IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X
PP. 69-73
www.iosrjournals.org

Evaluation of Performance and Emission Characteristics of Four Stroke Diesel Engine with Mahua Bio-Diesel Blends

Dr. V. Naga Prasad Naidu, Dr. R. Rama Chandra, Mr. P. Hussain Babu
Professor of Mechanical Engineering, GatesInstitute of Technology, Gooty, Ananthapuramu(Dist.)A.P, India.
Principal, S.K.D.EngineeringCollege,Gooty, Ananthapuramu(Dist.)A.P, India.
Head of Mechanical Engineering, Intell Engineering College, Ananthapuramu, AP, India.

Abstract: *In recent years the search for alternative fuels has become inevitable due to fast depletion of fuels and huge demand for diesel in transport, power and agricultural sectors. One of the best alternatives is Bio-Diesels obtained from different Vegetable oils. The present study focuses on Evaluation of performance and emission characteristics of a single cylinder four stroke diesel engine with Mahua biodiesel blended with diesel in various proportions like B0, B05, B10, B15, B20 and B25. The performance is compared with diesel fuel, on the basis of brake specific fuel consumption, brake thermal efficiency, exhaust gas temperature and emissions of hydrocarbons and oxides of nitrogen. This study reveals that the performance of the engine with Mahua biodiesel blends differs marginally from diesel fuel and hydrocarbon emissions are less than diesel. It is also observed that the Mahua biodiesel B20 can be used as a fuel for diesel engine without any engine modification.*
Keywords: *Alternative fuels, Emissions, Hydro Carbons, Performnce and Mahua Bio Diesel blends.*

I. Introduction

In the scenario of increasing industrialization and motorization of the world has led to a steep rise in the demand for petroleum products. If this situation continues there is every chance for the scarcity of petroleum products. A major solution to reduce this problem is to search for an alternative fuels. Vegetable oils can be an important alternative to the diesel fuel, since they are renewable and can be produced in rural areas (1). The inventor of diesel engine Rudolpf diesel predicted that the plant based oils are widely used to operate diesel engine. The bio diesel has great potentials as alternative diesel fuel (2). But use of pure vegetable oil can cause numerous engine related problem such as injector choking, piston deposit formation and piston ring sticking due to higher viscosity and low volatility (3). An effective method of using vegetable oils in diesel engine is by modifying the vegetable oils into its monoesters by transestrification(4). Transesterification of bio-diesel provides a significant reduction (5) in viscosity, thereby enhancing their physical and chemical properties and improve the engine performance.

Technical specifications of the engine
In This Work Experiments Were Conducted On 4 Stroke, Single Cylinder, C.I Engine (Kirloskar Oil Engineers Ltd., India) Of Maximum Power-3.68 Kw With Avl Smoke Meter And Delta 1600 S Gas Analyser.

II. Material & Methods

In the present work engine tests were conducted with Mahua Bio-Diesel blends to evaluate performance and emission characteristics. Mahua seeds (6) is also known as Kochia Latifolia, Madhuca indica. It’s also referred as Indian Butter Tree. Mahua may be a medium to giant tree, which can attain a height of up to twenty meters. Its provender (oil cake) is employed as bio-fertilizer and organic manure. Biological science name is “Madura long folia.” The foremost element fatty acids of mahua oil are Palmitic (16-28%), lipoid (20-25%), Arachidic (0-3.3%), Oleic (41-51%) and Linoleic (9-13%). Mahua may be non-traditional and non-edible oil. Mahua is a very important plant having vital socio-economic worth. This species will be planted on edges of roads and canal banks etc., on large scale and in social biological science programme, notably in social group (tribal) areas. Its flowers and fruits are devoured (eaten) historically by tribals. Mahua oil seed cake will be used as manure. It’s available in most of the states in india like Orissa state, Chhattisgarh, Jharkhand, Bihar, Madhya Pradesh, Andhra Pradesh and Tamil Nadu. It will be successfully grown in different lands like waste lands and dry lands. The various properties of the above bio diesel(7) are presented in table 1.

