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RESEARCH ARTICLE

THE PERFORMANCE AND EMISSION CHARACTERISTICS OF A CI ENGINE USING THE DIESEL,BIO-DIESEL, ETHANOL AND NANODIESEL

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ABSTRACT

The research paper aims to estimate the diesel engine performance and emission characteristics by using pure diesel and biodiesel – ethanol blends with addition of cerium oxide nanoparticles. The stability of pure diesel and diesel-biodiesel-ethanol fuel are analysed with addition of cerium oxide nanoparticles. By engine performance tests, it is noted that blends with high speed in ultrasonic bath stabilization increase the stability. The experiments are conducted in single cylinder four stroke diesel engine coupled with an eddy current dynamometer variable compression ratio engine to estimate performance characteristics. The cerium oxide acts as a catalyst and reduces the emissions like CO, NOx. In this experiments using diesel and biodiesel ethanol blend with additive cerium oxide nanoparticle to progress the combustion of the fuel and reduction of the exhaust emissions.

INTRODUCTION

The energy import is considered as one of the major issue to economic as well as social developments in world. India is facing a more deficiency in lack of crude oil. In india the resource crude oils is limed the utilization of the crude oil will be more and more. The major uses of the fossil fuels are agriculture, industrial and transportation sector which will effect the environment polluted. An urgent required for find the alternative sources such as the alternative fuels arise and the increase the efficiency also reduced the environmental polluted. Now a day's use the alternative fuels, biodiesel and ethanol are considered as a most desirable fuel and fuel additive have the high oxygen content and renewable in nature. Rao *et al*. (2009) evaluated the performance and emission of single cylinder four stroke diesel engines with Jatrophabiodiesel. The diesel to biodiesel ratio as 75:25 (B25), 50:50 (B50) and 25:75 (B75) are used to analyze and compared with diesel fuel. From the final results, the blend B25 has the performance nearer to diesel fuel. Altinet *et al*. (2001) conducted experiments in single cylinder direct injection compression ignition engine with the employment of methyl radical esters of vegetable oils (sun flower, Cotton seed, soya, and corn oils) as fuels. The test results shows that the thermal potency of the engine with biodiesel blends similar and fuel consumption is increased compared to diesel.

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The emissions like CO and HC were reduced by 15% and 16% as compared to diesel fuel results. Ranganatha *et al*. (2013) has conducted experimental investigation on a four stroke compression ignition engine with Mahua biodiesel blends with diesel at various proportions (20%, 40%, hour and 80%) at a constant engine speed of 1500 rpm. These investigations reveals that the brake thermal efficiency of biodiesel blend B20 is as regards (nearer) to the diesel fuel and the thermal efficiency of diesel fuel is higher by 12% when compared with neat biodiesel (100%) at full load. The CO emissions are lower for biodiesel and its blends with diesel as compared with diesel whereas NOx emissions are over the diesel. Siva Kumar A *et al*. (2009) investigated the performance check on a diesel engine with neat diesel fuel and Cotton seed biodiesel mixtures. The engine experimental results showed that exhaust emissions like carbon monoxide (CO), particular matter (PM) and smoke emissions were reduced for all biodiesel mixtures. However, a small increase in Nitrogen oxides (NOx) emission was found for biodiesel mixtures. Sudhakar *et al*. (2001) has conducted investigations to search out the suitability of Rape seed oil in compression ignition engine. Investigations are conducted with 25%, 50% and 75% of Rape seed oil in an exceedingly mix of Rape seed oil and diesel. From the experimental results it's found that the mix with 25% of Rape seed oil is showing higher performance. Qiu *et al*. (2001) conducted the behaviour of the pure diesel and nanodiesel (combination of diesel and nano particles).determine that a concentration of nickel nanoparticles between 0.2 and 0.5 give the best anti-wear behaviour and friction reduction. V. Arul Mozhi Selvan *et al*. (2009) has conducted the performance and emission characteristics of compression ignition engine.

