INFLUNCE OF COMPRESSION RATION ON THE PERFORMANCEAND EMMISIONS OF MANGO SEED BIO -DIESEL

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Abstract : The major problem associated with the fossil fuels are shortage and increasing prices in the world . The fossil fuel consists of sulphur due to sulphur the engine material is rusted . During the exhaust process in the cylinder the unburnt mixture is released. In this mixture the CO (carbon monoxide) gas is major polluted in the environment. The further problems of diesel engine are fuel shortage , environment pollution , fuel cost to minimize these problems the alternative fuels are used . The alternative fuels i.e, bio diesel alcohol fuels , ammonia , hydrogen , natural gas , propane etc. In this project discuss the bio fuel on the mango seed.The mango seed biodiesel is prepared using transertification process with various and the blend proportion such as B10,B20,B30 and B40 are used for the studies. The blends are tested in single cylinder four stroke CI engine .The compression ratio and injection pressures are varied for each blend from No load to Full load condition. The obtained results are compared with the standard diesel results and optimal combination is analyzed. For the mangoseed blend B20 shown good results interms of performance and emissions.

***IndexTerms* – Biodiesel, Performance, Emissions, IC Engine.**

1. INTRODUCTION

Biodiesel refers to a animal fat- based and vegetable oi diesel engine fuel consisting of long-chain alkyl (methyl ,ethyl, propyl) esters . Biodiesel is typically produced by chemically reacting lipids (example.,vegetable oil ,animal fat) with an alcohol.

The oil is extracted from algae methyl ester ,mango seed , jatropha cuecas seed ,rubber seed etc. This oil is mixing in the diesel as per required parameters examples that are

- B10 - 100 ml bio diesel +900ml diesel .
- B20 - 200 ml bio diesel +800ml diesel .
- B30 -300ml bio diesel +700 ml diesel .

The above example wise can be find the compression ratio ,ignition pressure ,indicated thermal efficiency,brake thermalefficiency ,mechanical efficiency, mean piston speed ,specific fuel consumption , fuel air ratio etc . This is easy to use in 4-stroke diesel engine with there is no modifications

- It can reduce pollution because for lower exhaust emissions in bio diesel .
- It can produce easily for waste like mango seed .
- It is less toxic than table salt and minimal environmental impact .
- The power ,performance and economy is compared to diesel it is equal than bio diesel .
- The bio diesel can store similar to diesel.

In most of all diesel engines Biodiesel is used. It is distinct from the vegetable and waste oils used in fuel converted diesel engines .It is a comination opetrol and diesel . Biodiesel used as a low carbon alternative to heating oil. The Blends of biodiesel products are most commonly are available in the retail diesel fuel marketplace . For these cases the world uses a system as "B" factor to state the amount of biodiesel in any fuel mix .

Blends , less than 20% biodiesel can be used in diesel engines without any or with very minor modifications of the engine .The pure biodisel can also be used certain engine modifications to avoid maintains and performance problems.

Biodiesel can be combined with petro-diesel at any concentration in most diesel engine injection pump . Bio-diesel has been known to break down deposits of residue in the fuel lines where petrol and diesel has been used . As a result , fuel filters may get clogged with particulates if a quick transition to pure biodiesel is made . Therefore , it is recommended to change the fuel filters on heaters and engines shortly after first switching to a biodiesel blend .In the year 2005 , biodiesel use has been increasing all over the world.

The mango seed are used as a generable source for functional good ingredients, antimicrobial compounds ,natural antioxides ,cosmetic carbon and activated carbon. In addition to that , it could be further processed into therapeutic functional food products .The mango seed is more useful for further now just discarded as a waste .

The chemical name of mango is Mangifera indica L . It is king of all fruits . It belongs to Anacardiaceae family . It is found in india . The cultivated varieties are spread-ed around the warm regions of the world . Mango is a national fruit in india , pakistan and philippines.

Figure 1 Mango Seed

Several researchers studied on several biodiesels and identified the biodiesel is an alternative to the diesel. [1-4].

