

Performance and Emission Characteristics of Dual Biofuel (CNSL and Rice Bran Oil) Blended with Diesel in CI Engine



Sangeetha Krishnamoorthi, M.Prabhahar, G.R.Muthu Kumar, Saberrish.S, Solai Raja.R

Abstract: In recent trends due to the increase in rate of petrol and diesel prices biodiesel has been used as an alternate fuel in many of the fast developing countries. However in our country also many research work has been done using different oils. In this paper instead of using a single oil, two different oils was mixed with diesel in different blends and the emissions were calculated and the results were plotted. The two different oils used was the Cashew nutshell liquid (CNSL) and the Rice bran oil. Cashew oil is found to be a by-product which is available from the Cashew industry and after the transesterification process the cardanol obtained was used without any modifications. Rice bran oil is mostly found in the places where rice is grown in a huge quantity and more number of research works has not been done in this oil. By the transesterification process the rice bran oil was prepared and mixed with the CNSL in the different proportions, which was also mixed with diesel in some amounts and the different characteristics were evaluated and plotted.

Keyword: CNSL, Rice bran oil, CI Engine

I. INTRODUCTION

The Variable Compression Ratio engine has been constantly used in different fields especially in the commercial purposes due to its construction which can undergo high pressures during the operating speed. Not only the cylinder head but also the piston crown can also be modified in the VCR engine. The flow of fuel can be controlled at different load conditions with the help of a governor. The VCR engine at even low engine power levels has a high efficiency. Coefficient of variance and burning rate was the two advantages of the VCR engine which leads to do more research by using different oils. In the VCR engine all the different characteristics were measured and the graphs were plotted. The values of diesel engine was compared with the given biofuel and the performance and emission characteristics were found out and compared. The applications of loads were four levels and they were 0,3,6 and 9 kgs respectively. At a speed of 1800 rpm the engine speed

was fixed for different load levels. At each different levels of load the Brake specific fuel consumption, Brake thermal efficiency and different emissions along with smoke density were recorded and the graph was plotted. The Table 1 provides the specification of the engine used in the analysis.

Table 1 Specifications of the engine

MANUFACTURER	APEX INNOVATIONS PVT. LTD
Engine	TYPE : 1Cylinder,4 Stroke, Water cooled, Stroke 100mm,bore87.5mm,capacity 661 cc Diesel Mode: Power 3.5 KW, Speed 1500 rpm, CR range 12:1-18:1, Injection variation 0-25 Deg BTDC ECU Petrol mode:3.5 KW @ 1500 rpm, Speed range 1200-1800 rpm, CR range 6:1-10:1
Dynamometer	Type eddy current, water cooled, with loading unit
Fuel tank	Capacity 15 lit, Type: dual compartment, with fuel metering pipe of glass
Piezo sensor	Combustion range:500 PSI ,with low noise cable Diesel line: Range 500 PSI ,with low noise cable
Crank angle sensor	Resolution 1 Deg , speed 5500 rpm with TDC pulse
Data acquisition device	NI USB -6210, 16 bit, 250ks/s
Engine control hardware	Fuel injector, fuel pump, ignition coil
Temperature sensor	Type RTD,PT100 and Thermocouple
Load indicator	Digital, range 0-50 Kg , supply 230VAC
Load sensor	Load cell , type strain gauge, range 0-50 Kg
Software	"Engine soft " Engine performance analysis software

