International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

COPY RIGHT

IJIEMR Transactions, online available on 05th Feb 2022. Link :http://www.ijiemr.org/downloads.php?vol=Volume-11&issue=ISSUE-02

DOI: 10.48047/IJIEMR/V11/I02/01

Title **PERFORMANCE ANALYSIS OF BIO DIESEL BLEND (B20) MIXING WITH NANO PARTICLES AL2O3 (0.025G) ON 4- STROKE SINGLE CYLINDER ENGINE**

Volume 11, Issue 02, Pages: 1-9

Paper Authors
DONTHIREDDY GOPI REDDY, Dr. M. MAHESH

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

PERFORMANCE ANALYSIS OF BIO DIESEL BLEND (B20)MIXING WITH NANO PARTICLES AL2O3 (0.025G) ON 4- STROKE SINGLE CYLINDER ENGINE

DONTHIREDDY GOPI REDDY
Department of Mechanical Engineering Guntur Engineering College NH-5, Yanamadala, Guntur-522019, Guntur District, Andhra Pradesh
Dr. M. MAHESH
Associate Professor, Guntur Engineering College NH-5, Yanamadala, Guntur-522019, Guntur District, Andhra Pradesh

ABSTRACT:

The impact of nano-additives with the diesel and biodiesel fuels is one of the current scopes of research with regards to the fuel modification techniques. Intensive research is underway to utilize the nano-additives judiciously without affecting our ecological environment. In the present work, the effects of nano-additives (Alumina and Carbon Nano tubes) blended biodiesel emulsion fuels on the performance, smoke, gaseous emission and combustion characteristics of a constant speed four stroke single cylinder direct injection diesel engine was investigated. It is recognized that emissions of nano particles from diesel engines is of great concern and that if this work demonstrates a performance benefit then further work will be focused on the health impact issues. Etherification and emulsification techniques were adopted to prepare the jatropha biodiesel and jatropha water-biodiesel emulsion fuels respectively. The whole investigation was carried out in five phases. In the first phase, both neat diesel and neat jatropha biodiesel fuel were tested in the diesel engine to obtain the reference readings. In the second phase, neat jatropha water-biodiesel emulsion fuel was prepared in the proportion of 76% of biodiesel, 20% of water and 4% of surfactants (by volume). In the third phase, 50 ppm Alumina, 50 ppm CNT, and 100 ppm (50 ppm Alumina + 50 ppm CNT) were blended with the neat biodiesel emulsion fuel separately to prepare the nano-additive blended water-biodiesel emulsion fuels. In the fourth phase, all the prepared emulsion fuels were subjected to the stability investigations. In the fifth phase, the prepared stable emulsion fuels were subjected to the experimental investigations in a constant speed (1500 rpm) four stroke air cooled direct injection diesel engine. The experimental outcome revealed an appreciable enhancement in the performance and reduced smoke and gaseous emissions for the nano-additive blended water-biodiesel emulsion fuels when compared to that of neat diesel and neat biodiesel. At the higher loads, the nano-additive blended water- biodiesel emulsion fuels exhibited higher brake thermal efficiency and reduced smoke and gaseous emissions when compared to that of neat diesel and neat biodiesel.

INTRODUCTION

Biodiesel is produced by combining vegetable oil or animal fat with an alcohol in the presence of a catalyst through a chemical process known as Transesterification. Oil for biodiesel

production can be extracted from almost any oilseed crop, globally; the most popular sources are rapeseed in Europe and soybean in Brazil and the United States of America. In tropical and subtropical countries, biodiesel is produces from palm, sun flower, Jatropha, Pongamia piñata and Cotton seed oils. The production process typically yields additional by-products such as crushed bean "cake" (an animal feed) and glycerine. It is well known that viscosity of fuels affects some processes such as atomization, vaporization and fuel– air mixing in the engine. The engine performance and emissions of diesel engines fuelled with biodiesels have been examined by many investigators. The biodiesels used in the experiments performed by these investigators were produced from different vegetable oils such as cottonseed, sunflower, rapeseed, soybean, karanja, rubber seed, etc. In this study, the performance parameters and thermal efficiencies of a single-cylinder, four- stroke diesel engine using diesel fuel and biodiesel, which is cottonseed oil methyl ester have been calculated.

