

Experimental Investigation of Performance & Emission of Biodiesel Blended (Palm Oil)

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ABSTRACT: The biodiesel are widely used in continually depleting with increasing consumption and price day to day .There is need to find out an alternative fuel to fulfill the energy demand of the world. An experimental investigation has been carried out to analyze the performance and emission characteristics of a compression ignition engine fuelled with biodiesel (make use palm oil). The biodiesel making process is two major steps, Frist preheating process and second convert to biodiesel preheating of palm oil to heat 70 to 80°C And convert the biodiesel by using trans esterification method. Take methanol and catalyst KOH or NaOH with net amount of the palm oil, The effect of temperature on the viscosity of palm oil has also been investigated. Generally Fuel preheating for reducing viscosity of oils and blends has been done by a specially designed hot plate magnetic stirrer apparatus, with and without preheating is have been conducted using each of the above fuel. The performance characteristics evaluated include thermal efficiency, brake power, specific fuel consumption (SFC), And exhaust emissions include mass emissions of CO, HC, NOx and smoke opacity.

KEYWORDS: Palm oil, Biodiesel, Performance & Emission

I.INTRODUCTION

Energy is one of the major inputs for the economic development of any country. In the case of the developing countries Historically, any change in the prime energy source of a society has resulted in a revolution in the life style. Before the industrial revolution, which began around 200 years ago, people were essentially dependent on manual and animal labour. Then in 1785, the invention of steam engine by James Watt of Scotland brought industrial revolution. It was the beginning of the mechanical age or the age of machines.

The country's annual crude oil production is peaked at about 32 million tonne as against the current peak demand of about 110 million tonne. In the current scenario, India's oil consumption by end of 2013 is expected to reach 136 million tonne. Annual growth rate (CAGR) at 3.6 % during the plan period. Domestic crude oil production is likely to rise marginally from 32.03 million tonnes in 2001-02 to 33.97 million tons by the end of the 10 plan period (2012-13). India's self-sufficiency in oil has consistently declined from 60% in the 50s to 30% currently. Same is expected to go down to 8% by 2020. As shown in the figure 1.8, around 92% of India's total oil demand by 2020 has to be met by imports.

India is projected to become the third largest consumer of transportation fuel in 2020, after the USA and China, with consumption growing at an annual rate of 6.8% from 1999 to 2020. India's economy has often been unsettled by its need to import about 70% of its petroleum demand from the highly unstable and volatile world oil market (India, 2013). The acid rain, global warming and health hazards are the results of ill effects of increased polluted gases like SO_x, CO and particulate matter in atmosphere. Rising petroleum prices, increasing threat to the environment from exhaust emissions and global warming have generated an intense international interest in developing alternative non-petroleum fuels for engines. In recent years, research has been directed to explore plant-based fuels

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and plant oils and fats as fuels. Biodiesel is described as a fuel comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats. It is oxygenated, essentially sulfur-free and biodegradable.

II.ALTERNATIVE FUELS

Searching the alternate fuels for IC engine for the following reason:

- Depletion of fossil fuel
- Vehicular populations
- Increasing Industrialization
- Extra burden on home economy for developing countries like India
- Growing Energy Demand
- Explosion of population
- Environmental pollution
- Stringent emission norms like Bharat – I, II, III, IV and V

REQUIREMENTS OF ALTERNATE FUELS

- Availability
- Better Performance
- Conformity to the environmental standards
- Competitive cost
- Safety in transportation

III.PALM OIL

Vegetable oil in neat form is one of the best substitutes for the diesel fuel, better lubricity and abundant availability. However studies conducted with vegetable oil showed that, vegetable oil in neat form are not suitable for long term engine application due to its high viscosity, poor volatility and high molecular weight. Hence, the vegetable oils are admitted into the engine either in the form of blended vegetable oil (diesel and alcohol) or esterified vegetable oil (biodiesel). The former is simple and cheap and latter is cumbersome and expensive. Palm oil is cost wise low because choose this make biodiesel.

An equal proportional of Palm oil and diesel is prepared on volume basis and admitted into the engine through regular diesel injection system to study the feasibility, performance and emission characteristics of 100% bio fuel operation.

