Performance and Emission analysis of Fish oil Biodiesel in Diesel Engine

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Abstract: **The work indicates the performance and emission analysis of waste fish oil methyl ester in CI engine at Constant speed and CR And variable load here B6,B12,B18,B24 and B30 blends has been used to analyse the data and result has been compared With the pure diesel fuel and it has been investigated that using non edible oil as a biodiesel can be used as a alternative fuel which show the greater and Better, performance and emission results here Brake thermal efficiency was seen slightly similar but at Higher load it was increase as Compared to diesel fuel and for Brake specific fuel consumption the blend of B24 has which is higher Consumption of fuel as compared to Diesel fuel the HC, CO, CO2 and NOx has been found to greatly reduction as a result has Tabulated that it is found that it is a alternative source of fuel in diesel engine without any engine modification which gives the Good results than diesel engine for all the blends.**

Keyword: CI engine, Fish Oil methyl ester, Brake thermal efficiency (BTE), Brake Specific fuel Consumption (BSFC), HC, CO, CO2, NOX

1. Introduction

The energy is increasing with current technologies development the energy is in the form of non renewable source such as fossil fuel, oil and natural gas. most of the developing countries import crude oil to meet their increasing energy demands in order to meet the requirement the invention of internal combustion engine and huge spreading of it exploitation of fuel reserves which is depleted day by day at a rapid rate[1]. Also the combustion of the natural fuel effect the environmental problem because of the NOx,CO_2, and SOx cause the hazardous effect in the global warming and green house effect also which deplete the layer causing the increasing the temperature of atmosphere[2]. the use of alternative fuel dependent increases because of the increasing in the capital cost, need of the fuel increasing and non-renewable fuel is decreasing so alternative source one such has become applicable which can be use as alternative energy source out which is biodiesel can be used as a alternative fuel because of it is non-toxic, renewable and bio-degradable Biodiesel is also called as methyl ester it is produce by transesterification of edible, non-edible oil vegetable oil and animal fats thus it is clean alternative fuel and renewable fuel. the advantage os using the biodiesel is that is reduces the CO,HC, PM and formation of sulpher dioxide has low aromatic chains and better ignition ability in the engine because of higher Cetane number[3]–[6].

One such biodiesel is fish oil in fish process industries generates large quantities of discarded part of waste fish this tissue waste and by product which leads to discarded or retain at low value for fertilizer or animal feed the another way to utilize from the by-products which is the waste fish to fish oil for the use in internal combustion engine. it has been reported that by product obtained from the fish oil has similar Calorific value to petroleum fuel and is renewable energy source although many studies were carried out for fish oil as a fuel for diesel engine[7], [8].

The study is an attempt to achieve diesel fuel equivalent performance from diesel engine with maximum replacement of diesel with biodiesel. Thus an experimental investigation on performance and emission characterize has carried out at constant compression ratio and constant speed with variable load.

2. Experimental setup and procedure

The experiment is conducted on computerized single cylinder, 4 stroke, direct injection, water cooled diesel engine at constant speed and variable load condition and at constant CR (compression ratio).the detail specification of engine test is given in table 2.1. The research engine test rig consists of diesel engine, eddy current dynamometer, exhaust gas analyzer and fuel tank. the engine was mounted on the engine bed with suitable connections for lubrication and cooling water supply. the fuel was supplied from a fuel tank. The engine and the dynamometer are interfaced to a control panel which is connected to a computer. these signal are interfaced to the computer through an analog to digital

conveter card PCI-1050 which is mounted on the motherboard of the computer. the biodiesel(waste fish oil) was purchased from biodiesel corporation,baramati and also the properties of fuel was tested as per ASTM 6751 in biodiesel corporation,baramati, the properties of the fuel is shown in table 2.2.the exhaust gas emission was measured by using HG-540 automotive emission analyzer.

