Influence of Metal Oxide Additives on Cotton Seed Biodiesel Fueled In CI Diesel Engine

A. Pakiya pradeep, S. Gowthaman

Abstract ***-Biodiesel is a standout amongst the most encouraging sustainable, elective and ecologically well disposed bio fuels that can be utilized in diesel engine without any modification. The exploratory work has been led on a four-chamber, four - stroke, direct infusion (DI) diesel motor. In this examination, biodiesel (Produced from cotton seed oil by transesterification procedure) and typical diesel have been utilized as a reference fuel. In this examination, two diverse nanoparticle fuel added substances in particular MgO2 and CeO2 were added to biodiesel at the option measurement of 250 and 500ppm. An experimental analysis of performance and emission for present of metal oxide nano-particles with cotton seed biodiesel used as a fuel in CI diesel engine and also optimized the quantity of dosing metal oxide can be effective for better performance. In this investigation could be done with present and absent of metal oxide additives are likewise displayed. The present of MgO2 nano-particles has been increased the flash point and viscosity of the biodiesel. It was clearly noticed that the Expansion of MgO2 nanoparicles resulted lower HC and NOx outflows.***

Keywords:Metal oxides, Biodiesel, CI engine, Low combustion temperature, Low NOx and smoke emissions.

I. INTRODUCTION

The Compression ignition engines are generally utilized in automobile sector, because of its dependable activity and economy. As the oil stores are draining at a quicker rate because of the development of populace and the resulting vitality use, a critical requirement for scan for an inexhaustible elective fuel emerge. Additionally, the danger of a worldwide temperature alteration and the stringent government guideline made the motor makers and the buyers to pursue the emanation standards to spare nature from contamination. As of late, stringent discharge enactment has been forced worldwide on the oxides of nitrogen (NOx), and smoke and particulate issue produced from car diesel motors.

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In light of test examinations, Guru et al. [1] found that manganese (Mn) added substances has more noteworthy impact on diesel fuel properties like lessening the point of solidification, streak point, consistency and expanded cetane number. What's more, that different added substances like cupper, magnesium and calcium has least impact on diesel fuel properties than manganese. It was seen from the outcomes for diesel with Mn added substance were conveyed lower motor surge of O2 and CO about 0.2% and 14.3%, separately. While at SO2 discharge could be diminished and from these all impacts can be expanded the net working effectiveness up to 0.8 %. Valentine et al. [2] demonstrated that the bimetallic platinum/cerium added substances with diesel fuel can be emanates lower measure of HC, CO, sediment discharge and without shifting NOx outflows. The economy of fuel regularly expanded for both hard core and light obligation fast diesel motors. The present contaminant of oxygen in the diesel fuel had been improved the oxidation of fuel particles, which came about lower smoke discharge and higher NOx emanation [3]. In whole of metal oxides like copper, iron, cerium and cobalt have been broadly utilized as fuel included substance with energizes. The effect of cerium on the size conveyance and sythesis of diesel particulate issue has been examined by Skill as et al.[4] and it was seen that the lower size of 10 nm width cerium particles can adequately diminish the motor discharge. Lahaye et al. [5] considered the impact of cerium oxide on arrangement of ash from the examination of warm debasement and oxidative warm corruption strategy. From this considered, it was seen that the few measure of sediment tests are oxidized and unequivocally lessen the start temperature of ash. This as a result of essence of oxygen content in the Ce (cerium oxide).

Jung et al. [6] contemplated the impact Ce added substance on ultra-fine molecule of diesel discharge and oxidation energy. The tried outcomes demonstrated that decrease the centralization of pinnacle number during the collection mode, degrease the light off temperature and without influencing the initiation vitality. Regardless of the way that the rate of oxidation extended quite with the extension of Ce with diesel fuel and found that the amount of dosing has very little impact [7,8]. Escribano et al., [9] considered the helper and morphological depiction of a Ce-Zr mixed oxide maintained Mn oxide similarly as on its synergist activity in the oxidation of particulate issue rising up out of diesel motors. Mn-Ce-Zr force shows high development in the buildup

oxidation making CO and furthermore CO as a reaction in the range 152-452° C. Barry park et al [10] studied the utilization CeO_2 nano-particles with diesel fuel was peril and danger during examination.

