International Journal of Scientific Engineering and Applied Science (IJSEAS) - Volume-1, Issue-9, December 2015
ISSN: 2395-3470
www.ijseas.com

Experimental Study on Performance of a Four Stroke Diesel Engine Using Bio-Diesel Blends at Different Loads and Speeds

Karunakaran Puravi[1], Meignanamoorthy Meiyanathan[2]

[1] Mount Zion College of Engineering and Technology, Tamilnadu, India

[2] Mount Zion College of Engineering and Technology, Tamilnadu, India

Abstract

In this research work, by varying the load and speed with different biodiesel blend percentage the performance of the four stroke diesel engine was investigated. In this work jetpropha oil was used as raw material. The properties such as density, kinematic viscosity has been identified. The performance test was conducted at various load conditions 1,3,6 & 7.5 and speed in rpm 1560, 1538, 1516 & 1504 with different propositions such as B20%, B40%, B60% of Bio-Diesel blend with pure diesel and B100% alone. From the result, it was revealed that addition of B20%, B40%, B60% of Bio-Diesel blend with pure diesel the Brake Power(B.P), Brake Thermal Efficiency($n_{t.h}$ %) was increased. The test was conducted with 100% Bio-Diesel blend alone at that time Brake Power, Brake Thermal Efficiency was significantly increased.

Keywords: *Jetropha Oil, Four Stroke Diesel Engine, Brake Power, Brake Thermal Efficiency.*

1.Introduction

Bio-Diesel has become more attractive recently because of its environmental benefits and the fact that it is made from renewable resources. There are four primary ways to make biodiesel, direct use and blending, micro emulsion, thermal cracking and transterification. Biodiesel, derived from the trans esterification of vegetable oils or animal fats, is composed of saturated and unsaturated long-chain fatty acid alkyl esters. In spite of having some application problems, recently it is being considered as one of the most promising alternative fuels in internal combustion engine. From scientific literatures, this paper has collected and analyzed the data on both advantages and disadvantages of biodiesel over conventional diesel [1]. Vegetable oils are produced from numerous oil seed crops. While all vegetable oils have high-energy content, most require some processing to assure safe use in internal combustion engines. Some of these oils already have been evaluated as substitutes for diesel fuels. With the exception of rape seed oil which is the principal raw material for biodiesel fatty acid methyl esters, sun7ower oil, corn oil and olive oil, which are abundant in Southern Europe, along with some wastes, such as used frying oils, appear to be attractive candidates for biodiesel production [2]. Neat vegetable oils pose some problems when subjected to prolonged usage in CI engine. These problems are attributed to high viscosity, low volatility and polyunsaturated character of the neat vegetable oils. These problems are reduced to minimum by subjecting the vegetable oils to the process of trans esterification. Various properties of the biodiesel thus developed are evaluated and compared in relation to that of conventional diesel oil. A series of engine tests provided adequate and relevant information that the biodiesel can be used as an alternative, environment friendly fuel in existing diesel engines without substantial hardware modification [3]. The fuels considered are primarily the methyl esters of fatty acids derived from a variety of vegetable oils and animal fats, and referred to as biodiesel. The major obstacle to widespread use of biodiesel is the high cost relative to petroleum. Economics of biodiesel production are discussed, and it is concluded that the price of the feedstock fat or oil is the major factor determining biodiesel price.

Biodiesel is completely miscible with petroleum diesel fuel, and is generally tested as a blend. The use of biodiesel in neat or blended form has no effect on the energy based engine fuel economy. The purity levels necessary for achieving adequate engine endurance, compatibility with coatings and elastomers, cold flow properties, stability, and emissions performance must be better defined [4]. Due to the depletion of non-renewable fossil fuels there are many alternative fuels introduced today, one of alternative fuel used is Bio-Diesel but Bio-Diesel has low performance characteristics and not commercially used [5]. The world is confronted with the twin crises of fossil fuel depletion and environmental degradation. The indiscriminate extraction and consumption of fossil fuels have led to a reduction in petroleum reserves. Alternative fuels, energy conservation and management, energy efficiency and environmental protection have become important in recent years. The increasing import bill has necessitated the search for liquid fuels as an alternative to diesel, which is being used in large quantities in transport, agriculture, industrial, commercial and domestic sectors. Biodiesel obtained from vegetable oils has been considered a promising option [6].