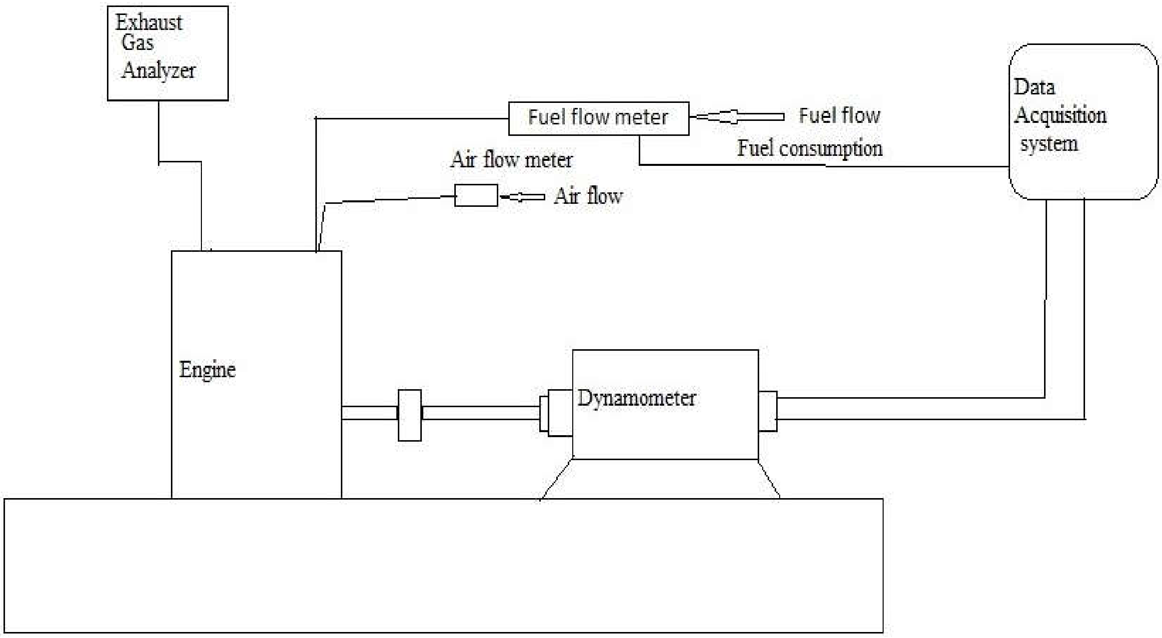

Fig. 1. Schematic diagram for experimental setup

Investigation are conducted with cerium oxide nanoparticle, ethanol, biodiesel and mix with pure diesel. Determine the mixing cerium oxide with diesel give the better result compared to pure diesel. Jung *et al*. (2005) has conducted the performance of the compression ignition engine. The influence of cerium oxide nanoparticle mix with diesel than better performance result obtained. Ozgur *et al*. (2015) used Nine different nanoparticles namely SiO_2, Al_2O_3, MgO, TiO_2, ZnO, iron oxide (Fe_2O_3), nickel iron oxide ($NiFe_2O_4$), nickel oxide (NiO), and nickel zinc iron oxide ($Zn0.5Ni0.5Fe_2O_4$) were added to diesel fuel and results are reported. Selvaganapthy *et al*. (2013) done experiments on single cylinder four strokes vertical water cooled diesel engine by using ZnO based nanodiesel.

Experimental set up

The experimental is conducted to find the phase separation phenomena of the bio-diesel ethanol blends. In this experimental use cerium oxide nanoparticles in diesel ethanol blend and pure diesel has the tendency to set down at the fuel tank. Used in the tests cerium oxide nanoparticle with the size of 32nm and ethanol (99.9%). After series of experiments, it's find that the blends subjected to high speed mixing followed by ultrasonic bath stabilization improves the state of being stable. The separation between ethanol and diesel.

