AN INVESTIGATION ON THE PERFORMANCE OF DIESEL ENGINE USING KARANJA OIL DIESEL BLENDS

Shubham Pandey[1], Prof. Amol Tripathi[2]

[1]M.Tech, Student, (Thermal Engineering) Department of Mechanical Engineering, Rewa Institute of Technology, Rewa (M.P), India
[2]Assistant professor, Department of Mechanical Engineering, Rewa institute of Technology, Rewa (M.P), India

---

Abstract - *In this paper, we are studying an investigation into the effect of biodiesel blending on emissions and efficiency in a non-road diesel engine. Rapeseed based biodiesel blended in increments of 25% with fossil diesel. The emissions of CO_2 show a decrease in emission (g/kwh) with increased engine load. Within the range of tests carried out, the NOx emissions from the biodiesel and its blends proved to be higher than those of petro-diesel fuel. Furthermore; in this study, a correlation was found relating the NOx emissions and the flame temperature. The efficiency of the system is improved with increased biodiesel content in the fuel. As predicted, the results for CHP show a considerable improvement to the overall efficiency.*

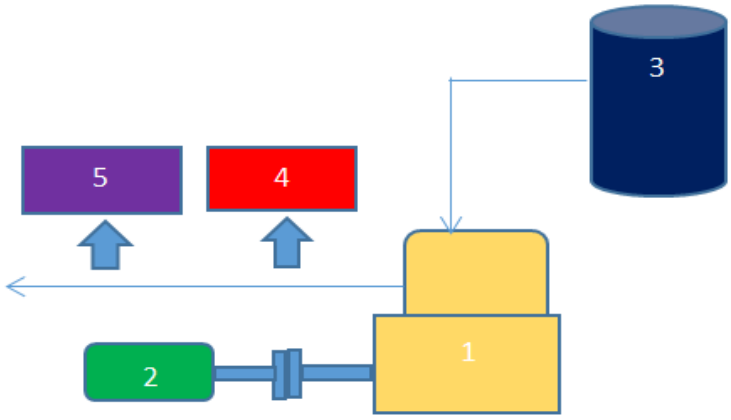
Keywords: - Biodiesel combustion, biodiesel blending, greenhouse gas emissions, alternative fuels, renewable energy combined heat and power.

1. INTRODUCTION

Biodiesel is a fatty acid ethyl or methyl ester and has properties similar to petroleum diesel fuels. Firstly, we are extracting oil from karanja seeds by means of hydraulic press and then preparing blends through chemical reactions of transesterification and esterification. This process involves oils being reacted with short-chained alcohol.

We are making blends in the form of B25 (B represents biodiesel and 25 means 25% oil and remaining 75% of diesel), B30, B35, B40, B45 and B00 as pure diesel.

2. Experimental Setup



1. Engine 2) dynamometer 3)fuel tank(B-d) 4) Ex. Analyser 5) smoke meter 6) exhaust flow

Fig 1 shows experimental setup on trial conducting on bio diesel. The blends of 5% Biodiesel with 95% diesel fuel,10% biodiesel with 95% diesel fuel.15% biodiesel with 85% diesel fuel and 20% biodiesel with 80% diesel fuel were used to conduct test on single cylinder four stroke water cooled diesel engine.

Specification: Make: Kirlosker Modal: TV1 water-cooled

Power: 8HP at 1500RPM Stroke: 110mm Bore 87.5mm

Volume: 661 cc Compression ratio: 1:17.

3. Results and Discussion

The following results are tabulated for **Pure Diesel (B00)** at different loads such as 0,3,6,9 and 12 in kg.

