PERFORMANCE AND EMISSION INVESTIGATIONS ON DI DIESELENGINE RUN BY MANGO SEED BIO-DIESEL BLEND WITH NANO PARTICLES

G.Abilash Ebenezer[1], G.Ajith Kumar[2], R.Ganesh Balaji[3], B.Giri Raju[4], S.Nandhagopan[5]

1,2,3,4, UG Students, Department Of Mechanical Engineering, K.Ramakrishnan College Of Engineering, Trichy-621 112.

5, Assistant Professor, Department Of Mechanical Engineering, K.Ramakrishnan College Of Engineering, Trichy-621 112.

ABSTRACT

In this study, the bio-diesel was prepared from raw mango seed oil by trans-esterification process subjected to temperature of 65^0C. The properties of mango seed oil have been found to be amazingly near to that of petroleum fuels with calorific value 41 MJ/Kg. The biofuel which is a mixture of diesel and nanoparticles of biodiesel were prepared and tested in a single cylinder direct injection (DI) diesel engine. The performance and emission characteristics of the engine were under five engine load at the speed of 1500 rpm. Here the Aluminium Oxide is used as an additive to enhance the combustion. The different combination of blends namely (B25, B25+2ppm of nanoparticles, B25+4ppm of nanoparticles, B25+6ppm of nanoparticles) were tested in engine. The results are compared with neat diesel operation. The effect of test fuels on engine Break Specific fuel consumption, Break thermal efficiency, Carbon monoxide (CO), Hydro carbon (HC), and Oxides of Nitrogen (NOx), Emissions was investigated.

KEY WORDS: ***Bio**-Diesel, Mango Seed, Blends, Nanoparticles, Performance, Emission.*

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1. INTRODUCTION

The automobile pollution has severe influence on climatic changes and urban pollution because of the largely increased numbers of automobiles and completely on the fossil fuels. In this context, globally many researches has been carried out in finding the suitable alternate fuel. The major pollutants from automobiles are carbon monoxide (CO), hydrocarbons (HC), oxides of nitrogen (NOx), lead compounds, sulphur compounds and particulates. Large engines emit large quantities of pollutants compared to smaller engines and the quantity of pollutants dumped into the atmosphere depends on the vehicle pollution. One of the variable alternative renewable sources is bio-fuel. The main advantage of bio-fuel is renewable nature. It can be used as substitute fuel in internal combustion engine with appropriate engine alternation and its use as fuel does not cause much environmental pollution. Hence its efficient utilization in engines can go a long way to meet the growing problems of fuel oil scarcity and exhaust pollution.

Due to growing number of engines oil consumption has been increasing rapidly. But the world reserves of crude oil are depleting very fast. Hence scientists and technologists all over the world are looking for an alternative fuel. The increase in prices of petroleum based fuels, a strict governmental regulation on exhaust emissions and future depletion of worldwide petroleum reserves encourages studies to search for alternative fuels. Another reason for motivating the development of alternative fuels for the IC engines is to minimize the emission problem of conventional engines.

2. OBJECTIVE

The main objectives of the project work are:

- To conduct base line test on diesel engine
- To conduct the experiment with blends of mango seed oil and additive of nanoparticles in diesel engine.
- To compare the emissions and performance of bio-diesel blended with mango seed oil and fuel additives with that of the pure diesel.

3. BIO-DIESEL PRODUCTION

3.1. Trans-Esterification Process

Mango seed oil is produced from mango seed which is commercially available in market. Generally it is used in soap industry and cosmetic industry. The mango seed oil is dried in room temperature and the shell is removed and subjected to crusher to crush the mango seed oil is derived. Mango seed oil is slight yellowish in colour.Preparation of biodiesel from mango seed oil is done by trans-esterification process.as shown in fig-1. It is the process of using methanol (CH_3OH) of 200ml and potassium (KOH) of 15kg to chemically brake the molecules of raw mango seed oil into ester and glycerol. This process reacts with the oil mixed with alcohol to remove the glycerin, a byproduct of biodiesel production. The stirring takes place at 1500rpm for about 15 min and there is no separation is observed and it becomes a homogeneous mixture.

