Performance and Evaluation of Blends of diesel fuel with Lemon grass oil and Waste plastic oil in a diesel engine

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ABSTRACT:

Diesel and other petroleum products being non-renewable sources of energy are fast depleting. Biodiesel refers to a non-petroleum based diesel fuel consisting of alkyl(like methyl, etc) esters, biodiesel was made by transesterification of vegetable oils and animal fats, which can be used (alone, or blended with conventional petro-diesel) in unmodified diesel-engine vehicles. In aspect of India biodiesel can play an important role in the production of alternative diesel fuel. In the first phase of this work bio-diesel is prepared from lemon grass oil and waste plastic oil be transesterification process. In the second phase of this work the performance study of a diesel engine with diesel and lemon grass oil and waste plastic oil based biodiesel were carried out at injection pressure (150 bars). Fuel characteristics(density, calorific value, viscosity and flash point and fire points), engine performance and characteristics have been investigated and significant improvements were observed. In this paper I have conduct experiments to chart out bio-diesel properties and compared them with those of neat diesel by preparing our own lemon grass oil and waste plastic oil bio-diesel and went to conduct load tests with 100% bio-diesel(also called B100) and also blend B80,B60,B40,B20 and compared this results with those done with neat diesel.

Keywords: lemon grass oil, waste plastic oil, diesel blends, engine performance, characteristics

1.INTRODUCTION:

In 1895 Rudolf Diesel designed the engine that bears his name to run on vegetable oil particularly peanut oil and a report on the use of alcohol for the motor fuel was utilization of bio fuels as a fuel followed the two main crisis of the globe namely: fuel shortages and air pollution

The increasing energy demand accompanied by the limited availability of fossil fuels and the environmental pollution caused by their use have induced researchers to explore alternative fuels in order to gradually substitute conventional fuel. Bio fuels are gaining popularity as they are an immediate substitute to the existing fossil fuels. Biodiesel may be obtained from plant resins or plant seeds. grass oil are renewable and have low sulphur contents. But the use of straight grass oil as a fuel for compression ignition engines is restricted by certain unfavorable properties, particularly its viscosity. This choking also leads to poor fuel atomization and incomplete combustion. Owing to incomplete combustion, partially burnt vegetable oil runs down the cylinder walls and dilutes the lubricating oil. so adding some amount diesel with combination of grass oil using complete combustion purposes.

1.1.Lemon grass oil:

The expend the bio-fuel is extracted from lemon rinds through the steam distillation process and blended with diesel for experimental testing. The Steam distillation process is done in order to extract oil from the fruit peel as it is the most clean and extensive production process . The goal of the current study arises from the various literatures ensures that there no research work has been carried out as a partial substitute using lemon essential oil in the operation of diesel engine. Hence, this work focus to evaluate the possible utilization of lemon essential oil as a diesel blends for ensuring the performance evaluation in diesel engine application. In this work the lemon essential oil of 20% is blended with 80% of diesel and the fuel named as LEO20 was used as fuel in the CI engine. The values obtained from the experimental analysis of performance and combustion are compared with other.

FIG 1.LEMON GRASS OIL

1.2.Waste plastic oil:

Vegetable oils and plastic oil have considerable potential to be considered as appropriate alternative as they possesses fuel properties similar to that of diesel. Vegetable oils can be classified into two types one is edible oil and other being non-edible oil. Since edible oils are in great demand for domestic consumption, the non-edible oil likes honge and rubber seed oil used as a substitute fuel due to following reasons. The use of bio diesel in conventional diesel engine results in substantial reduction of unburnt hydrocarbon, carbon monoxide and particulate matter (but NOx about 2% higher). The objects of this study is to experimentally and to compare performance, combustion and characters The waste plastic oil is compared with petroleum products and found that it can also be used as fuel in CI engine. Plastic oil is non-biodegradable and renewable oil. The engine behavior with respect to combustion, performance, and emission characteristics, are compared against a baseline of as standard diesel run.

