Performance and Emission Analysis of Eucalyptus Oil and Petrol Blends

K. Lakshmana Kumar[1], Dr. A. Swarna Kumari[2]
[1] *PG Student, Department of Mechanical Engineering, University College of Engineering, JNTU, Kakinada*
[2]*Professor and Director, Jawaharlal Nehru Technological University, Kakinada*

***Abstract*- In Today's Environment usage of fossil fuels such as Petrol, Diesel etc., are increasing tremendously day by day. But the Resources are limited. Identification and Exploring of these fossil fuels from Earth's crust are very expensive and at the same time these resources are limited and depleting day by day besides causing environmental pollution in the form of emissions such as CO, CO2, HC etc., Bio-Fuels are the alternative source in the vicinity that can be used as a substitute for fossil fuel or as a fuel additive to petrol or diesel engines. The main focus of this thesis is to find the performance and Emission analysis of Eucalyptus Oil blended with Petrol as a fuel additive on Four Stroke Single Cylinder Engine with Eddy Current Dynamo meter. The Experiment was conducted with different proportions of Eucalyptus Oil and petrol by volume i.e. EU10, EU20, EU30, EU40. Emission Analysis was conducted using Orsat Gas Analysis Apparatus (Fischer Type). Petrol and Eucalyptus Oil blends showed an improvement in the Brake Power, Brake Thermal Efficiency and Low Brake Specific Fuel Consumption reduced CO, CO2, HC, NOx levels of Exhaust Emissions.**

***Index Terms*- Bio-fuel, Brake Power, Emission, EU10 (10%Eucalyptus Oil+90% petrol)**

1. INTRODUCTION

Majority of the population in india depend upon fossil fuels such as petrol, Diesel, LPG, CNG etc., for Transportation, producing power and energy. Petrol, Diesel, LPG etc., are derived from crude oil after refining process. Our Domestic Supply of crude oil is low compared to our requirements. Up to 77% of fuel needs are covered by imports. India is one of the major importers of Crude Oil. Frequent increase in Crude Oil Price in the International market effecting our economy. Consumption of Fossil Fuels are increasing day by day and its price for exploring and refining also increasing. Over consumption of these fossil fuels may cause shortage for the future generations. Over consumption of these fossil fuels may lead to Environmental pollution in the form of increased carbon monoxide and carbon dioxide gases, hydrocarbons in the atmosphere and causing ozone layer depletion.

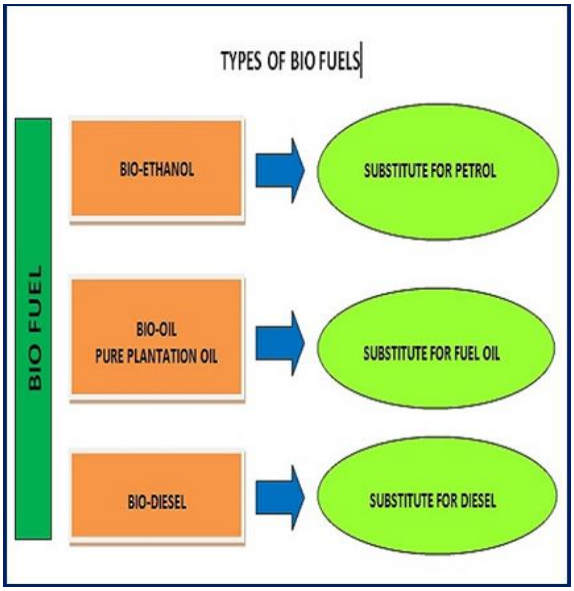

Fig.1 Types of Bio Fuels

Due to the depletion of fossil fuels there is a great demand for alternate fuels which are capable and suitable for the replacement of fossil fuels. Present trend and research is focussing on bio fuels. Bio fuels are plant derivatives that are produced from Bio-mass. Bio-Ethanol or simply Ethanol, Bio-Diesel, Methanol etc. are the examples for Bio-fuel. Bio-Ethanol is produced by the process of fermentation. Bio-Diesel is produced from vegetable oils by the process of trans esterification.