Table I: Properties of fuels used

Properties	Mahua	Diesel
Density (kg/m3)	880	830
Calorific Value (kJ/Kg)	39500	43000
Viscosity @400C(cSt)	5.8	2.75
Cetan Number	50	51
Flash Point (oC)	145	74

III. Results And Discussions

The performance and emission characteristics of a single cylinder four stroke diesel engine with Mahua biodiesel blended with diesel in various proportions like B0, B05, B10, B15, B20 and B25 evaluated and compared with diesel fuel, on the basis of brake specific fuel consumption, brake thermal efficiency, exhaust gas temperature and emissions of hydrocarbons and oxides of nitrogen.

Brake thermal Efficiency

The Figure 1 shows the variation of brake thermal efficiency with break power output. In general the thermal efficiency depends on the combustion process which is a complex phenomenon that is influenced by several factors such as design of combustion chamber, type of injection nozzle, injection pressure, spray characteristics and fuel characteristics such as cetane number, volatility, viscosity, homogeneous mixture formation, latent heat of vaporization, calorific value etc. It is evident that diesel fuel has the higher brake thermal efficiency compared to mahua biodiesel blends. The diesel fuel has the highest thermal efficiency because of its high calorific value and low viscosity as compared with mahua biodiesel blends. With the higher calorific value the amount of heat produced in the combustion chamber is more, further the combustion is complete and produced higher temperatures. The efficiency of diesel is 29.18%, B20 blend is 27.58 and B25 blend 26.74

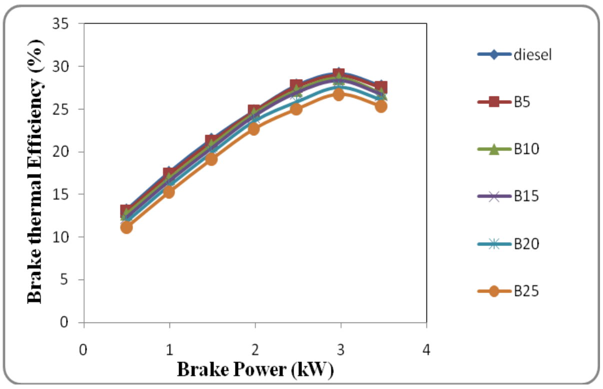

Figure1. Variation of Brake thermal Efficiency with power output.

Brake specific Fuel Consumption

The variation of brake specific fuel consumption (BSFC) with break power is shown in Figure 2. The BSFC reduced with the load for all the fuels. It is found that the specific fuel consumption for the blend is higher than diesel at all loads. This is because of the combined effects of lower heating value and the higher fuel flow rate due to high density of the blends. Higher proportion of Mahua biodiesel in the blends increases the viscosity which in turn increased the specific fuel consumption due to poor atomization of the fuel. The oxygenated biodiesels may lead to the leaner combustion resulting in higher BSFC

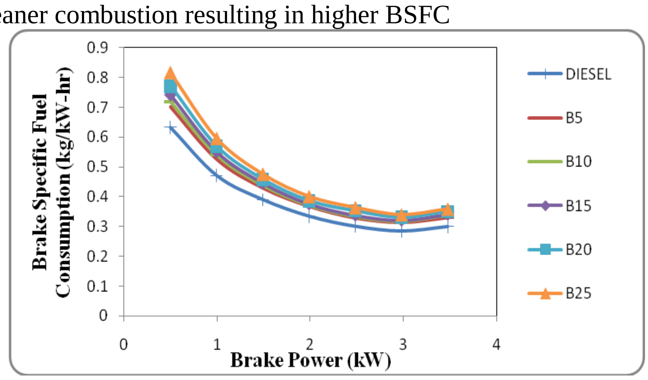

Figure 2 Variation of brake specific fuel consumption with power output

Exhaust Gas Temperature

The Figure 3 shows the variation of Exhaust gas temperature with break power output. Exhaust gas temperature was found to increase in both concentration of biodiesel in blends and engine load. The exhaust gas temperature rises from 110℃ at no load to 350℃ for various blends. The increase in EGT with engine load is due to the fact that a higher amount of fuel is required in the engine to generate extra power needed to take up conditional loading. Exhaust gas temperature for B-25 is highest. For the diesel fuel the exhaust gas temperature is lowest among all biodiesel blends. The exhaust gas temperature for the diesel at the rated load is 320℃, for B20 is 308℃. Though the viscosity for the Mahua biodieselis higher it is compensated by the calorific value of the fuels.

