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Research Papers

BIO-FUELS IN INTERNAL COMBUSTION ENGINES

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Abstract

After the industrial revolution the usage of conventional fuel like petrol, diesel, gas, exceeding rapidly. And also the domestic needs are increasing day by day. The situation continued for some decades. If so the deposits of conventional fuels will wiped off from earth crest. Their for the we have to concentrate to preserve the conventional fuel. 100% preservation cannot be possible. So we have to concentrate on alternative sources or bio fuels like Edible oils or Non Edible oils. In this project we are concentrating on Non Edible oils like Karanja, maghuva is produced from plant matter broken down by enzymes, fermented and distilled. This project involves preparation of Bio diesel from Non Edible oils by using distillation process and calibrates the performance evaluation on diesel engines by using distilled oils and comparing the results with diesel and suggesting the better substitution for diesel in the present used Bio fuels.

KEYWORDS:

Bio Diesel, Non Edible Oils Karanja, Distillation Process, Performance Evaluation

1.0 INTRODUCTION

An engine is a device which transforms one form of energy into another form. However while transforming energy from one form to another form, the efficiency of conversion plays an important role. Normally, most of engines convert thermal energy into mechanical work and therefore they are called "Heat engines". Today, internal combustion engines in cars, trucks, motorcycles, aircraft, construction machinery and many others, most commonly use a four-stroke cycle. The four strokes refer to intake, compression, combustion (power), and exhaust strokes that occur during two crankshaft rotations per working cycle of the gasoline engine and diesel engine. The cycle begins at Top Dead Center (TDC), when the piston is farthest away from the axis of the crankshaft. A stroke refers to the full travel of the piston from Top Dead Center (TDC) to Bottom Dead Center (BDC).

1.2 TYPES OF OILS:

There are two types of oils are there. They are

I.Edible oils
II.Non Edible oils

1.3 EDIBLE OILS:

The Edible oils is may be defined as the oils which is used for cooking purpose is known as Edible oils. Coconut oil, Corn oil, Cottonseed oil, Olive oil, Palm oil, Peanut oil or Ground nut oil, Rapeseed oil, Safflower oil, Soybean oil, Sunflower oil

1.4 NON EDIBLE OILS:

The Non Edible oils are may be defined as the oils which are not used for cooking purpose are known as Non Edible oils. Diesel, Petrol, Gasoline, Kerosene, Jetropha, Mahuva, Karanja, Neem, Ethanol etc.

2.0EXPERIMENTAL SETUP:

1)First we have checked all the electrical equipment's is perfectly or not before going to start the purification of crude oil. We arranged all the required equipment's before going to start to purify.
2)Now we have poured the 200 ml crude oil (Neem or Karanja) in the borosile flask and switch on the electrical automatic stove. We arranged the stove to 1000 c temperature continuously for to form the vapors of the crude oil.
3)At 1000 c the water present in the crude oil will be heated and becomes steam and escapes directly to the atmosphere, because the rubber cork are not closed for some time until the entire water vapours present in the crude oil is allows to escape.
4)The vapours which forms in the flask are allow passing through the neck of the flask. Now the rubber cork is closed, so the pure vapours of crude oil will escapes only through neck of the flask.
5)Now the vapour enters in to the burette and flows down and becomes pure liquid. The burette is arranged like that- The burette is inside the arranged manual condenser i.e. 2 liter plastic bottle which is filled with the cool water. So that the burette will become into chilled form, and some part of the burette is in the open air this allows becoming pure condensate liquid from vapor form.
6)The cooling water in the condenser will flows continuously with the help of motor, after every 20 minuets' the water will be changed because of to maintain perfect cooling effect.
7)At the end of the burette the pure condensate liquid is collected in the collecting tank.

