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Comparison Of Performance And Emission Characteristics Of Different Biodiesel Blends In Constant Speed Single Cylinder Diesel Engine

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Abstract

This paper investigated the performance and emission parameters of biodiesel blends J20 (combination of diesel 80% by volume ,with jatropha 20% by volume), P20 (combination of pungamia 20% by volume ,with diesel 80% by volume), N20 (combination of diesel 80% by volume ,with Neem 20% by volume) with diesel at standard engine specification (Injection timings at 27^0 bTDC, Compression ratio at 17.5:1, Injection pressure at 200 bar, 6.02 kW power output at a constant rated speed of 1800 rpm). The experiment results show that for all the blends, the brake thermal efficiency increases with increase in brake power. Among B20, B40, B60, B80 and B100, bio diesel blends up to B20 has a maximum brake thermal efficiency of 27.49% , 28.74% and 28.49% for MEOJ, MEOP and MEON respectively at full load condition at the injection timing of $27\ ^0$ BTDC. The aim of the investigation is to identify the best B20 biodiesel blends. Further investigation is carried out to compare J20, P20, and N20 biodiesel blends. It was observed that Brake thermal efficiency (BTE) of P20 blend has better brake thermal efficiency than J20 and N20 biodiesel blends. HC emission for P20 blend is decreased by 26.1% when compared with other two biodiesel B20 blends. NOX emission for Pongamia 20 blend is 28% higher than other tested fuels.

Keywords*:* J20, P20, N20, brake thermal efficiency, Hydrocarbon emission (HC), Oxides of Nitrogen (NO_X).

Nomenclature

bTDC - before top dead centre	B20MEOJ- 20% Methyl esters of jatropha+80% diesel by vol
BTE - Brake thermal efficiency	B40MEOP- 40% Methyl esters of pongamia+60% diesel by vol
HC - Hydrocarbon emission (ppm)	B60MEON - 60% Methyl esters of neem +40% diesel by vol
NOx - Oxides of Nitrogen	P20- 20% pongamia + 80% diesel
ppm - parts per million	J20 - 20% jatropha + 80% diesel
MEOJ - Methyl esters of jatropha	N20 - 20% neem + 80% diesel
MEOP - Methyl esters of pongamia	MEON- Methyl esters of neem

1. Introduction

The demand of petrodiesel is resend days due to depletion of fossil fuels. The substitute source of vegetable oil biodiesel blends can be used in CI engines. The various properties and performance of different biodiesel blends of cotton seed methyl ester and neem oil methyl ester compared to diesel fuel. C20 biodiesel blend results are closer performance to diesel [1]. Biodiesel has been found as an alternative fuel for compression ignition engine because of increased performance and reduced emission. The waste cooking oil methyl ester (WCO) biodiesel has similar results to that of diesel. Brake thermal efficiency, carbon monoxide emission, hydrocarbon emission, and smoke emission are lower compared to pure diesel and specific energy consumption and oxides of nitrogen is higher compared to diesel [2].The depleting petroleum fuel resources increase the price of fuel continuously. The various biodiesel fuels identified and tested successfully. The performance and emissions of different rubber seed oil (RSO) biodiesel blend compared with diesel. B30 biodiesel blend are closer performance and lower emission compared to diesel [3].Direct use of neem oil is problem for diesel engine because of very high viscosity. Esterified neem oil different biodiesel blends are tested in compression ignition engine. The experiment concluded that B20 biodiesel blend gave better performance and lower emission because of extra amount of oxygen present in the blend [4] [5] various properties of B20 biodiesel blends shown in table2.

Description of engine setup:

The experimental were conducted on a kirloskar engine (SV1) vertical inline diesel engine is shown in fig.1.1. The engine coupled to an eddy current dynamometer and equipment like emission analyzer was attached to the engine. The experiments are conducted throughout the process with fixed injection timing, constant injection pressure and constant speed. The engine performance parameters like thermal efficiency, emission parameters like HC, CO and NO_X are measured during the test. The engine specifications are shown in table 1.