Sr.no.	Load(Kg)	Torque(Kg)	BP(KW)	IP(KW)	BMEP(Bar)	
1	0	0.00	0.00	2.90	0.00	
2	3	5.44	0.865	3.766	0.041	
3	6	10.899	1.7038	4.5981	0.08344	
4	9	16.33365	2.49599	5.4387	0.12816	
5	12	21.77820	3.35079	6.278	0.16972	
Sr. no.	**IMEP(Bar)**	**A/F Ratio**	**BSFC(KG/KWh)**	**BT EFFI**	**MECH EFFI**	**VOL EFFI**
1	0.25111	70.79071	0.00	0.00	0.00	84.734
2	0.35684	51.51096	0.67870	0.1339	22.99	86.33
3	0.45340	40.60807	0.43357	0.2209	36.93	86.87
4	0.53990	35.65690	0.34033	0.2671	46.67	86.55
5	0.625	28.895	0.194	0.467	53.80	86.11

Result table for Biodiesel (B25):-

Sr.no.	Load(Kg)	Torque(Nm)	BP(KW)	IP(KW)	BMEP(bar)
1	0	0.000	0.000	2.3	0.000
2	3	5.444	0.863	3.163	0.082
3	6	10.889	1.709	4.009	0.166
4	9	16.333	2.521	4.821	0.253
5	12	21.778	3.350	5.650	0.339

Sr. no	IMEP (bar)	BSFC (kg/kwh)	BT EFFI.	MECH EFFI.	VOL. EFFI.
1	0.206	0.000	0.000	0.000	84.684
2	0.301	0.650	0.131	27.292	86.616
3	0.390	0.401	0.213	42.637	86.890
4	0.485	0.329	0.259	52.298	87.143
5	0.572	0.306	0.278	59.297	86.822

Result table for Biodiesel (B30):-

Sr.no.	Load(Kg)	Torque(Nm)	BP(KW)	IP(KW)	BMEP(bar)
1	0	0.00000	0.00000	2.55000	0.00000
2	3	5.44455	0.86334	3.41334	0.08234
3	6	10.88910	1.71414	4.26415	0.16589
4	9	16.33365	2.53873	5.08874	0.25201
5	12	21.77820	3.35079	5.90079	0.33945

Sr. no	IMEP (bar)	BSFC (kg/kwh)	BT EFFI.	MECH EFFI.	VOL.EFFI.
1	0.222	0.00000	0.000	0.00000	86.13695
2	0.325	0.68550	0.125	25.29316	87.20002
3	0.412	0.43710	0.196	40.19906	87.83800
4	0.505	0.35768	0.239	49.88935	87.76768
5	0.597	0.33012	0.259	56.78547	87.44027

RESULT TABLE FOR BIODIESEL (B35):-

Sr.no.	Load(Kg)	Torque(Nm)	BP(KW)	IP(KW)	BMEP(bar)
1	0	0.00000	0.00000	2.95000	0.00000
2	3	5.44455	0.86334	3.81334	0.08234
3	6	10.8891	1.69249	4.64249	0.16801
4	9	16.3336	2.52164	5.47164	0.25372
5	12	21.7782	3.34851	6.29851	0.33968

Sr. no	IMEP (bar)	BSFC (kg/kwh)	BT EFFI.	MECH EFFI.	VOL.EFFI.
1	0.263	0.000	0.000	0.000	86.58077
2	0.363	0.706	0.122	22.640	87.77965
3	0.460	0.439	0.197	36.456	88.366
4	0.550	0.358	0.241	46.085	87.755
5	0.638	0.327	0.264	53.163	88.113

RESULT TABLE FOR BIODIESEL (B40):-

Sr.no.	Load(Kg)	Torque(Nm)	BP(KW)	IP(KW)	BMEP(bar)
1	0	0.00000	0.00000	2.95000	0.00000
2	3	5.44455	0.85764	3.80764	0.08289
3	6	10.88910	1.69705	4.64705	0.16756
4	9	16.33365	2.52164	5.47164	0.25372
5	12	21.77820	3.34851	6.29851	0.33968

