RESEARCH ARTICLE OPEN ACCESS

Performance & Emissions Characteristics of a Four Stroke Diesel Engine Fuelled With Different Blends of Palmyra Oil with Diesel

T.Venkata Srinivasa Rao[1], V. Ranjith Kumar[2], Dr.P.Vijaya Kumar[3]
[1]M.Tech Student, Department Of Mechanical Engineering, Lakireddy BaliReddy college Of Engineering (Autonomous), Mylavaram,
[2]Assistant Professor, Department Of Mechanical Engineering, Lakireddy Balireddy College Of Engineering (Autonomous), Mylavaram,
[3]Professor, Department Of Mechanical Engineering, Lakireddy Balireddy College Of Engineering (Autonomous), Mylavaram,.

ABSTRACT
Diesel engines are used for automotive application because they have lower specific fuel consumption and superior efficiency compared to S.I engines. However in spite of these advantages NOx and smoke emissions from the diesel engines cause serious environmental problems. In the present work, biodiesel was produced from Palmyra oil. In this present work, investigations were carried out to study the performance, emission and combustion characteristics of Palmyra oil. The results were compared with diesel fuel, and the selected Palmyra oil fuel blends. For this experiment a single cylinder, four stroke, water cooled diesel engine was used. Tests were carried out over entire range of engine operation at varying conditions of load. To increase the engine performance parameters and to decrease the exhaust gas emissions with increase biodiesel concentration. The experimental results provide that the use of biodiesel in compression ignition engine is a viable alternative to diesel. Additive to add the Ethanol. The blending percentage in the steps of 10%, 20% & 30%.
Keywords: Palmyra oil, blended fuel, ethanol, NOx

I. INTRODUCTION

The fossil fuel demand is continuously increasing world over resulting in rapid depletion of fossil fuel deposits [1]. In several studies, it has been experimentally feasible, domestically available and environmentally acceptable [2-5].The petroleum based diesel fuel needs to be substituted with alternate fuel to meet the energy demands in the future for developing countries. Many bio diesels in the form of esters are being experimented to suit the diesel engine without any major engine modification. Biodiesel is an oxygenated, renewable, biodegradable and environmentally friendly bio-fuel with low emission profile. Pure coconut oil usage in diesel engine shows lesser smoke, carbon monoxide (CO), hydrocarbons (HC) emissions compared to diesel fuel since it has oxygen molecules which results in enhanced oxidation [6]. With pure coconut oil and diesel fuel blends in an automotive DI diesel engine increase in brake power and net heat release rate with a reduction in emissions such as HC, CO, NOx, smoke are reported for Coconut oil in the fuel blend. The increase in brake power is expected due to large fuel droplets and oxygen content in Coconut oil, which contribute to better combustion. When Coconut oil in the fuel is increased above 30% decrease in performance was reported which is attributed to lower calorific value, with a reduction in emissions [7].

II. FUEL PREPARATION

The major problems in direct use of Palmyra oil as fuel in diesel engine are fuel filter plugging, chocking of injector nozzle, sticking of piston rings and crankcase oil dilution. The kinematic viscosity of the Palmyra oil is generally higher than diesel fuel and can be brought down by various techniques such as preheating, blending and adding additive. The sediments are filtered and the fuel is used in diesel engine without any engine modification. The fuel thus prepared is tested and properties are listed in table.

III. PALMYRA OIL

Fig:1 BEFORE HEATING

Fig:2 AFTER HEATING


Fig:3 PALMYRA OIL BLENDS (B10,B20 ANDB30)

IV. FUEL PROPERTIES

Comparison of Properties of Diesel, Palmyra Oil and its Blends:

Properties	Diesel	Palmyra oil	B10	B20	B30
Specific Gravity	0.83	0.876	0.834	0.84	0.848
KinematicViscosity(Cst)	4.3	31.2	5.3	6.1	7.0
Flash Point(^{o}C)	54	172	78	90	98
Fire Point(^{o}C)	65	198	93	121	135
Calorific Value(kj/kg)	42500	37710	42250	41638	41015

