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Performance and Emission Characteristics of Eucalyptus Oil and Gasoline Blend in Four Stroke Multi Cylinder SI Engine

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Abstract - *Numerous alternative fuel blends have been introduced in past and they gave really satisfying results. In this article eucalyptus oil which is a high octane biomass derived fuel is blended with petrol 15% by volume Eu15 and is used as fuel in four stroke multi cylinder petrol engine. The performance and emission characteristics of the engine were studied. The results demonstrates the reduction in consumption of fuel as the brake specific fuel consumption was found to decrease. The improvement in brake thermal efficiency is also witnessed. While the emission parameters were also improved, both HC and CO emissions significantly reduces as the load kept increasing.*

Key Words: Gasoline, Emission characteristics, Alternative fuel, SI Engine, BSFC, Brake Thermal Efficiency.

1. INTRODUCTION

Many studies are going on for the enhancement of fuel economy of engines. There is an essential need of alternate fuels and improvement in its properties. Today intensive search for the alternative fuels for both spark ignition (SI) and compression ignition (CI) engines are carried out and it has been observed that the biomass derived fuels are suited for the application in alternate fuels. In spark ignition engines fuels like eucalyptus oil and orange oil are the suitable substituents for the petrol. They can be blended with petrol over a wide range of percentage according to the requirement.

Another reason for the need of alternate fuels for IC engines is the emission problems. Combined with other air polluting factors, the large number of automobiles is a major contributor to the air quality problems of the world. As these fuels cannot be run directly in the engines therefore these are blended with gasoline at various percentage. One of the main reasons for selecting these fuels is the similarity in the properties of these with gasoline and they are miscible with gasoline without any phase separation. The engines used for these blending or for alternate fuels are modified engines which were originally designed for gasoline fuelling. The eucalyptus oil can be used in spark-ignition engines with very little engine modification as a blend with gasoline. Since the octane number of eucalyptus oil is more than gasoline, so it enhances the octane value of the fuel when it is blended with low octane gasoline. At the same time the compression ratio (CR) which is dependent on knock can be increased when these fuels are blended with gasoline. M. Senthil Kumar et al. [1], carried out experiment on the use of vegetables directly in compression ignition engines. Along with that small quantities of orange oil were inducted along with air and ignited after compression. Methyl ester of Jatropha oil and diesel were also used as fuels for comparing the results with that of the vegetable oil. Purushothaman K.et al. [2], studied about the performance, emission and combustion characteristics of a single cylinder, constant speed, direct injection diesel engine using orange oil as an alternate fuel and the results are compared with the standard diesel fuel operation. The results shows that the brake thermal efficiency is higher than that of diesel operation throughout the load variation. Poola R.B. et al. [3] carried out an experiment with 20% by volume of orange oil and eucalyptus oil were separately blended with gasoline brake thermal efficiency, exhaust emissions and combustion parameters were obtained. The experiment was conducted on small capacity 145.45 cc displacement volume, 4.3 KW at 5200 rpm, loop scavenged, air cooled, single cylinder, two stroke -ignition engines with a compression ratio of 7.4. It was found out that the performance of fuel blends was better than gasoline fuel. Experiment was performed on two compression ratios viz. 7.4 & 9 and improvement of 20.5% in brake thermal efficiency was obtained at 2 KW, 3000 rpm, over the normal gasoline engine. Along with this hydrocarbon and carbon monoxide emission were reduced. While comparing the two fuel blends eucalyptus oil blend provides the best results for brake thermal efficiency with low exhaust emissions. Devan P K. et al. [4], they worked on to find out the performance, emission and combustion characteristics of a DI diesel engine using poon oil-based fuels and poon oil and poon oil methyl ester are tested in blended forms They prepared the blend with 20% poon oil and 40% poon oil methyl ester separately with standard diesel. Results obtained showed the reduction of CO and HC emissions.

2. EXPERIMENTAL SETUP

A Four stroke multi cylinder petrol engine is used for executing the performance and emission characteristics tests using Eu15 blend as fuel. The engine was coupled to an eddy current dynamometer (Vibrometer) for torque and speed measurements. A gas analyzer is used for measuring the emission parameters in the engine exhaust. Speed is kept to

be constant around 1200 rpm and the variable load test is to be conducted at constant engine speed, at every operating point values of the emission parameters has to be recorded. In the present investigation the high octane fuel viz. Eucalyptus oil is blended with gasoline in the proportion 15% by volume and the engine brake thermal efficiency, exhaust emission were evaluated. The table 1 below shows the specifications of multi cylinder being used.

