Performance And Emission Test on A Single Cylinder Compression Ignition Engine Using Neem Oil Blends by Sonication

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DOI: **https://doi.org/10.51584/IJRIAS.2023.8432**

Received: 26 March 2023; Revised: 15 April 2023; Accepted: 18 April 2023; Published: 20 May 2023

Abstract: - The transportation segment is the single biggest customer of oil determined vitality. Generally, fluid hydrocarbons have developed as the essential transportation fuel in light of their high vitality content per unit volume and as a result of the effortlessness of fluid fuel dealing with and conveyance frameworks rather than those required for strong or vaporous energizes. Thus, our present day transportation control plants have been intended to utilize fluid powers and oil refiners have, through a transformative procedure, been fitting to meet the prerequisites of cylinder motors. This fitting of the fuel to meet motor necessities must be reevaluated. As a transitional procedure, other vitality sources must be looked for which can be utilized as a part of altered cylinder motors. This transitional procedure could most recent a very long while as new but unclear, transportation frameworks are produced.

Keywords: Neem, Diesel engine, Sonification, Performance, Emission

I. INTEREST IN NEEM OIL

Endeavors for exchange diesel motor energizes were made a few back. Nonetheless, their Acknowledgment as suitable diesel fuel substitutes has not yet become a reality on account of less expensive and obviously adequate supplies of oil based powers gave recharged enthusiasm for Neem oil energizes, particularly for crisis use in spot deficiency circumstances. Reference records late research endeavors to decide the possibility of oils as diesel fuel substitutes.

Beginning utilization of Neem oil as diesel motor energizes might be local and limited to territories where they are promptly accessible. One of the likely first applications could be on cultivate and in farming gear; in this manner, enthusiasm for the impacts of Neem oil on diesel motor execution in fitting and convenient.

This explore exertion was intended to address the execution and emanation attributes of Neem oil energizes when utilized on a diesel motor. The test motor outline and design were chosen to speak to engineers as of now in wide use in farming and mechanical hardware and motors that were relied upon to be most delicate to fuel quality.

II. BIODIESEL PRODUCTION

Many standardized procedures are available for production of bio diesel. The commonly used methods are:

1. Blending
2. Micro Emulsification
3. Thermal Cracking
4. Transesterification

Among these, Transesterification of vegetable oils seems, by all accounts, to be more appropriate since the side-effect (glycerol) has business esteem. Transesterification is the synthetic response between triglycerides furthermore, liquor within the sight of impetus to deliver mono-esters. The long and expanded chain triglyceride particles are changed to mono-esters and glycerin.

Transesterification process comprises of a succession of three continuous reversible responses. That is, transformation of triglycerides to triglycerides, trailed by the change of triglycerides to monoglycerides. The glycerides are changed over into glycerol and yielding one ester atom in each progression. The properties of these esters are equivalent to that of diesel. The general transesterification response can be spoken to by the accompanying response conspire.

Triglyceride + ROH $\longrightarrow$ Diglyceride + $R^{I}COOR$

Diglyceride + ROH $\longrightarrow$ Monoglyceride + $R^{II}COOR$

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS | Volume VIII Issue IV April 2023

Monoglyceride + ROH $\longrightarrow$ Glyceride + R^{III}COOR

Processing of biodiesel from non edible oil (Neem oil)

Free unsaturated fat (FFA) rate in neem oil is high. There are numerous strategies to discover the free unsaturated fat rate content in oil. Basic titration with the KOH is a straightforward strategy. For titration initial 0.1 to 10 g of oil was weighed and broken up in around 50 ml of an appropriate dissolvable. Methanol, ethanol and ether are some ordinarily utilized solvents; in this case methanol was utilized as the dissolvable. It was warmed tenderly for quite a while. A little drop of marker was included. Phenolphthalein was utilized as indictor. At that point the arrangement was titrated with KOH. The measure of KOH required, in milligram (mg) to killing the free unsaturated fat in one gram of oil communicated as a number is known as acid number .Fatty acid content in the oil can be calculate from acid number.

Esterification setup

A round base cup is utilized as lab scale reactor for these trial purposes. A hot plate with attractive stirrer course of action is utilized for warming the blend in the cup. The blend is mixed at a similar speed for all trials. The temperature scope of 50– 60 °C is kept up amid this test.

Acid esterification

One liter of rough neem oil requires 250 ml of methanol for the corrosive esterification process. The neem oil is filled the flagon and warmed to around 50 °C. The methanol is included with the preheated neem oil and mixed for a couple of minutes. 1% of sulphuric corrosive is additionally included with the blend. Warming and mixing is proceeded for 30 min at climatic weight. On fruition of this response, the item is poured into an isolating pipe for isolating the overabundance liquor. The overabundance liquor, with sulphuric corrosive and polluting influences moves to the best surface and is expelled. The lower layer is isolated for additionally handling

Two step reaction process

The process includes two reactions of Transesterification, one with an acid and another with an alkaline catalyst. In this process, an acid catalyzed pre-treatment is done because of high percentage of Free Fatty Acids. The acid catalyst is used to convert Free Fatty Acids to Fatty Acid Methyl Esters. Tests have shown that the oils with FFA with 20-40% FFA after pre-treatment gets reduced to below 1% of FFA. An acid catalyzed technique has a much faster reaction rate and it gives more yield. It usually requires a temperature of 60 °C and atmospheric pressure. The product from this method can be used to perform alkaline for the highest yield of methyl esters.

Once the Transesterification is completed, the next step is to purify it. The raw products in the separation funnel are a mixture of excess alcohol, free fatty acids, catalyst and the unimportant by-product glycerol. These are to be separated as what we require is just the pure methyl esters.

Removal of glycerol

Glycerol is washed from the ester fluid by either washing the entire compound formed or by secondary reaction. Washing is done by using water or a mild acid. The ester loses the excess glycerol in the biodiesel layer which can be removed using the reaction with an alkaline catalyst instead of water washing. Catalysts is added after the methanol is removed which gets converted into the tri-glycerides. Once the tri-glycerides are removed, they can be again added to the raw feed oil and can re-enter the process. After this, they can be converted in usable methyl esters.

Removal of methanol

Excess methanol must be removed as it is not really necessary, so the ester phase must be purified. Heating the ester solution will remove the excess methanol present in the methyl ester layer. This must be performed before any stages of washing or treatment, in-order to avoid extra processing of methanol separation from water.

Removal of free fatty acids

If the Free Fatty Acids are left behind in the oil produced it will cause problems related to the fuel's efficiency. These FFA's can be removed after the Transesterification reaction by adding some acid. As mentioned before in acid catalyzed method, a small amount of acid can be added to react with excess FFA's. The acids must be washed out of the solution before further processes.

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Removal of catalysts

Catalysts can be eliminated from the bio-diesel by washing with water. The catalyst is more soluble in water than washed, which is not soluble with oil. The mixture can then let to settle and the two layers separate.

Washing procedures

Water is used as a washing element as it dissolves the catalysts and methanol which helps it get separated from the oil after being mixed. The biodiesel layer is usually washed three times. This technique is quite common which is used by mixing and separating the water.

Drying procedures

Since the biodiesel is washed for purification of the products and to remove the unnecessary compounds in the biodiesel. The bio-diesel after washing is quite wet, it has to be dried as the bio-diesel must be free from water content so as to be used as a fuel alternative. Drying water in biodiesel requires one simple process that is heating the mixture to a temperature. The water is hence separated and the bio-diesel is free from water content in the fuel.

III. NANO-FLUID AND FUEL PREPARATION

Nano-fuel is an addition of nickel oxide Nano-particles into the biodiesel to help improve the fuel’s performance. Nano-fluids using bio-diesel as base, usually contains elements capable of oxidizing carbon-monoxide gas and the harmful nitrous oxides. The flame propagation, reduced ignition delays and increase in the thermal efficiency of the CI engine is caused by these additives. Adding these the fuel can give higher performance at very low emission values and at a low fuel consumption. The nickel oxide Nano-particles are immiscible with methyl esters. Since they are immiscible, they form sediments.

In order to diffuse the particles of 40 parts per million, a surfactant is to be used in-order to dissolve the particles in the fuel. A total of 10 samples are prepared, 5 samples with nickel oxide Nano-particles and rest without them.

Nickel oxide

There are quite a number of advantages in using bio-diesel as an alternate fuel, on the other hand there are quite a few number of disadvantages as well. Drawbacks of conventional bio-diesel are that they have very meager oxidation stability. It also has a very high nitrous oxide emission release. Excess fuel consumption is also another concern with the usage of biodiesel. It has a very high molecular weight and got very low calorific value.

To overcome the drawbacks there are two main methods which is beneficial. Engine operating parameters like compression ratio, injection pressure and injection timing are to be altered for a better performance. But it is quite hypothetical approach as each blend of biodiesel has got its own viscosity and uniqueness. If this was what was supposed to be done then for every blend, testing is to be carried out and then the engine parameters are to be changed accordingly which proves out to be expensive. This is where Nano-metal oxides come into the picture. Nano particles in their oxide form like Ni_2O_3, CeO, and Al_2O_3help in releasing the oxygen molecules which enhances the combustion which increases the thermal efficiency.

It enhances the secondary atomization which again enhances the combustion rate. Nickel oxide Nano-particles have a greater surface area to volume ratio which helps in the reduction in physical delay of the combustion.

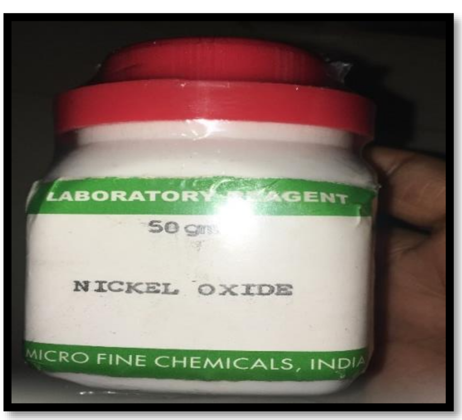

Figure: Nickel oxide powder

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Surfactants

Surfactants are compounds that reduce the surface tensions between 2 immiscible liquids, between a gas and a liquid, or between a liquid and a solid. A surfactant contains a water-insoluble and a water-soluble component. Surfactants will diffuse in water and adsorb at the interfaces between water and air.Isopropyl alcohol is a clear, colorless and volatile liquid. The most commonly used compound is rubbing alcohol, which contains 70% to 90% Isopropyl alcohol. Other means for exposure include household cleaners, cosmetic products, nail polish removers, paint thinners, disinfectants, and antifreeze. Isopropyl alcohol dissolves non-polar compounds and it evaporates very quickly and leaves nearly zero oil traces is relatively non-toxic, compared to alternative solvents. Thus, it is used as a solvent and as a cleaning fluid, especially for dissolving oils.

