PERFORMANCE AND IGNITION BEHAVIOR OF CI ENGINE FUELLED BY GRAPE SEED OIL BLENDED WITH NANOADDITIVES

Ganesh. M,* Dr.S.Sivaprakasam, Vinodraj. S***, Sasikumar. G,**** Sanjay Krishnan.G,**** Hariraj.R,**** Naveen.S, **** Dr.V. Rangasamy*****

*, Assistant Professor

**, Professor

***, Associate Professor

****, Students

*****, Librarian

Department Mechanical Engineering IFET College of Engineering, Villupuram

ABSTRACT

Due toward the swift growing of population and transportation, the industries there may be depletion there in petrol and diesel fuels, so researchers look for alternative diesel substitute fuels. Which not will create in the least injury to the atmosphere and similarly it fewer in price. Hence biofuel is sole of the substitute fuels due towards their nontoxic, no Sulphur, less emission and higher oxygen content. The standing investigation work is agreed ready to study the performance, ignition then exhaust emission behavior of common rail direct injection (CRDI) compression ignition engine using the blended biodiesel (B10, B20, B30) with ceric oxide (CeO_2) Nanoparticles. Biodiesel derived from raw grape seed oil promise be a substitute fuel for the conservative diesel combustible due to their parallel in physicochemical properties. Usage of nanoparticles for better performance, ignition then emission features to the biofuel. The Ceric oxide nano additives mixed with biodiesel blends by magnetic stirrer. The examination process was accepted away below the ensuing biofuel samples: 10% of biofuel mixed to 90% diesel (B10), 20% of biofuel mixed to 80% diesel (B20), 30% of biofuel mixed to 70% diesel (B30) and 100ppm ceric oxide nanoparticles added with each blend (B10, B20, B30). The experimental engine was functioned at constant compression ratio 17.5:1 then continuous speed on numerous load conditions 0%,25%,50%,75% and 100%. The test was concluded by compare, The performance and emission features of biofuel with performance and emanation characteristics of diesel. The CRDI engine harmful exhaust gas emission is reduced with increase biodiesel concentration

1.INTRODUCTION

India is a high energy consumption nation due to large population. The energy consumption increases day by day where the maximum energy demand is overcome by fossil fuels. The remnant fuels which contain Coal, Petroleum, Natural gas, Crude oil then Orimulsion. The remnant fuels are derived since fossilized plants and animals that lived in million years ago, this are the main source to generate energy and heat. All these fossil fuels are containing major element like Hydrogen, Carbon, Oxygen, Sulphur and Nitrogen. During the combustion process, fossil fuels will emit pollutant gases like Fly ash, Sulfur dioxides (SO_2), Oxides of nitrogen (NO_X), Carbonic acid gas (CO_2), Carbon monoxide (CO), Greenhouse gas emission (GHS) and Hydrocarbons. These gases can affect both human life and environment. The carbon dioxide and nitrogen oxides have a serious health impact on humans and animals like asthma, lung disease, cardiovascular disease, eye effect and environment effect like deplete the ozone, Acid rain and reduce photosynthetic ability of plants. The modern world needs to meet energy demand and unavailability of remnant fuels. The continuous uses of remnant fuels, the non-renewable sources are depleting fastly [1]. The exhaustion of nonrenewable fuels and environmental consequences of remnant fuels, the automobile industries need an alternative source to generate heat energy and green environment.

Biodiesel is single of the best substitute fuels for conventional fuels in diesel engine. Biofuel is a most attractive fuel [2]. Biodiesel stays synthesis as of vegetable oil then seed oils. Biofuel is less flammable, Nontoxic, No Sulphur and it will emit less pollutant gases compared to fossil fuels. The biodiesel is one of the renewable energies because it obtained from seeds and plants. Biofuels remain the fast forward-moving as substitute sources and renewable energy due toward their nonpolluting features [3]. The plant-based fuels are renewable energy because it cannot be depleted and promising alternative fuels. The biodiesel produced from safer methods, Biofuels have a high auto ignition temperature (cetane number 52-53) so it cannot be easily fired and avoid unexpected blast in industry. The oxygen content is one of the important factors for make use of biofuels. The biodiesel has high oxygen content (10-12%), So it will emit less emissions. As the price of the crude oil increasing day by day, so most of the county switch to biofuels, ethanol and hydrogen powered vehicles. Biodiesel reduce harmful exhaust emissions, so biofuels improve the environmental quality and human life.

