Investigation on Performance and Emission Characteristics of a Diesel Engine Using Ethanol as Fuel Additive

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Abstract— Air pollution is the most serious environmental problem across the world. Diesel emission also the major part of the air pollution. The global pollution of environment is generally caused by using of fossil based fuels. Many researches on the reduction of pollution have been in progress. For this purpose, some of the researches have been focused on fuel additives to reduce harmful emissions. So my aim is carried out to analyze the performance of engine and level of variation of exhaust emissions on single cylinder, four stroke, CI engine by adding ethanol in different ratios to diesel. Starting from 0% to 15% ethanol in steps of 5%. It is observed performance increases in terms of efficiency that the exhaust emissions CO , HC,CO2 NO and soot are considerably decreased

Index Terms— Diesel, Ethanol, Exhaust Emissions, Performance, CI Engine

1 INTRODUCTION

THE oxygenated compounds such as alcohols into diesel fuel is today the best way to have results in matter of pollution. Direct ethanol/diesel fuel blends and emulsions are among the most used alternatives. . The use of ethanol in diesel engines is, to begin with, unusual in that the ignition capacity of the diesel fuel is hindered by ethanol. But the addition of 0 to 15 %not effected the value of cetane number largely. The initial investigations into the use of ethanol in diesel engines were carried out in South Africa in the 1970s and continued in Germany and the United States during the1980s . Most of these works relate a reduction in the smoke and particle levels emitted in the exhaust. The easiest method by which alcohols can be used in diesel engines is in the form of blends. Pure ethanol is completely miscible with diesel fuel at temperature in excess of about 30◦C. At lower temperatures, or when the ethanol contains water, miscibility is limited Co. Solvents, such as ethyl acetate, may be added to increase the range of miscibility

To Perfomance tests were conducted for investigation ofindicated themal efficiency,Mechanical efficiency,Exhaust temperatue,brake specific fueel consumption while exhaust emission were analyzed for CO, CO_2, HC ,NO and Soot

2 EXPERIMENTAL SETUP

2.1 Set Up

Four stroke single cylinder engine is connected to the mechanical load by using pully. U tube manometer ,airfilter,fuel measuring tube,a five gas analyzer and opacity meter is also connected to the engine as shown in fig 1.

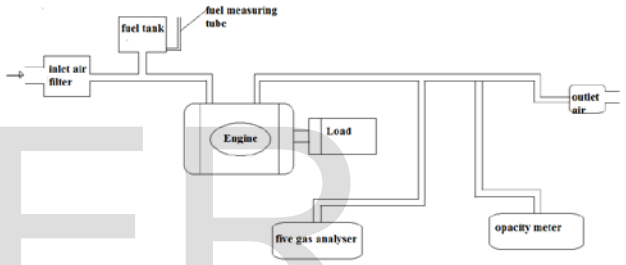

fig 1:layout

2.2 Specification

Engine

Number Of Cylinder - 1
Rated Power - 7.46kW
Rated Speed - 1000RPM
Bore - 114.3mm
Stroke - 139.7
Cylinder Capacity - 1432.7cc
Compression Ratio - 1:19
Injection Pressure - 175kg/cm²
Maximum Torque - 70.20Nm @1000RPM

2.3 Exhaust Gas Analyzer

The DELTA 1600-L determines the emissions of CO(%), CO_2(%), HC(ppm), with means of infrared measurement and O_2(%) and NO(ppm) with means of electrochemical sensors. The 5-gas analysis is processed by the integrated micro processor and described in the display.

2.4 Opacity Meter

Smoke opacity instumenta measure optical properties of diesel smoke.Opacity meter ,which evaluate smoke in the exhaust gas,and smoke number meters, which optically evaluate soot collected on paper filter.

2.5 PROCEDURE

The engine was started in pure diesel at no load condition. The engine was running at 10 minutes and then loaded to the test points. The above emissions were begun to measure when coolant and exhaust temperatures reached equilibrium. During this time, RPM and torque were maintained constant. In this engine governing system maintained constant speed. The engine was tested at six loads at1000 rpm. The coolant flow is also maintained constant . The engine speed, time for 10cc fuel consumption, exhaust temperature and exhaust gas emissions were noted down. Then engine is allowed to cool down sufficiently, before running the engine to a new fuel blend. The experiment repeated in different ratio 5 10 15 percentage ethanol blends.

3 RESULTS AND DISCUSSIONS

The results of analysis of experiment, both for performance and emission are discussed in this section.