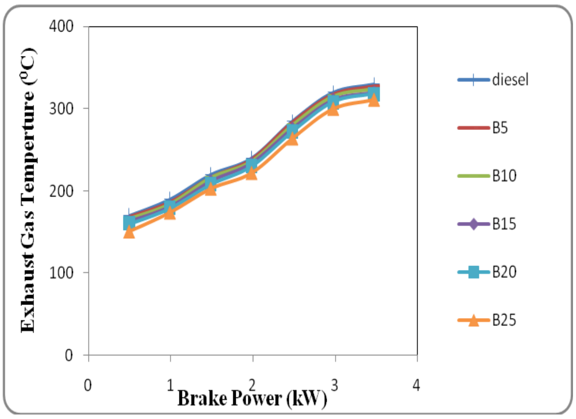

Figure 3 Variation of Exhaust gas temperatures with power output

Hydrocarbon emissions

The variation of hydrocarbon emissions with break power is shown in Figure 4. The HC emissions depend upon mixture strength i.e. oxygen quantity and fuel viscosity in turn atomization.

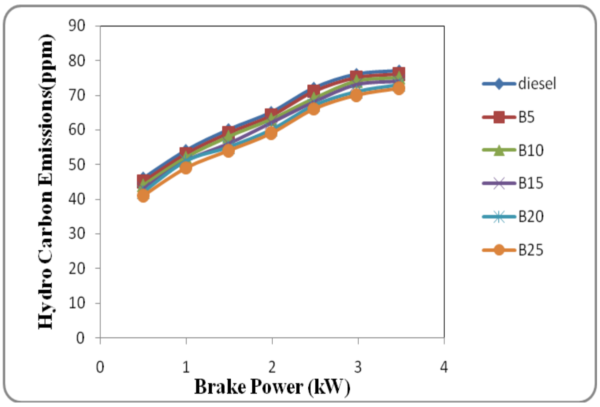

Figure 4 variations of hydrocarbon emissions with power output.

The HC emissions increase with increasing load as well as increasing the amount of bio diesel. Lower heating value leads to the injection of higher quantities of fuel for the same load condition. More the amount bio diesel leads to more viscosity. Viscosity effect, in turn atomization, is more predominant than the oxygen availability, either inherent in fuel or present in the charge. When compared to diesel, the oxygen availability in the bio diesels is more. So the emissions are less than diesel. It is observed from the figure that the decrease in hydro carbon emissions with Mahua biodiesel is more compared to diesel.

Carbon Monoxide Emissions

The variation of carbon monoxide emissions for with brake power is illustrated in Figure 5. It has been observed that the CO emissions are increased with increase in engine load and decrease with the increase in proportion of biodiesel in the blends. The lower CO emission of biodiesel compared to diesel fuel is due to the presence of oxygen in biodiesel which helps in complete oxidation of fuel.

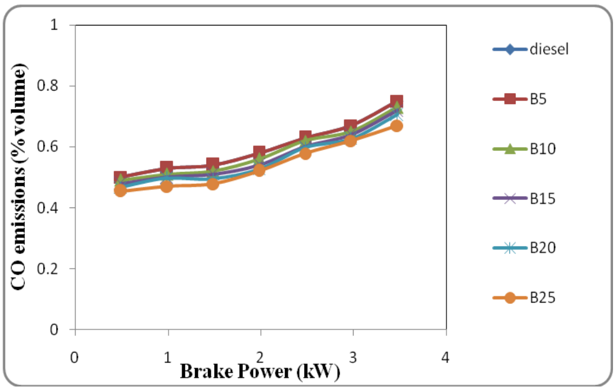

Figure 5 Variation of CO Emissions with Power output

Nitrogen oxide Emissions

The variation of Nitrogen oxide emissions oils is illustrated in Figure 6. The NOx emissions are higher for blend as compared with diesel fuel.

