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Performance of Diesel Engine Experimentally Using Neem Bio Diesel Fuel with Different Blends

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ABSTRACT: Biodiesel now a days is rising as an elective fuel which is a decent substitution to the oil diesel. Biodiesel is basically gotten from fats and oils by various strategies, for example, weakening, pyrolysis, small scale emulsification and transesterification however nowadays most business technique utilized for biodiesel creation is transesterification. Neem oil biodiesel was readied utilizing transesterification process by improving the creation boundaries, for example, liquor to oil molar proportion, impetus focus and so forth. Motor plan likewise assumes a significant job as though it is improved it diminishes fuel utilization and give better execution boundaries. In this proposal the primary accentuation has been laid on ideal creation of biodiesel from neem oil and afterward utilizing the biodiesel mixes with diesel contemplating the near fumes emanation attributes and motor execution and furthermore advancing the pressure proportion and the mixes produced using the biodiesel with diesel. A four stroke variable pressure proportion single chamber pressure start motor was utilized to gauge execution and emanation boundaries. Biodiesel (fire point and calorific worth) added to the diesel (fire point and calorific worth) at four distinctive volume focuses for example 10, 20, 30 and 40% of biodiesel. In view of the examination of execution and outflow boundaries the biodiesel mix B10 was discovered ideal for the most productive activity of the motor. The CR 14 was discovered ideal by contrasting the exhibition boundaries, for example, η_{BTH} , BSFC, and EGT and so forth for all the pressure proportions.

KEYWORDS: Biodiesel, Impainting, diminishes fuel, fire point and calorific worth.

I. INTRODUCTION

The utilization of vegetable oils and its subordinates has been utilized as elective diesel fills. From the hours of oil emergency in 1970 as the requests and costs has been expanded step by step more interests are seen towards replacement of petroleum products with biodiesel. Additionally biodiesel creation has been in extraordinary interests in light of concern seen towards world developing condition issues over the most recent couple of decades (Balat et al. 2008). Presently a days biodiesel is developing as an elective fuel as feasible option in contrast to oil diesel. Such a significant number of techniques are utilized for creation of biodiesel ordinarily, for example, pyrolysis, miniaturized scale emulsification, weakening, trans esterification and so forth. (Khandelwal et al. 2012).

Biodiesel

The specialized meaning of biodiesel is: "The mono alkyl esters of long unsaturated fats got from sustainable lipid feedstock, for example, vegetable oils or creature fats, for use in pressure start (diesel) motors" (National Biodiesel Board, 1996). The vegetable oils and creature fats used to deliver biodiesel basically have triacylglycerol's Labels Artificially, TAG are delegated esters of unsaturated fats (FA) with glycerol (1, 2, 3-propanetriol). Presently these TAG comprise of various FA (unsaturated fats) further every unsaturated fat connected to a glycerol. These FA present in TAG have various profiles or structures which further have a significant job in choosing the physical and compound properties of the FA which further impact the properties of comparing creature fats and vegetable oils. The biodiesel can Be delivered from a large variety of vegetable oils such as, cottonseed, coconut, peanut, soybean, rapeseed/canola, sunflower, palm safflower non-edible oils such as soapnut, mahua, jatropha, karanja, neem, etc and animal fats as tallow.



Paper is organized as follows. Section II describes automatic text detection using morphological operations, connected component analysis and set of selection or rejection criteria. The flow diagram represents the step of the algorithm. After detection of text, how text region is filled using an inpainting technique that is given in Section III. Section IV presents experimental results showing results of images tested. Finally, Section V presents conclusion.

II. RELATED WORK

Ramming et al. 2013 examined the impact of various parameters (oil to alcohol molar ratio, reaction time, acid concentration and base catalysts) during the preparation of neem oil methyl ester. They employed oscillatory baffled reactor 1-2% H₂SO₄. The experimentally determined optimum conditions for the production of neem oil methyl ester were 1:9 oil to alcohol molar ratio, reaction time 10 to 15 minutes and temperature was set in the range of 25-300C. It was observed that the viscosity decreases with the increase of molar ratio. They also suggested that adequate production of biodiesel from neem oil require more oil to alcohol molar ratio. They conducted transesterification reaction in the series of operation in a long reaction that involved immiscible liquid phases, due to which the yield of final product becomes significantly depends upon mixing and agitation.

Thangaraj et al. 2013 used a two-step reaction system for the production of biodiesel from neem seeds (*Azadirachta indica*). In this reaction system acid and alkaline esterification was done, with the help of short chain alcohol. They determined various important parameters of biodiesel produced from neem oil such as kinematic viscosity 5.81 cSt (40°C), density 0.898 g/m³ (15°C), flash point 175°C, pour point 8°C, total sulfur content 0.03%, ash 0.00 %, carbon residue 2% by mass (0.08), copper strip corrosion for 3 hours at 100°C, sediment 0.00%, water content 0.00%. Also, comparison was made with other methyl esters. The HPLC analysis was conducted to quantify the methyl esters. In the case of two step reaction process, by using 1:8 oil to alcohol molar ratio, biodiesel yield was found to be maximum i.e. 85%, when the acid catalyst was 0.08% and NaOH catalyst was 1%, at 60°C temperature.

III. METHODOLOGY

The increasing demands of fuels these days due increasing automobiles on planets has increased the risk of depletion of fossil fuels in the world. Also the increasing health problems around the world due to automobiles and use of fossil fuels as due to increase in pollution has reached to the demands of a clean burning and less polluting fuel so due to these demands as an alternative fuel biodiesel has emerged as a very good fuel in the automobile sector.