Once dissolved, water will not pose the same risk as insoluble water, as it will no longer hoard in the supply lines and freeze but would be consumed along with the biodiesel itself.

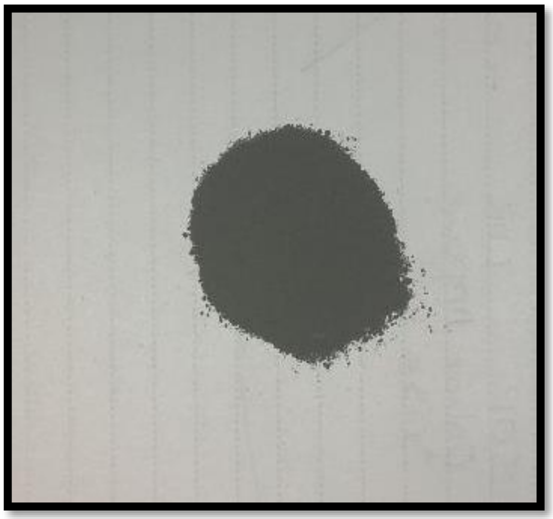

Figure: Isopropyl alcohol

METHANOL APPLICATIONS

PROPERTIES OF METHANOL

Formula : CH_3OH

Molecular weight : 32.04

Boiling point : 49°F

Reid vapor pressure : 4.6psi

Freezing point :-43°F

Flammability limit (% in air):.3 to 36

Liquid density @60°F :6063lb/gallon

Liquid viscosity @60°F : 0.59 centipoises

Lower heating value : 8570 Btu/lb

Auto ignition temperature : 867°F

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Table: Comparison of Properties for fuels

PROPERTIES	DIESEL	BIODIESEL	METHANOL
Density (kg/m^3)	0.83	0.9	0.904
Calorific Value (kJ/kg)	43400	33907.14	23000
Cetane Number CN	43	51	5
Specific gravity($m^{3/}$kg)	0.83	0.868	0.7915
Kinematic viscosity(m^2/sec)	8	8.08	0.12
Cloud Point ^{0}C	-6	19	-5
Pour Point ^{0}C	-13	8	-7
Flash point ^{0}C	89	157	11

Table: Flash and Fire point for fuels

S.NO	Fuel	Flashpoint °C)	Fire Point °C)
1	Neem Oil	150	158
2	Biodiesel	65	68
3	Methanol	59	62
4	Diesel	54	56

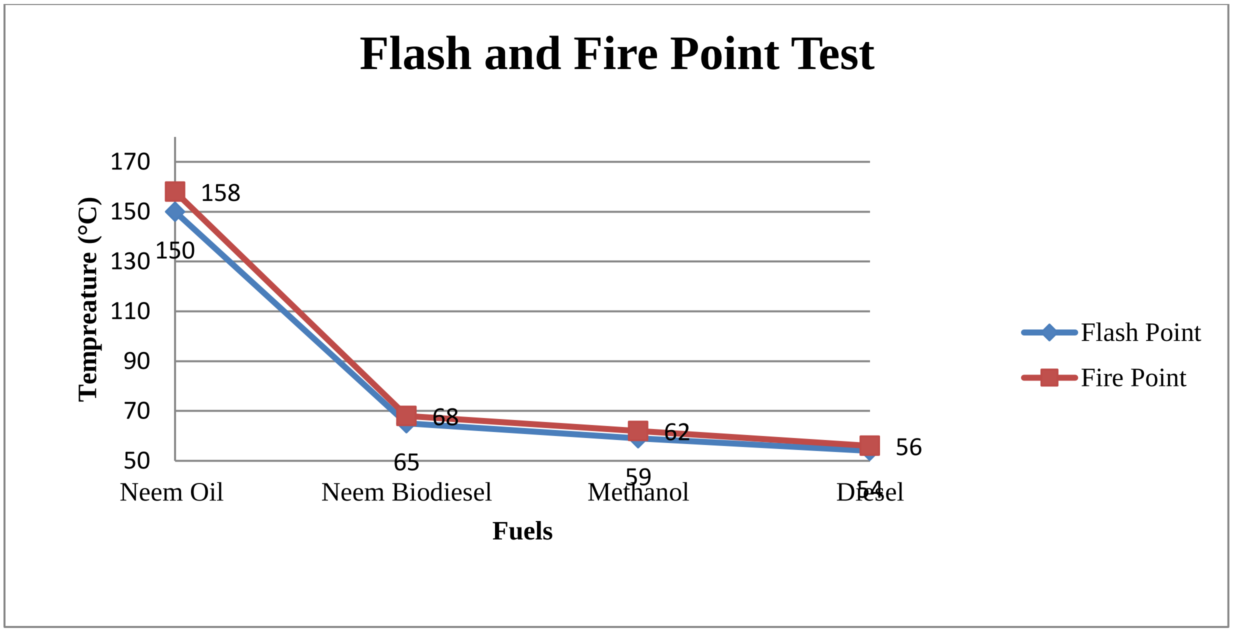

Figure: Flash and Fire Point Test

By this result we concluded that pure form Neem oil as fuel takes high temperature to take flash and fire.

and also Biodiesel has similar relation with methanol and diesel.

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Figure: Open cup apparatus flash point

FLASH AND FIRE POINT TEST FOR VARIOUS BLENDS

1. B5 - Neem oil (15ml) + Diesel (80ml) + Methanol (5ml)
2. B10 - Neem oil (20ml) + Diesel (70ml) + Methanol (10ml)
3. B15 - Neem oil (25ml) + Diesel (60ml) + Methanol (15ml)
4. B20 - Neem oil (30ml) + Diesel (50ml) + Methanol (20ml)
5. B25 - Neem oil (35ml) + Diesel (40ml) + Methanol (25ml)

Table: Flash and fire test for various blends

S.No	Chemical, oil and fuel	Time taken for the Flame test in second
1	Pure Neem oil	358
2	Pure Methanol	25
3	Pure Diesel	57
4	Pure biodiesel	60

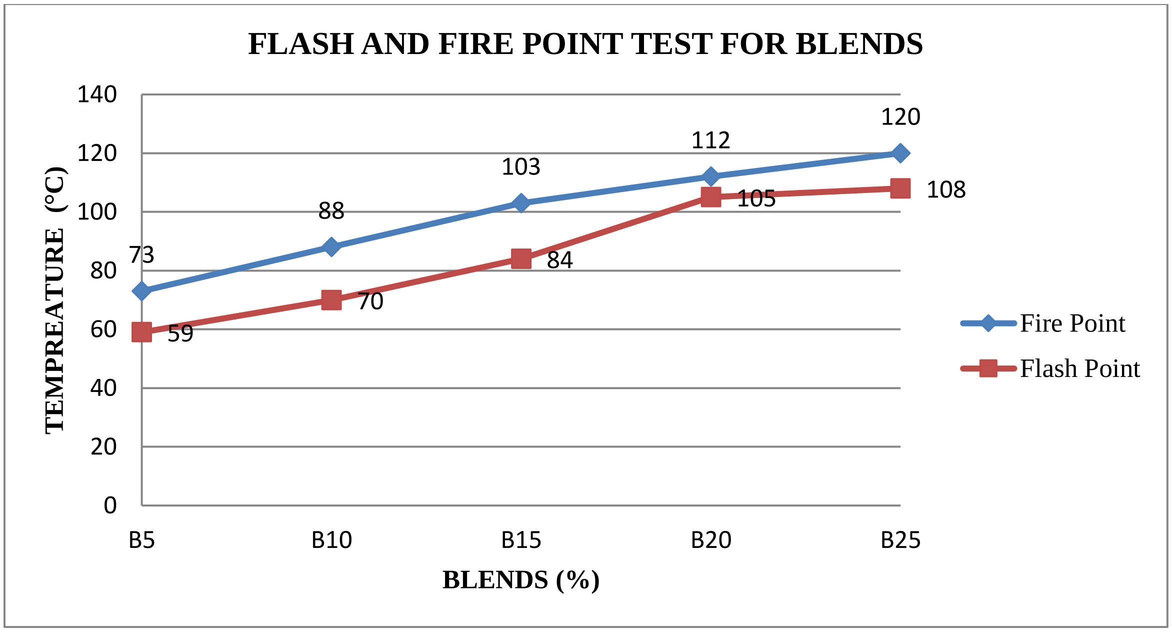

Figure: Flash and Fire Point test for various blends

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Observation

From this test we concluded that B10 & B20 is the standard blends which we going to use for the further test.

