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Emission Characterization of Micro-Algae Biodiesel using ZnO as an Additive & Diesel Fuel in Single Cylinder Diesel Engine

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ABSTRACT:- Experiment were carried out by using micro algae oil blends B08,B16, B20, B24, B30 on single cylinder diesel engine . Biodiesel physical and chemical properties are measured according toASTM standards. A “single cylinder diesel engine” is employed as the test engine in the present work.Exhaust emissions such as CO, CO2, NOx, HC, and smoke are measured and compared with diesel oil.CO, HC, CO2 and smoke emissions are lower for biodiesel mixtures B10 and B20 compared ‘‘to diesel fuel”. CO2 emissions from biodiesel blends B10 and B20 produced from waste cooking oil are higher compared to diesel fuel. NOX emissions from all biodiesel mixtures B10 and B20increases than diesel fuel for all biodiesel blend B10 and B20. Exhaust emissions such as CO, CO2, NOx, HC, and smoke are measured. The graph presentation of results was done to observe rate of decrease in losses and increase in efficiency of micro algae oil with respective blends and diesel.

KEYWORDS*:* Micro-algae oil, Biodiesel, Transesterification, Emissions.

I. INTRODUCTION

Industries like mining, automobile, construction and manufacturing use petroleum based crude oil as a fuel for various engines they use. One of the most common fuel used for heavy work is diesel. Using diesel fuel comes with its own challenges. Extracting oil from underground reservoirs then its purification and transport is time consuming process and it also becomes economically unreliable when it comes to problems like leakage and fire hazards. Using diesel in engines is also relatively costly due to its poor efficiency. Average efficiency of diesel based engine is between 40 to 44%and so is the performance. Another major problem regarding conventional fuel is its impact on nature and human beings due to pollution. All diesel based engines have exhaust gases such as CO, CO_2, NO_x,HC and smoke.

Due to all these issues depending on diesel as fuel is not beneficial. So it’s necessary to come up with an alternative to diesel fuel or at least we have to change properties of diesel fuel so that it will yield better performance with less emission of harmful gaseous. This is where biodiesel can be useful. Biodiesel can be made with help of many sources like vegetable oil, waste cooking oil, fish oil, cotton seed oil. Two chemical process esterification and transesterification are used. In esterification oil with accurate value of FFA content is mixed with methanol, further preheated ester oil used for transesterification along with methanol in presence of base catalyst. Once oil becomes from free fatty acid we can covert the oil into ester which is called as the biodiesel.

These oils which are used to make biodiesel can be divided into two main groups. Edible and non-edible. Though edible oils can be used to make bio diesel but it can have negative impact on food industry. So we use non edible oils for making biodiesel. There are several sources such asjatropha tree (Jatrophacurcas), karanja (Pongamiapinnata), mahua (Madhucaindica), castor bean seed (Ricinuscommunis), neem (Azadirachtaindica), rubber seed tree (Heveabrasiliensis), tobacco seed (Nicotianatabacum). Butbefore using these biodieselsit’s important to study their properties and behavior through various experiments. This will helps us to decide the optimum amount which can be added in diesel fuel for best performance. So we have selected micro algae based biodiesel for this experiment we have observed and study its emission characteristics. We have prepared 5 different blends of microalgae biodiesel. All with varying added quantity of algae oil in them and a pure diesel for comparison.

II. METHODOLOGY

The project focus on the Experimental investigation of Performance and emission evaluation of diesel engine fuelled with Diesel. Biodiesel Blend on variable compression ignition engine. The work can be divided in to following phase's information gathering, engine setup, test methodology and experiment conduction, determination exhaust gas emissions, result analysis and discussion and conclusion.

III. EXPERIMENTATION

Experiment is done on single cylinder four stroke diesel engine at the APEX INNOVATION SANGLI. Micro algae. Oil is used for the test, there is no change required in the set of engine before testing. Engine is single cylinder four stroke diesel engine with compression ratio which can be varies over range of 14:1,16:1 and 18:1, speed is 1500rpm, 5.2KW power rating and * is used.

Various blends used for test are as following:
B00, B08, B16, B20, B24, B30.