The biodiesel is produced using the transesterification process. all the blends fluids for phase separtion is taken for half an hour and markiness procedure is used to assess the state of being stable of the resulting suspension. The experimental procedure and experimental facility is descused by Mozhi Selvan *et al*., (Arul Mozhi Selvan, 2009; Arul Mozhi Selvan, 2008). The engine load connected to the dynamometer. The fuel flow is measured aburette with two infra red optical sensor, air flow rate is measured to air flow sensor. The inlet and exhaust gas temperature is measured by K type thermocouples sensor the gas analyzer is used to measured the exhaust gas constituents such as Nox, CO, HC and the smoke meter is used for measure the smoke. Steady state condition recorded for all result conditions.

Table 1.Engine Specification

Brake Power	5 kW
Speed	3000 rpm
Bore	90mm
Stroke	110 mm
Ignition	Compression ignition
Cooling	Air Cooling

RESULTS AND DISCUSSION

Brake Thermal Efficiency

The Fig.2. shows the variation of brake thermal efficiency with power. The pure diesel has higher BTE compared to other fuel blends. Due to lower calorific values of diesel ethanol blends BTE decreases. The addition of cerium oxide improves the BTE of diesel ethanol blends. The highest BTE is observed as 25.90%in pure diesel where it is 23.04% for the D70+C10E20 blendat power 2 kW.

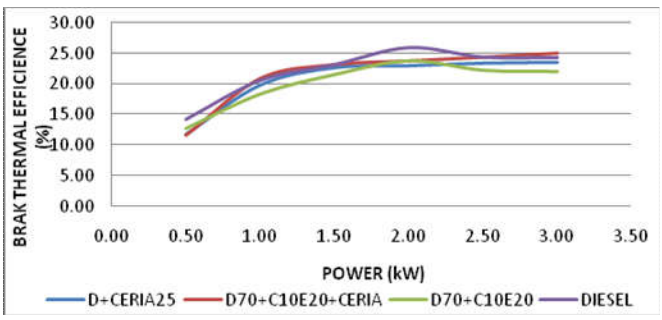

Fig. 2. Variation of Brake thermal efficiency Vs Power

Carbon Monoxide Emission

The Figure.3.Shows the variation of carbon monoxide emission with power. The CO emission is reducing use of the blend fuels compared to the pure diesel fuel. The presence of oxygen molecules in the castor oil decreases the CO emissions. The higher carbon monoxide is observed as 0.28%

in pure diesel where it is 0.20% for the D70+C10E20 blender under the same power 2kW. The use of blended fuels carbon monoxide is low compared to the pure diesel.

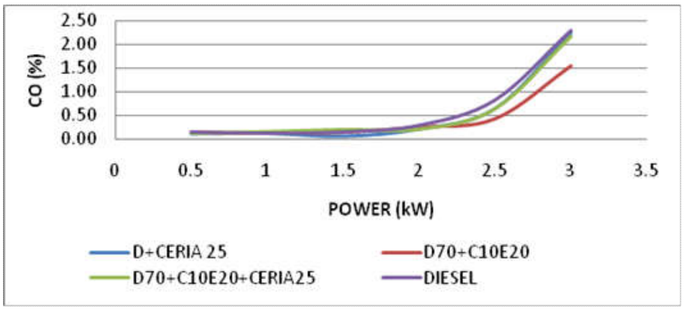

Fig. 3. Variation of Carbon Monoxide Vs Power

Hydrocarbon emission

The Figure 4 shows the variation of hydrocarbon emission with power. The emissions are decreases with the addition of cerium oxide compared to the pure diesel and diesel-biodiesel-ethanol blends. Presence of oxygen molecules leads to the complete combustion. The HC emission of pure diesel is 205.21ppm at maximum power. The hydrocarbon emission of D70+C10E20 blende fuel is 198.8 ppm at the power of 2kW.

