Experimental investigation on performance and emissions characteristics of direct injection diesel engine using alternative fuel blends and Al_2O_3nano particle additive

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***Abstract*—Alternative fuel blends and nano particles are improving the performance and diminish the emissions. In this experiment ethanol used as alternative fuel. This experiment investigated on four stroke single cylinder direct injection diesel engine using three different proportions of alternative blends and alumina nano particle additives. These three different proportions are 20%, 40% and 50% ethanol mixed with diesel by using magnetic stirrer and to estimate the performance, combustion and emissions. And also adding with 30nm sized alumina nano particles (each proportions 50 ppm quantity) are mixed with diesel-ethanol blends and also find out the combustion, performance and emissions. Final results are observed that the brake thermal efficiency of the given engine increases with increasing load for diesel and bio fuel blends withnano particle additives and fuel consumption decreases with increasing the loads.**

***IndexTerms*—Four stroke single cylinder diesel engine, ethanol, diesel and nano particles**

1. Introduction

Present day's mainimportant problem is reducing the fuel consumption and pollution control. Search for alternative fuels. So bio-fuels are one of the best available sources to fulfill the energy requirement of the world. Bio-fuels are used in energy fuel consumption reduces and lesser emissions provided. If bio-fuel uses in combustion process then engine energy output will be increases. Alternative fuels or bio-fuels used in diesel engines as blend with diesel so fuel consumption decrease. In this experiment ethanol is aalternative fuel blend with diesel as different proportions like 20%, 40% and 50% respectively. Alumina nano particle additive is also used in this work. These fuels used in four stroke single cylinder direct injection diesel engine and to estimate the performance and emissions.

There is a lot of research going on this area, a few of them discussed as below. PallaviGhogare and N.W Khale (2016) Experimental investigation on single cylinder diesel engine fuelled with cotton seed biodiesel blends with nano additives. They propsed the biodiesel was prepared by using cotton seed oil through trans esterification method. Aluminum oxide nano particles are also nano additives. Final results are observed that the BSFC decreases with increase in brake power diesel, biodiesel blends and with nano additives.

Nithin Samuel and Muhammedshefeek (2013) found that the performance and emission characteristics of a C.I engine. In this used cerium oxide as a nano additive. Find results showed that the performance of engine increases with the addition of CeO_2nano particle to find the fuel. Specific fuel consumption was 0.5 Kg/Kw hr decrease for biodiesel.V. Arul MozhiSelvan et al (2009) in this experiment stability of pure diesel and biodiesel blends with ethanol fuel with the addition of CeO_2nano particles are analysed. The final results observed in this work to estimate the performance and characteristic emissions of biodiesel and pure diesel. Bio diesel ethanol blends increase the ignition delay whereas the CeO_2nano fluid ignition delay decreases. Co emissions decrease with the use of CeO_2 nanoparticles in diesel-biodiesel-ethanol blends and pure diesel.A.Selvaganapthy et al (2013), in this study the effects of various nano particles with diesel on direct injection diesel engine. An investigation of this experiment is to analyze the possible effects of adding nano particles with diesel. Znonano particles have been used in this work. Final results were observed that the brake thermal efficiency and No_x emissions are increases.C. Syed Aalam et al (2015), in these experiments were conducted to estimate the exhaust emissions and performance of single cylinder common rail direct injection system. ZJME25 used in diesel engine. AONP25 and AONP50 nano particles are nano additives. Final conclusions of this experimental works are the fullload, the result of HC and smoke emission for the ZJME25 before the addition of Al_2O_3 was 13.459 g/kW h and 79 HSU, whereas it was 8.599 g/kW h and 49 HSU for the AONP 50 blended ZJME25 fuel respectively.S.P. Venkatesan (2015), in this work to determine the combustion, performance and exhaust emissions of diesel engine using n-Al_2O_3nano particle additives. The sizes of these particles are 40nm are used in this work. These additives are tested in different load conditions on DI diesel engine. Final results revealed that the brake thermal efficiency increases and No_x emissions decreases as follows.

