# Optimization of Compression Ratio for Computerized VCR CI Engine Fueled with Peanut Oil Blended with Diesel and Additive

**Subhani Shaik, Srinivas Kommana, Raghavarao Boppudi**

***Abstract:*** ***Degradation of environment and Fossil fuel depletion are serious problems confronted now-a-days. Fossil fuels are in future will become reduced due to its excess quantity of extraction and high consumption. Hence, the use of biodiesel is considered to be a promising as they are clean are clean, renewable fuels and better substitute for the diesel in all the CI engines. In this present research work performance and emission characteristics of 10%,30% and 50% trans esterified peanut oil blended with diesel on a single cylinder,4-stroke, water cooled CI engine test RIG varying different compression ratios were analyzed and emissions HC,CO, $CO_2$,$O_2$ and NOx were studied with 5-gas exhaust gas analyzer. The change of compression ratios from 14 to 19. At compression ratio 19 resulted in 32.85% PB10 blend gives the maximum brake thermal efficiency and minimize bsfc 0.28 kg/kWh respectively. At different compression ratios CR 19 given the best performance and lower emissions at all load conditions. The DEE additive 5% is added to the PB50 blend. This PB50+5% blend gives the better performance and lower emissions at CR 19.***

***Keywords:Biodiesel, Compression ratio, DEE additive, Emissions, Performance***

## I. INTRODUCTION

Demand of the fuel, raising with deterioration of nature conditions has increased concern for environmental problems and energy crisis. Peanut biodiesel is one of the capableselections as substitute fuels for compression ignition engines (non-edible or edible feedstock). Biodiesel is a mono-alkyl esters and having a long sequence of these greasy Acids are from plant oils, instinctive fats and wastefrom aromatic or sulfur compounds and air pollution reduced flue gases like hydrocarbons, carbonmonoxides, and particulate matter.

**Revised Manuscript Received on June 01, 2019**
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Hence, it makes the biodiesel as a recovering coal for the futuregenerations. Mohit Vasudev et al. [1] In this paper, an experimental study is agreed out on a four lash, single cylinder VCR diesel engine to evaluate the routine and emanation analysis of Rice brain biodiesel combinations of 10%, 20% and 40% by vol. at CR ratio 15,16,17 and 18.

He determined that complex B.S.F.C and minor B.T.E is celebrated for higher blends. Growth in B.T.E. And decline in B.S.F.C is detected to increase in compression ratio. Rise in compression ratio from 15 to 18 reduced emissions HC, CO and $CO_2$ but NOx emissions increased.HanchateSuresh babu rao et al.[2] He calculated and established that peanut methyl ester blends of 20,40,60,80 and 100, Obtainable of changed blends of peanut methyl ester with diesel, B20 and B40 showed superior performance while related to other blends, but at the same time produces larger NOx formation takes place. Suchthings of NOxcreation can be concentrated by using advanced methods like EGR system to the engine. K.Srinivas et al. [3] Studied the performance and emissions characteristic with palm kernel and the eucalyptus oil combination tests were conducted with blends and diesel on VCR engine for reasonable analysis with maximum compression ratio and increase in injection pressure 220. The entire test biofuels were used in computer based different compression ratio engine at different loads. Investigation depicts the reduced emissions and improved combustion for the palm kernel 85% and eucalyptus oil 15% combined after associating to diesel for The full weight condition. A. Sanjid et al.[4] This work investigates the mustard biodiesel presented possible biofuel's properties compared to further biodiesel. From the engine performance and emission analysis was also established satisfactorily. As a suggestion, mustard biodiesel 10% and 20% can be used in diesel engines. Promote investigation can be passed out to evaluate smoke and emissions of mustard biodiesel combinations.J. Jayaprabhakar [5]Popular this analysis, we charity diethyl ether as an oxygenated improver to consider the probable use of advanced extents of biodiesel in an unmovable diesel engine. Neem



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calmative was predominantly for erection of biodiesel. The experiments were done in a single-cylinder water cooled direct injection diesel engine. The combustion process elaborates in diesel engine would be better and the particulate matter would be concentrated if these biodiesel are blended. An examination, study is stayed to form the emission individualities of a diesel engine using diethyl ether as additive in Neat Neem oil Biodiesel. Emissions of hydrocarbon oxides of nitrogen and carbon monoxide significantly reduced by adding diethyl ether into neem oil biodiesel at 10% and 20% on a volume basis. Ramadhas et al. [6] Calculated the use ofDEE as a fuel additive for dropping the cold firstunruly and to improve the performance and emissionappearances of a diesel engine drove with biodiesel.