Ying et al. 2006[11] explored many oxygenates are practical in decreasing transmissions from diesel motors. A segment of the investigates have been based on fuel added substances to decrease hazardous releases. Fuel properties are made by using a couple added substances to improve start adequacy and to decrease poison surges. One of those additional substances is metallic based blends, which have been used as consuming driving force for hydrocarbon powers. Keskin et al. [12] communicated that effects of the metallic-put together added substances with respect to fuel use and exhaust outpourings of diesel motor were investigated. The metallic-based included substances were conveyed by mixing of gum destructive (abietic destructive) with MnOx or MgO_2. In this test fuel preparation method those metal additives are doped with diesel fuel in the form of 8 µmol/l and 16 µmol/l. The two included substances could be increased the characteristics of diesel fuel like instance, consistency, streak point, cloud and pour point. Invigorates present and missing of included substances were attempted in a prompt imbuement diesel engine at maximum load stipulation. The experimental investigation of metallic based additives (Mn and Mg) utilized in diesel engine has indicated that Mn additive consume less fuel consumption is about 4.16% than Mg. Additive of Mn with diesel can able to reduction of smoke by 29.82% and CO by 16.35%. In addition, that the present of oxygen content in the additive leads to higher oxidation of fuel resulted increased NOx (Keskin et al., 2010).

Escribano et al. [13] have been contemplated the individual fuel trademark, the motor execution and surge for expansion of metal oxide nano particles with and without diesel fuel and the further more examined on expansion of dosing sum. The fresh temperature attributes of diesel didn't display huge variety, because of the improvement of cerium oxide nano- particles. In pressure start diesel motor utilized biodiesel with various dosing dimension of metal oxide (CeO2) from

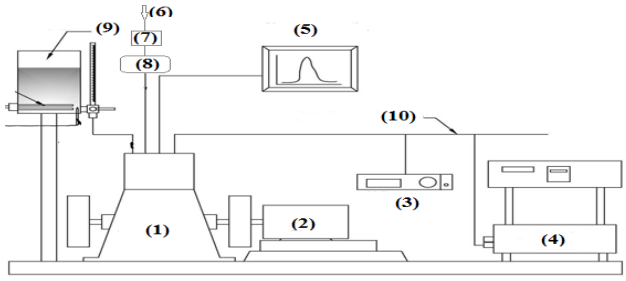
20 ppm to 80 ppm were shows an improvement in the gainfulness of the motor and its obviously seen that the decrease of NOx and HC [14-15]. This in light of the present of Cerium oxide nano-particles came about lower impact point and the thickness of biodiesel. The reason for this examination is to research impacts of nanoparticle included substances explicitly MnO2 and CeO2 at various dosing levels (250 and 500 ppm) to the biodiesel (cotton seed methyl ester) fuel for progression of the exhibition and outflows in a CI Engine.

II. EXPERIMENTAL SETUP

The test examinations were finished in two phases. In the first arrange, the diverse physicochemical characteristics of changed bio diesel were settled and appeared differently in relation to petroleum derivatives. The properties examined were the point of ignition, fire, cloud, pour and consistency. Standard ASTM test methodology was utilized in the analyses. In the second stage, broad execution tests were led on a solitary chamber CI engine utilizing the modified and base powers, so as to assess the motor execution just as the discharge attributes utilizing a fumes gas emanation analyzer. The strategy for arrangement of the powers with the added substance nano- particles alongside the test techniques for acquiring the fu9el characteristics and the subtleties of the exhibition test office are altogether introduced beneath.

A. Arrangement of Modified Fuels.

The transfection method was produce biofuel of cotton seed methyl ester from the cotton seed oil. Fuel characteristics are indicated in the table Table 1, as monetarily available nano-particle size of 10 to 30 nanometers. The amount of dosing nano-particle tests (by weight) in the base fuel was 250 and 500 ppm. The nanoparticle test required for the measure of each dosing measurement was evaluated by using a precision electronic balance and mixed with the fuel by strategies for a ultrasonic shaker, applying an enduring fomentation time of 30 minutes to make a uniform suspension. The modified fuel



1. Kirlosker TV-1 Engine
2. Loading device
3. AVL Five gas Analyser
4. AVL Smoke meter
5. AVL Combustion Analyser
6. Air inlet
7. Air Filter
8. Air Stabilizing tank
9. Fuel Tank
10. Exhaust gas pipe line

was utilized after arranging, in order to keep up a vital separation from any settling or for sedimentation to occur.