A)Neem Crude Oil

Fig. 2.0. Neem crude oil

B)After Distillation The Pure Form Of Neem Oil

Fig.2.0Neem pure oil

C) Karanja Crude Oil **D) After Distillation the Pure Form of Karanja Oil**

Fig. 3.8 karanja crude oil

Fig.3.9. Karanja pure oil

2.1DISTILLATION PROCESS:

The fuel which is used (Karanja, Neem) to run the engine is not available in the pure form. The fuel (Karanja and Neem) is available in the crude form, so we have distilled these fuels and make it in to pure form by heating process. The Apparatus which we have used in this experimental setup to convert crude oil into pure form is arranged manually.

Fig.2.1. experimental setup, pump

These Apparatus are: Electric Automatic stove, 500 ml Borosile round flask, Burette, 2 liter plastic bottle, Motor, Rubber pipes, Solar plates, Rubber cork Flask stand.

2.2 EXPERIMENTAL SETUP AND PROCEDURE:

The experimental setup to test the performance of the Engine with cottonseed oil is shown in Figure2.2.1. The engine is rigidly fixed to engine bed by bolts and nuts. A surge tank is fixed to the stand and the air enters into the surge tank through air filter and passes through an orifice plate. The difference in water column in two legs of U-tube manometer gives the pressure drop across orifice plate. This pressure drop is used to calculate the mass flow rate of air.

The dynamometer used here is brake dynamometer. It has a brake drum connected to the crankshaft. A belt having two spring balances connected on each side of it, which runs over the brake drum. The difference in the spring balance readings gives the value of loading on the brake drum. Tightening the nuts of bolts connected to the two spring balances increases the load.

Fig2.2.1: kirloskar engine

Make	kirloskar
BHP& speed	5Hp& 1500rpm
Type of engine	Single cylinder, DI& 4S
Compression ratio	18.6:1
Bore & stroke	80mm&110mm
Method of loading	Belt break dynamometer
Method of starting	Manual cranking
Method of cooling	Water
Orifice Diameter	17mm
Type of Ignition	Compression Ignition
Inlet Valve Opening	4.5° before TDC
Inlet Valve Closing	35.5° after BDC
Exhaust Valve Opening	35.5° before BDC
Exhaust Valve Closing	4.5° after TDC
Nozzle Opening pressure	210 bar

2.3 PROCEDURE:

Decompress the engine by decompression lever provided on the engine head. Crank the engine slowly, with the help of handle provided and a certain proper Flow of fuel in to the pump and in turn through the nozzle in to engine cylinder. When the maximum speed is attained pull the decompression level down, now the Engine started. And allow cooling water in to the engine. Allow the engine to run and stabilize without any load before loading the engine Calculate the max at load engine. Maintain the engine speed to a derived fixed value say 1500. Note down the dead weight, spring balance reading and time taken for 10cc of fuel consumption .water inlet and outlet temperature, ambient temperature air inlet temperature and exhaust gas outlet from the engine and manometer reading in the tabular column. Load the engine gradually by placing the necessary dead weight on the weighing hangers say(0,2,4,6,8,10,12 and the engine full load) and repeat the same aloe the engine to stabilize on every load change. To stop the engine after the experiment is over push/pull the governor lever towards the engine cranking side. With the above permeates recorded at each step load the value are calculated for obtaining the efficiency

3.0 ENGINE PERFORMANCE PARAMETERS:

The engine performance is indicated by the term efficiency. Important engine efficiencies and other related engine performance parameters are given below,

1) Indicated thermal efficiency (η ith)
2) break thermal efficiency (η bth)
3) Mechanical efficiency (η m)
4) Volumetric efficiency (η vol)
5) Relative efficiency (η rel)
6) Mean effective pressure (MEP)
7) Specific fuel consumption (sfc)
8) Fuel ratio (A/F)
9) Calorific value of the fuel (Cv)