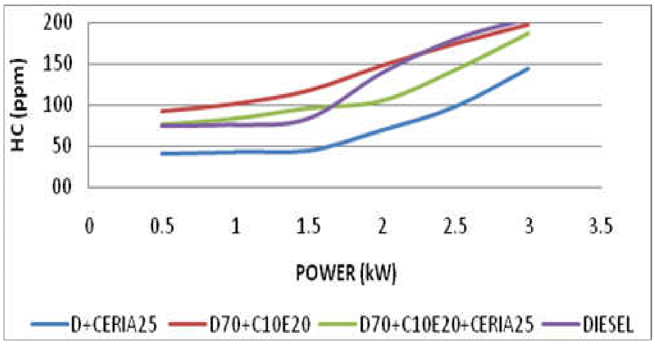

Fig. 4. Variation of Hydro carbon Vs Power

Nitrogen oxide emission

The Figure 5 shows the variation of NO_x emission with power. The NO_x emission of all blended fuels is higher compared to pure diesel fuel. The TheNO_x emission mainly depends upon in-cylinder temperature. Due to presence of oxygen molecules causes complete combustion. So, the temperature of the process increases. The effect of enhances combustion fuel causes to produce higher exhaust gas temperature and therefore increase in NO_x emission. The presence of oxygen molecule in biodiesel is also one of the reason to increase the NO_x emission.

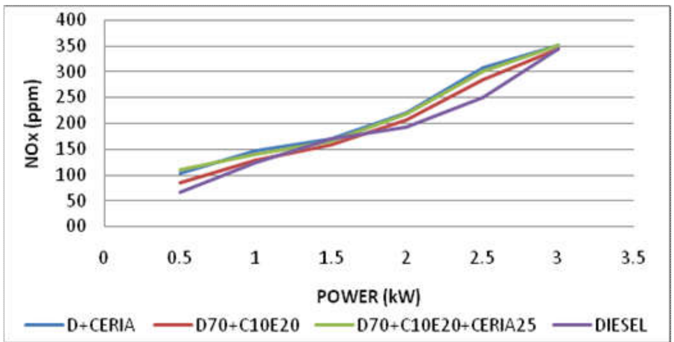

Fig. 5. Variation of Nitrogen Oxide Vs Power

Brake specific Fuel Consumption

The Figure 6 shows the variation of brake specific fuel consumption with power. The specific fuel consumption is low for the all blends than pure diesel at the all power. This is due to the higher calorific value of the pure diesel than the diesel ethanol blend. The higher specific fuel consumption is observed as 0.37712 kg/kW-hr for the pure diesel whereas it is 0.35182 kg/kW-hr for the D+CERIA 25 blend at the of 2 kW. This phenomenon is due to the observed of cerium oxide addition is promotes combustion.

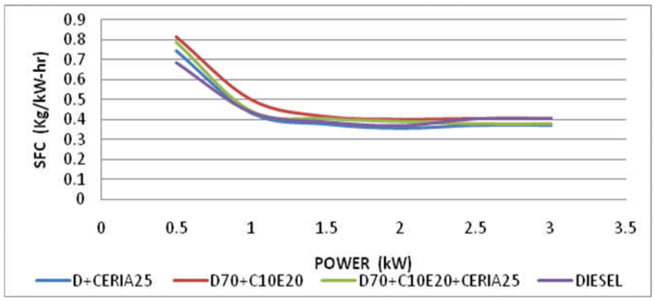

Fig. 6. Variation of specific fuel consumption Vs Power

Conclusion

- The specific fuel consumption is lower for the diesel than the diesel-biodiesel-ethanol blends at all the powers.
- The brake thermal efficiency of the diesel biodiesel-ethanol blends is low than pure diesel at the all powers and a low improvement is observed with the mixing of cerium oxide with diesel ethanol blends.
- The uses of cerium oxide nanoparticles in diesel biodiesel ethanol blends with the carbon monoxide decreases compared the pure diesel. Hydrocarbon emission is also reduced the use of cerium oxide nanoparticles.

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