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EFFECT OF MULTI-WALLED CARBON NANOTUBES IN DI DIESEL ENGINE

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ABSTRACT

Development of alternative diesel has to reduce exhaust emissions associated with change of environmental and energy protection. The most important alternative fuel options include synthetic fuel, biodiesel, dimethyl ether, diethyl ether, alcohols, methane and hydrogen. The mechanism to choose future fuel based on better performance energy efficiency and emissions analysis is limited by such factors like availability, production and transportation. In this present work thermal cracked carbon filter Sunflower Acid Oil (B20TCSAO) with Multi-Walled Carbon Nanotubes (MWCNT) in different concentrations (10ppm, 20ppm, 30ppm, 40ppm, and 50ppm) and diesel at (20%, 40%, 60%, 80% and 100%) load. The readings were taken in 20 %, 40 %, 60 %, 80 % and 100 % load. The brake thermal efficiency increases with the increasing of MWCNT level. The smoke density was reduced with the addition of MWCNT by about 2.2% to 5.2%, especially at full load.

Keywords: biodiesel, carbon nanotube, diesel engine, emission.

1. INTRODUCTION

Biodiesel is suitable alternate liquid fuel for diesel engine. It is obtained from plant animal and fats; it is converted by tranestrification process. It is a biodegradable transportation fuel, which emits low sulphur and carbon monoxide as well as particulate emissions to the atmosphere. Also, it is a renewable, domestically produced liquid fuel that can help to reduce India's dependence on oil imports. The biodiesel was produced from biomass, agricultural and other organic waste and also burn with low emission. The biodiesel can be blended with any petroleum product. Diesel engine can be run with biodiesel without modification of the engine (Karmee and Chala 2005, Chisti *et al* 2007). It was safe to handle and utilization; because higher flash point and fire point approximately more than 149 °C. Biodiesel reduces particulate matter considerably. The biodiesel was used in compression ignition engine, the results reported, that the emission HC, CO and PM reduced. But NOx emission was higher due to higher oxygen presents in biodiesel also complete burring compared to diesel (Venkateswaralu *et al*, 2009).

Oil from crop seeds are the main sources for the conventional energy gain and it is important resource for emerging fuel. Biodiesel has been most popular since its environment reimbursement and the fact that it is man created from conventional sources. The cost of the vegetable oil and biomass is 60 to 70 % of the total cost of the biodiesel fuel (Murugesan *et al* 2009). It is a possible confront with bio fuel. The non-edible oils are the desirable sources in India for the extraction of biodiesel. The Transesterification process and Thermal cracking method are used and it is cheapest and high yield of biodiesel production compared to other methods (Manieniyan *et al* 2012 and Dantas *et al* 2013). In this work production of biodiesel is carried out in two different methods, one for Transesterification process and the second one is Thermal cracking.

2. EXPERIMENTAL SETUP

The experiments biodiesel mixture with multi-walled carbon nano tube is conducted in single cylinder diesel engine. The layout of experimental system is shown in Figure-1. The specification of the engine was as shown in Table-1. Eddy current dynamometer is used as a loading device. The experiment is run in rated speed at 1500 rpm. The experimental investigations conducted on diesel engine with diesel and Thermal Cracked carbon filter Sunflower Acid Oil (B20TCSAO) with Multi-Walled Carbon Nanotubes (MWCNT) in different concentrations (10ppm, 20ppm, 30ppm, 40ppm, and 50ppm) at various load. The readings were taken in 20 %, 40 %, 60 %, 80 % and 100 % load. The optimum thermal cracked biodiesel blend is selected on the basis of performance, combustion and emission parameters.