The lots of research going in make a biodiesel from seed oils. The seed oils are most suitable feedstock to make biodiesel [4]. In case make a biodiesel in vegetable oil it possible to making scarcity of food, so wasted seeds are one of the best sources to make biofuels. The engine exhaust gas emission is reduced with increase the uses of biofuels concentration [5]. The seed oils include properties like kinematic viscosity (2.781cst), Water content (0.055vol%), Calorific value (42.510 kJ/kg), Density (0.931g/cm^3) and fatty acids like saturated fatty acid, monosaturated fatty acid and poly saturated fatty acid. Jatropha, Soybean, Canola, Palm, Sunflower, Safflower this are most commonly used feedstock seeds for biofuels. Tobacco seed oil is a hopeful feedstock used for biofuels production [6]. Before select a seeds one factor must to be consider the feedstock must be naturally abundant and not break the food scarcity. The oils derived from seed after it need to be transesterification before use, the transesterification finalized by adding methanol or ethanol. the transesterification come up with biodiesel and glycerin, so seeds are the promising feedstock to derive biodiesel

Nanotechnology is a branch of engineering is the use of atomic, molecular and supramolecular for industrial purposes, this technology has a most considerable research field for past few years. The research carries to study about their formation, Characteristication and detection of nanoparticles. The nickel -oxide nanoparticles blended biofuel reduces NOx

9% and increase break thermal efficiency (BTHE) [7]. The nanoparticles are a small particles or powder that size between 1 to 100 nanometers (nm). The nanoparticles are not able to detected by human eye and not visible. The nanoparticles are formed by a greater number of atoms, the atoms are measured by 0.1nm, Nanoparticles is measured by 1 to 100nm, Fine particles are measured by 100 to 2,500nm fine particles are also called as particulate matter-$PM_{2.5}$, Coarse particles are measured by 2,500 to 10,000nm, Coarse particles are also called as dust-PM_{10}. The Cerium oxide (CeO_2), Carbon nanotubes, Copper oxide (Cu0), Graphene oxide (GO), Alumina oxide (Al_2O_3), Titanium dioxide (TiO_2), Silica dioxide (SiO_2), Boron oxide (B_2O_3), Nano clay are the most common type of nanoparticles used in industry. Various nanoparticles have been using for dual engine in the present work [8], The engine testing result provide improvement benefits are 23% reduction in smoke was achieved for same fuel efficiency at 80% load. The Nanoparticles contain different physical, chemical and material properties. Physical properties like alter, Improve the pharmacokinetic, Pharmacodynamic properties of various molecules, huge segment of surface atoms, huge external energy, Spatial confinement then reduce imperfections. Chemical assets like it will enhance the chemical reaction during combustion process, Enrichment of mass transportation, Catalysis, Actual surface zone and Regulator over electrode microenvironment. Material properties like it made development in the improvement methods of synthesis of nanomaterials. nanoparticles can occur naturally and more abundant or produced by combustion reaction this particle used in variety industries like health care and cosmetics toward environmental conservation then air decontamination. In health care industry it uses being drug delivery, Carbon nanotubes are also used in antibodies, Fashionable Aerospace industry carbon nanotubes cannister be used in morphing of aircraft wings. The nanoparticles have wide range of application in thermal engineering it will be used in increase and enhance the chemical reaction in engine. the bioethanol and biofuels with Nano additives reduce the smoke emission like NO_x and Hydrocarbons [9].

