Effect of Bichamber Piston Geometry with Cerium Oxide as Additive on Sardine Biodiesel

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Abstract

High viscosity and low volatility are the major concern for the process of combustion.The combustion of biodiesel has an inbuilt draw back owing to its viscous nature and voltatile behaviour. In this work the modification of the chamber design is explored. The combustion chamber is altered with a meager level of modified design in order to enhance the efficiency of the mixture. The sardine oil methyl ester is used in this work with the addition of cerium oxide as a nano ingredient at a size of 25 ppm. The performance and emission chanracteristics is analysed in this work. A comparative study is done on sardine oil methyl ester with addition of nano particles. It is identified and both the performance and emission charactersitics is done with CI Engine. It is identified that the nano particles addition. The combustion of fuel after burning and reduction in exhaust gases emission value can be achieved by adding the nano particles.

Keywords: Combustion Chamber, Nano Particles, CI Engine.

INTRODUCTION

Generally it is a known fact that atmospheric air theaters a major partin combustion and emissions formation of a fuel. Further, sprig angle, time for injecting, inoculation pressure and spray characteristic too had a noteworthy role in combustion of engine. The most important patterns that afftecs air formation mainly are spins quish and tumble in combustion and mixing of air in diesel engine, apart from having a significant impact on combustion quality.(2). The respectable consumption design porting constitutes a motion in swirl through air in correct achievement. (3-9). The swirl squash produces a complex turbulence during finishing process of turbulence. It is a major concern in designing the combustion chamber(10). Intensification the air with turbulence leads to effective combustion but it leads to NOx emission higher with lesser HC(11). Ata high injection pressure, combustion of fuel and better air mixing are feasible(21-28). which produces lesser fuel droplets leading to faster evaporation and rapid mixing with airas reported by author (29-36).

Now a days, biodiesel plays an important role in society as a new generation fuel due to its cost economy and environment-friendly nature(37-45). The production of biodiesel reduces the dependence on oil imports and gives a great support to agricultural field (12). The biodiesel property differs from diesel owing to its low viscous and volatile behaviour in nature (46-52). These will impact the injection timing and injection pressure along with spray characteristics (53-65). During fuel injection, the cone angle decreases, leading to the poor viscosity with the increase in viscosity of biodiesel(14). In this author emphasizes that the preheating with vegetable oil enhances the performance and it can be used in diesel engine direcylt (66-78). The author concludes that the preheating of vegetable oil gives good performance than the raw oil which is used directly to the diesel engine (79-87). The outcome eludicate that the spray pattern and atomization has shoen good improvements. (15). The major studies shows that due to increase in pressure, the fuel penetration distance becomes longer and air fuel mixture has been improved (16-17). The result of increase in density ratio, injection pressure and injection timing will result in better combustion, performance. (18). The author observed that when BTE was increased, SFC with emission has been decreased in PME20. It was found that CR=19.1, IP=240 bar with 27BTDC of injection timing (19,20). In multi chambered piston, the best inoculation pressure for B-20 and B-30 blends has been observed by CFD.A 12.1 m/sec squish velocity was observed at 10 degree crank angle before TDC were observed. The current effort intends to analyse the effect of performance and emission characteristic in bi chamber pistons geometry with a nano additive on sardine oil biodiesel.The experiment has been carried at constant speed of of 1500rpm at FCR 17.5. The performance parameters such as SFC, brake thermal efficiency, carbon monoxide, NOx and UBHC have been studied.

