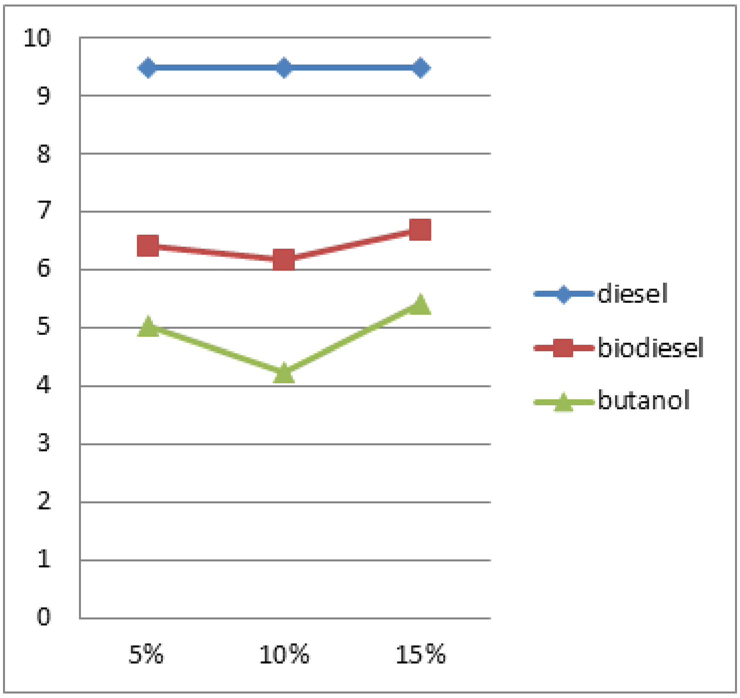

Fig 20

➢ *Brake thermal efficiency*

- After blending break thermal will increase significantly. At 15 % biodiesel blend it has highest BTE For most of the cases bio diesel has better value of BTE