FIG 2:WASTE PLASTIC OIL

2. EXPERMENTAL SETUP:

The experiments are performed on a Kirloskar TAF1 single cylinder diesel engine and the specifications are listed in Table 2. The load is varied from minimum to the maximum capacity of the engine by keeping speed constant at 1500 rpm. Experiments are conducted at a constant injection timing of 23°bTDC and 150 bar of injection pressure. Fuel consumption is measured using a stop watch and standard burette system. Digital K-type thermocouple (chrome alumel) is used to measure the engine exhaust gas temperature. Performance, combustion and parameters are obtained for lemon essential oil blends lemon grass oil and waste plastic oil as shown in below fig.

Table 1.Specification of engine

Engine parameters	Specification Ignition
Ignition	Compression Ignition
Bore	87.5mm
Stroke	110mm
Compression Ratio	17.5:1
Speed	1500rpm
Rated power	4.4kw
Number of engine and cooling	Single cylinder and air cooled
Injection timing	23°bTDC

3. RESULTS AND DISSUCUSION:

Table 2.properties of Biodiesel

	Kinematic viscosity(cts)	Density(g/ml)
Diesel	3.710	0.775
Lemon grass oil	8.5607	0.8706
Waste plastic oil	7.4727	0.8054

Table 3.Flash point and Fire point

	FLASH POINT	FIRE POINT
Diesel	49	58
Lemon grass oil	65	70
Waste plastic oil	52	60

3.1 Engine Instructions:

Bore(d)=80mm

Stroke length(l)=110mm

Compression ratio=16:1

Rated speed=1500rpm

Rated power(bp)=3.6kw at 1500rpm

Orifice diameter(d)=20mm

Coefficient of discharge(Cd)=0.65

CALCULATIONS:

1) Brake horse power(BHP)=V*I/1000*η_g

2) Total fuel consumption/hr(TFC)=(Measured fuel(20cc)*specific gravity *60*60)/Time taken in seconds*1000

3)Specific fuel consumption(SFC)=TFC/BHP

4)FHP is calculated from the graph in between TFC and BHP by William's line method

5)Indicated horse power(IHP)=BHP+FHP

6)Actual discharge(Qact)=Cd*A*$\sqrt{2gH_a}$

Where Cd=Coefficient of discharge=0.65

A=Area of section of orifice=∏/4*d^2

d=diameter of orifice =20mm

Ha= $\rho_w * H_w / \rho_a$

Hw=h1-h2/100 m of water

e_w = density of water=1000Kg/m^3

e_a = density of air =1.2Kg/m^3

7)Theoretical discharge (Qthe)=*D^2*L *N*K/60

Where D=diameter of the cylinder in meters=80mm

L= stroke length =110mm

k=1.0 constant

N=speed in RPM=1500rpm

8)Mechanical efficiency (η_{mech})=BHP/IHP*100

9)Volumetric efficiency (η_{vol})=Qact/Qthe*100

10) Indicated thermal efficiency (η_{ind})=IHP*3600/TFC*C_v

11) Break thermal efficiency (η_{brake})=BHP*3600/TFC*C_v

12) Air fuel ratio (A/F)=Ma/M_f=*Qa/TFC

TABLE 3. (D80%+L20%)

Volts	**Amps (load)**	**Manometer readings(m)**	**Time for 20cc of fuel in sec**	**BHP (kw)**	**BSFC (kg/kw-hr)**	η_{brake}	η_{mech}	**A/F ratio**
223	1.7	5.9	79.3	0.4738	1.6333	5.1851	28.31	35.3776
217	4.8	5.6	72.96	1.302	0.6461	13.1073	52.03	31.7107
206	7.5	5.4	60.56	1.9312	0.5248	16.137	61.67	25.8488
201	10.2	5.2	54.00	2.5627	0.4435	19.095	68.10	22.6171
194	12.6	4.9	53.82	3.0555	0.3732	22.6906	71.801	21.8826
186	14.6	4.6	46.68	3.3945	0.3573	21.86	73.88	18.3894

TABLE 4.(L100%)

