International Journal of Applied Engineering Research ISSN 0973-4562 Volume 13, Number 23 (2018) pp. 16697-16700

Performance and Emission Analysis on DI Diesel Engine with Multi-walled Carbon Nanotubes

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Abstract

Nowadays the diesel powered passenger cars are becoming increasingly popular due to its efficiency and performance. In the predictable future, the world's transportation requirements continue to relay on the diesel and petrol engine. Present technologies engine run with lower emission and higher efficiency. In this work performance and emission were analysis in DI diesel engine fuelled with thermal cracked groundnut acid oil biodiesel (B20TCGAO) B20 blended with multi wallet carbon nano tube in 40ppm and diesel at different load and various EGR ratios. The EGR ratio is varied from (5%, 10%, 15% and 20%). The EGR reduce NOx emission.

Keywords: Biodiesel, Emission, EGR, Carbon nanotube,

1. INTRODUCTION

All sustainable power sources rely on the nature and hard to store with the exception of biofuel. Biofuel is produced through bio mass in particular, wood, agricultural and city squander, bio fuel like liquor and different vegetable oils (C. Thayaparan et al 2007 and O. Ghazal et al (2018)). Bio-fuel have a bigger number of favorable circumstances than strong fills, since they can be effortlessly transported. The vegetable oils and their chemical conversions are one of the most suitable substitutes for diesel fuel. Bio fuels can be obtained from biomass in different kinds of mode such as solid liquid and gaseous form. It can be used to alternate fuel for internal combustion engine, boiler, furnace and industrial application (M. Vijay Kumaret al (2017), Sharma Rashedul, Hasan Khondakar, et al. (2017), velumani.V et al (2018)). It also develops the economic status of our country, as well as to satisfy the energy requirement. As the world stores of fossil energize and crude materials are restricted, dynamic exploration interest has been fortified in non-petroleum, renewable, and nonpolluting powers. Biofuels are the main exchange vitality hotspots for a long time to come can at present frame the premise of reasonable advancement as far as financial and ecological concerns. In this setting, vegetable oils as fuel for diesel motors are considered (Koder, Alexander, et al.(2018)). They now involve an unmistakable position in the improvement of option energizes. Overall vegetable oils are utilized as a part of pressure ignition (CI) engine either as a sole fuel or mixed with diesel fuel (Deivajothi, et al (2016)). The higher oxides of nitrogen (NOx) are formed in the biodiesel compare to diesel fuel. The NOx is leads to produce the acid rain. The EGR is used to reduce the NOx emission.

In compression ignition engine, EGR technique is used for reduce NOx emission. EGR technology is certain amount of exhaust gas is re-circulated in to inside the cylinder. This is reduce the oxygen supply is reduced to the combustion chamber. This leads to decrease the combustion temperature, also reduce the oxides of nitrogen. The exhaust gas, added to the fuel, oxygen, and burning items, builds the explicit warmth limit of the chamber substance, which brings down the adiabatic fire temperature. Since NOx shapes principally when a blend of nitrogen and oxygen is oppressed into high temperature, the lesser combustion temperatures were caused by EGR and it decreased the measure of NOx created. A large portion of the cutting edge diesel motors are presently introduced with fumes gas distribution framework to meet emission standard.

2. EXPERIMENTAL SETUP

The experiments biodiesel mixture with multi wallet carbon nano tube was conducted in mono cylinder diesel engine coupled with eddy current dynamometer. Figure 1 shown as the experimental arrangement in this investigation. The complete investigation engine was run with rated speed at 1500 rpm controlled by governor. Investigation was conducted to evaluate the performance and emission characteristics of a diesel engine when fuelled thermal cracked groundnut acid oil biodiesel (B20TCGAO) B20 blended with multi wallet carbon nano tube in 40ppm and diesel at different load and various EGR ratio. The EGR ratio is varied from (5%, 10%, 15% and 20%). The emission like HC, CO, and NOx, were measured in the exhaust gas analyzer and smoke density was measured in the smoke meter. The engine specification was mention in table 1.