Table 2.1 Test Engine Specification

Parameter	**Specification**
Engine Model	Kirloskar TV-1
No.of Cylinder	Single
No. of Stroke	Four
Cylinder diameter	87.5 mm
Stroke Length	110 mm
Connecting rod length	234 mm
Orifice diameter	20 mm
Power	3.5 KW
Speed	1500 RPM
Compression Ratio	18:1
Injection Point variation	0 to 25 BTDC
Method of Cooling	Water Cooled

The fish oil was taken in five levels in 6%, 12%, 18%, 24%, and 30% by volume. here for B6 the fish oil blends was 6% by volume and the remaining was 94% was diesel fuel, B12 % the fish oil was 12 % by volume and remaining 88 % was diesel fuel, similarly for B18 was 18 % fish oil by volume and 82 % was diesel fuel, B24 24 % of fish oil and remaining was 76 % diesel fuel and for B30 30% was the fish oil and remaining was 70 % of diesel fuel by volume was used.

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Table 2.2 Properties of Fish oil Biodiesel blends and diesel

Fuel Property	**Ref Std ASTM 6751**	**Unit**	**Diesel**	**Fish Oil biodiesel**				
				B6	B12	B18	B24	B30
Density	D1448	gm/cc	0.830	0.833	0.834	0.836	0.838	0.841
Calorific Value	D6751	MJ/kg	42.50	42.30	42.18	41.90	41.70	41.55
Cetane Number	D613	-	49	49.44	49.70	49.88	49.95	50.11

The engine was operated initially with the diesel fuel in order to avoid the environmental condition for 15 min (for warming) until the temperature of exhaust gases and cooling water reaches to steady condition. speed of the engine is kept constant at 1500 rpm and the load is varied in range of 0-12kg.the engine performance and emission characteristic was investigated include brake specific fuel consumption(BSFC), Brake thermal efficiency(BTE),hydrocarbon(HC), Carbon monoxide(CO), Carbon Dioxide(CO2), Nitrogen Oxide(NOx).

3. Performance Characteristic:

The comparison of the performance parameter in term of BTE, BSFC versus load for fish oil biodiesel blends (B6, B12, B24, B30) with diesel fuel is shown in fig with characteristic curve.

Figure 3.1 shows the comparison of brake thermal efficiency with load is seen. it is observed that brake thermal efficiency of diesel,B6,B12,B18,B24 and B30 at higher load is 33.73%, 32.44%,34.1%, 33.18%, 31.37%, 31.23%.

Brake thermal efficiency characteristics for diesel and B12 are highest and lesser in the case of all biodiesel blends. This may be due to the reduced calorific value and increased viscosity of biodiesel when compared to diesel. Since diesel is less viscous, atomization will be comparatively better which causes better combustion and thereby can produce higher thermal efficiency.

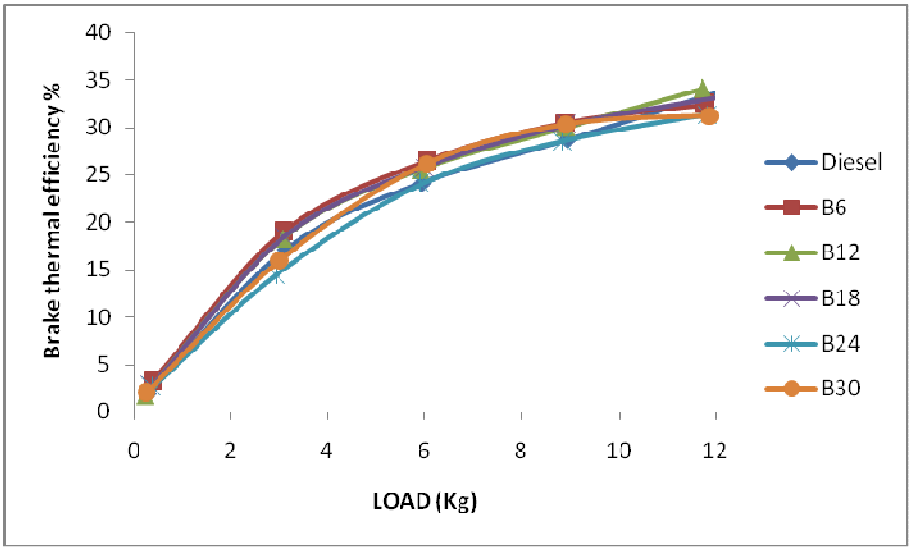

Fig 3.1 Load Vs Brake Thermal Efficiency (BTE)

Figure 3.2 shows BSFC at all various load is shown in fig under low load the value is higher because of low combustion temperature and formation of lean mixture in the combustion chamber leads to lower conversion fuel to work.