Table: Natural flame test for fuels

Blends	Flash Point (°C)	Fire Point (°C)
B10	70	88
B15	84	103
B20	105	112
B25	108	120

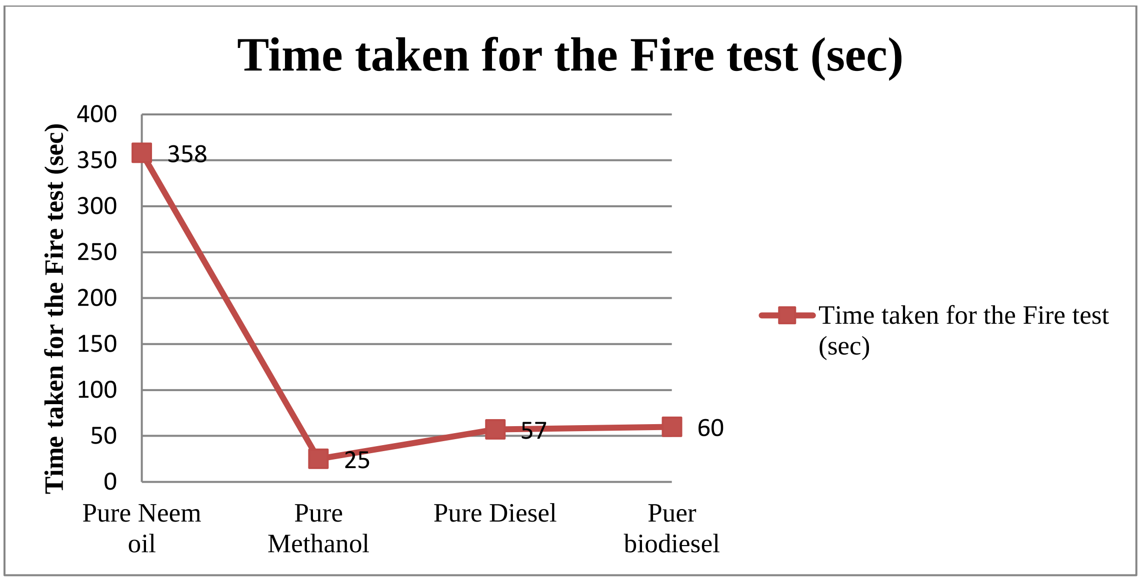

Figure: Natural flame test for fuels

Figure: Various Blends

MAGNETIC STIRRER TEST

A Magnetic stirrer or magnetic blender is a research center gadget that utilizes a pivoting magnetic field to drum up a buzz bar in a fluid to turn rapidly, in this manner mixing it. The pivoting field might be made either by a turning magnet or an arrangement of stationary electromagnets, set underneath the vessel with the fluid.

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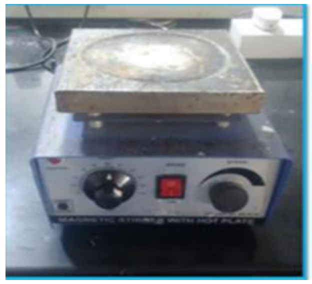


Figure: Magnetic Stirrer   Figure: Teflon type magnet

Magnetic stirrer test for B20 blend
(B20 - Neem oil (30ml) + Diesel (50ml) + Methanol (20ml))

The magnetic stirrer test for 60 ml of blend B20, the observation are:

Figure   : Weight before stirring process

Observation

After string process we observed that for 4 hours of string at 50 degree Celsius that glycerin from the B20 blend was removed.

Before string process the total weight was around 63.22 gram and after string process the net weight was around 57.23 grams

PROPERTIES TEST

The properties test for B20 blends are done at ITA LAB. B20 blend which has high biodiesel base and methanol base. So the properties like Kinematic viscosity, pour point cloud point, calorific value, certain number are tested.

SONICATION

Sonication uses sound energy to agitate the particles present in the sample. The devices use sound energy greater than 20 Kilo Hertz which leads to the process called Ultra-Sonication. There are two types of sonication.

Figure: Sonicater setup

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Direct Sonication

Energy is transferred by inserting a probe directly into a sample. It is the most commonly used method of processing. This method delivers high intensity sonication to an area that is concentrated. It is quite fast and efficient.

Indirect Sonication

With the help of a processor ultrasound is passed onto the sample with the help of a horn and is distributed through water and into the tubes where the sample is present. Advantage of using this is multi-sampling is also possible, i.e. many samples can be processed at the same time making it more time efficient.

Observation

After sonication we observed that for 2 hours of string at 50 degree Celsius that Nickel oxide is completely agitated with isopropyl alcohol.

BALL MILLING

High energy ball milling is a device that is used to grind the particles to the preferred size of the specimen. The nickel oxide particles generally come in micron sized particles, it has to be ground to Nano sized particles. The powder is put into the mixing chamber where the balls made of zirconium is put into it. The powder is ground with the help of the collision caused by the zirconium balls.

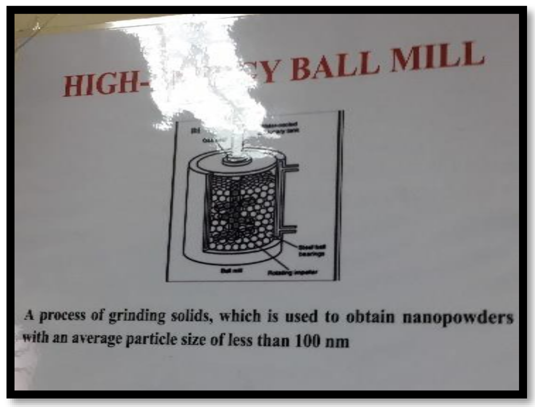

Figure: High Energy ball mill setup

Figure: Nano particle converting balls

For this grinding, weight of the balls means a lot. The size of the particle depends upon the time and weight of the balls.

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There is a calculation which is 1:6 ratio where one part is the weight of nickel oxide and six parts of the zirconium balls. The balls are each of 7.5g and they have 15mm diameter. The sample is grind for about 6 hours to get into the Nano scale range. Even though the ball milling is done lumps may still occur because of the oxidation of metal oxides, thus mortar grinding is done to eliminate the lumps hence formed.

At the initial stage of ball milling, the powder particles are reduced by the compressive forces due to the collision of the balls. The changes in the shapes of individual particles, or bunch of particles being impacted simultaneously by the milling balls with very high kinetic energy by micro-forging. However, such deformation of the powders shows no total change in mass.

At the transitional stage of the mechanical alloying process, drastic changes occur in comparison with those in the initial stage. Cold welding is now significant. Fracturing and cold welding are the influential milling processes at this stage. Although some suspension may take place, the chemical composition of the alloyed powder is still not uniform.

At the last stage of mechanical alloying processes, extensive refinement and reduction in particle size is clear. The microstructure of the particle also appears to be more uniform in the microscopic scale than those at the beginning and intermediate stages.

SEM ANALYSIS

A Scanning Electron Microscope (SEM) is a kind of electron magnifying lens that produces pictures of an example by filtering the surface with an engaged light emission. The electrons communicate with ions in the example, delivering different signs that contain data about the example's surface geology and piece. The electron bar is filtered in a raster check design, and the bar's position is joined with the identified flag to create a picture. SEM can accomplish determination superior to 1 nanometer. Examples can be seen in high vacuum in regular SEM, or in low vacuum or wet conditions in factor weight or natural SEM, and at an extensive variety of cryogenic or lifted temperatures with specific instruments.

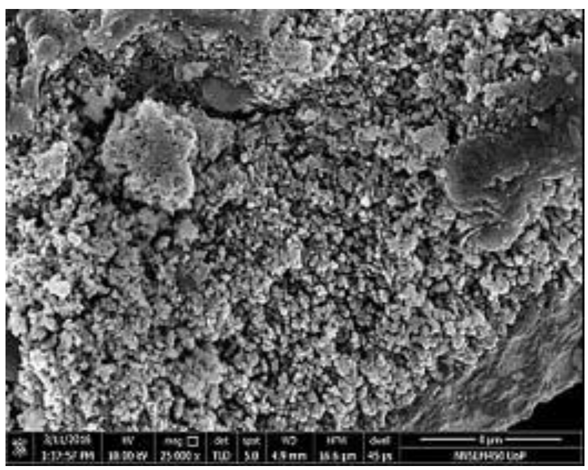

Figure: Micro size of nickel oxide before ball milling

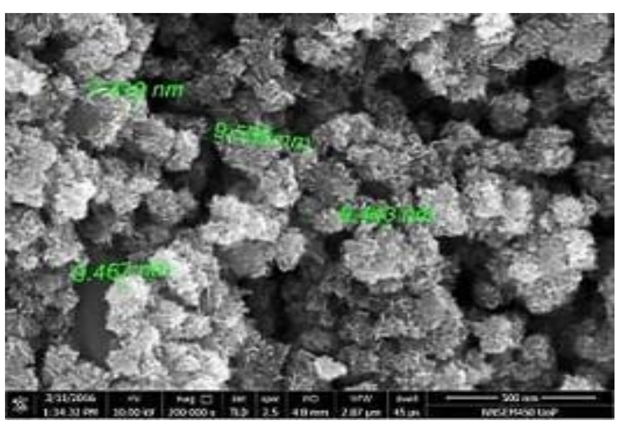

Figure: Nano size of nickel oxide after ball milling

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Observation

Before ball milling it is 4 micro meter and After Milling it is 500 micro meter.

ENGINE SETUP

DESCRIPTION

In this experimental setup we will be discussing about different sensors, meters and other materials which are used in this experiment.

Four stroke VCR engine

Figure: Four stroke VCR engine

The Setup consists of single cylinder, four stroke, VCR (Variable Compression Ratio) Research engine connected to eddy current dynamometer. It is provided with necessary instruments for combustion pressure, crank-angle, airflow, fuel flow, temperatures and load measurements. These signals are interfaced to computer through high speed data acquisition device.

The setup has standalone panel box consisting of air box, twin fuel tank, manometer, fuel measuring unit, transmitters for air and fuel flow measurements, process indicator and piezo powering unit. Rota meters are provided for cooling water and calorimeter water flow measurement.

In petrol mode engine works with programmable Open ECU, Throttle Position Sensor (TPS), fuel pump, ignition coil, fuel spray nozzle, trigger sensor etc. The setup enables study of VCR engine performance for both Diesel and Petrol mode and study of ECU programming. Engine performance study includes brake power, indicated power, frictional power, BMEP, IMEP, brake thermal efficiency, indicated thermal efficiency, Mechanical efficiency, volumetric efficiency, specific fuel consumption, Air fuel ratio, heat balance and combustion analysis.

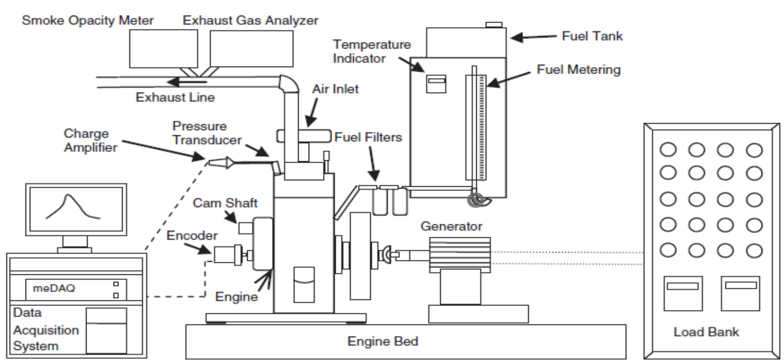

Figure: VCR Engine Setup

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Software

Engine Soft is Lab view based programming bundle created by Advancements Pvt. Ltd. for motor execution observing framework. Engine Soft can serve the majority of the motor assesses control, efficiencies, fuel utilization and warmth discharge. Different diagrams are acquired at various working condition.

