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Experimental Investigations on a Four Stoke Diesel Engine Operated by Neem Biodiesel Blended with Diesel

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ABSTRACT

The fast depletion of fuels and huge demand for diesel in transport, power and agricultural sectors activates the research and development of substitute energy resources to maintain economic development. One of the best alternatives is Biodiesels obtained from Vegetable oils. The present study focuses on Evaluation of performance and emission characteristics of a single cylinder four stroke diesel engine with different blends (B05, B10, B15, B20 and B25 in comparison to diesel) of Neem biodiesel and Diesel. The performance is compared with diesel fuel, on the basis of brake specific fuel consumption, brake thermal efficiency, exhaust gas temperature and emissions of hydrocarbons and oxides of nitrogen. From the experimental Results it is observed that the blend B20 have closer performance to diesel and hydrocarbon emissions are less than diesel.
Keywords: Bio Diesel, Performance, Emissions, Hydro Carbons, Neem oil.

I. INTRODUCTION

Conventional energy sources such as oil coal and natural gas has limited reserves and other side industrialization and motorization of the world has led to a steep rise in the demand for petroleum products. If this situation continues there is every chance for the scarcity of petroleum products. A major solution to reduce this problem is to search for an alternative fuels. Vegetable oils can be an important alternative to the diesel oil, since they are renewable and can be produced in rural areas [1].

The inventor of diesel engine Rudolf diesel predicted that the plant based oils are widely used to operate diesel engine. The bio diesel has great potentials as alternative diesel fuel [2]. But use of pure vegetable oil can cause numerous engine related problem such as injector choking, piston deposit formation and piston ring sticking due to higher viscosity and low volatility [3]. An effective method of using vegetable oils in diesel engine is by modifying the vegetable oils into its monoesters by transestrification [4]. Transesterification of bio diesel provides a significant reduction [5] in viscosity, thereby enhancing their physical and chemical properties and improve the engine performance. The present study aims to investigate the use of neem oil blended with diesel as an alternate fuel for compression ignition engine.

II. TECHNICAL SPECIFICATIONS OF THE ENGINE

In this work experiments were conducted on 4 stroke, single cylinder, C.I engine (Kirloskar Oil Engineers Ltd., India) of maximum power-3.68 KW with AVL smoke meter and Delta 1600 S gas analyser.

III. MATERIAL & METHODS

In the present work engine tests were conducted with Neem Bio Diesel blended with Diesel (B05, B10, B15, B20, and B25 in comparison to diesel) to evaluate performance and emission characteristics. Neem oil is a vegetable oil [6] produced from neem seeds of neem tree. Neem (Azadirachta indica) is a tree in the mahogany family Meliaceae which is abundantly grown in varied parts of India. Neem oil has several outstanding advantages among other oils. Neem plant is traditionally used for agricultural and medicinal purposes. These can grow on poor soils and areas of low rainfall. Neem seeds obtained from neem tree are de-pulped, sun dried and crushed for oil extraction. The seeds have 45% oil which has high potential for the production.

The various properties of the above bio diesel [7] are presented in table 1.

Table 1. Properties of fuels used

Properties	Neem oil	Diesel
Density (kg/m3)	912	830
Calorific Value (kJ/Kg)	39450	43000
Viscosity @400C(cSt)	5.2	2.75
Cetane Number	48	51
Flash Point (°C)	130	74

IV. RESULTS AND DISCUSSIONS

4.1. Brake thermal Efficiency

The Figure 1 shows the variation of brake thermal efficiency with break power output. In general the thermal efficiency depends on the combustion process which is a complex phenomenon that is influenced by several factors such as design of combustion chamber, type of injection nozzle, injection pressure, spray characteristics and fuel characteristics such as cetane number, volatility, viscosity, homogeneous mixture formation, latent heat of vaporization, calorific value etc. It is evident that diesel fuel has the higher brake thermal efficiency compared to Neem biodiesel blends. The diesel fuel has the highest thermal efficiency because of its calorific value and viscosity as compared with Neem oil. With the higher calorific value the amount of heat produced in the combustion chamber is more, further the combustion is complete and produced higher temperatures. The efficiency of diesel is 29.18%, B20 blend is 28.75 and B25 blend 27.47