2.EXPERIMENTAL SETUP AND PROCEDURE

Using Mango seed biodiesel oil tests are to be conducting on different equipment's, to be found some of the fuel properties. Later performance and emission tests were conducted on 4- stroke single cylinder water cooled diesel engine coupled with a rope brake dynamometer, with the help of d multi gas analyser and .Smoke meter

Figure 2 Pictorial view of Diesel Engine

The setup consits of singular cylinder ,4- stroke ,VCR (variablecompression ratio) .It is connected to eddy current type dynamometer for loading.The geometry of this engine is designed by tilting cylinder bock arrangement. In the combustion chamber the compression ratio can be changed without stopping the engine and without altering .In this engine instrument setup is provided for combustion pressure and crank-angle measurements.The indication of pθ-pv diagrams are interfaced in computer through signals. The provisions of this engine are interfacing fuel flow,air flow, temperatures and load measurement.The engine set up has stand-alone panel box consisting of air box, two fuel tanks for duel fuel test,manometer, transmitters for air and fluid flow measurements ,fuel measuring unit, process indicator and engine indicator . Rotameters is used to measure the water flow measurement and cooling water.The setup enables study of VCR engine performance for brake power, indicated power, frictional power, brake thermal efficiency, indicated thermal efficiency, volumetricefficiency, mechanical efficiency,IMEP, BMEP,A/F ratio, specific fuel consumption and heat balance. This engine is based on the software package name of EnginesoftLV.

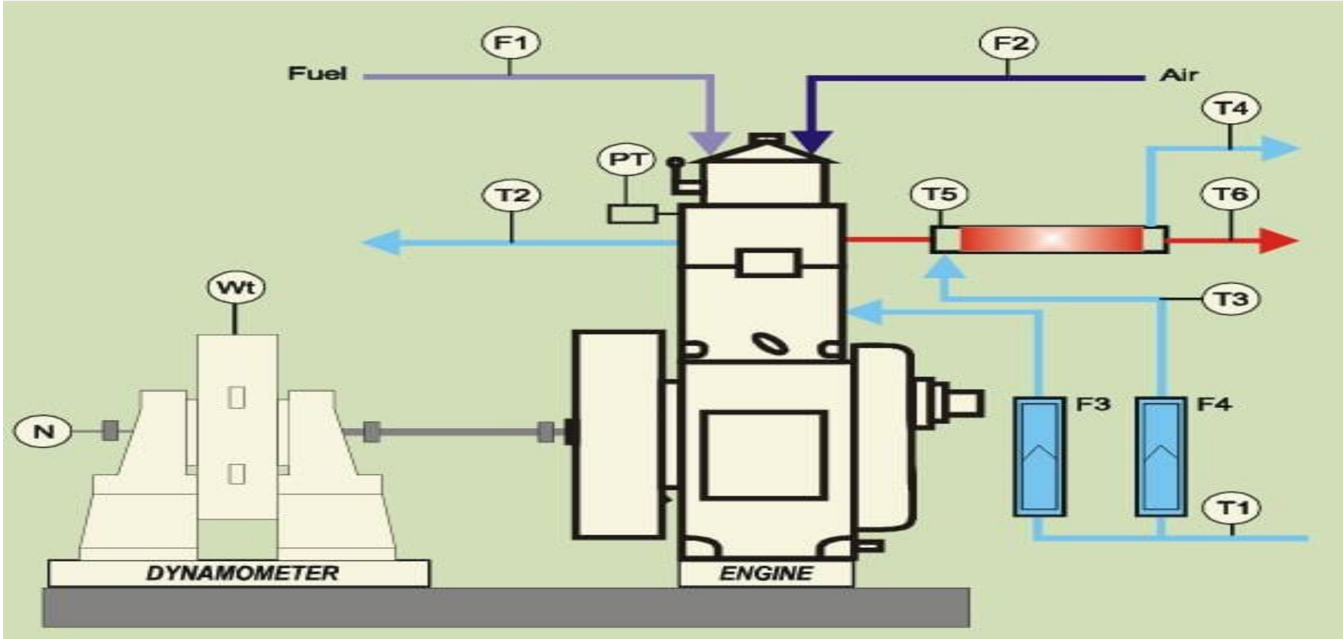

Figure 3 Line Diagram Of Single Cylinder 4- Stroke Diesel Engine

The components of the engine

1. Engine, 2. Dynamometer,3. Dynamometer loading unit,4. Propeller shaft, 5.Manometer, 6.Fuel measuring unit, 7. Piezo sensor, 8.White coaxial teflon cable, 9. Crank angle sensor, 10. Data acquisition device, 11. Piezo powering unit, 12.Temperature sensor, 13.Temperature transmitter, 14.Load sensor load indicator, 15. Power supply, 16. Digital voltmeter, 17. Fuel flow transmitter, 18. Air flow transmitter, 19. Rotameter, 20. Pump

