International Journal of Applied Engineering Research ISSN 0973-4562 Volume 14, Number 3 (2019) pp. 826-828

Performance and Emission Analysis on DI Diesel Engine with Methyl Ester of Rubber Seed Oil

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Abstract

Diesel engines are often considered as a good option when the objective is to cut fuel costs and become more eco friendly. Though the diesel engines are eco friendly and emit less of total greenhouse gases they still have other impacts on the environment. These diesel engines emit more of other pollutants like nitrous oxide and black carbon. Black carbon, also known as smoke is formed by incomplete combustion of fuels. In this present work various blends of methyl ester of rubber seed oil is used in the DI diesel engine such as (MEORB20, MEORB40, MEORB60, MEORB80 and MEORB100). The NOx and Smoke is reduced in MEORB20 compare to other blend.

INTRODUCTION

From all of these concerns, research is eagerly searching for viable alternative to substitute for existing fossil oil as the major energy supply for the industrial society. A lot of effort is currently being spent towards the study of combustion of alternative fuel like bio fuel to become the most promising alternative to oil derived fuel, at least for the transportation field. It is still challenging to predict combustion characteristics of this fuel such as great variance in their composition and no experimental data of reactions involving them are available in the literature, which makes the task more difficult. Development of alternative diesel has to reduce exhaust emissions associated with issue of change of climate and safety of energy. The most essential elective fuel choices incorporate engineered fuel, biodiesel, dimethyl ether, diethyl ether, alcohols, methane and hydrogen. The instrument to pick future fuel dependent on better execution vitality productivity and emanations examination is constrained by such factors like accessibility, generation and transportation.

The utilization of vegetable oil as fuel sources is as old as the diesel engine. Rudolph Diesel who imagined the diesel engine, watched vitality from an assortment of fills which incorporate a few vegetable oils. At the World's Fair in 1900, Rudolph Diesel is honored with Grand Prix, the Fair's highest honor for demonstrating the engine using peanut oil. In 1912, Diesel predicted and expressed, "the utilize of vegetable oils for engine fuels may seem unimportant today, but such oils may become in the course of time as important as the petroleum and coal tar products of our time".

EXPERIMENTAL PROCEDURE:

The performance and emission tests were conducted on a mono cylinder, four stroke and water cooled, kirloskar TV 1 diesel engine. The experimental setup was as shown figure 1. The specification of the engine mention in table 1. Eddy current dynamometer was acted as the engine loading device. The dynamometer was interfaced to a control panel. The engine was run at a constant speed of 1500 rpm. AVL Di gas analyzer was used to measure the HC, CO and NOx, and smoke density was measured by smoke meter. The exhaust gas temperature was measured with help of thermo couple. The engine was run with pure diesel and biodiesel rubber seed oil by various blend ratio (MEORB20, MEORB40, MEORB60, MEORB80and MEORB100).

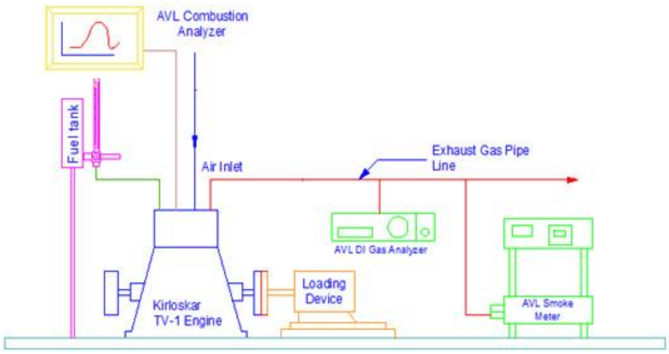

Fig. 1 Experimental Setup

Table 1. Test Engine Specification

Make	:	Kirlosker TV – I
Type	:	Vertical cylinder, DI diesel engine
Number of cylinder	:	Mono
Bore × Stroke	:	87.5 mm × 110 mm
Compression ratio	:	17.5:1
Cycle	:	Diesel
Speed	:	1500 rpm
Rated brake power	:	5.2 kW
Cooling system	:	Water cooling
Fuel	:	Diesel
Injection Pressure	:	205 kgf/cm^2
Ignition timing	:	23° before TDC (rated)
Ignition system	:	Compression Ignition

PERFORMANCE CHARACTERISTICS:

Figure 2 demonstrates the SFC versus engine brake power for diesel fuel, and MEOR mixes. It is seen that the SFC diminishes with increment in load for all mix fills. This might be expected the percent expansion in brake power being more than the percent increment in fuel utilization. The biodiesel blend increases also reduce the calorific value. The higher viscosity leads to improper injection in the cylinder.