`While on line testing of the motor in RUN mode fundamental signs are filtered, put away and exhibited in chart. Put away information record is gotten to see the information graphical and unthinkable configurations. The information in exceed expectations arrangement can be utilized for assist investigation.

Eddy current dynamometer

The motor was stacked by methods for a Vortex current Dynamometer. The Swirl current Dynamometer comprises of stator on which there are fitted various electromagnets and a rotor plate. Which is coupled to the external shaft from the motor. At the point when the rotor turns whirlpool streams are delivered in the stator because of the attractive transition setup because of the section of field current in the electromagnets. These swirl current restrict the rotor movement, in this way stacking the motor. Since the Vortex current is disseminated as warmth, it requires some cooling plan.

The working state of the motor and the dynamometer are portrayed by speed and torque. A refined control board is utilized to control the heap given to the dynamometer relying on the speed of the motor or dynamometer shaft.

AVL smoke meter

AVL smoke meter is utilized to quantify the sediment grouping of the fumes fan from diesel motor. The sediment focus valve can be shown as required in FSN (Channel Smoke Number) or mg/cubic m. amazingly low ash focus valve in the fumes gas can be estimated and the example volume can be fluctuated.

The smoke meter tests a volume of fumes gas, which is uninhibitedly quantifiable by the administrator with in liberal points of confinement by methods for test in the fumes line and sucks it through a perfect bit of channel paper. At that point the gas volume sucked through the channel paper in estimated in stream meter. The impact length is computed. The obscurity of the channel paper because of ash, is dictated by a reflect meter head. The residue content is shown as FSN or ash focus.

Figure: Smoke meter and AVL gas analyzer setup

EXPERIMENTAL SYSTEM

With perfect diesel, Neem oil mixes B5, B10, B15, B20, B25 stack tests were directed at steady motor speed. Over the span of examinations diesel – Neem oil mixes were set up on volume premise. At each working condition the dynamometer stack, fuel stream rate, barrel weight, and smoke were estimated in the wake of enabling adequate time for the motor to balance out.

Pure diesel activity

The engine was worked on flawless diesel at 80%, 70%, 60%, 50%, 40% load and the execution attributes of the motor were examined with diesel and these qualities were the reference for this work.

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IV. PERFORMANCE ANALYSIS

The performance of an engine is for the most part contemplated with the operating of working conditions. The characteristics by working by working the single barrel diesel motor with the mixes of Neem oil with methanol and diesel.

The obtained results are contrasted and the outcomes got when worked with diesel, Neem biodiesel and methanol and diesel blend at different mix proportions. The beneath showed diagrams are utilized to think about different attributes of engine like break thermal efficiency, mechanical efficiency, engine outlet temperature.

Brake thermal efficiency

The variation of break thermal efficiency with brake mean pressure for the Neem biodiesel blends and diesel is shown in figure. The thermal efficiency is slightly higher at part, but at full pressure they are comparable with the diesel.

That part load pressure comparatively low and dynamic operating condition cause to the low volatility, slightly higher viscosity of Neem biodiesel which affects mixture formation of fuel and leads to slow combustion.

The maximum efficiency of neem biodiesel blend is with diesel which is observed at full low.

Graph represents the variation of brake thermal efficiency with BMEP for various Neem biodiesel - methanol blends and neat diesel. It has been observed that up to 80% BMEP, the brake thermal efficiencies of the B10 Neem oil blends and B20 Neem oil blends with diesel slightly increased with neat diesel.

The variation of brake thermal efficiency with blends of Neem biodiesel and diesel, due to the change in calorific value and change in viscosity.

Table: Brake Thermal Efficiency vs. BMEP

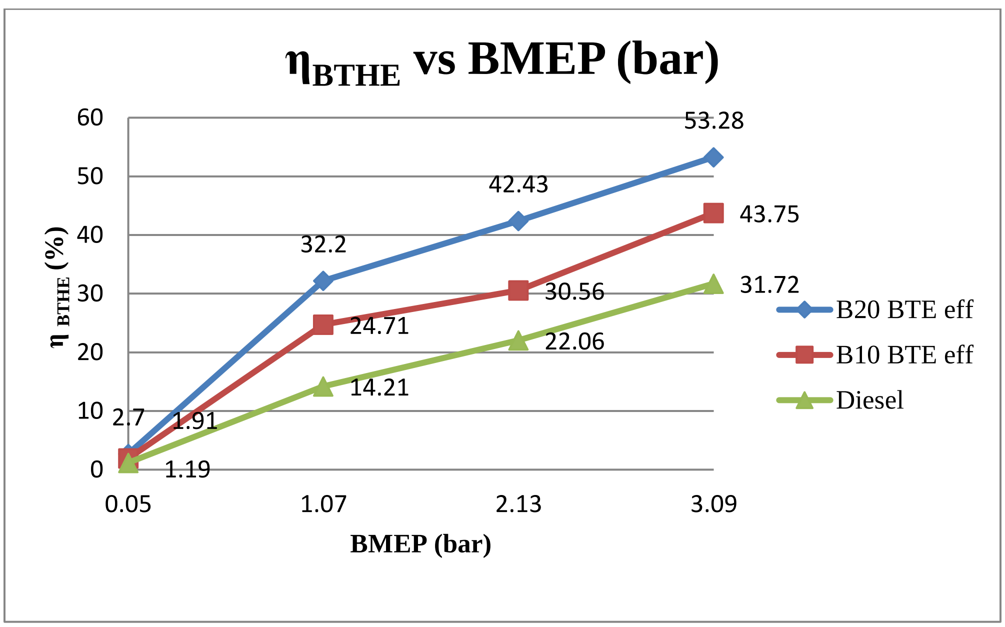

Figure: Brake Thermal Efficiency vs. BMEP

The graph in X-axis, Brake Mean Effective Pressure in Bar is considered as independent variable and in Y-axis, the dependent variable is Brake Thermal Efficiency in percentage is constructed for comparing the Brake Thermal Efficiency of Diesel, B10 Blends, B20 Blends.

Observation

The graph conclude that all fuels BMEP are directly proportional to the BTE.

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BMEP (bar)	B 20	B10	Diesel
0.05	47.89	53.51	71.76
1.07	63.03	44.52	60.47
2.13	52.23	48.9	59.13
3.09	54.3	56.72	67.21

The Diesel BTE varies slight linearly,

The Blend B10 is increasing suddenly from 0.05BMEP to 1.07BMEP as slope is more between this when compared with next two intervals of BMEP.

The Blend B20 is increasing suddenly from 0.05BMEP to 1.07BMEP as slope is more between this when compared with next two intervals of BMEP.

BMEP (bar)	B20	B10	Diesel
0.05	2.7	1.91	1.19
1.07	32.2	24.71	14.21
2.13	42.43	30.56	22.06
3.09	53.28	43.75	31.72

Indicated thermal efficiency

The variation of indicated thermal efficiency with brake mean pressure for the Neem biodiesel blends and diesel is shown in figure. The indicated thermal efficiency is slightly lower at part, but at full pressure they are comparable with the diesel.

Table: Indicated Thermal Efficiency vs. BMEP

That part load pressure comparatively low and dynamic operating condition cause to the low volatility, slightly higher viscosity of Neem biodiesel which affects mixture formation of fuel and leads to slow combustion.

The maximum efficiency of neem biodiesel blend is with diesel which is observed at full low.

Graph represents the variation of brake thermal efficiency with BMEP for various Neem biodiesel methanol blends and neat diesel. It has been observed that up to 80% BMEP, the indicated thermal efficiencies of the B10 Neem oil blends and B20 Neem oil blends with diesel slightly decreased with neat diesel.

The Diesel ITHE decreases between 0.05BMEP to 1.07BMEP and increases the ITE for next two intervals.

The Blend B10 ITHE is more similar like Diesel ITHE (decreases between 0.05BMEP to 1.07BMEP and increases the ITHE for next two intervals) for first two interval and in third interval the ITHE in more compared with Diesel.

The Blend B20 is increasing for first interval, decreases for second interval and maintains constant ITE in third interval.

Table: Indicated Thermal Efficiency vs. BMEP

BMEP (bar)	B 20	B10	Diesel
0.05	4.48	3.58	1.66
1.07	51.09	55.5	23.49
2.13	59.11	62.03	37.3
3.09	64.46	64.24	47.19

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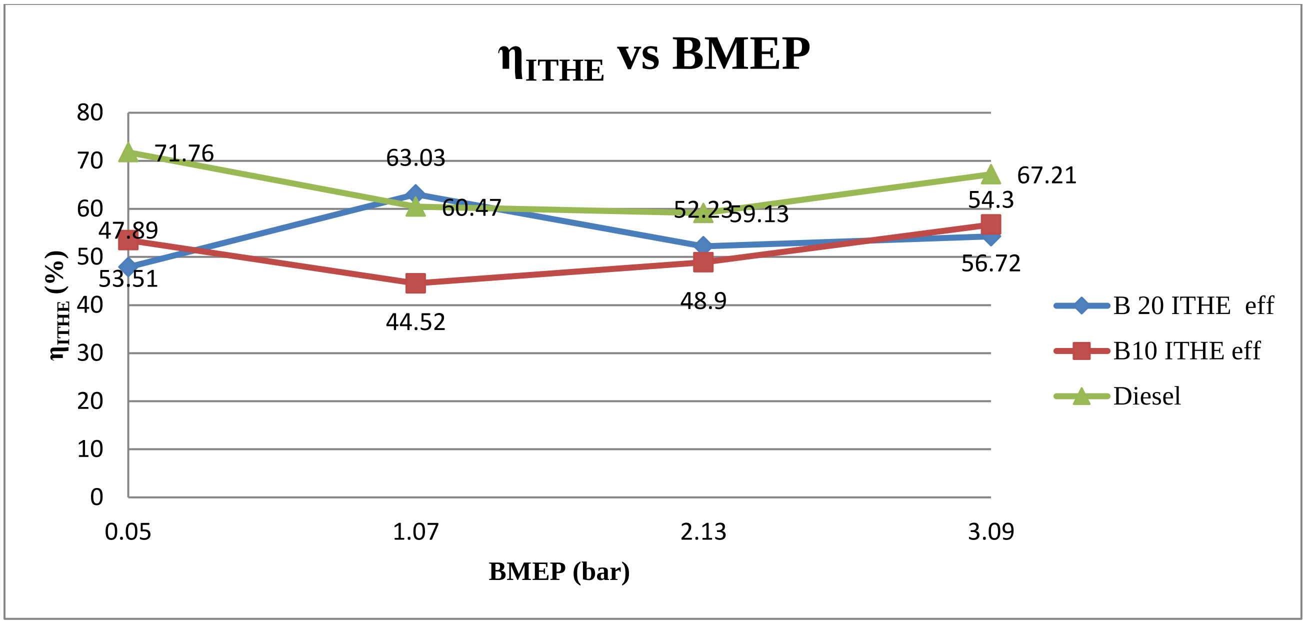

Figure: Indicated Thermal Efficiency vs. BMEP

Mechanical efficiency:

The variation of mechanical efficiency with brake mean pressure for the Neem biodiesel blends and diesel is shown in figure. The mechanical efficiency is slightly higher at part, but at full pressure they are comparable with the diesel.

