

Effect Of Ethanol Blend Addition On Performance And Emission Of Diesel Engine Operated With Rubber Seed Oil Methyl Ester

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ABSTRACT: Diesel engines dominate the field of commercial transportation and agricultural machinery on account of its superior fuel efficiency. Cost and limited reserves of conventional fossil fuels have intensified the search for alternative fuels for use in internal combustion engines. A possible alternative engine fuel is vegetable oil because it is clean burning, renewable, non-toxic, biodegradable and environmentally friendly transportation fuel. It can be used in neat form without any modification of the engine. They can be produced from the plants grown in rural areas. Vegetable oils are produced from crops such as Soybean, Jatropha, Corn Sunflower, Cotton Seed, Rice, Bran, Rubber Seed and etc., However they causes, serious problems such as carbon deposits buildup, poor durability, high density, high viscosity, lower calorific value, more molecular weight and poor combustion. These problems can be rectified by transesterification process. In this investigation the engine performance in a C.I engine using rubber seed oil and the emission control is found out, compared with diesel. The experimental work is carried out in a single cylinder computerized diesel engine test rig, which develops 5.2 kW at 1500 rpm and loaded by eddy current dynamometer. From the experimental results, the harmful pollutants such as HC, CO, NOX and smoke are reduced in the vegetable oil esters compared to that of diesel fuel. From the investigation, it is also concluded that in terms of performance characteristics and emission levels, vegetable oil esters can be regarded as the best substitute for diesel fuel.

KEYWORDS: I.C Engine, Performance and Emission

1. INTRODUCTION

Diesel engines dominate the field of commercial transportation and agricultural machinery on account of its superior fuel efficiency. Cost and limited reserves of conventional fossil fuels have intensified the search for alternative fuels for use in internal combustion engines. A possible alternative engine fuel is vegetable oil because it gives a clean burning, renewable, non-toxic, biodegradable and environment friendly transportation fuel. It can be utilized in neat form without any modification of the engine. Since it can be extracted from the plants grown in rural areas. In this investigation of the performance characteristics is carried out on a compression ignition engine using RSO (rubber seed oil) and compared with diesel for emission analysis. An experimental investigation is carried out to assess the Performance parameters and emission level of the RSO in single cylinder, four-stroke constant speed computerized engine test rig. The performance characteristics and emission levels such as NO_x, CO, HC, and Smoke are measured using eddy current dynamometer.

II. BIO-DIESEL

Due to shortage of petroleum diesel fuel and its increasing cost an alternate source of fuel is very much needed. It has been found that vegetable oils hold special promise in this regard, since they can be produced from the plants grown in rural areas. Vegetable oil from crops such as as Soybean, Jatropha, Corn Sunflower, Cotton Seed, Rice, Bran, Rubber Seed and etc., have been tried in many parts of the world, where there is a lack of petroleum reserves as fuels for compression ignition engines. Vegetable oils have better ignition characteristics; it causes serious problems such as carbon deposits buildup, poor durability, high density, high viscosity, lower calorific value, more molecular weight and poor combustion. These problems consequently lead to poor thermal efficiency, while using vegetable oil in the diesel engine. However these problems can be rectified by transesterification process.

III. TRANSESTERIFICATION PROCESS

The Rubber seed oil is taken in conical flask kept in the heater to heat the oil. Then oil heat is heated to 70°C. The methanol and catalyst (potassium hydroxide) mixed is poured into the preheated Rubber seed oil. The reaction flask is then placed in the magnetic stirrer with hot plate and the measurement of time is started at this point. The reaction mixture remained for 1½ hours at a temperature of 65°C and with a constant stirring. Heating and stirring are continued for reaction time at atmospheric

IV. EXPERIMENTAL WORK

The performance tests were carried out on a single cylinder, four stroke naturally aspirated and water cooled Kirloskar computerized diesel engine test rig. Diesel engine was directly coupled to an eddy current dynamometer. The engine and dynamometer were interfaced to a control panel which was connected to a computer. This computerized test rig was used for recording the test parameters such as fuel flow rate, air flow rate, temperature and load for calculating the engine performance, brake thermal efficiency and emissions like CO, HC, NOx.