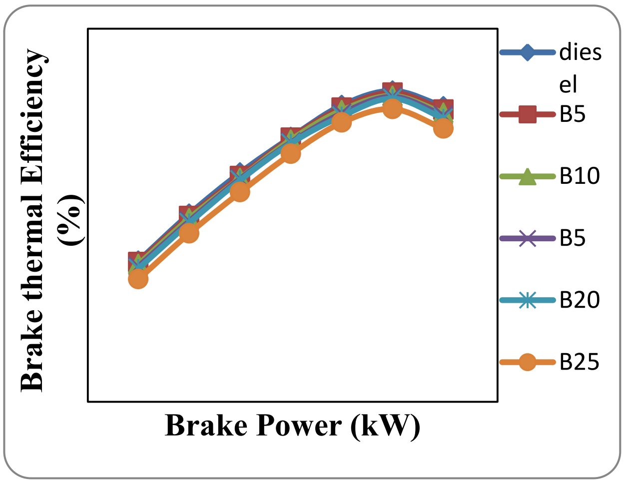

Figure 1. Variation of Brake thermal Efficiency with power output

4. 2. Brake specific Fuel Consumption

The variation of brake specific fuel consumption (BSFC) with break power is shown in Figure 2. The BSFC reduced with the load for all the fuels. It is found that the specific fuel consumption for the blend is higher than diesel at all loads. This is because of the combined effects of lower heating value and the higher fuel flow rate due to high density of the blends. Higher proportions of Neem oil in the blends increases the viscosity which in turn increased the specific fuel consumption due to poor atomization of the fuel. The oxygenated biodiesels may lead to the leaner combustion resulting in higher BSFC.

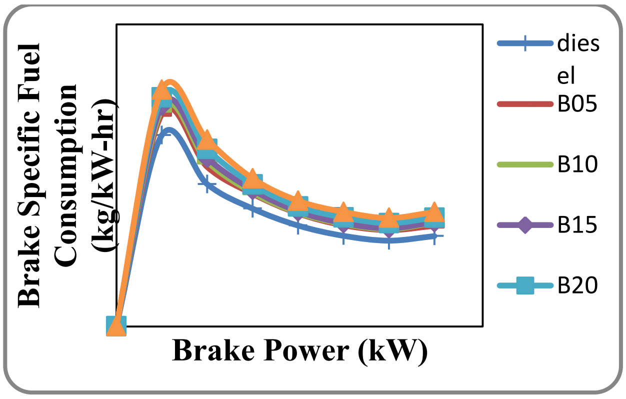

Figure 2. Variation of brake specific fuel consumption with power output

4.3. Exhaust Gas Temperature

The Figure 3 shows the variation of Exhaust gas temperature with break power output. Exhaust gas temperature was found to increase in both concentration of biodiesel in blends and engine load. The exhaust gas temperature rises from 110°C at no load to 350°C for various blends. The increase in EGT with engine load is due to the fact that a higher amount of fuel is required in the engine to generate extra power needed to take up conditional loading. Exhaust gas temperature for B-25 is highest. For the diesel fuel the exhaust gas temperature is lowest among all biodiesel blends. The exhaust gas temperature for the diesel at the rated load is 320°C, for B20 is 330°C. Though the viscosity for the Neem oil is higher it is compensated by the calorific value of the fuels.