Need for Bio fuel

Ever since their discovery, the fossil fuels have benefited the man and have made them prosper and develop. These fuels that are extracted from the decomposed fossils, millions of years old, buried in the depths of the earth, are the reason why we are living today. Imagine a life without coal, gas and oil it's impossible now to live without these resources. But the sad part is that these fuels are non-renewable resources and we will run out of them one day, in fact, we already are. With the increase in population, which has taken place drastically over the centuries, the demand of these fuels has also increased.This increase of demand has led to much more use of these fuels, that has made the earth's fuel bank half empty, and with the rapid increase of their demand, it will soon be completely emptied. It is predicted that by 2050 the demand of fuels will be the double of the fuel demand today and would triple by the end of the century and if the process of excess fossil fuel continues, we will be left with nothing within few years.Steps are being taken to preserve these fuels by making their alternative sources. The best replacement for the fossil fuels is the BIOFUELS.

LITERATURE REVIEW

GAURAV DWIVEDI, M.P. SHARMA et al (2020) carried out experiment on diesel engine. They conducted experimental investigation on compression ignition engine using is an alternative for diesel engine. The performance evaluation of engine has found that BSFC for B100 in case of Pongamia biodiesel was 30.4 % higher than diesel at full load.

JINDAL et al (2020) The main aim of this paper is to evaluation of effect of injection timing on the combustion, performance and emissions of a small power diesel engine, commonly used for agriculture purpose, running on pure biodiesel, prepared from JANTROPHA. As the combustion advances with biodiesel due to early entry, retarding the injection timing by 3o is found to increase the thermal efficiency by 8% and reduce the specific fuel consumption by 9% when jatropha methyl ester is used as fuel.

V.K Shahir et al (2019) they have described biodiesel as renewable, nontoxic, eco-friendly and sustainable alternative fuel for compression ignition engines. In spite of having some application problems, biodiesel in recent times being considered as one of

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

the most promising alternative fuels in internal combustion engine.

C. Syed Aalam (2019) proposed that the effect of fuel injection pressure on the combustion, performance and emission characteristics of a common-rail diesel engine(CRDI) using mahua methyl ester blend (MME20) have been deliberated In order to better utilization of mahua methyl ester blend, fuel injection pressure increased from 22Mpa to 88Mpa.

VCR Diesel Engine:

A fuel measuring system consists of a fuel tank mounted on a stand, burette and a three way cock. Air consumption is measured by using a mild steel tank which is fitted with an orifice and a U- tube water manometer that measures the pressures inside the tank. Also digital temperature indicator with selector switch for temperature measurement and a digital rpm indicator for speed measurement are provided on the panel board. A governor is provided to maintain the constant speed. For measuring the emissions the gas analyzer is connected to the exhaust flow.

THEORITICAL CALCULATIONSOF ENGINE PERFORMANCE PARAMETER:

The collected data is used to calculate parameters that measure engine performance. These engine performance parameters consist of Brake Power (B.P), Brake Specific Fuel Consumption (BSFC), Brake Thermal Efficiency (BTE), Indicated Thermal Efficiency (ITE) and Mechanical Efficiency (ME).

a) Brake thermal efficiency:

$$B.P = \frac{2\pi NR\,(S1-S2)\,X\,9.81}{60{,}000}\ Kw$$

In the above expression,

N –Speed (1000) in r.p.m,

R - Effective radius of the brake drum (0.171) in mt.