Bio-Ethanol is used as a fuel additive for petrol engines. Whereas Bio Diesel is used as an additive for Diesel Engines. Eucalyptus Oil is a bio fuel that can be added as an additive to petrol without any major modifications of the engine. Eucalyptus Oil can be extracted from the Leaves of Eucalyptus Tree, which has high calorific value and readily miscible with petrol.

2. LITERATURE REVIEW

Use of Bio Fuels as an alternative Fuel started at an early days. Henry Ford used Bio Fuel as a Fuel for his vehicle. In an Investigation "Impact of Bio-fuels on air pollutant emission from Road Vehicles", R Verbeek[6] concluded that Bio fuels are an essential for achieving less CO_2 emissions in the Automobile Section. It also concluded that bio fuel reduces green house gases as well as exhaust emissions. According to Dr.Filemon A. Uriarte Jr., ASEAN Foundation[2], "Bio Fuels from Plant Oils", Concluded that Strait Plant Oils gives better Engine performance and power output than conventional fuels. Types of Bio-fuels are First Generation Bio Fuels, Second Generation Bio Fuels, Third Generation Bio-Fuels. First Generation Bio-Fuels are derived from Food Crops such as Corn, Sugar Cane, Wheat Grain etc., Second Generation Bio-Fuels are derived from non-food crops such as waste wood etc., Third Generation Biomass is grown by using micro-organisms such as bacteria, lipids are extracted from these biomass and these lipids are converted into Bio-Diesel. Bio-Ethanol is the substitute for petrol Engines. Eucalyptus Oil and Orange Peel Oil are having high calorific value and are miscible with Petrol can be used as substitute for petrol and do not require major modifications of engine. In an investigation Eucalyptus Vs Ethanol: fuel for thought, R Kumar[12] to find the ability of an Eucalyptus oil as a bio-fuel, It concluded that Eucalyptus oil has the ability that can be used as the Bio-Fuel. 1-8 Cineole is the major component of Eucalyptus Oil. Chemical Formula for Eucalyptus Oil is $C_{10}H_{18}O$. According to Prof. Allan Barton[11], cineole and other components in Eucalyptus oil are biodegradable, unreactive, relatively non-toxic and can used as bio-fuel.

3. METHODOLOGY

Eucalyptus oil is a bio fuel extracted from the leaves of Eucalyptus tree. It has high calorific value. Eucalyptus oil is easily miscible with petrol. It does not require any engine modifications. Eucalyptus Oil and Petrol Blend is prepared in various proportions by Volume i.e. EU0, EU10, EU20, EU30, EU40. EU0 is prepared 100% petrol and 0% Eucalyptus Oil, EU10 is prepared with 90% Petrol and 10% Eucalyptus Oil, EU20 is prepared with 80% Petrol and 20% Eucalyptus Oil, EU30 is prepared with 70% Petrol and 30% Eucalyptus Oil, EU40 is prepared with 60% Petrol and 40% Eucalyptus Oil. The Experiment was conducted with these Proportions Starting from EU0, EU10, EU20, EU30, EU40 and Performance Parameters i.e. Brake Power, Brake Thermal Efficiency, Brake Specific. Fuel Consumption was noted. Emission Analysis was conducted on Orsat Apparatus (Fischer Type) for the Exhaust Emissions of CO, CO_2, HC, NOx.

4. EXPERIMENTAL SETUP

The Experiment was conducted on Four Stroke Single Cylinder Engine Test Rig with Eddy Current Dynamo Meter. Specifications of The Engine are shown in Table below.