3.1 Variation in Engine Performance

The thermal and mechanical efficiencies of engine with the engine power on tested speeds and loads when fuelled by with and without fuel blends of 5%,10%,15%..The test results show that there is a significant increase in the brake thermal efficiencies and mechanical efficiencies for different blends compared with those of diesel as shown in fig 2 , fig 3. The increase in efficiency were noticed when the loads were increased from low to highTemperature effect also shown in fig4.

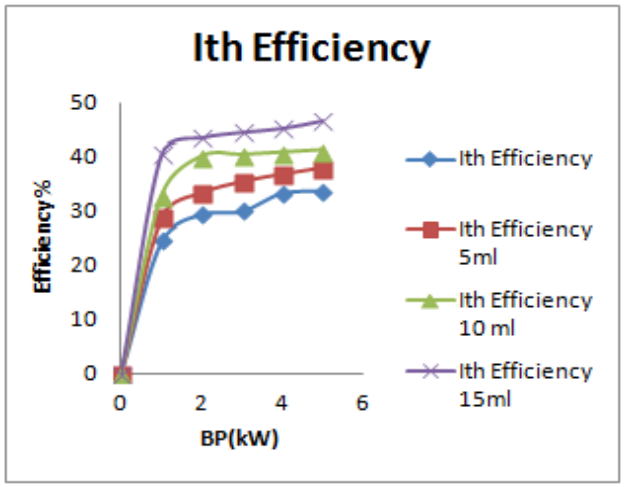

Fig 2: Thermal Efficiency Vs Bake Power

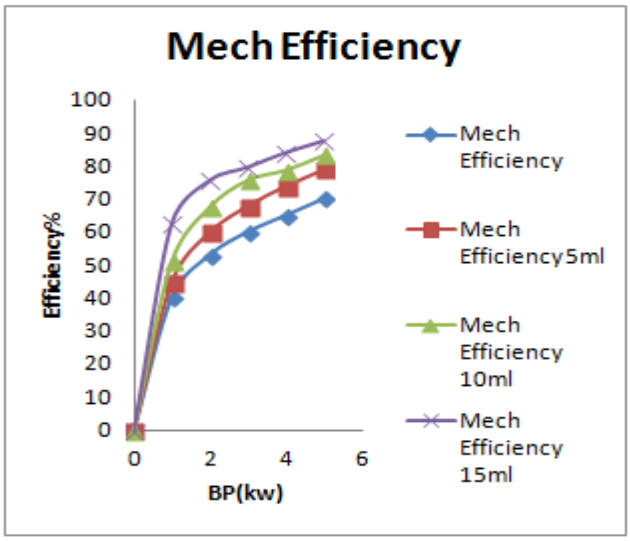

Fig 3: Mechanical Efficiency Vs Bake Power

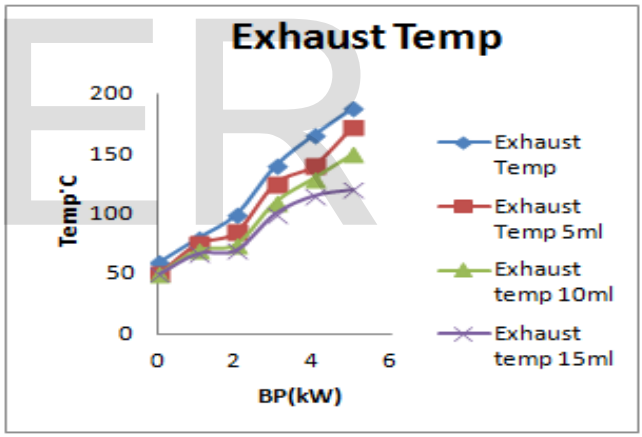

Fig 4:Exhaust temperature Vs Bake Power

3.2 Brake Specific Fuel Consumption

Fuel consumption is an important criteria, it is obvious that the SFC decrease with the increasing of load. Because ethanol has lower calorific value than that of diesel . As the calorific value of diesel decreases with increase in the proportion of ethanol,. Brake specific fuel consumption is decreasing with the increasing of loads as shown in fig5. SFC for ethanol diesel blends lower than that of diesel. This is due to the fact that the low heat value of ethanol than that of diesel