combining the nanotechnology and biotechnology can enhance the biofuels production. The combination includes three types biodiesel-diesel-nanoparticles (B20A30C30), Biodiesel-nanoparticles (B100A30C30), Biodiesel-diesel (B20) [10]. Nanotechnology provides perspective strategy for the sustainable production of biofuels and overcome the difficulties in biofuel similarly high level of molecular mass, high point of viscosity then pouring point. When adding a Nano additive with biodiesel it will increase the brake heat energy efficiency (BTE), specific fuel consumption (SFC), enhance and provide steady chemical reaction in diesel engine. The physiochemical properties like melting point, boiling point, vapor point, extrinsic properties of pressure and moles canister be enhanced by addition of Nano additives with biodiesel. Nanoparticles reduce the harmful exhaust emission like Hydrocarbons, Carbon monoxide (CO), Carbon dioxide (CO_2) and oxides of nitrogen (NO_X) discharged from diesel engine. Nanoparticles provide a remarkable performance in biodiesel production, production reached 94% and also it easily separates from the biodiesel. The use of Nano additives with moreover diesel or biodiesel has given away promising and different challenging outcomes. thus, the objective of this review paper discusses different approaches, Role of nanoparticles on biodiesel production, Benefits, Different challenges using nanoparticles, performance, and emanation characteristics of diesel engine fuelled via grape seed oil blended by cerium oxide (CeO_2) Nano additives.

2.Materials and methods

2.1. Preparation of biofuel

The base fuel remains extracted from grape seed oil. The GSO have huge quantity of fatty acid content. The physicochemical assets are actual similar toward diesel and petrol oil [11]. The density (843 kg/m^3) was increased to compare diesel (834 kg/m^3). The oxygen content is higher than diesel, Grape seed oil having high oxygen content naturally because it derived from plant seed, so it emits less emission. The Grape seed oil viscosity (3.3 mm^2/s) was improved to compare diesel (2.5 mm^2/s) and also auto ignition temperature (Cetane number) were increased. The obtained grape seed oil was process by transesterification. The transesterification is a process adding methanol in base fuel, after it was refining. The refining process come up with glycerin and biodiesel. The grape seed oil has high oxidation stability [12].