The biodiesel was produced in the School of Energy and Environment labs at Thapar University Patiala, Punjab (India) and the engine experiments and testing was done in internal Combustion Engine Laboratory, Department of Mechanical Engineering, Thapar University, Patiala, Punjab (India). Further the methodology is divided in to two parts:

1. First part shows the optimum production of biodiesel from non-edible oil i.e. neem (*Azadirachta indica*) oil.
2. Second part shows the emission and performance of the biodiesel blends tested on an engine.

Methodology for the production of biodiesel from Neem oil:

Here in this from starting the raw materials used for biodiesel production is discussed and after it with the each step with which the whole production process was undergone. The biodiesel properties are also discussed in this section.

Raw materials

1. Crude neem oil
2. Methanol (methyl alcohol)
3. Potassium hydroxide (KOH) as base catalyst
4. Sulphuric acid (H₂SO₄) as acid catalyst

Dewaxed and degummed crude neem oil was bought from the local general store. The Methanol (methyl alcohol), Potassium hydroxide (KOH), Sulphuric acid (H₂SO₄) were available in the School of Energy and Environment laboratories, Thapar University, Patiala. The transesterification was then carried out in the labs on a hot plate magnetic stirrer.

Biodiesel preparation

As the crude neem (*Azadirachta indica*) oil was used for the preparation of biodiesel therefore due to high Free Fatty Acid FFA content of neem oil i.e. approx. 7% the transesterification process was carried out in two stages

Neem oil biodiesel transesterification process (two stage process)

First stage (acid catalyzed transesterification reaction)

1. The known quantity of crude neem oil was taken in a conical flask.
2. Then the oil in the flask was heated on a heating plate up to 650C temperature



3. A mixture of a known amount of methanol and sulphuric acid as acid catalyst was added to the flask and mixed with the pre heated crude neem oil in the flask
4. The preheated oil mixture was constantly stirred for 35 min at a constant temperature of 500C on the magnetic stirrer with hot plate.
5. After the constant stirring of 35mins at constant temperature the mixture as for the impurities to settle down was poured in separating funnel. After 5-6 hours the impurities settled down were separated from the remaining oil.

Second stage (base catalyzed transesterification reaction)

1. The oil remained in the separating funnel was again measured and then pre heated up to 650C.
2. After that the known amount of methanol and potassium hydroxide mixture was added in the preheated remaining oil.
3. After that a constant stirring of 35 mins was again subjected at a constant temperature of 500C on the pre heated remaining oil in the flask on a hot plate magnetic stirrer.
4. After the constant stirring of 35 mins the mixture was poured in separating funnel to glycerol produced to settle down.
5. After 3-4 hours of settling down a layer of glycerol was made on the bottom which was separated and removed.
6. The remaining in the funnel is methyl ester (biodiesel) of neem oil i.e. yield 93% approximately which is further purified by hot water washing and drying to remove the excess of methanol, water, KOH from the oil

IV. EXPERIMENTAL RESULTS

Result and discussion is divided in to two parts. First objective is to produce the biodiesel from neem oil by optimizing the different parameters that significantly affect the production i.e. molar concentration of methanol to oil, catalyst concentration taken etc. The second objective of results and discussion is to optimize the compression ratio and to obtain a best blend out of all the blends used by considering the performance and emission parameters. Firstly production parameters are discussed with results obtained.

**Production parameters
Molar ratio variation**

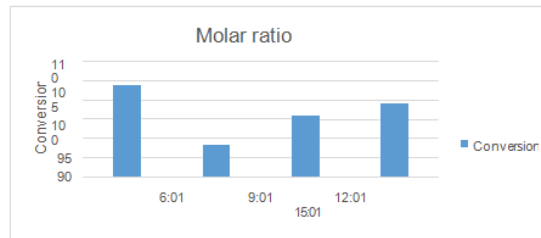


Figure 4.1: shows the variation of conversions with molar ratio of alcohol to oil for acid catalyzed stage.

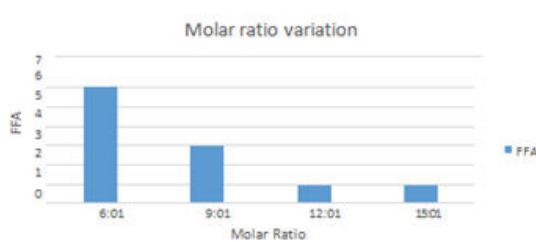


Figure 4.2: shows the variation of FFA with molar ratio of alcohol to oil for acid catalyzed stage.

For the first stage of trans esterification process of biodiesel i.e. acid catalyzed stage molar ratio of alcohol to oil is varied at 1% catalyst conc., 50o C temperature for 35mins and the conversions and FFA trends are obtained. As the above figure 4.1 and 4.2 shows that the conversions shows decreasing trend in first from 6:1 to 9:1 molar ratio and then increases with further increase in molar ratio but the increase is slight also it is seen that FFA with increase in molar ratio shows at decreasing trend but is almost similar for the molar ratios 12:1 and 15:1.



Catalyst concentration variation

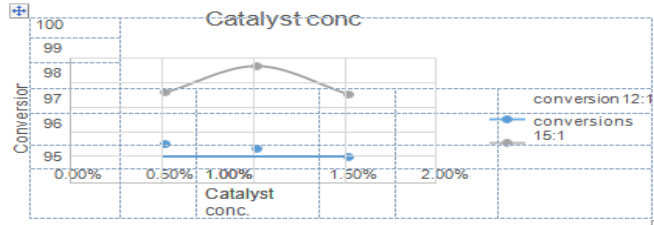


Figure 4.3: shows the variation of conversions with catalyst concentration for acid catalyzed stage.