EXPERIMENTAL TEST PROCEDURE

To generate the base line data the experiments are carried out initially using diesel fuel.At a constant speed of 1500 rpm the engine was allowed to run for 20 minutes to attain steady state at no load conditions. The is to run at steady condition at constant speed.Then gradually applied load from no load to full load using the eddy current dynamometer.Then the no load to full load condition the following oberations are made. Thease tests are carried out for full loads with injection pressure 200 bar and standard injection timing of 23 degree before TDC.The following measurements are tested in this engine

1. Time taken for 10 cc of bio fuel consumption

2. Exhaust gas temperature

3.Smoke opacity

4. Measurement of NOx, HC, CO and CO2 using emission analyser

5. Cylinder pressure variation with crank angle measurement

After the baseline tests with diesel fuel, various engine tests were conducted tostudy the performance, emission and combustion characteristics of DI diesel enginewith mango seed biodiesel blends and the experimental results were compared and discussed in the following chapter. Different biodiesel blends were prepared in various proportions such as B10,B20,B30,B40 and D100 for further investigations. Biodiesel blend was stored in separate fuel tank then connected to burette. The engine was started using diesel fuel and then ran for 25 minutes for the engine to warm-up. After the engine warmed up, biodiesel was used as fuel. Experiments were conducted with B10,B20,B30,B40 and D100 as fuels. All readings were taken for all measurements during every loading operation in each experiment in order to verify the repeatability of measured data. After completing the experiments with all biodiesel blends as fuels, the engine was allowed to run for a while (30 minutes) with diesel to wash away the residual biodiesel of the previous biodiesel blend.

RESULTS AND DISCUSSION

PERFORMANCE CRITERIA FOR CI ENGINES

BRAKE POWER VS LOAD

The variation of brake power and load for diesel fuel and biodiesel blends are B10,B20,B30,B40 and D100 .

Comparing the load and Brake power at compression ratio 16

The compression ratio 16 is performed on the below graph . The Fuel B20 gives maximum brake power which is 3.56 KW followed by B40 at full load condition .It was found that brake power of B20 is 5.89 % higher than B30 . It can be attributed to the fact that the higher viscosity of biodiesel results in the power losses due to poor atomization of fuel during the injection .

BRAKE POWER VS BRAKE THERMAL EFFICIENCY

The variation of brake power Brake Thermal Efficiency for diesel fuel and biodiesel blends are B10,B20,B30,B40 and D100 .

Comparing the brake power and Brake thermal efficiency on compression ratio 18

In figure 4 Shows that the brake thermal efficiency with respect to brake power of the engine . It is seen that all blend of mango seed oil shows lower brake thermal efficiency when compared to solo fuel . B30 mango seed oil shows 29.09% brake thermal efficiency at maximum brake power of the engine in compression ratio 18 and load 100% . It was found that brake power of B30 is 6.53 % higher than B10 . It is due to high viscosity of mango seed oil leads to lower the break thermal efficiency .

