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Analysis of Emission Characteristics on CI Diesel Engine using Safflower Methyl Ester

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Abstract- Unmatched supply of fossil fuels and its inflation of prices have promoted the interest and serious concern about the alternative sources for fossil fuels. In this work, investigations have been carried out to study the emission and combustion charecteristics of Safflower Methyl Ester (SME) as a fuel to diesel engine. For this experiments are conducted on a single cylinder, water cooled, and four stroke stationary engine of 5.2 KW. This engine is coupled with eddy current dynamometer as loading unit. The engine has run with safflower methyl ester using different pistons of combustion geometry by volume basis and readings are recorded. These tests are carried out over entire range of engine operations at varying conditions of load. The emissions obtained from these experiments are computed and compared for different pistons of geometry and presented in this paper.

I. INTRODUCTION

Biodiesel obtained from vegetable oil can be used directly in diesel engines on par with diesel fuel, because their properties are similar to petrodiesel []. In this connection there is no need for engine modifications. Several methods have been developed for biodiesel extraction, among which transesterification with alkali catalyst conversion of triglycerides to their corresponding methyl ester in short reaction time []. The process of transesterification is depends on the reaction condition, molar reaction of alcohol to oil, type of alcohol, type and amount of catalyst, reaction temperature and pressure, reaction time and contents of free fatty acids and water in oils or fats.Biodiesel has a higher cetane number than petrodiesel and also there were no aromatics, but contains 10-11 % oxygen by weight []. These characteristics of biodiesel reduce the emissions of carbon monoxide, hydrocarbons, and particulate matter in the exhaust gas compared with diesel fuel [].More than 95% of global biodiesel production is made from edible vegetable oils. The largest biodiesel producers are the European Union, the United States, Brazil, and Indonesia. Rapeseed and sunflower oils are used in EU, where as palm oil predominates in biodiesel production in tropical countries and soybean oil in the United States []. Esters produced from pilot plant were examined in the laboratory and evaluated their properties .Further its properties were improved by using the enhancing techniques depends on the properties of respective oils. The results indicated that the methyl ester produced from camelina oil has properties similar to rape methyl ester.

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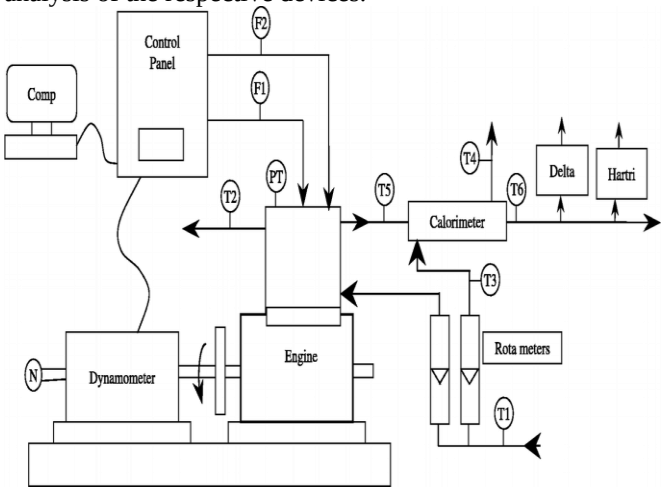
High free fatty acid levels reduce ester yields in a single stage process []. Fuel consumption and general vehicle operation with camelina ester are similar rape methyl ester []. Cottonseed oil was converted into biodiesel by alkali-catalyzed transesterification process with different catalyst concentration, catalyst type, temperature, methanol to oil molar ratio and agitation intensity. From these the obtained values ,it was concluded that as optimum catalyst $NaOCH_3$, Catalyst concentration 0.75%, temperature 65°C, methanol to oil molar ratio 6:1, and agitation intensity 600 rpm[].The oil content of crops is one of the important parameters in deciding on the suitability of a certain crops as biodiesel feedstock. Oilseeds with maximum content are very much attractive, due to their lower production cost. Safflower is an oilseed crop which is mainly grown in semiarid regions. It is used in both transportation and industrial sectors effectively. Safflower is a strongly top rooted annual plant belongs to Asteraceae family and its charecteristics are resistance to saline conditions, to water stress, and can reach the deep-lying water [].

