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Original Research

Effect of Neat Sardine Oil with Varies Blends on the Performance and Emission Characteristics of Diesel Engine

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Abstract

This study investigates the performance and emission characteristics of a diesel engine which is fuelled with neat sardine oil and diesel. A single cylinder four stroke diesel engine was used for the experiments at various load and speed of 1500 rpm. An AVL5 gas analyzer and a smoke meter were used for the measurements of exhaust gas emission. The results showed that break thermal efficiency is decreased and CO (Carbon-monoxide), HC (Hydro-Carbon) in the exhaust is increased when fuelled with neat sardine oil compared to diesel except NOx (Nitrogen Oxide). The future scope of the work is to do some modification (e.g may be engine, piston or values) in the engine to get better performance in same blending ratio.

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INTRODUCTION

Renewable alternative fuels as a substitute for petroleum based fuels have become increasingly important due to environment concerns and transportation problems. Due to the gradual depletion of petroleum reserves and the impact of environmental pollution of increasing exhaust emissions, there is an urgent need for suitable alternative fuels for use in compression ignition engines. Biodiesel has properties similar to those of traditional fossil diesel fuel which can be directly used in internal combustion engines with little or no engine modifications. Biodiesel is produced by the combination of alcohol which is usually alcohol with vegetable or animal oil/fats. In order to lesson harmful vehicle emission it can be utilized on its pure form as a renewable substitute for diesel engine. Biodiesel and ethanol are clean which can be produced on site local in villages and in renewable resources. Another gain is that many alternative fuels can be generated while oil is a non renewable resource. Present estimates predict that world oil production will reach its peak sometime in the next 10 to 15 years. Even low concentration of biodiesel reduces emission and provides significant health and compliance benefits wherever human receives higher levels of exposure to diesel engine. Amba Prasad Rao and Rama Mohan (2005) studies the performance of DI (Direct injection) and IDI (Indirect injection) engines with Jatropia oil based biodiesel and concluded that DI engine operation with biodiesel under supercharged condition the performance are very close to diesel fuel operation. Araya Ken *et al*. (1987) converted sunflower and fish oil to their methyl esters, tested in a single cylinder diesel engine and concluded that, the maximum output with both methyl esters was higher (0.11 kW, 3%) than the diesel fuel. Cherng-Yuan Lin and

Rong-ji Li (2009) trasesterified fish oil to produce biodiesel and they used discarded parts of mixed marine fish species as the raw material to produce biodiesel. They reported that Commercial biodiesel from waste cooking oil when compared with marine fish oil biodiesel had a large gross heating value elemental carbon and hydrogen content, cetane index, exhaust gas temperature, NOx (Nitrogen Oxide) and O_2 (Oxygen) emission and black smoke opacity with lower elemental oxygen content. Dilip Kumar Bora (2009) studied the performance of single cylinder diesel engine using blends of karabi seed biodiesel by using potassium hydroxide as catalyst to facilitate estarification process and concluded B20 fuel showed better break thermal efficiency than B100 fuel, B100 also showed maximum NOx (Nitrogen Oxide) emission however B100 emitted least CO (Carbon-monoxide) emission in comparison with B20 and diesel. Hulya (2003) analyzed qualitatively and quantitatively, the crude commercial fish oil, by gas liquid chromatography. The major fatty acids detected in this oil were as follows: 24.8% stearic, 23.6% palmitic, 9.84% myristic, and 6.56% octadecatetraenoic acids. The physical and chemical properties of crude commercial fish oil were established. Karthikeyan, Prasad and Durga (2009) studied the diesel performance with fish oil biodiesel and its blends with diesel in proportion of 20:80, 40:40, 60:40 and 100% by volume on single cylinder water cooled four stroke diesel engines and reported that break thermal efficiency of B60 blend and B100 was close to break thermal efficiency of diesel at all loads. Steigers (2002) demonstrated the use of fish oil as fuel in a large stationary diesel engine. Yusuf Ali and Hanna (1994) Alternate fuels like ethanol, biodiesel, LPG (Liquefied petroleum Gas), CNG (Compressed Natural Gas), etc have been commercialized in transport sector.