IV.VISCOSITY REDUCTION TECHNIQUES

- preheating
- blending
- transesterification
- benefits of transesterification

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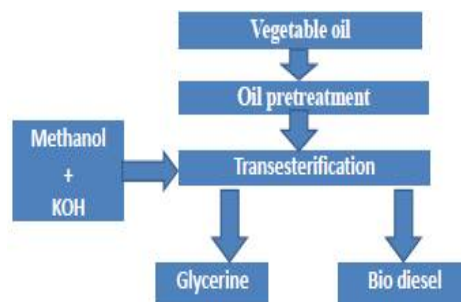
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V.PROBLEM IDENTIFICATION

- More emissions. Low performance like thermal efficiency, fuel consumption.
- Preheated Palm oil directly blending to the diesel.

VI.EXPERIMENTAL PROCEDURE



VII. PREPARATION OF BIODIESEL

- oil preheating
- mixing the alcohol and catalyst
- transesterification
- biodiesel filtration
- separating process

VIII.BLENDING

BLENDING PROCESS

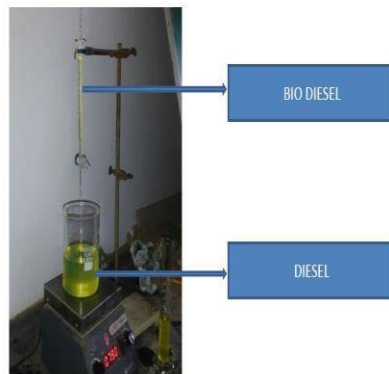
- To blend the biodiesel to diesel adding drop by drop at 900 rpm by using magnetic stirrer apparatus.
- The blending biodiesel with diesel in different ratios, to blend take 20% of biodiesel and 80% of diesel in B-20 blend.
- And next blend 30% of biodiesel and 70% of diesel in B-30 blend, another blend is 40% of biodiesel and 60% of diesel in B- 40 blend.
- This different ratio blends are called B-20, B-30 and B-40 respectively.
- This blending process is maintained in room temperature only.

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Blending process and Different blending ratios

IX. EXPERIMENTAL SETUP AND MEASUREMENTS

A single cylinder, 4-stroke, water cooled, diesel engine coupled with electrical dynamometer. The suction side of the test engine is attached with anti-pulsating drum to measure air inflow quantity. The inlet temperature of air is measured with inlet air thermometer. The exhaust side of the engine consisting of series of devices such as Exhaust Gas Thermometer (EGT), gas analyzer probe and smoke meter probe.

The set-up also consists of fuel flow measuring device to measure the fuel consumption of the engine. The output side of the engine consists of an electrical dynamometer and followed by a loading rheostat. The output is measured in terms of watts using digital wattmeter mounted in the panel. An 8 bit Data Acquisition system (DAS) is also connected with test rig to acquire the combustion pressure and crank angle, pressure – volume, MFB and HRR data for a stipulated number of cycles.

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EXHAUST EMISSION MEASUREMENTS

Five-gas analyzer is used to measure the quantity of emission constituents such as CO, CO₂, O₂, UBHC, and NO_x present in the exhaust gas. HC and NO_x were measured in ppm and CO, O₂ and CO₂ measured in percentage (%) by volume. The measurement of exhaust gases was carried out by placing the probe into the exhaust pipe. The probe can be pulled out after taking reading. Similarly measurements were made for all trials. The printout can be obtained from the analyzer for each trial.

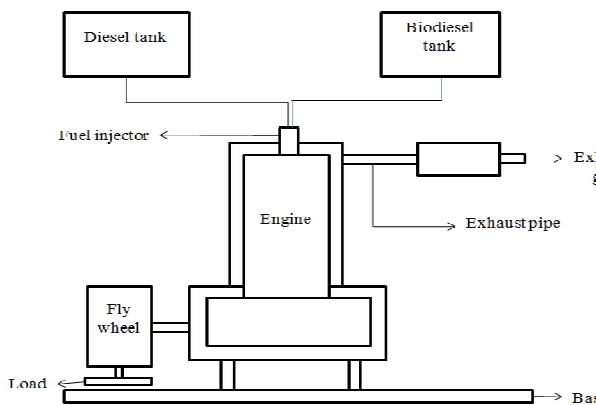
FUEL FLOW MEASUREMENTS

This device consists of graduated burette, fuel tank and two-way cock. During measurement, the two-way cock is arranged in such a way that the fuel descends from burette alone. Then the time taken for specific quantity of fuel consumption was found out using the stopwatch and the fuel consumption rate was evaluated.