Specifications of Engine

ENGINE	GREAVES
BHP	3HP
RPM(MAX)	3000
FUEL	PETROL
NO.OF CYLINDERS	SINGLE
WORKING CYCLE	FOUR STROKE
ENGINE COOLING	AIR COOLED
METHOD OF IGNITION	SPARK IGNITION
COMPRESSION RATIO	4.67
STARTING	ROPE STARTING

Specifications of Eddy Current Dynamo Meter

POWER	3KW
SPEED	3000
MAX. TORQUE	1 KG-M

Emission Analysis was Carried out by Using Orsat Gas analysis Apparatus (Fischer Type). It consists of five absorption pipettes. By using this apparatus we

can determine CO_2, CO, H_2O and Illuminants such as methane, ethane and nitrogen are found by difference. Two absorption pipettes are plain type filled with glass tubes, another two absorption pipettes are bobbling type pipettes with three way glass stop clocks. One pipette is Platinum Electrode Combustion Pipette with rheostat. It requires 220 Volts AC supply. It consists of Two leveling bottles, 100 ml gas burette with jacket. Manifold tube with glass stopcocks.

5. EXPERIMENTAL PROCEDURE

Experiment was carried out after Preparation of Fuel Blends. Initially Experiment was Conducted with EU0 (100% Petrol and 0% Eucalyptus Oil). Before starting the Engine, Precautions were taken. Engine Started with No Load Condition and allowed sufficient time to stabilize. Readings were taken as per the Observation sheet. Initially started with zero Load and Load was gradually increased in the steps of 0.5kg, 1.0 kg, 1.5kg, 2.0 kg, 2.5 kg. For Each Step readings were noted such as fuel consumption Kg/hr, inlet temperature, and Outlet temperature in deg C and other readings as per the observation Table. All the reading are taken at constant 2800 RPM.

Torque applied is calculated by using the formula for Eddy Current Dynamometer

Fig.2 Experimental Setup

Torque = Load (kg) x Arm Length (mm)

The Units of Torque is converted into N-M.

Based on the Torque Applied, Brake Power is calculated. Brake Power, Brake Thermal Efficiency, Specific Fuel Consumption are Calculated.

$$\text{Brake Power} = \frac{2\pi N T}{60} \text{ Watts}$$

$$\text{B.Th.}\eta = \frac{\text{B.P}}{\text{Mass of Fuel X Calorific Value}} \times 100$$

$$\text{Bsfc} = \frac{\text{Mass of Fuel consumed}}{\text{Brake Power}}$$

Emission Analysis was conducted for blends starting with EU0, EU10, EU20, EU30, EU40. Before operating the Orsat Apparatus, The Chemicals were prepared as per the following proportion

For absorbing CO_2 :
250 grams of KoH (potassium hydroxide) mixed
In 500 ml of distilled water were taken in burette 1

For absorbing O_2:
100 grams cuprous chloride + 125 ml of Liquid Ammonia + 375 ml of distilled water were taken in burette 3

For absorbing CO:
25 grams pyrogallic acid + 200 grams of KOH + 500 ml of distilled water were taken burette 2

Exhaust Gas at Reduced Temperature was allowed to Orsat Apparatus. A sample of 100ml was measured in the burette before and after absorption. The difference in the two readings is the volume of component absorbed. Alkaline pyrogallol acid will absorb both CO_2 and O_2. Hence CO_2 was first removed by Pottassium hydroxide. Methane was determined by slow combustion of Exhaust gas. A sample of 100 ml oxygen (O_2) was allowed to passing over platinum coil operated by rheostat. Ignition took over a hot platinum wire. Methane was converted into Co_2 and Water.

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

Hydrogen was determined by oxidation. By passing over hot platinum wire, hydrogen was converted into water. volume contraction due to water formed represents the amount of Hydrogen.

$2H_2 + O_2 \rightarrow 2H_2O$

6. RESULTS AND DISCUSSION

Experiment was conducted with each proportion of fuel blend EU0, EU10, EU20, EU30, EU40 On four stroke single cylinder Engine test rig with Eddy Current Dynamometer for performance. Emission analysis was carried out by Orsat Gas analysis (Fischer Type Apparatus). Based on the observations, the Results are plotted and the following Graphs were obtained.