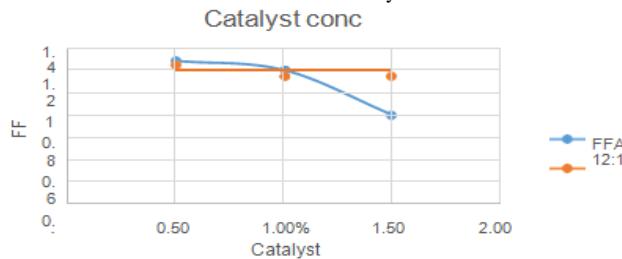


Figure 4.4: shows the variation of FFA with catalyst concentration for acid catalyzed stage

Now the above figures 4.3 and 4.4 shows the variation of catalyst concentration at 50oC temperature and molar ratios of 12:1 and 15:1 for 35 mins in the acid catalyzed stage and the conversions and FFA are obtained. As it can be seen that for molar ratio 12:1 conversions are more than 15:1 for all catalyst concentrations but the increase is not significant in the conversions but for 1% catalyst concentration it can be seen that both the 12:1 it has decreasing trend but for 15:1 it remains almost same everywhere except a slight decrease at 1% catalyst concentration.

Temperature variation

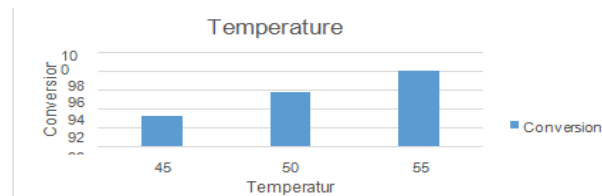


Figure 4.5: variation of conversions temperature for acid catalyzed stage

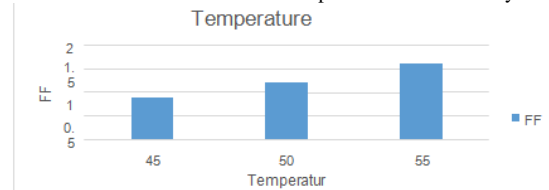


Figure 4.6: variation of FFA temperature for acid catalyzed stage

The above figures shows the variation of temperature at 1% catalyst concentration , 12:1 molar ratio for 35mins in the acid catalyzed stage obtaining the conversions and FFA for the temperature variations. From the above figures 4.5 and 4.6 it can be seen that with the increase in reaction temperature the conversions show increasing trends though there is not much variation is seen in the temperature 50 and 55 also in case of FFA it again shows an

Molar ratio variation

Figure 4.7 and Figure 4.8 shows the variation of molar ratio of alcohol to oil for the 6:1 and 9:1 acid catalyzed oil at temperature 50oC and catalyst concentration of 1% for 35mins and conversions and FFA is obtained. It can be seen that for molar ratio 9:1 acid catalyzed oil the conversions are more at each molar ratio then for 6:1 although there is not much variation in the 9:1 molar ratio acid catalyzed oil with the increase in molar ratio in the base catalyzed stage also the trends for 6:1 acid catalyzed oil are mixed with increase in the molar ratio in base catalyzed stage. Also it is seen that the highest conversions are obtained for the 9:1 acid catalyzed oil with 15:1 molar ratio in base catalyzed stage. For FFA it can be seen that the lowest values of FFA are obtained at 12:1 molar ratio of base catalyzed stage for both 6:1 and 9:1 molar ratio of acid catalyzed oil but it also shows that at 12:1 and 15:1 molar ratio of base catalyzed stage for 9:1 acid catalyzed oil have the lowest values of all the values obtained with a slight difference.

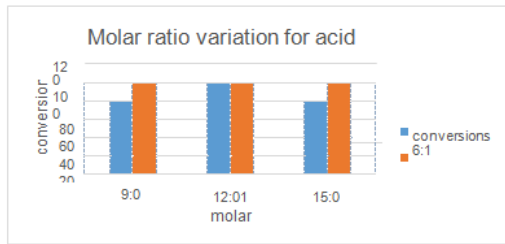


Figure 4.7: variation of conversions with molar ratio of alcohol to oil for the 6:1 and 9:1 molar ratio of acid catalyzed oil for base catalyzed stage

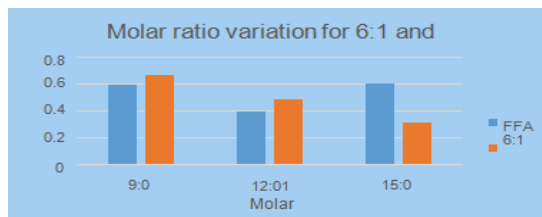


Figure 4.8: variation of FFA with molar ratio of alcohol to oil for the 6:1 and 9:1 molar ratio of acid catalyzed oil for base catalyzed stage

Catalyst concentration variation for 6:1 acid catalyzed oil

The above figures 4.9 and 4.10 shows the variation of catalyst concentrations for 6:1 molar ratio acid catalyzed oil at temperature of 50oC for 35 mins for the molar ratios of 12:1 and 15:1 for base catalyzed stage and conversions and FFA are obtained. From the figures it can be seen that conversions for 12:1 molar ratio of base catalyzed stage has increased with each step although the increase is slight whereas with the molar ratio 15:1 a decreasing trend can be seen. Also for the FFA it can be seen that FFA has a decreasing trend for both the molar ratios i.e. 12:1 and 15:1 but with increase in catalyst concentration the decrease is more in 15:1 molar ratio as compared to 12:1 having very slight changes. Also it is seen that with molar ratio 15:1 in base catalyzed stage and catalyst concentration of 1.5% soap formation was seen.