At higher load the Brake specific fuel consumption is 0.25%, 0.26%, 0.25%, 0.26%, 0.28%, and 0.28% for diesel, B6, B12, B18, B24 and B30.at higher load the combustion chamber heat ups properly and the value of BSFC biodiesel get almost equal to diesel operation. The B12 blend and diesel fuel shows the same BSFC and rest blends shows the increasing in Brake specific fuel consumption because of high in density of fuel and lower heating value.

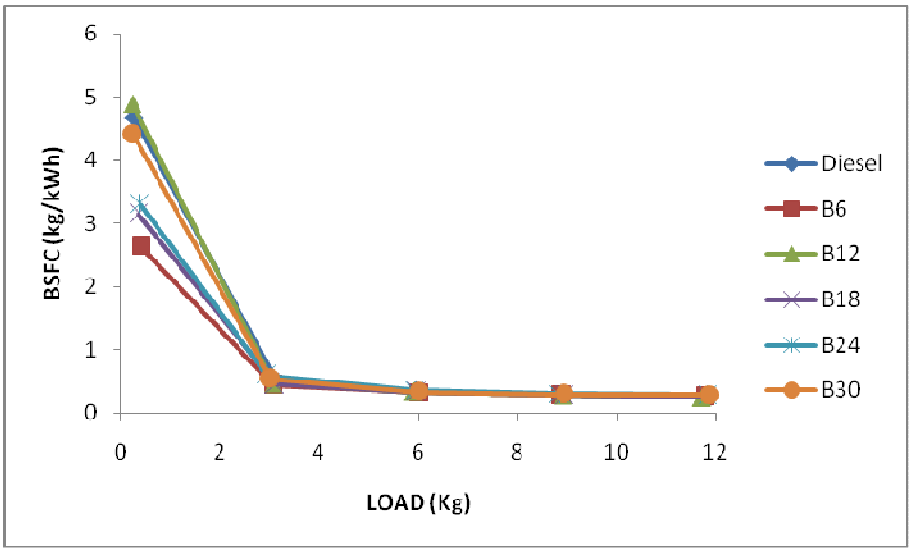

Fig 3.2 Load Vs Brake Specific fuel Consumption (BSFC)

4. Emission Characteristic:

Emission of HC, CO, CO2 and NOx has been investigated that reducing of HC, CO, CO2 and NOx shows great reduce result as compared to diesel fuel. The Characteristic curve of HC, CO, CO2 and NOx with respect to load in kg has been show as below.

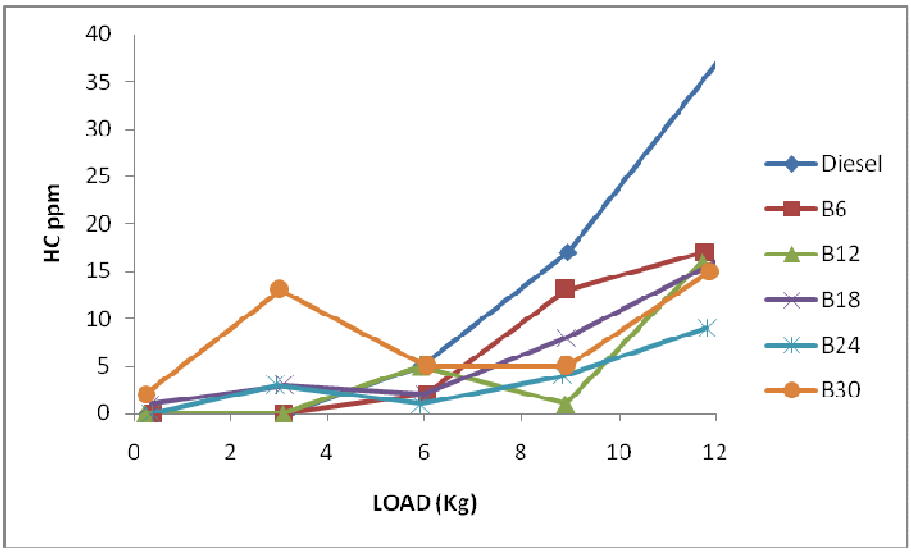

Fig 3.3 Load Vs HC

HC emissions decrease with increase in percentage of blend. Since the methyl esters are oxygenated fuel, it promotes combustion and results in reduction in HC emissions. lowest Hydrocarbon emission at maximum load This may be due to the higher volatility of the blend, which leads to better combustion when compared to other biodiesel blends.the HC ppm at higher load is 37 ppm, 17 ppm, 16 ppm, 16 ppm , 9 ppm , 15 ppm for diesel,B6 , B12, B18, B24 and B30.