Table 1: Engine specifications

Manufacturer	Kirloskar oil engines
Speed	1800 RPM
Rating at 1800 rpm	6.02 KW
Bore (B) & Stroke (S)	87.5 mm & 110 mm
Compression Ratio	17.5:1
Injection Timing	27˚ BTDC
Method of Cooling	Water cooling
Injection pressure	200bar

Table2. **Properties of Diesel and Bio-diesel Oils**

Properties	**DIESEL**	**J20**	**P20**	**N20**
Calorific Value(kJ/kg)	43000.43	41600.21	41300.32	35125.52
Flash Point (^{0}C)	50.1	57.3	56.21	68.24
Viscosity(cst)	3.9	4.3	4.1	4.7
Density(kg/m^3)	840.2	860.4	850.5	920.3
Cetane number	50	54	52	57

Fig 1.1: experimental setup

2. Result and Discussion

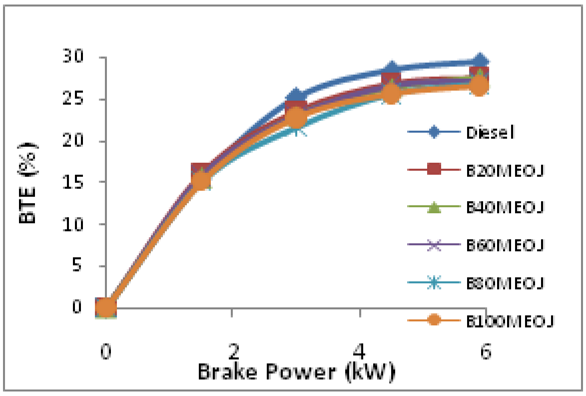

Fig 2.1 Variation of BTE vs. BP for different blends of MEOJ

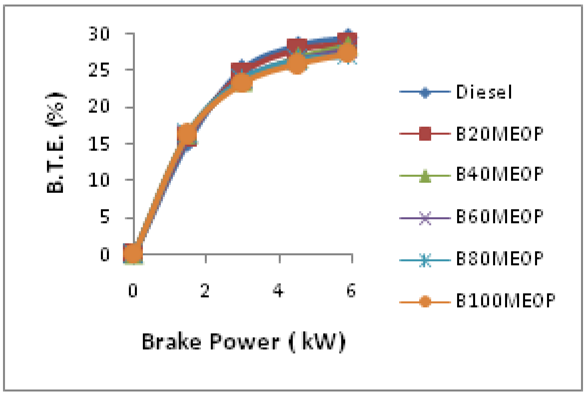

Fig 2.2 Variation of BTE vs. BP for different blends of MEOP

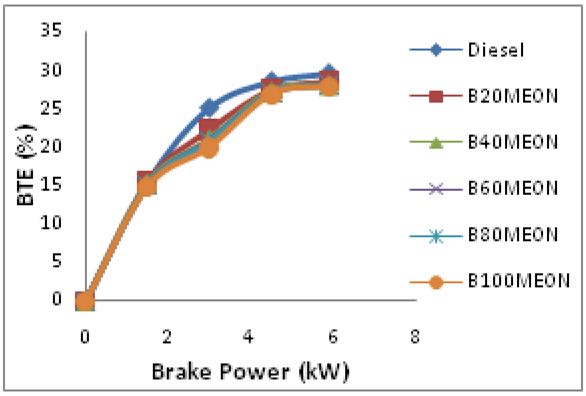

Fig 2.3 Variation of BTE vs. BP for different blends of MEON

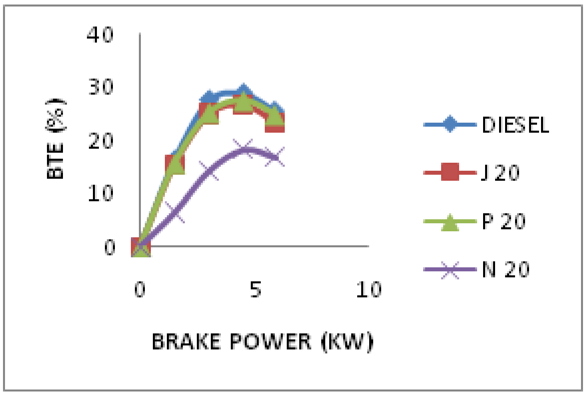

Fig 2.4 Variation of BTE vs. BP for J20, P20 and N20 Blends

Brake Thermal Efficiency (BTE) is the ratio of brake power to the energy released during the combustion process. A figure 2.1, 2.2, 2.3 in that vertical axis represents brake thermal efficiency and horizontal axis represents brake power. Result shows that highest brake thermal efficiency of diesel is 29.49% other biodiesel blends like jatropha, pongamia, and neem biodiesel blends are lower brake thermal efficiency because of calorific value, density and viscosity are decreased, are increased which leads to poor atomization and fuel vaporization. Along with the other blends B20 biodiesel bend is very closer to diesel because of additional amount of oxygen present in the blend.