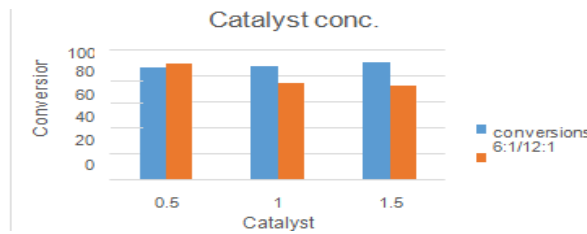


Figure 4.9: variation of conversions with catalyst concentration for the 6:1 molar ratio of acid catalyzed oil for base catalyzed stage of molar ratio 12:1 and 15:1

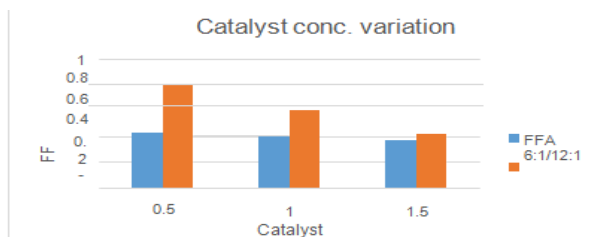


Figure 4.10: variation of FFA with catalyst concentration for the 6:1 molar ratio of acid catalyzed oil for base catalyzed stage of molar ratio 12:1 and 15:1

4.7 Catalyst variation for 9:1 acid catalyzed oil

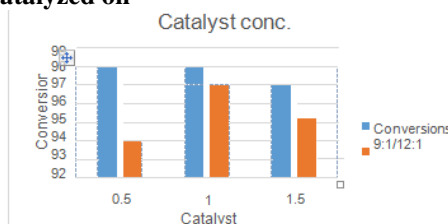


Figure 4.11: variation of conversions with catalyst concentration for the 9:1 molar ratio of acid catalyzed oil for base catalyzed stage of molar ratio 12:1 and 15:1

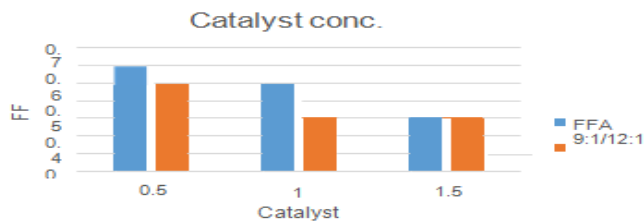


Figure 4.12: variation of conversions with catalyst concentration for the 9:1 molar ratio of acid catalyzed oil for base catalyzed stage of molar ratio 12:1 and 15:1

The above figures 4.11 and 4.12 shows the catalyst concentration variation for molar ratio 9:1 of acid catalyzed oil at temperature 50oC for 35 mins for the molar ratios of 12:1 and 15:1 for base catalyzed stage and conversions and FFA are obtained. From the figures it can be seen that conversions show a mixed trend for the molar ratio 15:1 having highest conversions at 1% catalyst concentration whereas the conversions for 12:1 molar ratio

shows a decreasing trend having highest value at 0.5% catalyst concentrations but the same point having the maximum FFA value from all the obtained. It is seen that the trends for both the molar ratios 12:1 and 15:1 have decreasing trend with increase in catalyst concentration. Also it is seen that for FFA the 12:1 molar ratio of base catalyzed stage has decreasing trend with lowest value at 1.5% catalyst concentration but it is also seen that for molar ratio 15:1 of base catalyzed stage has lowest values at both 1% and 1.5% then the 12:1 molar ratio's lowest value.

Hence the best optimized results were found to be for 9:1 molar ratio acid catalyzed stage at 50oC and 1% catalyst concentration for 35mins and then for the base catalyzed stage the best were found at 15:1 molar ratio at 50oC and 1% catalyst concentration for 35mins. After which the production was done at these parameters for the biodiesel production for further engine testing of performance and emission.

Performance parameters

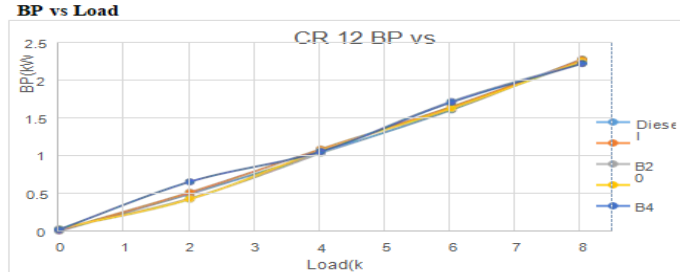


Figure 4.13: variation of BP vs Load for diesel and different biodiesel blends at compression ratio 12:1

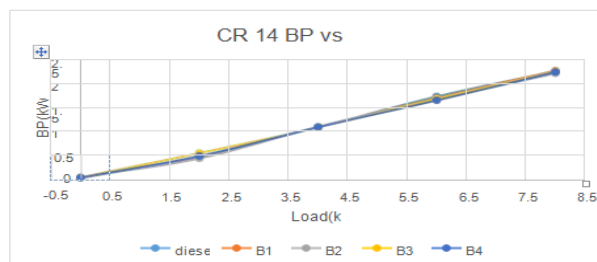


Figure 4.14: variation of BP vs Load for diesel and different biodiesel blends at compression ratio 14:1

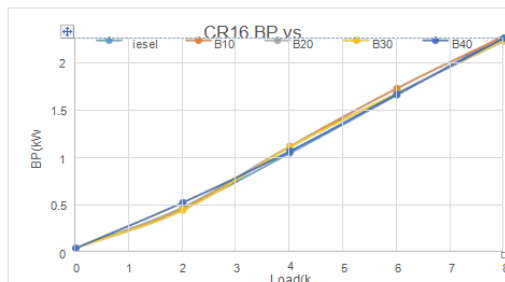


Figure 4.15: variation of BP vs Load for diesel and different biodiesel blends at compression ratio 16:1