TABLE:1[B10 means 10% palmyra oil + 90% diesel], [B20 means 20% palmyra oil + 80% diesel]&[B30 means 30% palmyra oil + 70% diesel]

V. ENGINE AND EXPERIMENTAL SETUP

Experiment were conducted on Kirloskar, four stroke, single cylinder, water cooled diesel engine. The rated power of the engine was 3.7kw at 1500 rpm. The engine was operated at a constant speed of 1500 rpm. The fuel flow rate was measured on volume basis using a burette and a stop watch. A smoke analyzer was used for the measurement of smoke in the exhaust.The performance and emission tests were started using 100%diesel and then fuel was replaced by blended fuels. Experimental set up shown in fig. Experiments were conducted using various blends increased the power output and reduced emission. Optimum performance was obtained for 30% palmyra oil blend biodiesel. The possible reasons for increased thermal efficiency more complete combustion and additional lubricity of palmyra oil. Hence Friction horsepower is reduced. So, the energy saved by decreased friction horsepower additional contribution towards useful energy, cooling losses and exhaust losses.


Fig:4 Experimental setup of four stroke, single cylinder, water cooled diesel engine.

VI. ENGINE SPECIFICATIONS

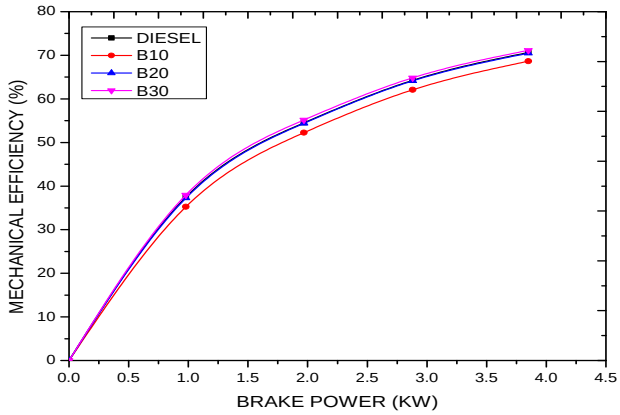
Make	Kirloskar
Power	5hp
Speed	1500rpm
no. of cylinders	1
compression ratio	16.5:1
Bore	80mm
orifice dia	20mm
type ignition	compression ignition
method of loading	rope brake
method of starting	crank shaft
method of cooling	Water

Table 2: specification of diesel engine

VII. RESULTS AND DISCUSSION:

Mechanical Efficiency:-

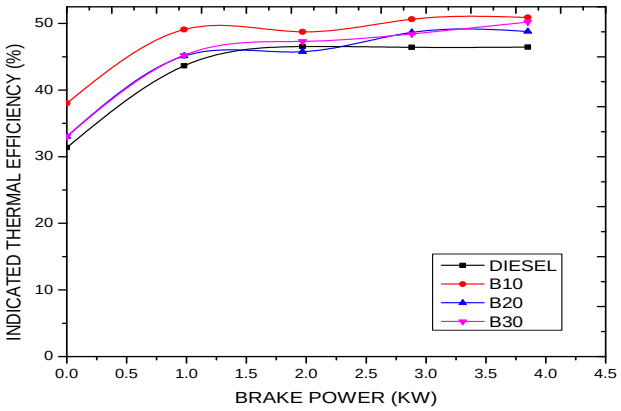
The variation of mechanical efficiency with brake power is shown in figure. The plot it is reveals that as the brake power increases mechanical efficiency increases .at full brake power condition the mechanical efficiency obtain are 68.64%,70.46%,71.11% and 70.64% for B10,B20,B30 and pure diesel respectively. The mechanical efficiency of Palmyra oil blend B30 increased when compared to the diesel at full brake power condition.