II. LITERATURE REVIEW

Ali Keskin and Duran Altiparmak et.al (2008) studied the biodiesel was produced by reacting cotton oil soapstock with methyl alcohol at determined optimum condition. The cotton oil biodiesel–diesel fuel blends were tested in a single cylinder direct injection diesel engine. B. Baiju and M.K. Naik et.al (2007) have investigated that the major problem of using neat Karanja oil as a fuel in a compression ignition engine arises due to its very high viscosity. Transesterification with alcohols reduces the viscosity of the oil and other properties have been evaluated to be comparable with those of diesel. K. Pramanik (2003) studied the properties and use of jatropa oil and diesel fuel blends in compression ignition engine. In the present examination the high thickness of the jatropa oil which has been considered has a potential elective fuel for the pressure start (CI) motor was diminished by mixing with diesel. The mixes of fluctuating extents of jatropa oil and diesel were arranged , dissected and contrasted with diesel fuel. Sanjay patil (2012) analysed that the use of straight vegetable oils in CI engine for long term deteriorates the engine performance and is mainly because of higher viscosity. The best way to use vegetable oils as fuel in CI engine is to convert it into biodiesel.

Manuscript published on 30 September 2019.

* Correspondence Author (s)

Sangeetha Krishnamoorthi –Associate Professor, Department of Mechanical Engineering, Aarupadai Veedu Institute of Technology, Vinayaka Mission Research Foundation, Deemed to be University sangeethas@avit.ac.in

Dr. M.Prabhahar - Professor, Department of Mechanical Engineering, Aarupadai Veedu Institute of Technology, Vinayaka Mission Research Foundation, Deemed to be University mprabhahar@gmail.com

G.R.Muthu Kumar, Saberrish.S, Solai Raja.R, UG Scholar, Aarupadai Veedu Institute of Technology, Vinayaka Mission'S Research Foundation

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an [open access](https://creativecommons.org/licenses/by-nc-nd/4.0/) article under the CC-BY-NC-ND license <http://creativecommons.org/licenses/by-nc-nd/4.0/>



Performance and Emission Characteristics of Dual Biofuel (CNSL and Rice Bran Oil) Blended With Diesel in CI Engine

III. RESULTS & DISCUSSION

The graphs were plotted between the different blends and for easy understanding it is denoted as First blend (Diesel 80+CNSL B10+RBO B10), Second blend (Diesel 60+CNSL B20+RBO B20), Third blend (Diesel 40+CNSL B30+RBO B30).

Fig.1 shows the variation in the Brake specific fuel consumption for different blends of CNSL and RBO mixed with diesel and the graph was plotted for different BP of 0 to 9 KW. The maximum load BSFC values for first blend was 0.33Kg/Kw-hr , for second blend was 0.33Kg/Kw-hr and for third blend was 0.29 Kg/Kw-hr.

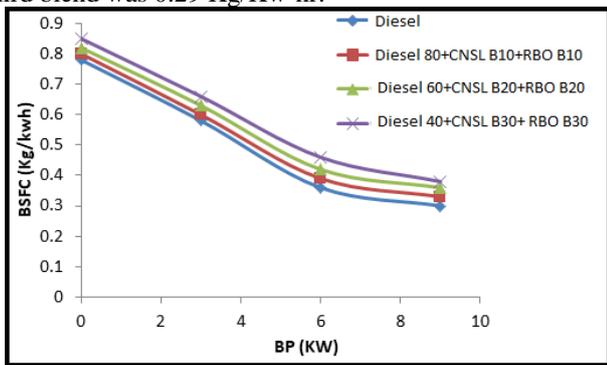


Fig.1 BSFC vs BP

The Brake thermal efficiency for different blends of CNSL and RBO mixed with diesel and the graph was plotted for different BP of 0 to 9 KW is shown in the fig. 2. The maximum load BTE values for first blend was 27.8% , for second blend was 26% and for third blend was 34.1%.

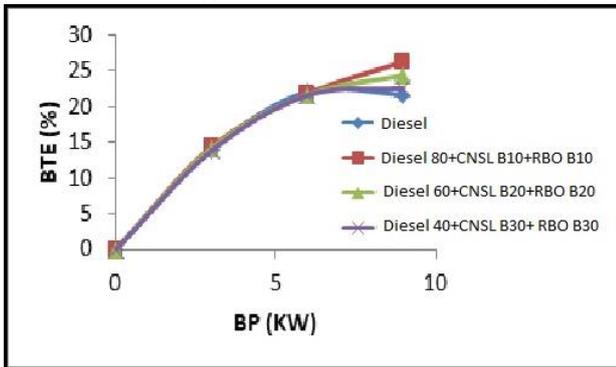


Fig.2 BTE vs BP

Fig. 3 shows the plot between Carbon monoxide emission with brake power. The maximum emission for first blend was 0.03% Vol , second blend was 0.02 % Vol , and for third blend was 0.05% Vol.