Volts	Amps (load)	Manometer readings(m)	Time for 20cc of fuel in sec	BHP (kw)	BSFC (kg/kw-hr)	ηbrake	ηmech	A/F ratio
231	1.9	5.9	76.44	0.5486	1.5194	6.1286	40.6803	32.84
225	4.9	5.7	68.2	1.3781	0.6779	13.7354	63.2711	28.80
218	7.9	5.4	58.2	2.1527	0.5085	18.3099	72.9066	23.92
208	10.5	5.1	52.36	2.73	0.4462	20.8661	77.3371	20.89
197	12.7	4.9	46.8	3.1273	0.4358	21.3650	79.6301	18.30
187	14.7	4.7	42.0	3.4361	0.4120	21.0667	81.1148	16.09

TABLE 5.(W20%+D80%)

Volts	Amps (load)	Manometer readings(m)	Time for 20cc of fuel in sec	BHP (kw)	BSFC (kg/kw-hr)	ηbrake	ηmech	A/F ratio
230	1.7	6.3	82.7	0.513	1.5013	5.6114	42.2918	36.72
224	4.9	6.1	74.12	1.372	0.6265	13.4506	66.2162	32.38
217	7.9	5.8	68.56	2.0865	0.4454	18.9209	74.8788	29.21
207	10.4	5.5	60.24	2.6393	0.4007	21.0299	79.0379	24.99
194	12.5	5.2	53.62	3.0156	0.3940	21.3873	81.1606	21.63
186	14.7	5.1	48.0	3.3531	0.3958	21.2884	82.7293	19.17

TABLE 6.(W100%)

Volts	Amps (load)	Manometer readings(m)	Time for 20cc of fuel in sec	BHP (kw)	BSFC (kg/kw-hr)	ηbrake	ηmech	A/F ratio

233	1.8	5.8	97.3	0.5242	1.3409	6.8333	24.679	38.62
223	4.9	5.5	87.26	1.3658	0.5738	15.9665	46.053	33.72
214	7.7	5.3	73.5	2.0597	0.4518	20.2808	56.281	27.88
204	10.2	5.1	64.64	2.601	0.4068	22.5229	61.913	2406
193	12.3	4.9	56.62	2.9673	0.4071	22.5074	64.968	20.65
183	14.4	4.8	52.24	3.294	0.3974	23.0521	67.306	18.86

5.CONCLUSION:

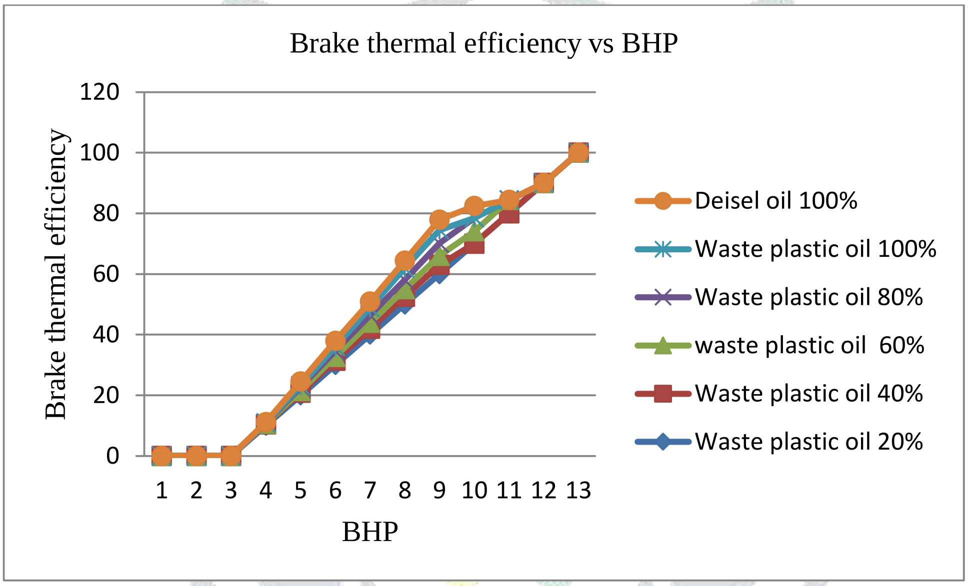

Fig 4: Brake thermal efficiency v_s BHP

This graph shows as BHP increases also the brake thermal efficiency increases. thermal efficiency is the higher for D100 while it is lower for W20. Thermal efficiency of D100 is observed to be much higher than the thermal efficiency of the W20.