SMOKE MEASUREMENTS

Smoke intensity is measured by means of a Bosch type smoke meter. Gas sample is drawn through a Watt man's filter paper fitted in the smoke sampler pump. The intensity of smoke is measured on a scale of 10 arbitrary units called Bosch smoke number (BSN), in which full white is assigned a number of 10 and full black is assigned.

EMISSION TEST APPARATUS:



Emission test apparatus

X.RUNNING THE IC ENGINE:

- To run the IC engine by using neat diesel and different biodiesel ratios (B20,B30,B40).



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XI.OBSERVED READINGS FROM CI ENGINE: NEAT DIESEL

B 20:

Type of Engine	Vertical, 4-Stroke cycle, single acting, High speed, DI, diesel engine.
Number of Cylinder	One
Speed	1500rpm
Maximum power output	5Hp(=3.7 kW)
Bore diameter	80mm
Length of Stroke	110mm
Cubic Capacity	0.553 liters
Normal compression ratio	17.5:1
Fuel timing by spill	23 Deg. BTDC
Lubrication	Forced Full Pressure lubrication
Type of cooling	Water cooled
BMEP at1500 rpm	5.42 bar
Radius of brake drum	162 mm
Diameter of orifice	20 mm
Orifice constant	0.6
Rope diameter	20 mm

B30:

S.N O	LOAD W (kg)	TIME TAKE N FOR 10CC FUEL CONSUMPTION (sec)	SM OK E OP ACI TY (%)	CO (% OF VOLU ME)	CO ₂ (% OF VOLU ME)	HC (PP M)	NO _x (PP M)
1	0	75	19	0.04	2.30	9	64
2	2.5	70	20	0.05	2.70	11	84
3	5	64	32	0.06	3.40	10	127
4	7.5	53	38	0.07	4.00	12	212
5	10	44	44	0.08	4.60	13	260

S N O	LOAD W (kg)	TIME TAKEN FOR 10CC FUEL CONSUMPTION (sec)	SM OKE OPA CITY (%)	CO (% OF VOLU ME)	CO ₂ (% OF VOLU ME)	HC (PP M)	NO _x (PP M)
1	0	70	12.5	0.04	1.7	8	63
2	2.5	57	15.8	0.06	2.4	12	95
3	5	50	18.6	0.05	2.5	18	114
4	7.5	42	20	0.04	2.7	19	158
5	10	35	24	0.03	2.8	12	168

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B40:

NO	LOAD W (kg)	TIME TAKEN FOR 10CC FUEL CONSUMPTION (sec)	SMOKE OPACITY (%)	CO (% OF VOLUME)	CO ₂ (% OF VOLUME)	HC (PPM)	NO _x (PPM)
1	0	72.24	9	0.03	1.10	3	63
2	2.5	58	14	0.05	2.20	12	84
3	5	52	20	0.04	2.20	13	96
4	7.5	43	24	0.06	3.20	11	166
5	10	36	28.3	0.04	4.31	14	275

S.NO	LOAD W (kg)	TIME TAKEN FOR 10CC FUEL CONSUMPTION (sec)	SMOKE OPACITY (%)	CO (% OF VOLUME)	CO ₂ (% OF VOLUME)	HC (PPM)	NO _x (PPM)
1	0	68	13.7	0.04	1.9	15	69
2	2.5	55	16	0.06	2.1	20	58
3	5	48	18	0.04	2.2	14	94
4	7.5	40	21.2	0.04	2.9	17	132
5	10	33	22	0.04	3.5	13	226

XII.RESULT EVALUATION TEST RESULT

PURE DIESEL:

	BP (kw)	TFC (kg/hr)	SFC (kg/kw-hr)	HI (kw)	ηBth (%)
0 KG	0.2649	0.3719	1.4043	4.684	6.65
2.5 KG	0.9275	0.3985	0.4296	5.0199	18.37
5 KG	1.5901	0.4359	0.2741	5.4911	28.95
7.5 KG	2.2528	0.5264	0.2336	6.6311	33.97
10 KG	2.9153	0.6340	0.2175	7.9866	36.5

