Exhaust gas Emission Revelations During the Study of Performance of Pongamia oil as Bio diesel

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Abstract

The use of bio diesel is becoming increasingly popular these days because of its low environmental impact and its potential as a green alternative fuel in an SI engine. The aim of this study is the use of Pongamia oil as an alternative fuel in an SI engine. Various proportions of diesel and Pongamia oil are prepared by the process Transesterification process and used as fuel in four stroke SI engine. The main aim is to study the exhaust emissions and performance of these fuels and compare with the standard engine.

***Keywords**: Bio diesel, Pongamia oil, Transesterification, exhaust emissions.*

1. Introduction

Pongamia oil is a non edible oil extracted from seeds of Pongamia pinnata Pierre, family Fabaceae popularly known as 'Karach', 'Karanja' in Assam. It is a hardy tree of 12-15 meter in height, branches spread into hemispherical crown of dense green leaves and native of the Asian sub-continent. It grows all over India from the cost line to the hilly slopes. In North East India it grows up to an elevation of ± 600 meter. It can be grown in different types of flood free soil and matured tree withstand water lodging. Pongamia grows very well along water ways. Its propagation is by direct seedlings or by planting nursery raised seedlings. Propagation by branch cuttings and root suckers is also possible .Its seeds can immediately be sown after removing from matured pods and start germination after 7 days of sowing and cent percent seeds germinate. Seeds may be stored for a year without removing from pods and when removed they may be stored in an airtight box for delayed sowing. Fruits setting of Pongamia starts from fifth year onwards of plantation. It flowers in April-May and fruits mature in January-February. Each pod bears single seed and average fresh weight of a matured seed is 1.2 gm. From 5th year onward of plantation it starts flowering and fruiting. Commercial productions of seeds start from 10 years onwards of plantation and a full-grown tree may yields up to100 kg. Or even more fresh seeds per annum up to 60-70 years. In North East India cattle do not browse Pongamia though in other parts of the country its leaves are used as fodder. It is very easy to grow and needs little care, though till today 'karach' is a much ignored tree.

Pongamia Pinnata (Honge) is one of the forest based tree borne non- edible oil with a production potential of 135,000 metric tons per year in India. It is capable of growing in all types of lands (sandy and Rocky). It grows even in salt water and can withstand extreme weather conditions with a temperature range of 0-50°C. And annual rainfall of 5-25 dm. The oil content is around 30-40%. It is a fast growing medium sized tree which grows to height of around 40ft. flowers are pink, light purple, or white. Pods are elliptical, 3-6cm long and 2-3 cm wide thick walled and usually contains a single seed. Seeds are 10-15 mm long, oblong and light brown in colour. A thick yellow-orange to brown non edible oil is extracted from the seeds. Usually this is used for tanning leather, soap and as illuminating oil. It is also used as a lubricant, water paint binder, and a pesticide. In the recent days this oil has been tried as a fuel in diesel engines showing good thermal efficiency which is comparable with diesel. Since the high viscosity of Pongamia oil poses problems in pumping,

atomization etc it is very essential to reduce the viscosity by transesterification.

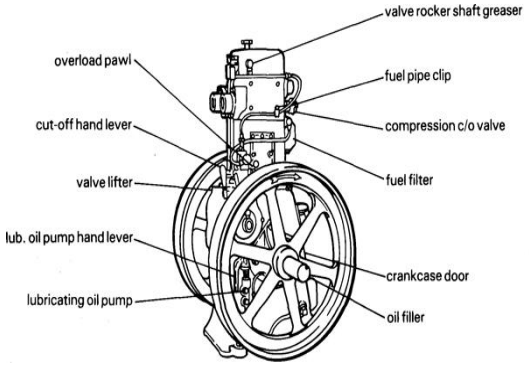


Fig 1. Single Cylinder Diesel Engine

2. Experimental Set-up

Diesel fuel and ethanol were obtained from local commercial markets. Biodiesel was prepared from raw Pongamia oil by following a two step acid-base catalyst transesterification reaction. A comparison was made between the exhaust emissions of diesel and bio diesel at various loads. The percentage emissions of NOx, smoke were found and also the emissions of HC and CO in ppm were noted. The compression ratio of any engine is the vale that represents the ratio of volume of its compression chamber from its largest capacity to its smallest capacity.

Different sets of loads were at taken at various Compression Ratio (CR) values. The readings are listed below in the following tables.

The exhaust gas analyser used was AVL Digas 2200.