Table -1: Specifications of Multi Cylinder SI Engine.

Parameter	Value
Engine Type	4 stroke, multi cylinder, SI Engine
Bore (mm)	85
Stroke (mm)	80
Compression ratio	8:5:1
Torque (N-m)	125
Output (kW)	58.4
Displacement (cc)	1820

3. RESULTS AND DISCUSSIONS

The engine performance is indicated by its efficiency. The fuel consumption characteristics of an engine are commonly expressed in terms of specific consumption in kg of fuel per kilowatt-hour. It is an important parameter that reflects how good the engine performance is. The relationship between speed, power developed and specific fuel consumption determines the performance of an engine.

3.1 Performance Characteristics

The brake thermal efficiency gives an indication of the output generated by the engine as compared to the heat supplied to the engine. This heat is derived from burning of the fuel. Fig 1 shows the comparison between the brake thermal efficiency of the engine when run with standard gasoline fuel and when eucalyptus oil blended with gasoline Eu15 .The brake thermal efficiency is plotted as a function of brake power (KW). It has been observed that the brake thermal efficiency increases when engine runs with Eu15. The increase in the brake thermal efficiency may be of eucalyptus oil which is highly volatile basically consist of cineole the major component of the eucalyptus oil, it decomposes easily at low temperature and due to that it release more intermediate components immediately after its injection. This may be one of the reasons for the better performance of Eu15 than that of the standard gasoline operation. When eucalyptus oil is mixed with petrol the overall density of the fuel decreases and that leads to improved atomization, fuel vaporization and combustion. The reason may be the better utilization of heat energy and better air entertainment.

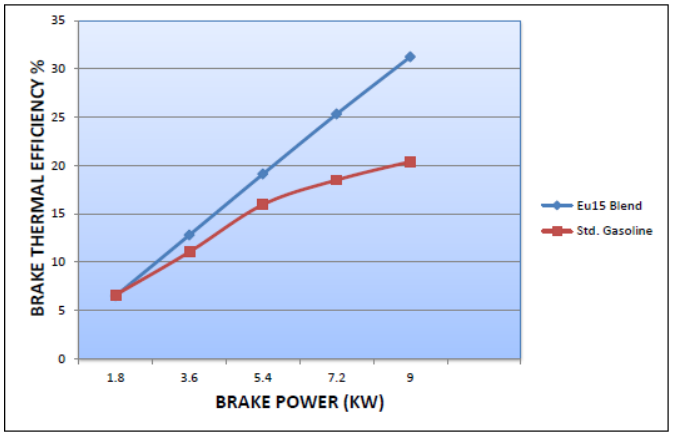

Fig -1: Variation of break thermal efficiency with brake power BP for Eu15 Blend and Std. petrol.

The fig 2 shows the variation of the brake specific fuel consumption (kg/h) versus brake power (KW) when petrol is used as fuel and is compared with brake specific fuel consumption when Eu15 is used as fuel. The bsfc of the Eu15 blend was lower than that of the std. petrol.

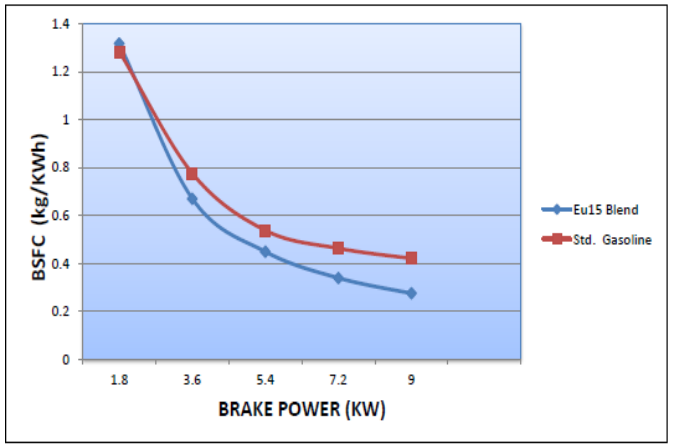

Fig -2: Variation of brake specific fuel consumption bsfc with brake power BP for Eu15 blend and Std. Petrol.