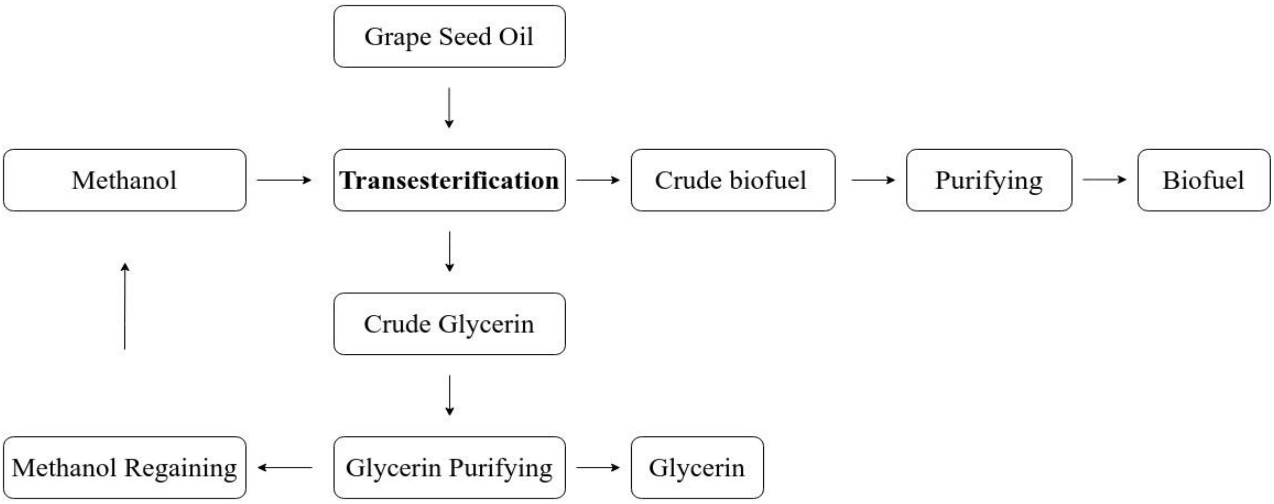

Fig. 2.1. Biodiesel preparation

2.2. Characterization of particle size and fuel test

The laboratory examination has been focused to get the properties of this Nano additives mixed with grape seed oil biodiesel. In this investigation the bellow properties were observed: density, viscosity, fire point, point of flash and calorific values. The blend Samples were named as per B10+100ppm, B20+100ppm, B30+100ppm for this investigation and it is specified in Table 1. The significant increment in flash point, fire point and actual density, it is observed from the investigation by adding Ceric oxide nano particles with biodiesel blend. Calorific value is significant property of any fuel and it is fewer for the additive blended sample than diesel, but it is improved in the biofuel. The nano additive blended biodiesel rises the brake heat energy efficiency with decrease in fuel consumption.

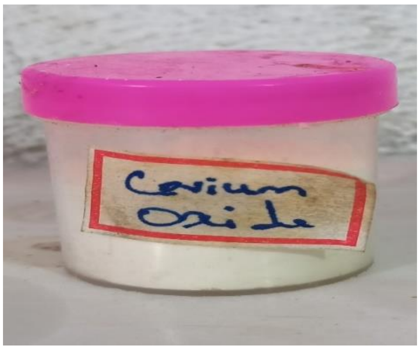

Fig. 2.2. Cerium oxide (CeO_2)

2.3. Blending of ceric oxide nano additives with biodiesel

The nanoparticles biofuels are derived through blending the ceric oxide (CeO_2) Nanoparticles in the grape seed oil biodiesel by magnetic stirrer. The magnetic stirrer technique is most appropriate method to disperse the nanoparticles in grape seed oil biodiesel (base fuel). Nano particle's maximum part consuming surface territory and henceforth external vitality [13]. So, like to make nanoparticles to be steady in the base fluid. The particles deposit was managed.so by way of to disperse the Nano particles toward base fuel magnetic stirrer system were followed. An acknowledged quantity of substance stood added and poured in the biofuel after stirred for 50 minutes. Then finally it will form as steady Nanofluid.

Fig. 2.3. Testing blends

Table 1 Properties of blended biofuel and diesel

Properties	Diesel	B10	B20	B30
Density (Kg/m^3)	834	843	851	854
Calorific value (KJ/Kg)	42,341	40,589	41,070	41,105
Kinematic viscosity at 50^0C(mm^2/s)	2.5	3.3	3.28	3.4
Fire point in ^{0}C	67	65	73	77
Flash point in ^{0}C	47	51	56	58
Boiling point in ^{0}C	254	NM	NM	NM
Cetane number	52.5	51.8	51.9	52.5
Latent heat of vaporization (KJ/Kg)	262	NM	NM	NM
Surface tension (mN/m) @70^0C	23.25	NM	NM	NM

3.Experimental setup

The engine arrangement consists of sole cylinder and 4 strokes. A 5.2 KW four stroke direct injection diesel engine selected to examine the performance and emission features. The dual mode engine consumes less fuel consumption [14]. The diesel engine linked towards eddy current typical dynamometer. Load stood applied to the diesel engine by help of eddy current dynamometer. The air flow rate is measured through mass flow sensor then fuel consumption is measured via burette method. Rotameters are provided cooling water for diesel engine. The experiment reading was obtained at different load conditions, load cell and type strain gauge are used to measure the loads. More number of sensors were performed during the experimentation. The engine software is playing a major role in engine testing application, Software estimates the power, efficiency, temperature and fuel consumption. The gas analyzer and smoke meter are used to evaluate the Carbon monoxide (CO), Hydro carbons (HC), Carbon dioxide (CO_2), Oxygen (O_2), NO_X emission and Opacity. The expected performance and results provided by MODTRAN smoke meter [15]. The result data analyzed by computerized acquisition system. The performance, combustion and emission obtained results are tabulated.