3.1EXPERIMENTAL RESULTS TABLES

Test –I: Table: DIESEL, KARANJI, NEEM Constant speed = 1500rpm

s.no	Load(kg)	Time taken for 10 cc of fuelconsumption (sec)	Manometer readings H1	H2	T1 °C	T2 °C	T4 °C	T6 °C	Mass flow rate of water (cc/sec)
1	0	90	9.3	3.2	27	35	95	27	40
2	2	73	9.3	3.2	27	36	102	27	40
3	4	67	9.3	3.2	27	39	120	27	40
4	6	54	9.3	3.2	27	40	129	27	40
5	8	48	9.3	3.2	27	42	152	27	40
6	10	41	9.3	3.2	27	42	162	27	40
7	12	34	9.3	3.2	27	43	175	27	40

s.no	Load(kg)	Time taken for 10 cc of fuelconsumption (sec)	Manometer readings H1	H2	T1 °C	T2 °C	T4 °C	T6 °C	Mass flow rate of water (cc/sec)
1	0	90	9.3	3.2	27	37	123	27	40
2	2	75	9.3	3.2	27	38	122	27	40
3	4	67	9.3	3.2	27	39	125	27	40
4	6	60	9.3	3.2	27	41	135	27	40
5	8	38	9.3	3.2	27	42	155	27	40
6	10	35	9.3	3.2	27	42	146	27	40
7	12	33	9.3	3.2	27	43	161	27	40

s.no	Load(kg)	Time taken for 10 cc of fuelconsumption (sec)	Manometer readings H1	H2	T1 °C	T2 °C	T4 °C	T6 °C	Mass flow rate of water (cc/sec)
1	0	74	9.3	3.2	27	39	129	27	40
2	2	54	9.3	3.2	27	39	127	27	40
3	4	50	9.3	3.2	27	40	127	27	40
4	6	43	9.3	3.2	27	41	132	27	40
5	8	38	9.3	3.2	27	41	141	27	40
6	10	33	9.3	3.2	27	43	151	27	40
7	12	30	9.3	3.2	27	44	164	27	40

Table 3.1: Performance Values In Diesel, Karanji, Neem Oils

TEST-I and TEST -II Averages:

Table=DIESEL, KARANJI, NEEM Constant speed=1500 rpm

s.no	Load(kg)	Time taken for 10 cc of fuelconsumption (sec)	Manometer readings		T_1 °C	T_2 °C	T_4 °C	T_5 °C	Mass flow rate of water (cc/sec)
			H_1	H_2					
1	0	91	9.3	3.2	28.5	38	109	28.5	40
2	2	74.5	9.3	3.2	28.5	38.5	113	28.5	40
3	4	66	9.3	3.2	28.5	40.5	123	28.5	40
4	6	55	9.3	3.2	28.5	41.5	131	28.5	40
5	8	48	9.3	3.2	28.5	43	149	28.5	40
6	10	41	9.3	3.2	28.5	44	163	28.5	40
7	12	36	9.3	3.2	28.5	45.5	176	28.5	40

3.2 SAMPLE CALCULATIONS:

For NEEM at 2kg load:

3.2.1 Heat balance sheet

Maximum load W_{MAX} $= (bhp*0.745*60*1000)/\ (2*\pi*r_n*N)$

$= (5*0.745*60*1000)/\ (2*\pi*0.116*1500)$

$= 14.2$ kgf

Torque (t) $= w*r_m*9.81$

$= 2*0.166*9.81$

$= 3.25$ N-M

Q_{BP} $= (2*\pi*N*T)/\ (60*1000)$

$= (2*3.141*1500*3.25)/\ (60*1000)$

$= 0.51$ kw

Fuel Consumption m_f $= \frac{\text{F.C in cc}}{\text{Time taken in sec}} * \text{Density} * \frac{3600}{1000}$