Fig.1Experimentation Set Up For micro algae Oil Biodiesel

Where,

T1= Temperature of jacket water in
T2= Temperature of jacket water out
T3= Temperature of water Calorimeter in
T4= Temperature of water Calorimeter out
T5= Temperature of Exhaust Gas, before calorimeter.
T6= Temperature of Exhaust Gas, after calorimeter

F1=Flow rate of fuel
F2= Flow rate of air
F3= Flow rate of engine cooling water
F4= Flow rate of calorimeter cooling water
Wt = Load cell reading
N=Engine speed Tachometer reading

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IV. RESULTS AND DISCUSSIONS

- **Emission Analysis**

1 Emissions of Carbon Monoxide (CO)

The carbon monoxide is very poisonous gas that mainly affects on respiratory system of animals.

It was observed that CO emission decreased with the increase of engine load at part load then it returned to increase up at full load. This was due to the increase of fuel consumption which led to a rich air-fuel mixture. Comparing with ‘‘pure diesel fuel”, a ‘‘significant reduction in CO emission throughout the engine load range had been observed when biodiesel and its blends were used. This was due to more oxygen content in biodiesel than diesel fuel that gave more complete combustion. Carbon monoxide is mainly produced due to incomplete combustion of fuel.Fig.1.1, Fig.1.2 and Fig. 1.3shows variation of CO emissions Vs load for blends B00, B08, B16, B20, B24, B30 at CR14 and 16.Itisobservedthat increase in load, emission of CO for the blends B08, B16, B20 and B30 are less compared to pure diesel at compression ratio 14 and 16 respectively.