Fig-1: Trans-esterification process

4. EXPERIMENTATION

4.1. Engine Components

- The Engine
- Dynamometer
- Smoke meter
- Exhaust gas analyzer

4.2. Test engine

A single cylinder water-cooled, four stroke direct injection compression ignition engine with a compression ratio of 17:5:1, developing 3.5kw at 1500rpm was used for this study. The schematic of the experimental setup is shown in figure 2. The engine was always run at its rated speed. The operating pressure of the nozzle was set at the rated value of 200kg/cm². The cooling of the engine was accomplished by supplying water through the jackets on the engine block and cylinder head. The engine is coupled with eddy current dynamometer. The specification of the engine is shown in the table-1.

Table -1: Specification of test engine

SI.No	Parameters	Specification
1	Number of cylinder	One
2	Bore diameter	87.5mm
3	Stroke	110mm
4	Compression ratio	17:5:1
5	Brake power	5.2kw
6	Speed	1500rpm
7	Dynamometer	Eddy current dynamometer
8	Injection pressure	220 kg/cm²

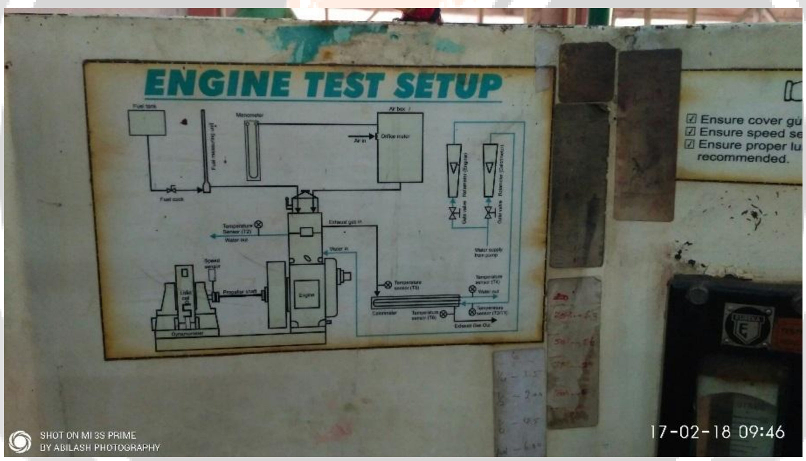

Fig-2: Experimental setup

5. RESULT AND DISCUSSION

In this experiments the test were conducted with blends of mango seed oil and compared with pure diesel results.

5.1. Performance Characteristics

5.1.1. Brake thermal efficiency

The variations of brake thermal efficiency with different loads for different fuels have been shown in fig- 3. It is observed that BTE of mango seed oil and its blends are slightly lower than that of diesel fuel at all loads. The maximum brake thermal efficiency of diesel fuel is 28% and that of B25+2ppm is 28.5%. It is seen that among different biodiesel blends, B25+2ppm showed better BTE than other proportions. The reason for BTE decrease is in sufficient oxygen causing incomplete combustion of the fuel. The higher viscosity, and density of biodiesels and therefore reduced the BTE for biodiesel.