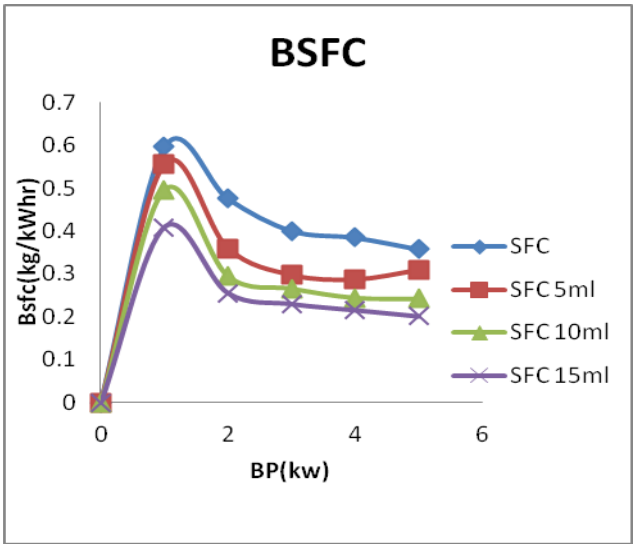

Fig 5: Brake Specific Fuel Consumptionvs Bake Power

3.3 Emission Characteristics

The test results for different blends for various blends of ethanol with diesel are plotted as graphs below.

Carbon Monoxide Carbon Dioxide

CO decreases with increase in loads for all the blends. If % of additive increases CO reduces. This is due to cleaner combustion of mixture. Because the ethanol contains more quantity of O_2 which provides sufficient conversion of CO to CO_2.So CO_2correspondingly increase, but level of increasing decreasesas shown in fig 6 and fig7.

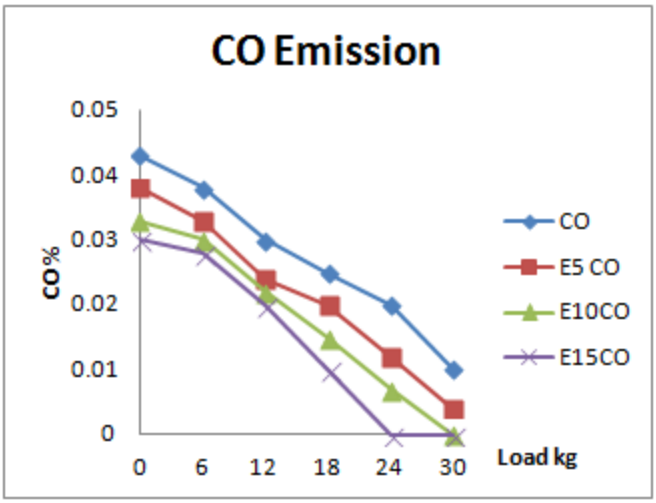

Fig 6: Carbon Monoxide Vs Various Loads And Blends.

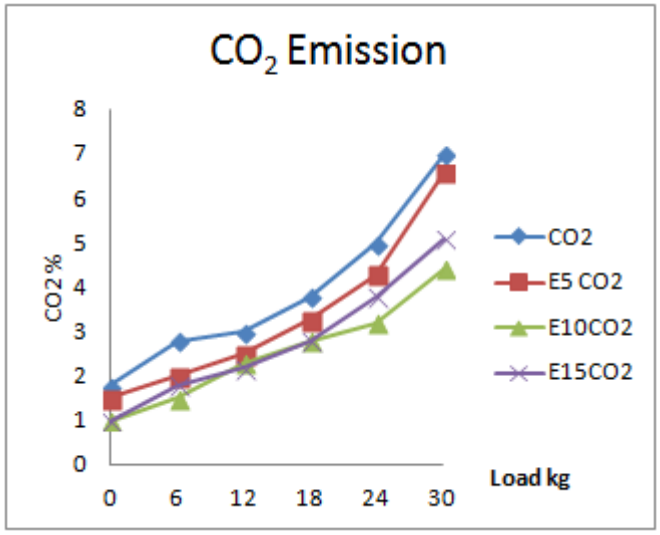

Fig 7 : Carbon Dioxide Vs Various Loads And Blends.

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Hydrocarbon

HC increases with increasing load for all the blends. If % of additive increases HC is found to reduce in generalas shown in fig8.