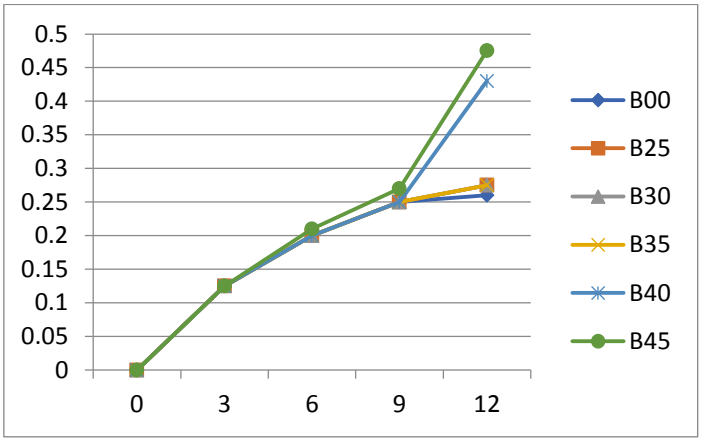
Sr. no	IMEP (bar)	BSFC (kg/kwh)	BT EFFI.	MECH EFFI.	VOL.EFFI.
1	0.258	0.000	0.00	0.000	85.268
2	0.368	0.688	0.129	22.526	88.362
3	0.458	0.450	0.195	36.518	86.930
4	0.550	0.357	0.24	46.085	87.755
5	0.638	0.230	0.38	53.163	87.499

RESULT TABLE FOR BIODIESEL (B45):-

Sr.no.	Load(Kg)	Torque(Nm)	BP(KW)	IP(KW)	BMEP(bar)
1	0	0.000	0.0000	3.10000	0.000
2	3	5.444	0.865	3.96505	0.082
3	6	10.889	1.703	4.80389	0.166
4	9	16.333	2.495	5.59600	0.2563
5	12	21.778	3.350	6.45079	0.339

Sr. no	IMEP (bar)	BSFC (kg/kwh)	BT EFFI.	MECH EFFI.	VOL.EFFI.
1	0.277	0.000	0.000	0.000	85.587
2	0.376	0.678	0.133	21.816	87.027
3	0.470	0.433	0.209	35.468	87.775
4	0.574	0.340	0.267	44.603	88.657
5	0.653	0.194	0.467	51.943	88.053

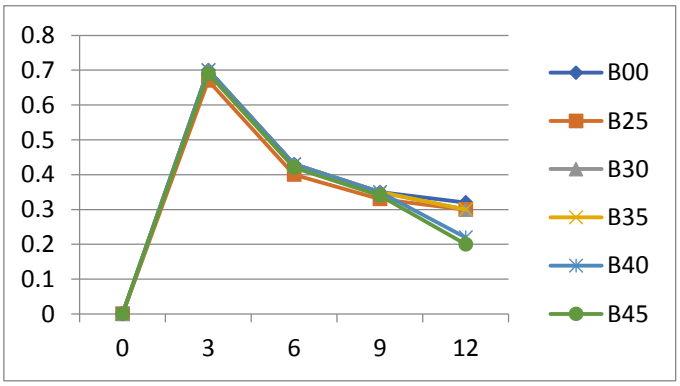
Brake Thermal Efficiency (BTE)



x axis : BTE (%) y axis : LOAD (Kg)

Figure 1 -Variation of brake thermal efficiency with load

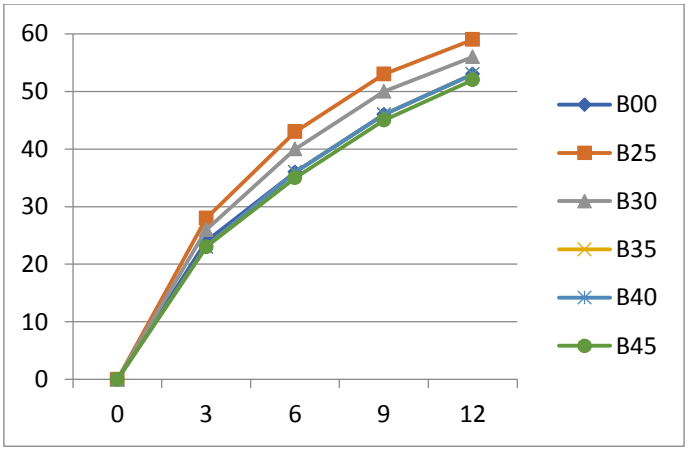
Brake Specific Fuel Consumption (BSFC)



x axis : BSFC (Kg/KWh) y axis : LOAD (Kg)