Fig.1 Experimental Setup

B. *Assurance of Fuel Properties*

The point of flash, fire, pour, cloud and consistency were estimated by utilizing standard test strategies. The thickness of fuel had been estimated utilizing the Redwood viscometer. Ignition and fire point can be measured by Cleveland open cup apparatus and a standard cloud and pour point mechanical assembly was utilized for estimating the cloud and pour focuses. The energizes properties are appeared table 1

C. Portrayal of the Test Engine

In the performance and spread esca mines, a four stroke single slot, water cooled CI engine was used. An ordinary persistent speed weight trials were furthermore performed on the engine. In eddy current dynamometer was used for slaking the motor, which specifications are given in the Table 2, and a graphic square

diagram of the preminary test offices plot in figure 1

Table: 1 Properties of Fuel

PROPERTIES	Density @ 15°C in gm/cc	Kinematic viscosity @ 40°C (mm^2/s)	Flash point (°C)	Fire Point(°C)	Calorific value (kJ/kg)	Cetane Number
DIESEL	0.8344	3.07	60	69	44125	51
BIODIESEL	0.8835	6.83	150	161	39292	52
CME+CeO2 25ppm	0.8722	6.91	155	161	39288	52
CME+CeO2 50ppm	0.8592	6.98	162	161	39247	52
CME+ZnO 25ppm	0.8724	6.91	155	161	39288	52
CME+ZnO 50ppm	0.8594	6.98	162	161	39247	52

Table 2: Engine Specification

Make	KirloskarTV-1 Engine
Type	Single cylinder vertical water cooled 4-stroke Diesel Engine
Bore X Stroke	87.5 mm X 110 mm
Compression ratio	17.5:1
Fuel	Diesel
Rated Brake Power	5.2 kW (7HP)
Speed	1500 rpm
Ignition timing	23^o BTDC (rated)
Injection Pressure	220 kgf/cm^2
Loading Device	Eddy current dynamometer
Orifice Diameter	0.02 m
Dynamometer arm length	0.195 m

III. RESULT AND DISCUSSION

The essential goal of this examination is to decide the variety because of the expansion of MnO2 and CeO2 Nano-particles, to evaluate the impact of the dimension of consideration of the added substances (dosing quantity) on the varieties. Execution trials are directed on the single chamber CI diesel engine utilizing the biodiesel fuel tests and contrasted and those with the base line diesel, to decide the engine execution upgrade and the decrease of emanations because of the expansion of impetus. In light of the exploratory outcomes, the varieties in the effectiveness and discharges of the CI motor utilizing the adjusted fills are resolved with different dosing level.

A. Engine Performance

In this figure 2 have been demonstrated that the variety of brake warm productivity (BTE) by use of standard and altered bio fuel. Higher BTE can be filed by expansion of MnO2 with diesel. Present of MnO2 in the fuel were expanded the start slack and complete burning, because of the defilement of oxygen. As appurtenance of CeO2 present with biodiesel fuel has extend the proficiency in light of oxygen cradle. Thusly a higher brake warm productivity of 5 % can be accomplished by expanded the dimension of dose from 250 ppm to 500 ppm. The use CeO2 with biodiesel fuel has improved the oxidation of carbon particles inciting an efficient activity.

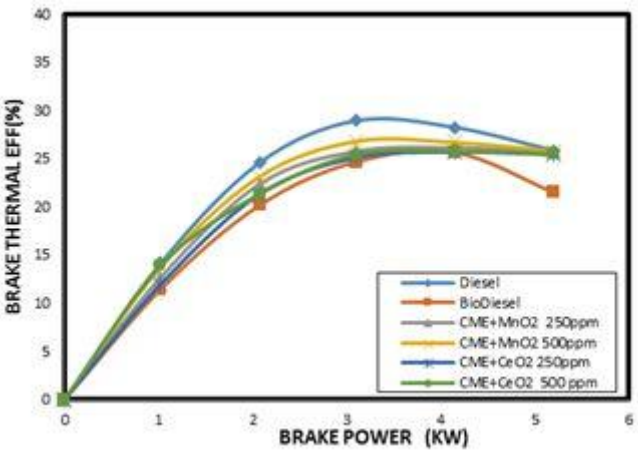


Figure 2. Variation of BTE with BP for various biodiesel blends

In figure 3 showed that the variety of explicit fuel utilization (SFC) with Brake control (BP) concerning different of metal oxide added substances present in the diesel fuel. Brake power regards normally extended with the extension of both Ce and Mn oxide added substances with bio energizes. Most extreme burden condition the fuel utilization is to be expanded for metal added substances. This as a result of balanced energies at the nano-particles development while at motor worked under cotton seed methyl ester (CSME). The most outrageous brake control increase as shown by CSME fuel result is 38 % and 4.6 % for Increased the nano-molecule of 250 and 500 ppm CeO2, 6.6% and 4.2% for the 250 and 500 ppm MnO2 independently. The best typical brake control addition is 2.4% as demonstrated by base fuel (CSME fuel) at the development portion of 250 ppm MnO2.