2. Proposed work

This work proposes an experimental investigation on the performance emission and combustion characteristics of DI-diesel engine using alternative fuel blends and alumina nano particle additives. The sequence of steps involved in this work shown in flow chart fig.1.

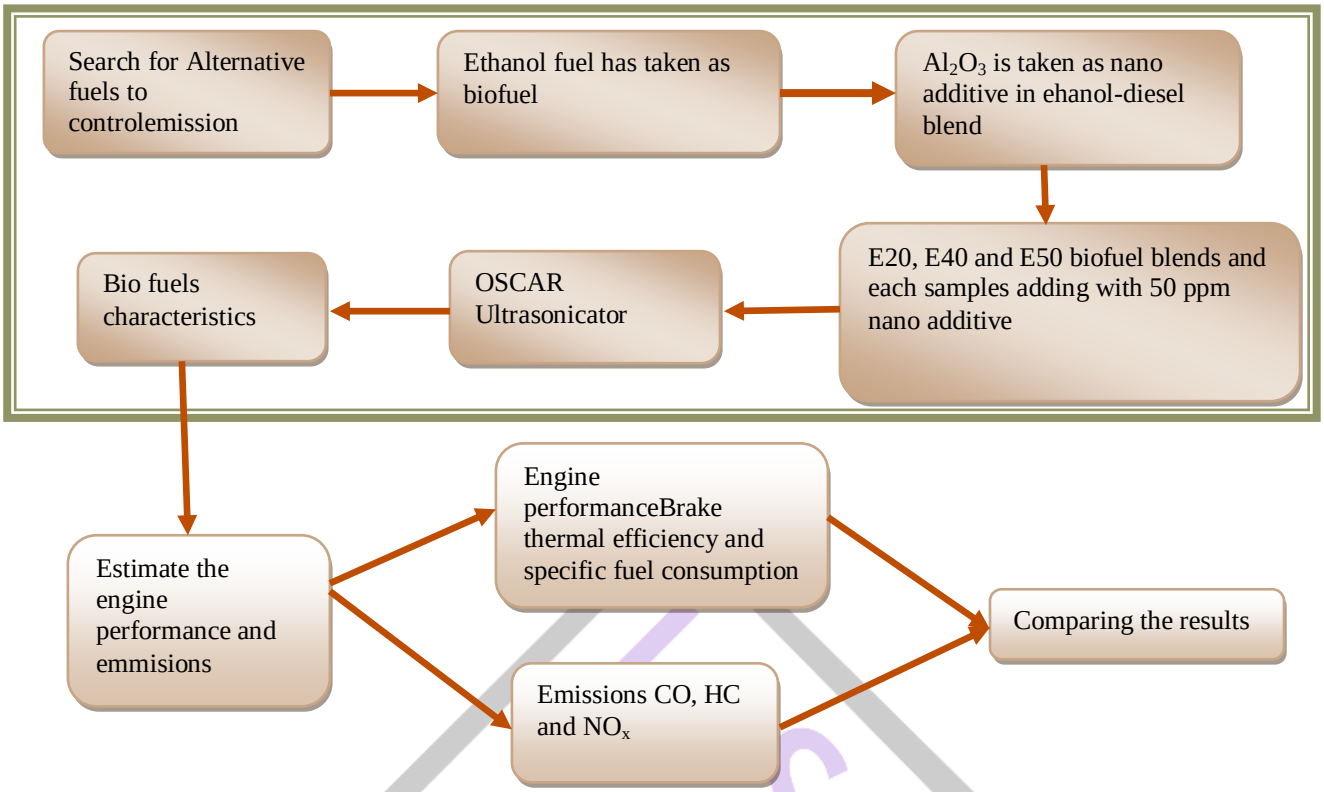

Fig.1. Flow chart for proposed work

3.Preparation methods for bio-fuel blends and nano fluid

3.1. Preparation for bio-fuel blends

This experiment biodiesel is taken as ethanol. Ethanol bio-fuel is utilized to prepare the blends and is used in three different proportions on the work. The following are the fuel samples, Diesel, E20 (20 percentage biodiesel and 80 percentage diesel in 1 liter volume), E40 (40 percentage biodiesel and 60 percentage diesel in 1 liter volume) and E50 (50 percentage biodiesel and 50 percentage diesel in 1 liter volume) respectively. Given percentages of bio-fuel or ethanol mixed with specified percentage of pure diesel by using magnetic stirrer. 50 ml of n-butanol chemicals are also adding with each sample by using stirring operation. All the fuel blends are shown in fig.2 and fig.3.

