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A REVIEW ON PERFORMANCE AND EMISSION CHARACTERISCS OF C.I. ENGINE WITH OXYGENATED FUEL ADDITIVES

Satish Kumar Kurrey*, Gopal Sahu, Prakash Kumar Sen
* Student, Mechanical Engineering, Kirodimal Institute of Technology, Raigarh (C.G.).
Faculty, Mechanical Engineering, Kirodimal Institute of Technology, Raigarh (C.G.).
Faculty, Mechanical Engineering, Kirodimal Institute of Technology, Raigarh (C.G.).

ABSTRACT

In our daily life the combustion products from the C.I. engine are one of the most pollution factor .These factor increasesgreenhouse effect, acid rain and tends to destroy the ozone layer .The chemical composition of carbon monoxide, hydro carbon, smoke emission etc. which produced by the C.I engine .These are very harmful for human health and environmental ecosystem .This paper concerned with the reduction of the reduction of the above problem by the use of oxygenated fuel additives when added in diesel at appropriate proportion then it will increases the engine performance and emission characteristics in the C.I engine so that it will reduced harmfully gases such as HC, CO, soot level without any significant increase in NOx emission.

KEYWORDS: Emission, Oxygenates, Additives, Performance, Diesel Engine.

INTRODUCTION

The addition of fuel oxygenates change that has created the greatest opportunity to reduce the use of harmful gasoline components and provide for cleaner combustion. it reduced the emission of carbon monoxide in winter months .A. C. Hansen, M. R. GrattonOne group of fuel additives is oxygenated compounds. The main reason of using oxygen to produce a cleaner burning of diesel fuels is few decades old [1]. In this century, it is believed that crude oil & petroleum products will become limited and expensive. Day-to-day, fuel economy of engine is getting improved and will continue to progress. However, massive increase in number of vehicles has started dictating the fuel demand. Gasoline and diesel fuels will become limited and very costly in the near future. World energy demand is increasing continuously, specifically the demand of petroleum fuels. World energy consumption is expected to increase to 180,000 GWh/year by 2020 [2].Ren et al. (2007), were investigated combustion and emission characteristics of a direct injection diesel engine fuelled with diesel diglyme blends. Their results show that the ignition delay and the amount of heat release in the premixed combustion phase decrease with the increase of the oxygen mass fraction in the blends. The diffusive combustion duration and the total combustion duration decrease, while the amount of heat release in the diffusive combustion phase increases with the increase of the oxygen mass fraction in the blends. The maximum mean gas temperature in the cylinder increases and the duration of the high gas temperature decreases with the increase of the oxygen mass fraction in the blends. Moreover, the smoke concentration decreases with the increase of the oxygen mass fraction in the blends. The NOx concentration shows a slight decrease or remains unchanged with the increase of the oxygen mass fraction in the blends [3].The reduction of soot generation by the addition of oxygenated compounds depends on the molecular structure and oxygen content of the fuel [4].

The investigation was carried out by T. Nibin, A. Sathiyagnanam and S. Shivprakasam, 2003 to improve the performance of a diesel engine by adding oxygenated fuel additive of known percentages. The effect of fuel additive was to control the emission from diesel engine and to improve its performance. The fuel additive dimethyl carbonate was mixed with diesel fuel in concentrations of 5%, 10% and 15% and used. The experimental study was carried out in a multi-cylinder diesel engine. The result showed an appreciable reduction of emissions such as particulate matter, oxides of nitrogen, smoke density and marginal increase in the performance when compared with normal diesel engine [5].

OXYGENATED ADDITIVES

Oxygenated Additive is nothing more than fuel that have a chemical compound containing oxygen. It is used to help fuel burn more efficiently and cut down on some types of atmospheric pollution. In many cases, it is credited with reducing the smog problem in major urban centres. It can also reduce deadly carbon monoxide emissions. Oxygenated additive works by allowing the gasoline in vehicles to burn more completely. Because more of the fuel is burning, there are fewer harmful chemicals released into the atmosphere. In addition to being cleaner burning, oxygenated additive also helps cut down on the amount of non-renewable fossil fuels consumed.

