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Experimental Investigation On Di Diesel Engine Operated With Rice Bran MethylEster Blends Mixed With Nanoparticles

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Abstract:
Diesel engines are well adapted by mankind because of their low fuel consumption of research has been done to improve its performance like engine modifications, alternate fuels etc. Inrecent times researchers have focused more on alternate fuels, with the depleting trend of petro diesel. Biodiesel is the one of such alternate fuel whose calorific value nearer to diesel. Most ofthe researchers concluded that with the usage of biodiesels the emissions can be reduced maintaining the consistency in efficiency, compared to diesel. In the present era of Nano technology there is the scope to improve the efficiency of engines using Nano additives in diesel.
In this work single cylinder 4 stroke DI diesel engine is selected. The performance of different blends of rice bran methyl esters for which cerium oxide (CeO_2) Nano additives of size 30-50 nm is added in different proportions in 4 stroke DI diesel engine. From the experimentalresults it is observed that for the blend B20 with 0.04 g Cerium oxide thermal efficiencies areincreased and brake specific fuel consumption is decreased. It is also observed that the emittedsmoke from the engine is also reduced.

INTRODUCTION

Since the invention of internal combustion engines the idea of using bio fuels has generated. Among the alternative fuels believed to be the solution of the energy and the environmental crisis, Biodiesel and Alcohol fuels were feasible fuels [1-3] .A lot of researches have been conducted by different scientists of the globe and of course attractive and appreciable results have come out. These two fuels can be used as pure as well as blended with the fossil origin fuel in any concentration in existing diesel engines with little or no modification [4-5]. This time the trend of Biodiesel is being practiced all over the globe. As far as the production is concerned, in most European countries the production of Biodiesel is from sunflower [6-8].

Materials' characteristics alter as they get closer to the nanoscale. Compared to how many atoms make up the majority of the material, the percentage of atoms at the surface is negligible.Nanoparticles' large surface area to volume ratio acts as a powerful driving force for diffusion. Products have been shown to gain some additional qualities from the nanoparticles. [9-11] Titanium dioxide nanoparticles provide a self-cleaning effect. The zinc oxide particles haveexcellent UV blocking capabilities. If they are small enough (usually below 10 nm) for electrical energy levels to quantize, semiconducting nanoparticles may also be referred to as quantum dots [12-14]. Semi-solid and soft nanoparticles have been manufactured. A prototype nanoparticle of semi-solid nature is the liposome.

Various types of liposome nanoparticles are currently used clinically as delivery systems for anticancer drugs and vaccines.
The amount of alumina nanoparticles (Al_2O_3) in waste chicken fat biodiesel at 25 and 50 ppm did not significantly enhance brake thermal efficiency but did significantly reduce HC and CO.However, NOx was observed. Under full load conditions, a B40 fuel blend containing 50 ppm alumina nanoparticles showed a 52.8% reduction in smoke. [15-17]
Using a constant engine speed with alumina and CNT (carbon nanotube) nanoparticles in biodiesel, The results showed that as compared to neat biodiesel fuel, the nanoparticle blended biodiesel fuel significantly improved brake thermal efficiency and very slightly decreased harmful emissions. [18-20]. The results showed that as compared to clean biodiesel fuel, nanoparticle blended biodiesel fuel significantly improved brake thermal efficiency and very slightly reduced hazardous emissions [21-22]. Cerium oxide nanoparticles are an additive used in straight diesel and blends with biodiesel and ethanol. When used as an oxygen-donating catalyst, cerium oxide either gives oxygen for the oxidation of CO or takes it away for the reduction of NOx. [23-25].

With the addition of the cerium oxide nanoparticles, it was discovered that the biodiesel's flash point, viscosity, and cerium oxide nanoparticle all improved. The inclusion of cerium oxide nanoparticles significantly lowers the amounts of hydrocarbon and NOx emissions. [21-25]

As the Cerium Oxide nano additive has the following qualities, it is selected for the present investigation

- Catalyze combustion reactions by donating oxygen atoms from its lattice structure. Participates in the decomposition of unburnt hydrocarbons and soot, reducing these pollutants emitted in the exhaust and reducing the amount of fuel used

I. EXPERIMENTATION

An ultra Sonicator shown fig 1 is used for the preparation of nano emulsion and the physical properties (table 1) and uel properties (Table 2) are tabulated.

