Comparison of Performance of Di Diesel Engine Using Jatropha Bio-Diesel, Jatropha Oil and Neem Oil

Samir Pandey

Student in Department of Mechanical Engineering, Madanapalle Institute of Technology & Science, Madanapalle-517325, A. P., India

Abstract: ***There is blending of Jatropha Bio-diesel oil, Jatropha oil and Neem oil with diesel for the performance of diesel engine. In the current investigation, the performance of Jatropha bio diesel oil, Jatrophaoil and Neem oil has been tested. Naturally available which long have been potential alternative fuel for the Direct Injection compression ignition (C. I.) engine were blended with diesel. The performance test consists of brake power, brake specific fuel consumption, brake thermal efficiency and mechanical efficiency. The performance evaluation was done using a twin cylinder, water-cooled, 14 bhp, 4-stroke, constant speed C. I. engine coupled with a swinging field dynamometer and the performance was compared with the performance obtained with diesel and jatropha bio diesel oil. we can use Jatropha oil as a next generation diesel oil in upcoming future.***

Keywords: Jatropha Bio-Diesel, vegetable Oils, Jatropha oil, Neem oil, Diesel oil

Abbreviations

JD	=	Jatropha bio diesel
EL	=	Electrical load
TE	=	Thermal Efficiency
η	=	Efficiency
BTE	=	Brake Thermal Efficiency
ITH	=	Indicated Thermal Efficiency
SFC	=	Specific Fuel Consumption
J oil	=	Jatropha oil
N oil	=	Neem oil

1. History

Transesterification of a vegetable oil was conducted as early as 1853 by scientists E. Duffy and J. Patrick, many years before the first diesel engine became functional. Rudolf Diesel's prime model, a single 10 ft (3 m) iron cylinder with a flywheel at its base, ran on its own power for the first time in Augsburg, Germany, on August 10, 1893 [2]. In remembrance of this event, August 10 has been declared "International Biodiesel Day".

During the 1920s, diesel engine manufacturers altered their engines to utilize the lower viscosity of petro diesel (a fossil fuel), rather than vegetable oil (a biomass fuel). The petroleum industries were able to make inroads in fuel markets because their fuel was much cheaper to produce than the biomass alternatives. The result, for many years, was a near elimination of the biomass fuel production infrastructure. Only recently, have environmental impact concerns and a decreasing price differential made biomass fuels such as biodiesel a growing alternative.

Despite the widespread use of fossil petroleum-derived diesel fuels, interest in vegetable oils as fuels in internal combustion engines is reported in several countries during the 1920's and 1930's and later during World War II. Belgium, France, Italy, the United Kingdom, Portugal, Germany, Brazil, Argentina, Japan and China have been reported to have tested and used vegetable oils as diesel fuels during this time. Some operational problems were reported due to the high viscosity of vegetable oils compared to petroleum diesel fuel, which result in poor atomization of the fuel in the fuel spray and often leads to deposits and coking of the injectors, combustion chamber and valves. Attempts to overcome these problems included heating of the vegetable oil, blending it with petroleum-derived diesel fuel or ethanol, pyrolysis and cracking of the oils.

On August 31, 1937, G. Chavanne of the University of Brussels (Belgium) was granted a patent for a "Procedure for the transformation of vegetable oils for their uses as fuels" [3]. This patent described the alcoholysis (often referred to as transesterification) of vegetable oils using methanol and ethanol in order to separate the fatty acids from the glycerol by replacing the glycerol by short linear alcohols. This appears to be the first account of the production of what is known as "biodiesel" today.

More recently, in 1977, Brazilian scientist Expedito Parente produced biodiesel using transesterification with ethanol, and again filed a patent for the same process. This process is classified as biodiesel by international norms, conferring a "standardized identity and quality. No other proposed biofuel has been validated by the motor industry. "C: \H: Biodiesel. htm-_note-6%23_note-6 Currently, Parente's company Tecbio is working with Boeing and NASA to certify bioquerosene (bio-kerosene), another product produced and patented by the Brazilian scientist.

2. Introduction

Vegetable oils are easily obtainable in rural areas, are renewable and must have reasonably high cetane number to be used in Direct injection CI engines with very simple modifications and can be easily blended with diesel. Jatropha oil, Karanji oil, coconut oil, sunflower oil, preheated waste frying oil, rapeseed oil and neem oil are some of the vegetable oils are tried as fuels in IC engines.