S_1 –Loa3d on rear end of the spring

S_2 - Load on front end of the spring

b) Secondly, fuel consumption per hour is calculated. The formula used for it is given as,

$$F.C/hr = \frac{x\,X\,Sp.Gravity\,X\,3600}{t\,X\,1000}\ Kg/hr$$

In the above expression,

x- Quantity of fuel (10 ml), t- Time in sec.

c) Thirdly, Brake Specific Fuel Consumption is calculated. It is the ratio of Fuel Consumption per hour to Brake Power. It is expressed as,

$$BSFC = \frac{F.C./hr}{B.P}\ Kg/Kw\ hr$$

Fourthly, Brake Thermal Efficiency is calculated. It is given by using the formula,

$$\eta_{bth} = \frac{B.P\,X\,3600\,X\,100}{F.C\,X\,C.V}\ \%$$

d) Fifthly, Mechanical Efficiency is calculated, using the formula

$$\eta_{mech} = \frac{B.P}{I.P} X100\ \%$$

$$I.P = B.P + F.P$$

Note: Friction Power (F.P) can be calculated by Willan's Line method

e) Lastly, Indicated Thermal Efficiency

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

is calculated, using the formula

$$\eta_{mech} = \frac{B.P}{I.P} X100\ \%$$

$$I.P = B.P + F.P$$

Note: Friction Power (F.P) can be calculated by Willan's Line method

Tabular for B20 and Nano B20: Experimental Observations for bio diesel (B20)

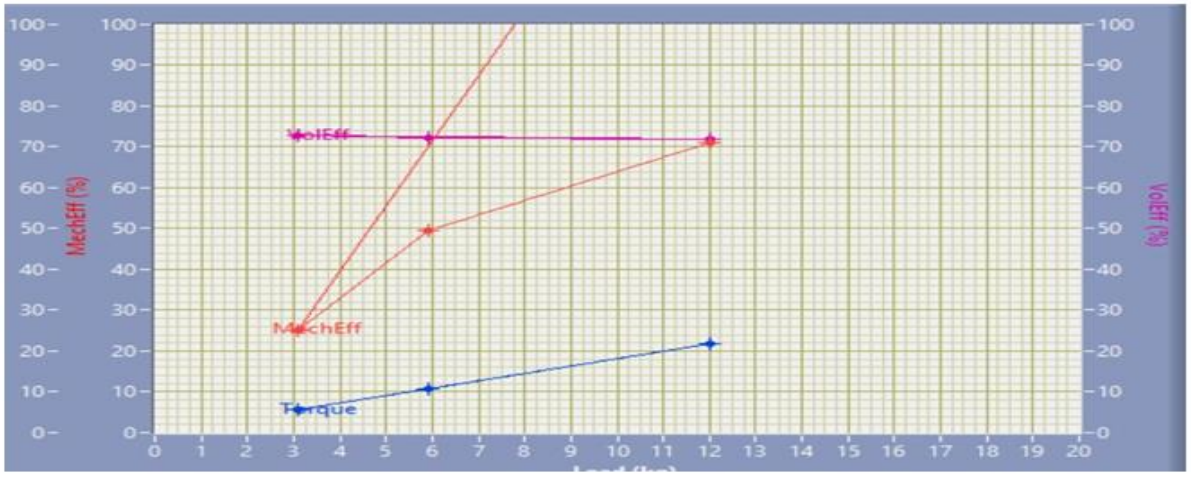
SNO	load	BP	FP	IP	BMEP	IMEP	BTHη	MECH EFFη	SFC	VOL
1	3	0.87	1.98	2.85	1.04	3.41	9.32	30.43	0.92	73.28
2	6	1.68	2.05	3.74	2.04	4.53	14.50	453.08	0.59	72.92
3	9	2.53	1.84	4.37	3.09	5.33	18.91	57.85	0.45	72.33

Experimental Observations for Cotton Seed oil (AL2O3) Blend B20

SNO	Load	BP	FP	IP	BMEP	IMEP	BTH	MECH E	SFC	VOL
1	3	0.87	2.08	2.95	1.07	3.62	9.98	29.52	0.86	73.63
2	6	1.68	1.81	3.49	2.07	4.30	15.25	31.62	0.56	73.83
3	9	2.49	3.91	6.41	3.09	7.95	18.5	38.90	0.46	73.02

