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EXPERIMENTAL STUDY ON D I DIESEL ENGINE PERFORMANCE AND EMISSION CHARACTERISTICS (NO_X) WITH COME - DIESEL BLENDS

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ABSTRACT

The biodiesel from edible oils is non-toxic, biodegradable and renewable alternate fuel that can be used as a substitute for diesel in diesel engines. The objective of present work is to study the performance and emission characteristics of single cylinder, direct injection diesel engine with coconut oil methyl ester (COME) and blends with diesel in varying proportions. Experiments were conducted when the engine fuelled with pure diesel and the blends of diesel - COME by volume for full load range. The exhaust conditions were measured using exhaust gas analyzer similarly AVL smoke meter for measuring smoke density. Results were compared graphically in performance of the engine for specific fuel consumption, brake thermal efficiency, exhaust temperatures and in exhaust emissions for concentrations of NO_x and smoke density.

Keywords: biodiesel, coconut oil methyl ester, diesel blends, engine performance, NO_x, exhausts emission.

INTRODUCTION

The increasing in vehicular population, pollution and fast depletion of fossil fuel requires the search for alternate fuels has become necessary. The vegetable oils which are rich in oxygen can be used as future alternate fuels for the operation of diesel engine [1]. The properties of biodiesels are very close to diesel after processing, and they are renewable by growing crops in rural areas with no cost and effort. From previous studies [2] it has been observed that various problems associated with vegetable oils being used as fuels in C I engines due to high viscosity.

Due to large molecular mass and chemical structure of oils the viscosity is very high. This in turn leads improper atomization of fuel during injection resulting incomplete combustion and higher smoke level in the exhaust [3]. The problem of high viscosity of vegetable oils has been reduced in several ways such as preheating the oils, blending with other fuels, thermal cracking and transesterificaton to make biodiesel [4-6]. Kalam *et al*., [7] showed that 30% of Malaysian coconut oil with diesel blends produced higher brake power, net heat release rate and with reduction in HC, NO_x, CO, smoke but at increased percentage of coconut oil, power and heat release rates are decreasing due to its lower calorific values. Raffiq *et al*., [8] concluded that by introducing 20% coconut oil blends with diesel found good in fuel efficiency and emissions.

Preparation of fuel

The coconut oil methyl ester (COME) is prepared by transesterification process in which fat of oil is converted into esters of coconut oil and glycerin. All fats are removed as glycerin in acid and base treatments with the help of acid, catalyst and methanol. A mixture of coconut oil and sodium methoxide are heated and maintained at 55^0C for one hour while the solution is continuously stirred. After allowing it for settlement two layers were formed. The lower layer glycerin is separated to retain upper one which is ester of the coconut oil. The formed ester is water washed to remove soaps and used for experimentation with the blends of diesel at various percentages.

EXPERIMENTATION

Four stroke single cylinder DI diesel engine details as shown in Table-1 and experimental setup shown in Figure-1, is used for experimental work with COME-diesel blends. Experiments were conducted with pure diesel, pure COME and with the blends of COME-diesel. The blends are prepared in volume at different proportions as shown in Table-2. Smoke density and NO_x emissions were measured using AVL smoke meter and exhaust gas analyzer respectively. The performance and emission graphs of the engine are shown in Figures 2 to 7.

Table -1. Engine details.

Engine:	Vertical, 4stroke, water cooled
Rated power:	3.68 kw @ 1500rpm
Cylinder diameter:	80mm
Stroke length:	110mm
Compression Ratio:	16:1

Table -2. Percentage of fuel blends.

S. No.	Fuel	Fuel blends
1	D100	100%Diesel
2	B20	20%COME, 80%Diesel
3	B40	40%COME, 60%Diesel
4	B60	60%COME, 40%Diesel
5	B80	80%COME, 20%Diesel
6	B100	100%COME

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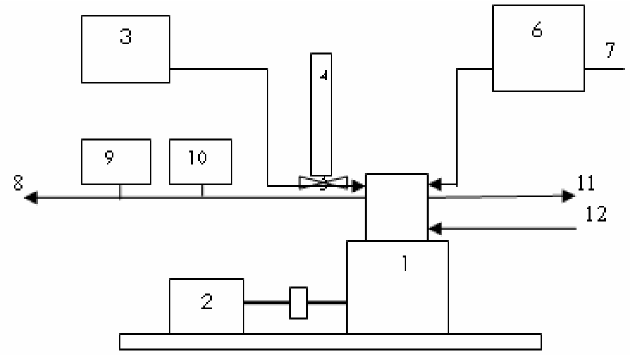

Figure -1. Experimental setup.