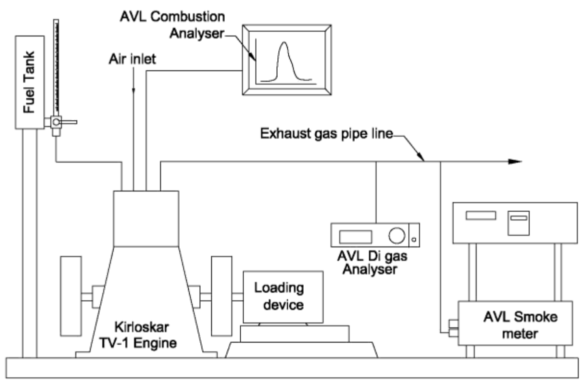

Figure-1. Experimental arrangement.

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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	:	

3. RESULTS AND DISCUSSIONS

The experiments were conducted using diesel and the various ratios of multi-walled carbon nanotubes blends with thermal cracked sunflower acid oil biodiesel (B20TCSAO) blends.

Figure-2 demonstrates the variant of specific fuel consumption (SFC) with brake power. It is noticed that the specific fuel consumption of the MWCNTB20TCSAO blends is lesser than B20TCSAO and slightly higher for diesel in all loads, this may be better atomization and superior mixing process. The lower in SFC is due to the optimistic effects of MWCNT on properties (physical and chemical) of the fuel (*Devarajan et al* 2018). The SFC decreases with an increase in the blends level of 10ppm to 50ppm of MWCNT blends with B20TCSAO. It is found the SFC for the blend MWCNT40ppmB20TCSAO was close to diesel in all load. The SFC of diesel is noticed to be 0.241 kg/kWh at full load condition. The SFC at full load is with MWCNT40ppmB20TCSAO 0.2780 kg/kWh.

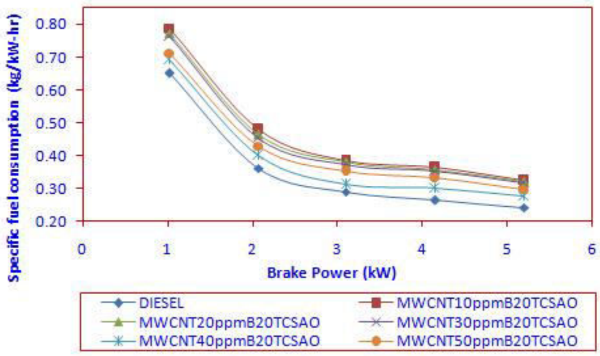

Figure-2. Specific fuel consumption against Brake power.

Figure-3 demonstrates increase in brake thermal efficiency (BTE) with increase in brake power. From the figure noticed brake thermal efficiency increase with addition of MWCNT in B20TCSAO. Normally nano sized elements have more surface area; it leads to higher chemical reactivity (Sukumar. *et al*., 2015; Keskin A *et al*., 2011). The lower viscosity of MWCNT blends to better atomization, fuel vaporization and combustion; hence the BTE of the MWCNT blends was higher. The maximum BTE found with diesel was around 31.77% and 29.92% for MWCNT40ppmB20TCSAO.

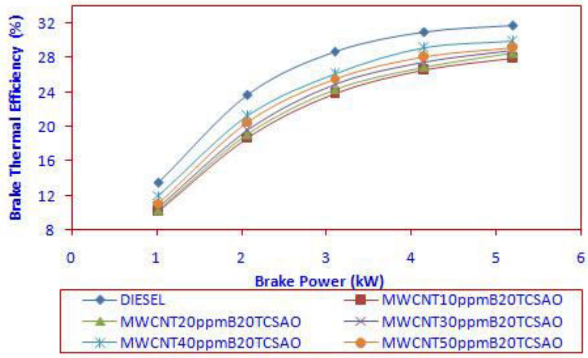

Figure-3. Brake thermal efficiency against Brake power.