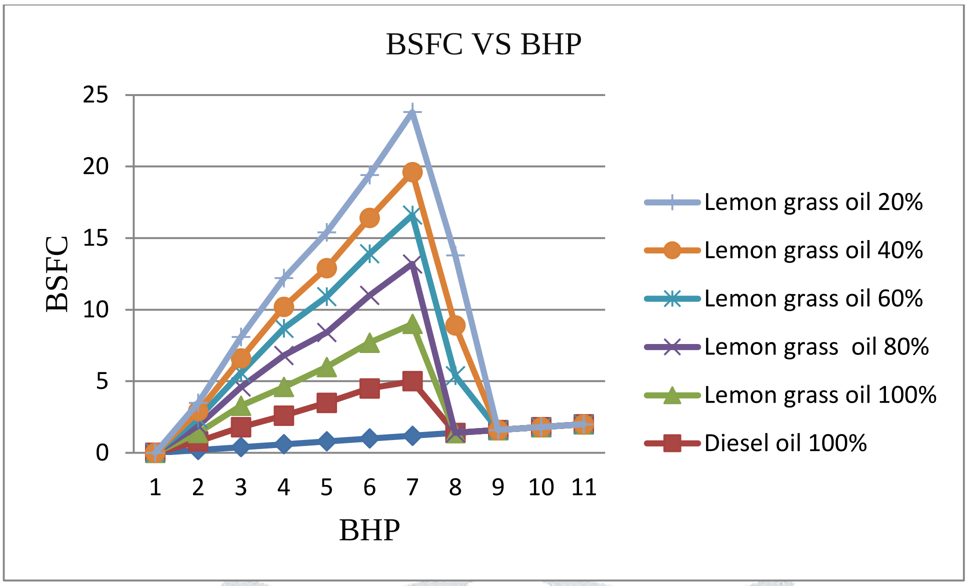

Fig 5: BSFC Vs BHP

From the above graph shows as BSFC increases and also the BHP has decreases. As per we can see that BSFC is inversely propositional to BHP.