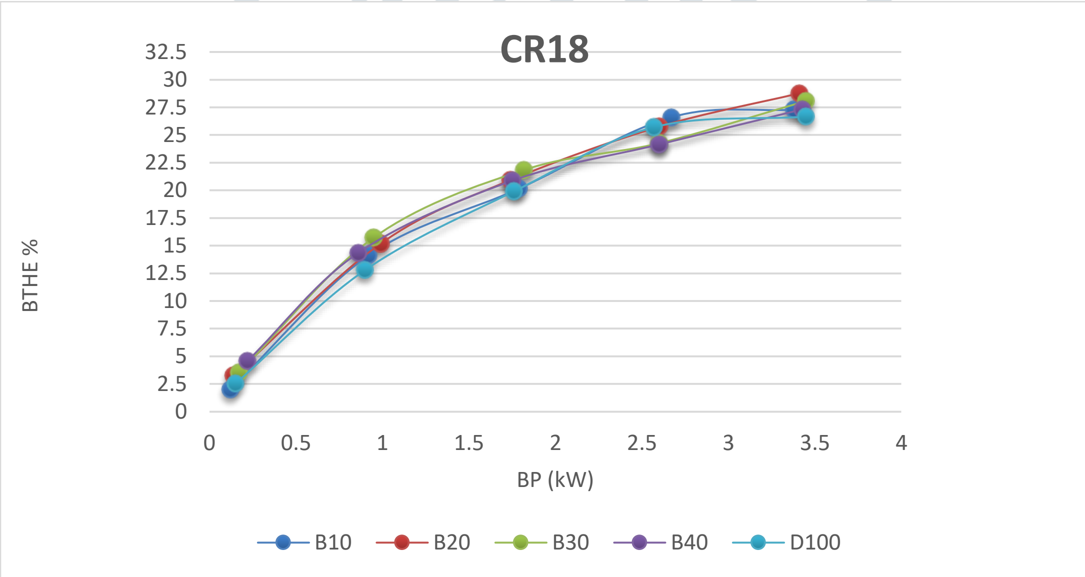

Figure 4 Brake Power vs Brake Thermal Efficiency

BRAKE POWER VS BRAKE SPECIFIC FUEL CONSUMPTION

The variation of brake power and Brake Specific Fuel Consumption for diesel fuel and biodiesel blends are B10,B20,B30,B40 and D100 .

Comparing Brake power and Brake specific fuel consumption on compression ratio 14

The variation of brake power vs brake specific fuel consumption was shown in figure 5 below .The graph reveals that brake power increases with decrease in brake specific consumption that means fuel consumption decreases . It is seen that all blends of mango seed oil shows higher specific fuel consumption a long with sole fuel of the engine . It is due to high viscosity and poor volatility of the mango seed oil as results in poor atomization and mixture formation and increases in fuel consumption . In the compression ratio 14 shows that B10 , B30 ,B40 ,D100 oil shows the maximum brake specific fuel consumption than other blends of mango seed oil and one interesting point is that B20 having less fuel consumption compared to other blends .

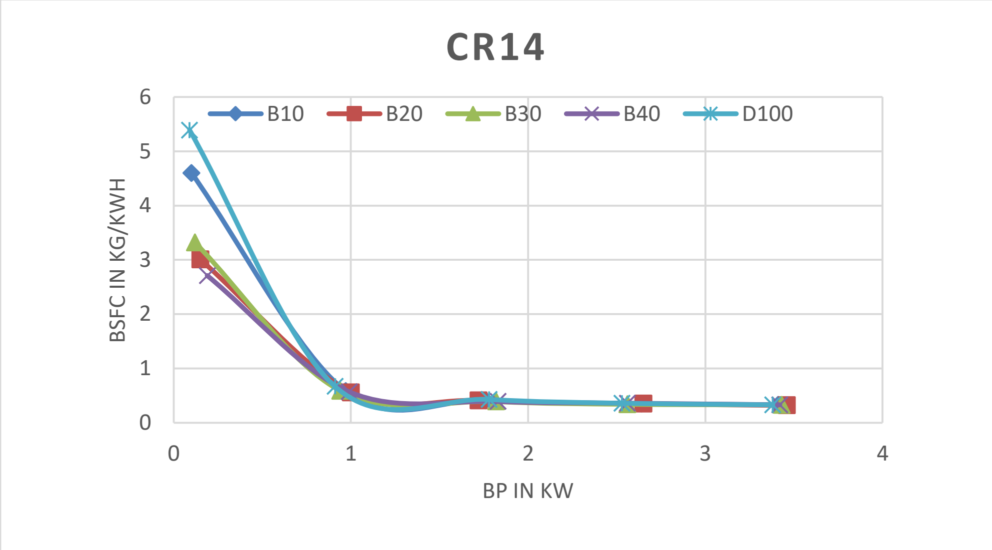

Figure 5 Brake Power vs Brake Specific Consumption

BRAKE POWER VS MECHANICAL EFFICIENCY

The variation of brake power and mechanical efficiency for diesel fuel and biodiesel blends are B10,B20,B30,B40 and D100 .