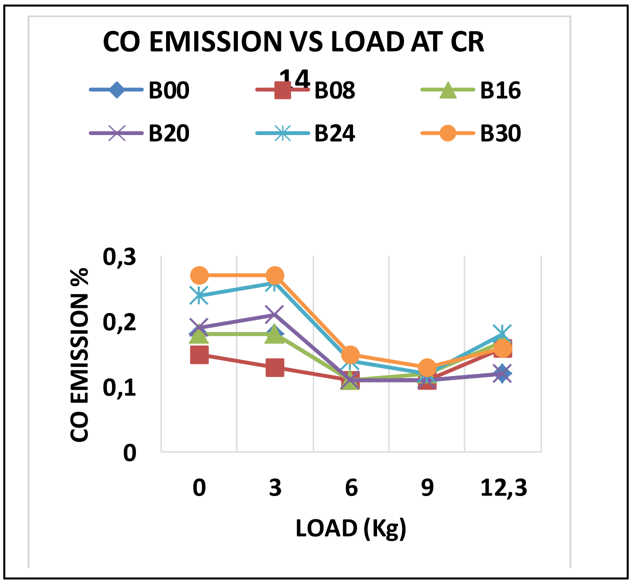

Fig. 1.1

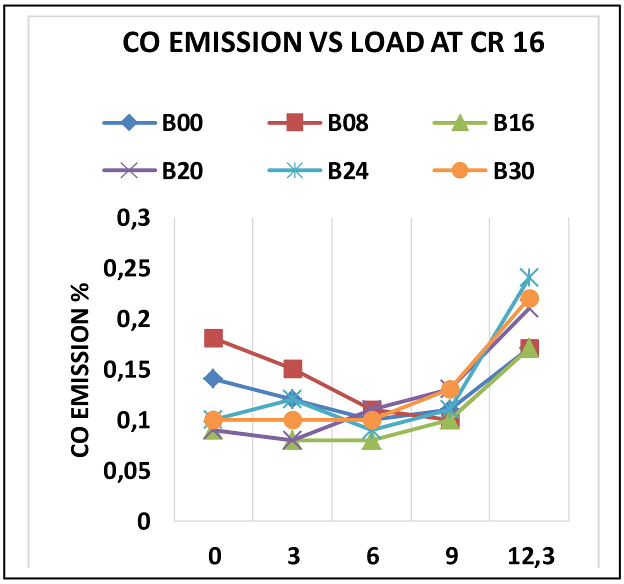

Fig. 1.2

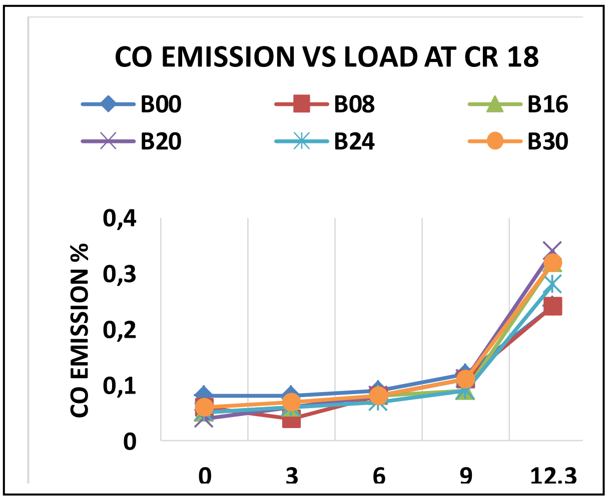

Fig. 1.3

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2. Emissions of Hydrocarbons (HC)

Fig.2.1 shows variation of HC emissions Vs load for blends B00, B08, B16, B20, B24 and B30 at CR14, It is observed that at low load emission of HC were less for blends B30, B16 compared to pure diesel but as load is increased HC emission for the blends B16, B24and B30 are greater than pure diesel. Fig.2.2 and Fig.2.3 shows variation of HC (ppm) Vs load for blends B00, B08, B16, B20, B24, B30 at CR 16 and 18. HC emission is showing similar behavior with increase in compression ratio for diesel, it is observed that with increase in load, emission of HC for the blends B08, B16, B20, B24 and B30 increases compared to pure diesel at compression ratio CR16 and CR 18 respectively.