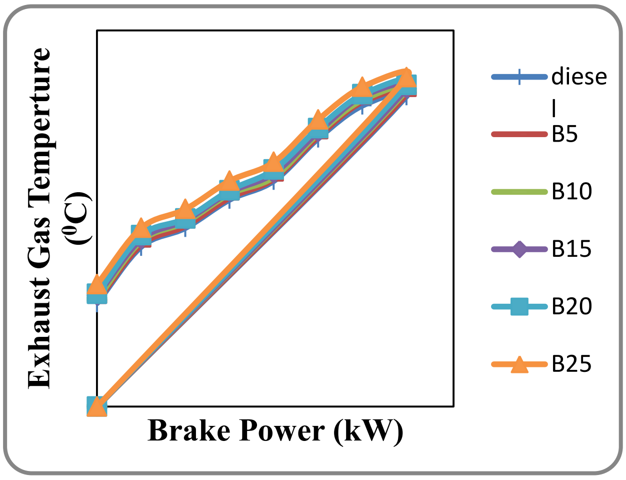

Figure 3. Variation of Exhaust gas temperatures with power output

4.4. Smoke Density

The variation of the smoke densities with power output is shown in Figure 4. The smoke emission increased with the increase of engine load. This is compensated up to certain extent due to the absence of aromatics and presence of inherent oxygen molecules in the bio diesel. These oxygen particles helps to promote stable and complete combustion by delivering oxygen to the combustion zone of burning fuel by reducing locally rich region and limit primary smoke formation and lower smoke emissions. For all loads the smoke density of the biodiesel blends were always higher than that of diesel fuel. The smoke density increases due to insufficient combustion and higher ignition delay. The biodiesel blend has high viscosity, larger fuel droplet sizes and decrease in fuel air mixing rate. These are the factors involved to increase the smoke density of biodiesel blends. The fuel blend B25 gives high smoke emission than all the other used fuels

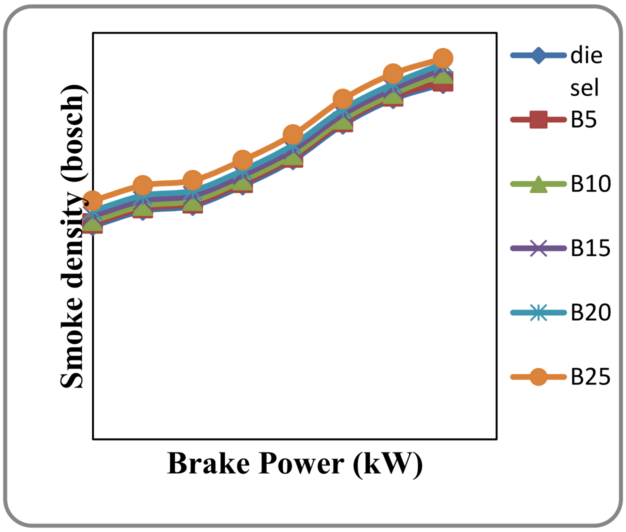

Figure 4. Variation of smoke density with power output

4.5. Hydrocarbon emissions

The variation of hydrocarbon emissions with break power is shown in Figure 5. The HC emissions depend upon mixture strength i.e. oxygen quantity and fuel viscosity in turn atomization. The HC emissions increase with increasing load as well as increasing the amount of bio diesel. Lower heating value leads to the injection of higher quantities of fuel for the same load condition. More the amount bio diesel leads to more viscosity. Viscosity effect, in turn atomization, is more predominant than the oxygen availability, either inherent in fuel or present in the charge. When compared to diesel, the oxygen availability in the bio diesels is more. So the emissions are less than diesel. It is observed from the figure that the decrease in hydro carbon emissions with Neem oil is more compared to diesel.

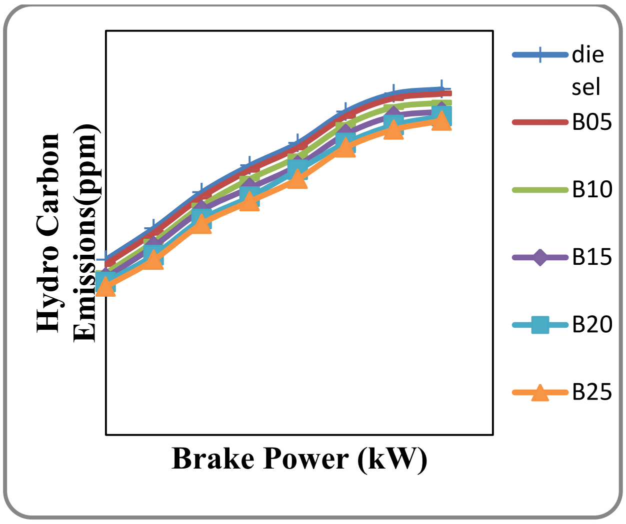

Figure 5. variations of hydrocarbon emissions with power output

4.6 Carbon Monoxide Emissions (co emissions)

The variation of carbon monoxide emissions for with brake power is illustrated in Figure 6. It has been observed that the CO emissions are increased with increase in engine load and decrease with the increase in proportion of biodiesel in the blends. The lower CO emission of biodiesel compared to diesel fuel is due to the presence of oxygen in biodiesel which helps in complete oxidation of fuel.