1. Engine
2. Dynamometer
3. Fuel Tank
4. Burette
5. Three way valve
6. Air Box
7. Air flow measurement
8. Exhaust outlet
9. Smoke meter
10. Exhaust analyzer (NO_x)
11. Cooling water in
12. Cooling water out

RESULTS AND CONCLUSIONS

At rated speed of the engine variation of brake thermal and mechanical efficiency and BSFC are drawn with respect to brake power for diesel and diesel - COME blends. It is observed that (Figure-2) brake thermal efficiency is gradually increasing and higher for B60 and (Figure-3) the mechanical efficiency is maximum for B20, where as there after decreasing and minimum for B100 at full load.

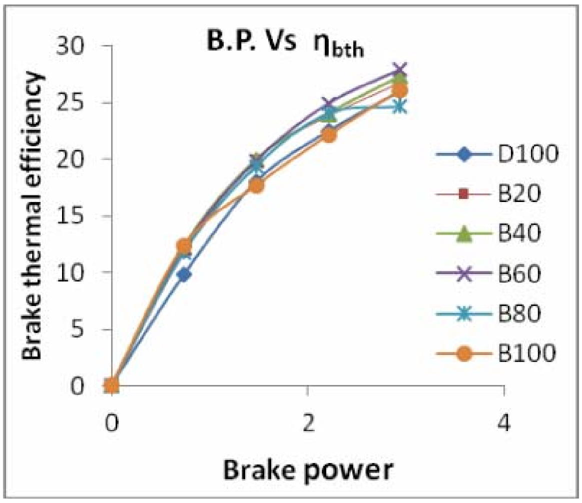

Figure -2. B. P. Vs η_{bth}.

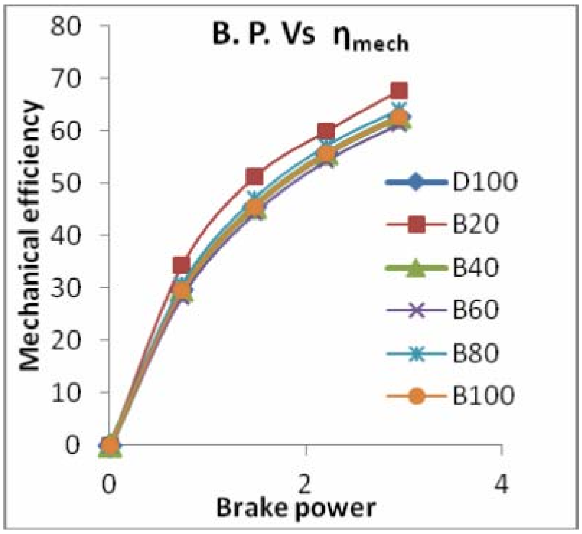

Figure -3. B.P. Vs η_{mech}.

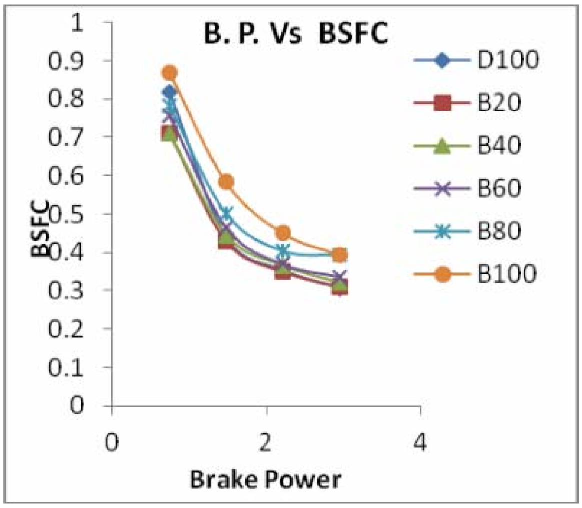

Figure -4. Fuel consumption Vs break power.