Figure 2 -Variation of brake specific fuel consumption with load

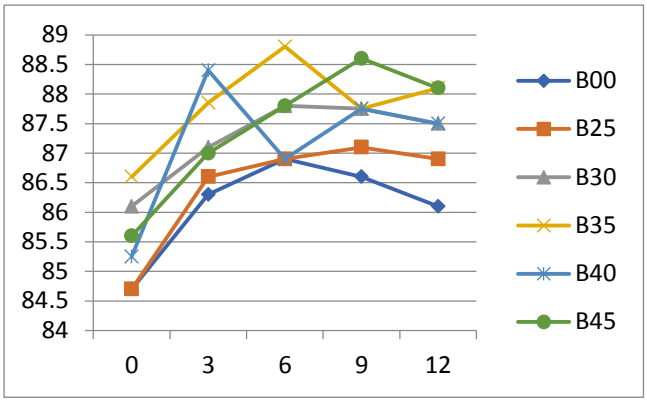
Mechanical Efficiency



x axis : MECH. EFFI. (%) y axis : LOAD (Kg)

Figure 3– Variation of mechanical efficiency with load

Volumetric Efficiency



x axis : VOL. EFFI. (%) y axis : LOAD (Kg)

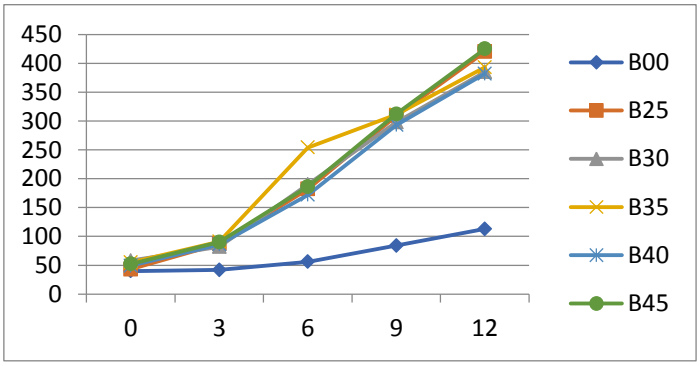
Figure 4– Variation of Volumetric efficiency with load

Emission Parameters

As per procedure of experiment, following readings about emissions are taken for various Biodiesel blends.

Table – Emission table for Nitrogen Oxide (ppm)

S.NO.	LOAD (Kg)	B00	B25	B30	B35	B40	B45
1	0	40	43	58	55	49	52
2	3	42	87	82	91	86	90
3	6	56	182	190	354	172	186
4	9	84	309	298	311	293	312
5	12	113	420	385	393	382	425

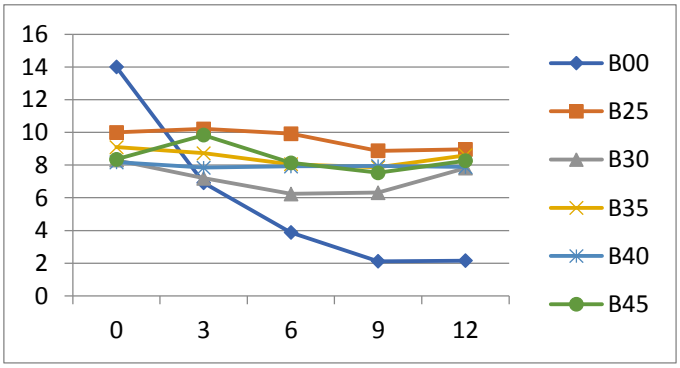


x axis : NO (ppm) y axis : LOAD (Kg)