Fig 1 Ultrasonicator

Table 1 : Physical Propreties of Crude & refined Rice bran oil

Character	Crude rice bran oil	Refined oil
Moisture	0.5-1.0%	0.1-0.15%
Density (15-15 °C)	0.913-0.920	0.913-0.920
Refractive Index	1.4672	1.4672
Iodine value	95-100	95-104
Saponification value	187	187
Unsaponifiable matter	4.5-5.5	1.8-2.5
Free fatty acids	5-15%	0.15-0.2%
oryzanol	2	1.5-1.8
Tocopherol	0.15	0.05

Table 2 : Properties of test fuel

Fuel	Flash point °C	Fire point °C	Calorific Value kJ/kg
Diesel	58	62	43320
B20+ 0.04mg CeO_2	81	84	45520
B20+0.08mg CeO_2	76	82	45400
B50+ 0.04mg CeO_2	93	96	45420
B50+0.08mg CeO_2	94	98	45360

The project is to test the engine with the diesel, rice bran derived bio-diesel influenced with cerium oxide nanoparticles. In this view an high speed diesel engine of 5 HP as rated power at 1500 rpm was used as shown in the (figure 2).

Fig 2: high speed diesel engine Experimental setup

2. RESULTS AND DISCUSSIONS

The following are the performance analysis obtained when fuelled with diesel and bio-diesel influenced with cerium oxide nano particle.

PERFORMANCE PARAMETERS

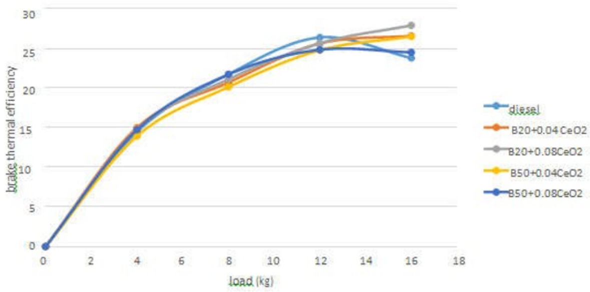

Fig 3.1 Brake thermal efficiency v/s load (kg)

The brake thermal efficiency (Figure 3.1)of the blend B20+ 0.08 CeO_2 is high at maximum load when compared with the diesel. As the load on the engine increases the efficiency also increases. All the blends used in the experiment has high brake thermal efficiency when compared with diesel. When cerium oxide of 0.04 g is used the efficiency is nearly same in the blends B20 and B50 and more than the diesel. The blend B50+0.08g CeO_2 is less when compared with the remaining blends

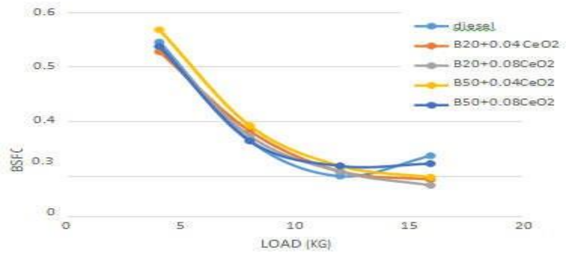

Fig 3.2. Brake specific fuel consumption v/s losd (kg)

The brake specific fuel consumption (**Fig 3.2.** decreased with increase in load. The graph reflects the trend indicates that the fuel consumption of the blends except diesel is low in which B20+0.08g CeO_2 has very low fuel consumption capacity when compared with diesel. The blend B50+0.08g CeO_2 consumes more fuel when compared with other blends.

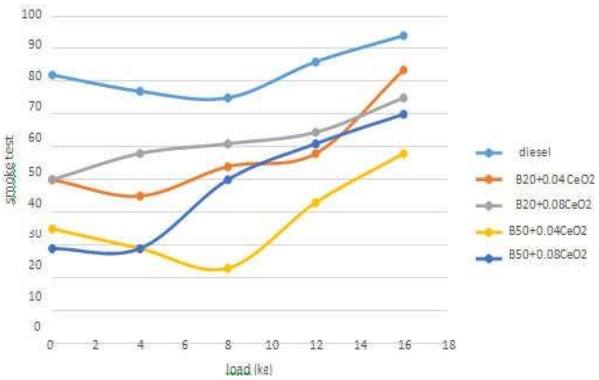

Fig 3.3: smoke test v/s load (kg)