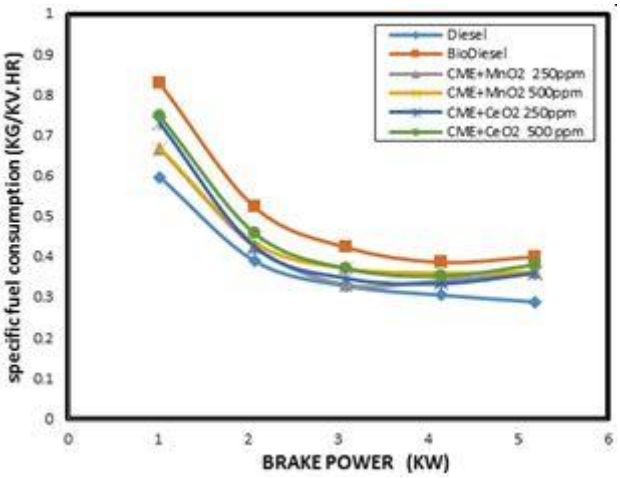


Fig 3.Variation of SFC with BP for various biodiesel Blends

B. Discharge Characteristics

A transmission analyzer has been assessed the hydrocarbon (HC) outflow for the different motor fuel like diesel, cotton

seed methyl ester and its metal added substance powers.

In figure 4 demonstrates that the grouping of HC discharges for CSME with different measure of dosing CeO2 and MnO2. It was seen that the HC flood altogether diminished because of the present of oxygen part in the metal additive's. In CI motor the nearness of lean or rich blend and low burning temperature are the purpose behind produce unburned hydrocarbon outflow (HC). The fumes discharge is containing unique fuel particles and mostly oxidized hydrocarbons. HC flood supposedly is significantly diminished on the augmentation of the extra substance. Cerium oxide can experience a change from the Stoichiometric CeO2 (+4) "valance state to the Ce (+3) state through an honorably low-essentialness response. Cerium oxide supplies the oxygen for the decay of the hydrocarbon likewise as the development and gets changed over to cerium oxide (Ce) as looks for after.

Cerium oxide (CeO) as an oxidation force in like manner cuts down the carbon start activation temperature and along these lines overhauls HC oxidation, propelling complete consuming. A commonplace lessening of 24% to 38% in the hydrocarbon radiations was secured for included substance dosing sum changes from 250 to 500 ppm of the extra substance. Wisdom has been made on the component of the NO transmissions from bio diesel, in the unadulterated structure and in the modified structure. On account of its high warm unfaltering quality, Ce molded from the oxidation of hydrocarbon and dregs remains dynamic in the wake of overhauling the fundamental consuming cycle and gets deoxidized to CeO through the lessening of nitrogen oxide.