Graph:1 Mechanical Efficiency vs Brake Power

Indicated Thermal Efficiency:-

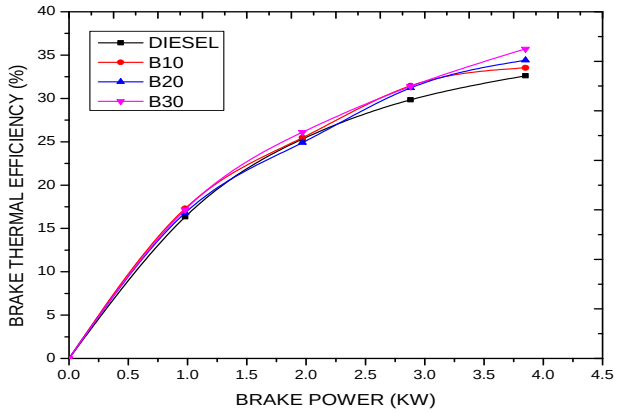
The variation of indicated thermal efficiency with brake power is shown in figure. The plot it is reveals that as the brake power increases indicated thermal efficiency increases .At full brake power condition the indicated thermal efficiency obtain are 50.9%,48.81%,50.21%, and 46.46% for B10,B20,B30 and pure diesel respectively. The indicated thermal efficiency of Palmyra oil blend B30 increased when compared to the diesel at full brake power condition.



Graph:2 Indicated Thermal Efficiency vs Brake Power

Brake Thermal Efficiency:-

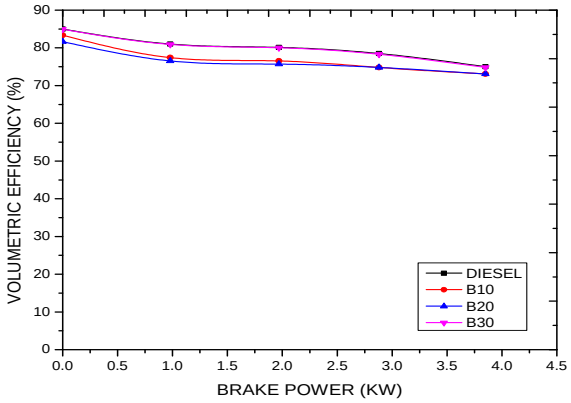
The variation of brake thermal efficiency with brake power is shown in figure.The plot it is reveals that as the brake power increases brake thermal efficiency increases .At full brake power condition the brake thermal efficiency obtain are 33.54%,34.4%,35.71%, and 32.62% for B10,B20,B30 and pure diesel respectively. The brake thermal efficiency of palmyra oil blend B30 increased when compared to the diesel at full brake power condition.



Graph:3 Brake Thermal Efficiency vs Brake power

Volumetric Efficiency:-

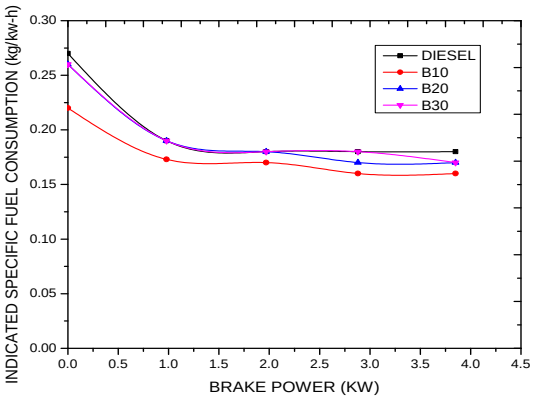
The variation of volumetric efficiency with brake power is shown in figure.The plot it is reveals that as the brake power increases volumetric efficiency decreases .At full brake power condition the volumetric efficiency obtain are 73.08%,73.08%,74.81%, and 75% for B10,B20,B30 and pure diesel respectively. The volumetric efficiency of palmyra oil blend B30 slightly decreased when compared to the diesel at full brake power condition.