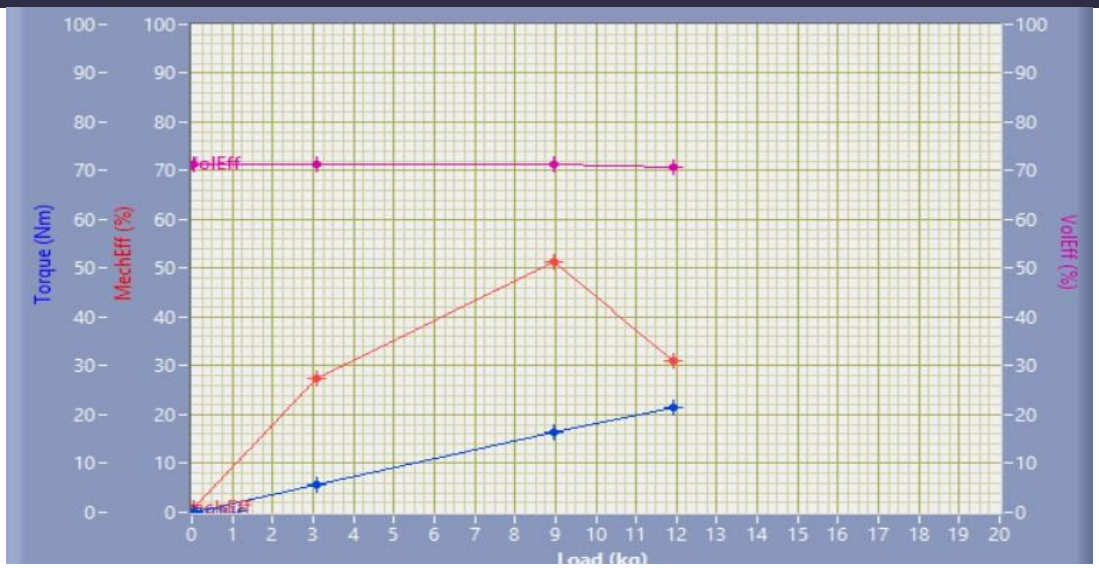
Mechanical efficiency:

It is the ratio of brake power to the indicated power. It may observe that mechanical efficiency is always less than unity. The comparison of Mechanical efficiency for various biodiesel blends with respect to brake power. From the plot it is observed diesel and its blends like B10 nearly equal at full load conditions. But considerable improvement in mechanical efficiency was observed by the blend B20 is 68.90% because of lowest frictional powers compared to diesel. Because of sufficient lubricating property of this blend frictional powers are reduced drastically and considerable improvement in mechanical efficiency has been observed and calorific value of this blend is more compared to other blends.



Mechanical efficiency for cotton seed oil (B20) AL2O3

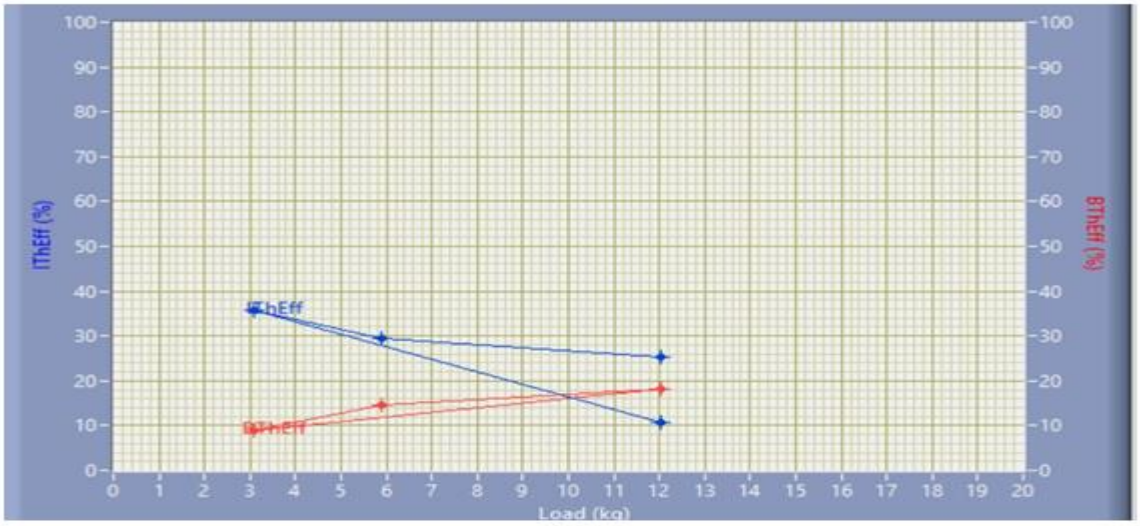
International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org