Comparing the Brake power and Mechanical efficiency on compression ratio 14

The variation of brake power vs mechanical efficiency in compression ratio 14 is plotted and shown in figure 6 below. The mechanical efficiency of a diesel engine was high while using mango seed oil blends when compared with diesel . As the brake power increases the mechanical efficiency also increased and blend B10 has showed maximum when compared to pure diesel .Figure 6 Shows that the mechanical efficiency with respect to brake power of the engine . It is seen that all blend of mango seed oil shows lower mechanical efficiency when compared to solo fuel . B10 mango seed oil shows 56.24% mechanical efficiency at maximum brake power of the engine in compression ratio 14 and load 100.% . It was found that brake power of B10 is 52.28 % higher than B30 . It is due to high viscosity of mango seed oil leads to lower the mechanical efficiency

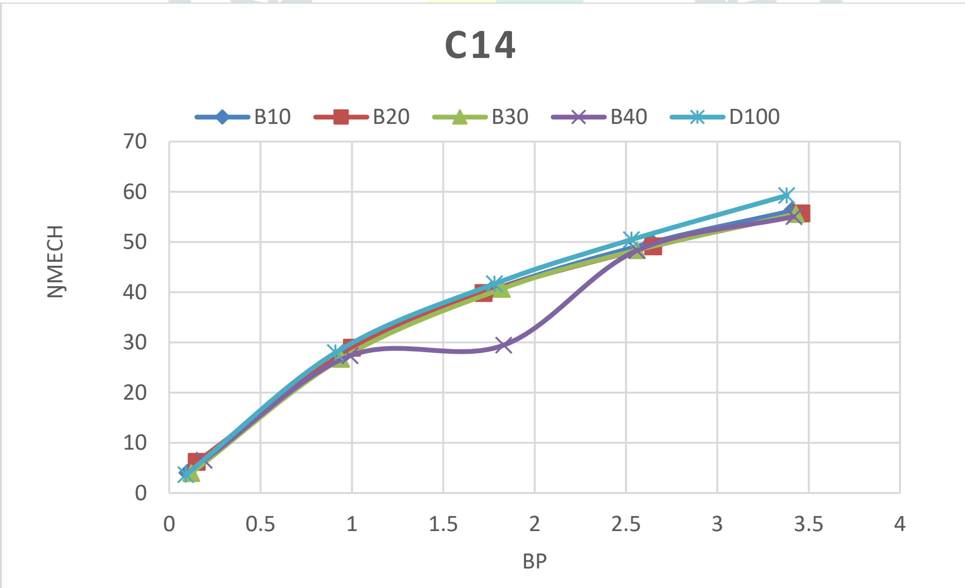

Figure 6 Brake Power vs Mechanical Efficiency

ENGINE EMISSIONS :

For the human existence energy is the most fundamental requirement . The usage of fossil fuels has highly increased and usage of these energy resources has major environmental impact as well. The generation of mechanical energy and electricity the diesel fuel is largely used in transport , agriculture, commercial , domestic and industrial sectors . The fossil fuels are available. But the bio-diesel obtained from animal fatty acids and vegetable oils promises to be more eco-friendly when compared to diesel fuel . For many countries to find the suitable sustainable fuel alternatives has become a high priority . In future it will play major role in various industries. Bio-diesel is a non-petroleum based fuel . It is one of these sustainable fuels . It consisting of alkyl esters derived from either transesterification of triglycerides obtained from vegetable oils or esterification of free fatty acids from animal fats with short-chained alcohols . It has many advantages that include biodegradable , better lubricity , low emissions and non-toxic.Bio-diesel has not become a better alternative fuel .The bio-diesel has higher production cost and non-availability of raw material . It is most serious restrictions in its commercialization and frequent use in diesel engines for poor oxidation stability.For these issues the research and development in the field of oxidation stability and cost of the biodiesel is reduced.

The engine emissions are classified into two categories

1. Exhaust emissions and

2. Non-exhaust emissions.

CARBON MONOXIDE (CO) EMISSION :-

Carbon moxide is a poisonous gas .It is a colorless and odorless. In this oxygen is not enough to convert all carbon to CO2 . In this unburned fuel and some carbon ends up as CO .

$CO + 0.5\ O_2 \rightarrow CO_2 + heat$

An engine runs rich the maximum amount of CO is generated . In the starting or when accelerating under load the rich mixture is required. Local rich regions , poor mixing and incomplete combustion will also be the source for CO emissions. CI engines that operate lean generally have low CO emissions .