The specific objective of the present work is to evaluate the performance and emission characteristics of a diesel engine which is fuelled with neat sardine oil in a diesel engine.

MATERIALS AND METHODS

Tests have been conducted on a Kirloskar Engine TAF1, four strokes, single cylinders, air-cooled direct injection, and naturally aspirated diesel engine at a constant speed of 1500 rpm. The layout of experimental setup and its engine specification is shown in Figure 1 and Table 1.

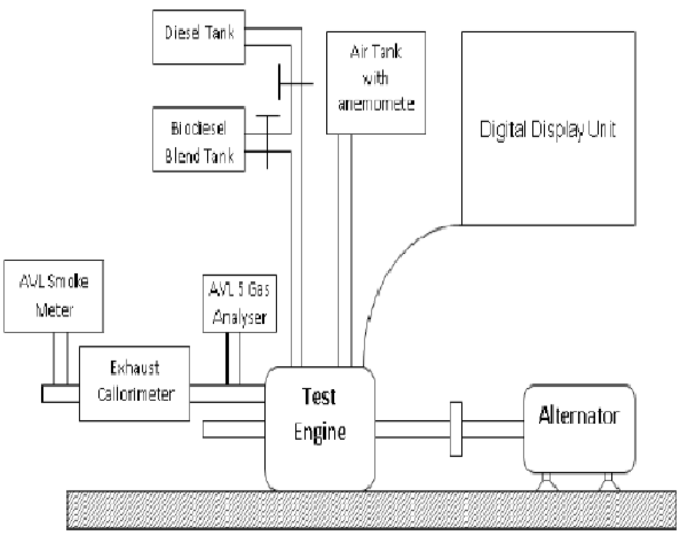

Figure 1: Layout of experimental setup with instrumentation.

Table 1: Engine specification.

Make	Kirlosker engine
Model	TAF 1
No of cylinder	Single
Bore and stroke	87.5X110mm
Bp	4.4KW
Displacement	2826cc
Type of cooling	Air cooled
Speed	1500rpm
Compression ratio	17.5:1
Combustion chamber	Direct injection

The engine was coupled to a generator set and loaded by electrical resistance to apply different loads on the engine. The voltage, current and power developed by engine were directly displayed on control panel. Performance and emission tests were conducted on various neat sardine oil blends in order to optimize the blends concentration for long-term usage in compressed ignition engines. To achieve this, several blends of varying concentration were prepared ranging from 0 percent (Neat diesel oil) to 100 percent through 25, 50, 75 and 100% by volume. The performance data was then analyzed from the graphs recording power output, fuel consumption, specific fuel consumption and thermal efficiency for all blends of neat sardine oil. The fuel properties of neat sardine oil are shown in Table 2.

Table 2: Fuel properties of neat Sardine oil.

Sl. No	Properties	Neat Sardine oil
1.	Density (kg/m^3)	933
2.	Specific gravity	0.93
3.	Kinematic viscosity at 40 C (Cst)	22
4.	Calorific value (KJ/kg)	38,006
5.	Flash point (C)	226
6.	Fire point (C)	236
7.	Oxygen contents	0.56 %.
8.	Iodine value	172
9.	Moisture	0.03 %
10.	Carbon	89.95 %
11.	Hydrogen	9.31 %
12.	Nitrogen	0.08 %
13.	Sulphur	0.02 %

RESULTS AND DISCUSSION

Brake Specific Fuel Consumption

The variation of Brake specific fuel consumption of the engine with various blends is shown in figure 2. The BSFC (Brake specific fuel consumption) in general, was found to increase with increasing proportion of B100 in the fuel blends with diesel, where as it decreases sharply with increase in load for all fuels. The main reason for this could be that percent increase in fuel required to operate the engine is less than the percent increase in brake power due to relatively less portion of the heat losses at higher loads. As density of neat sardine oil was higher than that of diesel, which means, the same fuel consumption on volume basis resulted in higher BSFC (Brake specific fuel consumption) in case of 100% neat sardine oil. The higher densities of biodiesel blends caused higher mass injection for the same volume at the same injection pressure. The calorific value of neat sardine oil is less than diesel. Due to these reasons, the BSFC (Brake specific fuel consumption) for other blends were higher than that of diesel.