3.2 Emission Analysis

While running any internal combustion undesirable emissions are generated during the combustion process, emphasis is given on reducing the emission as exhaust. The emissions which are exhausted into the surrounding pollutes the atmosphere and causes problems like global warming, acid rain, smog, odours and respiratory hazards. Usually running an engine with petrol as fuel, emission parameters are not specifically ideal that results in more emission of unburnt hydrocarbon HC and carbon monoxide CO and oxides of nitrogen NOx.

3.2.1 HC Emission

Fig 3 depicts the deviation of hydrocarbon HC emissions with brake power BP. Hydrocarbon emissions are generally lower as compared with normal gasoline fuel. Eu15 blend shows the reduction in HC emissions over the entire range of engine operations particularly at higher brake powers. The reason for the less HC emission is due to equivalence mixture ratio

and easy decomposition of eucalyptus oil gives more intermediate compounds and presence of oxygen in cineole which is the main component of eucalyptus oil results in availability of more oxygen for carbon to react causing less HC emissions.

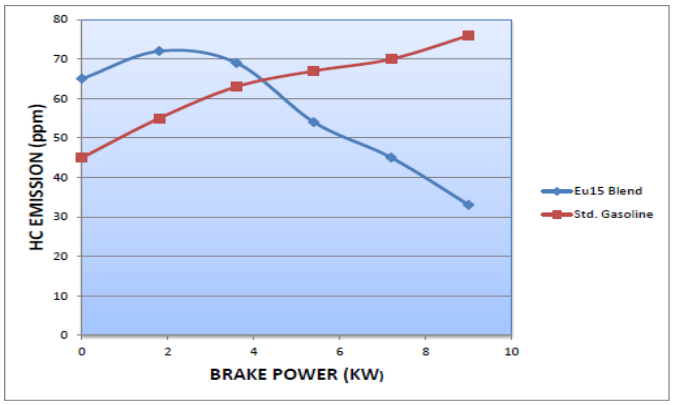

Fig -3: Variation of HC emissions with brake power BP. for Eu15 blend and Std. Petrol.

3.2.2 CO Emission

Fig. 4 illustrates the CO emission of Eu15 blend at various brake power output. It is found out that at low power output the CO emissions are significantly reduced but at higher loads the CO emissions decreases significantly. The reason for low CO emission may be the enrichment of oxygen in cineole which increases the production of oxygen and promotes the further oxidation of CO during the engine exhaust process.

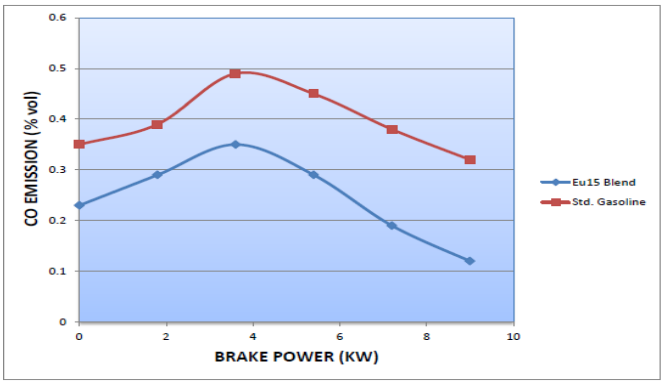

Fig -4: Variation of carbon monoxide CO with brake power BP for Eu15 blend and Std. Petrol.

3.2.3 NOx Emission

The results for the variations of NOx emission for Eu15 blends for different loads are shown in fig. 5 The NOx emissions were continuously increasing as the load increases because of the presence of oxygen in eucalyptus oil and the oxygenated fuel blends usually causes an increase in NOx emission. During complete combustion of the fuel high combustion temperature is achieved which results in higher NO formation. Another reason for rise in NO emission is due to longer ignition delay caused by eucalyptus oil and releases more heat during the premixed phase of combustion.