In present work the performance evaluation tests by using petroleum diesel fuel and also the blends of Jatropaand Neem oil have been carried out by test rig. Engine performance is an indication of the degree of success with which it does its assigned job i. e., conversion of chemical energy contained in the fuel into the use full mechanical work. In evaluation of certain basic parameters are chosen.

The specifications of the engine are as follows: cylinder four stroke diesel engine (water cooled)

Make	Kirloskar
Output	14 BHP
AC generator capacity	10 KA, 3φ 440V, 50Hz
Bore and stroke	87.5mm×110mm
Speed	1500 rpm
Compression ratio	17.5: 1
Torque arm distance	0.3

Sustainability of petroleum resources is one of the most important elements to effect world economy and politics, which is the main source of world energy supply. world is facing a lot of problem due to the crisis of petrol and diesel, so the comparsion between the different fuel and oil which has viscosity is done with the help of four cylinder stroke diesel engine. Diesel engines are mainly used in many fields, including electric production, transport of passenger and cargo, industrial and agricultural activities. Petroleum fuels are being used in diesel engines, which has a wide range of use in all sectors. With a probable situation that oil demand cannot be met by petroleum based fuels, all the sectors that contributed by oil based energy will negatively be effected. With any probable petrol crises, for all the sectors the alternative fuel is vital to be developed. Vegetables fuel is one of the best substitute of diesel oil because of its property and reliability, efficiency and power generation.

Description of the Test Rig

This test rig consists of two cylinder four stroke diesel engine (water cooled). It is coupled to AC generator swinging field facility and with spring balance and torque arm. The arrangement is made for the measurement of the following

- The rate of the fuel consumption is measured by using pipette reading against known time.
- Airflow is measured by manometer connected to air box.
- The differential electrical loading is achieved by three phase AC generator is steps which is connected to the electrical heaters resist load.
- Generator output is measured by voltmeter and ammeter.
- The torque on the engine is measured by spring balance with torquearm
- The engine speed is measured by electrical digital meter.
- To conduct Morse test on an arrangement is provided to cut of the fuel supply to each cylinder.

3. Result and Discussion

1) Brake Power

Table 1 Brake Power developed by engine at increasing electrical loads by using blends of jatropha bio-diesel oil, Neem oil and jatropha oil.

The result is analyzed in the form of both table and graphical formation.

Electric load	JD 100	J oil 10%	N oil 10%	J oil 20%	N oil 20%	diesel
1.5kw	2.076	1.222	1.321	1.057	1.244	1.237
3kw	3.435	3.233	2.341	2.578	2.456	2.344
4.5kw	5.221	4.589	4.367	4.234	4.076	4.107
6kw	7.166	7.136	6.984	7.387	7.177	7.103
7.5kw	9.503	8.671	8.566	8.765	8.471	8.567