That part load pressure comparatively low and dynamic operating condition cause to the low volatility, slightly higher viscosity of Neem biodiesel which affects mixture formation of fuel and leads to slow combustion.

The maximum efficiency of neem biodiesel blend is with diesel which is observed at full low.

Graph represents the variation of mechanical efficiency with BMEP for various Neem biodiesel - methanol blends and neat diesel. It has been observed that up to 80% BMEP, the mechanical efficiencies of the B10 Neem oil blends and B20 Neem oil blends with diesel slightly increased with neat diesel.

Table: Mechanical Efficiency vs. BMEP

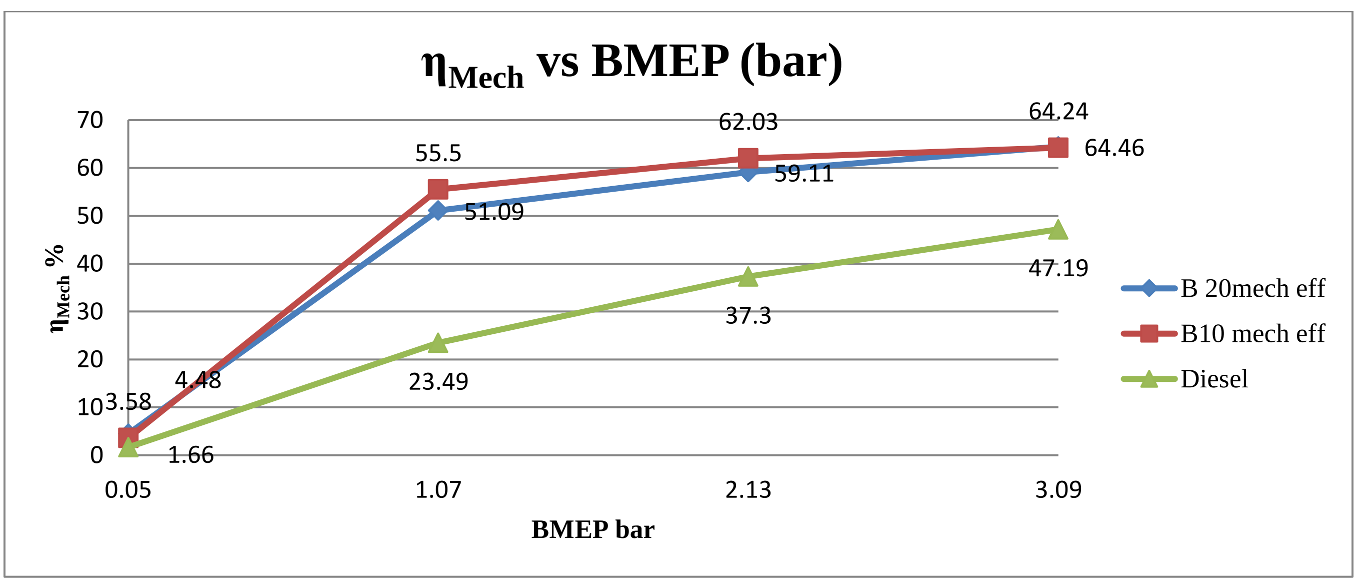

Figure: Mechanical Efficiency vs. BMEP

Observation:

The graph conclude that

The Diesel Mechanical Efficiency is less compared with other two blends.

The Blend B10 and B20 Mechanical Efficiency is high in slope for first interval and for next two interval the slope is less. This states that both Blends are more in actual efficiency.

Volumetric efficiency

The variation of volumetric efficiency with brake mean pressure for the Neem biodiesel blends and diesel is shown in figure. The volumetric efficiency is slightly higher at part, but at full pressure they are comparable with the diesel.

That part load pressure comparatively low and dynamic operating condition cause to the low volatility, slightly higher viscosity of Neem biodiesel which affects mixture formation of fuel and leads to slow combustion.

The maximum efficiency of neem biodiesel blend is with diesel which is observed at full low.

Graph represents the variation of volumetric efficiency with BMEP for various Neem biodiesel - methanol blends and neat diesel. It has been observed that up to 80% BMEP, the volumetric efficiencies of the B10 Neem oil blends and B20 Neem oil blends with diesel slightly increased with diesel.

Table: Volumetric Efficiency vs. BMEP

BMEP (bar)	B20	B10	Diesel
0.05	73.82	71.75	73.51
1.07	73.97	71.69	74.03
2.13	74.25	73.09	74.68
3.09	74.93	74.75	75.51

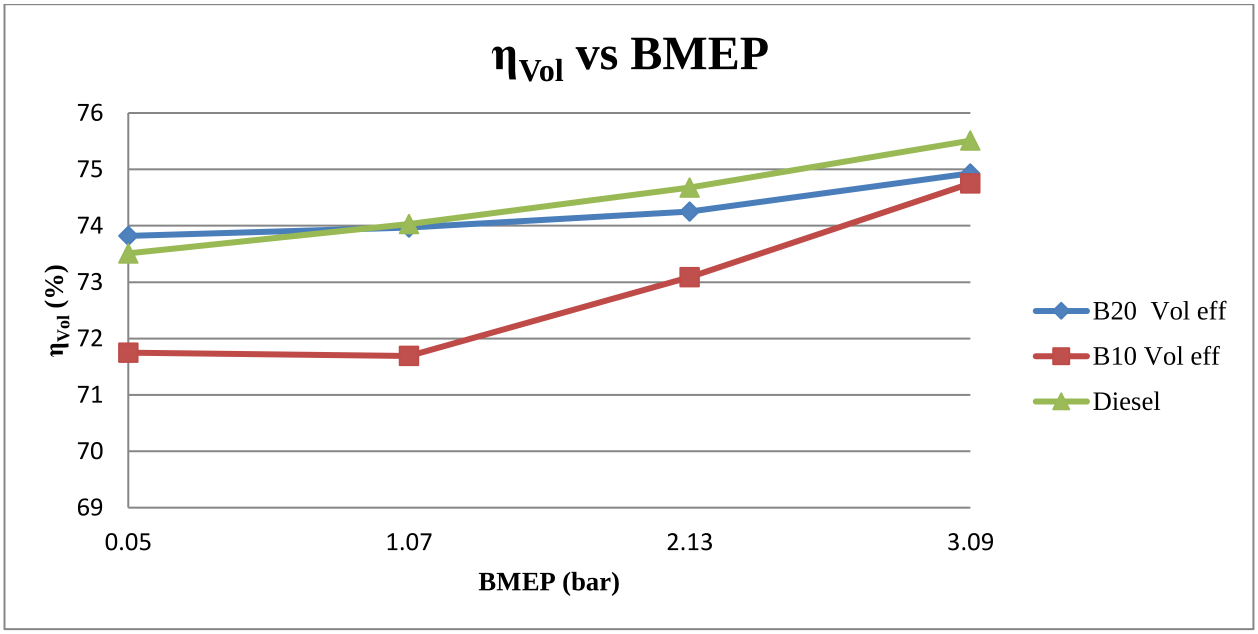

Figure: Volumetric Efficiency vs. BMEP

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Observation

The graph conclude that

The Diesel volumetric Efficiency is high compared with other two blends.

The Blend B10 and B20 volumetric Efficiency is high in slope for first interval and for next two interval the slope is less. This states that both Blends are more in actual efficiency.

Specific fuel consumption

The variation of Specific fuel consumption with brake mean pressure for the Neem biodiesel blends and diesel is shown in figure. The specific fuel consumption is slightly higher at part, but at full pressure they are comparable with the diesel.

That part load pressure comparatively low and dynamic operating condition cause to the low volatility, slightly higher viscosity of Neem biodiesel which affects mixture formation of fuel and leads to slow combustion.

The maximum fuel consumption of neem biodiesel blend is with diesel which is observed at full low.

Graph represents the variation of specific fuel consumption with BMEP for various Neem biodiesel methanol blends and neat diesel. It has been observed that up to 80% BMEP, the specific fuel consumption of the B10 Neem oil blends and B20 Neem oil blends with diesel slightly decreased with neat diesel…..