Figure 3 demonstrates the thermal efficiency versus engine brake power for diesel MEOR mixes. The Brake thermal efficiency for diesel fuel is likewise appeared for reference. The BTH diminishes with the expansion of MEOR to diesel. Increases of MEOR to diesel will higher consistency of mixes and it causes diminish in the state of fuel shower and atomization. The MEORB20 mix was nearer to diesel.

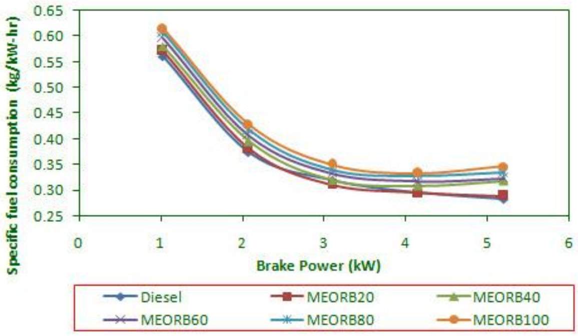

Fig. 2. Specific fuel consumption with Brake power

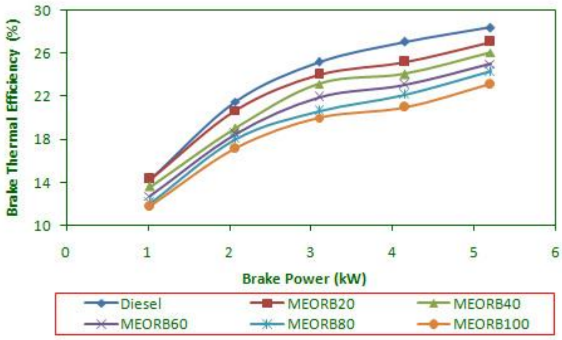

Fig. 3. Brake Thermal efficiency with Brake power

EMISSION CHARACTERISTICS:

Figure 4 demonstrates the impact of brake power on hydrocarbon emission. Hydrocarbon emanation was observed to be higher with the expansion of MEOR division in the mixes. This might be expected to the because of the high inactive warmth of vanishing of MEOR causing slower dissipation and poorer fuel air blending, which could prompt in total burning of the blend. However at low and part loads, there was no significant difference between different diesel-MEOR blends. The MEORB20 blends lightly higher into diesel compare to other blends.

Figure 5 demonstrates the impact of brake power on oxides of nitrogen. The outcomes demonstrate that NOx discharge increments with the expansion of engine load. In this investigation, the expansion of MEOR expands NOx emission contrasted with diesel fuel. The NOx focus increments with the expansion of MEOR portion in the mixes and this is because of temperature increment with the increment of MEOR division in the mixes. This will likewise bring longer start delay, prompting diminished premixed ignition part. It is discovered that MEORB20 have more prominent impact on the decrease of NOx outflow.