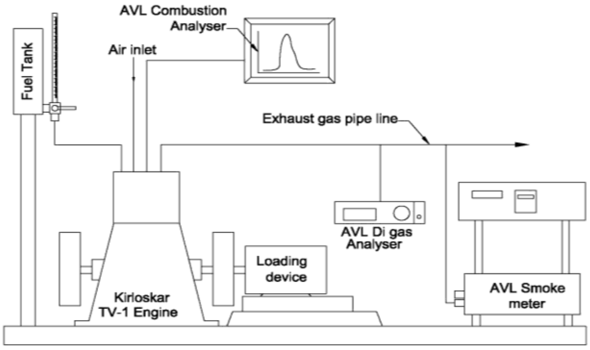

Fig.1 Experimental arrangement

Table.1. Specifications of Diesel Engine

Type	:	Four stroke, mono cylinder, Vertical, Water cooled.
Stroke	:	110 mm
Stroke length	:	0.1m
Power	:	5.2 kW
Cylinder diameter	:	0.0875 m
Bore	:	87.5 mm
Compression ratio	:	17.5 : 1
Loading device	:	Eddy current dynamometer
Speed	:	1500 rpm

3. RESULT AND DISCUSSION

The variation of specific fuel consumption with increasing brake power was shown in Figure 2. The measurement was carried out with EGR in different ratios for MWCNT40ppmB20TGAO blend. The specific fuel consumption was lower for diesel and slightly higher value for MWCNT40ppmB20TGAO with all EGR ratios. The specific fuel consumption is increased with increasing of EGR ratio. This is due to lack of oxygen presents in higher EGR parentage. The specific fuel consumption of MWCNT40ppmB20TGAO blend was about 0.285, 0.317, 0.353 and 0.363kg/kW-hr with 5%, 10%, 15% and 20% EGR. The optimum EGR is 5% MWCNT40ppm B20TGAO blend.

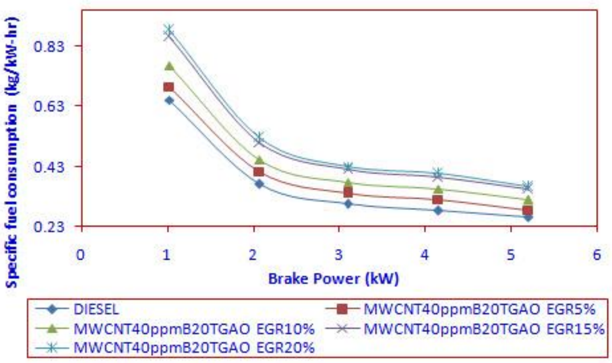

Fig.2 Specific fuel consumption against Brake power

The variation of brake thermal efficiency with brake power was shown in Figure 3. From the test conclusion it was seen that at first with increasing load, the brake thermal efficiencies (BTE) of the considerable number of energizes were increasing and afterward would in general abatement with further increment in load. BTE was observed to be marginally reduced with all EGR rate at all loads. The conceivable reason might be re-consuming of HC that enter the cylinder with the recycled exhaust gases (Zhang et al (2014)). At maximum loads, BTE remains unchanged by recirculated exhaust gases. The highest brake thermal efficiency 28.62% was found in case of MWCNT40ppm B20TGAO blend at 5%EGR. This is due to improved BTE noticed with oxygen content fuels. The brake thermal efficiency is decreased with increase in EGR percentage.