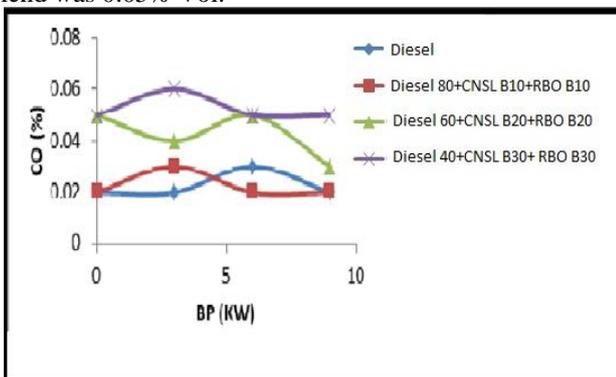


Fig.3 CO vs BP

Fig. 4 shows the variation in Nitrogen oxide for different blends of CNSL and RBO mixed with diesel and the graph

was plotted for different BP of 0 to 9 KW. The NOX values for biodiesel is always higher than diesel for all the different blends.

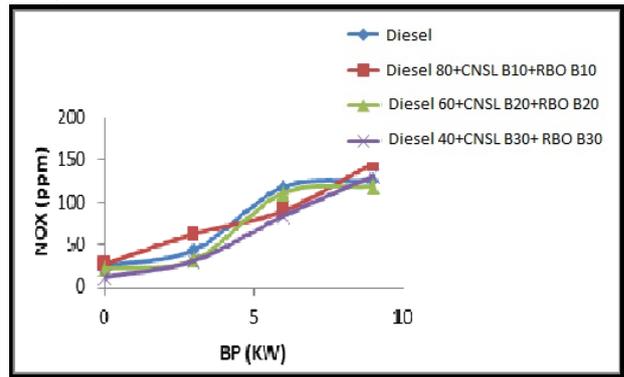


Fig.4 NOX vs BP

Fig. 5 shows the variation in Smoke density for different blends of CNSL and RBO mixed with diesel and the graph was plotted for different BP of 0 to 9 KW. The maximum values of smoke for first blend was 31.5% , for second blend was 41.6% and for third blend was 48.5%.

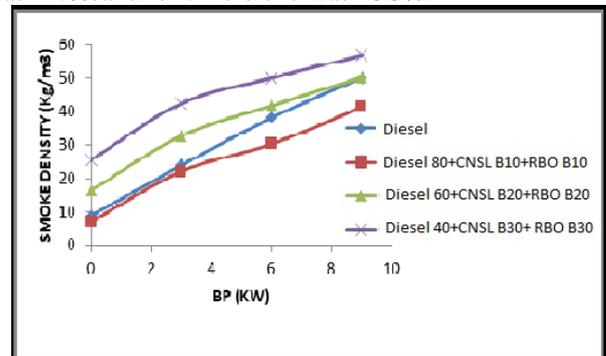


Fig.5 Smoke vs BP

Fig. 6 shows the variation in Hydrocarbon emission for different blends of CNSL and RBO mixed with diesel and the graph was plotted for different BP of 0 to 9 KW. The HC emission values was found to be nearer to the diesel values.