$= \frac{10*0.868}{63*1000}$

$= 1.377*10^{-4}$ kg/sec

Heat carried away by the engine jacket cooling water

Q_{CW} $= M_W*C_{PW}*(T_2-T_1)$

$= 0.04*4.18(12.5)$

$= 2.09$ kw

Density of air ρ_a $= \frac{P}{RT_A}$

$= \frac{101.32*10^3}{287*301.5}$

$= 1.170$ KG/M^3

h_a $= \frac{\Delta h * \rho_w}{\rho_a}$

$= \frac{6.1*1000*10^{-2}}{1.170} = 52.136$ m

Volume of air V $= \sqrt{2GH_a}$

$= \sqrt{2*9.81*52.136}$

$= 31.98$ m/sec

Volume of air V_A $= C_d*A_0*V$

$= 0.62*3.14*10^{-4}*31.98$

$= 6.22*10^{-3}$ m^3/sec

M_a $= \rho_a*V_A$

$= 1.170*6.22*10^{-3}$

$= 7.277*10^{-3}$ kg/sec

Specific heat of gas C_{PG} $= 1.0032$ kj/kg.k

Heat carried away by exhaust gas

Q_{ce} = $(M_f+M_a)\ C_{PG}\ (T_4-T_6)$
= $(1.377*10^{-4}+7.277*10^{-3})\ 1.0032\ (84.5)$
=0.73KW

Heat in put (Q_{in}) = $M_f * CV$
=$1.377*10^{-4} *35200$
=4.84KW

Heat carried away by unaccounted loss

Q_{un} = $Q_{in}-(Q_{b.p}+Q_{ce}+Q_{ce})$
=4.84-(0.51+0.73+2.09)
=1.51kw

% $Q_{b.p}$ = $\frac{Q_{b.p}}{Q_{in}}$
= $\frac{0.51}{4.84}$ =10

3.2.2 Volumetric efficiency and air fuel ratio

Volumetric efficiency (η_{vol}) = $\frac{\text{(volume of air admitted pe}}{\text{Swept volume}}$

Volume of air admitted per stroke = (v_a)/ stroke/sec
= $\frac{6.22*10^{-3}m^3/sec}{12.5}$
= $4.976*10^{-4}$ m^3/sec

Swept volume = $\frac{\pi d^2}{4} \times L$
= $\frac{\pi\ (0.08)^2}{4} \times 0.11$
=$5.529*10^{-4}$ m^3/sec

(η_{vol}) = $\frac{4.976*10^{-4}}{5.529*10^{-4}} \times 100$
= 89%

Air fuel ratio A/F = m_a
= $\frac{7.277*10^{-4}}{1.377*10^{-4}}$
=52.8

3.2.3Performance test:

B.P =0.51kw
m_f =0.496kg/hr

Indicated power (I.P) =B.P +F.P
=0.51+2
=2.51 kW

Break specific fuel consumption (B_{sfc}) = $\frac{mf}{B.P}$
= $\frac{0.496}{0.51}$
=0.972 kg/kw/hr

Indicated specific fuel consumption (I_{sfc})= $\frac{m_f}{I.P}$
= $\frac{0.496}{2.51}$
= 0.197 kg/kw/hr

η_{bth} $= \frac{B.P * 3600}{m_f * CV}$

$= \frac{0.51 * 3600}{0.496 * 35200}$

$= 0.105$

$= 10.5\ \%$

η_{mec} $= \frac{B.P \times 100}{I.P}$

$= \frac{0.51 \times 100}{2}$

$= 20.31\ \%$

η_{ith} $= \frac{I.P * 3600 * 100}{Mf * CV}$

$= \frac{2 * 3600 * 100}{0.496 * 35200}$

$= 51.75\ \%$

3.3 HEAT BALANCE SHEET OF DIESEL

m_f	Q_{in}	$\%_{in}$	$Q_{b.p}$	$\%Q_{b.p}$	Q_{cw}	$\%Q_{Cw}$	Q_{cg}	$\%Q_{cg}$	Q_{un}	$\%Q_{un}$	A/F
$9.12*10^{-5}$	4.002	100	0	0	1.58	39.4	0.59	14.7	1.832	45.77	79.71
$1.11*10^{-4}$	4.871	100	0.51	10.47	1.67	34.2	0.62	12.7	2.071	42.51	63.77
$1.25*10^{-4}$	5.48	100	1.02	18.61	2.00	36.49	0.70	12.7	1.76	32.11	58.16
$1.50*10^{-4}$	6.58	100	1.53	23.5	2.16	32.97	0.76	11.5	2.12	32.21	48.46
$1.72*10^{-4}$	7.54	100	2.04	27.05	2.43	32.07	0.89	11.8	2.32	30.76	42.25
$2.02*10^{-4}$	8.86	100	2.55	28.78	2.59	29.23	1.00	11.2	2.72	30.69	35.99
$2.30*10^{-4}$	10.09	100	3.06	30.32	2.84	28.14	1.11	11.0	3.08	30.52	31.60