Graph:4 Volumetric Efficiency vs Brake Power

Indicated Specific Fuel Consumption:-

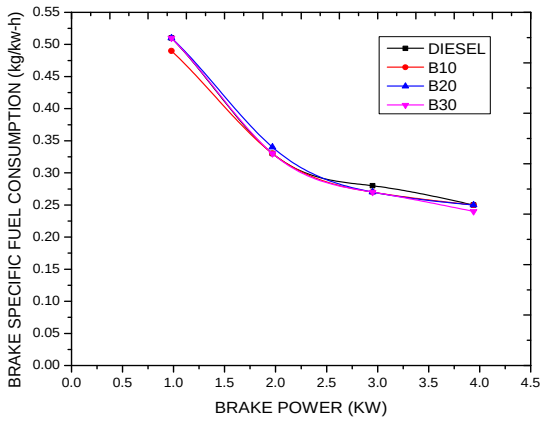
The variation of indicated specific fuel consumption with brake power is shown in figure.The plot it is reveals that as the brake power increases indicated specific fuel consumption decreases .At full brake power condition the indicated specific fuel consumption obtain are 0.16kg/kw-h,0.17 kg/kw-h,0.17 kg/kw-h, and0.18 kg/kw-h for B10,B20,B30 and pure diesel respectively. The indicated specific fuel consumption of palmyra oil blend B30 slightly decreased when compared to the diesel at full brake power condition.



Graph:5 Indicated Specific Fuel Consumption

Brake Specific Fuel Consumption:-

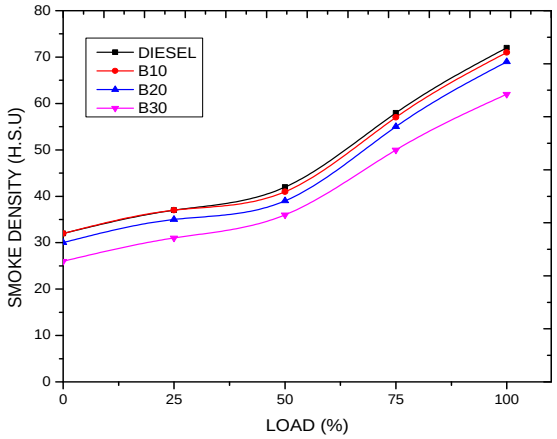
The variation of brake specific fuel consumption with brake power is shown in figure.The plot it is reveals that as the brake power increases brake specific fuel consumption decreases .At full brake power condition the brake specific fuel consumption obtain are 0.25kg/kw-h,0.25 kg/kw-h,0.24 kg/kw-h, and0.24 kg/kw-h for B10,B20,B30 and pure diesel respectively. The brake specific fuel consumption of palmyra oil blend B30 slightly decreased when compared to the diesel at full brake power condition.



Graph:6 Brake Specific Fuel Consumption vs Brake Power

Smoke Density(H.S.U):-

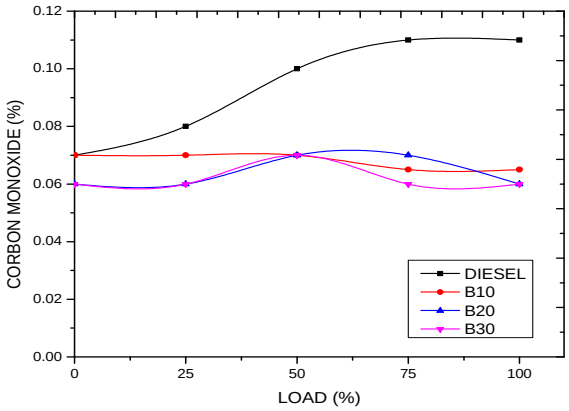
The variation of smoke density with load is shown in figure. The plot it is reveals that as the load increases smoke density decreases .At full load condition the smoke density obtain are 71(H.S.U), 69(H.S.U), 62(H.S.U), and72(H.S.U) for B10,B20,B30 and pure diesel respectively. The smoke density of palmyra oil blend B30 slightly decreased when compared to the diesel at full load condition