Mechanical efficiency for cotton seed oil (B20)

Brake thermal efficiency:

The brake thermal efficiency is calculated by the ratio of brake power to the product of mass of fuel consumption and the calorific value. From the observations and graph between brake thermal efficiency and load that the brake thermal efficiency is increases with the increase in engine load in Cotton seed oil the thermal efficiency of the engine is improved by increasing the concentration of the biodiesel in the blends and also the additional lubricates provided by biodiesel. The reason may be the leaner combustion of diesel and extended ignition delay resulting in a large amount of fuel burned. The graph between brake power and brake thermal efficiency is shown in the fig:



Brake thermal efficiency for cotton seed oil (B20) AL2O3

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

Brake thermal efficiency for cotton seed oil (B20)

EMISSION:

Combustion takes place when fuel, most commonly a fossil fuel, reacts with the oxygen in air to produce heat. The heat created by the burning of a fossil fuel is used in the operation of equipment such as boilers, furnaces, kilns, and engines. Along with heat, CO2 (carbon dioxide) and H2O (water) are created as by products of the exothermic reaction.

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O + Heat$$
$$C + O_2 \rightarrow CO_2 + Heat$$
$$2H_2 + O_2 \rightarrow 2H_2O + Heat$$

In most combustion processes, some additional chemicals are formed during the combustion reactions. Some of the products created such as CO (carbon monoxide), NO (nitric oxide), NO2 (nitrogen dioxide), SO2 (sulphur dioxide), soot, and ash should be minimized and accurately measured. The EPA has set specific standards and regulations for emissions of some of these products, as they are harmful to the environment. Combustion analysis is a vital step to properly operate and control any combustion process in order to obtain the highest combustion efficiency with the lowest emissions of pollutants.

EMISSION PARAMETER:

EMISSIONS FOR COTTON SEED OIL (B20) CR18 LOAD 3 KG:

SL.NO	PERAMETERS	RESULT
1	HC	0 PPM
2	CO	0.11%
3	CO2	3.09%
4	O2	15.83%
5	NOX	298 PPM
6	LAMBA	------
7	AFR	------
8	PEF	0.5
9	H/C	1.85

10	O/C	0

EMISSIONS FOR COTTON SEED OIL (AL2O3 B20) CR18 LOAD 3 KG:

SNO	PARAMETERS	RESULT
1	HC	30 PPM
2	CO	0.58%
3	CO2	3.12%
4	O2	16.28%
5	NOX	193 PPM
6	LAMBA	------
7	AFR	------
8	PEF	0.5
9	H/C	1.85
10	O/C	0

EMISSIONS FOR COTTON SEED OIL (B20) CR18 LOAD 6 KG:

SNO	PARAMETERS	RESULT
1	HC	78 PPM
2	CO	0.162%
3	CO2	4.70%
4	O2	14.03%
5	NOX	630 PPM
6	LAMBA	2.930
7	AFR	43.07
8	PEF	0.5
9	H/C	1.850
10	O/C	0.000

EMISSION FOR COTTON SEED OIL (AL2O3B20) CR18 LOAD 12KG

SNO	PERAMETERS	RESULT
1	HC	13 PPM
2	CO	0.126%
3	CO2	5.16%
4	O2	12.24%
5	NOX	1178 PPM
6	LAMBA	2.568
7	AFR	37.75
8	PEF	0.5
9	H/C	1.850
10	O/C	0.000

CONCLUSION

The main objective of this experiment is to use biodiesel oil as an alternative fuel with nano particles addition and tested on4-stroke single cylinder diesel engine .this fuel is tested on diesel engine for various load conditions keeping the pressure and crank angle constant. And there performance is summarised

Performance Analysis of Cotton seed Oil Blends (AL2O3)

The flash and fire points of Cotton seed oil are 210o c and 228o c respectively.

