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Experimental Investigation on Engine Performance and Emission Characteristics of Turpentine Oil Blends with Diesel

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Abstract:
This paper is to introduce pinus product (Turpentine) which has been proposed as an alternate to fuels used presently. The main present work employs a novel approach by investigation of the turpentine oil blend with diesel in direct injection C.I engine as an alternate fuel having similar properties as that of diesel. The blends of turpentine oil are mixed with diesel fuel (i.e.10%, 20%, 30%, 40% and 50%) of samples. The present work will be carried out for performance and emission characteristics of single cylinder, water cooled, direct injection diesel engine under different load conditions thus laying foundation for the search in reduction of emissions.

Keywords: C.I engine, Turpentine, Blend, Diesel, Emissions.

I. INTRODUCTION

The discovery of engine was made to convert one form of energy into mechanical energy. Generally heat engines burn a fuel to create heat, which is then used to create a force. Many attempts have been made to increase the thermal efficiency and reduce the emissions of a diesel engine. This project is carried out on a four stroke single cylinder, direct injection, water cooled diesel engine. The blends are made with turpentine and diesel in different proportions such as 10% turpentine and 90% diesel, 20% turpentine and 80% turpentine and so on till 50% turpentine and 50% diesel. Turpentine is a product obtained by fractional distillation of resin obtained from live trees, mainly pines by chipping the trunk of the tree. Turpentine is composed of terpenes, mainly the monoterpenes alpha pinene and betapinene with lesser amounts of carene, camphene, dipentene, and terpinolene. The word turpentine derives from the Greek word terebinthine, the name of a species of tree, the terebinth tree. By some experimental results it was found to be that turpentine has higher volatility which makes it a convenient fuel to be used in engines.

II. PROPERTIES OF TURPENTINE OIL:

The following are the various properties of turpentine oil

Freezing point	: -	-55 ^{o}C
Boiling point	: -	153-175 ^{o}C
Density	: -	0.86 g/ml at 25 ^{o}C
Vapour density	: -	4.84
Vapour pressure	: -	4 mm of Hg
Flash point	: -	36 ^{o}C
Viscosity	: -	0.001375 N s/m^2
Calorific value	: -	44000 kJ/kg

III. ENGINE SPECIFICATIONS

The schematic figure consists of the engine having the following specifications:

- Type of Cylinder – Single Cylinder
- Make – Kirloskar
- Model – 15 EC
- Number of Strokes – Four Stroke
- Cooling System – Water Cooling
- Stroke Length – 110mm
- Bore Diameter – 87.5mm
- Compression Ratio – 17.5:1
- Power – 7HP
- RPM – 3000 to 5000

Figure.1.Schematic figure of diesel engine

IV.COMPONENTS REQUIRED

In this project, following are the components used:-

- Four-stroke single cylinder water cooled diesel engine
- Blends with different compositions
- Digital smoke test analyser
- Hydraulic load
- Tachometer

V.OPERATION

In this present work, operation is done on four stroke water cooled diesel engine at different hydraulic load conditions.

Firstly the blends of turpentine and diesel are made into different compositions i.e. 10% Turpentine + 90% Diesel, 20% Turpentine + 80% Diesel, 30% Turpentine + 70% Diesel, 40% Turpentine + 60% Diesel, 50% Turpentine + 50% Diesel by volume and mixed with the help of beakers. Then to examine the performance characteristics of turpentine blend at different load conditions, the blend is poured into the fuel tank whose characteristics has to be found.

The engine is made to run at a rated speed of 1500 rpm during each operation at different load conditions. To find out the performance taking a volume of 50cc of blend introducing into engine and finding out the time taken for consumption of 50cc fuel which ultimately leads in finding out total fuel consumption of that fuel.

After exhaust stroke place the digital smoke analyser sensor at the engine exhaust pipe. The values of emissions will be displayed on the digital screen display of the analyser as shown. The temperature evolved after the exhaust stroke is also noted with the help of temperature indicator connected to the engine exhaust pipe.

VI. OBSERVATIONS

At load=5 kg

	Brake Thermal Efficiency (η_{bth})	**CO emissions (%)**	**CO_2 emissions (%)**	**HC emissions (ppm)**	**NO_X emissions (ppm)**
100 % Diesel	30.459	2.957	13.16	1596	1302
10 % Blend	26.889	2.947	12.06	1602	1365
20 % Blend	26.652	3.26	12.93	1633	1493
30 % Blend	32.010	2.84	12.04	1573	1233
40 % Blend	26.960	3.00	12.35	1603	1267
50 % Blend	25.774	2.96	12.28	1613	1291

From the observations it is evident that the brake thermal efficiency (η_{bth}) of 30% turpentine + 70% diesel blend is higher compared to 100% diesel and all other blends which is a good sign. The emissions released by the engine when 30% turpentine blend as the fuel is low compared to 100% diesel and other blends.