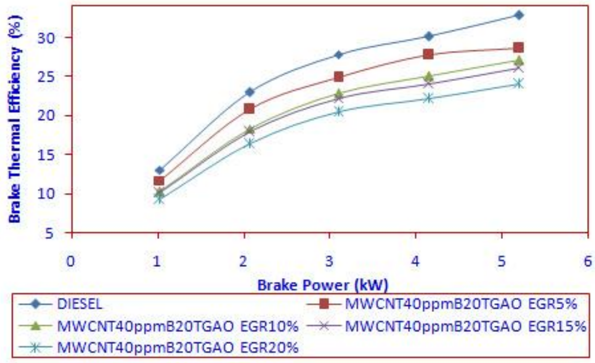

Fig.3 Brake thermal efficiency against Brake power

The figures 4 shows in smoke density against brake power. At full load condition for MWCNT40ppm B20TGAO blend, the smoke density value with EGR (5%, 10%, 15%, and 20%) of 56, 63, 66 and 68 HSU respectively. The smoke density of without EGR diesel was 59 HSU.. Smoke density for MWCNT40ppm B20TGAO blend without EGR was found lesser than that of diesel. The particle of MWCNT40ppm B20TGAO mix have certain amount oxygen that participates in ignition and this might be a conceivable explanation behind enhanced burning and hence reduction of smoke (Zeraati-Rezaei et al (2017)). Smoke density was reduces in 5%EGR using MWCNT40ppm B20TGAO blend compared to other EGR percentage.

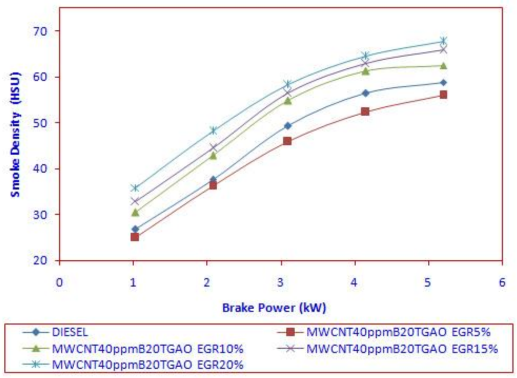

Fig.4 Smoke density against Brake Power

Figure 5 shows the variation in the Oxides of nitrogen emission of diesel and MWCNT40ppm B20TGAO blend with respect to brake power. At the point when EGR was connected, NOx was reduced with high rate of EGR. The level of decrease in NOx at higher load was higher. The purposes behind decrease in NOx emission utilizing EGR in diesel engine were lessened oxygen focus and decreasing combustion temperatures (Devarajan et al (2018). In this manner, it very well may be seen that when EGR was connected to diesel engine, NOx was reduced however smoke density was higher. But in case of MWCNT40ppm B20TGAO blend also reduce the smoke density. MWCNT40ppm B20TGAO blend 20% EGR ratio was able to reduce NOx by a large amount. It was observed that NOx emission values in MWCNT40ppm B20TGAO blend without EGR was 1023 ppm and for 20% EGR was 814 ppm.

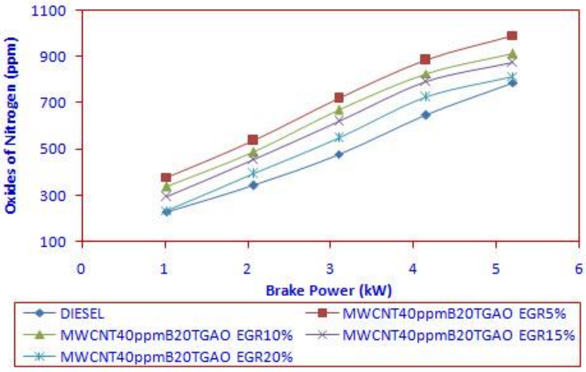

Fig. 5 Oxides of nitrogen against Brake Power

Figures 6 indicate the variation of hydrocarbon emission with brake power. HC emissions for MWCNT40ppm B20TGAO blend at 5% EGR was lowest compared to other EGR percentage. HC emissions of all the blends were lesser in middle load, incase of lower load and maximum load increased. The conceivable reason might be reduction in oxygen accessible for burning (Praveen et al (2018)). Lower oxygen focus results in poor air-fuel blends inside the cylinder. Adding MWCNT40ppm B20TGAO mix to diesel increase the oxygen needed for ignition in view of quality of sub-atomic oxygen in blend. The optimum EGR is 5% with MWCNT40ppm B20TGAO blend.

