OPTIMISING THE COMPRESSION RATIO FOR A MAHUA FUELLED C.I. ENGINE

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ABSTRACT

Experimental investigations were carried out on a single cylinder variable compression ratio C.I engine using neat Mahua oil as the fuel. Both the performance and exhaust analysis were carried out to find the best suited compression ratio. Tests have been carried out at 7 different compression ratios viz.13.2, 13.9, 14.8, 15.7, 16.9, 18.1 and 20.2. All the experiments were carried out at standard test conditions like 70^{0}c cooling water temperature and at constant speed of 1500 rpm. The results shows that 15.7 is the best compression ratio with Mahua oil. All the results were obtained without any modifications on either engine side or fuel side.

Keywords: mahua oil, variable compression ratio, c. i. engine, performance analysis.

1. INTRODUCTION

The ever rising demand for the petroleum based fuels and their scarce availability is the main reason for turning our attention towards the alternatives. Among all the petroleum based fuels available, Diesel finds its chief place. Diesel is mostly used in industrial as well as transportation sectors. The fast depleting diesel sources is of concern to the world now. Vegetable oils are found to be best alternatives to the Diesel oils. These are having 90% of the heat energy of diesel which makes them better alternative to the Diesel. The main dis advantage with these oils is high viscosity and low volatility which makes it difficult to get injected into the engine cylinder. Though there are varieties of vegetable oils, their properties lie within fairly close range (Ventura *et al*., 1982). Vegetable oil molecules are generally triglycerides generally with non branched chains of different lengths and different degrees of saturation. Vegetable oils have good ignition qualities since they have non-branched long chains. Certain functional groups and the non volatility may be responsible for the low cetane number. The low heating value of vegetable oils can be attributed to the presence of excess oxygen .Viscosity and carbon residue is higher due to their large molecular mass and chemical structure. Vegetable oils are 10%denser than Diesel (Bari *et al.*, 2002). Their flash and fire points are high making it easer for transportation and storage. Vegetable oils have cetane number of about 35 to 50 depending upon their composition (Bandel, 1982). It is seen that this value is very close to diesel.

The properties of various vegetable oils in comparison to diesel are given in Table-1.

Table-1. Properties of vegetable oils.

Properties	Diesel	Mahua oil	Jatropha oil	Karanji oil	Rapeseed oil	Rubber seed oil	Tobacco seed oil
Density (kg/m^3)	840	920	918	927	918	926	920
Calorific value (kj/kg)	42390	38863	39774	35800	36890	38957	39400
Cetane Number	45-55	40	45	40	39	40	38
Viscosity (cst)	4.59	50	49.9	56	55	55.6	27.7
Flash Point (^{0}c)	75	260	240	250	275	242	220
Carbon residue (%)	0.1	0.4215	0.44	0.66	0.31	0.46	0.57

Mahua oil was selected for the present work with an intention to find the optimum compression ratio when used in C. I. engines.

2. EXPERIMENTAL SETUP

Experiments were carried out on a single cylinder 4 stroke, variable compression ratio C. I. engine at a constant speed of 1500 rpm. Specifications of the engine are given as under:

Make: Kirloskar
Compression ratio: variable from 13.2 to 20.2
Bore: 70mm.
Stroke: 110mm.
Loading: Eddy current dynamometer
Maximum power: 3.75kW.

The entire experimentation was carried out while keeping the cooling water temperature at 70^{0}C. Observations were made at different compression ratios and the results were plotted.

3. RESULTS AND DISCUSSIONS

3.1 Brake thermal efficiency

The variation of Brake thermal efficiency of the engine at different compression ratios is presented in the Figure-1. The highest brake thermal efficiency obtained is 27.98% with a compression ratio of 15.7 at peak load. The least being 16.24% at a compression ratio of 13.2. The low and high compression ratio ends have yielded poor brake thermal efficiencies. The low BTE at high compression ratios can be attributed to the dilution of charge at these compression ratios. The residual gases play a vital role in combustion of the fuel.
The low efficiencies in the low compression ratios can be attributed to the poor compression and hence poor combustion temperatures.

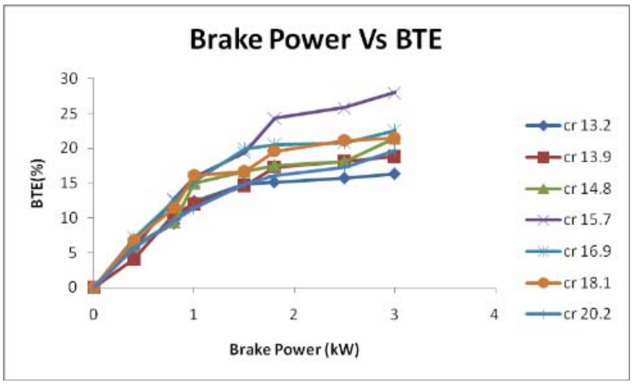

Figure-1. Brake power Vs BTE.