2. Experimental Details

2.1 Viscosity

Viscosity is the resistance of a fluid to flow. Simply stated, viscosity, which is also called dynamic viscosity (η), is the ease with which a fluid will flow. We intuitively understand viscosity as evidenced by the fact that we know, for example, honey is more viscous than water. In contrast, the kinematic viscosity (ν) is the resistance to flow of a fluid under gravity. Therefore, the kinematic viscosity of a fluid is related to the dynamic viscosity through the density (ρ). The kinematic viscosity of Biodiesel blend was increased when compared to compare to pure diesel table 1 shows the values.

Diesel

Table 1.a: Viscosity for Diesel

Time of 50 ml collection of oil in sec (t)	Temperature of oil T in °C	Kinematic viscosity centistoke
27.22	73	0.78
29.50	70	1.86

Bio-Diesel

Table 1.b: Viscosity for Biodiesel

Time of 50ml collection of oil in (sec) t	Temperature of oil T in °C	Kinematic viscosity centistoke
36.90	58	4.95
40.75	53	6.39

2.2 Flash and Fire Point

The flash and fire point test was conducted by using red wood viscometer apparatus. The Bio-Diesel value was increased when compared to pure diesel table 2 shows the values.

Table 2: Flash and Fire Point

Fuel Type	Flash point	Fire point
Pure Diesel	65	72
Bio-diesel	98	162

2.3 Performance Test

The test was on conducted on the engine in two stages (Bio-Diesel with pure diesel & Bio-Diesel alone). The performance test such as Brake Power, Total Fuel Consumption and Specific Fuel Consumption Brake Thermal Efficiency has been done at different loads and different speeds. While conducting the test with 100% Bio-Diesel (Jetropha) the Brake Power, Total Fuel Consumption and Specific Fuel Consumption Brake Thermal Efficiency has been increased a lot when compared to pure diesel, B20%, B40% and B60%. The performance table and performance graph clearly shows the result.

Table 3.1: Performance of Bio diesel 20% at
(Room temperature: 33℃)

Load		Net load W Kg	Speed Rpm	Brake power Kw	Total fuel consumption Kg/hr	Specific fuel consumption Kg/kw.hr	Brake thermal efficiency
W1 kg	W2 kg						
0	0	1	1560	0.264	0.254	.962	9.36
3	1	3	1538	0.782	0.328	.419	21.48
6	1.5	6	1516	1.413	0.426	.301	29.88
9	2.5	7.5	1504	1.912	0.584	.304	28.38

Table 3.2: Performance of Bio diesel 40% at
(Room temperature: 33℃)

Load		Net load W Kg	Speed Rpm	Brake power k.w	Total fuel consumption Kg/hr	Specific fuel consumption Kg/kw.hr	Brake thermal efficiency
W1 kg	W2 kg						
0	0	1	1562	.265	.265	1.003	9.011
3	1	3	1540	.783	.362	.462	19.49
6	1.5	6	1530	1.426	.4385	.307	29.33
9	2.5	7.5	1518	1.929	.493	.255	35.33

Table 3.3: Performance of Bio diesel 60% at
(Room temperature: 33℃)

Load		Net load W Kg	Speed Rpm	Brake power k.w	Total fuel consumption Kg/hr	Specific fuel consumption Kg/kw.hr	Brake thermal efficiency
W1 kg	W2 kg						
0	0	1	1542	.261	.254	.973	9.25
3	1	3	1530	.778	.3508	.4508	19.98
6	1.5	6	1514	1.539	.4385	.284	31.62
9	2.5	7.5	1514	1.924	.5092	.2646	34.06