In Figure 2.4, shows that comparison of Jatropha 20percentage blend , Pongamia 20 percentage bland and Neem 20percentage blend in that maximum brake thermal efficiency of Pongamia 20 percentage blend is 28.74% this is because properties of Pongamia 20percentage blend are very close to diesel compared with Jatropha 20percentage and Neem 20percentage biodiesel blends. The better spray characteristics and dissolved oxygen in P20 blend in the combustion chamber, which leads to effective utilization of air resulting complete combustion of the fuel. So 20percentage blend can be recommended blend for biodiesel preparation with Pongamia oil.

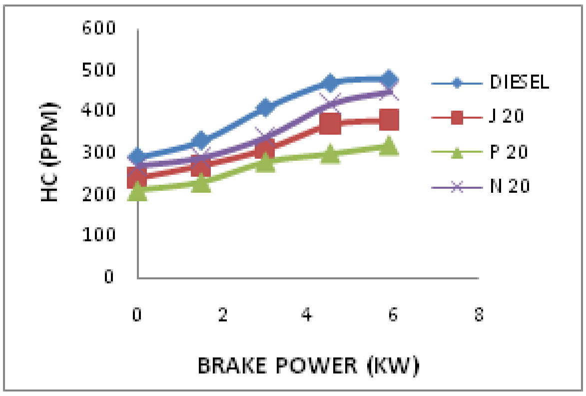

Fig 2.5 Variation of HC vs. BP for J20, P20 and N20 Blends

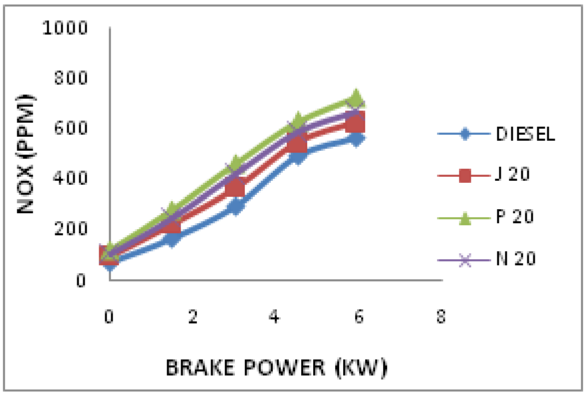

Fig 2.6 Variation of NOX vs. BP for J20, P20 and N20 Blends

Figure 2.5 shows the HC emissions for Blend20 Jatropha, pongamia, neem biodiesel blends compared with petrodiesel. The experiment indicated that HC emission for diesel at maximum load was 481 ppm. All B20 biodiesel blend having extra oxygen content this will guide absolute combustion results reduced hydro carbon emission. Compared to other biodiesel blends P20 blend give 3% higher Hydrocarbon emission drop then jatropha and neem. This is due to inferior viscosity lead to enhanced mixture formation gave improved atomization compared to other biodiesel blends.

Figure 2.6 shows the NO_X emissions for Blend20 Jatropha, pongamia, neem biodiesel blends compared with petroleum diesel. The research results show that for all the blends, the NO_X emissions were increased. As stated, the occurrence of oxygen in the biodiesel has led to inclusive combustion of biodiesel better than diesel. The adiabatic flame temperature inside the cylinder is extra in case of biodiesel than pure diesel. The NOx emission for diesel at maximum load was 567ppm. Pongamia 20percentage biodiesel blend is 4% higher NOx emission than jatropha and neem. P20 biodiesel shortens ignition delay advancing combustion this lead extra NOx emission compared to other biodiesel blends.

3. Conclusions

Following are the conclusions based on the experimental results obtained while operating single cylinder diesel engine fuelled with biodiesel from jatropha seed oil, pongamia seed oil, and neem seed oil. The conclusions are

1. Pongamia biodiesel can be directly used in diesel engine without any engine modifications.
2. Brake thermal efficiency of Pongamia 20% bio-diesel blend is very close to pure diesel because fuel properties like viscosity, flash and fire point, calorific value are closer to diesel.
3. HC emission for P20 blend is very less when compared to pure diesel. This may be due to superior oxygen content of bio-diesel.
4. NOx emission for P20 blend is very high. This may be due to high adiabatic flame temperature at the end of combustion and higher oxygen content compared to pure diesel.

4. References

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