3.2 Exhaust gas temperatures

From the Figure-2 it can be shown that there is not much variation in the exhaust gas temperatures at peak loads for compression ratios other than 15. 7. This can be attributed to the complete burning and perfect mixing of air and Mahua oil at the compression ratio of 15.7, the exhaust gas temperature is found to be 405^{0}C.

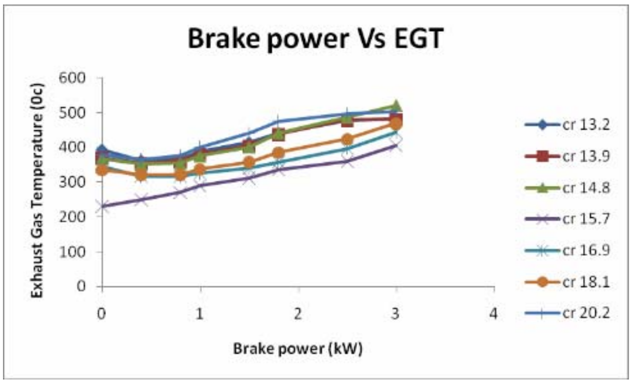

Figure-2. Brake power Vs EGT.

3.3 Fuel consumption

From Figure-3 it can be observed that fuel consumption is less with the compression ratio 15.7. Since the compression ratio 15.7 is supported by better brake thermal efficiency, the fuel consumption is also less when compared to other compression ratios. At 15.7 compression ratio, the fuel consumption is found to be 1.32 kg/hr.

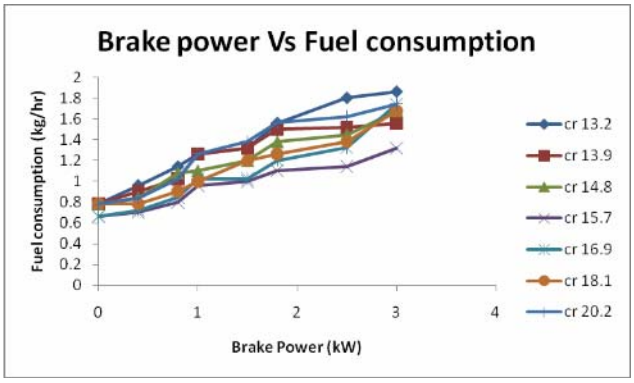

Figure-3. Brake power vs FC.

3.4 Smoke density

Better combustion and better utilization of fuel at compression ratio 15.7 is evident from the Figure-4. The smoke density is also found to be less with this compression ratio.

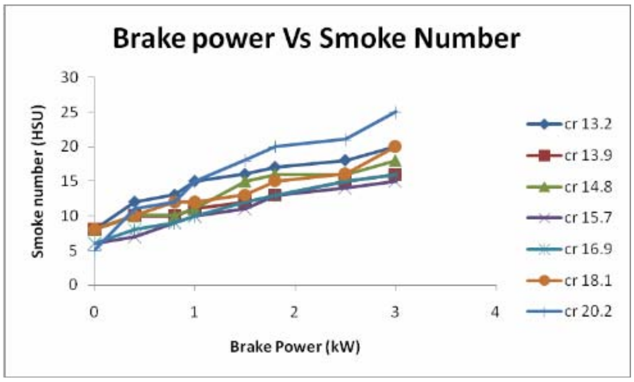

Figure-4. Brake power vs smoke number.

4. CONCLUSIONS

15.7 is the best compression ratio with Mahua in the C. I engines. Thermal efficiency is very high at this compression ratio where as fuel consumption, smoke number and the exhaust gas temperatures are marginally low at compression ratio 15.7.

REFERENCES

Ventura M. Luso, Wolfgang Bandel. 1982. First results with Mercedes Benz D. I diesel Engine running on monoesters of vegetable oils; International conference on plant and vegetable oils as fuels, North Dakota, USA.

Bari S. 2002. Effect of preheating of crude palm oil on injection system. International Journal of renewable energy. 27: 339-351.

Basker T. 1992. Experimental Investigations on the use of vegetable oil and vegetable oil ester in a low heat rejection engine. M. S Thesis. Indian Institute of Technology Madras, Chennai. May.

Heywod J. B. 1998. Internal combustion Engines-Fundamentals. Mc Grawhill Book Company, New York.

M. Senthil Kumar. Experimental investigations on diesel engine with vegetable oils. Ph.D Thesis. IIT Madras, Chennai.