Dimethyl carbonate, often abbreviated DMC, having molecular formula is C3H6O3. The oxygen content is up to 53.3 wt%. So it is usually used as an oxygenated additive to blend with diesel fuel to improve combustion and reduce emissions of diesel engines. However, the low heating value and the boiling point of DMC are 15.78 MJ/kg and 90-91ºC, respectively which are much lower than that of diesel fuel. The energy density of DMC is 16.9 J/mm3. As results, when the same volumetric fuel blends are delivered, the engine power output will decreases when fueled with DMC-diesel blend, especially at condition of high loads[6] . Dimethyl carbonates (DMC) and Dimethoxy methane (DMM) also have high oxygen content and have been considered as diesel fuels. DMC and DMM contain 53.3% and 42.1% of oxygen by mass respectively; and both of which are higher than the ethanol oxygen content. Their cetane numbers are 36 and 30, respectively, higher than ethanol's cetane number too. Therefore, according to the above basic principles – a high oxygen content and a high cetane number – these two oxygenates are both better than ethanol especially ideal for DMC. The boiling point of DMC is 910 C which is higher than ethanol's 780 C and DMM's 430 C. The viscosity values of DMC, DMM, and ethanol are all very low, which could be used to offset the high viscosity of the biodiesel constituent in the blended fuel.[7] Ethylene glycol monoacetate, often abbreviated EGM, having molecular formula is C4H8O3. It is another promising oxygenated additive with the oxygen content of 46.1 wt%. The energy density of EGM is 26.2 J/mm3. The low heating value of EGM is 26 MJ/kg, which is higher than that of DMC. The boiling point of EGM is 210-220 ºC, and is near to that of diesel (180-360 ºC). Therefore, it can improve the properties of diesel engines that DMC in blends is partly replaced by EGM [6].

PROPERTIES OF DIFFERENT FUEL AND ADDITIVES

PROPERTIES OFGOOD OXYGENATED ADDITIVES

1.oxygenates reduce the long-term reactivity of CO in the atmosphere, which, in turn, reduces ozone formation.
2. The oxygenate additive must be miscible with various biodiesel fuels over the range of environmental temperatures seen in vehicle operation.
3. The oxygenate additive must not show excessive volatility when mixed with various biodiesel fuel.
4. The mixture of base fuel and oxygenate must have an adequate cetane number and preferably allow the mixture to show an increased cetane number.
5. The oxygenate additive must show a sufficient water tolerance.
6. Available studies show that the use of oxygenates also substantially reduces primary particulate matter (PM) by as much as 25% to 30%.
7.Oxygenates offer beneficial gasoline blending properties such as high octane and low distillation temperatures, which would not normally occur without their use.

PERFORMANCE AND EMISSION CHARACTERISTICS

BRAKE THERMAL EFFICIENCY

The brake thermal efficiency could be estimated from the BSFC and lower heating value (LHV) of the three different fuels. Following equation was used to calculate the BTE was:

BTE=3600/ (BSFC (g/kWh) QLHV (MJ/kg))

where LHV of NM, NE and diesel fuel are 10.52, 18.1 and 42.5 MJ/kg, respectively. However, in spite of the large quantity of injected fuel, the brake thermal efficiency of the oxygenated additives was higher than that of the diesel. This result shows that it has higher reaction activity in the fuel-rich zone due to oxygenate of them in high speed and high-load conditions. The higher brake thermal efficiency of the fuel additives is due to the following reasons: since the boiling point of additives is lower than that of diesel; thus quality of the spray with blend fuels was improved. Higher reaction activity in the fuel-rich zone due to oxygenate of them [8].

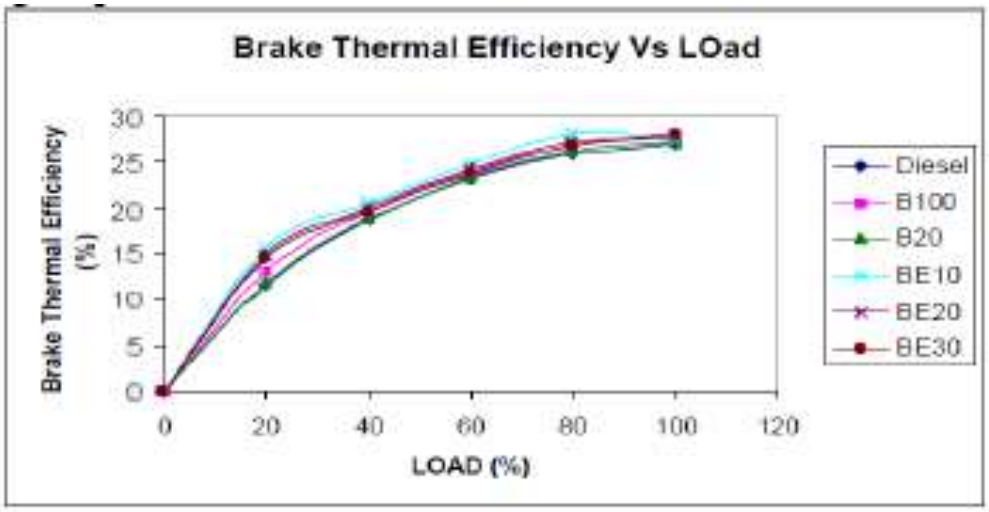

Fig 1 Brake Thermal Efficiency Vs Load [9]