The above figures shows the brake power variation at different loads of the diesel and different biodiesel blends. The load vs BP graph shows that at first of all at no load condition the BP is same for all the diesel and biodiesel blends but as the load increases the BP of diesel increases more as compared to others because of having higher heating value than biodiesel blends. At part loads the BP of biodiesel blends decreases than diesel because of having higher viscosity and density but low heating value than diesel and such decrease further on increasing biodiesel amount(%age). Hence maximum BP can be achieved by using diesel other than B10, B20, B30, and B40. An exception in CR12 with B40 has shown more BP all the loads in comparison to BP obtained for all other blends and diesel. Now on increasing the CR there is no much change in trends as shown by above figures with using CR14 and 16 i.e. the diesel heating value is more so the BP produced bydiesel in CR14 and 16 is more than biodiesel blends because of the same reason stated above.

Brake specific fuel consumption vs Load

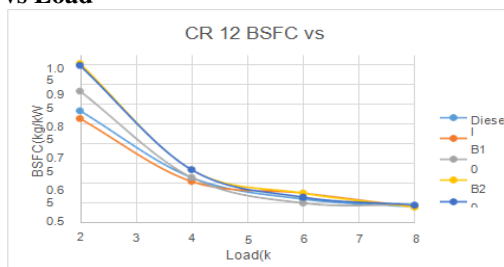


Figure 4.16: variation of BSFC vs Load for diesel and different biodiesel blends at compression ratio 12:1

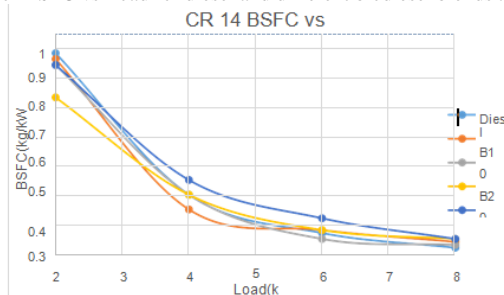


Figure 4.17: variation of BSFC vs Load for diesel and different biodiesel blends at compression ratio 14:1

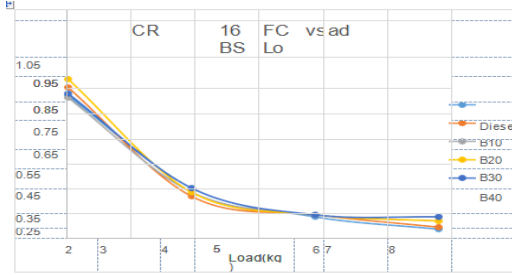


Figure 4.18: variation of BSFC vs Load for diesel and different biodiesel blends at compression ratio 16:1

The above figures shows the variation of BSFC (brake specific fuel consumption) with load of diesel and different biodiesel blends. As the load increases in the abovefigures the BSFC decreases at lower loads and then it remains almost constant. In the previous work Dhar et al. 2012 using neem oil biodiesel has shown similar trends in the BSFC. Nayak et al. 2014 has also shown similar trends in BSFC using mahua oil biodiesel blends. Ashrafu et al. 2014 using neem oil biodiesel has shown trends as slight increase for B20 and for all other biodiesel the BSFC is nearly close to the diesel fuel on engine1-Cylinder DI, CR: 17.5:1, RP: 4.4 kw, 1500 rpm similar to that of above trends. As the load increases firstly the rate of increase of BP compared to fuel consumption is more and as the load moves towards fullload conditions the rate of increase of BP and fuel consumption remains same so at these loads BSFC remains almost constant. With increase in the biodiesel %age in the blends the BSFC values increases because the fuel consumption increases due to the lower calorific value of biodiesel. It is also seen that B40 has maximum BSFC at allCR. Further it is recorded that with increase in CR there is not much change in the trends i.e. B40 has maximum BSFC at all loads.



Brake thermal efficiency vs Load

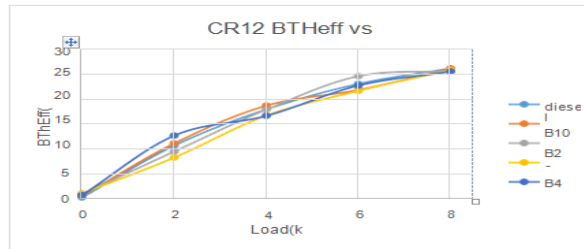


Figure 4.19: variation of BThEffvs Load for diesel and different biodiesel blends at compression ratio 12:1

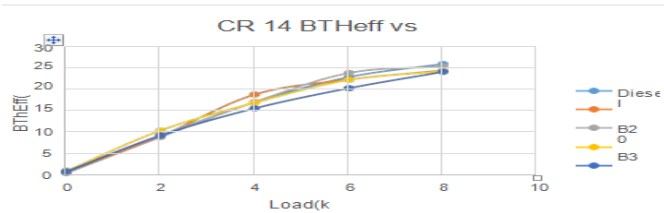


Figure 4.20: variation of BThEffvs Load for diesel and different biodiesel blends at compression ratio 14:1

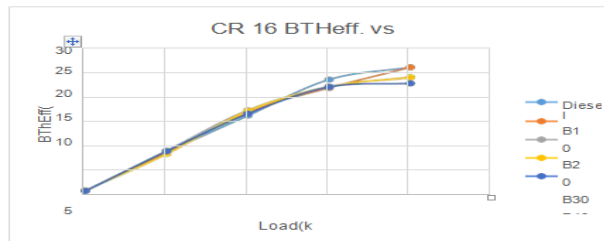


Figure 4.21: variation of BThEffvs Load for diesel and different biodiesel blends at compression ratio 16:1