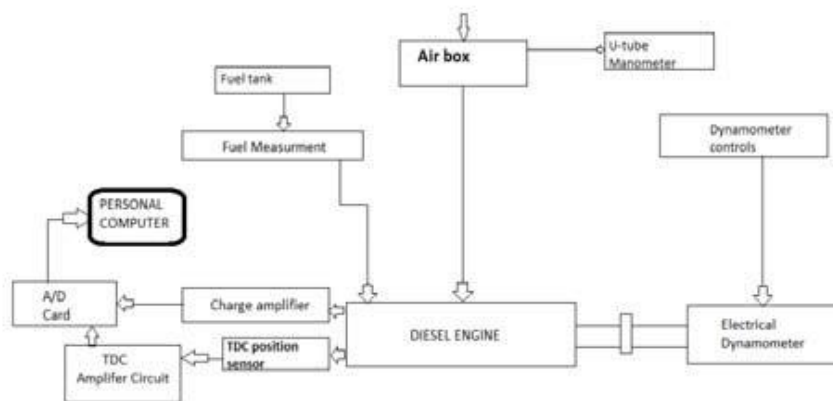


Fig.1. Schematic diagram of experimental set-up

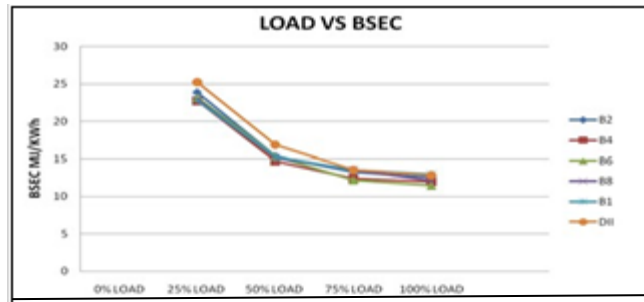
Table 1 ENGINE CONFIGURATION

Make and Model	Kirlosker
No. of Cylinder	One
Orientation	Vertical
Cycle	4 Strokes
Ignition System	C.I.
Bore and stroke	80 x 110 mm
Arrangement of valves	Overhead
Rated power	3.5 kW @ 1500 rpm
Cooling Medium	Water
Combustion Chamber	Open
Compression ratio	18:1
Displacement volume	553

V. PERFORMANCE ANALYSIS

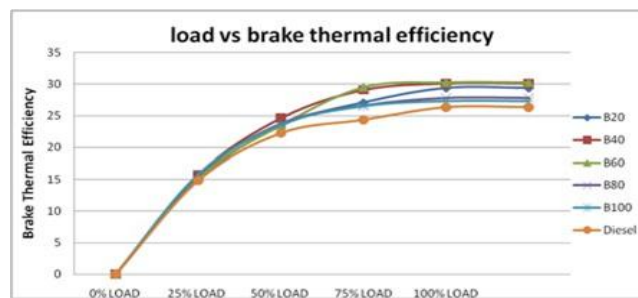
5.1 Variation of BSEC of various rubber seed oil diesel blends with respect to load

Figure 5.1 shows the variation of BSEC of various rubber seed oil – diesel blends with respect to load. Brake specific fuel consumption is a measure of volumetric fuel consumption for any particulate fuel. The BSEC of the blend decreases with the increase of load. BSEC of diesel is high compared with various rubber seed oil – diesel blends. This is due to the high calorific value of diesel.



5.2 Brake thermal efficiency of rubber seed oil – diesel blends with respect to load.

Figure 5.2 show the variation of brake thermal efficiency of various rubber seed oil – diesel blends with respect to load. Brake thermal efficiency increases with the increase in load. Brake thermal efficiency decreases with the increase in the concentration of the rubber seed oil in rubber seed oil – diesel blends.



VI. EMISSION ANALYSIS

6.1 Variation of NOX emissions with load of various rubber seed oil – diesel blends

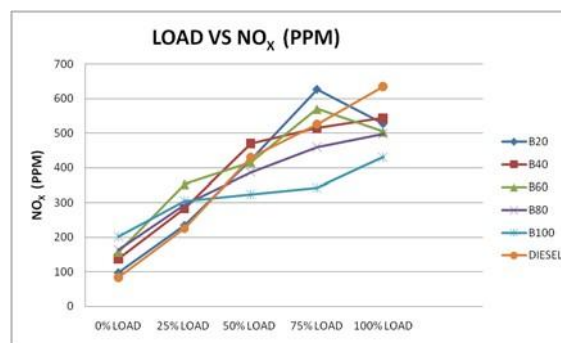


Figure 6.1 shows the variation of NOx emissions with various

loads of various rubber seed oil – diesel blends. NOx emissions increases with increase in diesel proportion in blend. Pure rubber seed oil emits less NOx emissions at higher load than lower load compared with diesel. This may be due to lower premixed combustion and the combustion temperature.