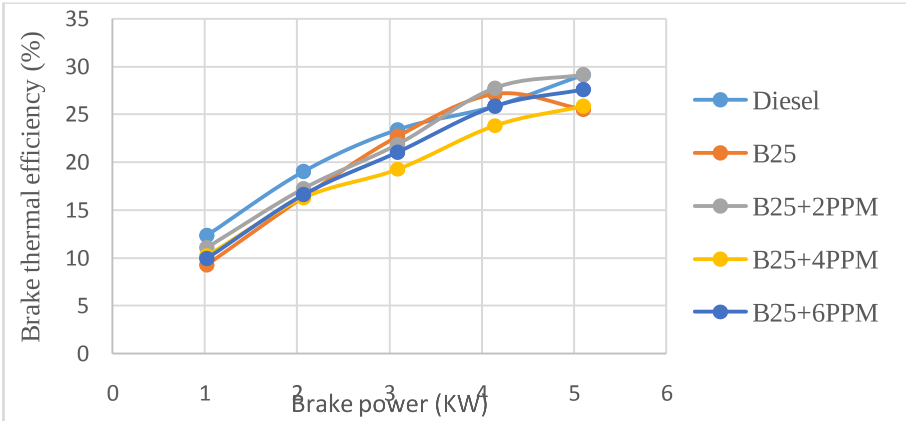

Fig-3: Variation of BTE with BP for various mango seed blends

5.1.2. Brake specific fuel consumption (BSFC)

Figure1.2 shows the variation of BSFC for different blends of mango seed oil bio-diesel and pure diesel with different operating conditions. It is observed that BSFC of diesel is minimum compared with other biodiesels blends at all loads. It is also observed that among different biodiesels blends, B25+2ppm showed better SFC than other biodiesel blends. The brake specific fuel consumption (BSFC) of biodiesel is higher than that of diesel fuel due to the lower LHV and higher viscosity of biodiesel. Therefore, the amount of fuel introduced to the cylinder for a desired energy input has to be greater with the biodiesel.

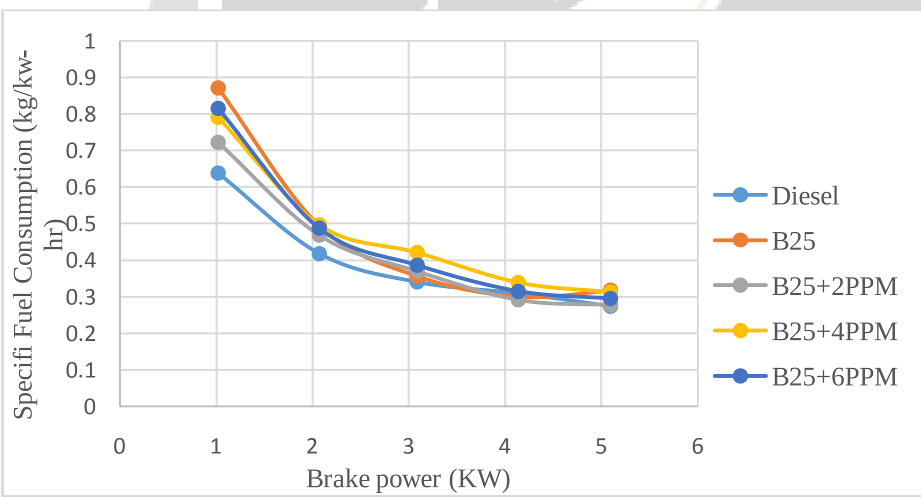

Fig- 4: Variations of BSFC with BP for various mango seed blends

5.1.3. Exhaust Gas Temperature

The variation of exhaust gas temperature with brake power of the engine for various proportion of mango seed bio-diesel blends and diesel is shown in Fig 5.3. It is observed that EGT of diesel and its blends are higher than that of diesel fuel. The maximum EGT of B25+6ppm fuel is 350^{0}C and for the diesel is 300^{0}C. Biodiesel fuel and its blend give higher exhaust gas temperatures (EGT) than diesel fuel. The increase in exhaust gas temperature is due to complete combustion of bio diesel.