The above figures shows the variation of brake thermal efficiencies with load. The brake thermal efficiency has increased with increase in the load. The rate of increase was more at lower loads whereas it has decreased with increasing the load further. Dhar et al and Heroor et al. 2013 has also obtained similar trends for brake thermal efficiency using neem oil biodiesel. Nayak et al. 2014 and Sakhivel et al. 2014 also showed similar variations for brake thermal efficiency using mahua oil biodiesel and fish oil biodiesel. Ashraful et al. 2014 has shown increasing trends with increasing biodiesel percentage in fuel blends at all load conditions using neem oil biodiesel which are similar to the above shown trends. At all the CR highest values of brake thermal efficiency was obtained for B20 for all the loads. This trend is because at higher load the rate of increase of BP decreases whereas the rate of increase of fuel consumption remain almost constant. So the decrease in rate of increase of BP at higher loads leads to decrease in the rate of increase of brake thermal efficiency. Variation of brake thermal efficiency has shown that CR negligible influence on the BThEff at different loads for different blends.

Mechanical efficiency vs load

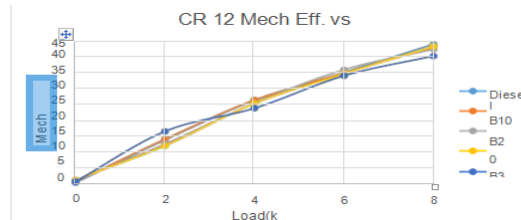


Figure 4.22: variation of Mech Eff vs Load for diesel and different biodiesel blends at compression ratio 12:1

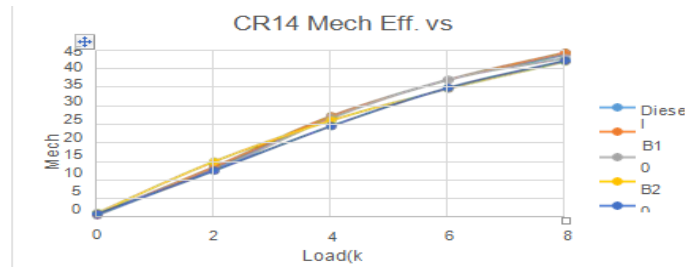


Figure 4.23: variation of Mech Eff vs Load for diesel and different biodiesel blends at compression ratio 14:1

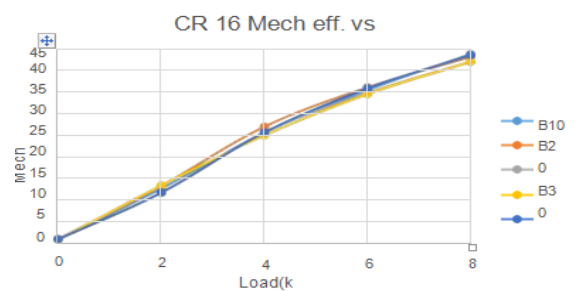


Figure 4.24: variation of Mech Eff vs Load for diesel and different biodiesel blends at compression ratio 16:1

These figures show the variation of mechanical efficiency with load of diesel and different biodiesel blends. The mechanical efficiency has shown increasing trends with increase in the load at all the CR for all the blends. The rate of increase is more at low loads as compared to the rate of increase at higher values of load. This is due to the fact that at higher loads the increase in BP is less as compared to lower loads whereas IP power increases with the same rate at all loads. At higher loads the temperature of engine increases which leads to decrease in viscosity of the lubricating oil hence frictional power losses increase with more rate at higher loads. From the figures it can be seen that the CR has not much affected the mechanical efficiency. The mechanical efficiency obtained for B10 blend was maximum at higher loads for all CRs.

Volumetric efficiency vs Load

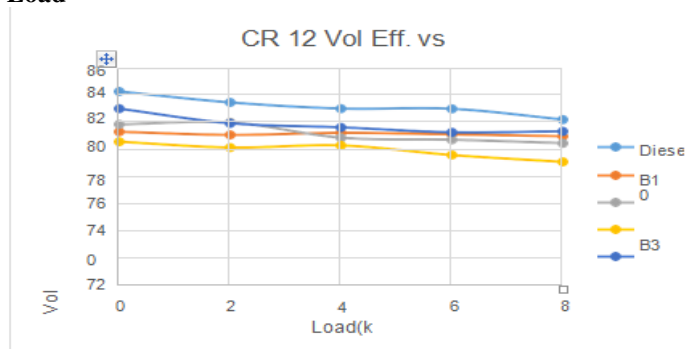


Figure 4.25: variation of Vol Eff vs Load for diesel and different biodiesel blends at compression ratio 12:1

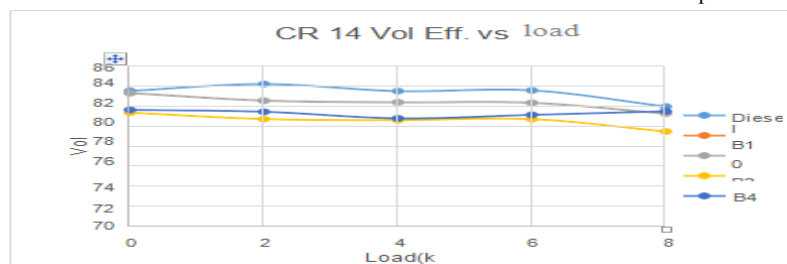


Figure 4.26: variation of Vol Eff vs Load for diesel and different biodiesel blends at compression ratio 14:1