In the smoke test (**Fig 3.3)**, smoke paper is arrange in the smoke gun when the smoke is suckedinto the gun smoke is absorbed by the smoke paper. With the help of the smoke meter the amount of smoke obsorb by the paper is noted. The smoke emitted by the diesel is high than the blended fuel. B50+ 0.04g CeO_2 has very low smoke emitted from the engine.
From the above analysis the performance of the fuel B20+ 0.08g CeO_2 at maximum load has high brake thermal efficiency and indicated thermal efficiency. The fuel consumption of this fuel is also low. Smoke emitted by this fuel is also comparatively less. As the size of the cerium oxide increases in B20 efficiency also increases. Where as in the B50 blend there is no improvement in any of the aspects and nearly equal to diesel.

Comparing the analysis of b20 and b50 with biodiesel influenced with Cerium Oxide

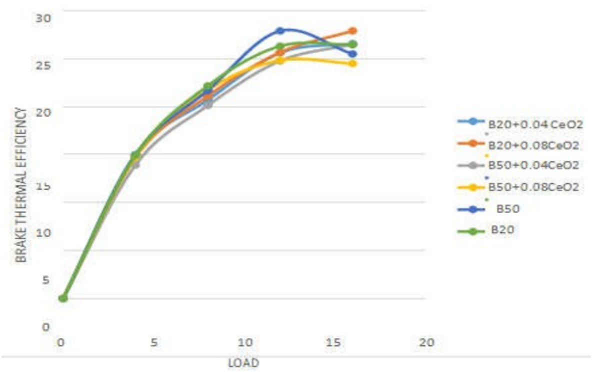

Fig 3.4 brake thermal efficiency v/s load (kg

The above fig 3.4 shows the brake thermal efficiency and indicated thermal efficiency between the biodiesel blends and biodiesel influenced with cerium oxide. The efficiencies of the cerium oxide blends is high at maximum load compared with B20 and B50. There is an increase in blends influenced with cerium oxide when compared with B20 and B50.

Comparison between temperatures of fuels with diesel

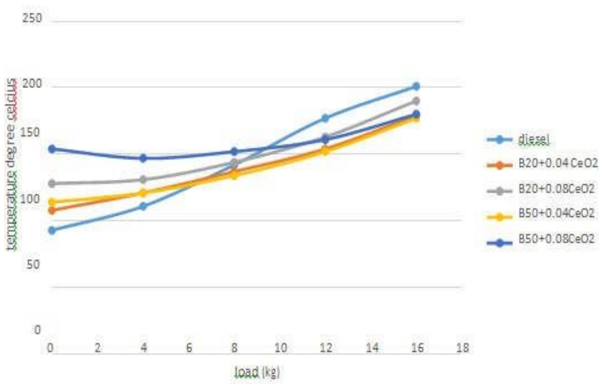

Fig 3.5 temperature v/s load (kg)

From the above graph fig 3.5 B50+0.04 CeO_2 and B20 + 0.04 CeO_2 has less temperature at maximum load when compared with the petrol diesel. When the proportions of cerium oxide increases the temperatures are also increases.

3. CONCLUSIONS

Observations from the experimental investigations on performance of rice bran methyl ester mixed with cerium oxide nano particles in the operation of 4 Stroke DI diesel engine are as given below:
In this the brake thermal efficiency, indicated thermal efficiency, brake specific fuel consumption and smoke content are the parameters used for the experimentation.

1. For B20+0.08g of CeO_2 thermal efficiency increases and brake specific fuel consumption decreases compared to petro diesel.
2. For the same fuel with increase in percentage of bio diesel brake specific fuel consumption increased, maintaining the consistency of thermal efficiency.
3. 3. At maximum load condition B20+0.04g CeO_2 and B50+0.04g CeO_2 results in approximately same brake thermal efficiency which is greater than that of diesel.
4. The smoke density of all the tested fuels is less than conventional petro diesel.
5. 0.04g of CeO_2 addition with bio diesel blends results in less smoke densities and also it isin decreasing trend with increase in percentage of bio diesel in petro diesel.

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