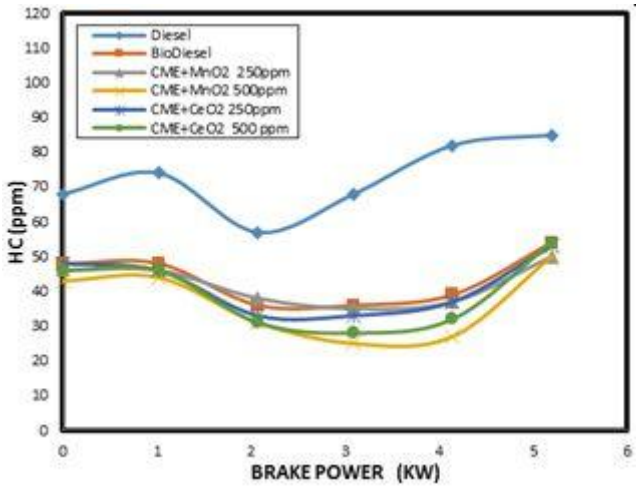


Figure 4. Variation of HC with BP for various biodiesel blends

Nitrogen oxides (NO) created by oxidation inside the chamber at temperature of 1927^{o} C. Subsequently the NOx arrangement is relied upon the oxygen content in the fuel and chamber temperature. In figure 6 found that the NOx radiation, exactly as expected, is influenced by the extension of the CeO2 nano-particles in CSME bio energizes. It very well may be seen that the NOx outpouring usually degreased on the development of CeO2 nano- particles with biodiesel, as showed up in Figure 5, where a typical decrease of NOx is around 33%, while a dosing measurement of 250 ppm for CeO2 nano-particles than biodiesel. At the point when all is said in done, there is a reduction in NOx transmission on account of the development of cerium oxide could be watched the warmth during depleted, which came about lower burning temperature. An extension of CeO2 with biodiesel came about expanded oxidation of fuel particles prompts higher ignition temperature and higher NOx outpouring than diesel fuel.

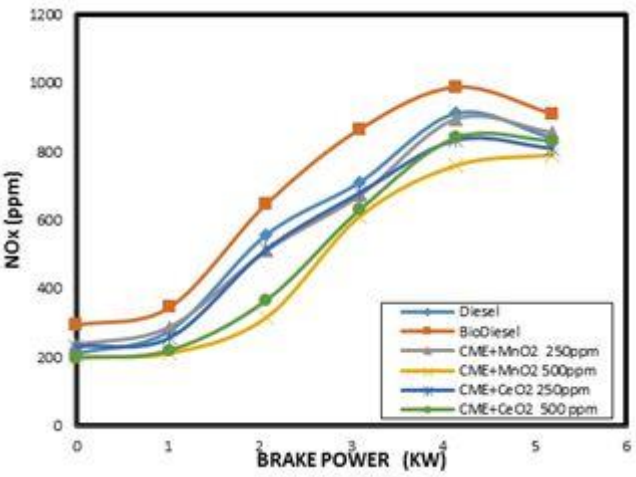


Figure 5. Variation of NOx with BP for various biodiesel blends.

The emanation of carbon monoxide (CO) requires a temperature of 1200o C to create CO2 by oxidation. Figure 4 exhibits the carbon monoxide (CO) floods versus different dosing dimension of CeO2 and MnO2 with cotton seed methyl ester bio fuel. CeO2 and MnO2 nano-particles with improvement estimations of 250 and 500 ppm diminished the CO floods of the cotton seed methyl ester fuel. CO discharge decay as appeared by CSME fuel result is 12.2% and 13.1% for the reasonable powers at the nanoparticle advancement estimations of 250 and 500 ppm CeO2, 16.4% and 15.9% for the 250 and 500 ppm MnO2 autonomously. The commonplace CO overflowing reduction is 10.2% and 7.6% for the balanced fills at the nanoparticle expansion segment of 250 and 500 ppm CeO2, 3% and 1% for the 25 and 50 ppm MnO2 freely. The best run of the mill CO decrease is 10.2% as appeared base fuel at the expansion segment of 250 ppm CeO2.

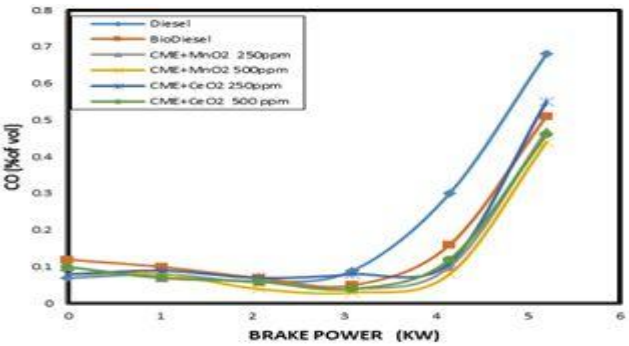


Figure 6. Variation of CO with BP for various biodiesel blends

VI. CONCLUSIONS

Following are the real ends drawn from the trial work directed with biodiesel and two various nanoparticle fuel included substances specifically MnO2 and CeO2 were added to biodiesel at the alternative estimation of 250 and 500ppm.

- The brake thermal efficiency (BTE) of the diesel motor is improved by the development of manganese oxide in the biofuel.
- Higher fuel utilization biofuel is at higher engine speed and diminished SFC by expanded in Brake control.
- A critical decrease in Hydrocarbon (HC) surge is seen by extension of the additional metal oxides with biodiesel fuel.
- NOx outflow was diminished on the extension of cerium oxide nano-particles to biodiesel.
- Both metal oxides with present of biodiesel are altogether decreased the CO discharge at higher burden CO outflow expanded.

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