Graph:7 Smoke Density vs Load

Carbon Monoxide (CO):-

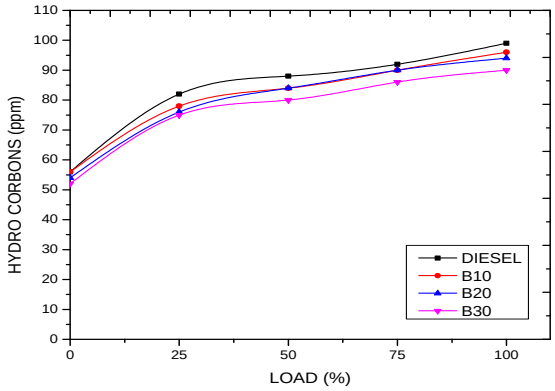
The variation of carbon monoxide with load is shown in figure. The plot it is reveals that as the load increases carbon monoxide decreases .At full load condition the carbon monoxide obtain are0.065%,0.06%,0.06% and 0.11% for B10,B20,B30 and pure diesel respectively. The carbon monoxide of palmyra oil blend B30 slightly decreased when compared to the diesel at full load condition.



Graph:8 Carbon Monoxide vs Load

Hydro Carbons (HC):-

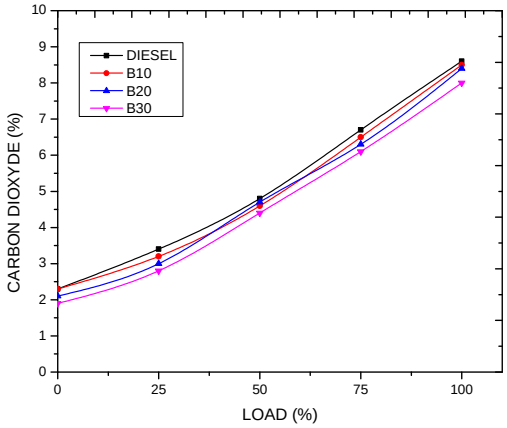
The variation of hydro carbons with load is shown in figure. The plot it is reveals that as the load increases hydro carbons decreases .At full load condition the hydro carbons obtain are0.96ppm,94ppm,90ppm and 99ppm for B10,B20,B30 and pure diesel respectively. The hydro carbons of palmyra oil blend B30 slightly decreased when compared to the diesel at full load condition.



Graph: 9 Hydro Carbons vs Load

Carbon Dioxide (CO2):-

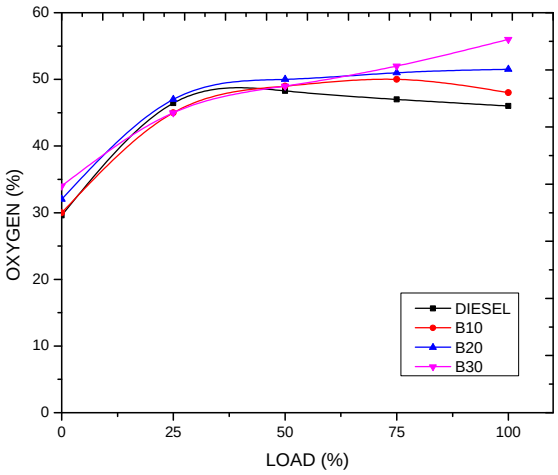
The variation of carbon dioxide with load is shown in figure. The plot it is reveals that as the load increases carbon dioxide decreases .At full load condition the carbon dioxide obtain are 8.5%,8.4%,8% and 8.6%for B10,B20,B30 and pure diesel respectively. The carbon dioxide of palmyra oil blend B30 slightly decreased when compared to the diesel at full load condition