Break Specific Energy Consumption

The variation of Brake specific energy consumption of the engine with various blends is shown in figure 3. The BSEC (Break specific energy consumption) is calculated as the product of brake specific fuel consumption and calorific value. The BSEC (Break specific energy consumption) consumption of the engine with neat sardine oil is higher compared to diesel at all loads. This is due to the lower heating value, higher viscosity and density of neat sardine oil.

Break Thermal Efficiency

The variation of break thermal efficiency of the engine with various blends is shown in figure 4. In all cases, it increased with increase in load. This was due to reduction in heat loss and increase in power with increase in load. The brake thermal efficiency obtained for b25, b50, b75, and b100 were less than that of diesel. This lower brake thermal efficiency obtained could be due to reduction in calorific value and increase in fuel consumption compared to diesel.

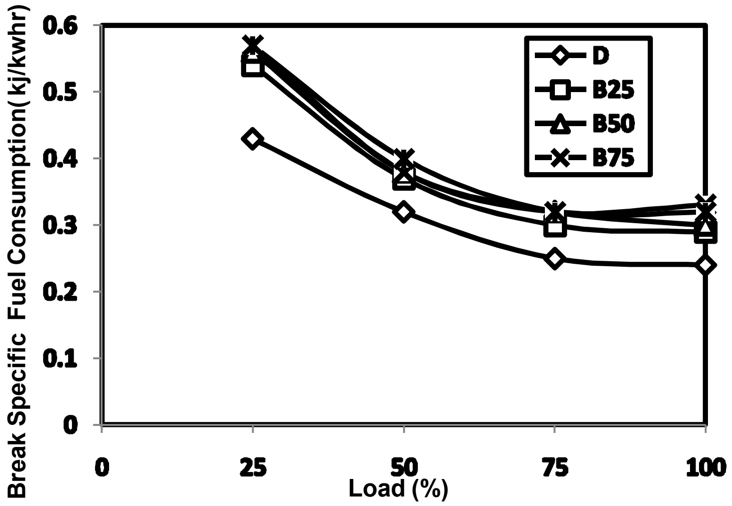

Figure 2: Comparison of Break Specific Fuel consumption vs Load with neat sardine oil.

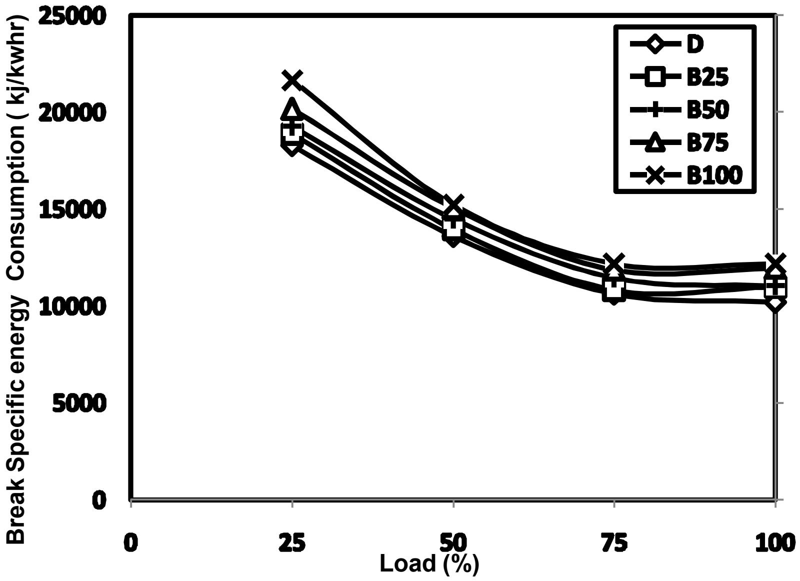

Figure 3: Comparison of Break Specific energy consumption vs Load with neat sardine oil.