Variation of carbon monoxide (CO) emission with load in the compression ratio of 18

In the graph 7 shows that increasing load , the air fuel mixture becomes higher resulting in increased rate of post flame oxidation reactions because of the increased temperature. But at very high loads , the air fuel mixture being very rich results in a high proportion of rich local zones . Due to this , only partial oxidation of carbon occurs giving more CO emissions .For the comparision of pure diesel the bio-diesel CO emission is high.In B10 the highest emission is 0.12 is high for starting the engine low is 0.011 at 9KN at B10 in the compression ratio of 18.

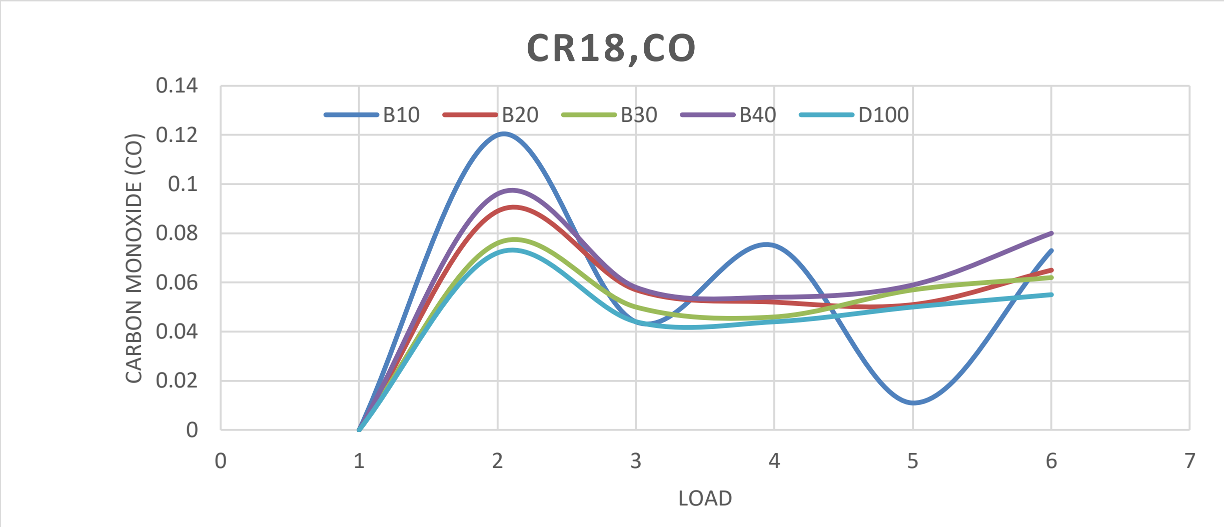

Figure 7 Load vs Carbon Monoxide

HYDROCARBON EMISSIONS

The overall fuel-lean equivalence ratio is operated in CI engines. The average higher molecular weights are in diesel compared to gasoline blend. Then the results are higher boiling and condensing temperatures.In the combustion process some HC particles condenses onto the surface of the solid carbon soot.In the CI engines the formation of soot is more in out of the cylinder. In the non homogeneous fuel air mixture some local spots in the combustion chamber will be too lean to combust properly. In the biodiesel tests are performed on HC compared to load.

Variation of Hydro carbon(HC) emission with load in the compression ratio of 16

In figure 8 the HC emissions are increases with load .Because of lower oxygen content available for combustion ,that is lower excess oxygen concentration results rich mixture which results incomplete combustion and results higher hydro carbon emission.In this graph B30 and B40 is high 46 at maximum loads and low at 7 in B20 at compression ratio 16.