Experiment arrangement

Various observations were observed by using electronically computerized Compression ignition asexposed in Fig. 1 and Table 1.
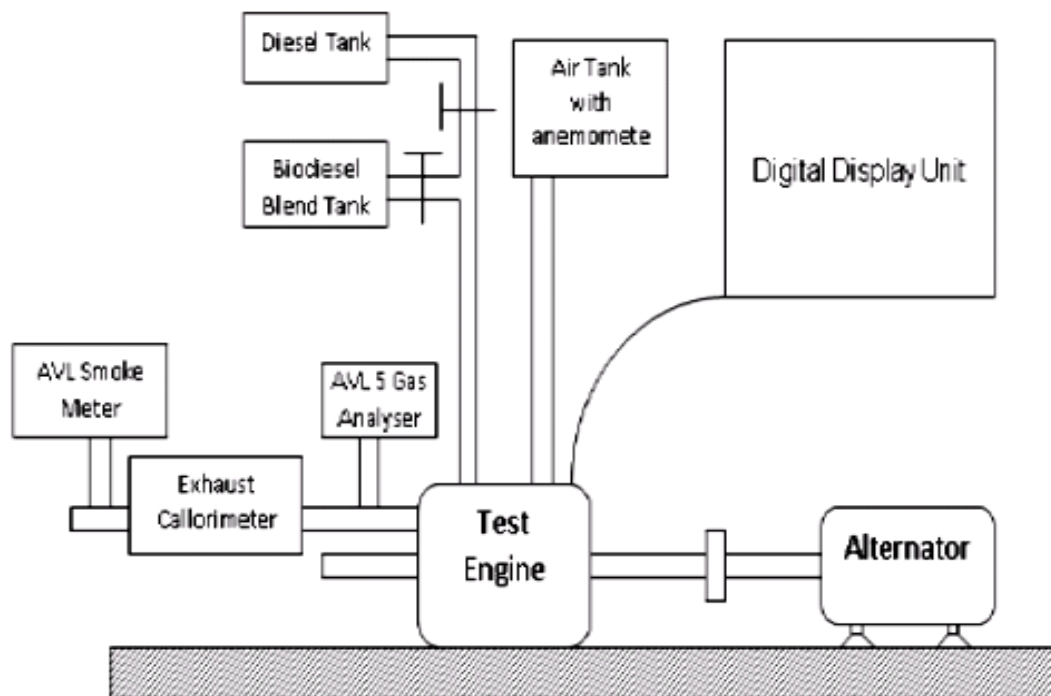

Fig. 1. Design of experimental arrangement

Table 1. Engines requirement

Makers model	Kirloskear engine.
Used Model	TAF 1
No of cylinders	3 inline
Bore and stroke	87.5X110mm
BP	4.4KW
Movement	2826cc
Type of refrigeration	Air cooled
Firing instruction	1-3-2
Rapidity	1500rpm
Compression ratio	17.5:1

A kirloskearsole cylinder four strokes, D.I with water cooled Compression Ignition engine test rig of 4.4KW, compression ratio of 17.5 was used at a speed of 1500rpm. Amalgamation of nanoparticles with SOME The nano particles are mixed with SOME fuel at the rate of 25 ppm. The fuel properties of sardine oil methyl ester with additives are shown in Table 2.

Table 2. Possessions of SOME with extracts

Properties	SOME	SOME +Ceo2
Compactness @ 15^0C in gm/cc	0.890	0.894
Kinematic viscosity@ 40^0C (mm2/s)	4.5	4.70
Calorific value(kJ/kg)	37405	45365
CetaneNumber	45	56
Flashpoint(c)	58	191
Firepoint (c)	68	185
Cloudpoint(c)	32	36

Modification on piston crown

In CI engine, turbulence plays ansignificant role in mingling and combustion of fuel. In the current work, the modification has been done from single face to double face chamber piston. During this modification a great care has been taken to obtain the compression ratio of 17.5. The double face piston consists of 2 cavities at an angle of 180 degree apart on piston land. This was done by the grinding operation in such a way that the volume of material removed and added equals the compression ratio of corresponding piston. To avoid the thermal stress over the piston head, the author has taken more effort during the design stage itself.

Experimental procedure

The comparative test was conducted for optimized piston levels with engine speeds at the degree of 1500rpm at a C.R of 17.5 for SOME and SOME with additive at 25ppm. Tests were conducted at 25 to 75 percentage loading conditions. Performance and emission characteristics such as SFC, BTE, EGT and CO, HC were observed and recorded for SOME and SOME with additive at 25ppm.