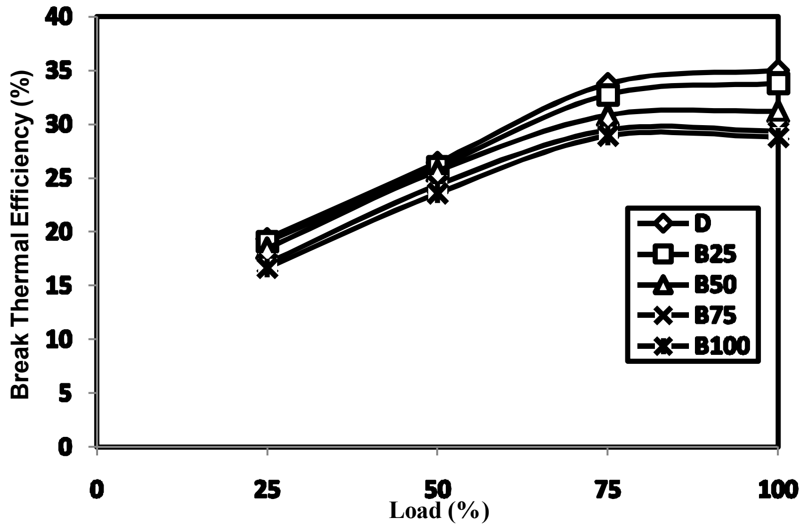

Figure 4: Comparison of Break thermal efficiency vs Load with neat sardine oil.

Exhaust Gas Temperature

The variation of Exhaust gas temperature of the engine with various blends is shown in figure 5. In general, the Exhaust gas temperature increased with increase in engine loading for all the fuel tested. This increase in exhaust gas temperature with load is obvious from the simple fact that more amount of fuel was required in the engine to generate that extra power needed to take up the additional loading. The exhaust gas temperature was found to increase with the increasing concentration of neat sardine oil with blends. This could be due to the increased heat loss of the higher blends, which are also evident from, their lower brake thermal efficiencies as compared to diesel.

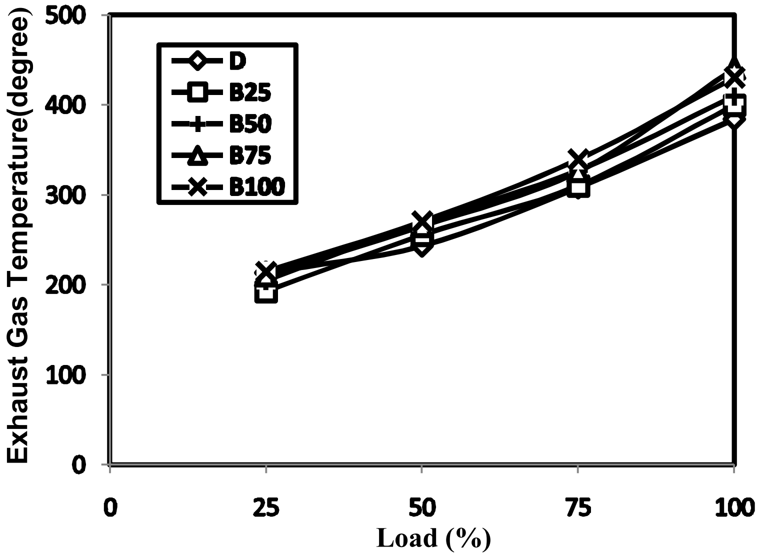

Figure 5: Comparison of Exhaust gas temperature vs Load with neat sardine oil.

Carbon Monoxide

The variation of Carbon monoxide of the engine with various blends is shown in figure 6. The minimum and maximum Carbon monoxide produced was observed from the graph for all blends. These higher Carbon monoxide emissions of neat sardine oil blends may be due to their less oxidation as compared to diesel. Some of the Carbon monoxide produced during combustion of neat sardine oil might have converted into CO_2 (Carbon dioxide) by taking up the oxygen molecule present in the biodiesel chain and thus higher in Carbon monoxide formation.