Table: Specific Fuel Consumption vs. BMEP

BMEP (bar)	B20	B10	Diesel
0.05	0.01	0	0
1.07	0.27	0.35	0.6
2.13	0.42	0.42	0.65
3.09	0.65	0.62	0.7

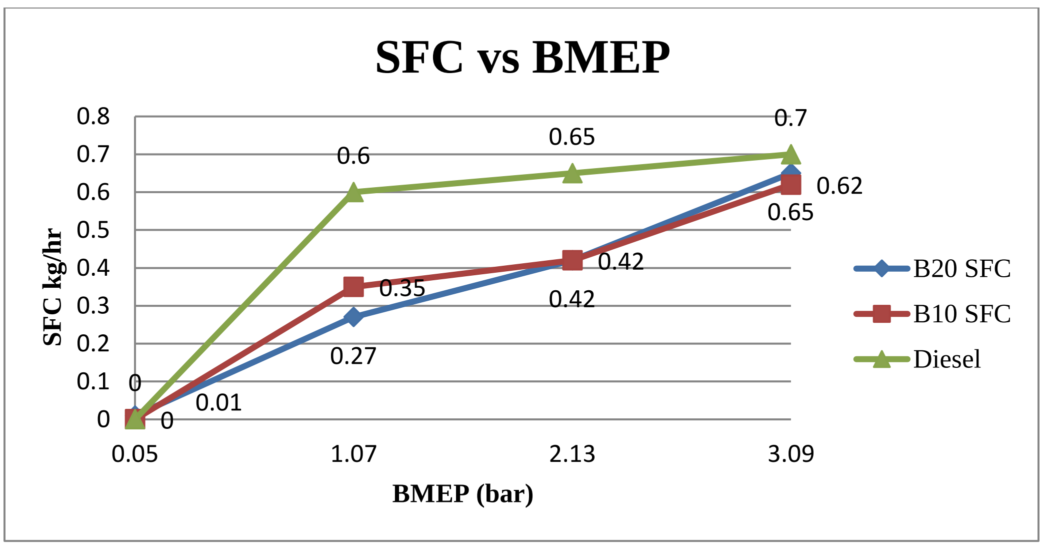

Figure: Specific Fuel Consumption vs. BMEP

Observation

The graph conclude that

The Diesel SFC increases between 0.05BMEP to 1.07BMEP and maintain linearly between 1.07BMEP to 2.13BMEP.

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The Blend B10 SFC is high until 2.13BME as compared with B20 and has higher variation in third interval.

The Blend B20 is more similar for first two interval and collinear in third interval.

Exhaust gas temperature

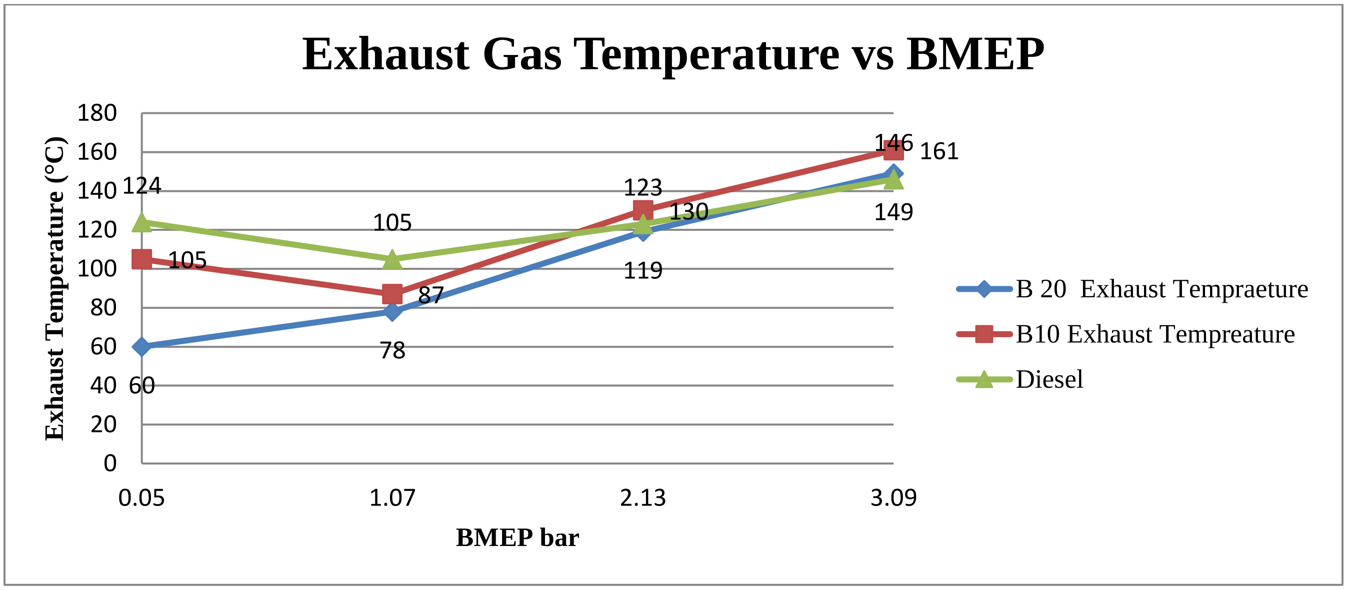

Figure: Exhaust Gas Temperature vs. BMEP

The variation of exhaust gas temperature with brake mean pressure for the Neem biodiesel blends and diesel is shown in figure. The exhaust gas temperature is slightly higher at part, but at full pressure they are comparable with the diesel .That part load pressure comparatively low and dynamic operating condition cause to the low volatility, slightly higher viscosity of Neem biodiesel which affects mixture formation of fuel and leads to slow combustion.

The maximum exhaust gas temperature of Neem biodiesel blend is with diesel which is observed at full low.

Graph represents the variation of mechanical efficiency with BMEP for various Neem biodiesel - methanol blends and neat diesel. It has been observed that up to 80% BMEP, the exhaust gas temperature of B20 Neem oil blends with diesel slightly increased with neat diesel and compared with B10 neem oil blends with diesel there is no change.

Table: Exhaust Gas Temperature vs. BMEP

BMEP (bar)	B 20	B10	Diesel
0.05	60	105	124
1.07	78	87	105
2.13	119	130	123
3.09	149	161	146

Observation for following graph

The graph conclude that

The Exhaust Gas of Diesel is more for first two intervals and reduces in third interval on compared with Blends.

The Blend B10 Exhaust Gas has lies between Diesel and B20 until 2.13BMEP and after 2.13BEMP its position is high.

The Blend B20 is low compared with other fuels through the graph.

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EMISSION ANALYSIS

The emission characteristics of the blends with various ratios are discussed below.

Carbon monoxide (CO) Analysis

Carbon monoxide is an important emanation happening in an engine. CO discharges happen because of the inadequate burning of the fuel, mostly because of absence of oxygen atoms for compelling ignition to happen. The accessibility of adequate oxygen ions makes the majority of the CO be oxidized and changed over to CO2 however the total transformation of CO to CO2 is never conceivable.

TABLE: CO EMISSION IN %vs. BMEP

BMEP (bar)	B10 with Nickel oxide	B20 without Nickel oxide	Diesel
0.05	0.01	0.01	0.02
1.07	0.01	0.01	0.03
2.13	0.01	0.02	0.04
3.09	0.02	0.03	0.04

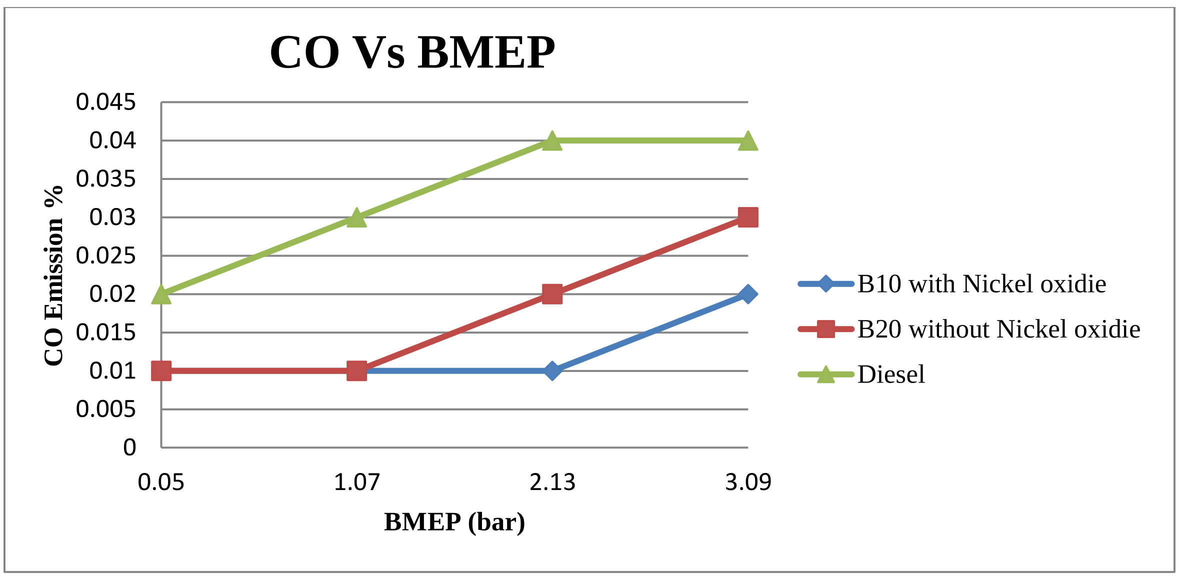

Figure: CO emission vs. BMEP

Observation

The graph conclude that

The Carbon Monoxide Emission is high in Diesel, till 2.13BMEP is increasing linearly and maintains constantly through 3.09BMEP.

The Blends B10 and B20 are constant and equal until 1.07BMEP

The Blend B10 is increasing linearly after 1.07BEMP.

The Blend B20 is constant till 2.13BEMP and increases linearly.

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Hydrocarbon (HC) emission

Hydrocarbons (HC) are another noticeable parameter in the outflow qualities of a diesel an engine. Like CO discharges, HC outflow likewise happens when the fuel particles neglect to copy totally inside the engine. The varieties in HC outflow for diesel fuel and the different mixes at different loads on the engine. The decrease in HC discharges while utilizing biodiesel as the fuel can be ascribed to the productive and more total burning occurring because of the nearness of more noteworthy number of oxygen molecules in the biodiesel fuel mixes.