VII. GRAPHICAL REPRESENTATIONS

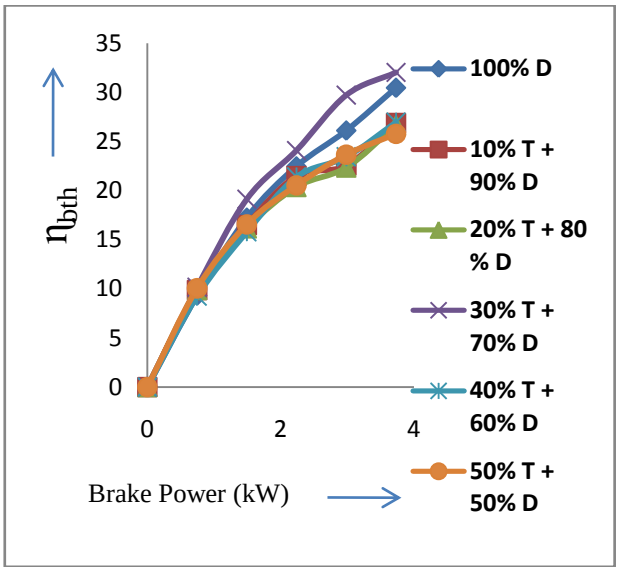

Figure.2. Analysis for η_{bth} vs Brake Power

The variation of η_{bth} is depicted in the figure.2. Then η_{bth} of 30% turpentine-70% diesel is higher compared to that of diesel.

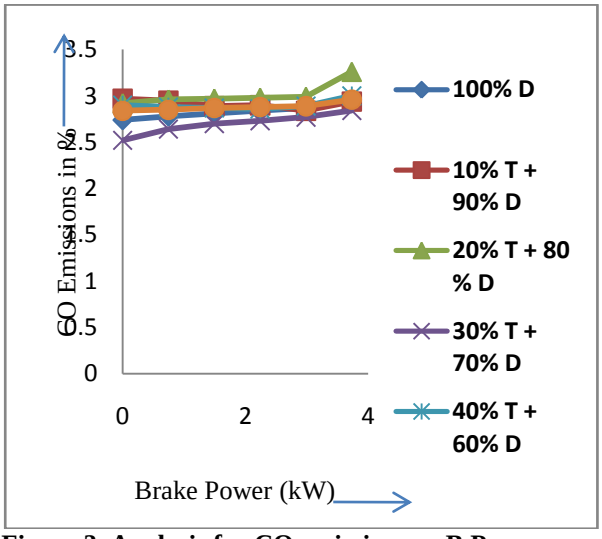

Figure.3. Analysis for CO emissions vs B.P

The variation of CO emission is shown in figure.3. The emissions for 30% turpentine-70% diesel are lesser compared that of diesel and other blends.

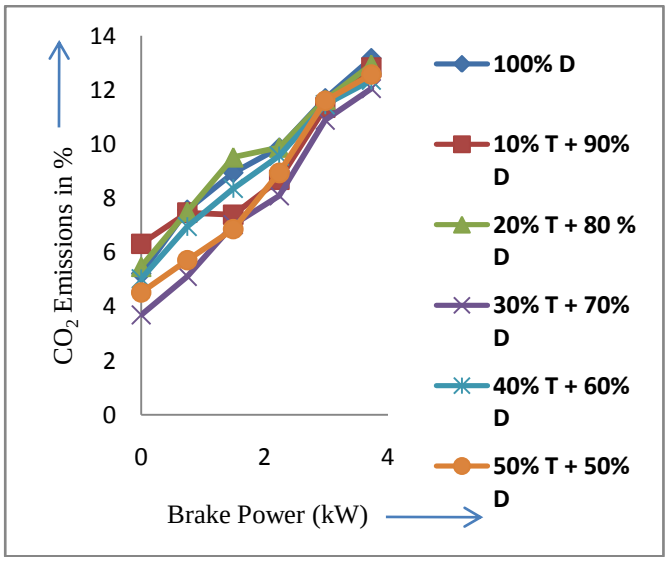

Figure.4. Analysis for CO_2 emissions vs B.P

The variation of CO_2 is shown in figure.4. The emissions for 30% turpentine- 70% diesel are lesser compared to that of diesel and other blends.