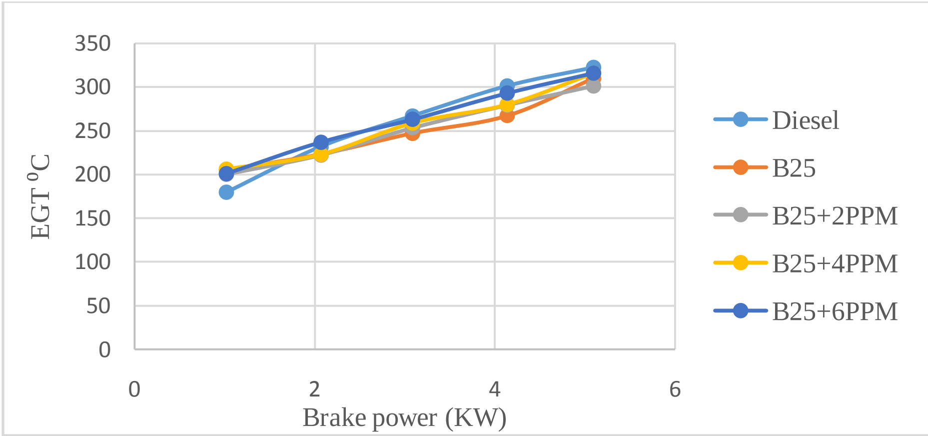

Fig- 5: Variation of EGT with BP for various blends

5.2. Emission Characteristics

5.2.1. Carbon Monoxide (CO)

The variation of carbon monoxide emission with brake power for diesel and blends of mango seed and nanoparticles of bio-diesel in the test engine are shown in fig-6. The CO emission depends upon the strength of the mixture, availability of oxygen and viscosity of fuel. CO emission of all blends is higher than that of diesel, CO emission of all blends higher than that of diesel, except the blend B25+2PPM has a lower CO emission that of diesel, CO emission of B2+2PPM blends of maximum load is 0.13%. Carbon monoxide emission of pure mango seed bio-diesel is nearer to the diesel and B25+4PPM is higher than that of all blends. This is due to incomplete combustion at higher loads which results in higher CO emission.

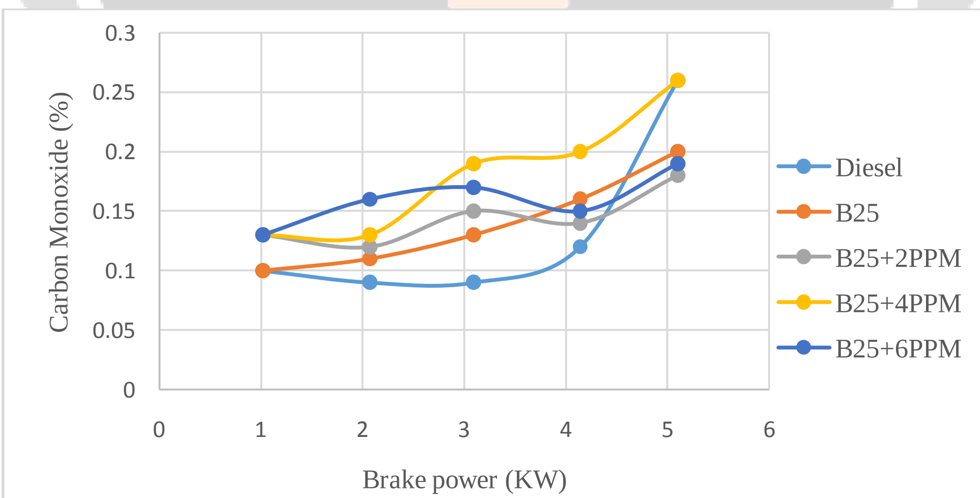

Fig- 6: Variation of CO with BP

5.2.2. Unburned Hydrocarbon (HC)

Fig- 7 Shows the variation of unburned hydrocarbon with change in brake power with under five different loads, from the figure that for B25+2PPM bio-diesel blends the emission of HC is less that of the diesel. Unburned hydrocarbon emission is the results of incomplete combustion. A reason for reductions of hydrocarbon emission with bio-diesel is the oxygen content in the bio-diesel molecule, of using aluminium which leads to more complete and cleaner combustion.

