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Effect of Varying Compression Ratio and Blend Percentage on Performance of Single Cylinder Diesel Engine Operating with Blends of Plastic Pyrolysis Oil and Diesel

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Abstract: Polluting emissions are a major problem faced by operation of diesel engines. Various alternatives have been researched to address this issue. Of all alternatives, use of plastic pyrolysis oil provides additional benefit of plastic waste disposal issue. Paper presents results obtained by operating single cylinder diesel engine with blend of plastic pyrolysis oil (0%, 15% and 30%) and diesel at varying compression ratio (16, 17 and 18). Results of brake thermal efficiency, mechanical efficiency and fuel consumption are presented.

Keywords: Plastic Pyrolysis Oil, Blend Percentage, Compression Ratio, Brake thermal efficiency, Mechanical Efficiency, Fuel Consumption

I. INTRODUCTION

Diesel engines find extensive application in various power generation applications due to some of important advantages viz. high fuel conversion efficiency, reliability and robustness. But along with these advantages comes a major limitation, polluting emissions. Also diesel, being non-renewable energy source, demands search for alternative fuel.

Extensive research has been done in area of alternate fuels and alternatives ranging from oils, alcohols, biogas and biodiesel have been experimented. Among various alternatives, use of plastic pyrolysis oil provides an additional advantage of plastic waste disposal, which too is an alarming environmental issue. The present paper aims to investigate effects of using plastic pyrolysis oil as alternate fuel in diesel engines.

II. EXPERIMENTAL SET-UP

Experiments were conducted on single cylinder, four stoke, multi-fuel research engine connected to eddy current dynamometer for loading. Engine specifications are shown in table 1 and figure 1 & 2 shows figure and schematic layout of experimental set-up.

TABLE IENGINE SPECIFICATIONS

Model	TV1	
Make	Kirlosker Oil Engines	
Type	Four stroke, Water Cooled Diesel Engine	
No. of cylinder	One	
Bore	87.5 mm	
Stroke	110 mm	
Connecting rod length	234 mm	
Cubic capacity	0.661 liters	
Orifice diameter	20 mm	
Dynamometer Rotor radius	141 mm	
Compression ratio range	12 to 18	
Peak pressure	77.5 kg/cm^2	
Direction of rotation	Clockwise (Looking from flywheel end side)	
Max. Speed	2000 rpm	
Fuel timing for std. engine	0 to 25^0 BTDC	
Valve timing	Inlet opens BTDC	4.5^0
	Inlet closes ABDC	35.5^0
	Exhaust opens BBDC	35.5^0
	Exhaust closes ATDC	4.5^0