Fig.2. Magnetic Stirrer**Fig.3.** Samples of biofuel blends E20, E40, E50

3.2. Preparation of Nano fluid

Different proportions of biodiesel blends are prepared by using magnetic stirrer. Each sample prepared on stirrer time taken as 20 minutes. After that each samples are added with 50 ppm nano particles by using OSCAR Ultra sonic sonicator shown in fig.5. This sonicator processing capacity is used upto 1 liter.

Fig.4. Gas Analyser

Fig.5.OSCAR Ultra sonicator

The following fuels calorific values are observed below table

Table.1. Calorific values for diesel- biodiesel- nano additives

Fuel samples	**Calorific value (kj/kg)**
Diesel	44820
E20	42250
E40	39875
E50	39406
E20+50ppm nano particles	43230
E40+50ppm Nano particles	41310
E50+50ppm Nano particles	39630

4. Experimental setup

First check the engine condition along with lubricating oil and fuel is supplied to the engine. Start the engine is run initially for 15 minutes to pick up the rated speed shown in fig.6. In this work conducted at different loads. The different loads are 0kg, 2kg, 4kg, 8kg and 12kg respectively. In this diesel applied to the four stroke single cylinder diesel engine and to observe the emissions and performance. Similarly bio-fuel blends and nano particle additives are applied to the engine at different proportions and also estimate the performance and emissions of the specific engine.

Fig.6. Four stroke single cylinder direct injection diesel engine

5. Results and Discussions

5.1. Performance test

5.1.1. Brake thermal efficiency (BTE)

The variation of brake thermal efficiencies of pure diesel, E20, E40, E50, E20+50ppm, E40+50ppm and E50+50ppm are shown in above relation with load and brake thermal efficiency shown in fig.7. In this observed that E40 blend offers comparatively higher brake thermal efficiency than the other biodiesel blends.

5.1.2. Specific fuel consumption (SFC)

Fig.8. shows the relationship of specific fuel consumption and different loads of different proportions. It is observed that lower fuel energy consumption is 0.36 kg/kw-hr for pure diesel in 12 kg load and higher fuel energy consumption is 1.22 kg/kw-hr for E50 biodiesel blend with the other proportions.