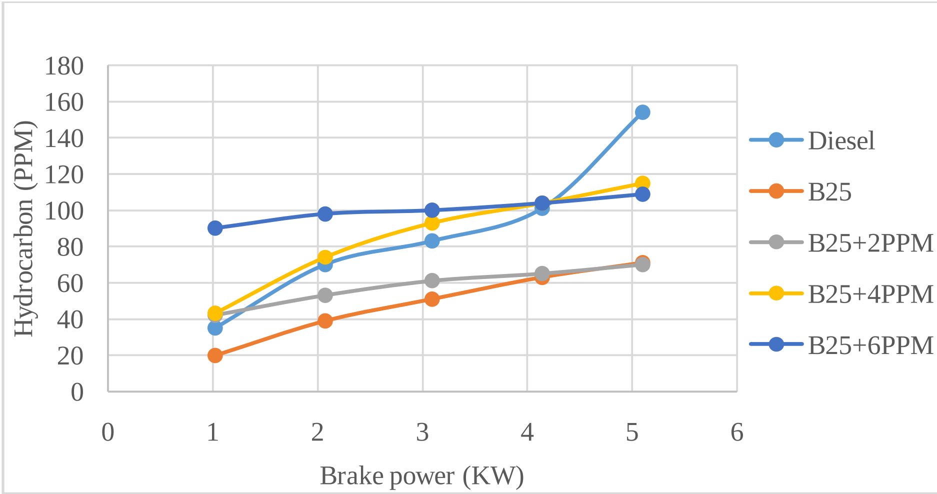

Fig-7: Variation of HC with BP

5.2.3. Carbon dioxide (CO_2)

The variation of carbon dioxide with brake power for diesel and blends of mango seed bio-diesel are shown in fig-8. Carbon dioxide emission increased with increase in load for all blends. The B25+2PPM blend emit less amount of carbon dioxide in comparison with diesel. This blend emit very low emissions. This is due to the fact that bio-diesel in general is a low carbon fuel and has a lower elemental carbon to hydrogen ratio then diesel fuel. This is because of less viscosity and improved atomization of fuel.

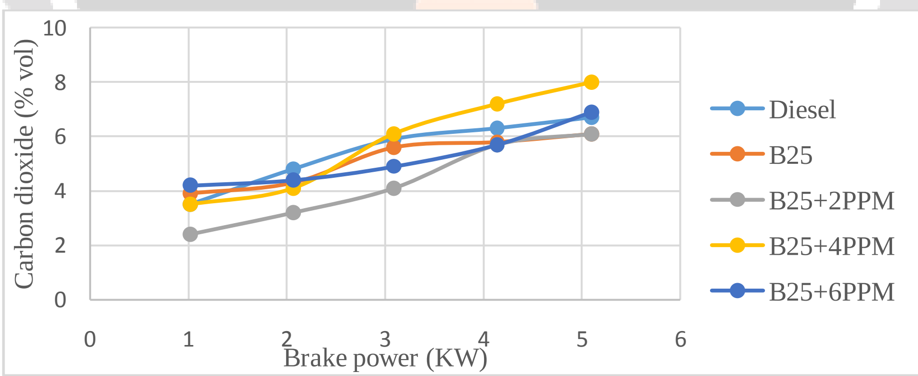

Fig-8: Variation of CO_2 with BP

5.2.4. Oxides of nitrogen (NOx)

Fig- 9 Shows the variation of nitrogen oxides emissions with brake power indicates that blends of (B25, B25+2PPM, B25+4PPM, B25+6PPM) Shows higher NOx emissions compared to pure diesel fuel. Blends are higher emission compared to diesel.

