A REVIEW FOR EFFECTS OF CERIUM OXIDE ON THE PERFORMANCE AND EMISSION CHARACTERISTIC OF VARIABLE COMPRESSION RATIO IGNITION ENGINE USING EMULSION

SHARVAN KUMAR, RESEARCH SCHOLAR
IK GUJRAL PUNJAB TECHNICAL UNIVERSITY,PUNJAB,INDIA

PANKAJ SHARMA, ASSISTANT PROFESSOR
IK GUJRAL PUNJAB TECHNICAL UNIVERSITY,PUNJAB,INDIA

AJAY KUMAR, ASSISTANT PROFESSOR
AMBALA COLLEGE OF APPLIED RESEARCH, AMBALA,HARYANA,INDIA

ABSTRACT

The limited fossil fuel resources along with the need to reduce emissions are major impulse to the development of alternative fuel. The heavy vehicular density in big cities and different operating conditions of CI engine are the alarming problem of emissions. In recent research biodiesel has been developed as an alternative fuel for CI engine. Emulsion have shown slightly lower performance and reduction in SOx, CO, HC and CO_2 as compare to diesel. But formation of NOx with Emulsion fuel was observed higher. After the advent of nanotechnology nanofuels prepared with nanoparticles has become interesting field of research topic around the world. Nanofuels have shown better improvement in combustion, performance and emission characteristics of CI engine. In this present work, nanofuels were prepared by adding the cerium oxide nanoparticles to the Emulsion. Nanofuels were prepared with high speed ultrasonication and mechanical agitation process to increase the stability.

The experiments were conducted on variable compression ignition single cylinder four stroke diesel engine at constant 1500 RPM to evaluate the influence of cerium oxide nanoparticles. The load and compression ratio was varied from 0 to 6 kg and 14 to 18 on the engine. Experiments were performed using neat diesel and Emulsion E15. The BP, BSFC, BTE, EGT, CO, NOx and HC parameters were compared to pure diesel. Results concluded that cerium oxide blended Emulsion E15 considerably improve the performance parameters and decline the harmful emissions especially NOx.

Keywords: *Nanoparticles,BSFC,CO,HC,NOx*

Introduction

Diesel engine plays a significant role in the generation of power, transportation, and industrial activities. The advantage of the combustion ignition engine over the spark ignition engine embraces its reliability, reduced fuel consumption as well as lower emission of monoxide and unburned hydrocarbons. Because of higher efficiency, diesel engines are of high interest in lightweight duty vehicles. India stands 6th within the world of

overwhelming oil countries with an oil usage of 2,438,000 barrels per day, and its pollution's harmful effects appeared a few years ago [3].

Pollution Conservation research analysis Association stated that the transport sector exclusively ingests over one half of the total oil consumption within the country [3]. The transport sector contributes to environmental pollution mostly and out of those waste matter CO is prime waste matter followed by hydrocarbons emission. In India, the transport sector emanates an approximate 261 tones of carbon dioxide, of that 94.5% is subscribe by road transport. The transport sector is responsible for 60% staging of green house gases [2].

Air pollution isn't solely thought of a nuisance, however additionally a threat to human health. A person on the average breathes 22,000 times, and he took 35lbs of air daily [4]. Health impacts of poor air quality range from irritation of eyes to some significant health problem like impaired respiratory organ operate, weakened resistance to infection, accrued incidence and severity of lung cancer, congenital disabilities and premature death chiefly because of metabolic process and cardiovascular disease [1,2].

Conventional fuels are found rather inadequate in rising emission characteristics that is the initiative would like of preventive emission regulation. Nanofluids could decrease the emission parameter and can improve combustion efficiency by increasing the ignition delay and fuel properties. Nanofluids had the potential because of the next-generation fuel for lowering emission and combustion efficiency improvement. Though nanofluids have displayed tremendously exciting potential applications, some crucial hinders additionally exist before the commercialization of nanofluids.