## II. MATERIALS AND METHODS

### A.*Preparation of peanut oil methyl ester:*

Initially, 200 ml methanol and 5-8Gm KOH were mixed in the correct proportions of the measured quantity Measured 1Lt of peanut crude oil usingmeasuring cylinder and pour it in a flask and it was heated up to a temperature of 100-110$^0$C.When the temperature of oil reached to 100$^0$C the water particles evaporate. After that, the oil was cooled to 50-55$^0$C.Methanol and KOH were mixed with peanut oil continuously stirring at a constant temperature of 55$^0$ heating is continued till 1 - 2 hours make sure that the temperature remains constant. Pour the oil separation funnel and keep it for at least 6 hours, which permits glycerin to settle down; hence it is denser than biodiesel.Remove the glycerin from the separating funnel.It is taken to be in a conical flask. Now wash the biodiesel obtained with water so as to remove the chemicals.Finally, we have obtained pure peanut biodiesel, which, if free from all chemicals and any water, we added in the process.

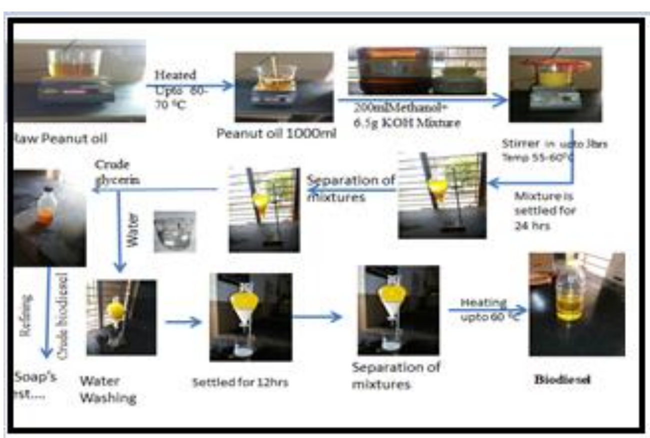


Fig A.Tran's esterification Process of biodiesel

### B. Blends Preparation:

Blends were preparedin several proportions of groundnut oil and diesel PB10, PB30 and PB50 the classified properties of testing fuels like density, viscosity, calorificvalue, flash and firepoint were determined by exploitation ASTM ways. The mixed blends appearances given that consists of the mixed blends will increase with biodiesel proportions. The biodiesel and diesel description is given below in Table1. The consistence was higher for biodiesel and lower for diesel. The density of the mixed blends (i.e.PB10, PB30 and PB50) showed an ordinarily in respect toa rise in blends proportion. It absolutely wasrepresented the lower calorific value of biodiesel is due to longer oxygen content than compare to diesel. Density and betterconsist of blends aredue to their difficult chemical structure and highmolecular weight.

Fig B. Different blends

**Table 1.** Properties of fuels

| S. NO | PARAMETERS | DIESEL | B10 | B30 | B50 | B100 |
|---|---|---|---|---|---|---|
| 1 | Kinematic Viscosity @40˚C | 2.7 | 1.99 | 2.92 | 4.3 | 8.38 |
| 2 | Flash point | 58$^0$C | 72$^0$C | 93$^0$C | 124$^0$C | 196$^0$C |
| 3 | Fire point | 66$^0$C | 79$^0$C | 99$^0$C | 132$^0$C | 213$^0$C |
| 4 | Gross calorific value kj/kg | 42,500 | 41,087.56 | 39,313.36 | 37,522.14 | 33,044.62 |
| 5 | Density in kg/m$^3$ | 840 | 849 | 859 | 871 | 895 |

### C. Diethyl ether additive:

Diethyl ether, additionally called ethyl ether, chemical element ether, merely ether,



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or inhalation anesthetic, is a chemical compound withinthe ether group with the formula (C2H5O2). It's a colorless, extremely volatile ignitable liquid.It is normally used as a solvent. Ethyl ether comprises a high cetane range of 85-96 and is an active as a commencement fluid, incombination with fossil fuel distillates for hydrocarbon and diesel engines as an influence of its tall volatility and short flash resolution.For identical reasons, it's moreover used as a part of the fuel mix forcarbureted compression ignition model engines.

### *D. Experimental Setup:*

An Electronic device sole cylinder, four lash, continual speed, water chilled, direct injection; variable solidity ratio diesel engine was used to study the presentation, combustion and emission analysis. Specifications areas below.