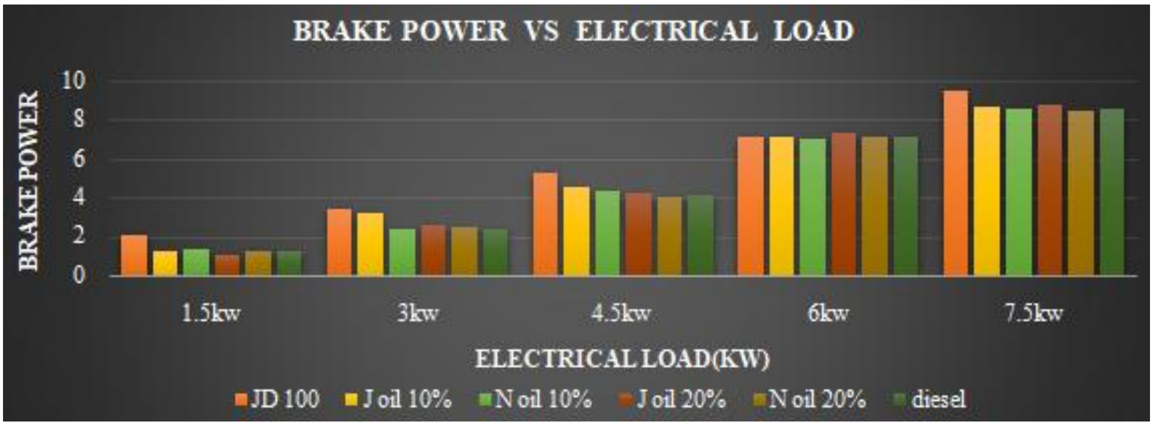

Figure: Graph representation of Brake power vs Electrical load

The brake power developed by the engine using Jatropha bio-diesel oil, jatropha oil and neem oil at different loads are presented in Table 1. We can analyzed that the maximum brake power of 9.503 KWwas developed by the engine while using with jatropha bio diesel 100%. The corresponding engine speed was 1445RPM. The brake power produced by the engine by using jatropha bio-diesel is more in comparision of jatropha oil and neem oil of 10% and 20% respectively is observed. Only jatropha bio-diesel is producing little bit more power at full load that can be observed in 1.5 kw, 4.5kw and 7.5kw electric load whereas jatropha 10% oil is also performing good in 3kw and 6kw electric load.

2) Specific Fuel Consumption

Table 2: Specific fuel consumed by engine at increasing electrical loads by using blends of jatropha bio-diesel oil, Neem oil and jatropha oil

Electric load	JD 100	J oil 10%	N oil 10%	J oil 20%	N oil 20%	diesel
1.5	0.6	1.012	0.975	1.254	1.004	1
3	0.46	0.623	0.612	0.496	0.625	0.6
4.5	0.375	0.432	0.425	0.412	0.429	0.45
6	0.345	0.41	0.4	0.389	0.403	0.4
7.5	0.334	0.394	0.399	0.398	0.391	0.4

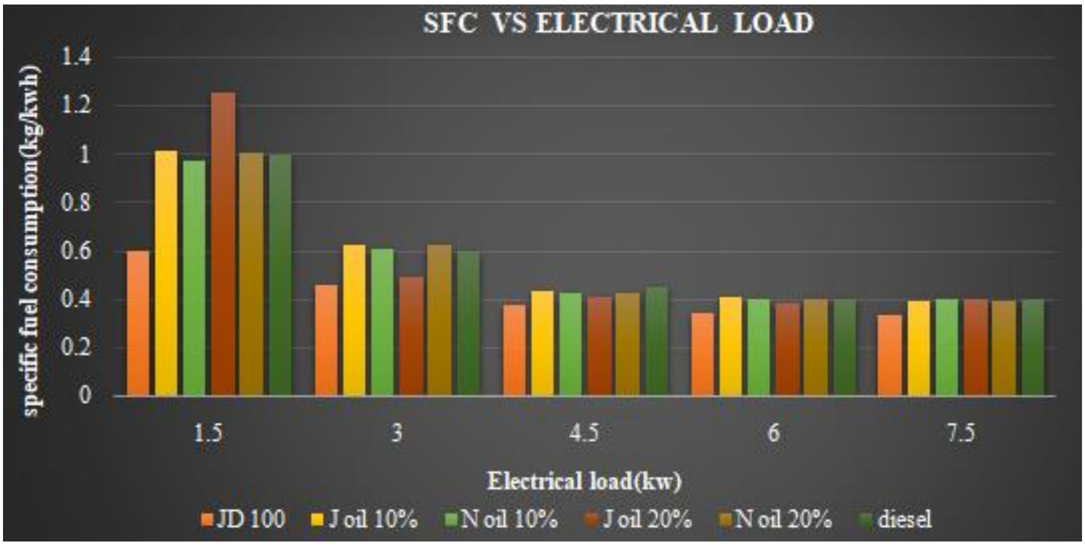

Figure: Specific fuel consumption vs Electric load

A schematic graph drawn between electrical load & SFC. Taking electrical load on X-axis & SFC on Y-axis. As the E load increases, SFC decreases for all oils, but compare to 1.5 electric load in jatropha oil the SFC increases to the 1.254 in 20% and 1.012 in 10%. This is the fact that brake power of the engine increases with an increase in brake load, but after a certain percentage of maximum load, any for their increase in brake load caused only a small increase in brake power. The difference in SFC is reflection of the difference in fuel density and calorific value of fuel used.