The (Figure-5) increase in percentage of COME in the fuel blend leads reduced in exhaust gas temperature at all loads; this is due to higher latent heat of vaporization than the diesel fuel. The NO_x emissions are increased with engine load due a higher combustion temperature. It is observed that (Figure-6) NO_x emissions at all loads for COME and its blend are lower than that of diesel fuel.

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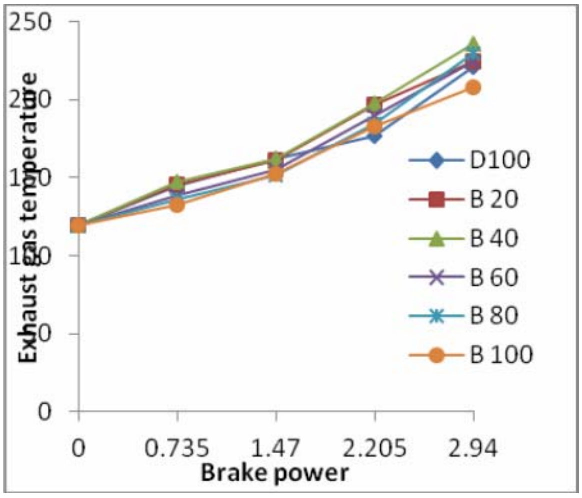

Figure -5. Exhaust gas temp. Vs brake power.

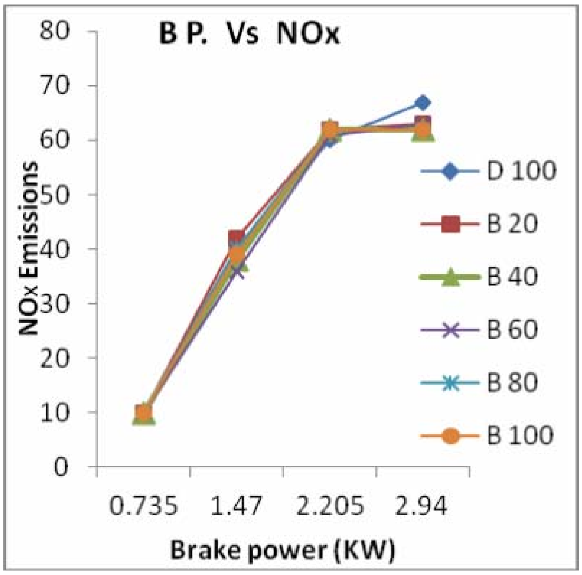

Figure -6. NO_X Vs brake power.

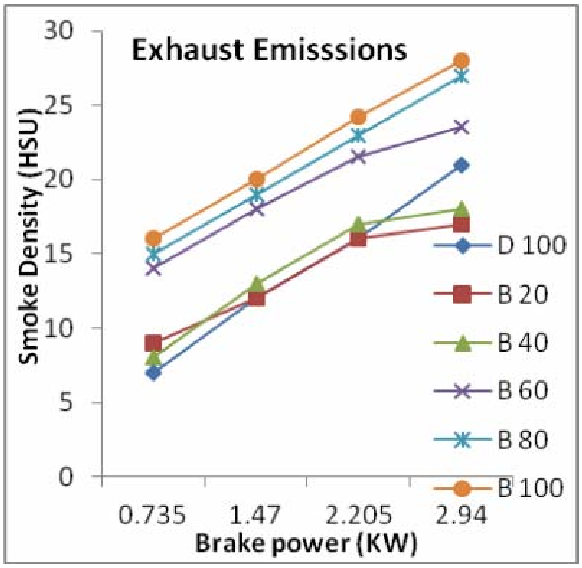

Figure -7. Exhaust emissions. Vs breake power.

With pure COME (Figure-7) smoke emission is increased due to poor atomization of fuel. However there is reduction in smoke emission due higher oxygen with biodiesel which leads complete combustion of blended fuels.

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