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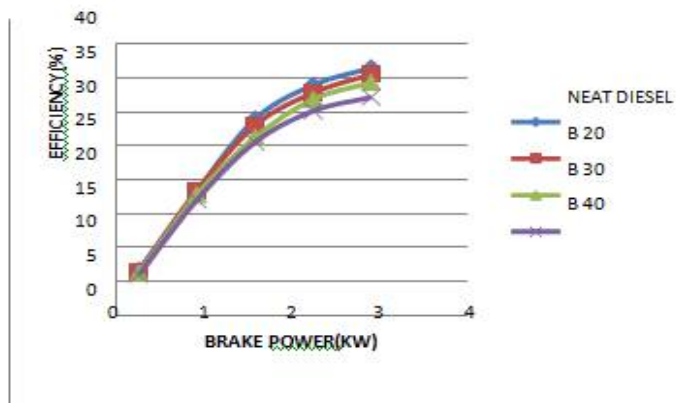
B40:

	(kw)	(kg/hr)	(kg/kw-hr)	(kw)	(%)
0 KG	0.2649	0.3916	1.4786	4.0846	6.48
2.5 KG	0.9275	0.4835	0.5213	5.0431	18.39
5 KG	1.5901	0.544	0.3442	5.6752	28.01
7.5 KG	2.2528	0.658	0.2921	6.8633	32.82
10 KG	2.9153	0.786	0.2696	8.1984	35.55

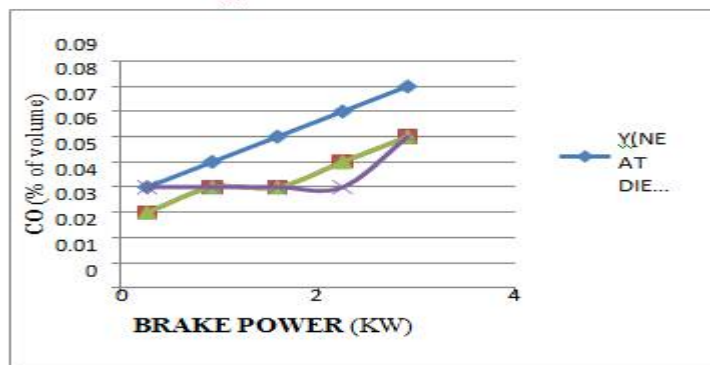
	BP (kw)	TFC (kg/hr)	SFC (kg/kw-hr)	HI (kw)	η_{Bth} (%)
0 KG	0.2649	0.4214	1.5908	4.3954	6.02
2.5 KG	0.9275	0.521	0.5617	5.4343	17.06
5 KG	1.5901	0.5969	0.3754	6.2259	25.54
7.5 KG	2.2528	0.7164	0.318	7.4724	30.14
10 KG	2.9153	0.8683	0.2978	9.0568	32.18

GRAPHS:

BRAKE POWER vs EFFICIENCY:



BRAKE POWER vs CO



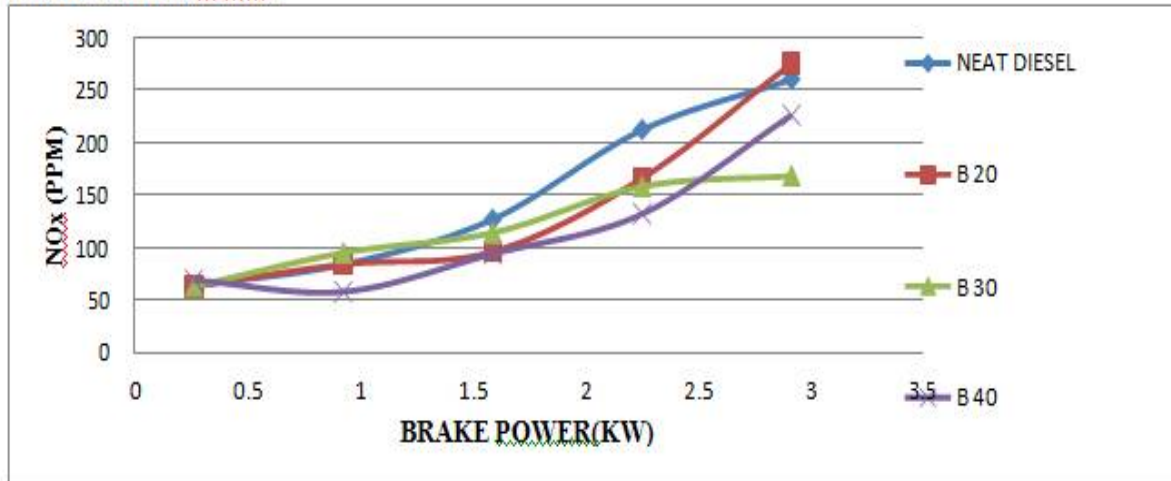
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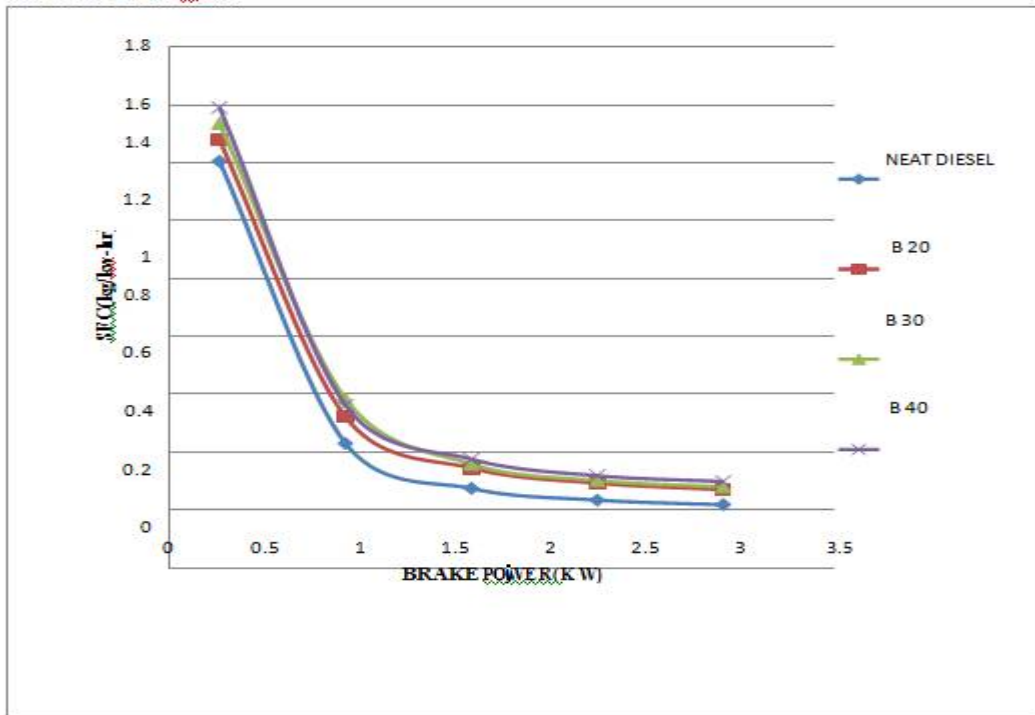
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BRAKE POWER vs NOx:



BRAKE POWER vs SFC:



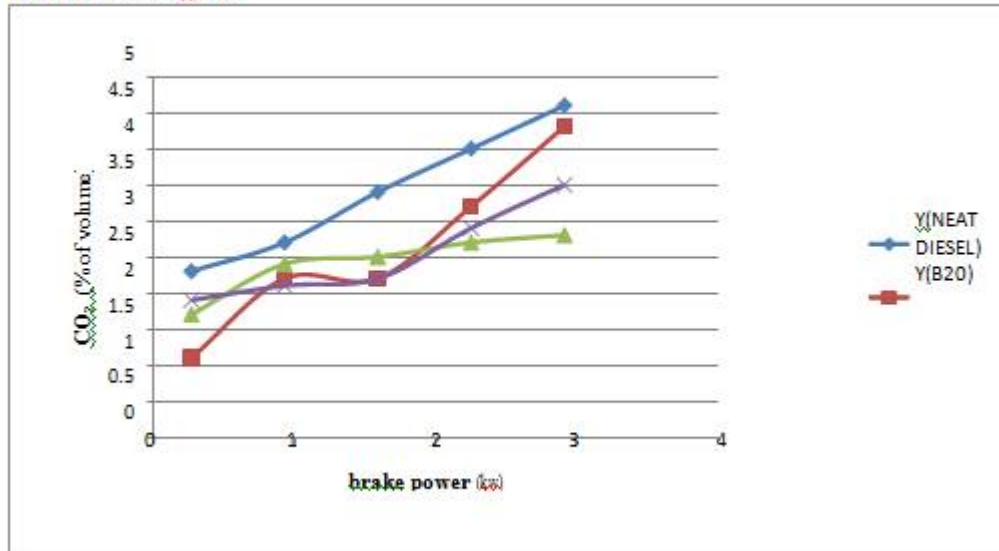
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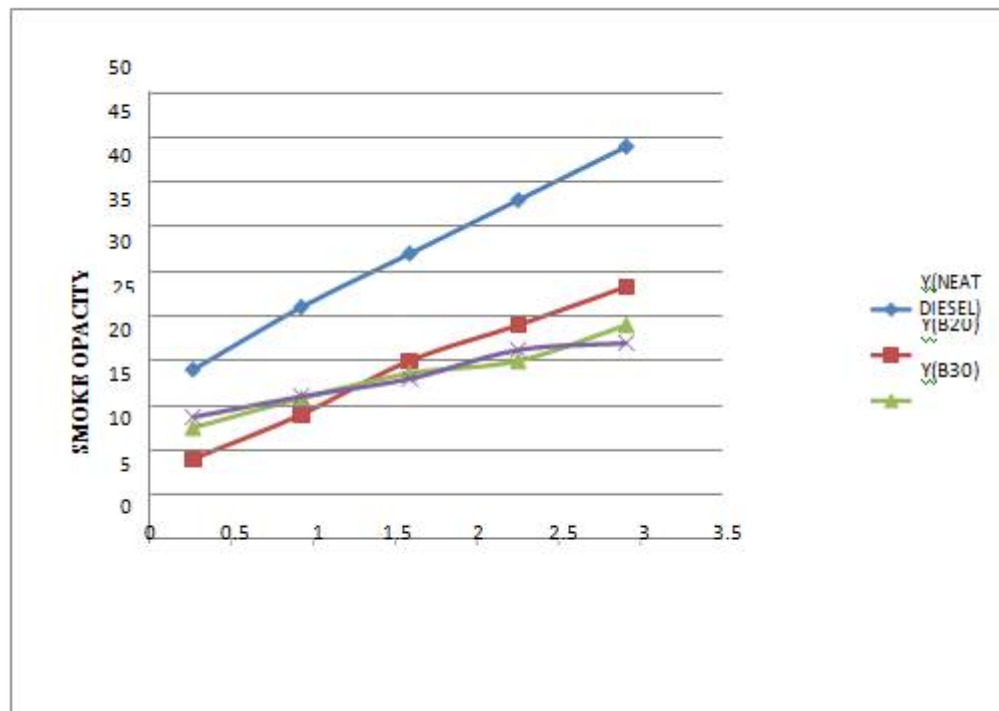
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BRAKE POWER vs CO2



BRAKE POWER vs SMOKE OPACITY:



XIII.CONCLUSION

Single cylinder diesel engine ran successfully during tests on Palm oil and its blends even without preheating and require no modification in engine hardware. However while using pre-heated fuel, engine efficiency improved slightly. Performance and emission characteristics of Palm oil and its blends were found to be comparable to

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that of mineral diesel. Thermal efficiency of the engine with preheated oil blends is nearly 36% and for lower blends (unheated) such as B20, B30 and B40, it was 32–35%. The brake specific fuel consumption and brake specific energy consumption of the engine with preheated lower blends showed an improved trend. The unheated oil blends up to B40 also showed an improved trend compared to mineral diesel. The smoke density from exhaust gas of preheated lower blends as well as unheated lower blends was almost similar to that of diesel fuel. The HC emissions from unheated and preheated lower blends (B20 and B30) are lower than that of mineral diesel. The emission of NOH from all blends with and without preheating are lower than mineral diesel at all load conditions. This is a significant advantage over mineral diesel while using vegetable oil and their blends. Hence it can be concluded that the Palm oil blends with diesel up to 50% (v/v) without preheating as well as with preheating would replace diesel for running the CI engine for lower emissions and improved performance.

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