➢ *Emission*

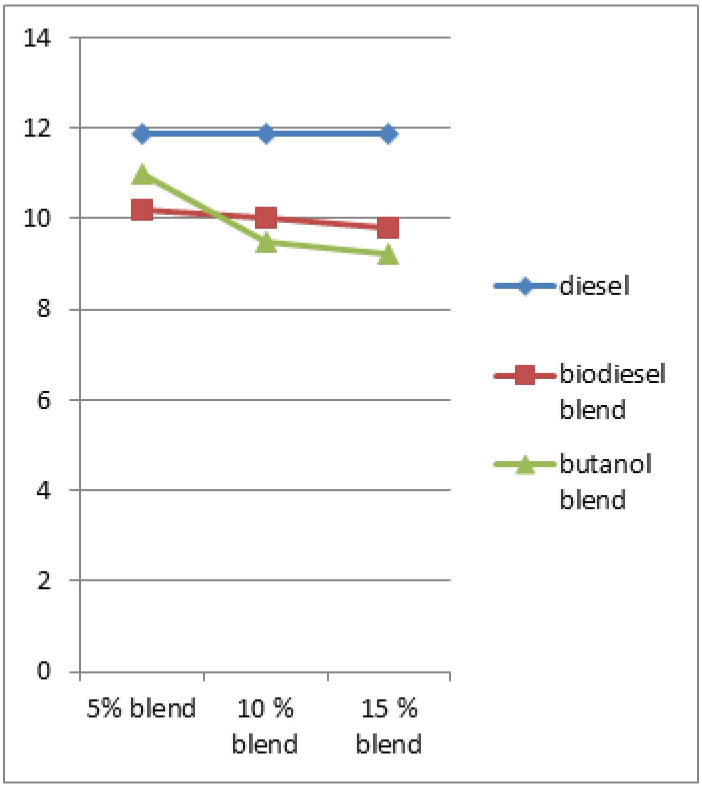

Fig 21:- Emission of carbon dioxide in%

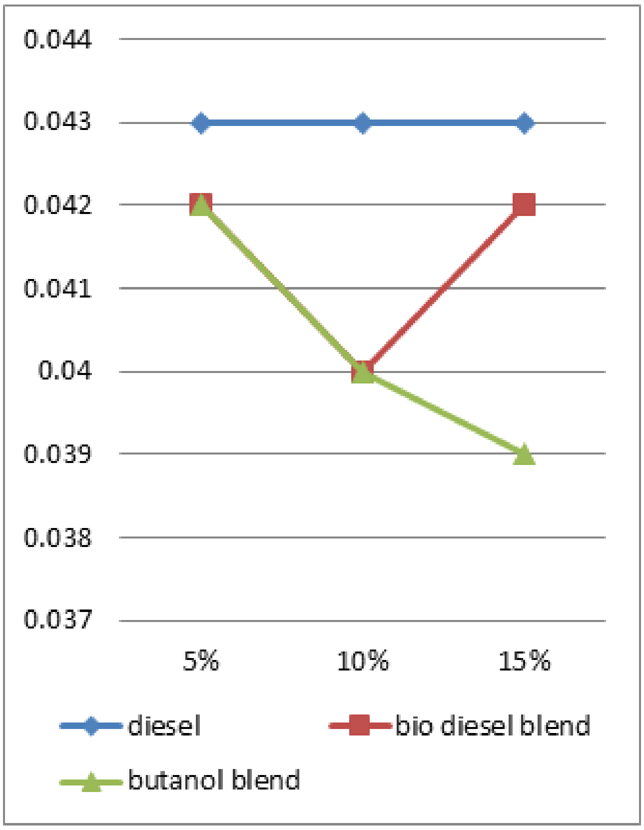

Fig 22:- Emission of carbon monoxide in %

➤ *Oxygen content*

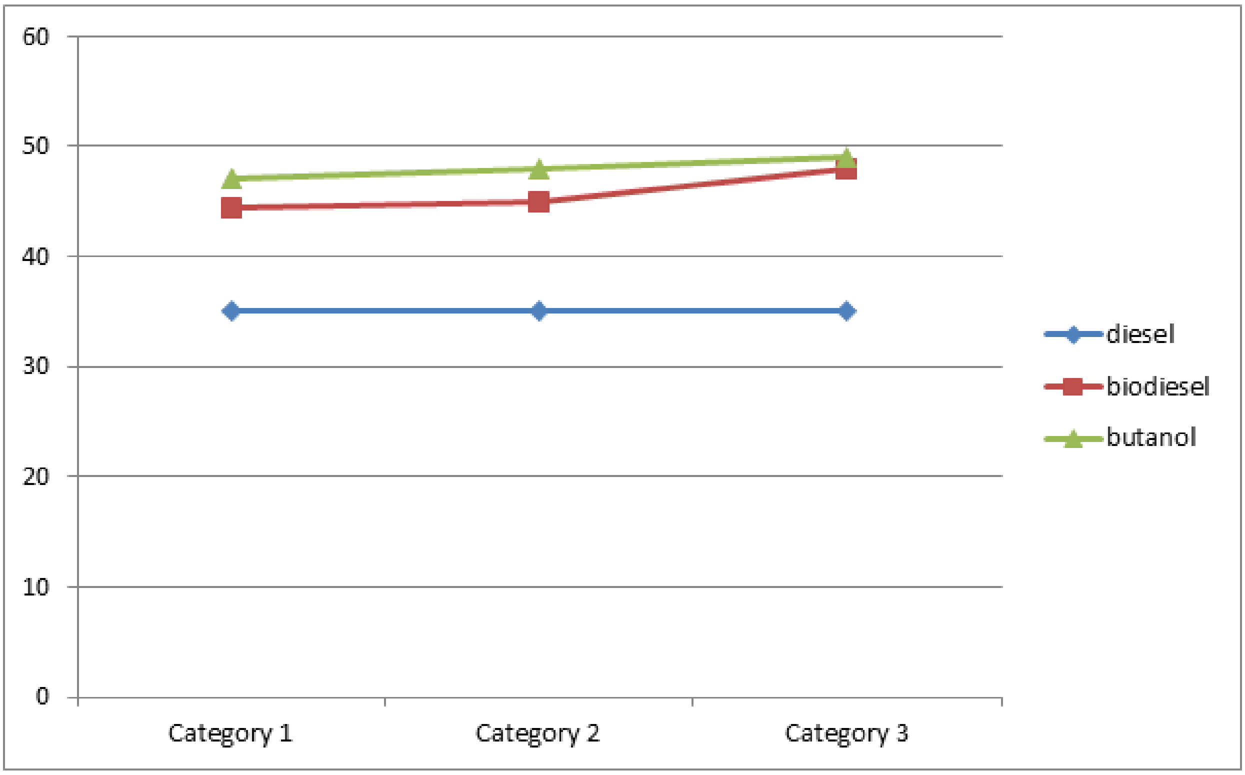

Fig 23:- Emission of oxygen in %

III. DISCUSSION

From the above experiment we investigate that after blending with ethanol and methanol break thermal efficiency will increase. Oxygen content in exhaust will increase but at the same time SFC will decrease for low load condition.CO2 and CO will decrease significantly. So blending of ethanol and methanol leads good control over exhaust gas. Most of the cases methanol at 10% is good enough. the values of methanol and ethanol blended fuel are nearly equal but the calorific value of ethanol is more than methanol so the combustion will better for ethanol and hence it has high octane number.

As Benzol is an aromatic compound so its combustion is better than methanol and ethanol but it produces more CO in the output of exhaust. Its BTE nearly equal to petrol.SFC for benzol is nearly equal to SFC of ethanol.From emission diagram we know that biodiesel blend & butanol blend emit less carbon monoxide ,carbon dioxide than diesel Butanol emit less carbon dioxide than biodiesel blend .As blend strength increae there is increase in oxygen content in smoke & less carbon dioxide & carbon monoxide Ethanol blend can used for si engine ,biodiesel blend for ci engine.

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