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PERFORMANCE STUDY OF FOUR STROKE C.I. ENGINE USING DIESEL - ORANGE OIL BLEND

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Abstract

The raised mission for alternative fuels for compression ignition engines has concentrated thought on fuels which can be gotten from biomass. In such manner, orange oil is observed to be a potential possibility for compression ignition engines. The properties are like to diesel in nature and miscible with diesel without any phase separation. In the present work, 10 %, 30 % and 50 % by volume of orange oil were blended with diesel and the performance and emission characteristics were assessed on a single cylinder, four stroke and air cooled diesel engine. Test outcomes demonstrate that the performance of 30 % orange oil mixes was greatly improved than the 10 % and 50 % orange oil mixes and diesel. The specific fuel utilization was increased with raise in orange oil mixes due to lower calorific estimation of orange oil. The outflows of hydrocarbon (HC), carbon monoxide (CO) and smoke were reduced but nitric oxide (NOx) was expanded compared to diesel than the orange oil mixes. It is concluded from the aftereffects of the test examination that 30 % orange oil mixes could be utilized as a diesel fuel substitute in diesel engine.

Keywords: Diesel Engine, Orange Oil, Performance and Emission.

1. INTRODUCTION

Compression ignition engines play a greater role than spark ignition engines especially in the field of substantial transportation and agriculture on account of their higher thermal efficiency and strength. Then again, since the worldwide vitality emergency in the 1970's, research on alternative and renewable fuels has turned into an extremely extraordinary zone in the most recent decade. Simultaneously, diesel engines are the real contributors of various types of air unsafe mixes. More stringent norms are imposed on exhaust emissions to ensure nature. Many research works are in advancement to create more up to date innovations to reduce emissions.

Huang Z.H et al [1, 2] have considered diesel/methanol mix in the diesel engine, and their outcomes demonstrated that the engine could accomplish the cylinder pressure with increment in methanol mass fraction. In addition of methanol mass part will bring about an expansion in the heat discharge rate in the premixed burning phase and abbreviate the combustion duration in the diffusive burning phase.

Usta et al [3] conducted a diesel motor utilizing a methyl ester biodiesel delivered from hazelnut soapstock/ squander sunflower oil blend. Exploratory outcomes demonstrated that hazelnut soapstock/squander sunflower oil methyl ester can be in part substituted for the diesel fuel all things considered working conditions as far as the presentation parameters and emanations with no motor alteration and preheating of the mixes. Kyle Scholl, Spencer Sorenson [4] demonstrated that soybean oil methyl ester in an immediate infusion diesel motor gave lesser HC emanations and smoke number than diesel fuel at ideal working conditions. The outcomes for CO emanations were changed with various burden conditions and distinctive infusion timing. The relative patterns in the NOx discharges are comparative in conduct to the relative patterns in the pinnacle weight ascend for a similar infusion timing with spout distance across variety.

Biodiesel is biodegradable, non-lethal, sulfur free, sustainable fuel and can be created from agribusiness or backwoods assets accessible locally. Carbon process duration for obsession of CO2 from biodiesel is very little contrasted with mineral diesel. It implies that biodiesel use decreases ozone depleting substance emanations [5].

India is a farming based nation and the accessibility of the biomass like orange skin is in enormous amount. Henceforth the disposal of solid waste turns into an issue. Oranges are accessible in enormous amounts around the world. Orange skin is a biomass and oil extracted from orange skin is by and by utilized in the manufacture of scents, synthetic compounds and so forth. Recently specialists have studied the utilization of orange oil as fuel for spark ignition engines. Since the vast majority of its properties are closes to gasoline, it tends to be a good alternative fuel for spark ignition engines. Results show that gasoline-orange oil mix with catalytic coating performs better when contrasted with the ordinary lean burn engine. The expansion in brake thermal efficiency is 10 % and in brake power is 9.7% due higher heating estimations of orange oil. HC and CO discharges diminished with catalytic coating [6]. Ramesh B Poola [7] examined that orange oil and eucalyptus oil were observed to be potential contender for spark ignition engines. The high octane estimation of these fuels can improve the octane value of the fuel when it is mixed with low-octane gasoline. Thus, the Knock constrained compression ratio (CR) can be additionally expanded when this fuel is mixed with gas. The fumigation system offers the benefit of simple transformation of the diesel engine to take a shot at the dual fuel mode with unstable fuels and vegetable oils. The dual fuel engine with proper transformation has better qualities than those of straight fuel task [12]. Orange oils were disinfected up to 35 % and high cetane number fuel was injected as pilot fuels for ignition. In this investigation diesel, Jatropha oil and methyl ester of Jatropha oil were utilized as pilot fuels [8].