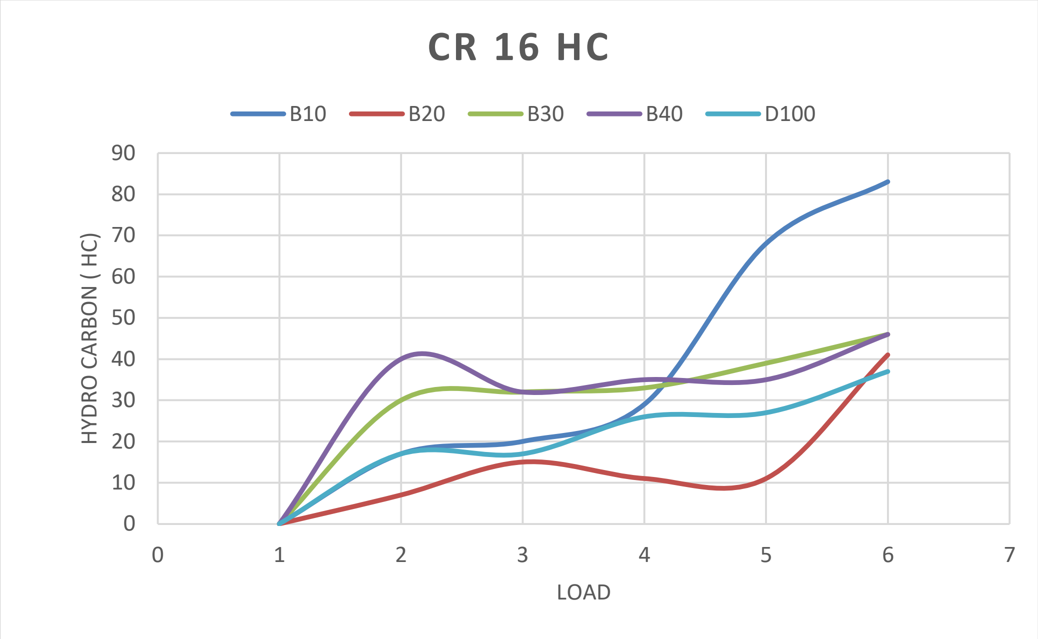

Figure 8 Load VS Hydro Carbon

OXIDES OF NITROGEN (NOX)

The oxides of nitrogen released from an engine upto 2000ppm. In this small amount of NO2 is present. There will also be traces of other nitrogen-oxygen combinations.These are all grouped together NOX , with x respresenting some suitable number. The releasing NOX emissions in the atmosphere to form ozone and is one of the major causes of photochemical smog.In fuel blends also nitrogen is founded. There are a number of possible reactions that form NO. These include but are not limited to :-

$O+N_2 \rightarrow NO+N$

$N+O_2 \rightarrow NO+O$

$N+OH \rightarrow NO+H$

NO can further react to form NO_2

$NO+H_2O \rightarrow NO_2 +H_2$

$NO +O_2 \rightarrow NO_2+O$

In the higher combustion process the more diatomic nitrogen N2 will dissociate to monatomic nitrogen.The formation of NOX depends on pressure and air -fuel ratio In this air-fuel ratio is mango seed biodiesel.

Variation of oxides of nitrogen (NOX) emission with load in the compression ratio of 14

In this Graph 9 shows the variation of oxides of nitrogen (NOX) emission with load in the compression ratio of 14.In the mango seed biodiesel the reasons for reduction in NOX emissions using mango seed biodiesel in diesel engines are reduced oxygen concentration and decreased the flame temperatures in the combustion chamber . However, NOX emissions in case of biodiesel blends without exhaust gases are higher than diesel due to higher temperatures prevalent in the combustion chamber.In this the B40 is higher is 1740 and B20 is 5 is lower at compression ratio 14