Table: HC Emission in ppm vs. BMEP

HC			
BMEP (bar)	**B10 with Nickel oxide**	**B20 without Nickel oxide**	**Diesel**
0.05	1	1	5
1.07	4	4	6
2.13	8	11	6
3.09	10	19	7

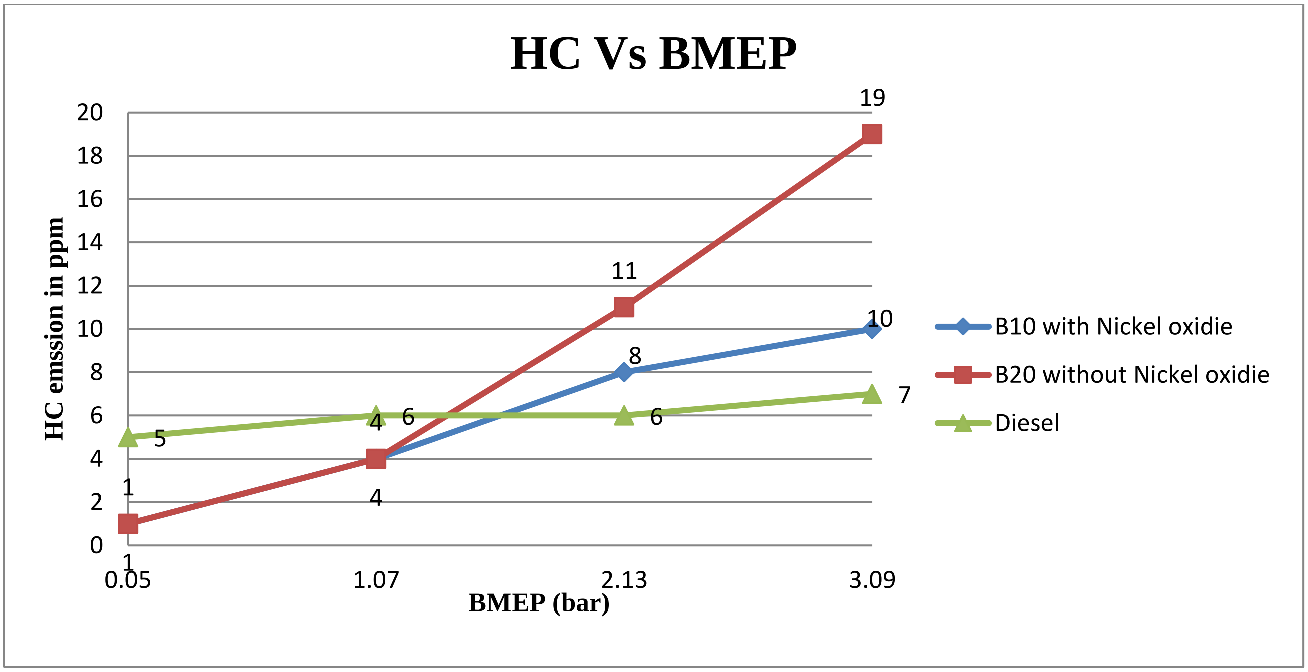

Figure: HC Emission in ppm vs. BMEP

Observation

The graph conclude that

The Carbon Monoxide Emission is high in Diesel, till 1.07BMEP and maintain constant value till 2.13BEMP. After 2.13 increasing linearly.

The Blends B10 and B20 are having constant slope till 1.07BEMP and lies between B20 and Diesel till 3.09BMEP.

The Blend B20 is high compared to other fuels.

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Nitrous oxide (NO) emission

The variation of NOx discharges for diesel and biodiesel mixes for different engine loads are appeared in figure. NOx discharge from a motor increments with increment in control yield of the motor. Since the burning temperature is higher and the oxygen fixation is more noteworthy for biodiesel, it can be seen that the NOx outflows of biodiesel and its mixes are higher than those of diesel at all heaps on the engine

Table: NOx Emission in ppm vs. BMEP

BMEP (bar)	B10 with Nickel oxide	B20 without Nickel oxide	Diesel
0.05	12	45	61
1.07	28	65	89
2.13	80	161	157
3.09	145	263	479

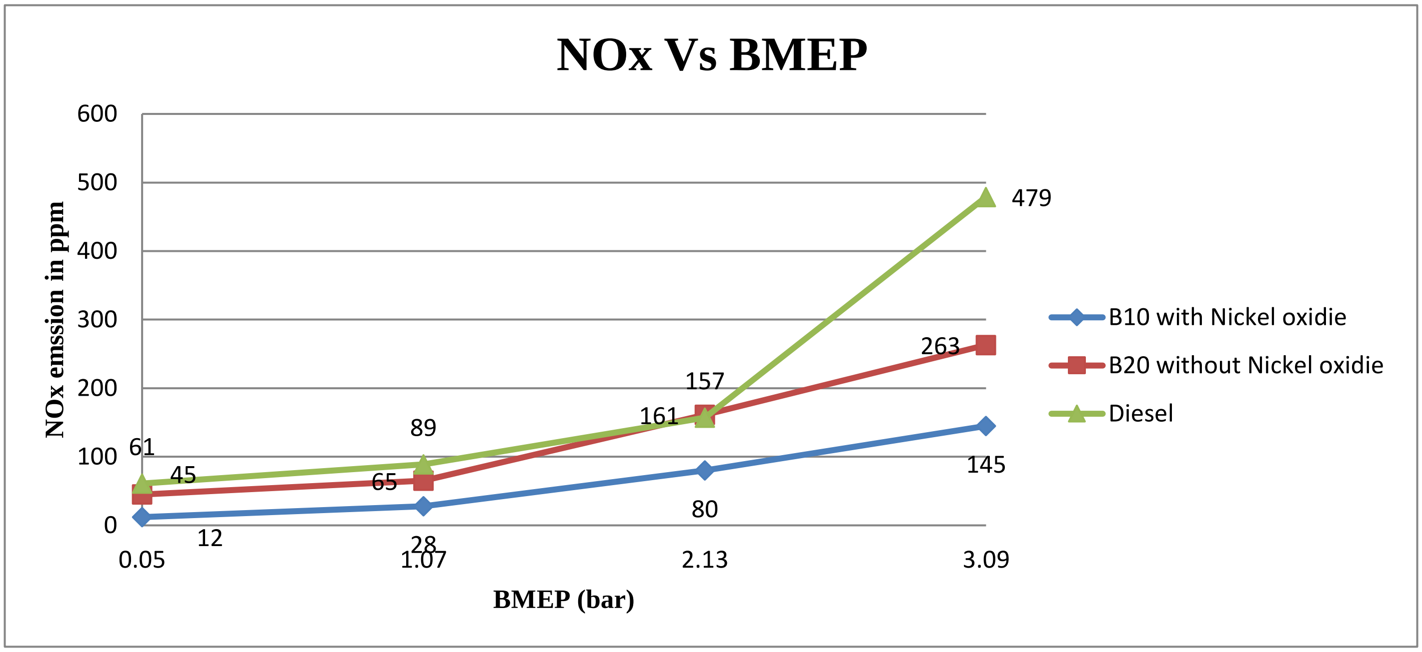

Figure: NOx Emission in ppm vs. BMEP

Observation

The graph conclude that

The Carbon Monoxide Emission is high in Diesel, till 1.07BMEP and high after 1.07BEMP.

The Blends B10 is the lowest among all fuels.

The Blends B20 lies between B10 and Diesel till 3.09BMEP.

Carbon dioxide (CO_2) emission

The variations CO_2 emissions for diesel and biodiesel blends for various engine loads are shown in figure. CO_2 emission from an engine increases with increase in power output of the engine. Since the combustion temperature is higher and the oxygen concentration is greater for biodiesel, it can be seen that the CO_2 emissions of biodiesel and its blends are higher than those of diesel at all loads on the engine.

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Table: CO_2 Emission in ppm vs. BMEP

CO_2			
BMEP (bar)	**B10 with Nickel oxide**	**B20 without Nickel oxide**	**Diesel**
0.05	0.3	1.3	1.2
1.07	0.5	1.3	1.8
2.13	0.6	1.6	2.4
3.09	0.8	2.9	3.3

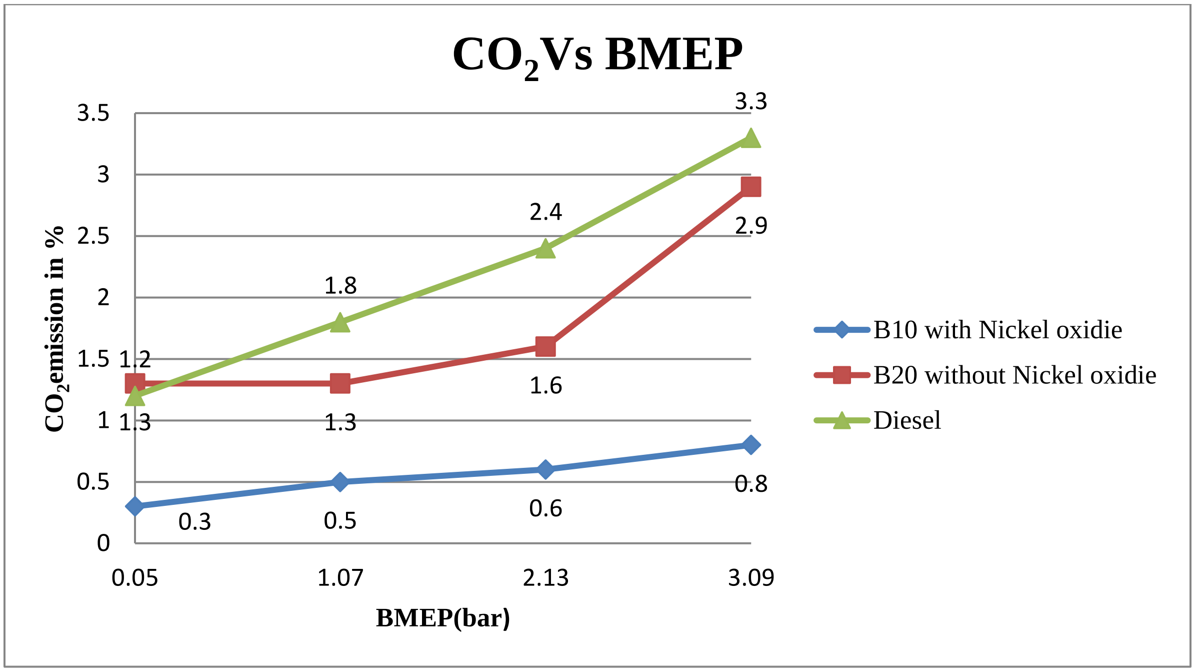

Figure: CO_2 Emission in ppm vs. BMEP

Observation

The graph conclude that

The Carbon dioxide Emission is high in Diesel, and high after 1.07 BEMP.

The Blends B10 is the lowest among all fuels.

The Blends B20 lies between B10 and Diesel till 3.09BMEP.

Oxygen emission

The variations O_2 emissions for diesel and biodiesel blends for various engine loads are shown in figure. O_2 emission from an engine increases with increase in power output of the engine. Since the combustion temperature is higher and the oxygen concentration is greater for biodiesel, it can be seen that the O_2 emissions of biodiesel and its blends are higher than those of diesel at all loads on the engine.