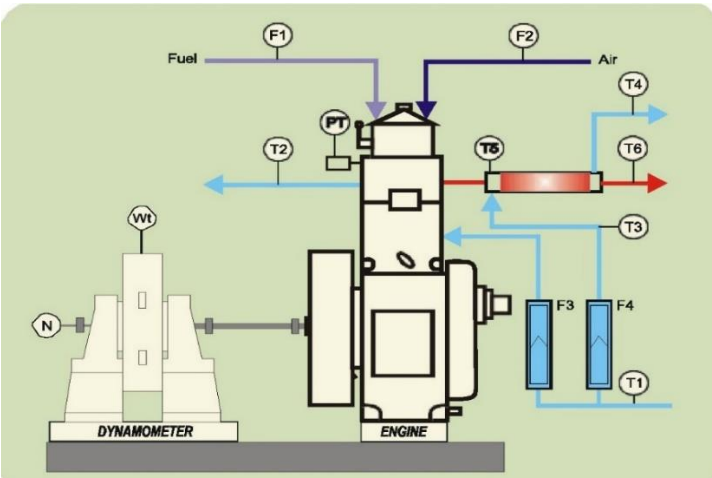

Fig. 3.1. Engine setup

Table 2 Description of the engine setup

Basic details	Kirloskar, 4 stroke, single cylinder, water cooled
Rated power	5.2 KW
Speed	1500 RPM
Compression ratio	17.5
Number of cylinders	One
Stroke	110mm
Bore	87.5mm
Loading	Eddy current type dynamometer
Ignition	Compression ignition
Rotameter	Engine cooling 40-400 LPH

Calorimeter	Type pipe
Air flow transmitter	Pressure transmitter
Fuel flow meter	DP transmitter
Load sensor	Load cell, type strain gauge
Temperature sensor	Type RTD, PT100 and Thermocouple
Crank angle sensor	Resolution 1 Deg, speed 5500 RPM
Cooling	Water

4.Results and discussion

4.1. Brake thermal efficiency (BTE)

Fig 4.1 records the history of BTE against various loading condition. The BTE is defined as the amount of heat generated per unit fuel. From the line graph, it is detected that by way of load rises BTE is also increases. It is because as brake power increases due to the increase in pump work. The test results were observed for B10+100 ppm, B20+100 ppm, B30+100 ppm and diesel are 32.03, 31.01, 29.85 and 33.22. diesel records as the highest BTE compared biodiesel for all blends. B10 finds the closer BTE with diesel, it is because due to the oxygen content and over viscosity.

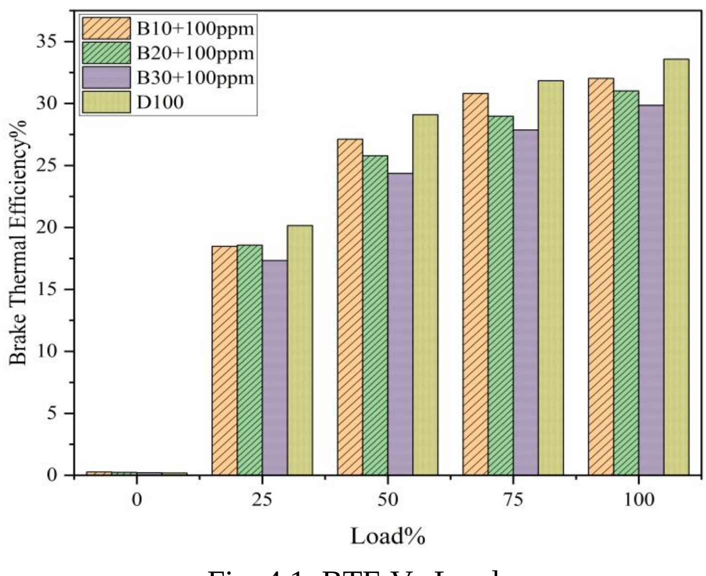

Fig. 4.1. BTE Vs Load

4.2. Brake specific fuel consumption (BSFC)

The BSFC is well-defined as the sum of fuel consumed in unit of time for generating heat. Fig 4.2 represents the various specific fuel consumption against various loading condition. From the graph, it stays observed that as load growths fuel consumption is decreases. It is because as nanoparticles leads to better combustion process, this is the main factor for reduction in fuel consumption. The test results were observed for B10+100 ppm, B20+100 ppm, B30+100 ppm and diesel are 0.27 (kg/kWh), 0.28 (kg/kWh), 0.29 (kg/kWh) and 0.25 (kg/kWh). diesel records as the lowermost BSFC compared biodiesel for all blends. B10 finds the closer BSFC with diesel, it is because due to the surface volume fraction and oxygen cushion.