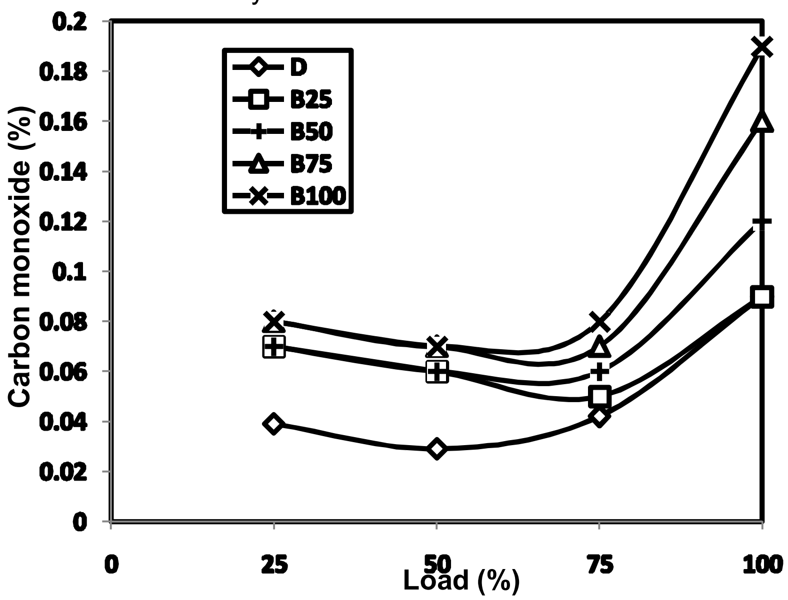

Figure 6: Comparison of Carbon monoxide vs Load with neat sardine oil.

Hydrocarbon

The variation of Hydrocarbon of the engine with Neat sardine oil is shown in figure 7. It can be seen that there is an increase in Hydrocarbon emission for all test fuel as the load increases. This is due to the presence of fuel rich mixture at higher load. There is a significant increase in Hydrocarbon emission for neat sardine oil compare to diesel.

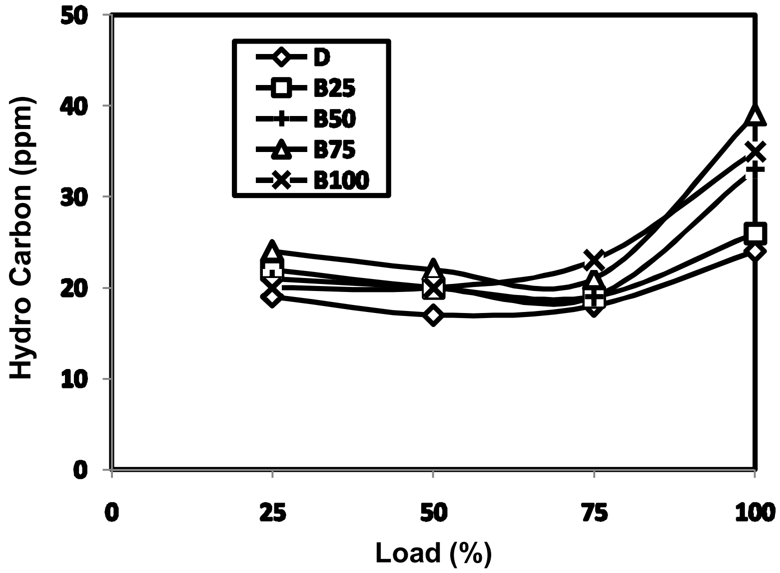

Figure 7: Comparison of Hydro-Carbon vs Load with neat sardine oil.

Nitrogen Oxides

The variation of Nitrogen oxides of the engine with various blends is shown in figure 8. It can be seen that the decreasing proportion of biodiesel in the blends was found to decrease NO_x (Nitrogen oxide) emissions, when compared with that of pure diesel. This could be attributed to the increased exhaust gas temperatures and the fact that biodiesel had some oxygen content in it which facilitated NO_x (Nitrogen oxide) formation. In general, the Nitrogen oxide concentration varies linearly with the load of the engine. As the load increases, the overall fuel-air ratio increases resulting in an increase in the average gas temperature in the combustion chamber and hence NO_x (Nitrogen oxide) formation, which is sensitive to temperature increase.