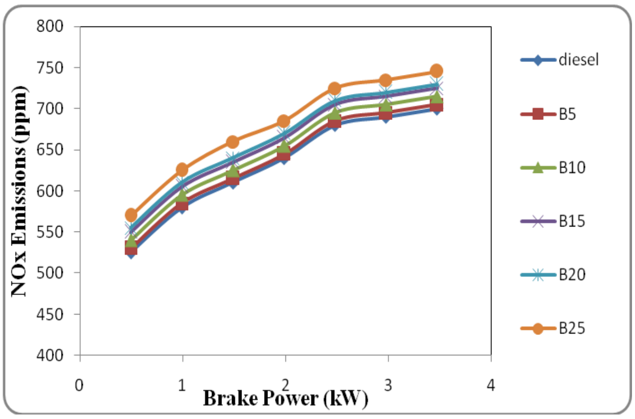

Figure 6 Variation of NOx emissions with power output

The increase of NOx in the emissions may be associated with the oxygen content of the biodiesel, since the biodiesel fuel provided additional oxygen for NOx formation. Thus one of the main reasons for the formation of NOx is the higher availability of oxygen in the combustion chamber.

IV. Conclusions

The following conclusions are drawn based on the experimental results of the above work:

- The brake thermal efficiency of the engine depends majorly on the heating value and viscosity. The brake thermal efficiency of B20 is nearer to the diesel fuel.
- With the higher combustion rate, the temperature inside the engine and in turn in the exhaust increases
- The Hydrocarbon emissions of Mahua biodieselbiodiesel blends are less than diesel fuel
- The CO emissions are lower for bio diesel blends due to presence of oxygen.
- The NOx emissions increase with increase in concentration biodiesel in blend due to high temperature.

Finally it is concluded that the blend of mahua biodiesel blend– B20 is the optimum blend for Diesel engines for better performance and emissions. The Mahua biodiesel can be used as alternative to diesel.

Nomenclature

B05 : Blend with 5% biodiesel + 95% diesel by volume.
B10 : Blend with 10% biodiesel + 90% diesel by volume.
B15 : Blend with 15% biodiesel + 85% diesel by volume.
B20 : Blend with 20% biodiesel + 80% diesel by volume.
B25 : Blend with 25% biodiesel + 75% diesel by volume.
BSFC : Brake specific fuel consumption.
CO_2 : Carbon dioxide.

Cm : Centimeter.
EGT : Exhaust Gas Temperature
KJ : kilo Joule.
KW : Kilo watt.
NO_X : Nitrogen oxide.
Ppm : Parts per million
rpm : Revolutions per minute..

References

[1]. **Cummins, C., Lyle**, Jr. (1993). Diesel's Engine, Volume 1: From Conception to 1918.Wilsonville, OR, USA: Carnot Press, ISBN 978-0-917308-03-1.
[2]. **Agarwal A.K and Das L.M**, *Bio diesel development and characterization for use as a fuel in CI engine*, Transaction of ASME 2001-123, 440- 447
[3]. **Bari, S., Lim, T.H., Yu, C.W. (2002).** *Effect of preheating of crude palm oil on injection system*
[4]. **MK Senthil,A Ramesh,**Performance studies on CI Engine using methyl ester of Jatropha as afuel,*XVI National conference on IC Engines*-calcutta,India-2000:89-94
[5]. **Plank C E lobeer**, Quality control vegetable oil Methyl esters used as diesel fuel substitute, *Journal of high resolution chromatography*-1992.
[6]. Bio energy Technology (BE) *World Renewable Energy Congress-2011* Sweden,8-13 May 471-478
[7]. Report of the committee on Development of Bio fuels-Planning Commission, Government of India.