Fig C. Experimental Setup

**Table 2. Engine Specifications**

| S. No. | Details | Specifications |
|---|---|---|
| 1 | Power | 3.7kW |
| 2 | Speed | 1500 RPM |
| 3 | Compression Ratio | 12:1 to 20:1 |
| 4 | Stroke Length | 56 mm |
| 5 | Cylinder Bore | 80 mm |
| 6 | No. of Cylinders | 1 |
| 7 | Stroke type | 4 |
| 8 | Cooling Type | Water |
| 9 | Speed Type | Constant |

## III. RESULTS AND DISCUSSION

The investigation data from tests on VCRengine has been methodically calculated. The effect of blend ratio and fuel injection pressure at compression ratios of 14:1, 16.5:1, 19:1 has been presented with varying loads. Three blends characteristics have been compared with diesel to understand the effect of each parameter. The procedure of the VCR (Variable Compression Ratio) diesel engine was created to be smooth all over the full load condition at different Compression ratios without any operational difficulties for the peanut biodiesel blends with diesel fuel (i.e. PB10, PB30 PB50).In this study performance constraints such as detailed fuel feasting and brake current efficiency, were unwavering, and emissions such as oxides of nitrogen, carbon monoxide, hydrocarbon and carbon dioxide weremeasured.

### *A. Brake Thermal Efficiency:*

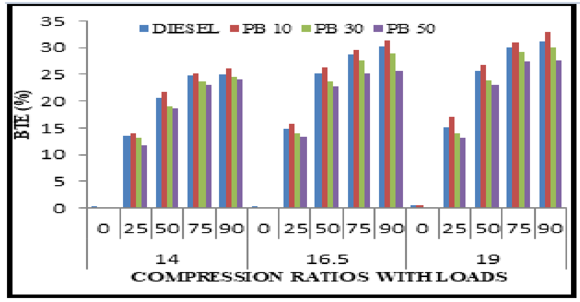


Fig D. CR vs. Brake thermal efficiency

The transformation of brake thermal efficiency (BTE) with percentage load for various peanut biodiesel blends with changed compression ratios is reachable in above Figure D. The brake thermal efficiency of PB10 is higher than diesel, mostly at full load state. From the graph it is marked that the brake thermal efficiency has increased with increases the compression ratio from 14 to 19. For peanut biodiesel at compression ratio 19 the brake thermal efficiency is maximized for blends PB30 and PB50 and are 30.09 (3.5%) and 27.65 (11.3%) correspondingly lower than diesel at complete consignment state but PB10 blend is 32.85 (5.05%) higher than diesel. Eventhe viscosity of biodiesel blend PB10 is lower than diesel, suitable fuel mixing provides superiority combustion. This expression that PB10 biodiesel blend provides better brake thermal efficiency than diesel. The reason maybe the lower viscosity of the peanut oil biodiesel blend that leads to richatomization in the injector. B10 has shown better results than other blends since it has lower viscosity when related to additional biodiesel mixtures.

### *B. Brake Specific FuelConsumption:*

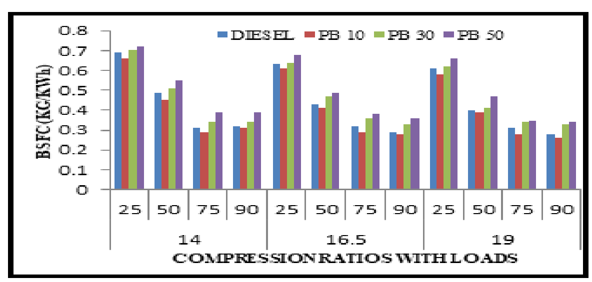


Fig. E. CR vs. Brake specific fuel consumption

Brake specific fuel consumption (BSFC) change with different compression ratios for several peanut biodiesel blends is presented in Figure E. As load rises the brake specific fuel consumption marginally drops for the peanut biodiesel blends. As the compression ratio increases from 14 to 19. The brake specific fuel consumption (BSFC) slightly decreases. The BSFC of PB10 is lesser than diesel, particularly at full load condition. From the graph it is marked that the BSFC has



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reduced to increase in compression ratio from 14 to 19. At compression ratio 19 provides the well specific fuel ingesting of peanut biodiesel blends for PB30 and PB50 is 0.33 kg/kW h and 0.34 kg/kW h, correspondingly, higher than diesel at full load situation but PB10 mixture is 0.26 kg/kW h lesser than diesel. Finds the calorific charge of biodiesel is PB10 is lesser than diesel.