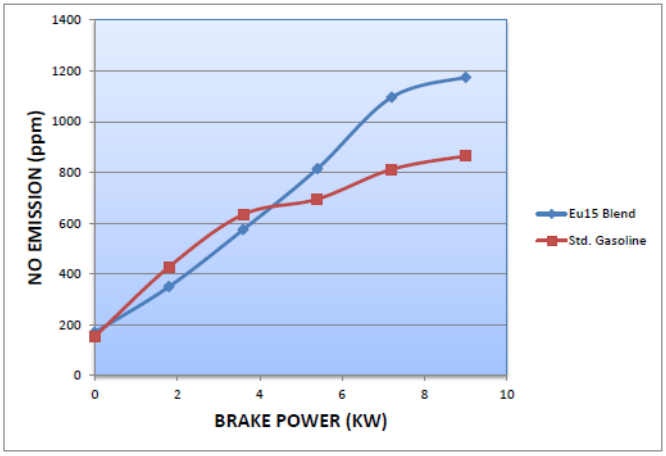

Fig -5: Variation of NO emission with brake power BP for Std. petrol and Eu15 blend.

3.2.4 CO_2 Emission

Fig 6 gives the variation of carbon dioxide emission with brake power when Eu15 is used as fuel. The carbon dioxide emission is found to increase at all power outputs when Eu15 fuel is used. The results show the growth in CO2 emission as the power output increases as compared with the std. gasoline operation.

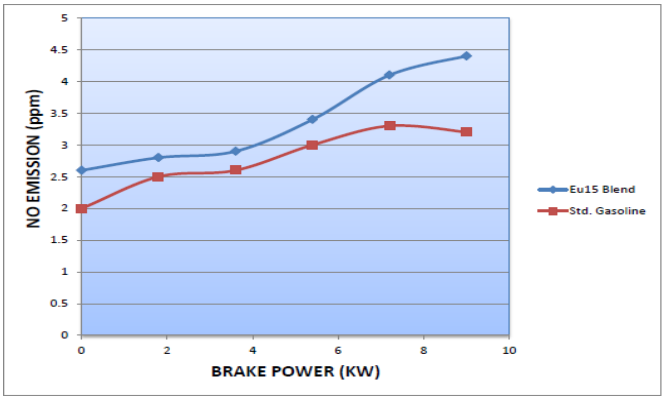

Fig -6: Variation of CO2 emission with brake power BP for Std. petrol and Eu15 blend.

4. CONCLUSIONS

Eucalyptus oil is blended with petrol and petrol engine was operated with this fuel .Performance and emission characters were investigated and concluded as follows:

1. Brake thermal efficiency has been improved by using Eu15 blend. The maximum improvement in brake thermal efficiency is obtained at higher brake power (9 KW). The BTE is 30.16% at full load.
2. Brake specific fuel consumption bsfc is found decreasing on increasing load. At full load bsfc is lowest and found out to be 0.2810.
3. The improvement in the brake thermal efficiency and brake specific fuel consumption may be of

eucalyptus oil which is highly volatile basically consist of cineole, it decomposes easily at low temperature and due to that it release more intermediate components immediately after its injection. This may be one of the reasons for the better performance of Eu15 than that of the standard gasoline operation

4. While studying the emission characteristics maximum progress is seen. At low power outputs the HC emission is considerably more but as the load increases the reduction in HC emissions can be seen.
5. From the graph it can be seen that at medium and low loads CO emissions of the blend is not much impressive, but CO emission of the blend significantly decreases at full load. The lowest value obtained for CO emission is 0.11% vol. at full load.
6. At the same time when HC and CO emissions are reduced the CO2 and NOx emissions are found to be increasing as the load increases. The reason for increase in these two parameters may be due to presence of oxygen in eucalyptus oil and the oxygenated fuel blends usually causes an increase in NOx emission. During complete combustion of the fuel high combustion temperature is achieved which results in higher NOX and CO2 formation.

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REFERENCES

[1] Senthil kumar M, Ramesh A and Nagalingam B (2001), 'Complete vegetable oil fueled dual fuel compression ignition engine',SAE International,28-0067, P.441-448.

[2] K.Purushothaman and G.Nagarajan (2009), 'Performance, emission and combustion Characteristics of a compression ignition engine operating on neat orange oil Renewable energy', volume 34, issue1, pages 242-245.

[3] Ramesh B. Poola, Nagalingam B and Gopalakrishnan K.V (1994), 'Performance studies with biomass-derived high-octane fuel additives in a two stroke spark-ignition engine, Biomass and Bioenergy 6 (5), 369-379.

[4] P.K.Devan and N.V.Mahalakshmi (2009),'Utilization of unattended methyl ester of paradise oil as fuel in diesel engine', Fuel88,1828-1833.