Table 3.4: Performance of Bio-Diesel 100% at
(room temperature 33^{0}C)

Load		Net load W Kg	Speed Rpm	Brake power k.w	Total fuel consumption Kg/hr	Specific fuel consumption Kg/kw.hr	Brake thermal efficiency
W1 kg	W2 kg						
0	0	1	1542	.261	.254	.973	9.25
3	1	3	1530	.778	.3508	.4508	19.98
6	1.5	6	1514	1.539	.4385	.284	31.62
9	2.5	7.5	1514	1.924	.5092	.2646	34.06

2.4 Comparison Between The Blenders

The below table clearly shows the comparison between the blenders increase in Brake power, Efficiency and Specific fuel Consumption

Table 2.4.1: Brake Power

LOAD	DIESEL	B20	B40	B60	B100
0	0.265	0.264	0.264	0.261	0.262
3	0.788	0.782	0.783	0.778	0.779
6	1.426	1.413	1.426	1.539	1.551
9	1.923	1.912	1.929	1.924	1.929

Table 2.4.2: Efficiency

LOAD	DIESEL	B20	B40	B60	B100
0	7.92	9.39	9.01	9.25	8.77
3	20.44	21.48	19.49	19.98	19.12
6	29.19	29.88	29.33	31.62	31.55
9	35.19	28.38	35.33	34.06	33.62

Table 2.4.3: Specific Fuel Consumption

LOAD	DIESEL	B20	B40	B60	B100
0	1.041	0.964	1.003	0.973	1.026
3	0.403	0.419	0.462	0.45	0.471
6	0.282	0.361	0.307	0.284	0.268
9	0.234	0.317	0.225	0.264	0.268

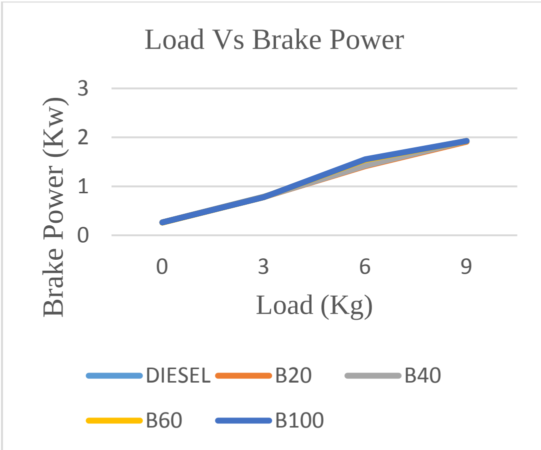
Table 2.4.4: Total fuel consumption

LOAD	DIESEL	B20	B40	B60	B100
0	0.276	0.254	0.265	0.254	0.269
3	0.318	0.328	0.362	0.351	0.367
6	0.403	0.426	0.438	0.438	0.415
9	0.453	0.607	0.493	0.509	0.517

2.5 Performance Graph

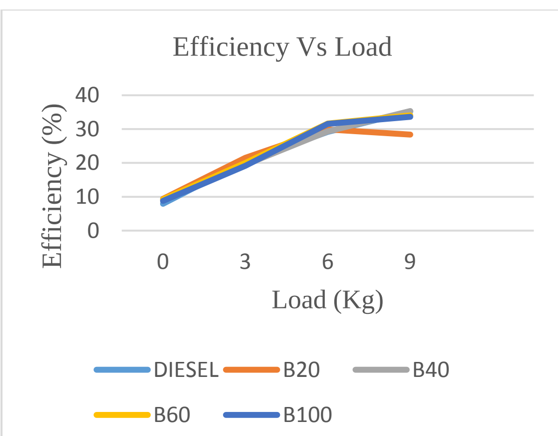
The performance graph 2.5.1 shows the variation between load and brake power. From this it is clearly understand that when load increases brake power also increased at B-100%.