3) Brake Thermal Efficiency Vs Electric Load

Table 3: Brake thermal efficiency of engine at increasing electrical loads by using blends of jatropha bio-diesel oil, Neem oil and jatropha oil

Electric load	JD 100	J oil 10%	N oil 10%	J oil 20%	N oil 20%	diesel
1.5	15.16	8.101	8.32	6.507	8.511	8.093
3	21.111	14.325	15.322	17.112	14.223	15.023
4.5	25.312	20.111	19.897	19.272	19.331	18.243
6	28.323	23.543	22.321	24.234	24.123	23.444
7.5	29.011	23.234	22.579	24.121	24.893	23.732

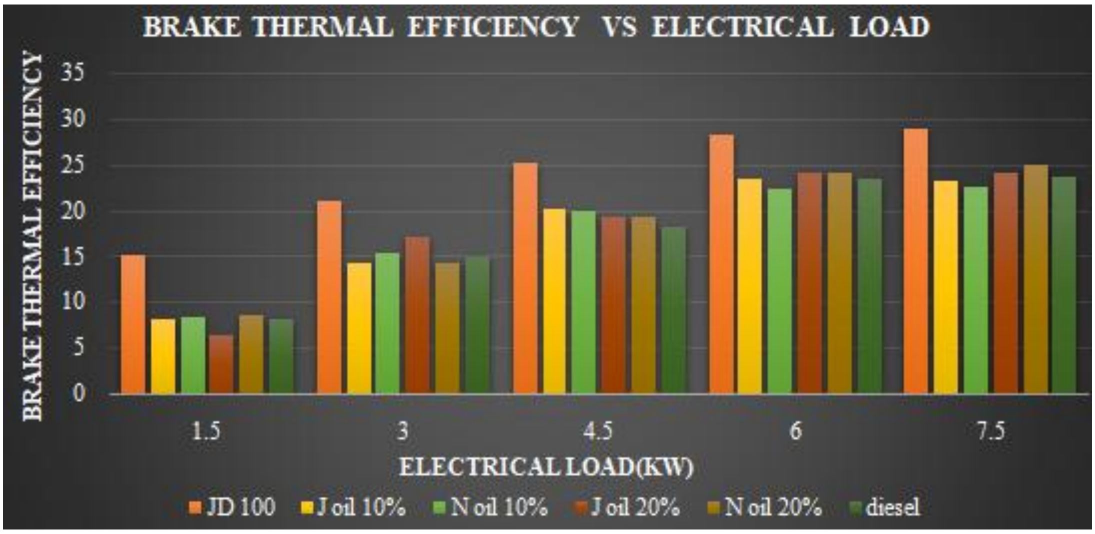

Figure: Brake thermal efficiency vs Electric load

The relation between engine load and brake thermal efficiency for the jatropha biodiesel, jatropha oil and neem oil. It is very predominant that brake thermal efficiency is increasing according to the increase in load but at particular load it started decreasing it's because the increase in specific fuel consumption had increased at the same load. This indicates the fuel is not combusting totally. That is the reason brake thermal efficiency is decreasing. The Brake thermal efficiency of the jatropha bio diesel oil is good and more as compare to 10% jatropha oil, 20% jatropha oil, 10% neem oil, 20% neem oil and diesel oil.

A schematic graph drawn between electrical load & Brake thermal efficiency (ηBth). Taking electrical load on X-axis & ηBth on Y-axis. As the E load increases, ηBth increases for all oils, but it impact more in JD100.

4) Mechanical Efficiency vs Electric Load

Table 4: Mechanical efficiency of engine at increasing electrical loads by using blends of jatropha bio-diesel oil, Neem oil and jatropha oil

Electric load	JD 100	J oil 10%	N oil 10%	J oil 20%	N oil 20%	diesel
1.5	27.5	16	16.1	13	17.2	17
3	37.5	30.2	31	33	33	31.5
4.5	47.5	45	44.2	44.7	44.2	43.5
6	56	54.1	52.3	54	53.5	54.2
7.5	64	61	61.1	58.8	58.4	61