ENGINE PERFORMANCE

As energy densities of the blends containing DMC and EGM decrease, the engine power outputs are reduced. But as the percentages of power losses are smaller than the reductions of the energy densities hence the engine performance increases when fuel with DMC-EGM diesel blends [9]

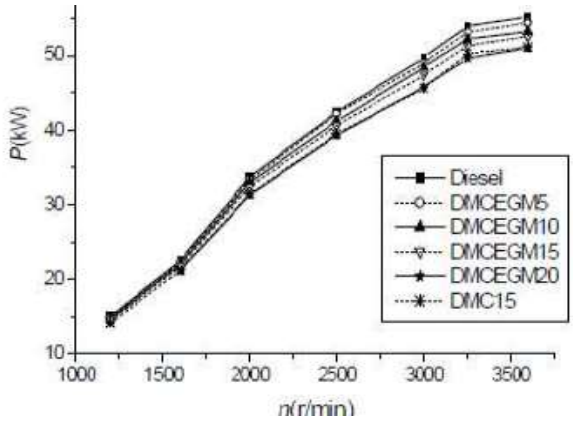

Figure 2 Engine power at full load operating condition[6]

SMOKE EMISSION

It is more effective to reduce exhaust smoke by adding oxygenated additives in diesel according to the studies done by other investigators. It is obvious from Figure 2 that the smoke emission can be reduced with the addition of DMC and EGM to diesel. [10]

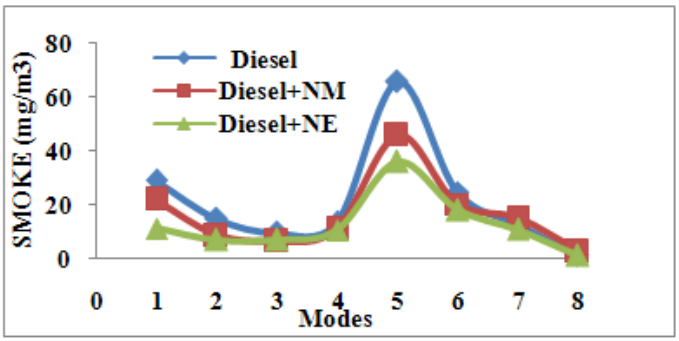

Fig.3 smoke emission for various fuel [9]

CO EMISSION

CO emissions will increase quickly when diesel engines are operated under very high load conditions. It is clear from review of previous researches that CO emissions can be reduced significantly by using DMC-EGM-diesel blends, especially at higher loads. Figure 4 shows CO emission characteristics when various fuels are used. The changing trend of the CO emission curve is similar to that of smoke emission .

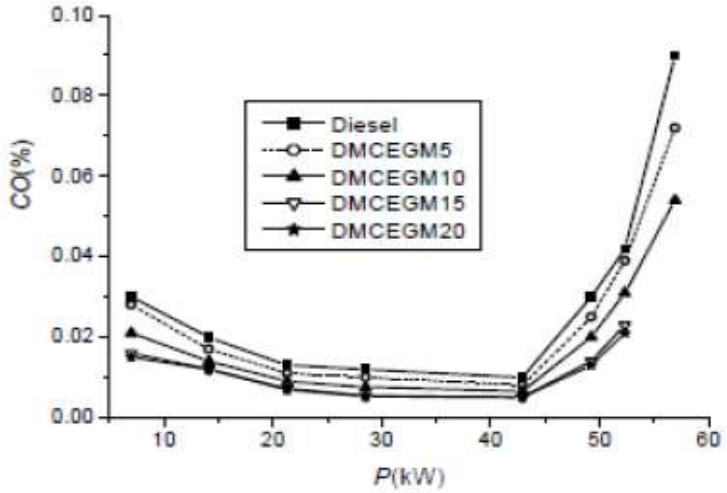

Fig 4 CO emission for various fuel [6]

NO_X EMISSION

It is found that the NOx concentration decreases with additive blended fuel.the addition of DMC and EGM in diesel has little effects on the NOx emission. At higher loads, NOx emissions for all DMC-EGM-diesel blends increase little.the presence of additive, the combustion temperature could be reduced which cause to control the NOx , Moreover the flame temperature also reduced dramatically which cause complete fuel combustion.