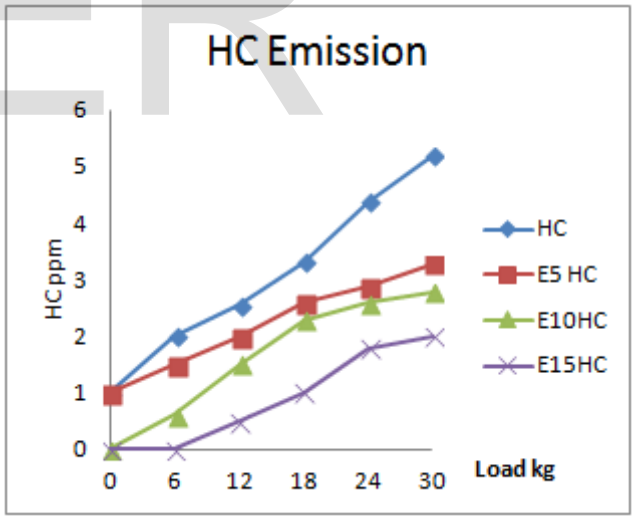

Fig 8: Hydrocarbon Vs Various Loads And Blend

Nitrogen Monoxide

NO increases with increasing load for all the blends. If % of additive increases NO is found to reduce in generalas shown in fig 9.

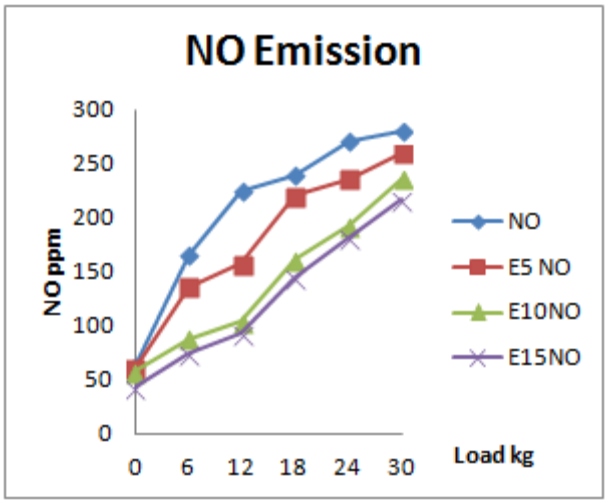

Fig 9 : Nitrogen Monoxide Vs Various Loads And Blends

Soot

Soot increases with increasing load for all the blends. If % of additive increases soot is found to reduce in general as shown in fig 10.

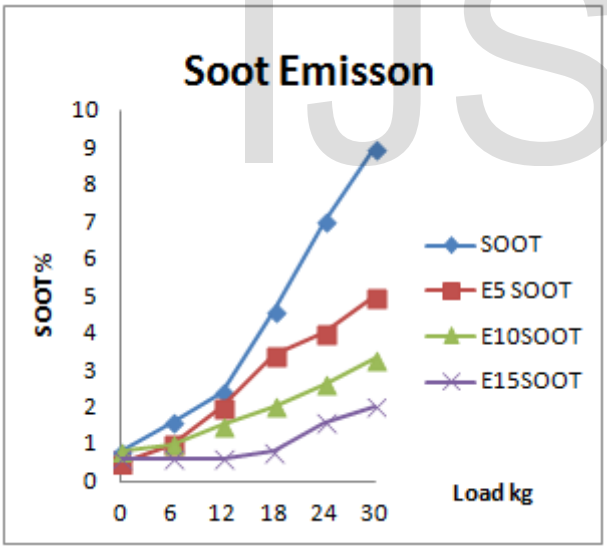

Fig 9 : Nitrogen Monoxide Vs Various Loads And Blends

4 Conclusion

An experimental investigation was conducted on the solubility of the blends of ethanol with diesel and the effects of the application of these blends on the engine performance parameters. The tested blends were from 5% to 15% of ethanol by volume; The engine was operated with each blend at different loads on which the engine speed run at the constant speed of 1000 rpm From the test results, the following conclusions can be made.

Ethanol can be blended with diesel without the assistance of additive. The thermal efficiencies of the engine fuelled by the blends were comparable with those fuelled by pure diesel, with extent increases at different loads and speeds.
Test conducted in 3 ratio(5%,10%,15%) and it compared to pure diesel
From the above ratio 15% gave best result
With the increase of ethanol, performances increases and CO ,HC emissions decrease. but CO_2 NO and soot increasing level deceases.

5 Acknowledgement

We Navaneeth jayachandran and Jayabalaji are pursuing M.Tech in the Automotive Engineering department in the Amrita School of Engineering, Amrita Vshwa Vidyapeetham. We would like to thank Dr.S Thirumalini, Professor, Department of Mechanical Engineering, Amrita School of Engineering for her encouragement, motivatio and for guiding us to write this paper.

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