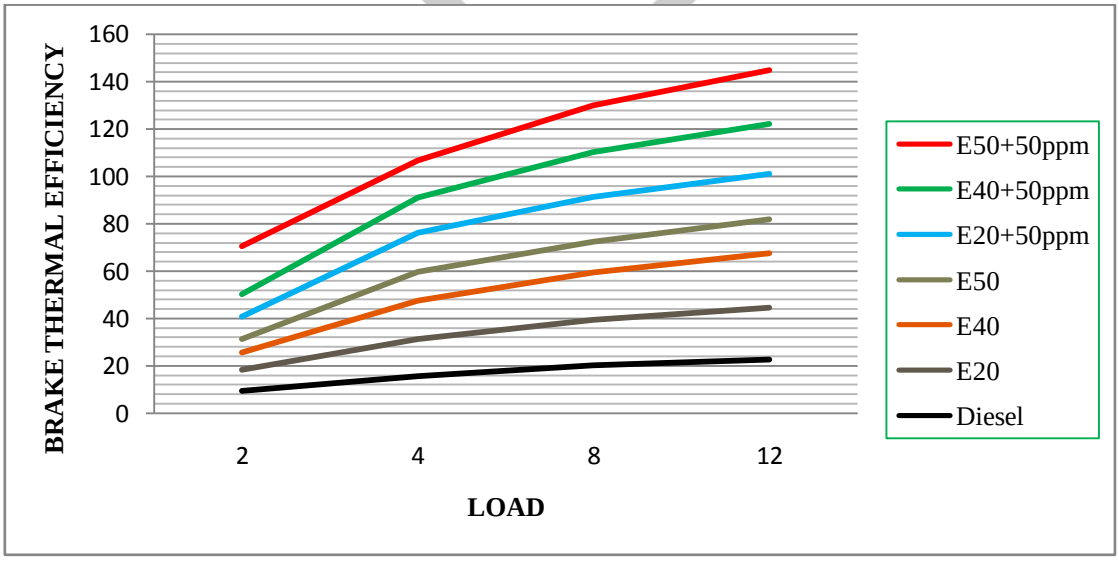

Fig.7. Load vs Brake thermal efficiency

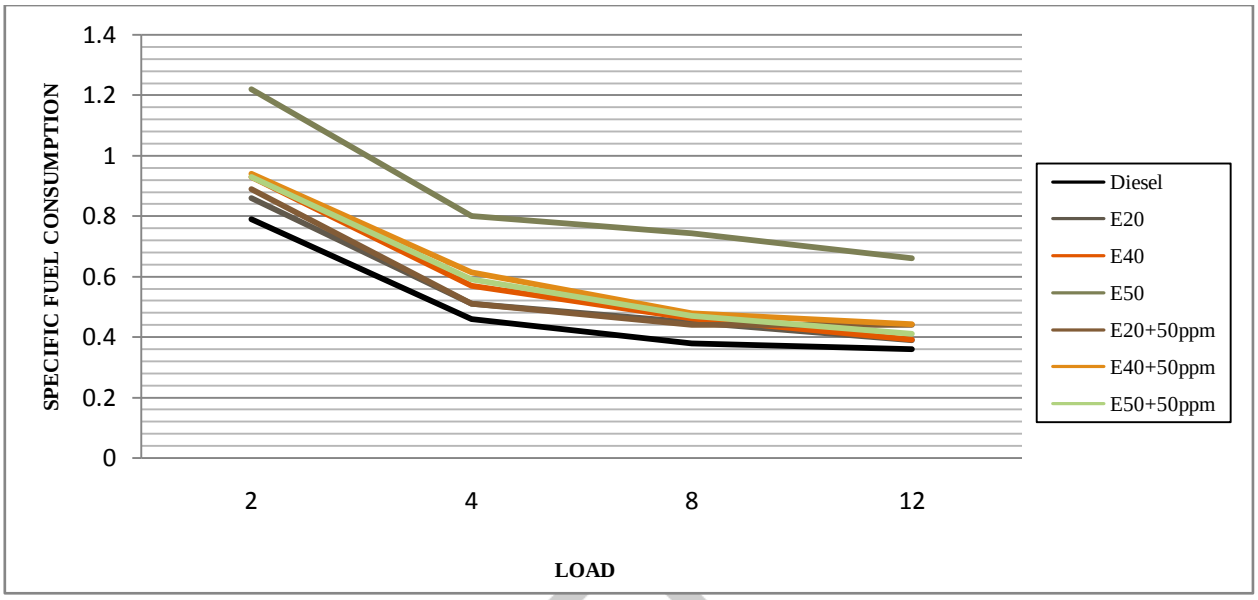

Fig.8. Load vs Specific fuel consumption

5.2. Exhaust emissions

5.2.1. NO_X Emission

Fig.9. shows the variation of diesel and biodiesel with nano additives are applied on the four stroke single cylinder direct ignition engine emissions are observed. The nitrogen oxide emission will increase with increase in load on the four stroke engine for each pure diesel and ethanol-diesel blends with nano additives.

5.2.2. CO Emission

Fig.10. shows CO emissions are drawn the relation between different loads for various diesel and biodiesel blends with alumina nano additives. CO emissions are lesser values for ethanol-diesel and with alumina nano additives as compared with pure diesel.

5.2.3. HC Emission

Fig.11. shows the relationship with load and hydrocarbon emissions with various diesel and different proportions. For determining the emission parameter depends on the HC parameter. In this shows the HC emissions are decreased as compared to pure diesel and other fuels.