### C. *Carbon Monoxide Emissions:*

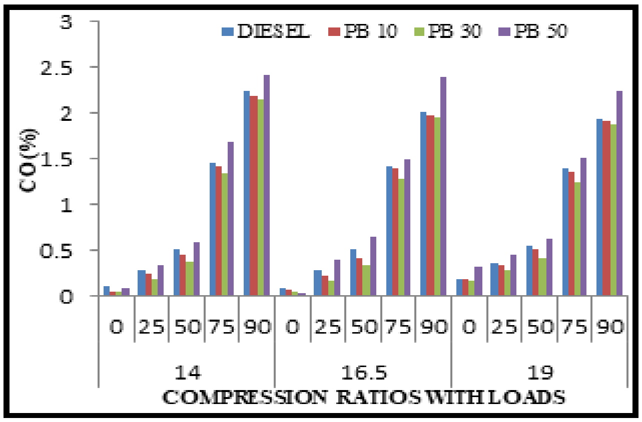


Fig. F. CR vs. Carbon Monoxide Emissions

Carbon monoxide variation with different compression ratios for various peanut biodiesel blends is shown in above Figure F. From the design it was detected that as the load rises the carbon monoxide also improved. The carbon monoxide emissions of PB10 and PB30 are lower than diesel at all load conditions. From the graph it is obvious that the carbon monoxide emissions have decreased with increase in compression ratio from 14 to 19. The carbon monoxide emissions of biodiesel blends are PB10 and PB30 are1.92% and 1.88%, respectively lower than diesel at CR19 for full load condition. But for PB50 blend CO increases at all compression ratios compared to diesel at all load conditions.The reason is PB50 may source an incomplete combustion of fuel, but PB10 and PB30 blends decrease the CO emissions because of complete combustion of fuel.

### D. *Hydro Carbon Emissions:*

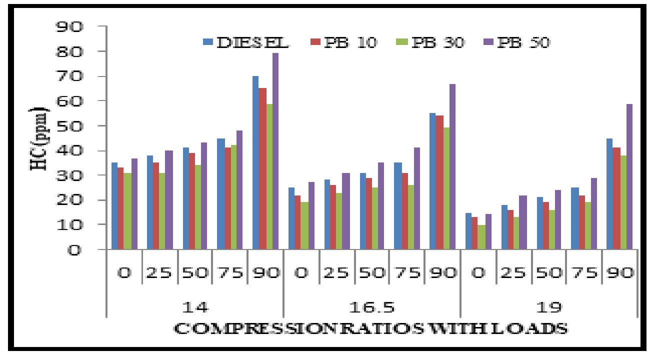


Fig.G.CR vs. Hydrocarbon emissions

Hydrocarbons variation with different compression ratios for various peanut biodiesel blends is presented in above Figure G. From the plot it was practiced thatas the weight increases the hydrocarbons rise. The hydrocarbon emissions of PB10 and PB30 are lower than diesel at all load conditions. After the graph it is evident that the hydrocarbon emissions have decreased with increase in compression ratio from 14 to 19. The hydrocarbon emissions of biodiesel blends are PB10 and PB30 are 41ppm and 38 ppm, respectively lower than the diesel at CR19 for full load condition. But for PB50 blend increases at all compression ratios compared to diesel at all load conditions.The reason is PB50 may cause an incomplete combustion of fuel, but PB10 and PB30 blends have decreased the HC emissions because of complete combustion of fuel.

### E. *Nitrogen Oxide Emissions:*

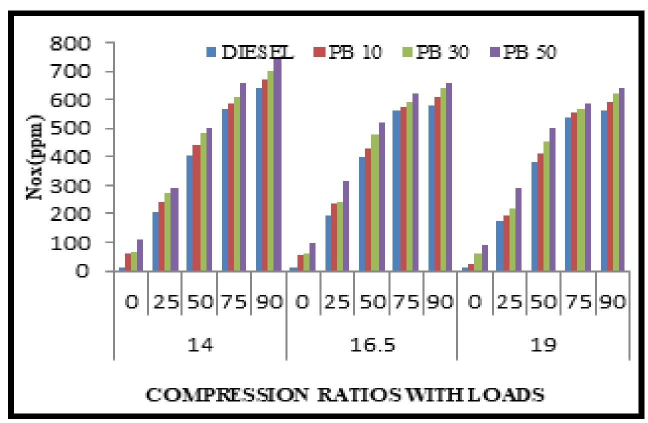


Fig. H. CR vs. Nitrogen oxide emissions

Nitrogen oxide variation with different compression ratios for various peanut biodiesel blends is revealed in above Figure H.From the plot it was pragmatic that as the load increases the Nitrogen oxides increases. From the graph it is evident that the Nitrogen oxide emissions have decreased withthe surge in