Engine Performance

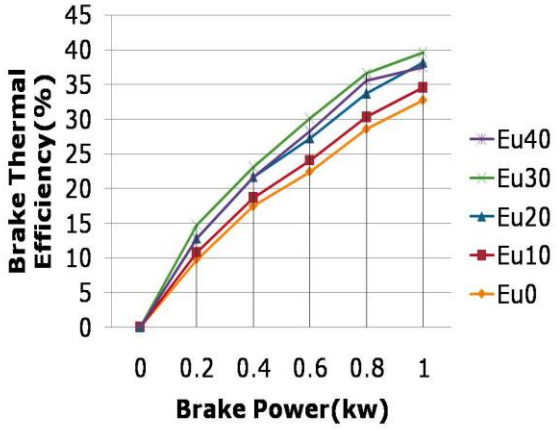

Fig.3 B.Th.η Vs Brake Power

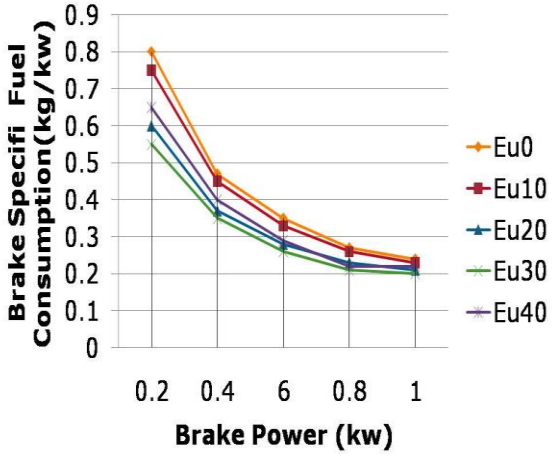

Fig.4 Bsfc Vs Brake Power

RESULT:

From Fig.3, It showed that the Brake Thermal efficiency is gradually improved for EU10 to EU30. When compared to EU0(100%petrol), EU10, EU20, EU30 showed an improved performance. Initially EU40 has shown improved B.Th.η, In later stage it showed decreased B.Th.η. From Fig.4,It showed that low Brake Specific Fuel consumption from EU10 to EU40. When compared to EU0(100% petrol), E10, E20, E30, E40 has given low Brake specific fuel consumption.