Figure-4 demonstrate variation of smoke density with brake power for MWCNT blends with biodiesel and diesel. Smoke density is reduced with MWCNT blends with biodiesel about 2.2% to 5.2%, especially at full load. From the figure noticed smoke density reduced with increase MWCNT with biodiesel blends. At the full load, the smoke density were 58 HSU, 60 HSU, 57 HSU, 59 HSU, 55 HSU and 56 HSU emissions for diesel MWCNT10ppm B20TCSAO, MWCNT20ppmB20TCSAO, MWCNT30ppm B20TCSAO, MWCNT40ppmB20TCSAO and MWCNT50ppmB20TCSAO, respectively. The lower smoke density was observed in MWCNT40ppmB20TCSAO.

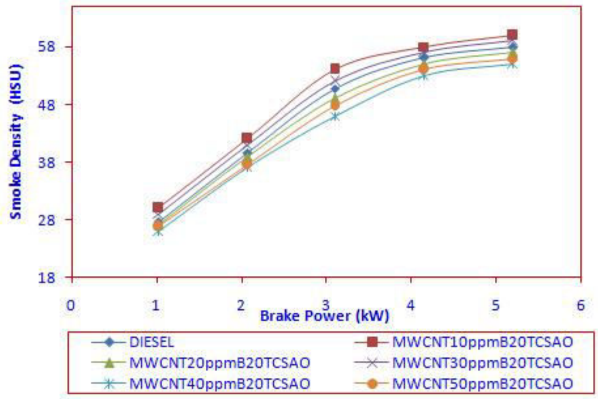

Figure-4. Smoke density against Brake Power.

The Oxides of Nitrogen (NOx) emissions were noticed gradually increasing trends in MWCNT as shown in Figure-5. Oxides of Nitrogen are found because of nitrogen noticeable all around among uncontrollable of air-fuel blend in the combustion chamber. On account of satisfactory temperature ascends to consume and therefore more free oxygen particles consolidate nitrogen, this thusly, expands the arrangement rate of Oxides of Nitrogen (Mahalingam *et al* 2018). NOx emissions of

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diesel were 795 ppm and lower NOx is found in 935ppm for MWCNT50ppmB20TCSAO.

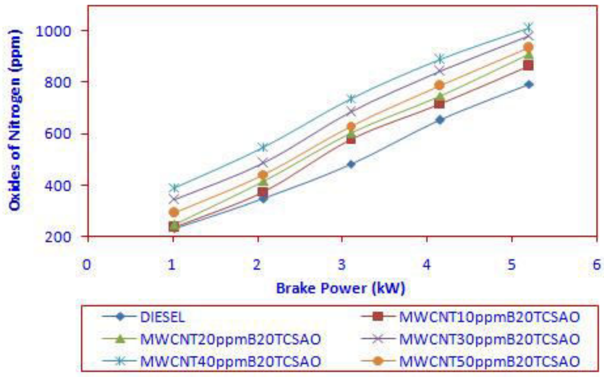

Figure-5. Oxides of nitrogen against Brake Power.

The variation of hydrocarbon (HC) emission with brake power is shown in Figure-6. The HC emission is slightly decreased in MWCNT40ppmB20TCSAO when compared with other blends of MWCNT and diesel. This was due to, MWCNT are oxygen enhance catalyst that leads complete combustion and thus reduced hydrocarbon emission (Deivajothi *et al* 2017). The results from the figure HC emission is higher in higher blend MWCNT50ppm B20TCSAO. HC emission for MWCNT40ppmB20TCSAO was 25ppm at low load and 83 ppm at higher load.

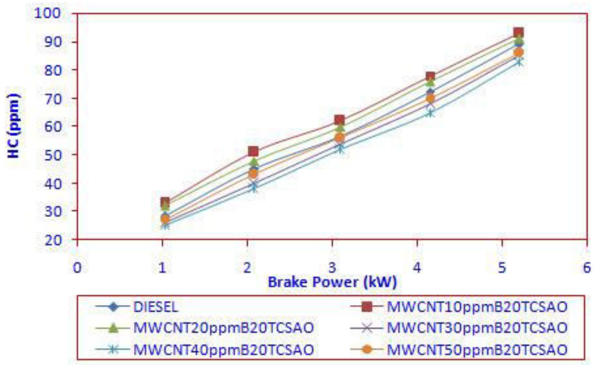

Figure-6. Hydrocarbon against Brake Power.