II. EXPERIMENTATION

The experimental set-up consists of a single cylinder water cooled and four stroke diesel engine of 5.2 KW.A eddy current dynamometer of water cooling is used as loading unit. The instrumentation available in the test rig are used to measure air consumption, fuel consumption, in cylinder pressure, crank angle, cooling water flow rate,exaust gas temperature. A separate gas analyzer is used which is coupled to the computerized test rig to measure CO,CO_2,HC,O_2&NO_X.An oblique manometer is used to measure air consumption. The lubricating oil, fuel and ambient temperatures are measured by thermocouples .The computed values are recorded by considering the error analysis of the respective devices.



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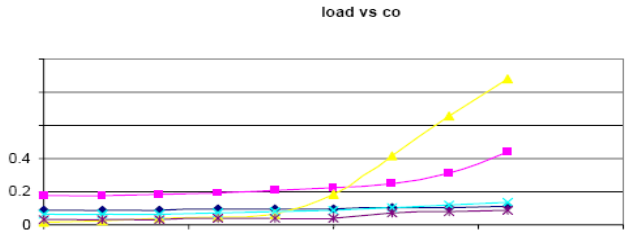
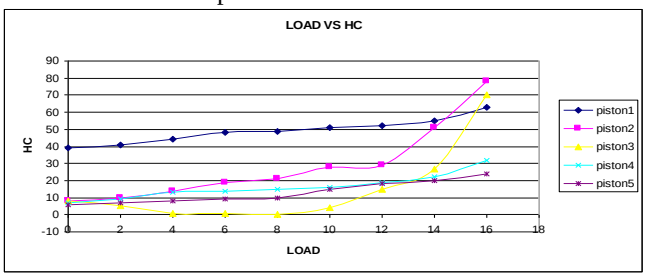
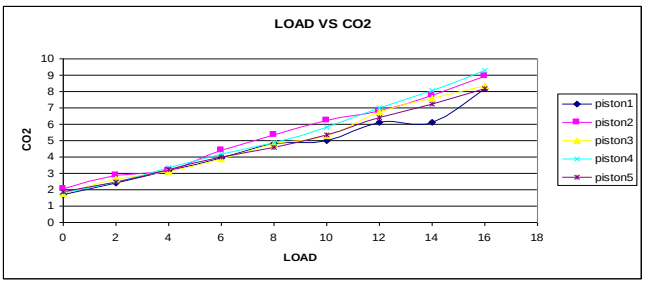
III. RESULTS& DISCUSSIONS



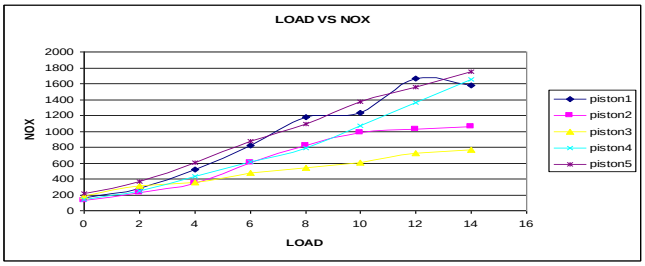
From the graph it is observed that the carbon monoxide emissions are more or less same at low loads and medium loads. Closer to rated load the carbon monoxide emissions of the fuel are increased significantly for the piston3.This is due to inadequate air moment, where relative velocity between the fuel droplets and the air affected.



From the graph it is learnt that the hydrocarbon emissions for piston 2, piston3, piston4, and piston 5 are in the same trend and less compared to piston1 for low and medium load operations .At rated load operation for the pistons 4&5 are better compared to other pistons. Where as for piston1 at all range of load operations the HC emissions are high compared to other pistons. This is because of disturbance in combustion of spray cone.



From the graph it is observed that the carbon dioxide emissions are almost same at lower loads for all the pistons. For medium and higher loads the co_2 emission are more for piston 4, and is about12.5% compared to piston1.For piston2& piston5, CO_2 emissions are high compared to other pistons at rated load. However for the piston4 the CO_2 emissions are slightly higher compared to other four pistons. This may be occurred due to concentration of oxygen in the mixture after dilution.