In the present work, tests were directed to revise the performance, emissions and combustion characteristics of orange oil mix with diesel in a diesel engine. It was seen that the chamber weight, NOx and exhaust gas temperature expanded with increment in level of orange oil. The hydrocarbon, carbon monoxide, smoke were diminished with expanded orange oil. The principle point of the present work is to evaluate the opportunity of utilizing the orange oil got from the orange skin mix with diesel in a compression ignition engine.

2. FUEL PREPARATION

D - Limonene is the significant segment of the oil separated from the citrus skin during the citrus squeezing process. At the point when the organic product is squeezed, the oil is squeezed out of the skin, at that point isolated from the juice and refined to recoup certain flavor and scent mixes. After the squeezing procedure, the peels are passed on to a steam extractor. At the point when the steam is condensed, a layer of oil floats on the surface of the condensed water. This removes the bulk of the oil from the peel. Food grade d-limonene is separated through the squeezing procedure and specialized evaluation d-limonene is expelled through the peel steam extraction process. In the market three grades of orange oil are available:(i) Natural Orange oil with 40 % propylene glycol, (ii) 2 fold orange oil, (iii) 5 fold orange oil. The first type of Orange oil was taken for the study as it has a low viscosity and available at low cost. The properties of orange oil are compared with that of diesel fuel and given in Table 1. The ultimate analysis of orange oil is given in Table 2.

Table1 Comparison of properties of orange oil with diesel fuel

Properties	Diesel	Orange oil
Calorific Value, kJ/kg	43,000	34650
Density@30°C kg/lit	0.8284	0.8169
Viscosity@40°C, cSt	2.7	3.52
Flash Point, °C By PMCC Method	52	74
Fire Point, °C By PMCC Method	65	82

Table 2 Ultimate Analysis of Orange oil

	Percentage of components
Moisture	Nil
Mineral matter	Nil
Carbon	84.28
Hydrogen	12.47
Nitrogen	0.19
Sulphur	0.007
Oxygen	3.05

3. EXPERIMENTAL SETUP

A progression of tests were completed on a single cylinder, air cooled, direct injection stationary diesel engine that has a bore diameter of 87.5 mm, stroke of 110 mm and displacement of 661 cc. The schematic graph of the test arrangement is appeared in Fig. 1. The engine (1) had an output of 4.4 kW at 1500 rpm with compression ratio of 17.5:1 and injection pressure in 215 bar at 23° before top dead centre, as set by the producer. The engine was coupled to an electrical dynamometer (2) to give the brake load an electric board (3). A fuel switching circuit (7) was utilized to change over starting with one fuel then onto the next while the engine was running. The fuel utilization was estimated with the guide of a burette (5, 6) and a stopwatch arrangement. The exhaust gas temperature was estimated using a thermocouple (10). For emission measurements, a Five Gas Exhaust Analyzer (11) (CO, HC, CO_2 – NDIR Method, O_2, NO_x - Electro Chemical Method) was used to measure the level of HC, CO_2, CO, O_2 and NO_x. The accuracy of this instrument is ± 5 ppm and the resolution is ± 1 ppm.

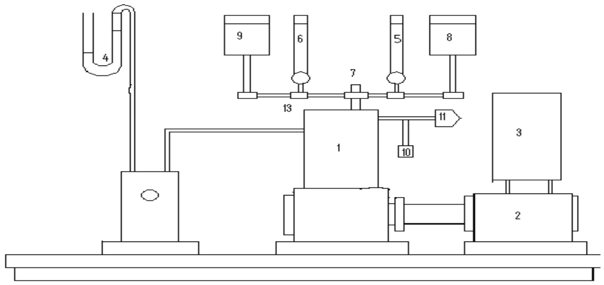


Fig. 1 Experimental Setup 1. Test Engine, 2. Dynamometer, 3. Panel Board, 4. Orifice Flow meter, 5. Diesel Burette, 6. Orange Solution burette, 7. Fuel shifting valve, 8. Diesel Tank, 9. orange oil blend fuel tank, 10. Exhaust gas thermocouple, 11. Five gas analyzer.