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Table: O_2 Emission in ppm vs. BMEP

O_2			
BMEP (bar)	**B10 with Nickel oxide**	**B20 without Nickel oxide**	**Diesel**
0.05	20.58	20.5	19.24
1.07	20.34	19.17	18.53
2.13	20.13	20.12	17.56
3.09	19.6	19.77	16.21

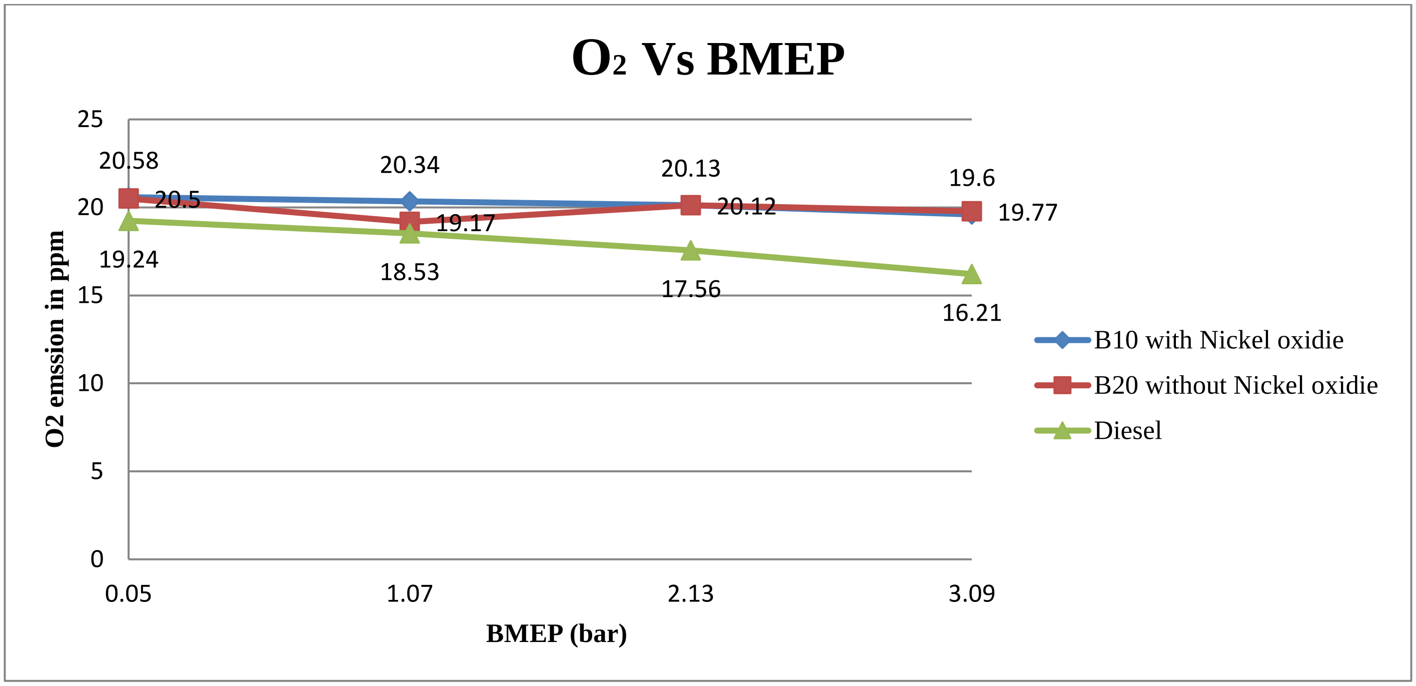

Figure: O_2 Emission in ppm vs BMEP

Observation

The graph conclude that

The Oxygen Emission is low in Diesel, and high in blends after 1.07 BEMP.

The diesel is the lowest among all fuels

The Blends B20 lies between B10 and Diesel till 3.09BMEP

Smoke density

Smoke defined as the visible products of combustion, is due to the poor combustion of the fuel in the engine. The three main operating conditions under which smoke is heavily produced in an engine are acceleration, overloading and during full load operation of the engine. Figure shows the smoke intensity of the tested diesel and biodiesel fuel blends with respect to various loads on the engine. The smoke intensity at lower engine loads is almost the same for diesel and biodiesel blends.

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Table: Smoke Density vs. BMEP

Smoke Density %			
BMEP (bar)	**B10 with Nickel oxide**	**B20 without Nickel oxide**	**Diesel**
0.05	30.2	28.5	24.3
1.07	43.8	50.1	34.8
2.13	44.8	53.2	55.5
3.09	66.2	66.2	72.5

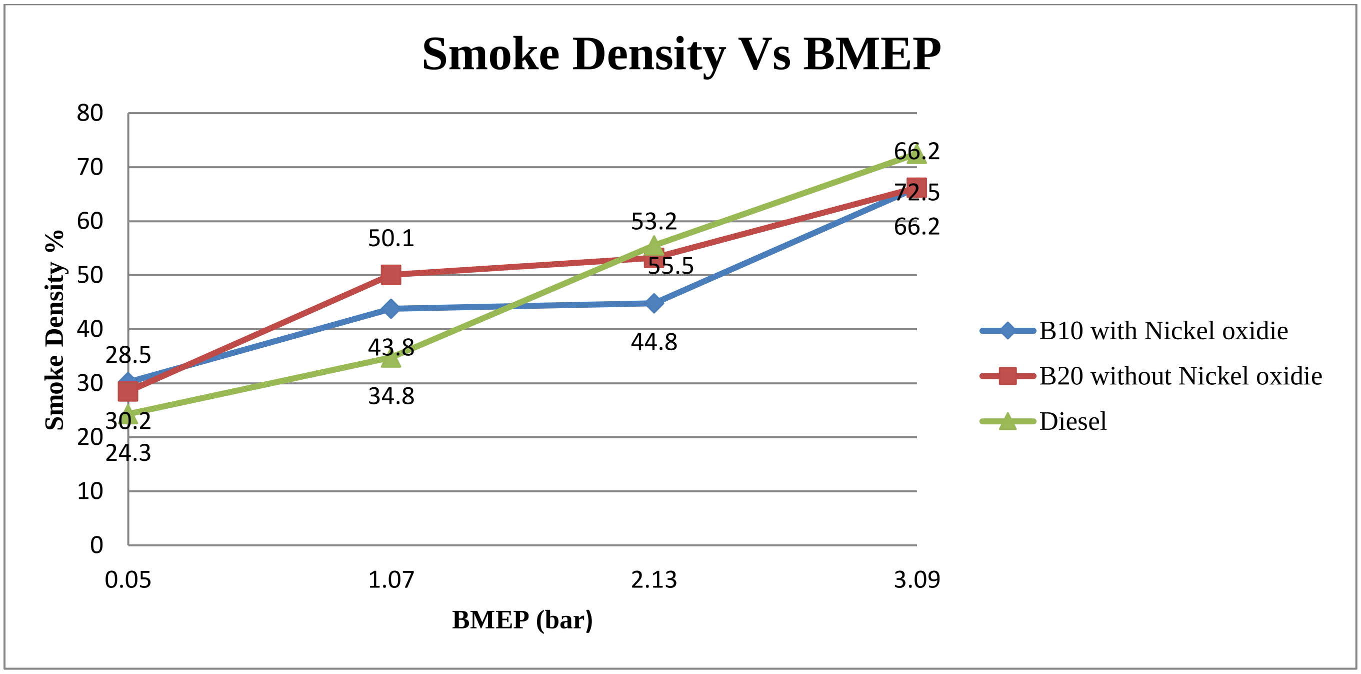

Figure: Smoke density vs. BMEP

Observation

The graph conclude that

The Smoke is high in Diesel, and low in blends after 1.07 BEMP.

The blend B10 is the lowest among all fuels

The Blend B20 lies between B10 and Diesel till 3.09BMEP

VI. CONCLUSION

A single cylinder water cooled compression ignition engine was operated successfully using Neem oil biodiesel, methanol, with and without nickel oxide and diesel blends

Neem oil biodiesel, methanol, with and without nickel oxide and diesel blends results in a slightly increases with 40 % brake thermal efficiency as compared to the of diesel.

Neem oil biodiesel, methanol, with and without nickel oxide and diesel blends results in a slightly decreases with 13 %indicated thermal efficiency as compared to the of diesel.

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Neem oil biodiesel, methanol, with and without nickel oxide and diesel blends results in a slightly increases with17 % mechanical efficiency as compared to the of diesel.

Neem oil biodiesel, methanol, with and without nickel oxide and diesel blends results in a slightly decreases with 0.1 % specific fuel consumption as compared to the of diesel.

Neem oil biodiesel, methanol, with and without nickel oxide and diesel blends B10 results in a slightly increase with 15'C exhaust gas temperature as compared to the of diesel.

Combustion parameters for Neem oil, methanol, with and without nickel oxide and diesel blends such as ignition delay and peak pressure were nearly close to those observed for diesel oil combustion at the same load, speed and nozzle diameter.

Neem oil biodiesel, methanol, with and without nickel oxide and diesel blends results in a slightly decreases with 2 % CO emission as compared to the of diesel. Neem oil biodiesel, methanol, with and without nickel oxide and diesel blends results in a slightly decreases with 2.16 % NOx emission as compared to the of diesel.

Neem oil biodiesel, methanol, with and without nickel oxide and diesel blends results in a slightly increases with 0.12 % HC emission as compared to the of diesel.

Neem oil biodiesel, methanol, with and without nickel oxide and diesel blends results in a slightly decreases with 0.4 % CO_2 emission as compared to the of diesel.

Neem oil biodiesel , methanol, with and without nickel oxide and diesel blends results in a increases with 3.56 % O_2 emission as compared to the of diesel

Filter smoke number for the Neem oil methanol, with and without nickel oxide and diesel blends was lower than the diesel.

On the whole it is concluded that the Neem oil methanol, with and without nickel oxide and diesel blends and diesel blend will be good alternative fuel for the diesel engine.

Efficiency and Emission of to B20 blends is equal and lesser than, When compared to Diesel.

Performance and emission test on compression ignition engine using Neem oil methanol, with and without nickel oxide and diesel blends is done.

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