Fig. 1 Experimental Set-up

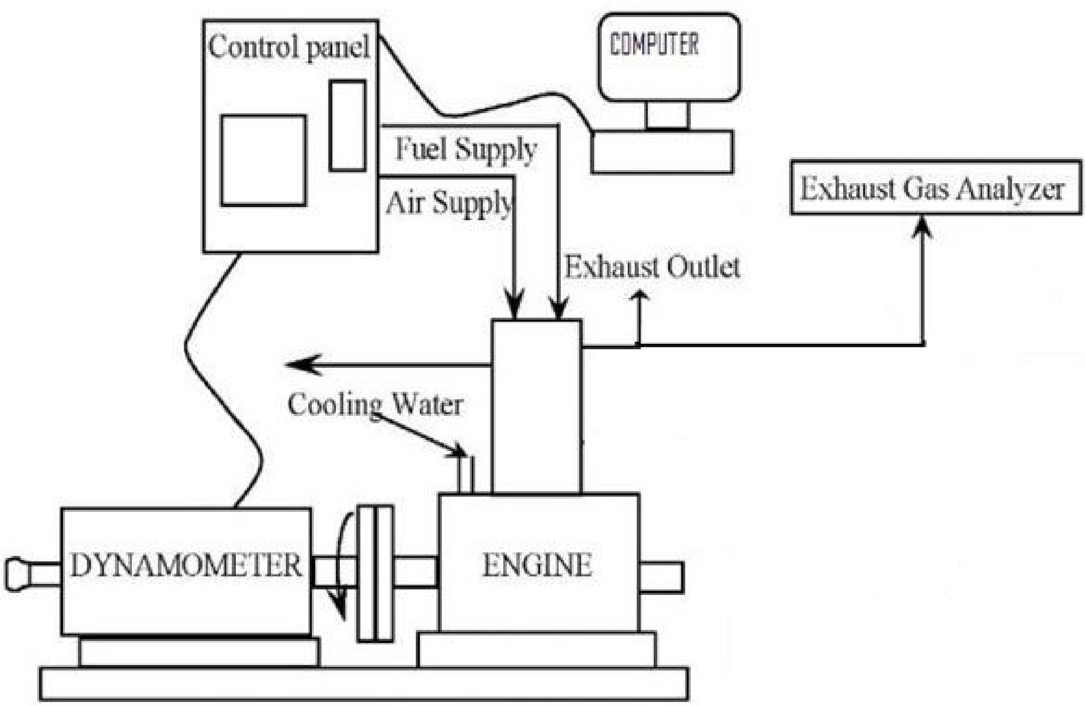


Fig. 2 Schematic of Experimental Set-up

Experiments were conducted with following operating parameters;

1) Compression ratio – 16, 17, 18
2) Oil Blend Percentage – 0(100D), 15(85D), 30(70D)
3) Engine load (kg) - 2, 7, 12

Properties of plastic pyrolysis oil are shown in table II.

TABLE II
PROPERTIES of PLASTIC PYROLYSIS OIL

Kinematic Viscosity (cSt)	9.12
Flash point (^{0}C)	44
Pour Point (^{0}C)	6
Density @27^{0}C (gm/cc)	0.909
Gross Calorific Value (kCal/kg)	10232

As per full factorial design, total 27 experiments were conducted as shown in table III.

TABLE III
FULL FACTORIAL ARRAY OF EXPERIMENTS

Experiment no.	Compression Ratio	Blend	Load (kg)
1	18	100D	02
2	18	100D	07
3	18	100D	12
4	18	85D	02
5	18	85D	07
6	18	85D	12
7	18	70D	02
8	18	70D	07
9	18	70D	12
10	17	100D	02
11	17	100D	07
12	17	100D	12
13	17	85D	02
14	17	85D	07
15	17	85D	12
16	17	70D	02
17	17	70D	07
18	17	70D	12
19	16	100D	02
20	16	100D	07
21	16	100D	12
22	16	85D	02
23	16	85D	07
24	16	85D	12
25	16	70D	02
26	16	70D	07
27	16	70D	12

Results for Brake thermal efficiency, mechanical efficiency and fuel consumption are presented.

III. BRAKE THERMAL EFFICIENCY

Figure 3 & 4 shows effect of varying compression ratio and blend percentage on brake thermal efficiency. With increase in load, brake thermal efficiency increases. Compression ratio of 18 results in higher brake thermal efficiency at blends of 70D and 85D as observed from figure 3. At 100D, change in compression ratio does not show major change in brake thermal efficiency. Keeping compression ratio constant, brake thermal efficiency is observed to be maximum at blend of 70D. The reason attributed to same is higher calorific value of oil and hence the blend.