3.4HEAT BALANCE SHEET OF KARANJI

m_f	Q_{in}	$\%_{in}$	$Q_{b.p}$	$\%Q_{b.p}$	Q_{cw}	$\%Q_{Cw}$	Q_{cg}	$\%Q_{cg}$	Q_{un}	$\%Q_{un}$	A/F
$1.03*10^{-4}$	3.519	100	0	0	1.83	52.0	0.7	20.17	0.979	27.82	70.30
$1.21*10^{-4}$	4.114	100	0.51	12.39	1.92	46.6	0.6	16.77	0.994	24.16	60.14
$1.41*10^{-4}$	4.80	100	1.02	21.25	2.09	37.94	0.7	15	0.97	20.20	51.53
$1.62*10^{-4}$	5.508	100	1.53	27.77	2.34	31.76	0.8	14.32	0.84	15.25	44.91
$2.16*10^{-4}$	7.36	100	2.04	27.69	2.59	35.15	0.9	12.2	1.83	24.84	33.58
$2.51*10^{-4}$	8.856	100	2.55	29.78	2.67	31.18	0.9	10.86	2.411	28.16	28.89
$2.55*10^{-4}$	8.68	100	3.06	35.25	2.84	32.71	1.1	11.6	1.77	20.39	28.50

3.5HEAT BALANCE SHEET OF NEEM

m_f	Q_{in}	$\%_{in}$	$Q_{b.p}$	$\%Q_{b.p}$	Q_{cw}	$\%Q_{Cw}$	Q_{cg}	$\%Q_{cg}$	Q_{un}	$\%Q_{un}$	A/F
$1.05*10^{-4}$	3.72	100	0	0	2.09	56	0.7	20.17	0.88	23	68.78
$1.37*10^{-4}$	4.84	100	0.51	10	2.09	43	0.7	15	1.51	31	52.84
$1.57*10^{-4}$	5.55	100	1.02	18	2.25	40	0.7	13	1.54	27	46.11
$1.84*10^{-4}$	6.49	100	1.53	23	2.42	37	0.8	12.1	1.75	26	39.42
$2.11*10^{-4}$	7.45	100	2.04	27	2.50	33	0.9	11.5	2.05	27	37.37
$2.44*10^{-4}$	8.60	100	2.55	29	2.84	33	0.9	11	2.26	26	29.76
$2.59*10^{-4}$	9.12	100	3.06	33	2.92	32	1.0	11.1	2.75	30	28.08

4.0 VOLUMETRIC EFFICIENCY AND AIR FUEL RATIO

S.No	Speed (Rpm)	Load (Kg)	Diesel		Karanji		Neem	
			$\%H_{vol}$	A/F	$\%H_{vol}$	A/F	$\%H_{vol}$	A/F
1	1500	0	89	79.79	89	70.30	89	68.78
2	1500	2	89	65.32	89	60.14	89	52.8
3	1500	4	89	57.89	89	51.5	89	46.11
4	1500	6	89	48.22	89	44.5	89	39.42
5	1500	8	89	42.95	89	33.58	89	34.48
6	1500	10	89	35.95	89	28.9	89	29.34
7	1500	12	89	31.57	89	28.20	89	27.66