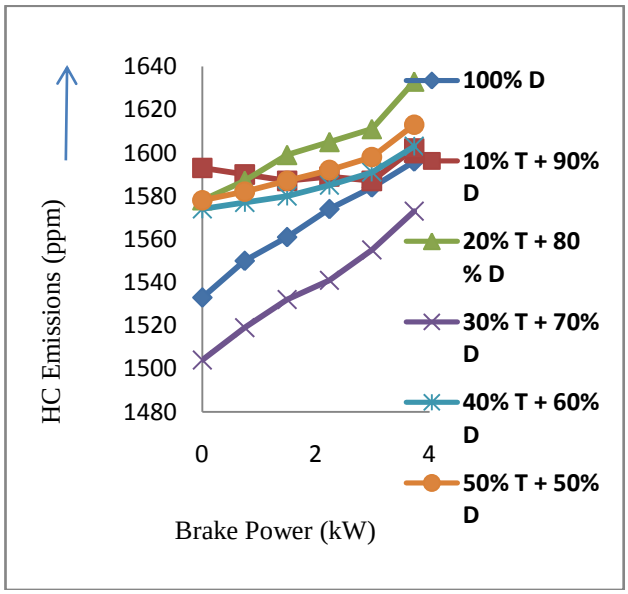

Figure.5.Analysis for Hydro Carbon (HC) Emissions vs B.P

The variation of HC emissions is shown in figure.5. The concentration of Hydro Carbons is less for 30% diesel –70% turpentine up to full load compared to that of 100% diesel and other blends

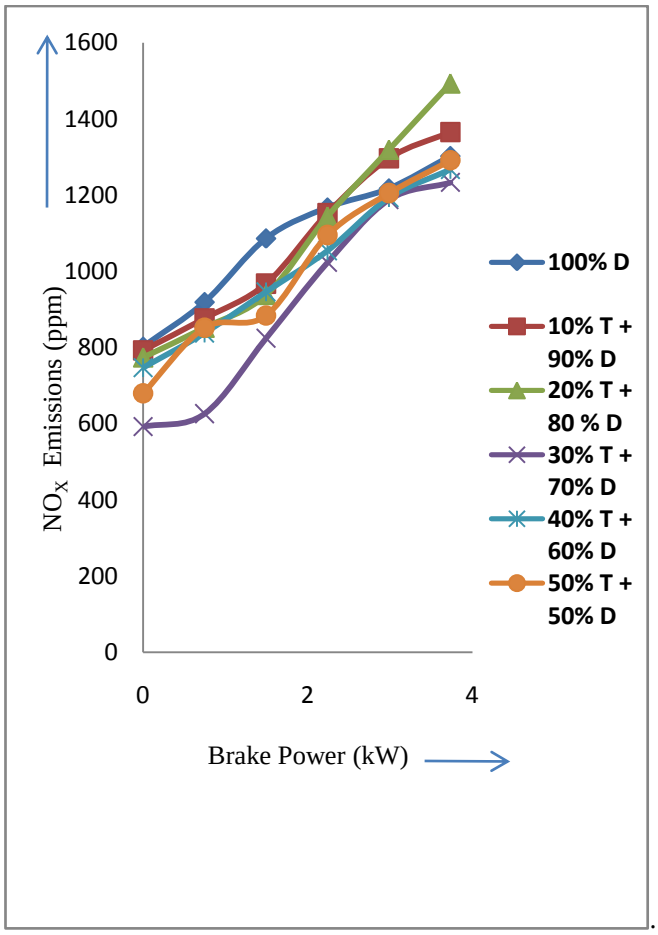

Figure.6.Analysis for NO_xemissions vs

The variation of with NO_X Load for blends is depicted in Fig.6. From the results, it can be noticed that the concentration of NO_X is less for 30% blend up to full load compared to that of 100% Diesel.

VIII. RESULT

In this present investigation the performance characteristics of a four stroke diesel engine with 100% diesel composition is compared with performance of diesel-turpentine blends. It is found that 30% turpentine- 70%diesel blend gave better performance compared to 100% diesel and other blends as there is reduction in emissions and increase in thermal efficiency.

IX. SCOPE FOR FUTURE WORK

1. This project can be studied further and used in automobiles as there is reduce in emissions at 30% Turpentine and 70% Diesel blend.
2. Further study can be made by making different compositions to increase the efficiency of engine as well as reduce the emissions.
3. As there is scarcity of Diesel in future, these blends will be helpful for future purpose. Present work can be extended for multi-cylinder engines.

X. APPLICATIONS

- It can be used for green concept cars as there are reduced emissions.
- Increased efficiency makes it economical to use for small cars.

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