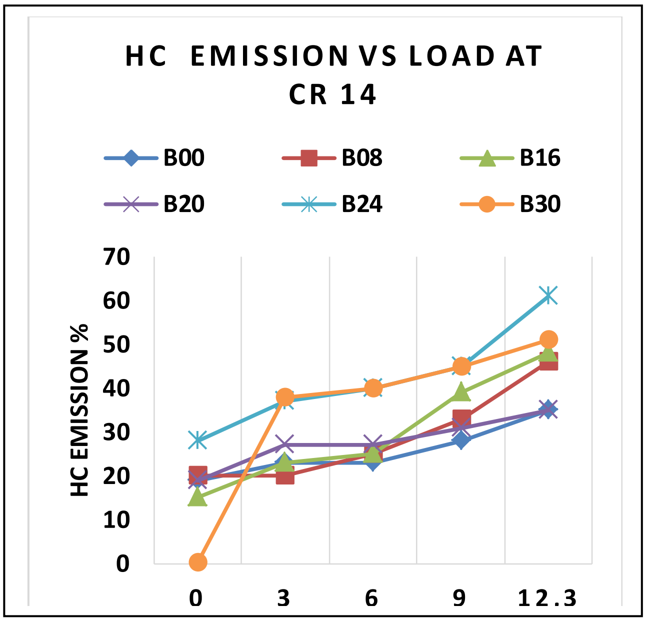

Fig 2.1

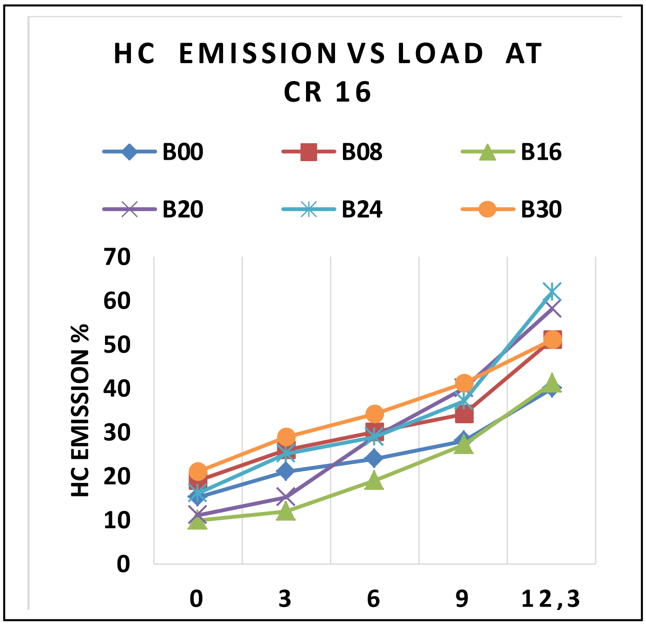

Fig 2.2

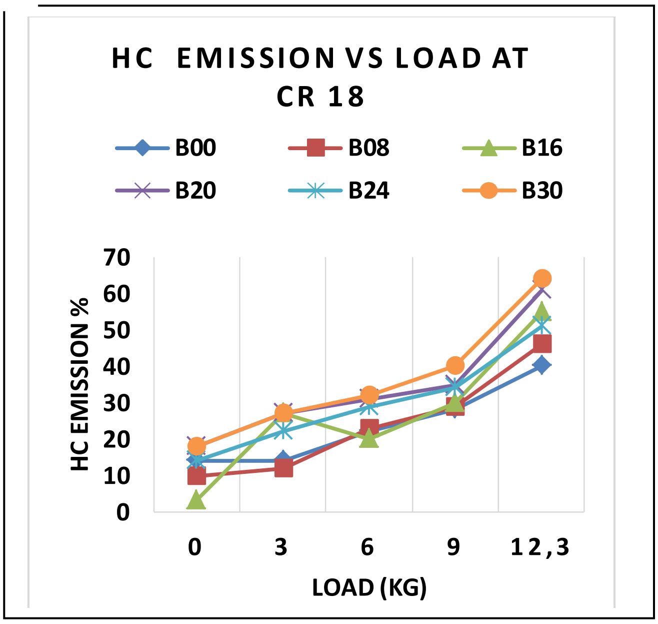

Fig 2.3

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3. Emissions of Nitrous Oxides(NO_X)

There are different oxides of nitrogen which include NO, N_2O, NO_2 etc. therefore oxides of nitrogen are called as NO_x, CO and HC are mostly produced due to incomplete combustion of fuel but NO_x are formed due to complete combustion as high temperature are reached. NO_x causes eye irritation, throat problem like cough and damaged lungs. Fig.3.1, Fig.3.2 and Fig.3.3shows variation of NO_x (ppm) Vs load for blends B00, B08,B16, B20, B24, B30 at CR 14, 16 and 18. It is observed that with increase in load emission of NO_x increases. For CR 14 NO_x emissions for all blends are nearly equal to pure diesel but with increase in CR NO_x emissions for blends B08,B16, B24 are more as compared to pure diesel. But as compression ratio increase blend B16 and B24 show lesser emission.