Graph: 10 Carbon Dioxide vs Load

Oxygen (O2):-

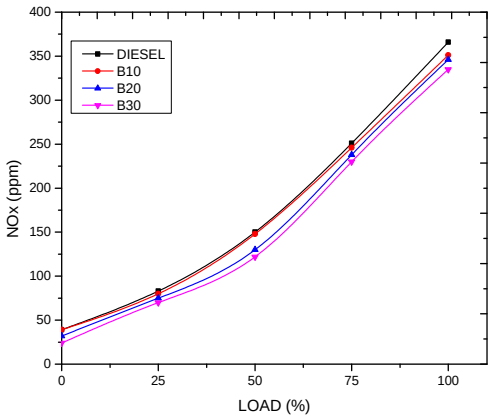
The variation of oxygen with load is shown in figure. The plot it is reveals that as the load increases oxygen increases .At full load condition the oxygen obtain are 48%,51.5%,56% and 46%for B10,B20,B30 and pure diesel respectively. The oxygen of palmyra oil blend B30 slightly increased when compared to the diesel at full load condition.



Graph:11 Oxygen vs Load

Nitrogen Oxide (NOx):-

The variation of N0x with load is shown in figure. The plot it is reveals that as the load increases N0x decreases .At full load condition the N0x obtain are351ppm,346ppm,335ppm and 366ppm for B10,B20,B30 and pure diesel respectively. The N0x of palmyra oil blend B30 slightly decreased when compared to the diesel at full load condition.



Graph: 12 Nitrogen Oxide vs Load

VIII. CONCLUSION

- The experiments are conducted on the four stroke single cylinder water cooled diesel engine at constant speed (1500rpm) with varying 0% to 100% loads with diesel and different blends of Palmyra oil like B10,B20 and B30.
- The performance parameters such as ηMECH, ηBTE, ηITE, ηVOL, BSFC and ISFC were calculated from the observed parameters and shown in the graphs.
- The emissions characteristics such as carbon monoxide(CO),hydro carbons(HC),carbon dioxide(CO2),oxygen(O2),nitrogen oxide (NOx),smoke density(H.S.U) are also decreased, will compared to diesel and other blends.
- It is observed that having 30% Palmyra oil blend with diesel CI engine gives energetic results for as performance parameters.
- And emissions characteristics also decreases will compared to diesel at 30% Palmyra oil blend with diesel.

REFERENCES

[1] The B, Mishra R, Gu, F, Ball AD. Water injection effects on the performance and emission characteristics of a CI engine operating with biodiesel. Renewable Energy 2012; 37:333-344.

[2] Tornqvist M, Ehrenberg L. On cancer risk estimation of urban air pollution. Environmental health perspectives 1994; 102 (Suppl 4): 173.

[3] Iwai K, Adachi S, Takahashi M, Moller L, Udagawa T, Mizuno S, Sugawara I. Early Oxidative DNA Damages and Late Development of Lung Cancer in Diesel Exhaust-Exposed Rats. Environmental Research 2000; 84(3): 255-264.

[4] Dybdahl M, Risom L, Bornholdt J, Autrup H, Loft S, Wallin H. Inflammatory and genotoxic effects of diesel particles in vitro and in vivo. Mutation Research / Genetic Toxicology and Environmental Mutagenesis. 2004; 562(1): 119-131.

[5] Vincent R. Acute Cardiovascular Effects in Rats from Exposure to Urban Ambient Particles, STATEMENT: Synopsis of Research Report 104. Safe Environments Programme, ERA Grant Number: R828112C104, Environmental Protection Agency, 2003.

[6] Herchel, T.C.; Machacon,; Seiichi Shiga,; TakaoKarasawa,; Hisao Nakamura. Performance and emission characteristics of a diesel engine fuelled with coconut oil – diesel fuel blend. Biomass Bioenergy, 2001, 20, 63-69.

[7] Kalam, M.A.; Husnawan, M.; Masjuki, H.H. Exhaust emissions and combustion evaluation of coconut oil – powered indirect injection diesel engine. Renewable Energy, 2003, 28, 2405 –2415.