Exhaust Emissions

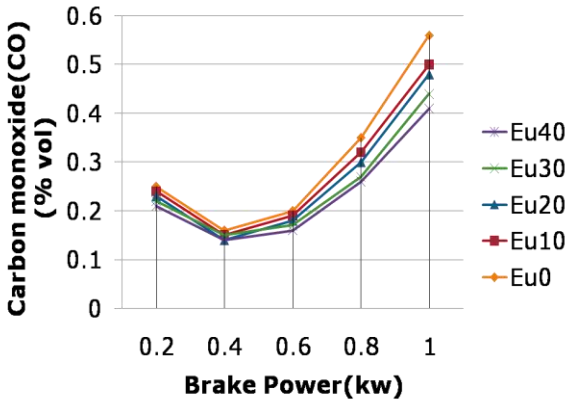

Fig. 5 Carbon Monoxide Vs Brake Power

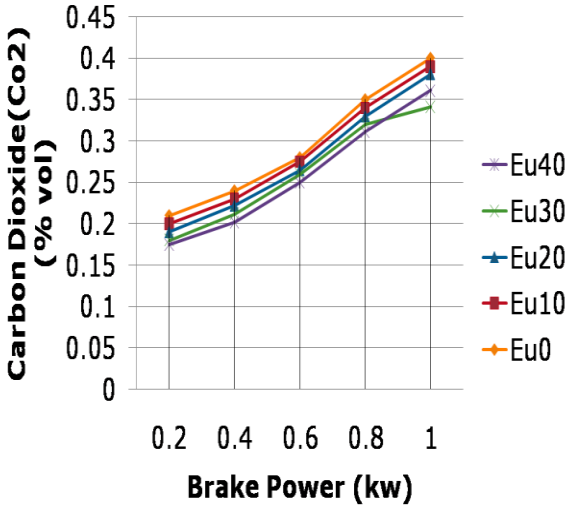

Fig. 6 Carbon Dioxide Vs Brake Power

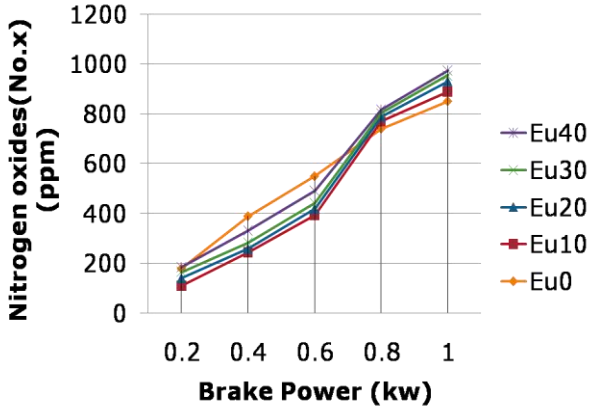

Fig. 7 Nitrogen Oxides Vs Brake Power

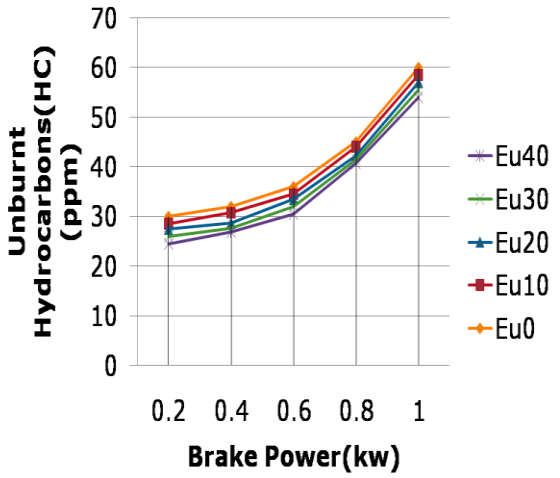

Fig. 8 Unburnt Hydrocarbons Vs Brake Power

Emissions:

From Fig.5, It showed that the Carbon Monoxide Levels in the Exhaust are reduced for blends EU10 to EU40. When compared to EU0 (100% Petrol), EU10, EU20, EU30, EU40 have given less Carbon Monoxide. From Fig.6, Carbon Dioxide levels in Exhaust Gas are reduced from EU10 to EU40. When compared to EU0(100% petrol), EU10, EU20, EU30, EU40 have given reduced Carbon Dioxide Levels in the Exhaust. From Fig,7, It showed that Nitrogen Oxides(Nox), Initially EU10, EU20, EU30, EU40 have shown reduced Nox levels, later Nox levels are increased when compared to EU0(100% petrol). From Fig.8, Unburnt Hydrocarbon Emissions, EU10, EU20, EU30, EU40 have given less Hydrocarbon Emissions when compared to the EU0 (100% petrol).

7. CONCLUSIONS

As Per the Results Obtained from the Experiment, The Eucalyptus Oil and Petrol blends has shown improvement in the performance from EU10 to EU30. For E30 it showed an upto 7% improvement in Brake Thermal Efficiency. Brake Specific Fuel Consumption has given reduced levels from EU10 to EU40. When Compared to EU0. Eucalyptus Oil and Petrol blends from E10 to E40 have given reduced CO, CO2, HC, and Moderate Nox Emissions.

8. NOMENCLATURE

B.Th.η = Brake Thermal Efficiency

Bsfc = Brake Specific Fuel Consumption

NOx = Nitrogen Oxides

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