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A Study of Consolidate Heat Energy generated from Diesel and Biodiesel Fuel for Four Stroke Diesel Engine

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Abstract-*Fast growth of automobile industry worldwide increases the fuel demand. Fossil fuels available are exhaustive type of resource and having an adverse effect on environment. So there is need of alternate fuel option which should be environment friendly. Biofuel is the suitable option, biofuel obtain from vegetable seeds like jatropha, karanja etc. which can be easily cultivated. This fuel used in different proportion (Blends) with diesel without any modification in engine. It also reduces the Smoke Emission of Exhaust Gaseous. The aim of the research work is to find out the performance and Heat generated from diesel and biodiesel. The results critically examines the Heat energy available from fuel burnt, Heat energy equivalent to output Break power,*

Heat lost due to engine cooling water, Unaccounted heat energy loss, Heat energy lost due to exhaust gas, Brake Power,

Keywords: *JB (Jatropha Biofuel), Brake Power, Heat energy available from fuel burnt, Heat energy equivalent to output Break power, Heat lost due to engine cooling water, Unaccounted heat energy loss, Heat energy lost due to exhaust gas,*

1. INTRODUCTION

Many energy fuels are being investigated as potential substitutes for the current high-pollutant diesel fuel derived from diminishing commercial sources. Vegetable oils may provide one such alternative and their potential has been examined in the past years by several researchers..Our current research effort has been directed towards the use of vegetable oil as a diesel fuel substitute with minimal fuel processing and no engine modification. To take advantage of emulsification as a way of improving the combustion of vegetable oil in a diesel engine, some amount of water was introduced in the vegetable oil during the extraction process. The research paper evaluated the consolidated heat generated from diesel and biodiesel blends. Heat energy includes following heat energy Heat energy available from fuel burnt, Heat energy equivalent to output Break power, Heat lost due to engine cooling water, Unaccounted heat energy loss, Heat energy lost due to exhaust gas,

2. EXPERIMENTAL SETUP

3. ENGINE SPECIFICATIONS

Cylinders	01
Strokes	04
Fuel	Diesel
Power	5 hp @ 1500rpm
Cylinder bore & Stroke	87.5 & 110 mm
Compression Ratio	17.5:1
Dynamometer	Rope brake
Cooling	Water cooled

4. TESTING PROCEDURE

Experiment was conducted with jatropha oil and diesel at various load levels. Using pure diesel engine performance tests was also conducted for comparison purpose. Engine performance will be measure in term of brake specific fuel consumption, air flow rate, and exhaust gas temperature and emissions. Engine should be run for few minutes to attain steady state before the measurements get started. The experiment was repeated thrice and average values of performance and emission get measured. In this experimental setup dynamometer was used to load the engine at varying load of 2-10 kg. Spring balance attached to the dynamometer to measure the torque by means of a 100 x 0.5 N arrangement. Three way, hand operated, two-positional directional control valve added in fuel supply system used to switch from diesel fuel and the test plant fuels. Tachometer is used to measure speed of the shaft at each loading. Under gravity and the volumetric flow rate fuel supplied to injector pump and measured the time taken for 10 ml of fuel to flow through a graduated measuring device. A smoke emission of exhaust gas was monitored by portable combustion analyser fitted near the exhaust valve. Exhaust gas temperature was measured by thermocouples. Test runs carried for pure Jatropha oil, diesel fuel and their blends in order to make comparative assessments. Engine warm up to some extent is required to run on all fuels. The outcome of preheating of the pure Jatropha oil and a blend of equal proportion of the Jatropha oil and the diesel fuel on engine performance was also studied.

5. EXPERIMENTAL DATA TABLE AND CALCULATIONS

C.V = Calorific value of fuel (KJ/kg)
Mf = Fuel consumption (kg/s)

1. Heat energy available from the fuel brunt (KJ/hr)
   Qs = Mf * C.V * 3600 (KJ/hr)
2. Heat energy equivalent to output brake power
   Qbp = B.P. * 3600 (KJ/hr)
3. Heat lost due to engine cooling water
   Qcw = Mcw * Cpw * (T6 - T5) * 3600 (KJ/hr)

Mcw = Flow of water from engine jacket (kg/s)
T5 = Water inlet temp to engine jacket (deg C)
T6 = Water outlet temp from engine jacket (deg C)
Cpw = Specific heat of water = 4.184 KJ/kg-K