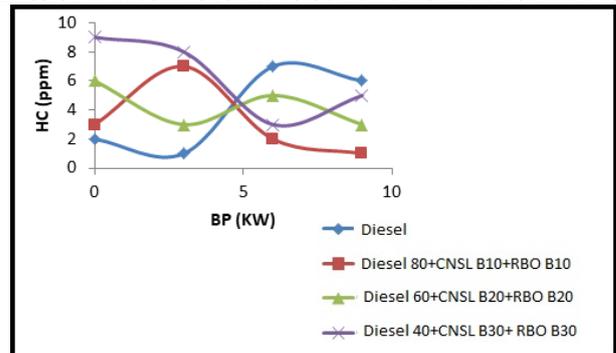


Fig.6 HC vs BP

IV. CONCLUSION

The CNSL and RBO oil when mixed with diesel has shown a various changes in the values when comparing with diesel. The value of Brake specific fuel consumption was found to be nearer to the diesel for lower blends compared to the higher blends. The Brake thermal efficiency was for the blend the Diesel 60 + CNSL 20+ RBO 20 was found to be lower than the other blends.

The emission values were also nearly comparable with diesel for the lower blends. Thus it can be concluded that with a diesel of about 60 and the other two oil with a ratio of about 20 can be used in the CI engine without any change in the engine.

REFERENCES

1. Ali Keskin, et. al., "Using of cotton oil soapstock biodiesel- diesel fuel blends as an alternative diesel fuel" Renewable energy, Science direct, Elsevier, Vol 33., April 2008., pp 553-557
2. K.Pramanik., "Properties and use of jatropha curcas oil and diesel fuel blends in CI engine" Renewable energy, Science direct, Elsevier, Vol. 28., Feb 2003., pp 239-248
3. Jalpesh Solanki H. and Tushar Javiya V. (2002) "Cashew nut shell liquid fuel as substitute for diesel fuel to be used in C.I engine". International Journal of Advanced Research in Science, Engineering and Technology, Vol.01, pp. 8-12.
4. Sanjay Patil "Computer modelling of CI engine performance for parametric study of injection timing fuelled with POME and its blends with diesel", IJERT, Vol. 1 , Sep 2012
5. M. Saravanakumar, M. Prabhahar, Sangeetha Krishnamoorthi and S. Sendilvelan "Emission Characteristics of Biodiesel Derived From Used Cooking Oil Blended With Diesel In The Presence of Potassium Hydroxide (KOH) Catalyst As Alternative Fuel For Diesel Engines" In Journal of Rasayan J. Chem., Volume 11 No.1 , pp. 372-377, 2018
6. Damodhar Garka J. and Ramesh Bhande S. (2014) "Review on extraction and isolation of cashew nut shell liquid", International Journal of Innovations in Engineering Research and Technology(IJERT), Vol.1.
7. M. Prabhahar , S. Sendilvelan and J. Francis Xavier "Effect of Dimethoxy-Methane (C₃H₈O₂) On Combustion Characteristics Of A Direct Injection Diesel Engine With Variable Compression Ratio Fuelled With Biodiesel Blends With Diesel (C_{10.8} H_{18.7}) Journal of Oriental Journal of Chemistry Vol 33, No 6 , 2017
8. Murugasan A., Umarani C., Subramanaiam R. and Neduchezhian N. "Bio diesel as an Alternative Fuel for Diesel Engine – A Review", International Journal of Renewable and Sustainable Energy Review 2007.
9. S. Nallusamy (2003) "Experimental analysis of emission characteristics using CNSL biodiesel in dual fuel mode", <https://www.researchgate.net/publication/293555771>
10. Murugesan A. (2009) 'Experimental and theoretical Investigation of using Biodiesel in Diesel Engines; Ph.D., Thesis. Anna University, CHENNAI.
11. Raghavendra Prasad S.A (2009) "A review on CNSL biodiesel as an alternative fuel for diesel engine", International Journal of Science and Research (IJSR).
12. Sundarapandian and Devaradjane, "Performance and Emission Analysis of Bio Diesel Operated CI Engine", Journal of Engineering, Computing and Architecture. Internal Combustion Engines – John B. Heywood