Literature Review

In the course of "Alternative fuels for CI engines," many journals as well as books were referred which has been reviewed in under mentioned pargraphs:

Ajin et al. [5] had conducted an associate degree experiment to analyze the catalytic activity of cerium oxide, particularly in nanosized type. Cerium oxide nanoparticles were prepared by chemical technique and added diesel to get a stable suspension. The performance tests were conducted on a naturally aspirated four strokes single cylinder water cooled compression ignition engine, operative at rated speed 1500 revolutions per minute. The surfactant agent used was a dodecenyl succinic anhydride that has HLB value 1.34. The concentration of cerium oxide nanoparticle sample in diesel was 5, 15, and 35PPM. It had been noticed that viscosity, flash, and fire point would increase with the addition of nanoparticle. The load tests were conducted by varied the dosing level of cerium oxide nanoparticle in diesel that shows that HC emission was reduced on the addition of catalytic nanoparticle by concerning 40 to 45%, particularly at higher load. The NOx was found to be reduced by a most of 30%, on the addition of cerium oxide nanoparticle in diesel, particularly at higher load and additional reduction up to 50% with the addition of 5% volume fraction of surfactant treated nanoparticle.

Sajith et al. [6], evaluated the influence of dose level of cerium oxide nanoparticle in biodiesel. To get the performance and emission characteristics, performance test was disbursed on single cylinder water cooled direct injection ICE, operative at 1500 revolutions per minute. The scale of nanoparticle 10 to 20 nm, and the density of 7.13g/mL was used. The dosing level in base fuel was 20PPM, 40PPM, and 80PPM respectively. All the results were drawn against the load on the test engine. An increasing trend was ascertained within the properties of fuel like viscosity and volatility with the addition of nanoparticle. The results showed that a median reduction of 25% to 46% within the HC emission was obtained for the additive dosing level starting from 40 to 80 PPM of the additive. The NOx emission was found to be usually reduced on the addition of cerium oxide nanoparticle to biodiesel wherever an average reduction of around 30%was found to occur with dosing level of 80 PPM nanoparticle. The reduction influence of the fuel additive on CO emission wasn't as distinguished.

Scarpet [7], reviewed the diesel-water emulsion fuel to reduce IC Engine emissions. The diesel-water emulsion fuel was contained water within the range of 5–15% and diesel oil with specific surfactants, to maintain the system. The results exhibited that NOx was reduced from the reduction of local high temperature because of vaporised water throughout combustion. The reduction of local high-temperature causes the decrease of reaction rate that includes a possibility of affording a mixture time for better combustion for reducing Particulate Matter. Smoke emissions tended to reduce because the emulsion magnitude relation will increase because of the lower peak temperature in the cylinder. The study showed that engine power was reduced with water content, because of lower calorific value of emulsion fuel compared to pure diesel oil. The development of micro-explosion, thought-about because the second atomization that improved fuel combustion and reduces fuel consumption. The heterogeneous results concerning the utilization of diesel-water emulsion as fuel for diesel engines advised that

experimental work to optimize the emulsion formulation in terms of water content and internal structure is suggested.

Mozhi et al. [8], had investigated the performance and emission characteristics of compression ignition engine using clean diesel and diesel-biodiesel-ethanol blends with cerium oxide as additive. Cerium oxide nanoparticle size was 32 nm, and a concentration of 25 PPM was employed in the test. The nanoparticle was spread in neat diesel and produced diesel-biodiesel-ethanol Blends. The turbidity procedure was accustomed to assess the stability of the resulting suspension. The performance test was carried on single cylinder four stroke injection variable compression magnitude relation water cooled engine at the compression ratio of nineteen. All the results were drawn against brake mean effective pressure (BMEP). The lower SFC was ascertained for cerium oxide mix of neat diesel. The addition of cerium oxide shows more reduction in the CO, HC emission compared with neat diesel. The NO emission was lower for the neat diesel scrutiny to all or any the fuel blends. The smallest amount smoke absorption coefficient was ascertained as 1.273 for the cerium oxide mixed diesel-biodiesel-ethanol blends at the BMEP 0.44MPa.