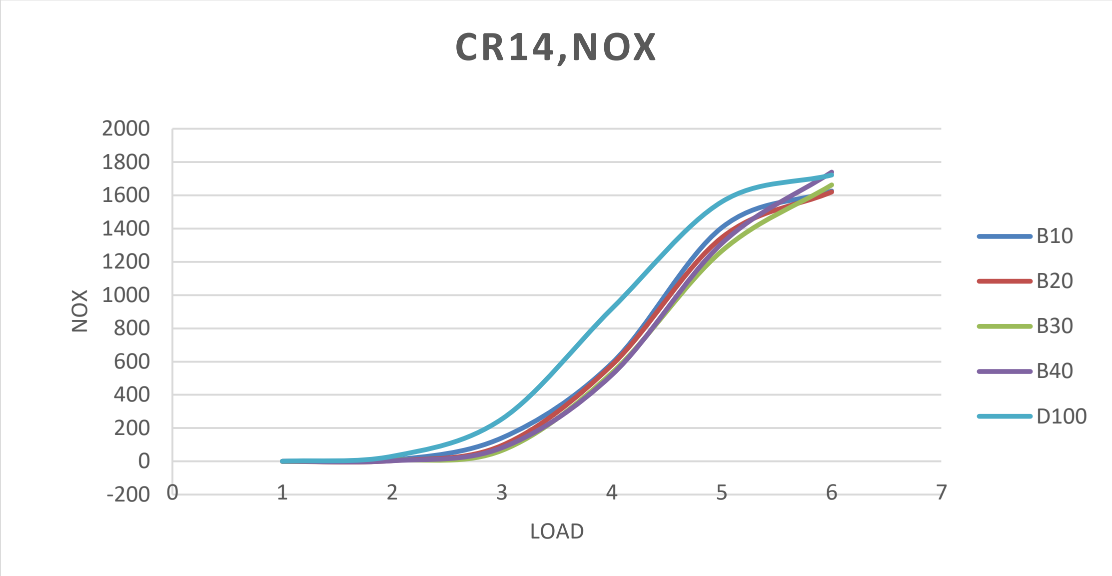

Figure 9 Load vs Oxides Of Nitrogen

CARBON DIOXIDE EMISSIONS

In diesel engines the usage of fuel is less and air is more for the comparision of petrol engines.So in diesel fuel contains slightly more carbon than petrol engines.

Variation of oxides of Carbon dioxide (CO2) emission with load in the compression ratio of 16

In the Graph shows that the variation of oxides of Carbon dioxide (CO2) emission with load in the compression ratio of 16.In this graph 10 CO2 is highest at 5 in B10 and less is 1.65 at B10 in the compression ratio of 16.

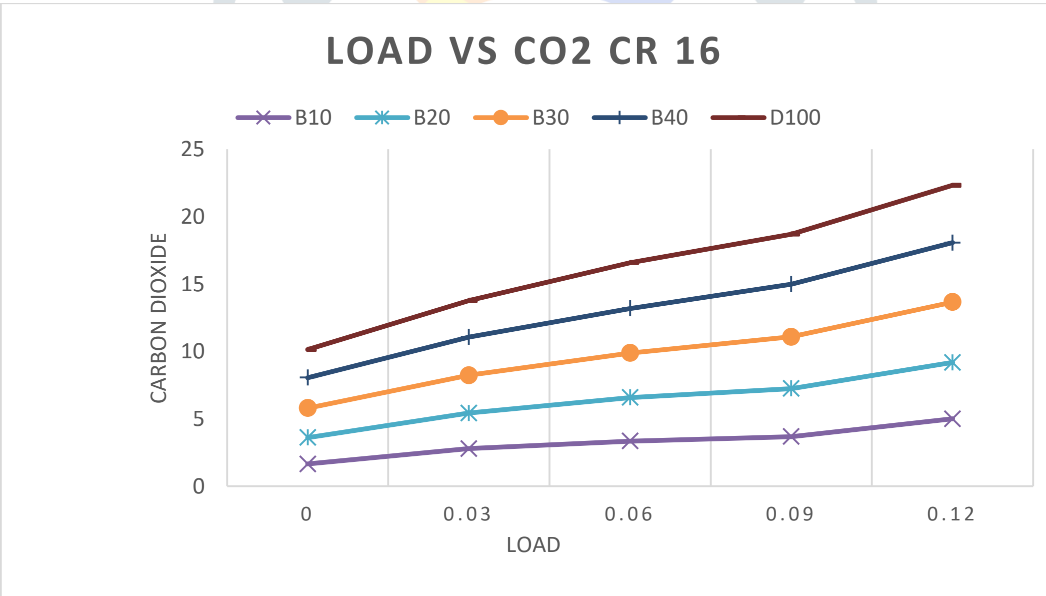

Figure 10 Load vs Carbon Dioxide

14.CONCLUSION

In this project experiments were conducted on computerized variable compression ratio four stroke single cylinder water cooled direct injection diesel engine at constant speed using various Mango seed biodiesel blends. The conclusions were as listed here after comparing all the test results with baseline test results based on performance and emission parameters. From the results the mango seed biodiesel blend B20 shows good results interms of performance and emissions when the engine is operated at compression ration 18. With out modification in the engine design more or less the B20 blend shown good results in terms of performance and emissions.

15.SCOPE OF FUTURE WORK

In the present investigation the performance and emission are evaluated with constant operating parameters such as injection timing and speed but at different compression ratios and injection pressures. With varying these parameters the investigation of the engine also carried out based on combustion analysis and heat release rate.

In the future work the investigation will be carried out by varying the operating parameters like injection timing by using Mango seed oil methyl esters we add the ignition improve the performance of the engine will be enhanced.

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