4.1 PERFORMANCE TEST ON DIESEL

Speed = 1500 rpm Fuel consumption = 10 cc Friction power = 2.4 kW

s.no	Load Kg	B.P kw	m_f kg/h	I.P kw	η_{mec} %	η_{bth} %	η_{ith} %	imep kn/m^2	bmep kn/m^2	Isfc Kg/kw /h	bsfc Kg/kw /h
1	0	0	0.328	2.4	0	0	60	347	0	0.136	-
2	2	0.51	0.401	2.91	17.52	10.4	59.5	421	73.91	0.167	0.786
3	4	1.02	0.452	3.42	29.85	18.5	62.0	495	147.9	0.188	0.442
4	6	1.53	0.543	3.90	39.30	23.1	58.0	565	222.1	0.226	0.354
5	8	2.04	0.622	4.44	46.01	26.9	58.5	643	296.0	0.259	0.304
6	10	2.55	0.728	4.95	51.59	28.7	55.7	717	370.1	0.303	0.285
7	12	3.06	0.830	5.46	56.15	30.2	53.9	791	444.3	0.345	0.271

4.2 PERFORMANCE TEST ON KAANJI

Speed = 1500 rpm Fuel consumption = 10 cc Friction power = 2.4 kW

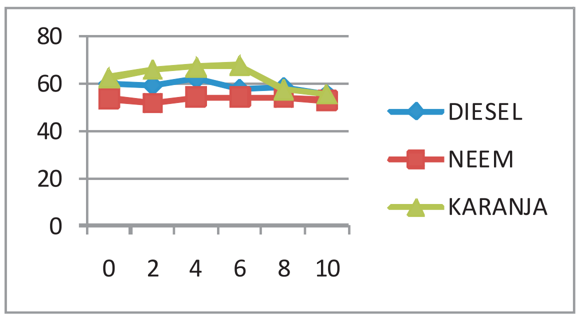
s.no	Load Kg	B.P kw	m_f kg/h	I.P kw	η_{mec} %	η_{bth} %	η_{ith} %	imep kn/m^2	bmep kn/m^2	isfc Kg/kw /h	bsfc Kg/kw /h
1	0	0	0.381	2	0	0	53.6	289	0	0.190	-
2	2	0.51	0.496	2.51	20.31	10.5	51.7	363	73.91	0.197	0.972
3	4	1.02	0.567	3.02	33.79	18.3	54.3	437	147.9	0.188	0.556
4	6	1.53	0.664	3.53	43.3	23.6	54.4	512	222.1	0.187	0.433
5	8	2.04	0.762	4.04	50.53	27.4	54.2	585	296.0	0.188	0.372
6	10	2.55	0.880	4.54	56.08	29.6	52.9	660	370.1	0.193	0.344
7	12	3.06	0.880	5.06	60.05	35.6	58.8	734	444.3	0.173	0.287

4.3 PERFORMANCE TEST ON NEEM

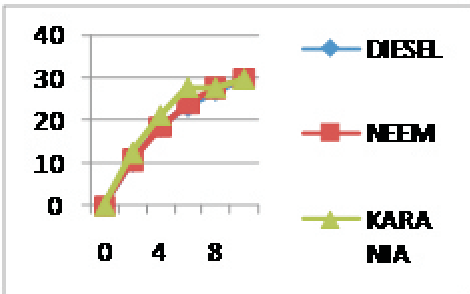
Speed = 1500 rpm   Fuel consumption = 10 cc Friction power = 2.4 kW

s.no	Load Kg	B.P kw	m_f kg/h	I.P kw	η_{mec} %	η_{bth} %	η_{ith} %	imep kn/m^2	bmep kn/m^2	isfc Kg/kw /h	bsfc Kg/kw /h
1	0	0	0.381	2	0	0	53.6	289	0	0.190	-
2	2	0.51	0.496	2.51	20.31	10.5	51.7	363	73.91	0.197	0.972
3	4	1.02	0.567	3.02	33.79	18.3	54.3	437	147.9	0.188	0.556
4	6	1.53	0.664	3.53	43.3	23.6	54.4	512	222.1	0.187	0.433
5	8	2.04	0.762	4.04	50.53	27.4	54.2	585	296.0	0.188	0.372
6	10	2.55	0.880	4.54	56.08	29.6	52.9	660	370.1	0.193	0.344
7	12	3.06	0.880	5.06	60.05	35.6	58.8	734	444.3	0.173	0.287