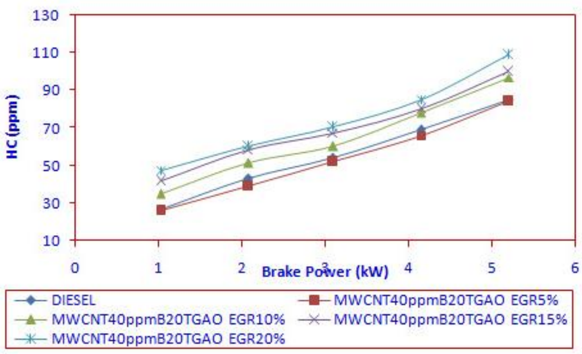

Fig. 6 Hydrocarbon against Brake Power

Figures 7 indicate the variation in CO emission with brake power. Without EGR for whole load range, the CO emission from the MWCNT40ppm B20TGAO blend was same as diesel fuel. This was possible because of the molecular oxygen availability in MWCNT40ppm B20TGAO blend fuel. With increasing EGR ratio, CO emission remains same at lower loads but increases at higher loads. At full load condition in 10%, 15% and 20% EGR ratio rise in CO emission was probably due to dilution effect of exhaust gases and lower air fuel ratio (Manieniyan et al (2013)). In case of MWCNT40ppm B20TGAO blend, 5% EGR ratio 0.05% and diesel of 20% EGR was 1.28% CO emission at full load.

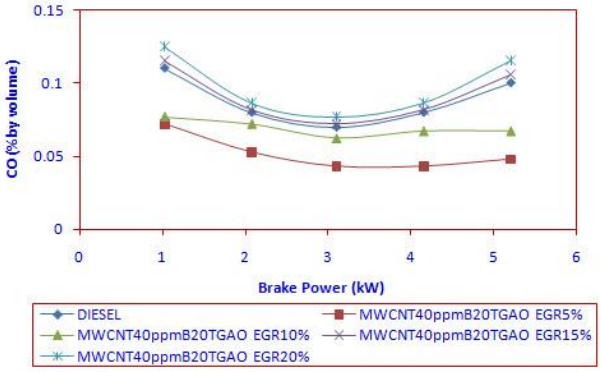

Fig.7 CO against Brake Power

The differences of exhaust gas temperature (EGT) with respect to brake power are in Figure 8. Normally, the EGT is reduced with an increase in the EGR all load conditions for MWCNT40ppm B20TGAO blend. This decrease in EGT with load is clear from the simple fact that more oxygen is needed to the engine to produce the more power to take up the additional loading (Liu, Jie et al(2018). The EGT is noticed to lower with the higher concentration of EGR. The optimum EGR is 5% in all loads with MWCNT40ppm B20TGAO blend.

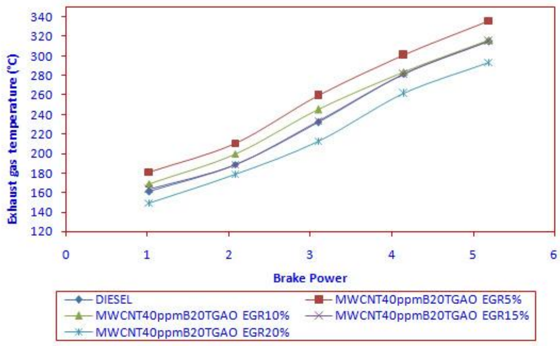

Fig. 8 Exhaust gas against Brake Power

4. CONCLUSION

The specific fuel consumption is increased with increasing of EGR ratio. This is due to lack of oxygen presents in higher EGR parentage. The brake thermal efficiencies (BTE) of the considerable number of energizes were increasing and afterward would in general abatement with further increment in load. BTE was observed to be marginally reduced with all EGR rate at all loads. The particle of MWCNT40ppm B20TGAO mix contains some oxygen that participates in ignition and this might be a conceivable explanation behind enhanced burning and hence reduction of smoke. MWCNT40ppm B20TGAO blend 20% EGR ratio was able to reduce NOx by a large amount. HC emissions for MWCNT40ppm B20TGAO blend at 5% EGR was lowest compared to other EGR percentage. In case of MWCNT40ppm B20TGAO blend, 5% EGR ratio 0.05% and diesel of 20% EGR was 1.28% CO emission at full load. The optimum EGR is 5% in all loads with MWCNT40ppm B20TGAO blend.

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