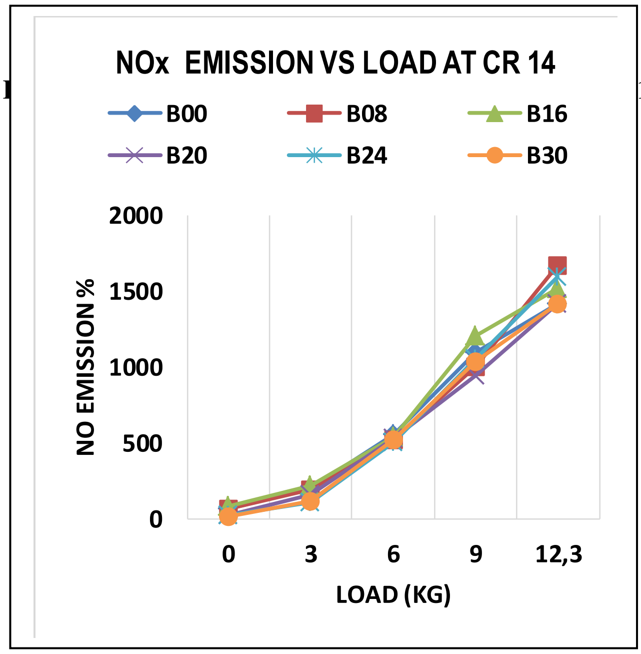

Fig. 3.1

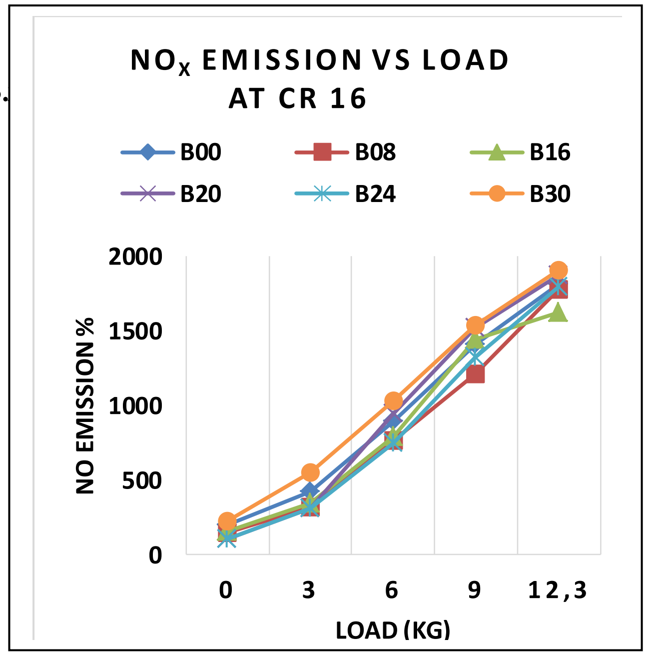

Fig. 3.2

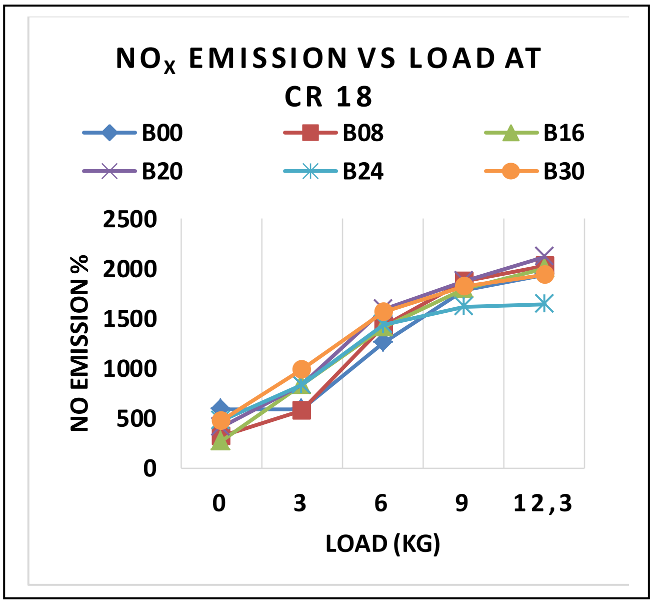

Fig. 3.3

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4. SMOKE OPACITY

Smoke opacity instruments measure optical properties of diesel smoke, providing an indirect way of measuring of diesel particulate emissions. There are two groups of instruments: opacity meters, which evaluate smoke in the exhaust gas, and smoke number meters, which optically evaluate soot collected on paper filters. Correlations have been developed to estimate PM mass emissions based on opacity measurement. Second generation opacity meters based on laser light scattering are much more sensitive and appear to hold promise for application to newer engines with much lower particulate emissions. Fig.4.1 & 4.2 & 4.3 shows variation of smoke opacity vs load for blends B00, B08, B16, B20, B24, B30 at CR 14, 16 and 18. It is observed that with increase in load smoke opacity increases. For CR 14 smoke opacity or all blends is higher than pure diesel but with increase in CR smoke opacity for blends B08 are less as compared to pure diesel.