Figure-7 shows the carbon monoxide (CO) emissions on influence of the MWCNT blends with biodiesel and diesel. Carbon monoxide emission is mainly formed by insufficient oxygen and lower temperature in inside the combustion chamber. MWCNT performed an increase in oxygen catalyst; this leads MWCNT blended biodiesel blend lower CO emission. In maximum load, carbon monoxide emissions for diesel were 0.1% (by volume) and 0.08% (by volume) for MWCNT40ppmB20TCSAO. The lower CO emission is obtained in MWCNT40ppmB20TCSAO.

Figure-8 delineates the variety of exhaust gas temperature (EGT) with brake power at different load. It is seen that the EGT increments with load since more fuel is singed to meet the power condition. It found from the figure in diesel operation it ranges from 161°C at low load to 315 °C at full load, the EGT various from 185°C at lower load to 341°C at maximum load in the case of MWCNT40ppmB20TCSAO. For MWCNT40ppm B20TCSAO at maximum load the EGT higher compare to diesel and other blends of MWCNT. This is due to higher temperature in combustion chamber.

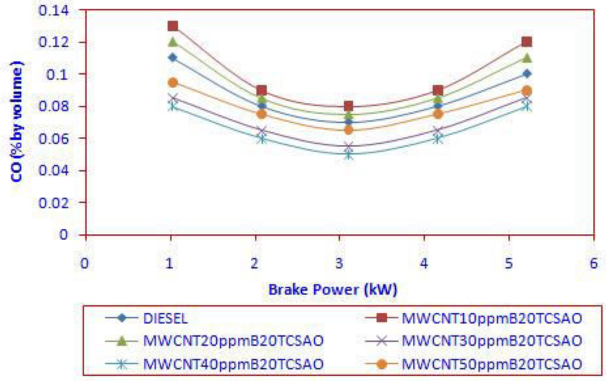

Figure-7. CO against Brake Power.

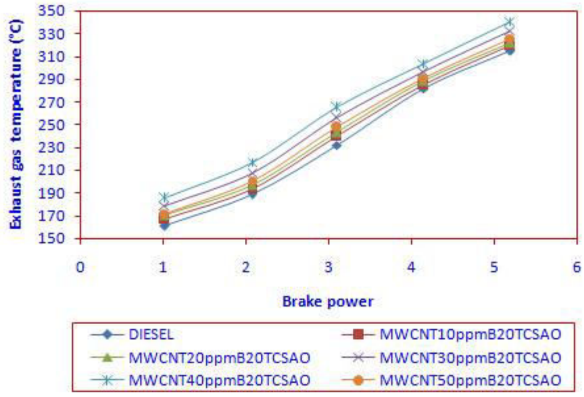

Figure-8. Exhaust gas Temperature against Brake Power.

CONCLUSIONS

It was observed that the specific fuel consumption for the blend MWCNT40ppmB20TCSAO was close to diesel in all loads. MWCMT is better atomization and better mixing process. Brake thermal efficiency increase with addition of MWCNT in B20TCSAO. Smoke density is reduced with MWCNT blends with biodiesel about 2.2% to 5.2%, especially at full load. Smoke density reduced with increase MWCNT with biodiesel blends. NOx emissions of diesel were 795 ppm and lower NOx is found in 935ppm for MWCNT50ppmB20TCSAO. MWCNT40ppmB20TCSAO slightly decrease the HC emission when compared with neat diesel and other blends of MWCNT. This was due to, MWCNT are oxygen enhance catalyst. The lower CO emission is obtained in MWCNT40ppmB20TCSAO. MWCNT40ppmB20TCSAO at full load the exhaust gas temperature higher compare to diesel and other blends of MWCNT.

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