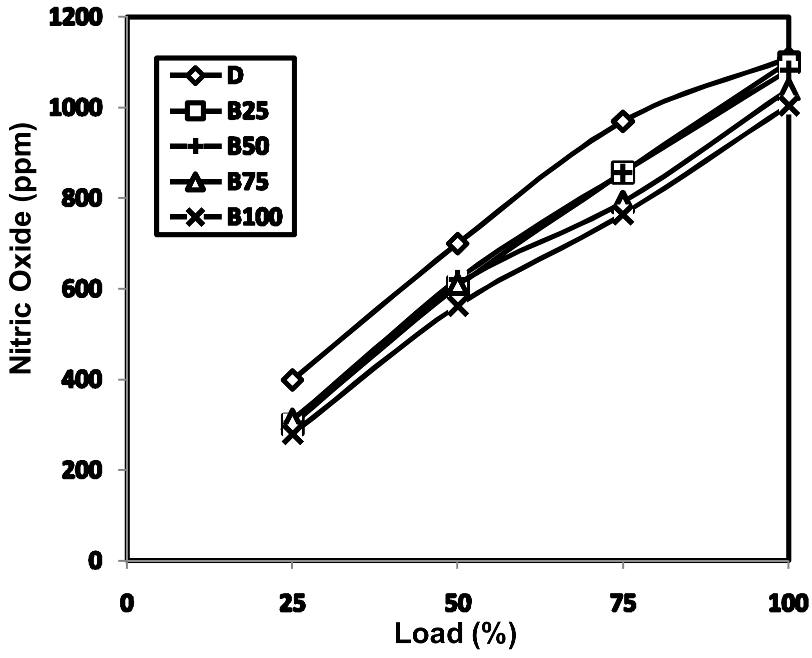

Figure 8: Comparison of Nitric Oxide vs Load with neat sardine oil.

CONCLUSION

The following conclusions are drawn based on the experimental result that the specific fuel consumption and specific energy consumption is higher than diesel for neat sardine oil blends. The BTE (Break thermal efficiency) for neat sardine oil blends is lower as compared to diesel at all loads. It is observed from the emission analysis that there is an increase in CO (Carbon monoxide), HC (Hydrocarbon) emission for neat sardine oil as compared to diesel and there is a decrease in NOx (Nitrogen oxide) emission. The future research directions for scientists or researcher can be done with different engine modification.

REFERENCES

Amba Prasad Rao and Rama Mohan. (2005). Performance evaluation of DI and IDI engine with Jatropha 0.7 based Biodiesel. *Journal of the Institution of Engineers (India)* 86:130-136.

Araya Ken. (1987). Diesel engine performance with sunflower oil and fish oil. *Journal of Senshu University Hokkaido* 20:137-54.

Cherng-Yuan Lin and Rong-ji Li (2009). Engine performance and emission characteristic of marine fish Biodiesel produced from discarded parts of marine fish. *Fuel processing Technology* 90:883-888.

Dilip Kumar Bora. (2009). Performance of Single by Diesel engine with Karabi Seed Biodiesel. *Journal of Scientific and Industrial Research* 68:960-963.

Ganesan. (1994). Internal Combustion Engine by Tata McGraw-Hill Publishing Co.Ltd. New Delhi.

Hulya. (2002). Commercial fish oil. *Turkish University Journal of Science Research B* 3 (1):1-6.

Karthikeyan and Prasad., Durga. (2009). Experimental investigation on Diesel engine using Fish oil Biodiesel and its Diesel Blends. *International Journal of Applied engineering Research* 4:7-14.

Raheman, H & Ghadge, S.V. (2007). Performance of compression ignition engine with Mahua (*Madhuca indica*) biodiesel. *Fuel* 86(16): 2568-2573.

Steigers. (2002). Demonstrating the use of fish oil as fuel in a large stationary diesel engine. Advances in seafood byproduct conference proceedings, Alaska Sea Grant, Pp 1-5.

Yusuf Ali and Hanna. (1994). Alternative diesel fuels from vegetable oil. *NiSource Technology* 50:153-163.