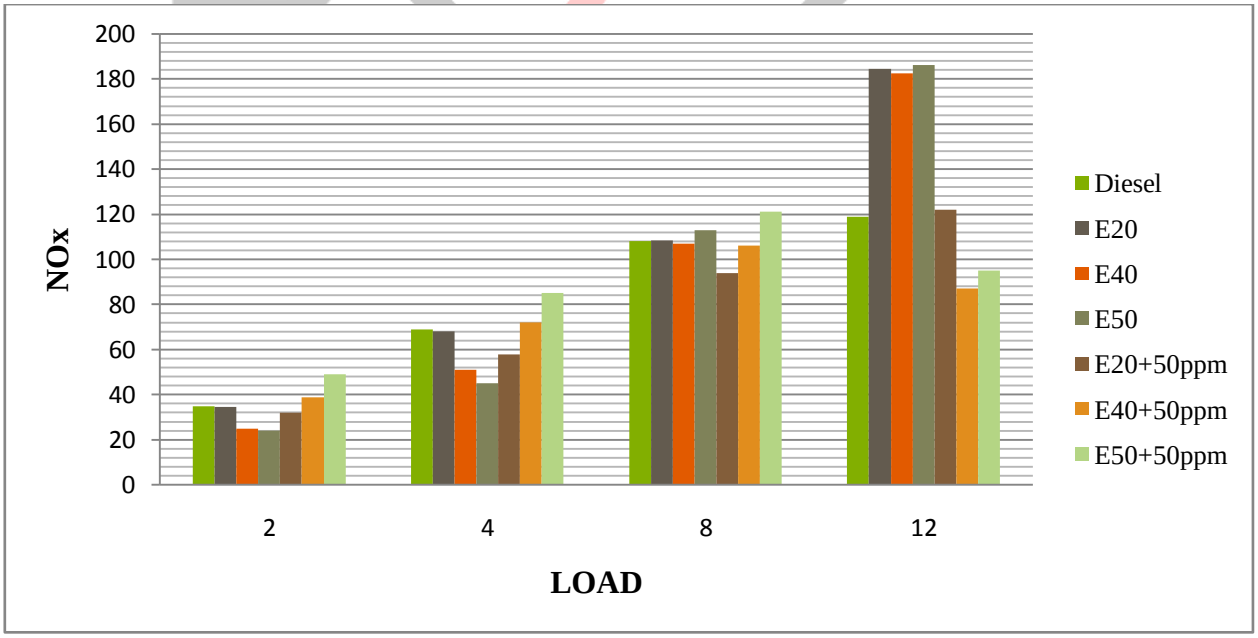

Fig.9. Load vsNO_x emission

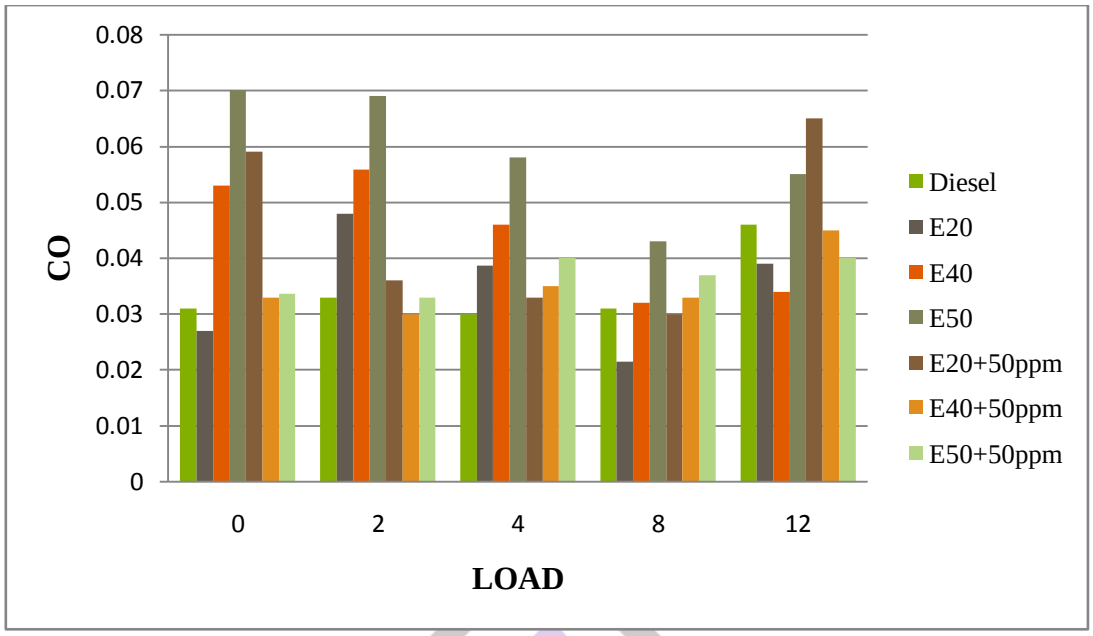

Fig.10. Load vs CO emission

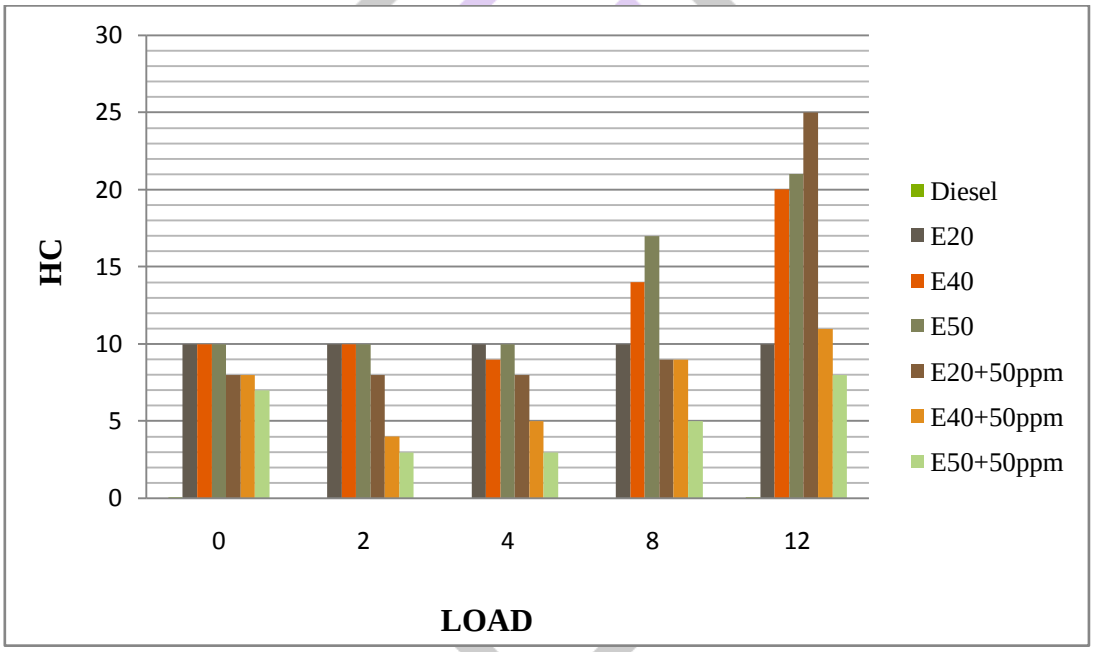

Fig.11. Load vs HC emission

6. Conclusion

The proposed work investigated in a single cylinder, constant speed direct injection diesel engine due to calculating emissions, performance and combustion characteristics of alumina nano particles dispersed test fuels. Based on this experiment the following observations were drawn.

1. Increases the different loads for diesel and ethanol-diesel blends with alumina nano particle additives then the increases the brake thermal efficiency.
2. Bio fuel blends with nano particle additives and fuel consumption decreases with increasing the loads.If increases the loads for working fuels then air fuel ratio of the engine will decreases.
3. CO and HC emissions are less at lower loads for different proportions compared to diesel fuel.
4. NO_x emissions of the fuel blends are higher with increase of load compared with diesel fuel emission.

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