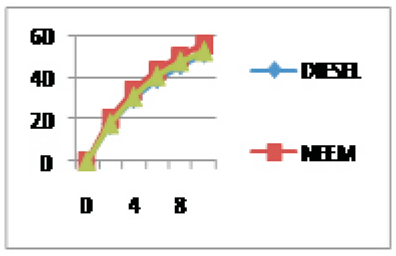
5. GRAPHICAL REPRESENTATION OF FUEL PERFORMANCE:



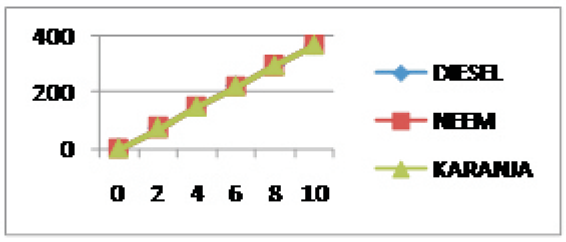
Break thermal Efficiency vs. Load



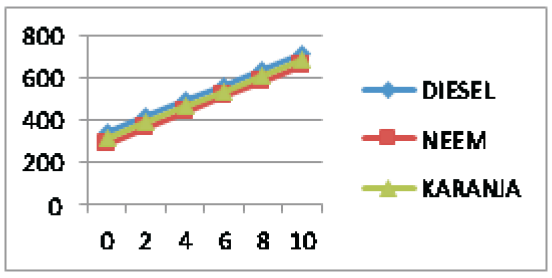
Indicated thermal efficiency Vs. load



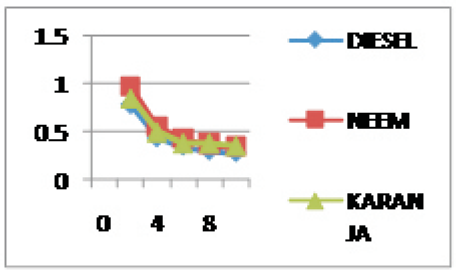
Mechanical Efficiency Vs. Load



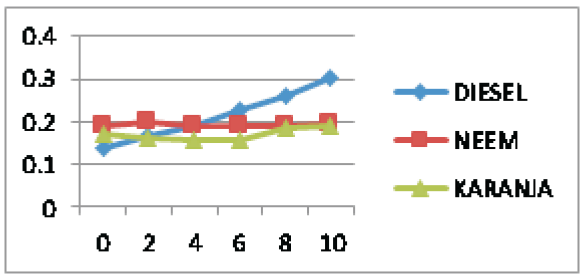
Break Mean Effective pressure Vs. Load



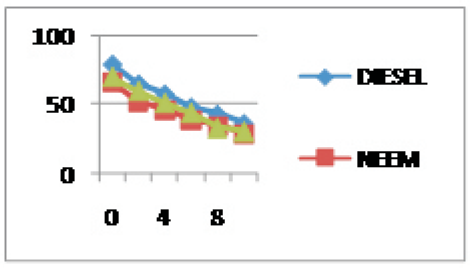
Indicated Mean Effective Pressure vs. Load



Break Specific Fuel Consumption vs. Load



Indicated Specific Fuel Consumption vs. Load



Air Fuel Ratio vs. Load

6.0 CONCLUSION:

We have concluded that the usage of conventional fuel like petrol, diesel, gas exceed rapidly. If this situation is continued for some decades the conventional fuels will wiped off from the earth crest. So here we replaced the alternate fuels like karanja and neem oil in the place of conventional fuels. By using the fuels- Karanja, Neem and Diesel we run the engine and have taken three different calculations. By comparing these three different performance calculations the neem oil has got higher efficiency than another two. By using the bio fuels the organic compounds presented in the exhaust gases will be reduced. So that we can reduce the weather pollution and global warming. Researches has been conducted on this and also both central and state government authorities have to give enough encouragement to the people who are interested in the field of the production of Karanja, Neem trees by giving subsidies, bank loans etc.. If the production rate increases the cost will also come down, so it can meet our demands in future.

Finally we have concluded and suggested that the bio fuels also will give the better performances than the conventional fuels. So we can replace the bio fuels in the place of conventional fuels.

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