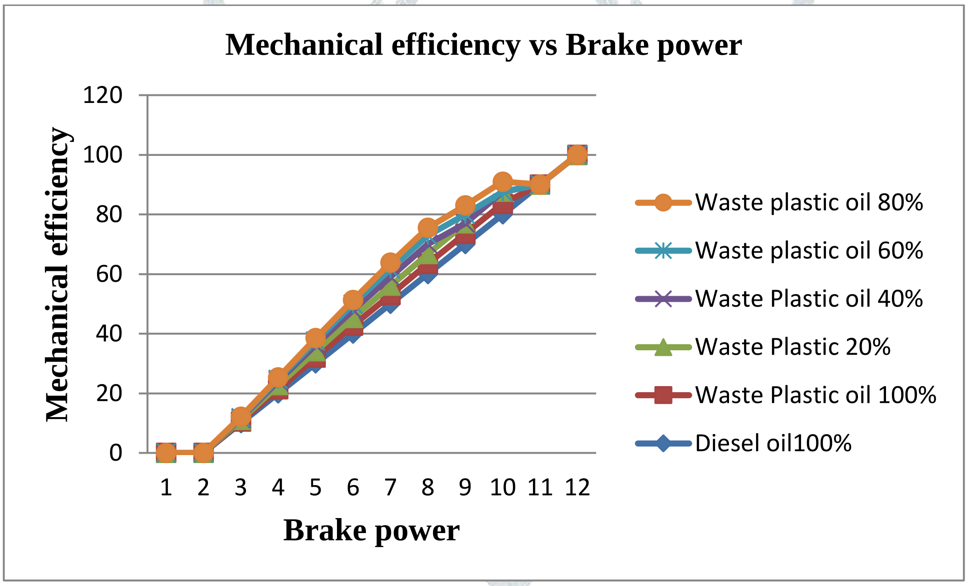

Fig 6: η_{mech} Vs BHP

From the above diagram we can see that Mechanical efficiency has increases but also BHP has decreases. so the mechanical efficiency of waste plastic oil (W80) has higher than compared to the other oils and lower than the D100 has decreases compare to the other oils.

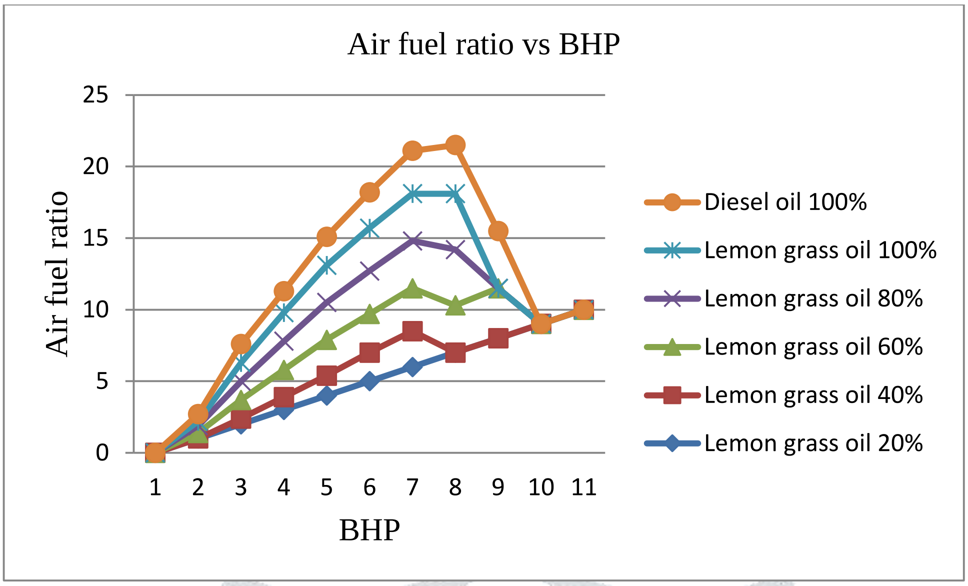

Fig 7: Air fuel ratio Vs BHP

From the above figure the air fuel ratio has increases and also BHP has decreases. The diesel oil air fuel ratio has increases other fuels and also lemon grass oil (L40) has lower air fuel ratio other any compared.