4. Mass of air (kg/s)

M air = Cd * Ao * √2*g*hw*(ρw/ρa)
Where,
Cd = Coe. Of orifice meter = 0.6
Ao = Area of orifice meter = $1.539*10^{-4}$ (m^2)
hw = Manometer difference (m)
ρw = Density of water = 1000 kg/m^3
ρa = Density of air = 1.2 kg/m^3

5. Heat energy lost to exhaust gas, (KJ/hr)

Qex = m(ex) x Cpg (T1 - T2) x 3600,
Where (m.ex = ma+mf)
Cpg = Specific heat of exhaust gas = 2.1 KJ/kg-K
T1 = Exhaust gas inlet Temperature (deg C)
T2 = Exhaust gas outlet Temperature (deg C)

6. Unacconted heat energy loss (KJ/hr)
Q unaccounted = Qs – (Qbp + Qcw + Qex)

Table 1: Test Report of Biodiesel & Diesel Blends ASTM standard

SR NO	SAMPLE	DENSITY (kg/m3)	VISCOSITY	CALORIFIC VALUE (kJ/kg)
1	BIODIESEL	872	5.68	39170
2	DIESEL	830	2.7	42500

Table2a): Experimental Data table for Biodiesel

Sr no	(W) Kg	(hw) meter	Time required for 10 ml fuel consumption in (sec)	T1 (˚C)	T2 (˚C)	T5 (˚C)	T6 (˚C)	Mf (kg/s)	B P (kw)
1	0	0.220	91	74	23	23	25	0.000096	0.000
2	2	0.216	76	85	23	23	26	0.000115	0.539
3	5	0.212	68	97	24	23	27	0.000128	1.348
4	7	0.208	64	114	25	24	28	0.000136	1.887
5	10	0.200	54	128	26	24	28	0.000161	2.695

Table 2b): Table for Biodiesel (Heat Generation)

Qs (KJ/hr)	Q(BP) (KJ/hr)	Qcw (KJ/hr)	Mass of air (kg/s)	Qex (KJ/hr)	Qunacc (kj/hr)	(b.s.f.c) (kg/kw hr)
13512.4	0.0	4217.5	0.00554	2172.2	7122.7	0
16179.3	1940.6	6326.2	0.00549	2625.9	5286.6	0.766
18082.7	4851.5	8434.9	0.00544	3071.0	1725.2	0.343
19212.9	6792.1	8434.9	0.00538	3714.9	270.9	0.260
22770.8	9703.1	8434.9	0.00528	4196.3	436.5	0.216

Table3a): Experimental Data table for Diesel

Sr. no	(W) Kg	(hw) meter	Time required for 10 ml fuel consumption in (sec)	T1 (˚C)	T2 (˚C)	T5 (˚C)	T6 (˚C)	Mf (kg/s)	B P (kw)
1	0	0.210	108	79	22	22	25	0.000077	0.000
2	2	0.210	85	95	22	22	26	0.000098	0.539
3	5	0.206	75	115	23	23	27	0.000111	1.348
4	7	0.200	68	126	24	24	28	0.000122	1.887
5	10	0.200	54	130	28	23	28	0.000154	2.695

Table 3b): Table for Diesel (Heat Generation)

Qs (KJ/hr)	Q(BP) (KJ/hr)	Qcw (KJ/hr)	Mass of air (kg/s)	Qex (KJ/hr)	Qunacc (kj/hr)	(b.s.f.c) (kg/kw hr)
11758.3	0.0	5535.4	0.00541	2364.7	3858.2	0
14940.0	1940.6	7380.6	0.00541	3040.0	2578.8	0.652
16932.0	4851.5	7380.6	0.00536	3804.3	895.6	0.296
18675.0	6792.1	7380.6	0.00528	4165.9	336.4	0.233
23516.7	9703.1	9225.7	0.00528	4190.3	397.6	0.205

6. CONCLUSION

1) Heat energy equivalent to brake power is almost same for both Biodiesel and Diesel fuel for maximum loading condition.
2) Heat energy available from fuel burnt is more for diesel in comparison with biodiesel for maximum loading condition.
3) Average heat loss i.e. heat loss due to engine cooling, exhaust gas and unaccounted heat is more for diesel fuel. Overall it is concluded that Biodiesel is the best source of energy.

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