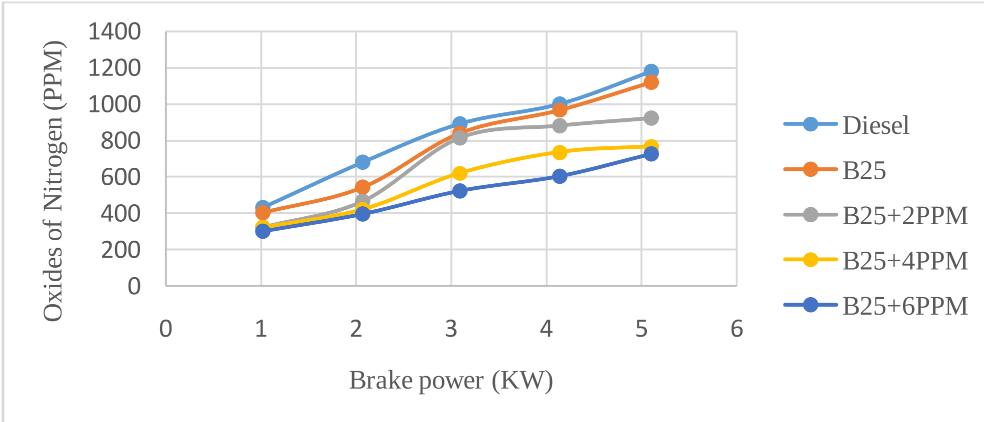

Fig- 9: Variation of NOx with BP

6. CONCULUTION

Experimental investigations are carried out on a single cylinder diesel engine to examine the suitability of mango seed oil bio-diesel as an alternative fuel. The performance and emission characteristics of various blends are evaluated and compared with pure diesel. The above study of investigations clearly reveals the possibility of using mango seed blends B25+2ppm gives optimum performance and emission characteristics than diesel. Thus, B25+2ppm is found to be an optimum blend than other blends.

7. REFERENCES

[1]Manimaran, **"**Experimental Investigation of a Diesel engine fueled by Emulsified B20 Biodiesel", International journal of chemical and pharmaceutical sciences. 2015

[2] Manimaran, "Performance and emission characteristics of jatropha- ethanol blend with compression ignition engine", International journal of chemical and pharmaceutical sciences. 2015

[3] Meher Lc, Sagar DV, Naik SN, Journal of renewable energy (10) (2006) 248-268.

[4] Komninos NP, Rakopoulus CD. Energy Fuels (24) (2010) 1665-1667.

[5] Miyamoto N, Ogawa H, Nabi MN. International journal of engine research (1) (2000) 71-85.

[6] Arinash Kumar, Agarwal Rajamanoharan, "Experimental investigation of performance and emission of karanja oil and its blends in a single cylinder agricultural diesel engine", Journal of applied energy: (86) (2009), pp. 106-112.

[7] P.K Devan, N.V. Mahalakshmi, " A study of the performance, emission and combustion characteristics of a compression ignition engine using methyl ester of paradise oil –eucalyptus applied energy (86), (2009), pp.675-680.

[8] Demisbas, "A progress and recent trends in biofuel", proceeding of energy comyst SCI: (33) (2007), pp. 1-18.

[9] Dennis YC Leung, Xuan Wu, MKH Leung, "A review on biodiesel production using catalyst Trans esterification", Applied energy (84) (2010), pp. 1083-1095.

[10] Banapurmatha P.G., Tewaria R.S. Hosmath, Performance and emission characteristics of a DI compression ignition engine operated on Honge, Jatropha and sesame oil Methyl Esters, Renewable energy (33), (2008) 1982-1988.

[11] Dharmendra Yadav, Nitin Shrivastava and Vipin Shrivastava, "Experimental investigation of performance parameters of single cylinder four stroke di diesel engine operating on neem oil biodiesel and its blends" , issn 2278-0149 vol.1, no.3 ,2012

[12] Kirankumar, "Experimental investigations on performance, combustion characteristics of diesel engine by using cotton seed oil", International journal of engineering trends and technology, 2013

[13] Duraid F.Maki, P.Prabhakaran "An experimental investigation on performance, emission of a multi cylinder diesel engine fueled with hydrogen –diesel blends", World renewable energy congress. 2011

[14] Fukuda H, Kondo A, Node H, Journal of bioscience bioenergy (92) (2001) 405-426.

[15] Abu-Jrai A, Rodriguez-Fernandez J, Tsolakis A. Megarities A. Theinnoi K, Cracknell RF, performance, Journal of fuel (88) (2009) 1031-1041.

[16] Pepiot-Desjardins P, Pisch H, Malhotra R, Kirbu SR, Boehman AL, structural group analysis for shoot reduction tendency of oxygenate fuels combustion flame (154) (2008) 191-205.

[17] D.C Rakopoulos, C.G. Rakopouls, E.G. Giakoumis, A.M. Dimaratos, M.A. Founti, Journal of fuel (90) (2011) 3439-3446.