Figure 5 – Variation of Nitrogen Oxide emission with load

Table – Emission table for Hydrocarbons (ppm)

SR. NO.	LOAD (Kg)	B00	B25	B30	B35	B40	B45
1	0	14.0	10.0	8.30	9.10	8.18	8.35
2	3	6.91	10.21	7.20	8.72	7.84	9.83
3	6	3.88	9.92	6.24	8.05	7.92	8.14
4	9	2.12	8.87	6.32	7.86	7.94	7.53
5	12	2.16	8.96	7.81	8.60	7.88	8.26

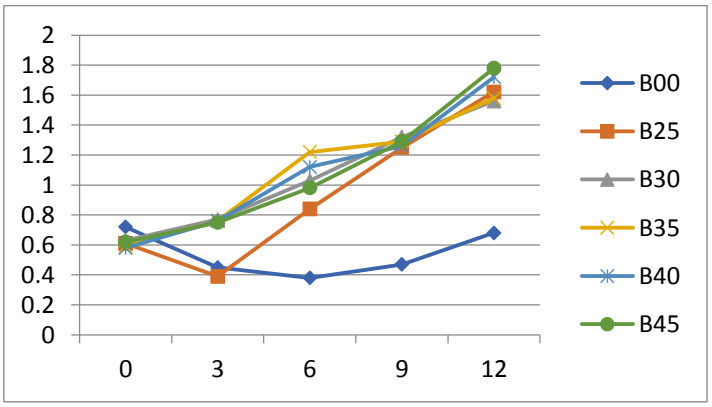


x axis : HC (ppm) y axis : LOAD (Kg)

Figure 6– Variation of hydrocarbon emission with load

Table – Emission table for Carbon Dioxide (%)

SR. NO.	LOAD (Kg)	B00	B25	B30	B35	B40	B45
1	0	0.72	0.61	0.63	0.59	0.58	0.62
2	3	0.45	0.39	0.77	0.76	0.76	0.75
3	6	0.38	0.84	1.03	1.22	1.12	0.98
4	9	0.47	1.5	1.32	1.29	1.26	1.29
5	12	0.68	1.62	1.56	1.58	1.72	1.78



x axis : CO2 (%) y axis : LOAD (Kg)

Figure 7–Variation of carbon dioxide emission with load

CONCLUSIONS

Karanja methyl ester seems to have a potential to use as alternative fuel in diesel engines. Blending with diesel increases the viscosity considerably. The following results are made from the experimental study:-

i. The brake thermal efficiency of the engine with karanja methyl ester diesel blend B45 was approximately same to the diesel fuel.

ii. Brake specific fuel consumption is lower for B25, B30 Blends then diesel as 2.374% and 9.012% respectively.

iii. The mechanical efficiency achieved with B25 and B30 is higher than diesel at lower loading conditions as 11.628 and 6.821% respectively.

iv. The emission characteristics are higher than pure diesel but the B25 and B30 has relatively better performance with respect to other blends.

v. B25 and B30 can be accepted as a suitable fuel for use in standard diesel engines.

References

[1] Agarwal Avinash Kumar, "Biofuels (alcohols and diesel) applications as fuels for Internal combustion Engines", progress in energy and combustion science 33(2007)/pp.233-271.

[2] Vivek and A.K Gupta, "Biodiesel production from karanja oil", journal of scientific & industrial research, vol.63 (January 2004)/pp.39-47.

[3] Sahoo P.K and Das L.M., "Combustion analysis of jatropha, karanja and polanga Based Biodiesel as fuel in diesel engine", fuel 88(2009)/pp.994-999

[4] Singh R.K., Kiran Kumar A., Sethi S., "Preparation of karanja oil methyl ester", published in Offshore World (April-May 2006)/pp1-7.

[5] Ganesan. V, Internal combustion engine, TMH publications, ISBN 10:0-07-0648172008)/pp.27-33.