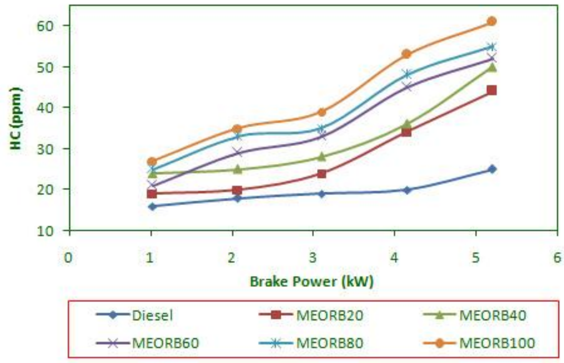

Fig. 4. Hydrocarbon with Brake power

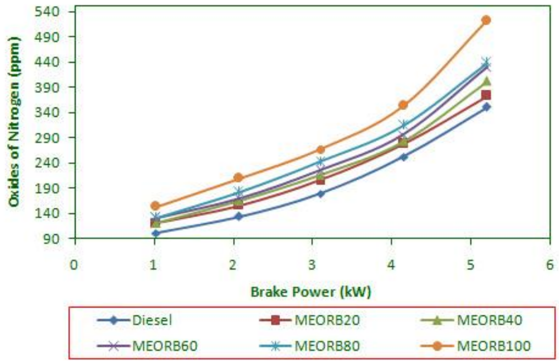

Fig. 5. Oxides of nitrogen with Brake power

Figure 6 shows the effect of brake power on smoke density for diesel and MEOR blends. Smoke is mainly produced in the incomplete combustion, the higher viscosity of biodiesel fuels leads to incomplete combustion. Addition of MEORB20 has shown lower smoke density compare to higher biodiesel blends, at all load conditions. This might be because of diminished Air-fuel proportion at higher burdens, when bigger amounts of fuel are infused into the burning chamber, quite a bit of which goes unburned into the fumes.

Figure 7 demonstrates the impact of brake power on carbon monoxide. At low and part stack, little contrast of CO emission is seen among the tried MEOR mixes. At high load, the fumes CO outflow increments with increment of MEOR portion in the mixes. The reason is that carbon monoxide

International Journal of Applied Engineering Research ISSN 0973-4562 Volume 14, Number 3 (2019) pp. 826-828

discharge (CO) in inner burning motors chiefly relies upon the blend fixation. The expansion of carbon monoxide emanation with the expansion of MEOR at high loads might be because of the high dormant warmth of vanishing of MEOR causing slower dissipation and poorer fuel – air blending. This will expand the rich district in the barrel and will build the CO emission.

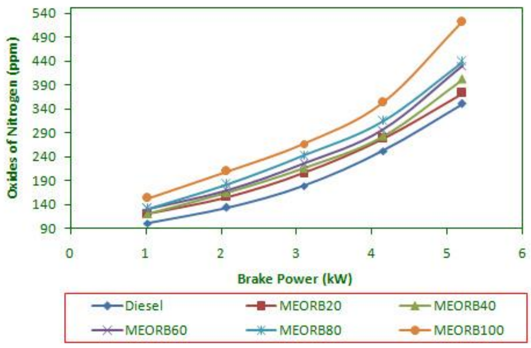

Fig. 6. Smoke density with Brake power

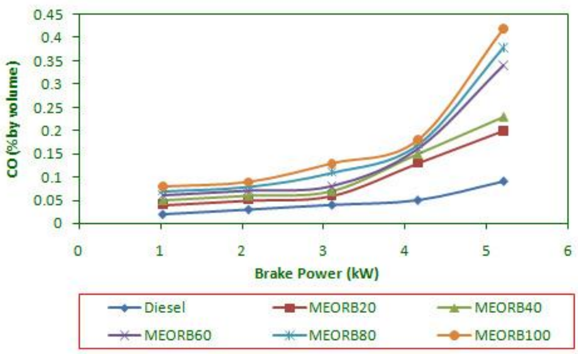

Fig. 7. CO with Brake power

CONCLUSION

The performance and emission characteristics of diesel, various MEOR blends are analyzed and compared. Based on the experimental results, the following conclusions are drawn.

The Brake thermal efficiency of MEORB20 is found to be lower than that other biodiesel fuel. The higher thermal efficiency after the addition of MEORB20 is due to its oxygen content and effect on lowering the viscosity of the blend, which led to an improvement in the combustion. The specific fuel consumption for MEORB20 is lower than that of other biodiesel at the maximum load. The smoke intensity is increased with MEOR blends. There is no remarkable increase in smoke intensity at no load and part load conditions with MEOR blends. NOx emission is higher by the addition of MEOR. The effect of MEORB20 NOx emission is lower effective when compared with other blends. The use of MEOR has showed an increase in CO and HC emissions at maximum load. Hence it is concluded that the MEORB20 is found to be the optimum blend on the basis of performance and emission characteristics.

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