Engine Specifications

Engine Type	Single Cylinder, Four Stroke, Direct Injection, Water Cooled
Speed	1500rpm
BoreXStroke	80X110mm
Compression Ratio	18.5:1
Rated Power Output	3.8KW@1500rpm

The Performance test is conducted on a computerized single cylinder, four stroke, direct injection, water cooled diesel engine test rig. An engine indicator is fitted in control panel which 755 senses pressure and crank angle data interfaces with computer .Digital display of speed in RPM is indicated on engine indicator .The engine indicator is connected to COM port of computer. The engine and dynamometer were interfaced to a control panel, which is connected to a computer. Performance analysis software Engine soft version 2.4, supplied by test rig supplier "Apex Innovations Pvt. Ltd." was used for recording the test parameters such as fuel flow rate, air flow rate, temperatures, load etc and for evaluating the performance characteristics such as brake thermal efficiency, brake specific fuel consumption, mechanical efficiency , volumetric efficiency etc. The calorific value and density of the particular fuel was fed to the software for calculating the above said parameters.

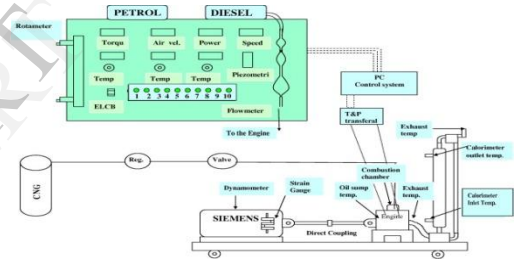


Fig 2. Single cylinder 4 stroke Diesel Engine

3. Exhaust emissions for diesel engine

Following were the readings for the exhaust gases that were obtained from Bio diesel. A comparison was made with the values obtained from diesel.

The following observations were made at different brake power values and different values of Compression Ratio. Graphs were plotted with Brake power on the X-axis and emissions on Y-axis.

Table 1. Compression Ratio 12

	Brake power			
	1.8	2.2	3.5	4.6
CO (%)	0.04	0.03	0.05	0.06
HC (ppm)	11	10	9	13
NO(ppm)	92	117	200	263
Smoke(%)	1.1	10.8	74.2	30.4

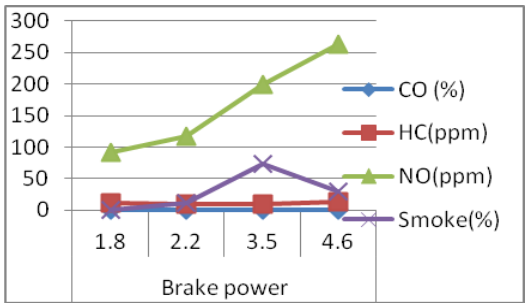


Table 2. Compression ratio 14

	Brake power			
	1.8	2.2	3.5	4.6
CO (%)	0.06	0.04	0.06	0.08
HC(ppm)	25	12	10	28
NO(ppm)	75	110	140	259
Smoke(%)	2.8	22.3	10	63.8

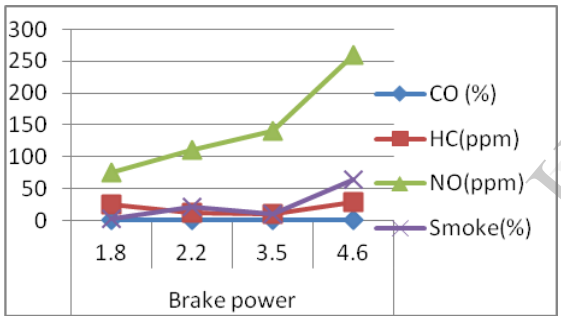


Table 3. Compression ratio 16

	Brake power			
	1.8	2.2	3.5	4.6
CO (%)	0.08	0.06	0.03	0.08
HC(ppm)	29	21	17	22
NO(ppm)	86	106	149	258
Smoke(%)	1.7	47.3	12.5	3.3

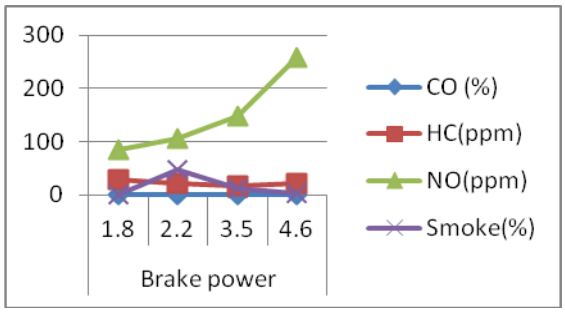
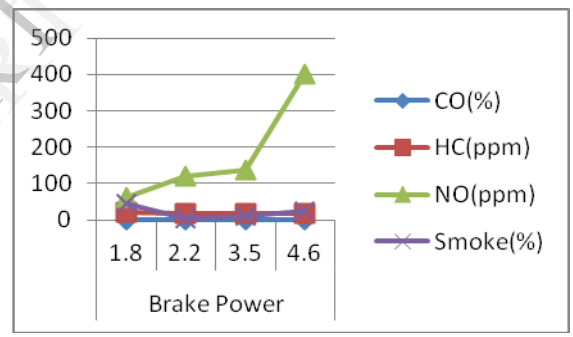