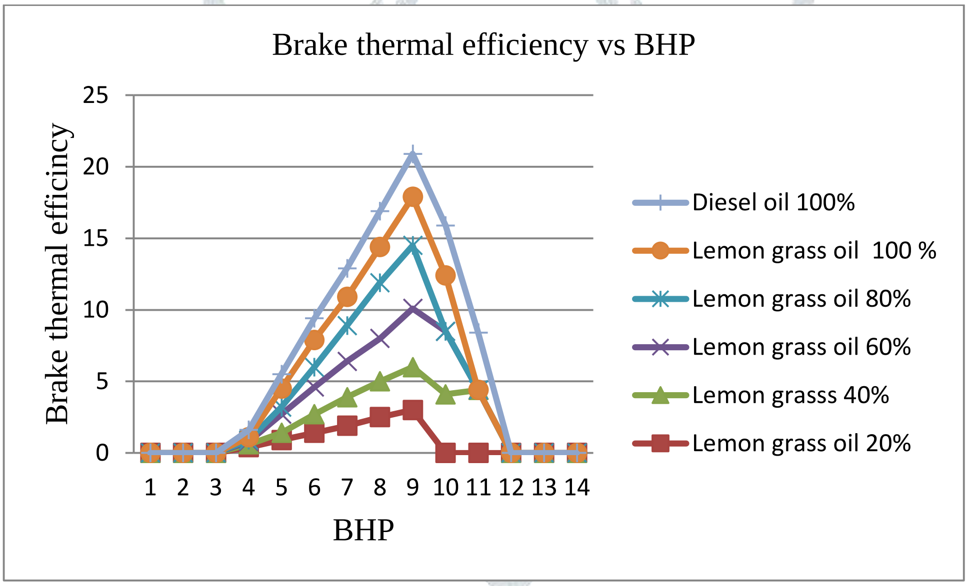

Fig 8: Brake thermal efficiency vs BHP

From the above Brake thermal efficiency has increased with D100% and with lemon grass oil 100% has decreased other oil compared and also lemon grass oil L20 has lower grass oil compared to other oils efficiency

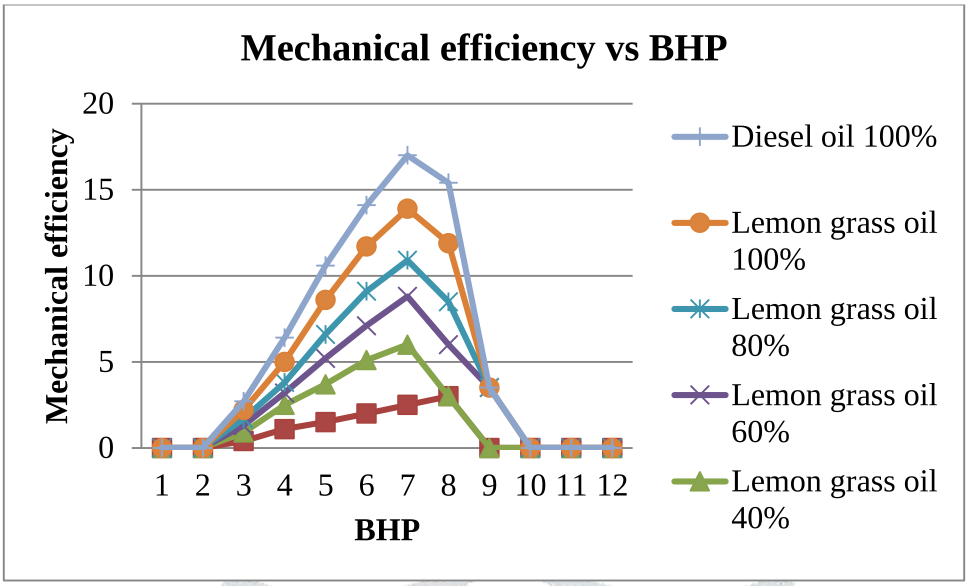

Fig 9: η_{mech} Vs BHP

From above graph diesel oil has oil increased to other oils mechanical efficiency and also L20 has also decreased and this oils was inversely propositional to compare one and another.