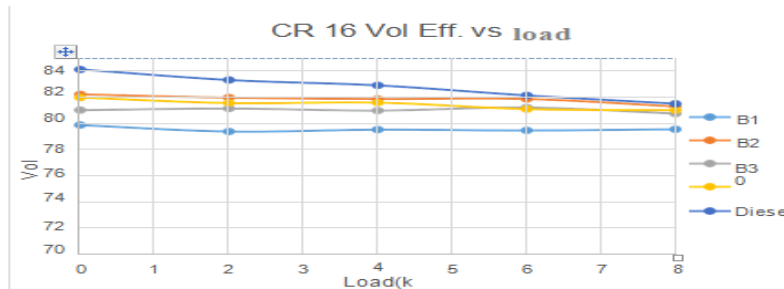


Figure 4.27: variation of Vol Eff vs Load for diesel and different biodiesel blends at compression ratio 16:1

The above figures show the variation of diesel and biodiesel blends volumetric efficiency with the load. It is seen that with increase in load volumetric efficiency has shown a decreasing trend but the amount of decrease is very small when the load was varied from no load to full load conditions. Not much change in trends of volumetric efficiency was seen with the increase in CR. The maximum volumetric efficiency was obtained with diesel whereas minimum volumetric efficiency was recorded for the B30 blend.

Exhaust gas temperature vs load

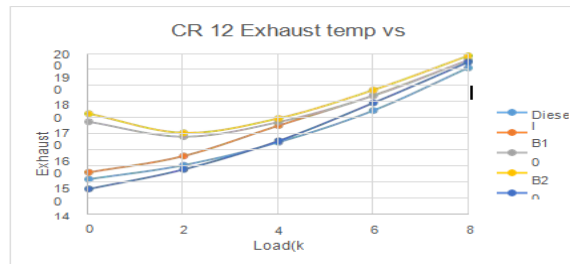


Figure 4.28: variation of EGT vs Load for diesel and different biodiesel blends at compression ratio 12:1

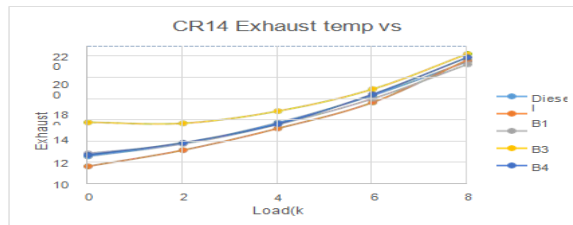


Figure 4.29: variation of EGT vs Load for diesel and different biodiesel blends at compression ratio 14:1

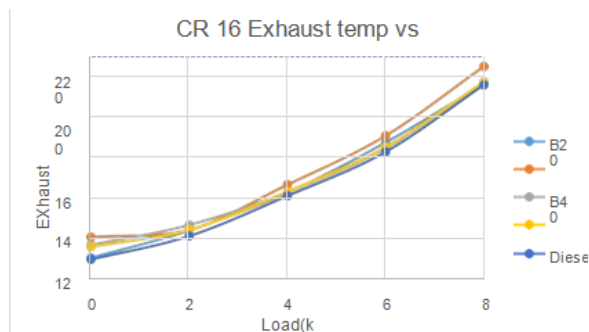


Figure 4.30: variation of EGT vs Load for diesel and different biodiesel blends at compression ratio 16:1

The above figures show the variation of exhaust gas temperature with load for diesel and different biodiesel blends. From all the figures it can be seen that exhaust temperature of gases has shown a parabolic increasing trend with increase in the load for all the CR. Similar trends for exhaust gas temperatures were also obtained by Dhar et al.2012 using neem oil based biodiesel as fuel in direct injection diesel engine and Sakthivel et al.2014 and Nayak et al. 2014 using fish oil ethyl ester and mahua oil biodiesel respectively as fuel with diesel. As the amount of biodiesel was increased from 10 to 30% the temperature of exhaust gasses has also increased at all the CR due to improvement in the combustion process as the biodiesel has more cetane number as compared to diesel. The cetane number also leads to



decrease in ignition delay hence giving availability of more time for combustion process which leads to complete combustion of A/F ratio of fuels hence further giving maximum exhaust temperature. As the amount of biodiesel is increased the effect of low calorific value became more predominant. On further increase of biodiesel amount i.e B40 the decrease in exhaust temperature was recorded due to lower calorific value of the biodiesel which decreases the overall heat content of fuel blend leading low exhaust temperatures.

EMISSIONS PARAMETERS

CO emissions

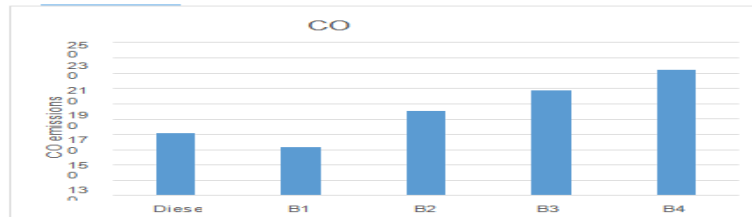


Figure 4.31: variation of CO emissions vs biodiesel blend %age for load 6 at compression ratio 14:1

The above figure shows the CO emissions for diesel and other biodiesel blends at 6 load and 14 CR. The CO emissions has decreased by 14.39% on addition of 10% biodiesel (B10). On further addition of biodiesel i.e. methyl esters the CO emissions has increased due to incomplete combustion caused by the improper mixing at higher concentrations of biodiesel. An increase of 62% was obtained in CO emissions in comparison to diesel when biodiesel was added at 40% concentration. As with increase in biodiesel amount of methyl ester increases which leads to improper combustion of mixture due to deficiency of oxygen. As on lower concentration i.e. B10 the oxygen amount was sufficient for combustion of mixture leading to lower CO emissions.