Table 4. Compression ratio 18

	Brake Power			
	1.8	2.2	3.5	4.6
CO(%)	0.07	0.05	0.06	0.08
HC(ppm)	20	18	17	19
NO(ppm)	61	121	138	400
Smoke(%)	45.1	4.6	9.4	24.4



4. Exhaust emissions for bio-diesel

Following were the values obtained for bio diesel at different compression ratio values at different load conditions.

Table 5. Compression ratio 12

	Brake Power			
	1.8	2.2	3.5	4.6
CO(%)	0.04	0.03	0.06	0.08
HC(ppm)	14	11	10	13
NO(ppm)	93	116	118	264
Smoke(%)	1.2	10.9	75	30.5

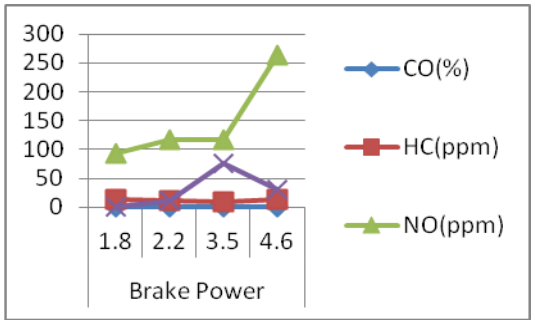


Table 6. Compression ratio 14

	Brake Power			
	1.8	2.2	3.5	4.6
CO(%)	0.06	0.04	0.05	0.07
HC(ppm)	23	14	12	22
NO(ppm)	74	111	142	260
Smoke(%)	2.9	22.5	10.2	62.9

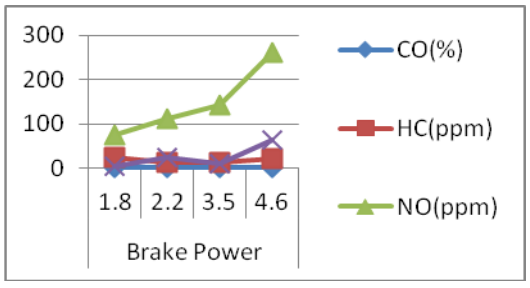


Table 7. Compression ratio 16

	Brake power			
	1.8	2.2	3.5	4.6
CO(%)	0.07	0.06	0.04	0.08
HC(ppm)	30	24	20	28
NO(ppm)	87	105	148	260
Smoke(%)	1.8	48	12.6	3.6

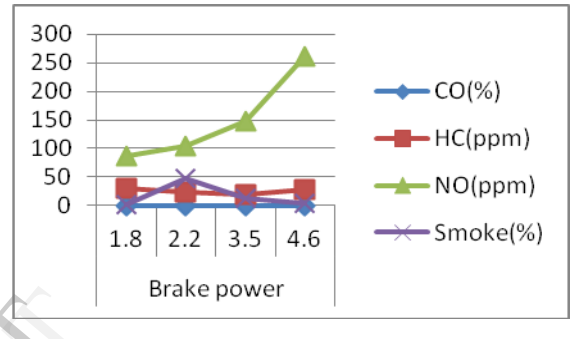
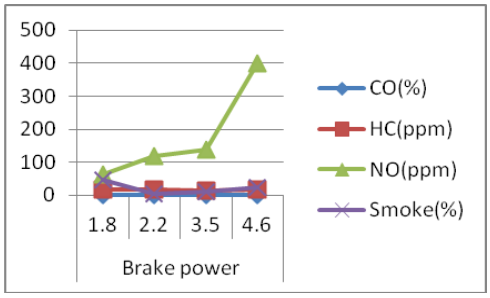


Table 8. Compression ratio 18

	Brake power			
	1.8	2.2	3.5	4.6
CO(%)	0.07	0.05	0.06	0.08
HC(ppm)	19	17	15	18
NO(ppm)	63	120	137	398
Smoke(%)	45.8	4.5	9.6	23.9



5. Conclusion

From the above readings, it is noted that at higher Brake Power values and higher load values, the emissions of smoke, NOx, HC and CO increase in diesel when compared to bio-diesel. At lower load values, the difference in emission values is only marginal but these values can be further improved hence reducing the emission of these exhaust gases.

6. References

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