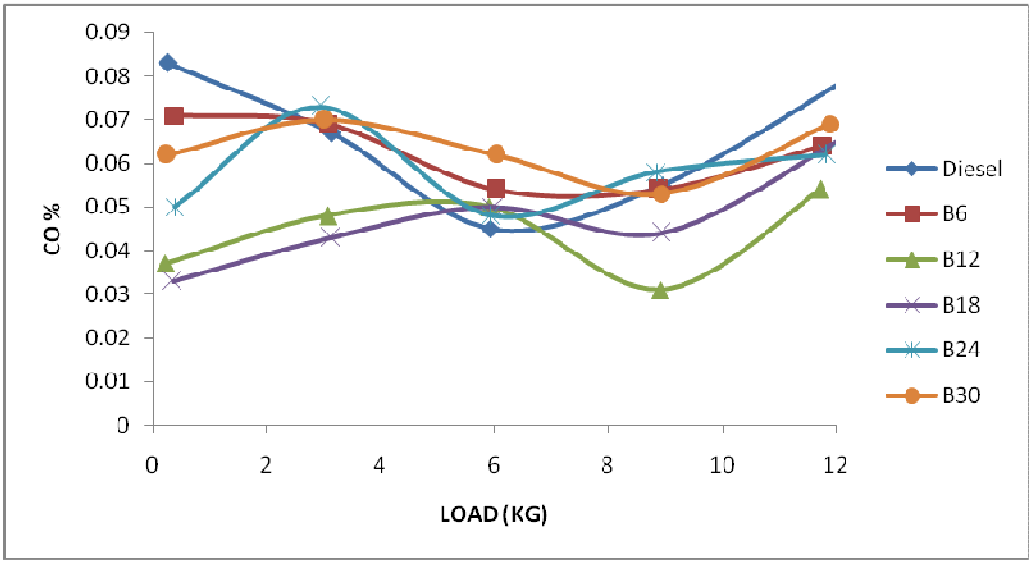

Fig 3.4 Load Vs CO

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Carbon monoxide is a product of incomplete combustion shown in fig 3.4 it is due to the insufficient amount of air in the air-fuel mixture or insufficient time in the cycle for the completion of combustion but CO for all the blends show reduce result as

compared to diesel fuel at maximum load the CO % is 0.078 %, 0.064%, 0.054%, 0.065%, 0.062%, 0.069% is of diesel, B6, B12, B18, B24 and B30.

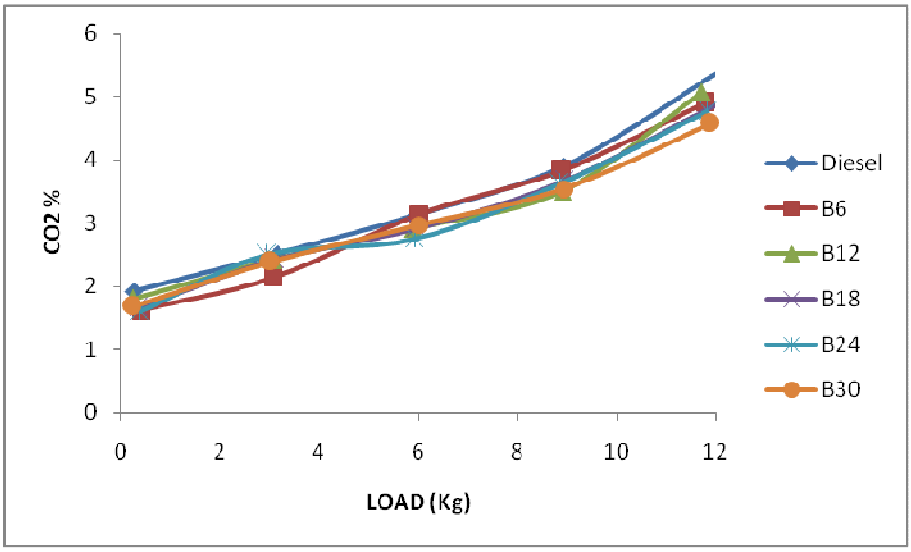

Fig 3.5 Load Vs CO2

Fig 3.5 show The CO2 for diesel,B6,B12,B18,B24 and B30 is 5.37% , 4.9% , 5.07% , 4.87% , 4.77% , 4.58%, it has been seen that CO2 of all the blends is lower as compared to diesel fuel because of Completion combustion of fuel in the combustion chamber and have more oxygen elements in the blends.