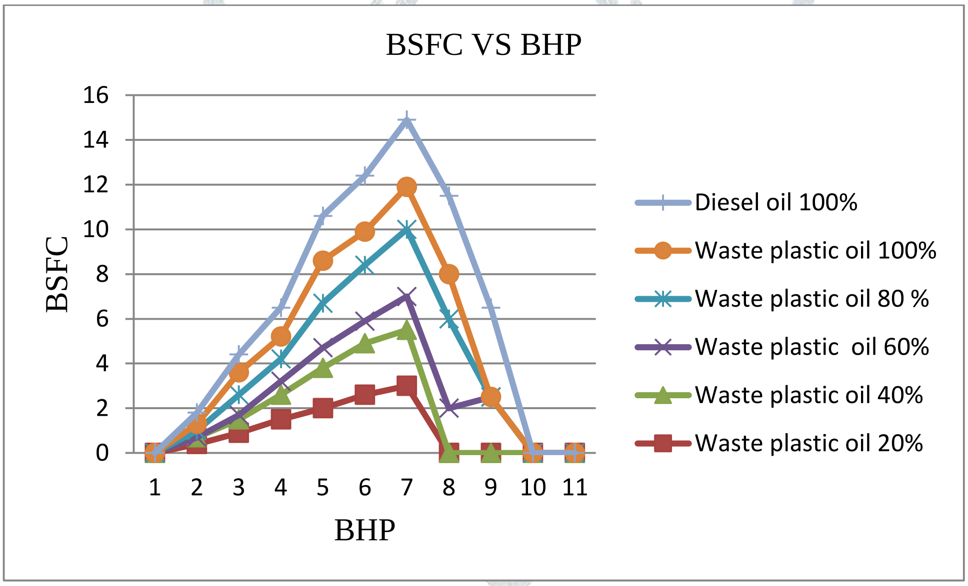

Fig 10: BSFC Vs BHP

From the above Brake thermal efficiency has increased with D100% and with lemon grass oil 100% has decreased other oil compared and also lemon grass oil W20 has lower grass oil compared to other oils efficiency

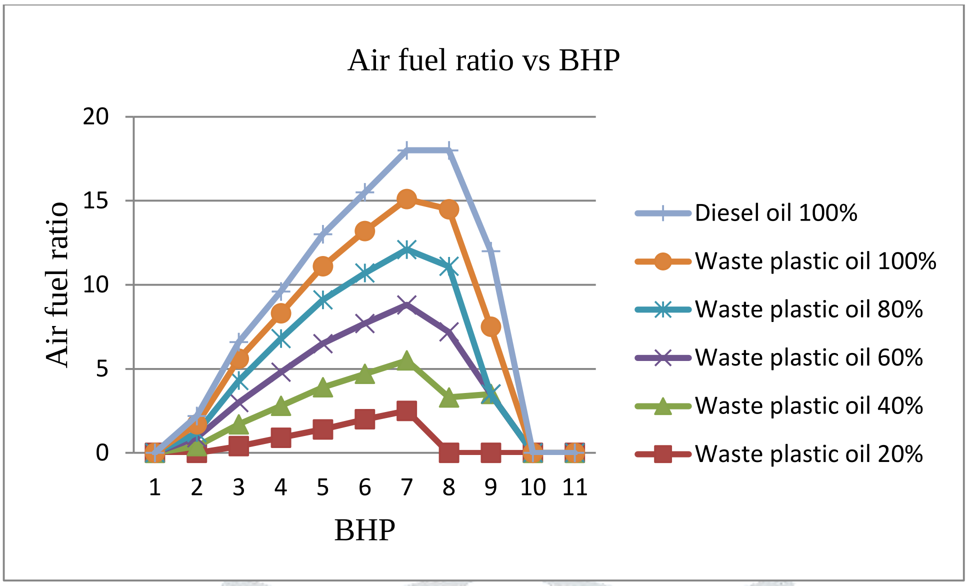

Fig 11: Air fuel ratio Vs BHP

From the above figure the air fuel ratio has increases and also BHP has the decreases. The diesel oil air fuel ratio has increases other fuels and also lemon grass oil (L40) will be lower air fuel ratio other any compared.

6.CONCLUSION:

The experimental work investigates the possible substitution of diesel fuel in CI engine operation with lemon grass oil and waste plastic oil. Engine parameters, namely brake thermal efficiency, brake specific fuel consumption, Mechanical efficiency, Air fuel ratio were measured to investigate the effects on its performance of the engine. The results of study may be find outed as follows:

1) Lemon grass oil and waste plastic oil and diesel blends can be directly used in diesel engines without any engine modifications and I have observed the performance is slightly reduced while brake specific fuel consumption is increased when using bio-fuels.

2) I have observed that the oil of L20% are used the air fuel ratio reduced to compared to other oils and also the brake thermal efficiency decreased to compare to the other oils

3) The waste plastic oil (W20%) of air fuel ratio has reduced compare to other oils. The mechanical efficiency has increased to (W80%) compare to other oils .

5) I have concluded that the waste plastic oil is better mechanical efficiency compare to lemon grass oil mechanical efficiency.

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