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compression ratio from 14 to 19. The Nitrogen oxide emissions of biodiesel blends are PB10, PB30 and PB50 are 590 ppm, 620 ppm and 639 ppm, respectively at CR19 for full load condition whereas Diesel have 559 ppm.From the graph it is clear that the NOx emission in PB10, PB30 and PB50 is high when related to neat diesel. The purpose is the reduced combustion a temperature that overcomes inside the combustion chamber due to the developed heating value of the peanut oil biodiesel blends.

### *F. Brake Thermal Efficiency:*

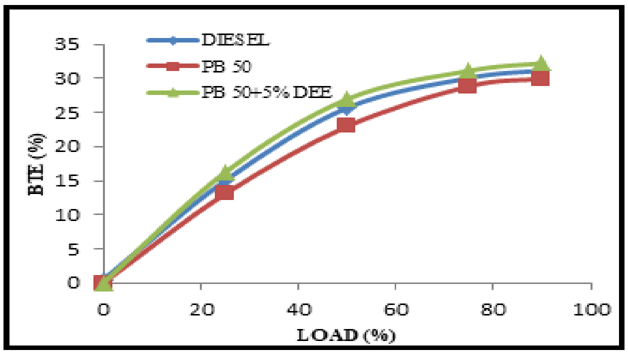



Fig. I. Load Vs. Brake thermal efficiency

Fig I. Shows the variation of brake thermal efficiency With respect to the load. The Load is booked on the x-axis and Efficiency is engaged on y-axis. The graph shows changes in brake thermal efficiency with different loads. It can be seen that PB50+5% DEE additive blend at compression ratio 19 showing (32.25%) at full load condition. The reason may be the lower viscosity of the peanut biodiesel blend PB50+5% DEE that leads to rich atomization in the injector. PB50+5% DEE has shown better results than the diesel.

### *G. Brake Specific Fuel Consumption:*

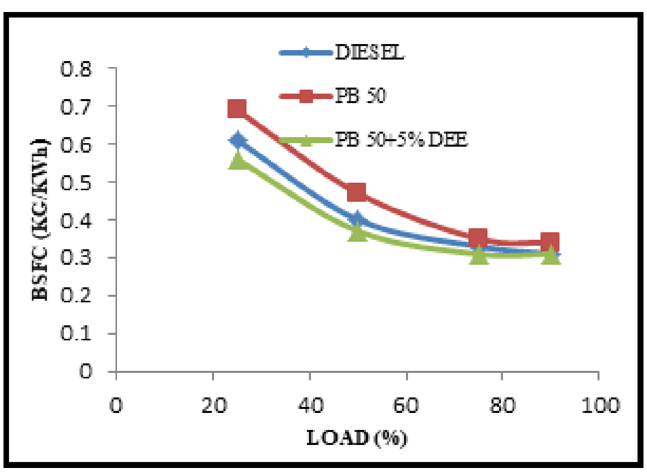
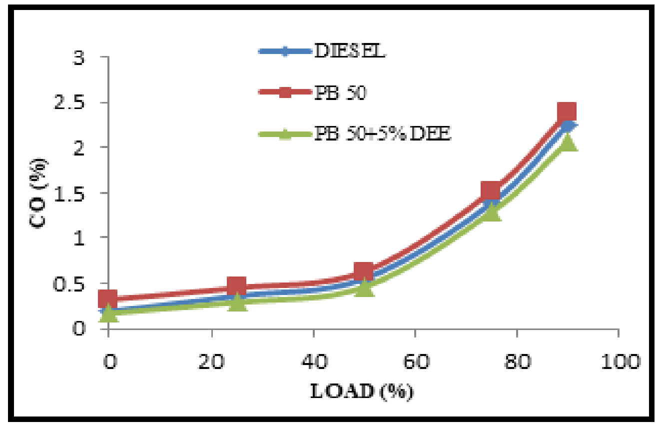



Fig. J. Load Vs. Brake specific fuel consumption

Fig J. Shows the variey of brake specific fuel consumption with respect to the load.The Load is occupied on the x-axis and brake specific fuel consumption is occupied on y-axis. It can be seen that PB50+5% DEE additive blend at compression ratio 19 showing the lowest brake specific fuel eating than the diesel. Diesel has a lesser calorific value than PB50+5% DEE additive Biodiesel blend, so the bsfc for the PB50+5% is higher than the diesel. The reason is that PB50+5% DEE additive blend higher calorific value and lower viscosity than the diesel.