6.2 Variation of smoke with load of various rubber seed oil

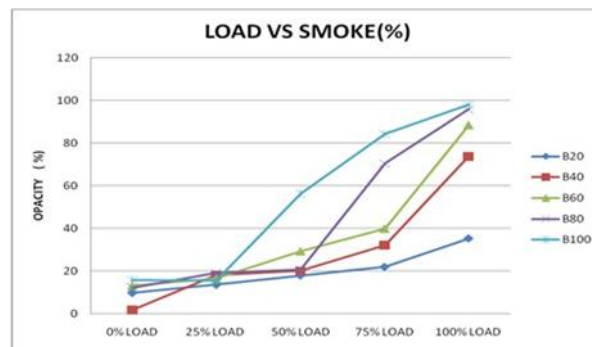


Figure 6 shows the variation of smoke with various load of various rubber seed oil – diesel blends. The concentration of smoke increases with the increase in the concentration of rubber seed oil in blends. As the load increases the amount of smoke emitted also increases gradually. B20 emits less smoke at all the loads compared with other blends. B100 emits large amount of smoke for all the loads. This may be due to the late combustion and high viscosity.

VII. CONCLUSION

From the experimental investigation on the use of rubber seed in single cylinder diesel engine, the following conclusions have been made. The single cylinder requires no modification in hard ware. Break thermal efficiency of rubber seed oil – diesel blend is higher than the diesel and the fuel consumption is also higher for rubber seed oil .the emissions are similar to that of diesel. These emissions can be reduced by using emission control equipment.

REFERENCES

- W. Tsai, "Energy sustainability from analysis of sustainable development indicators: a case study in Taiwan", *Renewable and Sustainable Energy Reviews*, vol. 14, no. 7, pp. 2131–2138, 2010.
- B. Amigun, F. Muller-Langer, and H. von Blottnitz, "Predicting the costs of biodiesel production in Africa: learning from Germany", *Energy for Sustainable Development*, vol. 12, no. 1, pp. 5–21, 2008.
- K. J. Singh and S. S. Soodh, "Comparative study of economics of different models of family size biogas plants for state of Punjab, India", *Energy Conversion and Management*, vol. 45, no. 9-10, pp. 1329–1341, 2004.
- Meher LC, Sagar DV, Naik SN, "Technical aspects of biodiesel production by transesterification – a review", *Renewable and Sustainable Energy Reviews*, Volume 10, Issue 3, June 2006, pp. 248–268.
- Friedrich MS., "A worldwide review of the commercial production of biodiesel – a technological, economic and ecological investigation based on case studies", Department of Technology and Sustainable Product Management (ITNP), Wien, August 2–6, 2004
- Demirbas A, Kara H., "New options for conversion of vegetable oils to alternative fuels", *Energy Sources, Part A: Recovery, Utilization, and Environmental Effects*, Volume 28, Issue 7, 2006, pp. 619–26.
- Sundarapandian.S, G. Devaradjane Anna University "Theoretical and Experimental investigation of the performance of Vegetable oil operated C.I Engine. 2007/6567 (JSAE), 2007-32-0067 (SAE)
- Heywood, J. B. (1989) "Internal Combustion Engine Fundamentals", McGraw Hill Book Co., 1989.
- Abdul Monyem Monyem., Jon, H and Van. Gerpen Gerpen. (2001) 'The effect of Biodiesel Biodiesel oxidation on Engine Performance and Emissions', *oxidation International Journal of Biomass and Bio Energy International Energy*, No. 20, pp. 317317--325.
- John Einfalt Einfalt and Carroll E. and Goering Goering (1995) 'Methyl (Soyate Soyate as a fuel in a Diesel Tractor' *Transactions of American society of automotive engineers automotive engineers*, Vol. 85, pp. 70, 70--74.
- Kyle W Scholl, and Spencer C Sorenson (1993) 'Combustion Analysis of Soybean oil Methyl Ester in a Direct Injection Diesel Engine', *Society of Automotive engineers Society engineers*, Paper No. , 930934.
- Larry E. Wagner., Stanley J. Clark and Mark D. Schrock (1984) 'Effect of Soybean Oil Esters on the Performance, Lubrication Oil and Water of Diesel Engines', *Society of Automotive engineers engineers*, Paper No. 841385.
- Nobukazu Nobukazu Takagi, and Takagi, Koichiro Koichiro Itow Itow (1984) 'Low Carbon (Flower Buildup Low Smoke and Efficient Diesel Operation with Vegetable Oils by Conversion to Monoesters and Blending with Diesel Oil or alcohols', *Society of automotive engineers Society engineers*, Paper , No. 841161.
- Recep Recep Altin Altin. Selim Selim Cetinkaya Cetinkaya and Huseyin Huseyin Serdas Serdas Yucese Yucese. (2001) 'The Potential of Using Vegetable oil. Fuels as Fuel for Diesel Engines', *International Journal of Energy Conversion management Energy management*, No. 42, pp. 529, —538
- Shaheed Shaheed, A and Swain, E. (1999) 'Combustion Analysis , of Coconut Oil and Its Methyl Esters in a Diesel Engine', *Proceedings of Institute of Mechanical Engineers Proceedings Engineers*, , Vol Vol 213, Part A, pp. 417213, 417425.