Graph 2.5.1: Load Vs Brake power



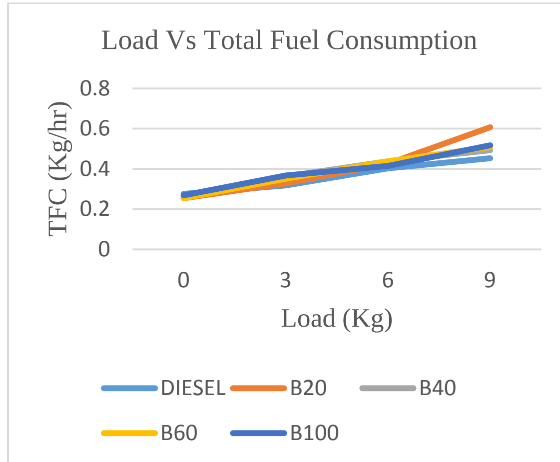
The performance graph 2.5.2 shows the variation between load and Efficiency. From this it is clearly understand that when load increases efficiency also increased at B-100%.

Graph 2.5.2: Load Vs Efficiency



The performance graph 2.5.3 shows the variation between load and Total Fuel consumption. From this it is clearly understand that when load increases Total Fuel consumption also increased at B-100%.

Graph 2.5.3: Load Vs Total Fuel Consumption



3. Conclusions

The experiment was conducted in four stroke diesel Engine.. In this experiment along with the pure diesel, Bio-Diesel was blended with different propositions and Bio-Diesel alone. The jetropha oil mixed with pure diesel of B20%, B40%, and B60% and B100% alone. For B100% the Brake Power, Specific Fuel Consumption, Total Fuel Consumption and Brake Thermal Efficiency has significantly increased when compared to other blends with pure diesel. From the results it is concluded that jetropha oil alone can be used as alternate fuel in four stroke diesel engine.

References

[1] M.A.Fazal, A.S.M.A. Haseeb, H.H.Masjuki, Biodiesel feasibility study: An evaluation of material compatibility; Performance; Emission and Engine Durability, Renewable and Sustainable Energy Reviews 15(2011) 1314-1324.

[2] S.Kalligeros, F.Zannikos, S.Stournas, E.Lois, G.Anastopoulos, Ch.Teas, F.Sakellaropoulos, An Investigation of Using Biodiesel/Marine Diesel Blends on the Performance of a Stationary Diesel Engine, Biomass and Bioenergy 24 (2003) 141 – 149.

[3] A. K. Agarwal, L. M. Das, Biodiesel, Development and Characterization for Use as a Fuel in Compression Ignition Engines, Transactions of the ASME, Vol. 123, April 2001.

[4] Michael S. Graboski and Robert L. McCormick, Combustion of Fat and Vegetable Oil Derived Fuels in Diesel Engines, Prog. Energy Combust. Sci. Vol. 24, pp. 125-164, 1998.
[5] Tom Varghese, Jesu Raj, E. Raja, C. Thamotharan, Performance and Emission Testing on Algae Bio Fuel using Additives, International Journal of Engineering and Advanced Technology, Volume-4 Issue-5, June 2015.
[6] B.K. Barnwal, M.P. Sharma, Prospects of Biodiesel Production from Vegetable Oils in India, Renewable and Sustainable Energy Reviews, (2005) 363–378.

Biographies

P.Karunakaran is presently working as an Assistant Professor in the Department of Mechanical Engineering at Mount Zion College of Engineering and Technology, Pudukkottai. He obtained his B.E in Mechanical Engineering and M.E in Thermal Engineering from Annamalai University, Chidambaram.

M.Meignanamoorthy is presently working as an Assistant Professor in the Department of Mechanical Engineering at Mount Zion College of Engineering and Technology, Pudukkottai.