NO_x EMISSIONS

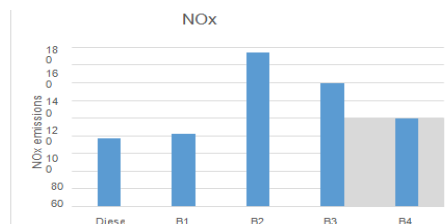


Figure 4.32: variation of NOx emissions vs biodiesel blend %age for load 6 at compression ratio 14:1

This figure shows the variation of NOx emission with the increasing biodiesel concentration in it at CR 14 at load 6 kg. A slight increase of 6.5% in NOx emission was seen on addition of 10% biodiesel concentration. The NOx emission became almost 2 times of the emissions obtained for diesel when biodiesel was added at 20% volumetric concentration. This increase was due to the proper combustion of A/F mixture which liberated maximum amount of heat due to which temperature of gases went up and lead to nitrogen present in air to combine with oxygen and increase NOx emissions. On further addition of biodiesel the NOx emissions has decreased but these were more than emissions obtained for diesel. As with increase in concentration the amount of methyl ester increases which lead to improper mixing and combustion due to lower amount of oxygen present leading to lower exhaust temperature and hence lesser NOx emissions.

CO₂ emissions

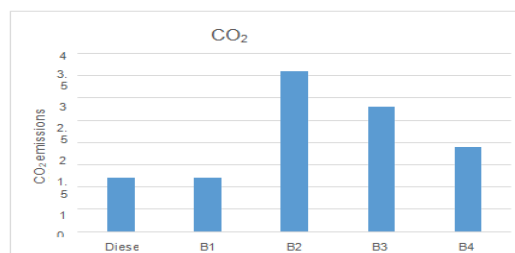


Figure 4.33: variation of CO2 emissions vs biodiesel blend %age for load 6 at compression ratio 14:1



This figure shows CO₂ emissions with increasing biodiesel concentration at 6 load and 14 CR. The CO₂ emissions were almost same for the diesel and B10 blend. The CO₂ emissions became almost thrice of the emissions obtained from diesel because at 20% concentration of biodiesel in the blend the proper combustion of A/F mixture took place which lead to the conversion of C and CO into CO₂. The further addition of biodiesel blend has led to decrease in CO₂ emissions due to improper mixing and combustion due to high viscosity of biodiesel and oxygen deficiency respectively.

Dhar et al. 2012, Radha et al. 2011, Nayak et al. 2014, Sakthivel et al. 2014, Al_dawody et al. 2014, Solaimuthu et al. 2015 have shown mixed variation of CO, NO_x and CO₂ emissions on addition of biodiesel depending upon the specific properties of the fuel, intermixing, oxygen availability, viscosity etc. The combustion characters of the fuel is also influenced by the ambient conditions such as humidity, temperature etc.

V. CONCLUSION

We Biodiesel was prepared from the neem oil using transesterification process which includes a two stage process first stage is acid catalyzed stage and the second stage is base catalyzed stage. In the process it was seen that the molar ratio optimum for the acid catalyzed stage was 9:1 at 1% catalyst concentration and 50oC was found to be the optimum temperature for the process. Further it was seen by considering the affecting factors i.e. conversions and FFA values that for the second stage i.e. base catalyzed stage the optimum molar ratio was found to be 15:1 and catalyst concentration of 1% at 50oC temperature for the production of biodiesel.

Experiments were performed on the duel fuel diesel engine using diesel and neem oil based biodiesel at different volume concentrations. Performance and exhaust emission parameters were measured during investigation at different loads and compression ratios. It has been found that the brake power has shown increasing trend with the load at all the compression ratios. Similar trend was observed for diesel as well as the biodiesel as fuel at all the concentrations. BSFC has shown decreasing trends with the load at all the compression ratios also at lower loads decrease in BSFC is more due to higher rate of increase of brake power at lower loads as compared to rate of increase in fuel consumption. Brake thermal efficiency has shown linear increasing trend with load at lower loads whereas the curve becomes almost flat at higher loads due to the small rise in the brake power at higher loads. No change in the brake thermal efficiency was found on addition of biodiesel because the biodiesel has almost same heating value and fire point to that of diesel.

The mechanical efficiency has increased with increase in the load at all the compression ratios. Volumetric efficiency has shown decreasing trend with increasing load due to high engine temperatures at higher loads. The exhaust gas temperature has increased with increase in the load due to the use of rich air fuel mixtures at higher loads. Carbon monoxide emissions has increased on addition of biodiesel to the diesel whereas NO_x emissions has increased up to 20% volume concentrations and after that it has increased on further addition of biodiesel this is due to the maximum temperatures obtained in the engine because of proper combustion of air fuel mixture at this concentration. CO₂ emissions has become almost thrice to that of CO₂ emissions obtained for diesel, at 20% volume concentration of biodiesel whereas it has decreased on further addition of biodiesel. After analyzing the performance parameters it has been found that the brake thermal efficiency, mechanical efficiency have maximum BSFC and exhaust gas temperatures were also obtained for the same biodiesel blend (B10). The CO emissions has slightly increased on addition of B10 however it was less as compared to emissions obtained for other blends. A slight decrease in NO_x emission was observed at B10 whereas NO_x emission has increased for all other blends. Also CO₂ emissions were similar to that of diesel for this blend (B10) however these have increased on further addition of biodiesel. From this it can be concluded that the blend B10 is optimum for the variable compression ratio compression ignition engine considering performance and exhaust emission parameters. Also it was seen that the variation in performance parameters for different compression ratios was seen to be constant at all the loads when it was seen for a particular biodiesel blend except the EGT and BSFC. These two parameters i.e. EGT and BSFC were seen to be lowest at all the loads for a particular biodiesel blend hence it can be concluded that CR 14 is optimum for the operation of the engine region.

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