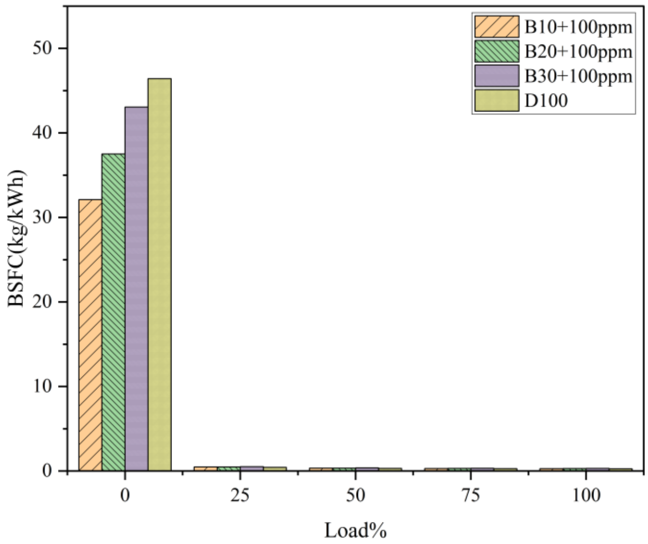

Fig. 4.2. BSFC Vs Load

4.3. Carbon monoxide emission (CO)

The dissimilarity of carbon monoxide emanation for all blends is exposed in fig 4.3. The CO emission is defined as colorless, odorless and flammable gas. From the graph, it is detected that as load increases CO is also increases. The test results were observed for B10+100 ppm, B20+100 ppm, B30+100 ppm and diesel are 0.216%, 0.181%, 0.109% and 0.104%. The blend B30 has lowermost level of CO, it is because as addition of nanoparticles and increase the percentage of biodiesel will give further oxygen source which increases the chemical reaction. diesel records as the deepest CO compared biodiesel for all blends. B30 finds the closer with diesel, it is because due to the better ignition.

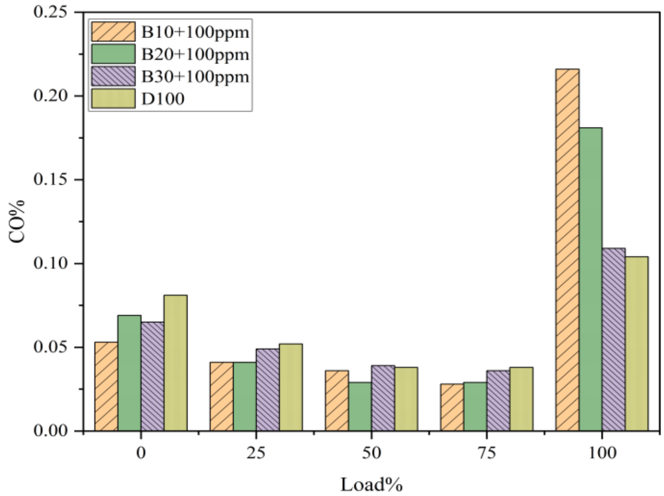

Fig. 4.3. CO Vs Load

4.4. Hydrocarbon emission (HC)

The HC is defined as more appropriately organic discharge. The different variation of HC emission with various loads for all blends is shows in fig 4.4 From the line graph, it is detected that as load rises HC is also increases. It is because as HC emission increase with increasing the volume of biofuel in their blend. The test results were observed for B10+100 ppm, B20+100 ppm, B30+100 ppm and diesel are 51 ppm, 49 ppm, 52ppm and 87 ppm. diesel records as the highest HC compared biodiesel for all blends. B30 finds the closer HC with diesel, it is because due to the unburned particles.