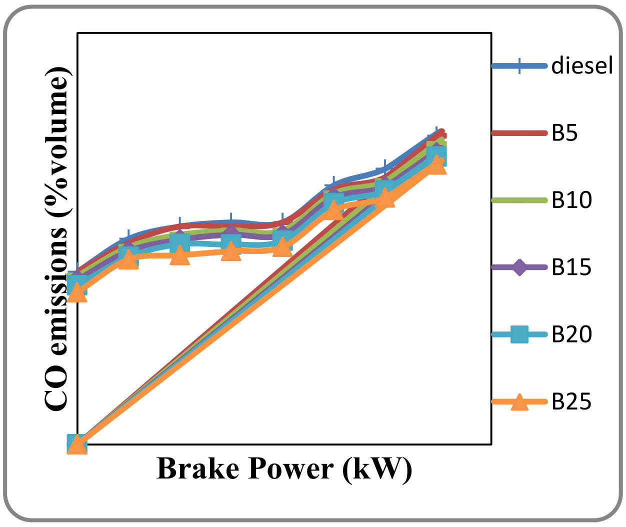

Figure 6. Variation of CO Emissions with Power output

4.7 Nitrogen oxide Emissions

The variation of Nitrogen oxide emissions oils is illustrated in Figure 7. The NOx emissions are higher for blend as compared with diesel fuel.

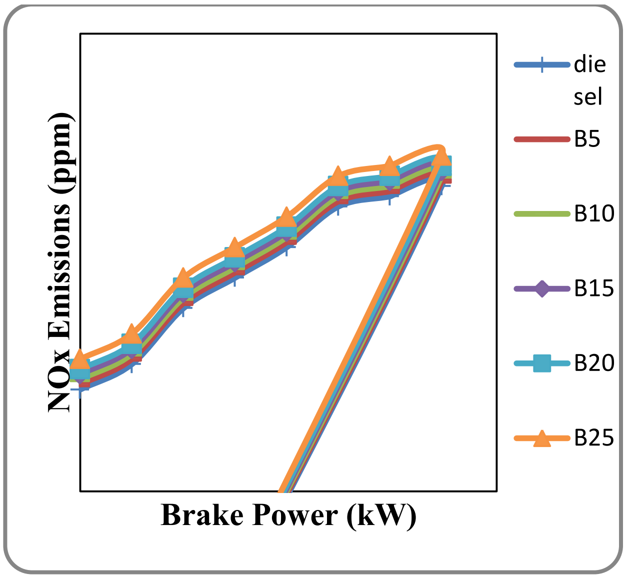

Figure 7. Variation of NOx emissions with power output

The increase of NOx in the emissions may be associated with the oxygen content of the biodiesel, since the biodiesel fuel provided additional oxygen for NOx formation. Thus one of the main reasons for the formation of NOx is the higher availability of oxygen in the combustion chamber.

V. CONCLUSIONS

The following conclusions are drawn based on the experimental results of the above work:

- The brake thermal efficiency of the engine depends majorly on the heating value and viscosity. The brake thermal efficiency of B20 is nearer to the diesel fuel.
- With the higher combustion rate, the temperature inside the engine and in turn in the exhaust increases
- The Hydrocarbon emissions of Neem oil biodiesel blends are less than diesel fuel
- The CO emissions are lower for bio diesel blends due to presence of oxygen.
- The NOx emissions increase with increase in concentration biodiesel in blend due to high temperature.

Finally it is concluded that the blend of neem bio diesel– B20 is the optimum blend for Diesel engines for better performance and emissions. The Neem oil biodiesel can be used as alternative to diesel

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VII. REFERENCES

[1]. Cummins, C., Lyle, Jr. (1993). Diesel's Engine, Volume 1: From Conception to 1918.Wilsonville, OR, USA: Carnot Press, ISBN 978-0-917308-03-1.
[2]. Agarwal A.K and Das L.M, Bio diesel development and characterization for use as a fuel in CI engine, Transaction of ASME 2001-123, 440- 447
[3]. Bari, S., Lim, T.H., Yu, C.W. (2002). Effect of preheating of crude palm oil on injection system
[4]. MK Senthil,A Ramesh,Performance studies on CI Engine using methyl ester of Jatropha as afuel,XVI National conference on IC Engines-calcutta,India-2000:89-94
[5]. Plank C E lobeer, Quality control vegetable oil Methyl esters used as diesel fuel substitute, Journal of high resolution chromatography-1992.
[6]. Bio energy Technology (BE) World Renewable Energy Congress-2011 Sweden,8-13 May 471-478
[7]. Report of the committee on Development of Bio fuels-Planning Commission, Government of India.