The viscosity of Cotton seed oil is 66 centipoise .Meanwhile viscosity of diesel oil is 55centi poise. The high viscosity gives poor atomization when at the time of fuel is injecting in the engine cylinder. For this purpose Cotton seed oil is transesterified by transesterification process.

The mechanical efficiency of B20 blend for Cotton seed oil shows better performance when compared to the other blends.

With reference to the b20 blend positive result taking into consideration this blend is mixing with nano particles aluminium oxide (Al2O3) for further testing.

For conducting the experiment various process has been done like adding of surfactants to get stability like getting base value 10,after obtaining it has been sent for sonification for dissolving particles.

HC -78 PPM, CO-0.162% ,CO2-4.70%, O2-14.03% ,LAMBA-2.930, AFR-43.07 ,PEF-0.5, H/C- 1.850,O/C-0.00.NOX193 ppm whereas it was HC-53PPM ,CO-0.132%, CO2-0.132%,O2-13.90% LAMBA,----AFR--- ,PEF-0.5, H/C-1.850, O/C-0.000. NOX298. .This result also showed a considerable enhancement in FP, IP, BMEP, IMEP. And reducing the smoke emission and slightly increasing in NOX .to influence of aluminium oxide nano particles addition in bio-diesel blends.

Based on this investigation, it is observed that a time will be reached in the future when demand for non-polluting and efficient energy sources will be met by other sources than fossil fuel globally. It is concluded that in order to overcome the energy crisis in future, mega cultivation of this species may be carried out for biodiesel production at large-scale. Based on the findings, Cotton seed oil is suggested to be an alternative fuel for compression ignition engine.

Scope of Future Work

In the present investigation, the performance parameters are evaluated with all load conditions. In the future work the experiment can be reduce the nox and FP forming precipitate around nozzle and cylinder valve.

REFERENCES

[1]. MdNurunNabi*, MdShamimAkhter, MdAtiqurRahman “Waste transformer oil as an alternative fuel for diesel engine” 5th BSME International Conference on Thermal Engineering - Procedia Engineering 56 (2013) 401 – 406

[2]. [2]A.M. Liaquat, M.A. Kalam, H.H. Masjuki, M.H. Jayed“Engine Performance andEmissions Analysis using “Envo Diesel” and Coconut Biodiesel Blended Fuel as Alternative Fuels” 2011 2nd International Conference on Environmental Science and Technology IPCBEE vol.6 (2011)

[3].GauravDwivedi, Siddharth Jain, M.P. Sharma “Diesel engine performance and emission analysis using biodiesel from various oil sources - Review” J. Mater. Environ. Sci. 4 (4) (2013) 434-447 ISSN: 2028-2508 CODEN: JMESCN

[4].Trilok Kumar, Lava Kumar

"Performance and Emission characteristics of Diesel Engine Fuelled with Tire Pyrolysis Oil, Utilized Transformer Oil and Diesel Blends"
International Journal of Innovative Research in Science, Engineering and Technology Vol. 4, Issue 7, July 2015

[5]. GauravDwivedi*‡, M.P. Sharma** "Performance Evaluation of Diesel Engine Using Biodiesel from Pongamia Oil" International Journal of Renewable Energy Research GauravDwivedi et al., Vol.3, No.2, 2013

[6]. A. Haiter 1 Lenin, 1R. Ravi and 2K.Thyagarajan "Performance Characteristics of a Diesel

[7]. R. Senthil , N.Ravichandiran, Silambarasan " Experimental Investigation of Single Cylinder
C.I Engine Using Mustard and Neem Oil as a Biodiesel" International Journal of ChemTech Research Vol.7, No.6, pp 2738-2744

[8]. KirtiSaxena, TarunSoota "Experimental Investigation of Non Edible Cotton Seed Oil Biodiesel in Single Cylinder Diesel Engine" International Journal of Engineering Research and General Science Volume 3, Issue 4, July-August, 2015