### *H. Carbon Monoxide Emissions*




FigK.LOAD Vs. Carbon monoxide emissions

Fig K. Shows the variation of carbon monoxide With respect to the load. The Load is taken on the x-axis and Carbon monoxide is taken on y-axis. It can be seen that PB50+5% DEE additive blend at compression ratio 19 showing the lowest carbon monoxide (2.07%) lower than the diesel. It ispractical that at lower loads the carbon monoxide emissions are low and increases the load the carbon monoxide emissions increases.The reason is PB50+5% DEE additive may cause complete combustion of fuel, decrease the CO emission, but PB50 blend increase the CO emission because of an incomplete combustion of fuel.

### *I. Hydro Carbon Emissions*

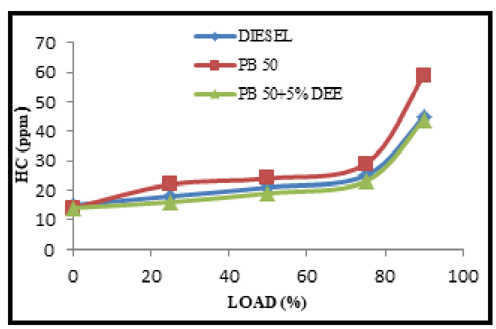



Fig L. LOAD Vs. Hydrocarbon emissions

Fig L. Shows the dissimilarity of hydrocarbon with respect to the load. The Freight is booked on the x-axis and hydrocarbons are booked on y-axis. It can be seen that PB50+5% DEE additive blend at compression ratio 19 showing the lowest hydrocarbons than the diesel. The reason is PB50+5% DEE additive may cause complete combustion of fuel, decrease



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the HC emission, but PB50 blend increase the HC emission because of an incomplete combustion of fuel.

### J. *Nitrogen Oxide Emissions*

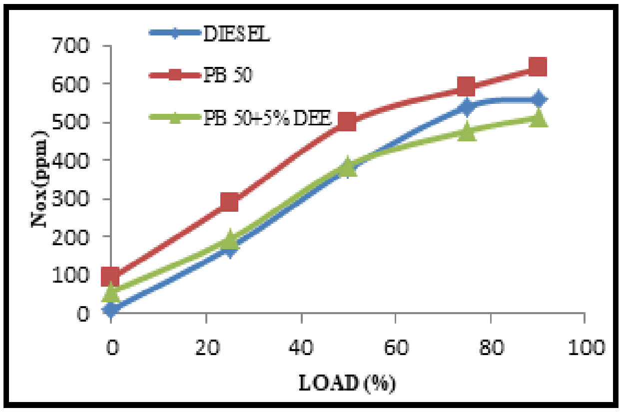


Fig. M. LOAD Vs. Nitrogen oxide emissions

Fig M. Expressions the dissimilarity of nitrogen oxide with respect to the load. The Load is reserved on the x-axis and nitrogen oxide is taken on y-axis. It can be seen that PB50+5% DEE additive blend at compression ratio 19 showing the lowest nitrogen oxide at full load condition than the diesel.From the diagram it is clear that the NOx emission at full load condition is low, when related to neat diesel. The purpose is the reduced combustion a temperature that overcomes inside the combustion chamber due to the developed heating value of the PB50+5% DEE additive biodiesel blend.

## IV. CONCLUSION

Diesel fuel in the possible diesel engine is relieved by severalblends of peanut biodiesel and several trials are done at variable loads with changed compression ratios. Founded on the results, the succeeding conclusions are drawn. To find the optimum PB 10 biodiesel blend, the results attained using diesel and PB 10 and PB 30 biodiesel blends are compared based on the performance and emission parameters. PB50+5% DEE additive presented well performance and lesser emissions. Afterwards showing a complete an investigation a efficacious, worthwhile Blend is developed PB10 Blend which can run the engine giving the maximum brake thermal efficiency at CR19:1 and INJ PR 220 bar this study furnishes qualitative and quantitative information about the performance of engine with peanut biodiesel.

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