4. RESULTS AND DISCUSSION

4.1 Brake Thermal Efficiency

The thermal efficiency of orange oil blends is compared with base line data in Fig. 2. It can be observed that 30 % orange oil shows a better thermal efficiency of 30.4 %, which is 2.2 % higher than the diesel fuel at full load. The effect of fuel blends on

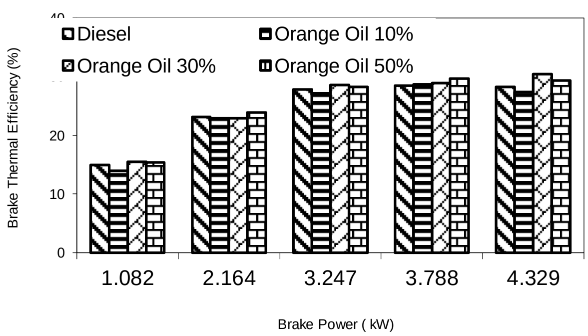
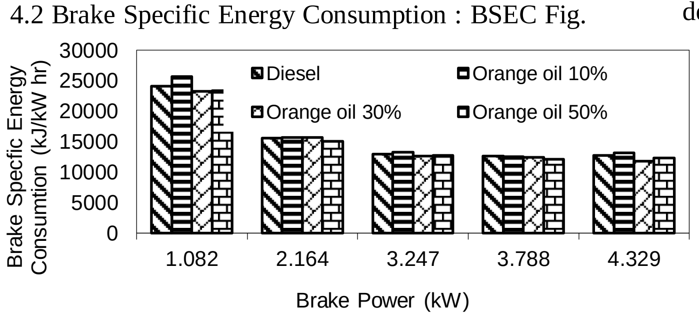


Fig. 2 Comparison of Brake Thermal Efficiency

brake thermal efficiency could be explained by their energy content on volume basis and the stoichiometry of the blends. In addition to that, the flame propagation and ignition limits play a key role in the changes in the performance of the fuel blend [7].

4.2 Brake Specific Energy Consumption : BSEC Fig.



3 Comparison of Brake Specific Energy Consumption

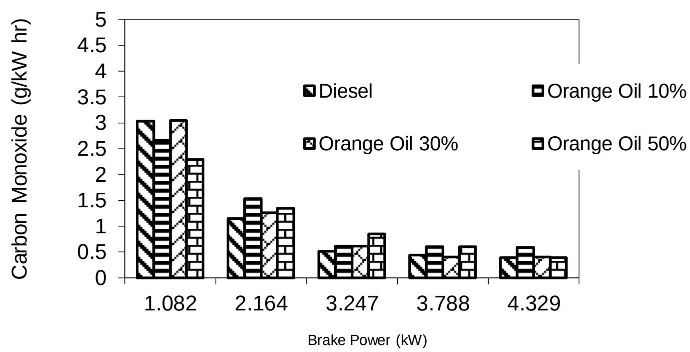
Fig. 3 shows the compression of brake specific energy consumption with brake power. It is seen that the BSEC decreases with increase in orange oil blends. At full load it is observed that the engine with 30 % orange oil blend consumes lesser energy due to maximum rate of heat release in the premixed combustion phase. This may be due to very fine fuel droplets and have combustion resulting in higher rate of heat release.

4.3 Carbon Monoxide

The comparison of the CO emission with

Fig. 4 Comparison of Carbon Monoxide

brake power is shown in Fig. 4. Generally, diesel engines produce lower CO due to lean air fuel mixture. The CO emission decreases with increase in



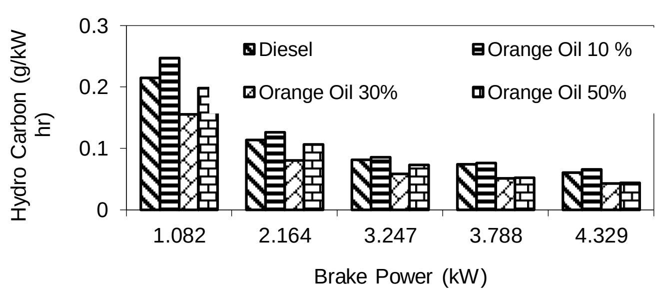
the percentage of orange oil blend than diesel fuel. The CO emission at part load is higher than that at full load for all the blends. It varies from 3 g/kW h to 0.4 g/kW h for diesel fuel. Similar trends are seen for all other blends. It may be noted from Table 2 that orange oil contains 3.05 % oxygen by mass and hence the orange oil blends contain oxygen. This leads to more complete combustion and there by lowering CO emissions [8].