RESULTS AND DISCUSSION

BSFC

The figure depicts the disparity of S.F.C for normal and altered piston with varying loadsata compression ratio of 17.5. It is practical that at developed loads the SFC decreases for both standard and modified piston.
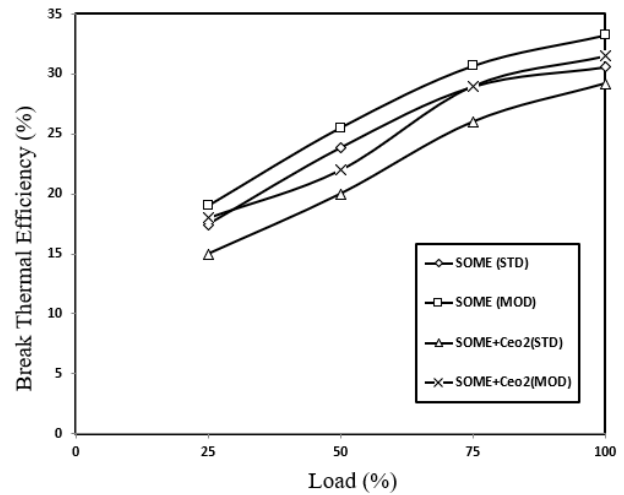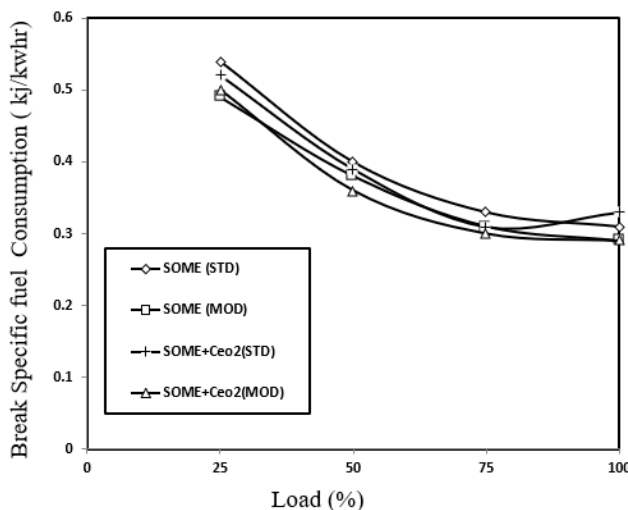
1. Break thermal efficiency

Fig. 1. Break thermalefficiency

The figure 1 shows the disparity of B.T.E for normal and customized piston with unstable loads at a CR of 17.5. It is observed that break thermal efficiency increases for SOME modified piston compared to all other fuels. In all other cases, it increases with increase in load. The brake thermal efficiency obtained for SOME(STD), SOME+Ceo2(STD) and SOME+Ceo2(MOD) was lesser than that of SOME(MOD). This low brake thermal efficiency could be attributed to an augmentation in C.F values than that of the SOME with additives.
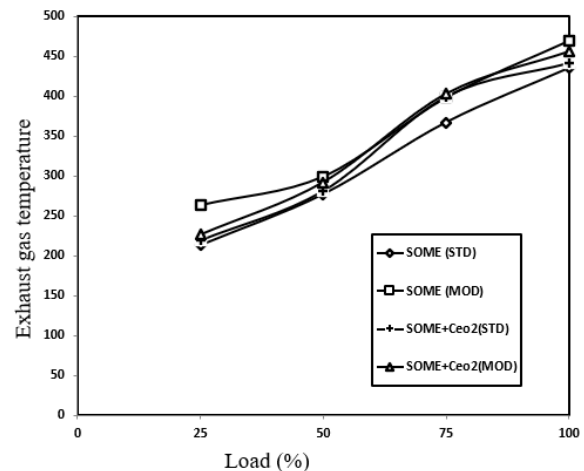
Exhaust gastemperature

Fig. 2. Exhaust gastemperature

The figure 2 Shows the Exhaust gas temperature demonstrations depicts the dissimilarity of exhaust gas temperature for standard and modified piston with varying loads at a compression ratio of 17.5. Based on various literatures it was seen that the EGT Shows increasing

trends with fuels testing at higher loads. This up surge in EGT observed for flexible loads and it was clear from the context that high quantity of fuels were needed for generating the additional power to maintain the additional loadings given. The exhaust gas temperature was found to increase with the increase in concentration of SOME+Ceo2(MOD).