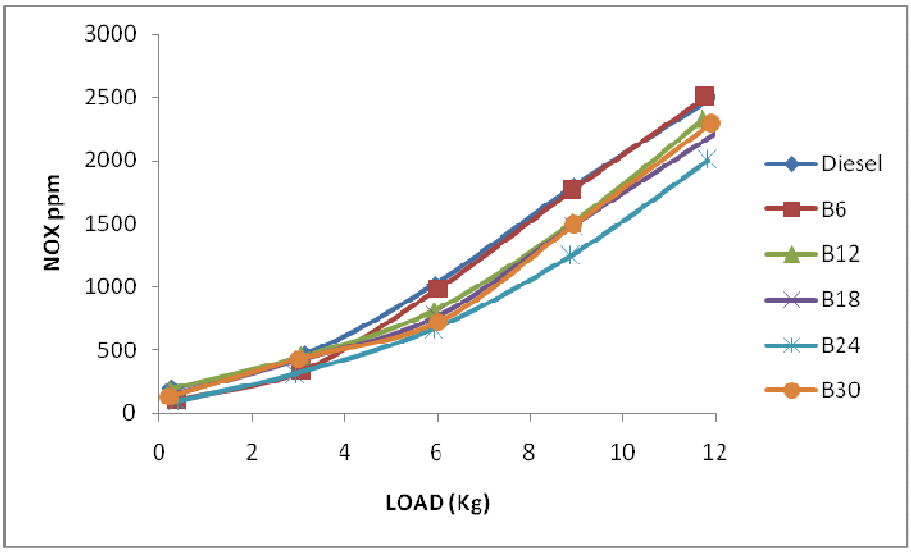

Fig 3 6 Load Vs NOx

The most important critical emission from the diesel engine is NOx emission.the percentage of NOx ppm for diesel,here B24 is found to be lower emitting NOX as compared to Diesel.The NOX of Diesel, B6, B12, B18, B24 and B30 is 2514 ppm, 2501 ppm, 2329 ppm, 2225 ppm, 2006 ppm, 2290 ppm The formation of nitrogen oxide (NOx) is significantly influenced by the cylinder gas temperature and the availability of oxygen during combustion

5. . CONCLUSION

The main objective is to determine the waste fish oil of current investigation in diesel engine to evaluate the performance and emission of the engine with new alternative fuels. Based on the experimental results, the conclusion can be summarized as follows:

- Engine test shows performance parameter of B6, B12, B18, B24, and B30 blends do not differ greatly from those of diesel fuel. thermal efficiency of diesel,B6,B12,B18,B24 and B30 at higher load is 33.73%, 32.44%,34.1%, 33.18%, 31.37%, 31.23%.Brake thermal efficiency characteristics for diesel and B12 are highest and lesser in the case of all biodiesel blends. It is due to the reduced calorific value and increased viscosity of biodiesel when compared to diesel. Since diesel is less viscous, atomization will be comparatively better which causes better combustion and thereby can produce higher thermal efficiency.
- At higher load the Brake specific fuel consumption is 0.25%, 0.26%, 0.25%, 0.26%, 0.28%, and 0.28% for diesel, B6, B12, B18, B24 and B30. The B12 blend and diesel fuel shows the same BSFC and rest blends shows the increasing in Brake specific fuel consumption because of high in density of fuel, lower heating value the average value of brake specific fuel consumption is 0.27%.
- Emission of HC,CO,CO_2 and NOx were reduced for all the blends at higher compression ratio some blends shows same results as compared to diesel fuel because the less oxygen present in the fuel and because of the combustion temperature of the engine.
- The various blends of the fuel shows great reduction in the emission as compared to the diesel fuel can be said that it can use as a alternative source of fuel which reducing environmental effect and saving the renewable fuel.

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