4.4 Hydrocarbon

The HC emissions are compared for orange

Fig. 5 Comparison of Hydrocarbon

oil blends and diesel in Fig. 5. The HC emission decreased with increase in the percentage of orange



oil blends. Among the orange oil blends, 30 % orange oil blend shows lowest HC emission for the entire range of operation. This is due to complete combustion, which reflects in higher brake thermal efficiency with 30 % orange oil than the diesel, 10 % and 50 % orange oil blends [8]

4.5 Smoke

Fig. 6 shows the smoke for the orange oil blends and diesel fuel. It may be observed from the figure that smoke decreases with increase in the orange oil blend. 30 % orange oil blend gives lesser smoke compared to the other orange oil blends and

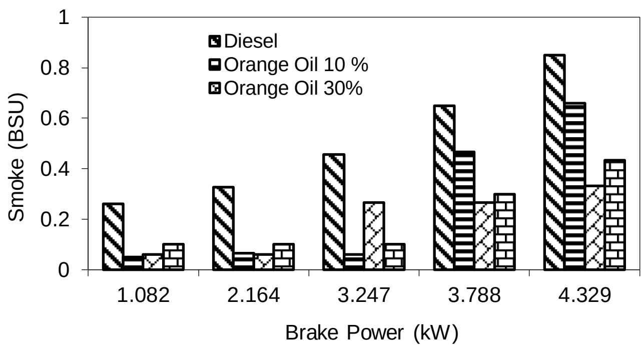


Fig. 6 comparison of Smoke

this may be due to better and complete combustion of the orange oil. Oxygen content in the fuel may also be the reason for lower smoke levels for all the orange oil blends compared to that of diesel fuel operation [7, 8].

4.6 Nitric Oxide

The emission of NO_x is significantly influenced by the in cylinder gas temperature and availability of oxygen during combustion. There is an increase in NO_x emissions due to the enhancement of the oxygen level of orange oil blends as seen in Fig. 7. Another probable reason for the increase in NO_x may be due to higher intense heat release in the premixed combustion phase for orange oil [7].

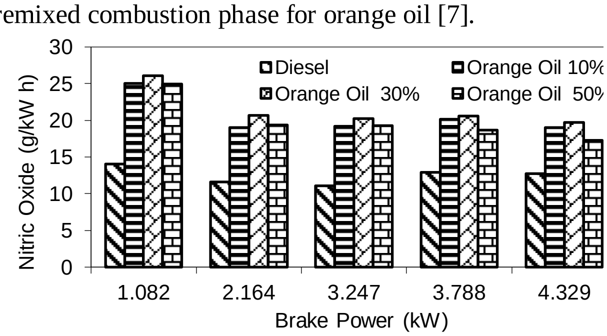


Fig. 7 Comparison of Nitric Oxide

CONCLUSIONS:

A single cylinder compression ignition engine was operated successfully using orange oil blend with diesel as an alternative fuel and the performance was compared with diesel fuel. The following conclusions are made based on the experimental results:

- The brake thermal efficiency was higher for about 2.2 % for 30 % orange oil blend than the diesel.
- Increasing the orange oil blend reduces HC and CO level than diesel fuel.
- Smoke level was lower for 30 % orange oil and higher for diesel. It is 0.85 BSU for diesel and drops down to 0.333 BSU for 30 % of orange oil at full load condition.
- NOx level was increased with increase in the orange oil upto 30 %

REFERENCES:

1 Huang Z.H, Lu H.B,JIang D.M, Zeng K, Liu B, Zhang J.Q and wang X.B. “Combustion characteristics and heat release analysis of a compression ignition engine operating on a diesel / methanol blend”. Proc. IMechE 2004 Vol. 219 Part D: J Automobile Engineering.

2 Zuohua Huang, et al, 2004, “Combustion behaviors of a compression – ignition engine fuelled with diesel/ methanol blends under various fuel deliveries advance angles”. International Journal of Bio Resource Technology 95 (2004) PP 331 – 341. Elsevier publications.

3 Usta. Net at. “Combustion of biodiesel fuel produced from hazelnut soapstock waste sunflower oil mixture in a diesel engine”. Energy Conversion & Management. 46 (2005) 741-755. Elsevier science ltd.

4 Kyle W. Scholl, Spencer C. Sorenson. “Combustion of soybean oil methyl ester in a direct injection diesel engine” SAE Paper -930934. pp:1450-1462.

5 Ali Y Hanna M.A , Alternative diesel fuels from vegetable oils, Bioresource Tech, 50, 1994, pp 153-165.

6 Parthasarathy.S et al. “Performance study of a lean burn four stroke S.I. engine gasoline – orange oil blend” Conference Anna University.

7 Ramesh B. Poola.B.Nagalingam and Gopalakrishnan.K.V. “Performance studies with biomass-derived high-octane fuel additives in a two-stroke spark- ignition engine”. Biomass and bio energy, Vl. 6, pp

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