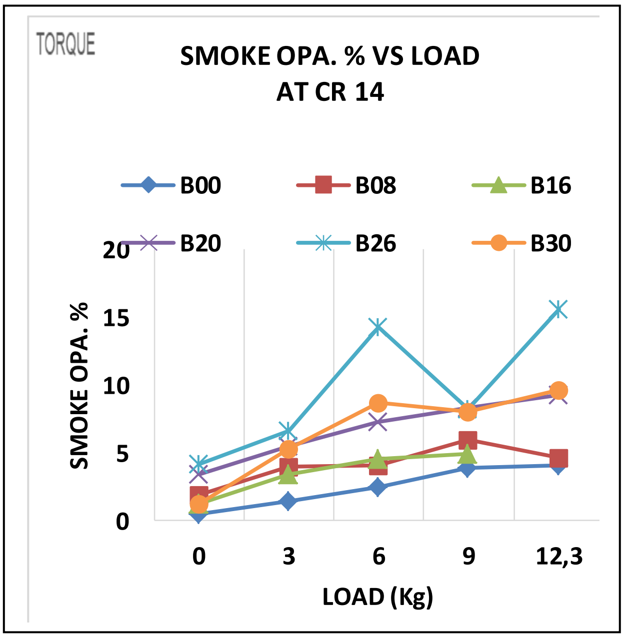

Fig.4.1

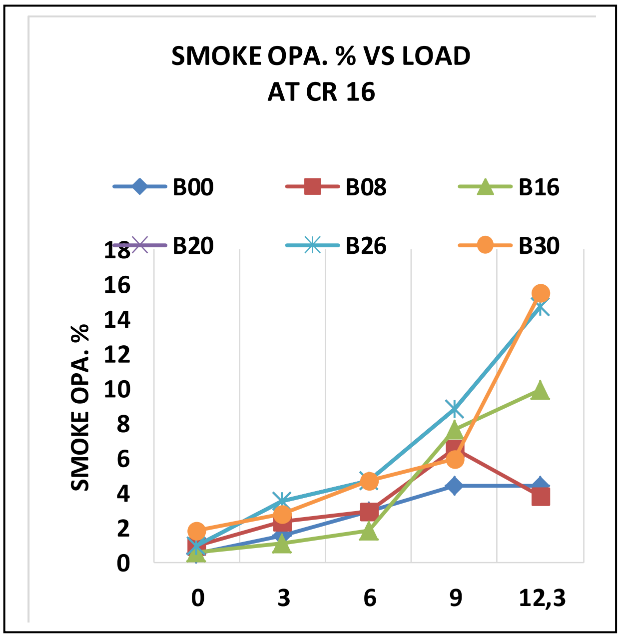

Fig.4.2

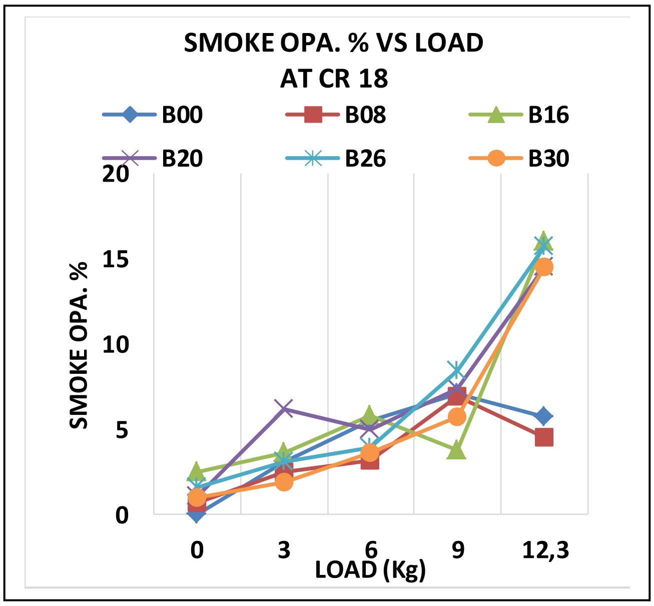

Fig. 4.3

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V. CONCLUSIONS

The experiment was done on single cylinder four strokes diesel engine using Micro algae oil biodiesel blends and compared with diesel fuel gives conclusions as follows:

1. Due to higher oxygen complete combustion of fuels leads to CO emissions decreased as the load increased. Emission of CO for the blends B08, B16, B20 and B30are 17.31% and 42.90% less compared to pure diesel.
2. It is observed that HC emissions are increased as the load increased. Nozzle chocking is also observed. Blend B08 shows35.97% less HC emission than pure diesel at all loads for CR 16.The increase of NOx emissions with the increase of engine load resulted from higher cylinder combustion temperature and higher adiabatic flame temperature. The formation of NOx was favoured by higher cylinder combustion temperatures and availability of oxygen.
3. The combustion of biodiesel produced more NOx emission compared to diesel oil.
4. There was an ''increase of smoke emission with an increase of engine load". This was due to the increase in fuel consumption which led to rich air-fuel mixture. The decrease in smoke emissions was due to the fact that there 'were more oxygen molecules and lower carbon content in the fuel as compared to diesel oil which led to better combustion.

REFERENCES

[1] Prafulla D. Patil, Shuguang Deng, Optimization of biodiesel production from edible and non-edible vegetable oils, Fuel, 2009, Vol. 88, pp. 1302-1306.