Carbon Monoxide

The figure 3 shows the disparity for the CO emissions for the normal and otimised modified piston with fluctuating loads at a CR of 17.5. The CO emission molded due to the imperfect burning of fuel air-mixture in the ignitioncavity was found to reducE with the presence of the nano elementzests. It was observed from the graph. The higher CO emissions for SOME+Ceo2 (STD) may be due to the higher oxidation levels, when compared to diesel.
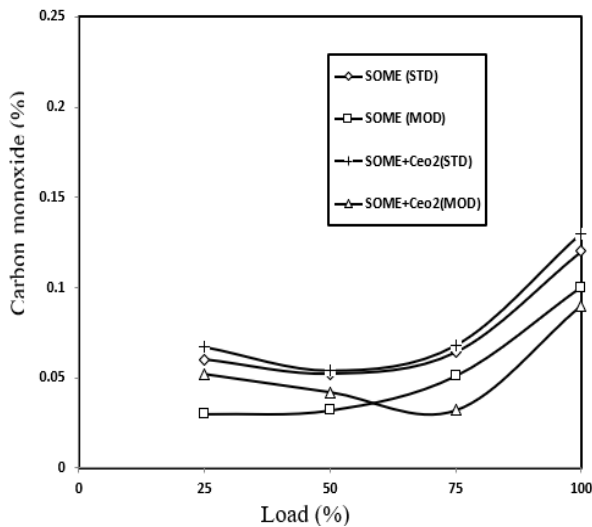

Fig. 3. Carbon Monoxide

Nitric Oxide

The disparity of nitric oxide for normal and altered piston with variable loading with a CR ratio of 17.5.It can be seen that the cumulative quantity of SOME+Ceo2(STD) was found to upsurge NO_x emanations, when compared with that of SOME(STD), SOME(MOD) and SOME+Ceo2(MOD). In general, the NO_x absorption varied linearly with the load of the engine. As the load upsurges, the overall fuel-air ratio upsurges resulting in an surge in the average gas temperature in the combustion chamber and hence NO_x formation, which is complex to temperature increase.

Hydro carbon

The figure 4 shows the disparity of HCS for standard and modified piston with varying loads at a compression ratio of 17.5. The results depicted that the augmentation in HC as the load increase. Considerable reduction in HC release

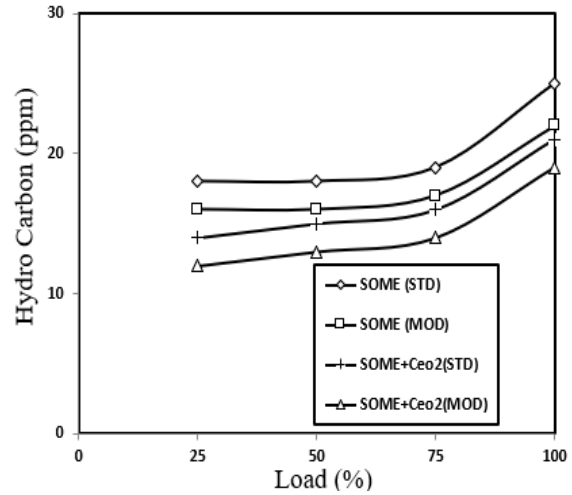were observed for SOME+Ceo2(MOD) with the SOME(STD), SOME(MOD) and SOME+Ceo2(MOD).

Fig. 4. Hydro carbon

CONCLUSION

The examination has been made in a bi chambered piston in CI engine and carried in a test rig with specifications of a 4 stroke engine with CR-17.5 to identify the performance and emission parameters and the results obtained were as follows:

In terms of performance analysis, It was experiential that B.T.E (Brake Thermal Efficiency) increases in SOME(MODI) compared to all other fuels with standard and modified piston. Based on previous works it getsincreased with increase in load. This lesser B.T.E (Brake Thermal Efficiency) attained is mainly because of augmentation in c.v(calorific value)as compared to SOME with additives.

In terms of emission analysis, it is observed that NOx for SOME+Ceo2(STD) shows an increase, while HC emission is lower for SOME+Ceo2(MODI) as compared to others.

From the above analysis, it is clearly shown that Modified piston will give better performance with lower emission when compared to all other standard piston designs.

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