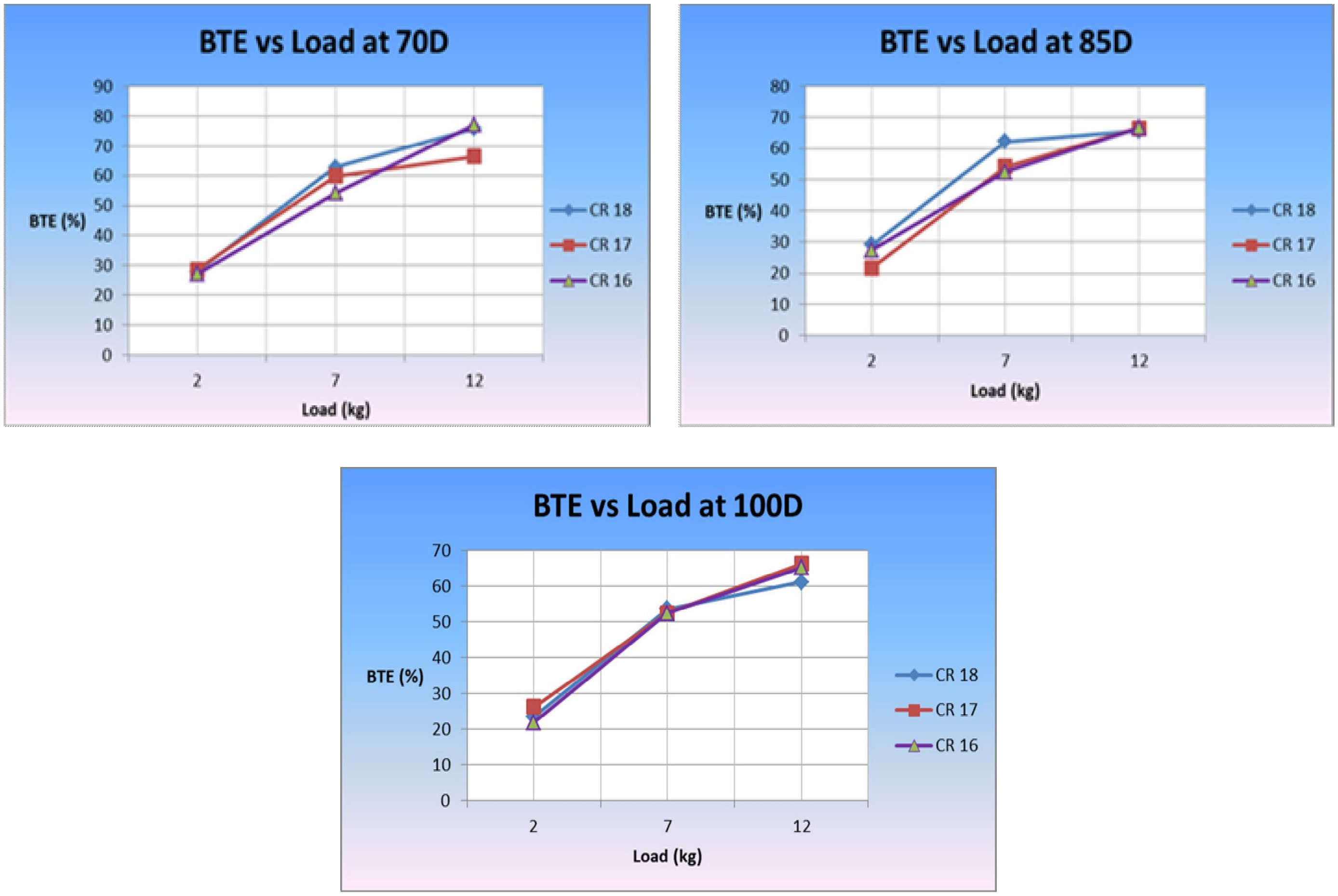
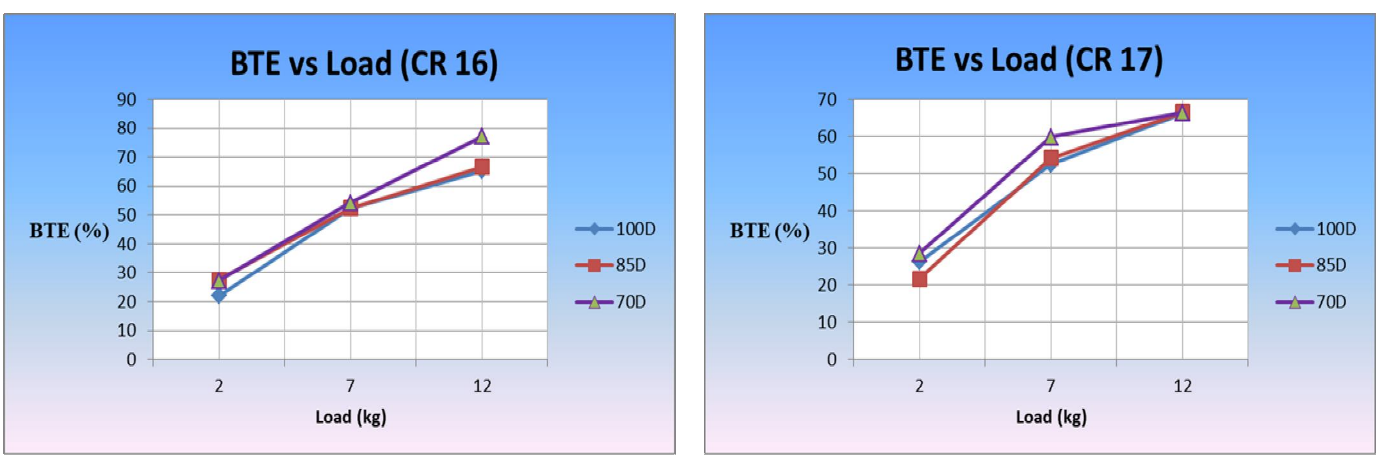


Fig. 3 Effect of varying compression ratio at given blend on brake thermal efficiency