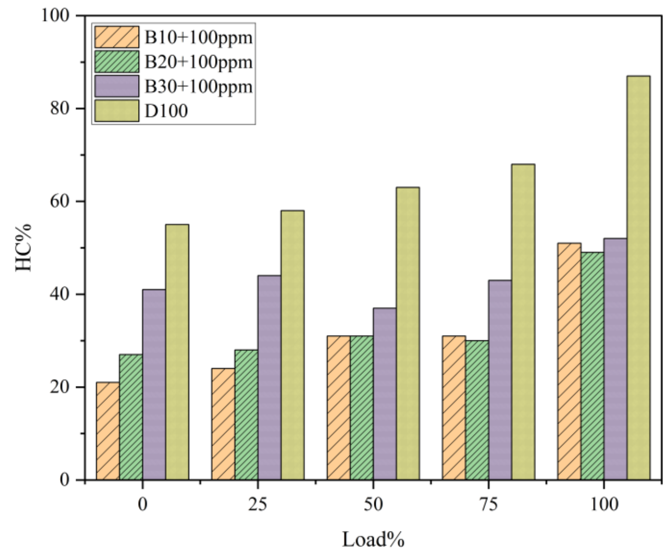

Fig. 4.4. HC Vs Load

4.5. Nitrogen oxides (NO_x)

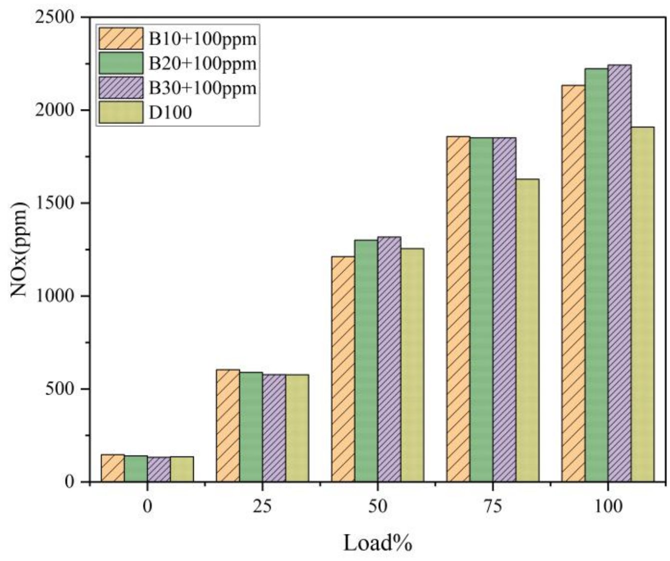

Fig. 4.4. NO_x Vs Load

Fig 4.5 records the history of NO_x against different loading condition. Nitrogen oxide emission is one of the hazardous pollutant gasses. From the line graph, it is detected that as load rises NO_x is also increases. The test results were observed for B10+100 ppm, B20+100 ppm, B30+100 ppm and diesel are 2133 ppm, 2223 ppm, 2243 ppm and 1909 ppm. The blend B30 emit high level NO_x emission, it is because as blend B30 has massive volume of biodiesel and contains more oxygen content. The addition of nanoparticle it will lead for better combustion. While increasing a load the engine mains to grow temperature and pressure, this are the reason to increases NO_x emission. Diesel records as the bottommost NO_x compared biodiesel for all blends. B10 finds the closer NO_x with diesel, it is because due to the less oxygen content.

5.Conclusion

The investigation was performed to examine the impact of ceric oxide nanoparticles in grape seed oil biodiesel on performance and ignition behavior of CI engine, founded on the investigation result the conclusion are drawn:

Brake thermal efficiency (BTE) for grape seed oil biodiesel and diesel is almost same at all loading condition.

The Carbon monoxide (CO) emission was possibly reduced with adding high percentage of grape seed oil biodiesel.

The carbon dioxide (CO_2) emission decrease with increases the percentage of grape seed oil biodiesel

The hydrocarbon (HC) emission reduced with increase of cerium oxide (Ceo2) Nano additives and percentage of biodiesel.

Nitrogen oxides (NO_x) emission rises with increase the load of the engine

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