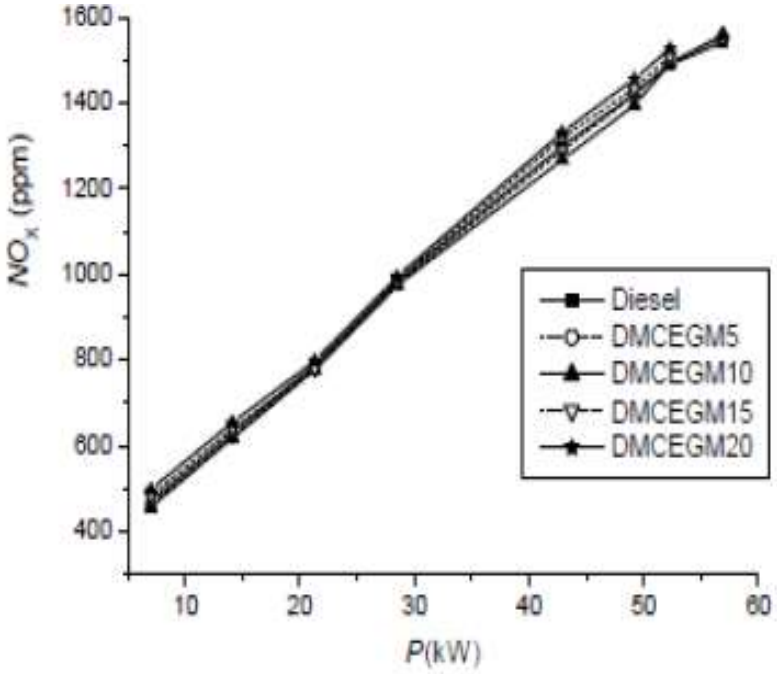

Fig5 NO_x emission for various fuel [6]

HC EMISSION

HC emissions for all the fuels. It is found that fuel B20+1% produces lower level of HC emission followed by B20+2%, B100, B20 and OD fuels respectively. The maximum level of HC was produced by OD fuel. It can be seen that additive added biodiesel fuel produces comparatively lower level of HC as compared to OD fuel. This is mainly due to complete combustion in the combustion process.

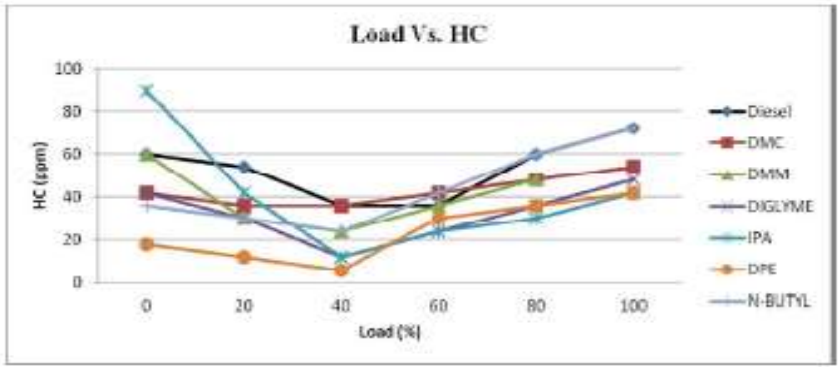

Fig6 HC emission for various fuel [11]

SOOT

The variation of soot with brake power. It can be observed that soot increases with increasing the brake power. It can be seen that 5% DMC added to diesel fuel effectively reducing the soot by 52 %

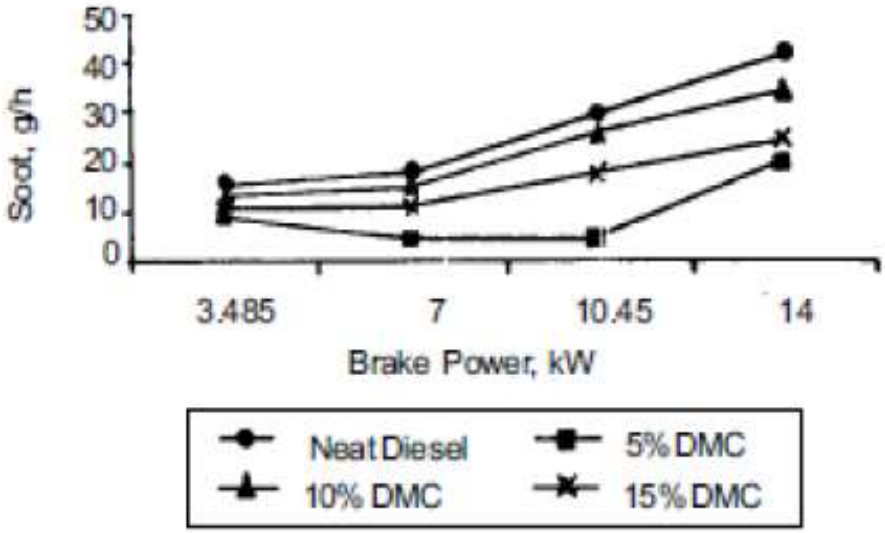

Fig-7 soot against breake power for different proportion of DMC [5]

CONCLUSION

The present review it is concluded that the oxygenated fuel additives such as DMC,DMM DEE etc. are added in diesel at appropriate proportion then it will increases the engine performance and emission characteristics in the C.I. engine .These additives also provide higher brake thermal efficiency, lower soot level scope of our work is to make economic blend which gives improved performance and emission characteristics in the C.I engine.

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