From the graph it is observed that at all loads of operation the NOx emissions in case of piston 5 are high compared to other pistons. For piston4 the NO_x emission are very low compared to any other pistons particularly at low load operations.

IV. CONCLUSIONS

The following conclusions are drawn from the experiments carried out on stationary CI engine at thermal engineering lab of mechanical department, JNTUCEH.

1. For The piston 3 the CO emissions are higher than existing piston (piston1) and is about eight times that of piston 1.This could be due to relative velocity between the fuel vapor injected and compression air moment.
2. The HC emissions are high for piston 1 compared to other pistons and at rated load the HC emissions are high compared to piston5 and is about three times that of piston5.This is due to small disturbance in combustion of spray cone.
3. For rated load operation of diesel engine both CO_2 and NO_x emission are high with piston 4 and piston5.This is due to concentration of oxygen and break specific fuel consumption

REFERENCES

1. shyam pandey, amit sharma, p. k. sahoo" experimental investigation on the performance and emission characteristics of a diesel engine fuelled with ethanol, diesel and j" international journal of advances in engineering & technology, sept 2012.©ijaet issn: 2231-1963,341 vol.
2. Sehmus altun" performance and exhaust emissions of a DI diesel engine fueled with waste cooking oil and inedible animal tallow methyl esters" Turkish j. eng. env. sci.35 (2011) , 107 – 114.c_t{ub˙itak.
3. E. I. Bello, F. Out and A. Osasona" Cetane number of three vegetable oils, their biodiesels and blends with diesel fuel" Journal of Petroleum Technology and Alternative Fuels Vol. 3(5), pp. 52-57, October, 2012 Available online at http://www.academicjournals.org/JPTAF DOI: 10.5897/JPTAF12.009 ©2012 Academic Journals
4. Nitin Shrivastava, Dr. S.N. Varma, Dr. Mukesh Pandey" A Comparative study of the Behaviour of Biodiesels of Different origins on the Diesel Engine Performance and Emission" IRACST – Engineering Science and Technology: An International Journal (ESTIJ), ISSN: 2250-3498,Vol.2, No. 4, August 2012
5. Ekrem b"effect of biodiesel on a DI diesel engine performance, emission and combustion characteristics, fuel" 89(2010), 3099-3105.
6. Siddalingappa R. Hotti, Omprakash Hebbal" Performance and Combustion Characteristics of Single Cylinder Diesel Engine Running on Karanja Oil/Diesel Fuel Blends" Engineering, 2011, 3, 371-375doi:10.4236/eng.2011.34042 Published Online April 2011 (http://www.SciRP.org/journal/eng)
7. rajneesh kumar, anoop kumar dixit, gursahib singh manes, rohinish khurana shashi kumar singh"emission and performance characteristics of jatropha ethyl ester blends with diesel fuel in a c.i. engine" international journal of automobile engineering research and development (ijauerd)issn 2277-4785vol.2, issue 2 sep 2012 34-47.
8. S.kirankumar, prof. k. apparao, prof. r.nagendra babu" experimental investigation on performance, combustion characteristics of diesel engine by using fish oil" engineering research and applications (ijera) issn: 2248-9622 www.ijera.com, vol. 2, issue6, November- December 2012, pp.1258-1263.
9. p. Suresh kumar, ramesh kumar donga, p. k.sahoo"experimental comparative study between performance and emissions of jatropha biodiesel and diesel under varying injection pressures" international journal of engineering sciences & emerging technologies, august 2012.issn: 2231 – 6604 volume 3, issue 1, pp: 98-112 ©ijeset.
10. s.jaichander, k.annamalai"performance and emission analysis on pongamia biodiesel with different open combustion chambers in a DI diesel engine"journal of scientific and industrial research, vol 71, july 2012, pp.487-491.

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Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

11. Nitin shrivastava, dr. s.n. varma, dr. mukesh pandey" a comparative study of the behaviour of biodiesels of different origins on the diesel engine performance and emission" iracst – engineering science and technology: an international journal (estij), ISSN: 2250-3498, vol.2, no. 4, august 2012.
12. c.v. subba reddy, c. eswara reddy , k. hemachandra reddy" effect of tangential grooves on piston crown of d.i. diesel engine with blends of cotton seed oil methyl easter" ijrras 13 (1) october 2012.

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