Mozhi et al. [9], had investigated the performance, combustion and emission characteristics of a variable compression ratio engine using cerium oxide nanoparticles and carbon nanotubes as fuel-borne nanoparticles additives in diesterol (diesel–biodiesel–ethanol) blends. Stability studies were observed using cerium oxide nanoparticles and carbon nanotubes. The concentration of each was used 25, 50, 100 ppm within the diesterol blends. Blends were subjected to high-speed mechanical agitation followed by ultrasonic bath stabilization. The performance, combustion, and emission characteristics were observed at a compression ratio of 19:1. The result showed that the addition of an cerium oxide and CNT in the diesterol mix, the cylinder gas pressure was found to extend once scrutiny with the neat diesterol blends. The carbon nanotubes was a catalyst to accelerate the burning rate that resulted in reduced ignition delay and cause for the lower heat release and advancement of the peak heat release rate. The cerium oxide compound nanoparticles were with oxygen donating catalyst that provides oxygen for the oxidization of CO and absorbs oxygen for the reduction of Nitrogen oxides. The energy of activation of cerium oxide was to burn off carbon deposits and helps to stop the deposition of non-polar compounds on the cylinder wall resulted in a considerable reduction of an hydrocarbon and smoke emissions.

Singh et al. [10], had experimented with single cylinder direct injection IC Engine operating between1500-2700 revolutions per minute to gauge the performance and emission characteristics of emulsified diesel oil of 0, 5, 10, 15 and 20 water/diesel ratios by volume. The Span 80 within the range of 1% value-added to all emulsion blends and it had been stirred by mixture machine at 1500-18000 revolutions per minute for several minutes. All the graphs were drawn against the speed. The results have shown that the 20%water contents emulsion given highest brake specific fuel consumption among all blends however emulsion followed .it was seen that emulsion with 20% showed highest brake thermal efficiency. The emulsion with 20% water content establishes lowest exhaust gas temperature. The emulsion with 20% water content found to lowest CO and CO2. It had been ascertained that the reduction of HC emission within the range of 60-93% happens because of the utilization of emulsion fuel. Emulsion fuel shown lessens smoke opacity. Much more water contents created more significant variations in NOx emission among the entire emulsions.

Yang. et.al [11], evaluated the performance moreover emission of the fuel in an exceedingly IC Engine with standard common rail fuel system and compared with pure diesel. Water concentration employed in emulsion oil was 10% and 15% respectively. Glycerine was used as an additive for emulsion oil by mass 11.5% and 10% respectively. In contrast to different emulsion fuels, it had been transparent with superior stability. The performance of all the fuels compared at a different speed and dealing load. It had been ascertained; torque decreases with the rise of water content. An improved brake thermal efficiency was determined for the emulsion fuel. Emulsion fuel was found to reduce the combustion period. Particularly for E15, the brake thermal potency of the engine was considerably improved by 14.2% compared to pure diesel and NOx was additionally reduced by 30.6% .

CONCLUSION AND FUTURE SCOPE

CONCLUSION

Present study focus on the influence of cerium oxide dose level on water-diesel emulsion fuels performance and emission characteristics when charged in compression ignition engine.

Based on the results of present work, following conclusion can be drawn:

Engine Performance:

Nearly 1% improvement was observed in brake thermal efficiency for E15 and it was further found to improve up to 2% by varying dose level in range of 40 to 80 ppm as compared to base line fuel diesel.

The minimum specific fuel consumption was observed for diesel, E15 were 0.242 Kg/kW-hr and 0.260 Kg/kW-hr respectively.

Emission Parameters:

The magnitude of NOx emission for diesel, E15 observed were 1126 ppm, 917 ppmrespectively. The magnitude of NOx emission was very low in case of cerium oxide nanoparticle blended emulsion as compared to diesel

The unburned hydrocarbon and smoke opacity was found to lower in case of cerium oxide nanoparticle blended emulsion as compared to diesel

There was marginal improvement in reduction of carbon monoxide emission for cerium oxide nanoparticle blended emulsion as compared to neat diesel

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