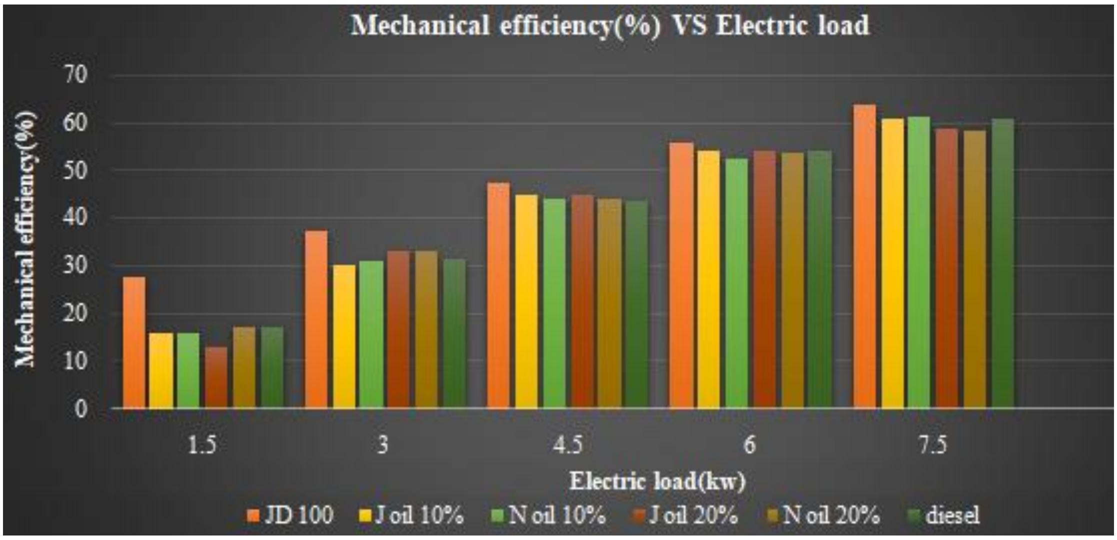

Figure: Mechanical efficiency (%) vs Electrical load

The relation between engine load and mechanical efficiency for different blends of jatropha bio-diesel, pure jatropha bio-diesel and jatropha oil and neem oil are shown. The figures show mechanical efficiency of engine operated with jatropha bio-diesels are all most the same efficiency coming to jatropha oil its showing jatropha bio diesel oil is giving batter mechanical efficiency compared with jatropha oil blends, neem oil blends and diesel. The reason for increase of mechanical efficiency is decrease in heat input. Heat input is decreased because calorific value is decreased and density is increased.

4. Conclusion

1) The brake power of JD100 is more as compared to the jatropha oil, diesel and neem oil blends.
2) This can say that cost, energy and time for transesterification are reduced.
3) We can observe the diversification of the engine while applying different load condition and also we can conclude that the JD100 is more efficient in more category.

References

[1] Dorado, M. P., Ballesteros, E., Arnal, J. M., Gomez, J., & Lopez Gimenez, F. J. Testing waste olive methyl ester as a fuel in a diesel engine. Energy and Fuels, 2003, 17 (6), 1560– 1565.
[2] Ozsezen, A. N., Canakci, M., & Sayin, C. Effects of biodiesel from used frying palm oil on the performance, injection, and combustion characteristics of an indirect injection diesel engine. Energy and Fuels, 2008, 22 (2), 1297–1305.
[3] Schumacher, L. G., Marshall, W., Krahl, J., Wetherell, W. B., & Grabowski, M. S. Biodiesel emissions data from Series 60 DDC engines. Transactions of the ASAE, 2001, 44 (6), 1465–1468.
[4] Pundlik R. Ghodke and Dr. J. G. Suryawanshi, “Simulation and Optimization of HSDI Diesel Engine for Suv to Meet Bharat 4 Emission Norms in India”, International Journal of Mechanical Engineering & Technology (IJMET), Volume 3, Issue 2, 2012, pp.494-510, ISSN Print: 0976 – 6340, ISSN Online: 0976 – 6359.
[5] A critical review of bio-diesel as a vehicular fuel by Mustafa Balat, Havva Balat, Energy Conversion and Management 49 (2008) 2727–2741
[6] Chavanne, C. G. (1938). Belgian Patent 422, 877, Aug.31, 1937. Chem. Abs, 32, 4313.
[7] Prof. A. V. Mehta, M. G. Joshi, G. D. Patel and Saiyad M J. I., “Jatropha Oil with Exhaust Heat Recovery System in 4 Stroke Single Cylinder Diesel Engine”, International Journal of Mechanical Engineering & Technology (IJMET), Volume 4, Issue 2, 2013, pp.512-520, ISSN Print: 0976 – 6340, ISSN Online: 0976 – 6359.
[8] Report of petroleum market. Energy market regulatory authority, 2007.
[9] Parametric studies for improving the performance of a Jatropha oil-fuled compression ignition engine by J.

Narayana Reddy, A. Ramesh, Internal Combustion Engines Laboratory, Mechanical Engineering Department, Indian Institute of Technology Madras, Chennai-600 036, India