[2] Murugesan, C. Umarani, T.R. Chinnusamy, M. Krishnan,R. Subramanian, N. Neduzchezhain, Production and analysis of bio-diesel from non-edible oils-A review, Renewable and Sustainable Energy Reviews, 2009, Vol. 13, pp. 825-834.

[3] Hwanam Kim and Byungchul Choi, The effect of biodiesel and bioethanol blended diesel fuel on nanoparticles and exhaust emissions from CRDI diesel engine, Renewable Energy, 2010, Vol. 35, pp. 157-163.

[4] A. E. Atabani, A.S. Silitonga, H.C. Ong, T.M.I. Mahlia, H.H. Masjuki, Irfan AnjumBadruddin, H. Fayaz, Non-edible vegetable oils: A critical evaluation of oil extraction, fatty acid compositions, biodiesel production, characteristics, engine performance and emissions production, Renewable and Sustainable Energy Reviews, 2013, Vol. 18, pp. 211-245.

[5] A. S. Silitonga, H. H. Masjuki, T. M. I. Mahlia, H. C. Ong, W. T. Chong, M.H.Boosroh, Overview properties of biodiesel diesel blends from edible and non-edible feedstock, Renewable and Sustainable Energy Reviews, 2013, Vol. 22, pp. 346-360.

[6] J. SadhikBasha, R.B. Anand, Performance, emission and combustion characteristics of a diesel engine using Carbon Nanotubes blended Jatropha Methyl Ester Emulsions, Alexandria Engineering Journal, 2014, Vol. 53, pp. 259-273.

[7] V. Arul MozhiSelvan, R. B. Anand, and M. Udayakumar, Effect of Cerium Oxide Nanoparticles and Carbon Nanotubes as fuel-borne additives in Diesterol blends on the performance, combustion and emission characteristics of a variable compression ratio engine, Fuel, 2014, Vol. 130, pp. 160-167.

[8] Ali M.A., Attia Ahmed I., El-SeesyHesham M., El-Batsh Mohamed and S. Shehata, Effects of Alumina Nanoparticles Additives in to Jojoba Methyl Ester-Diesel Mixture on Diesel Engine Performance, Proceedings of the ASME, 2014, pp 1-10.

[9] Naresh Kumar Gurusala and V Arul MozhiSelvan, Effects of alumina nanoparticles in waste chicken fat biodiesel on the operating characteristics of a compression ignition engine, Clean Techn Environ Policy, 2014, pp. 1-12.

[10] MehrdadMirzajanzadeh, MeisamTabatabaei, Mehdi Ardjmand, AlimoradRashidi, Barat Ghobadian, Mohammad Barkhi and Mohammad Pazouki,A Novel Soluble Nano-catalysts in Diesel-Biodiesel Fuel Blends to Improve Diesel Engines Performance and Reduce Exhaust Emissions, Fuel, 2015, Vol. 139, pp. 374-382.

[11] C. Syed Aalam, and C.G. Saravanan, Effects of nano Metal Oxide Blended Mahua Biodiesel on CRDI Diesel Engine, Ain Shams Engineering Journal, 2015, Vol. IX, Issue II, pp. 82-90.

[12] A. Prabu and R. B. Anand, Emission control strategy by adding alumina and cerium oxide nano particle in Biodiesel, Journal of the Energy Institute, 2015, Volume 89, Issue 3, pp. 366-372.

[13] G. Vairamuthu, S. Sundarapandian, C. Kailasanathan and B. Thangagiri, Experimental investigation on the effects of Cerium oxide nanoparticle on Calophylluminophyllum (PUNNAI) biodiesel blended with diesel fuel in DI diesel engine modified by nozzle geometry, Journal of the Energy Institute, 2015, Journal of the Energy Institute. Vol. 89(4), pp. 668-682.

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 5.928

| Volume 4, Issue 6, June 2021 |

[14] M. Srinivasa Rao and R. B. Anand, Performance and Emission Characteristics Improvement Studies on A Biodiesel Fuelled DICI Engine Using Water and AlO(OH) Nanoparticles, Applied Thermal Engineering, 2015, Vol. 98, pp. 636-645

[15] C. Syed Aalam, C. G. Saravanan, M.Kannan, Experimental investigations on a CRDI systemassisted diesel engine fuelled with aluminium oxidenanoparticles blended biodiesel, Alexandria Engineering Journal, 2015, Vol. 54, pp. 351-358.

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