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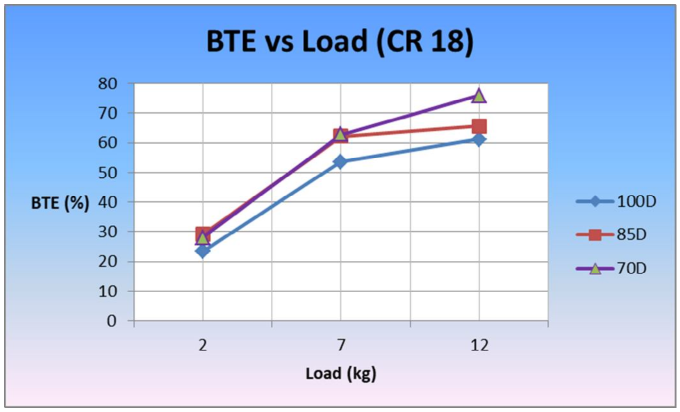
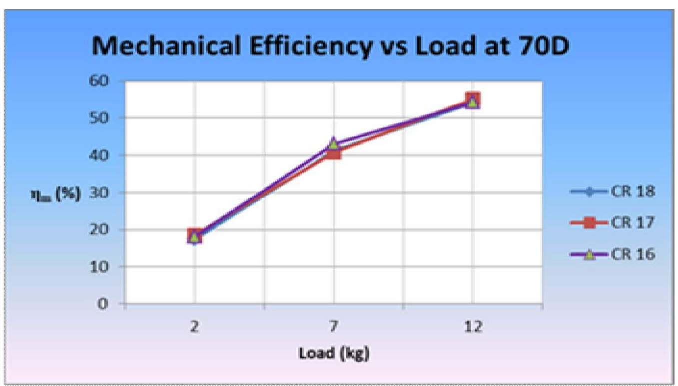
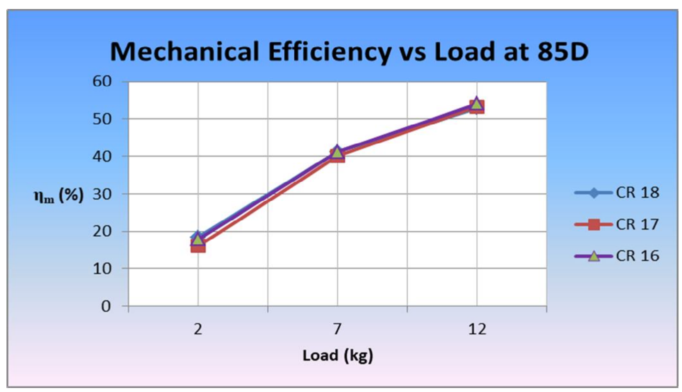


Fig 4. Effect of varying blend percentage at given compression ratio on brake thermal efficiency

IV. MECHANICAL EFFICIENCY

Figure 5 & 6 shows effect of varying compression ratio and blend percentage on mechanical efficiency. As observed from figure 5, change in compression ratio does not produce major change in mechanical efficiency at blends 70D and 85D while at 100D, efficiency is highest at compression ratio of 17. Similar to brake thermal efficiency, blend of 70D results in maximum mechanical efficiency at all loads and compression ratio. There are no major variations observed at compression ratio of 17 with variation in blend percentage.





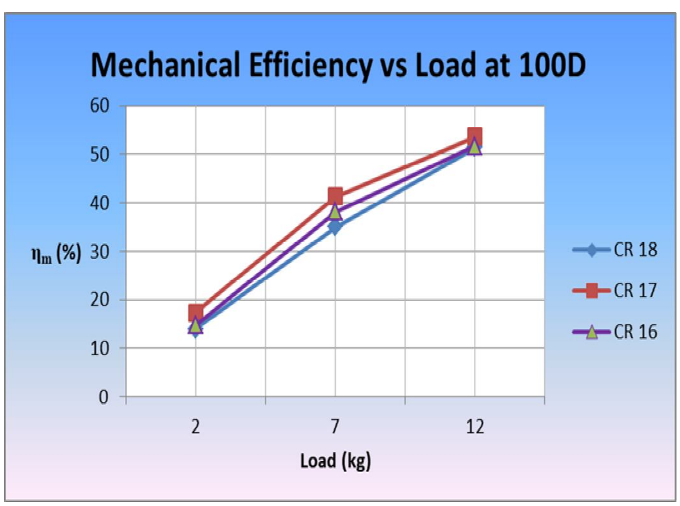


Fig. 5 Effect of varying compression ratio at given blend percentage on mechanical efficiency

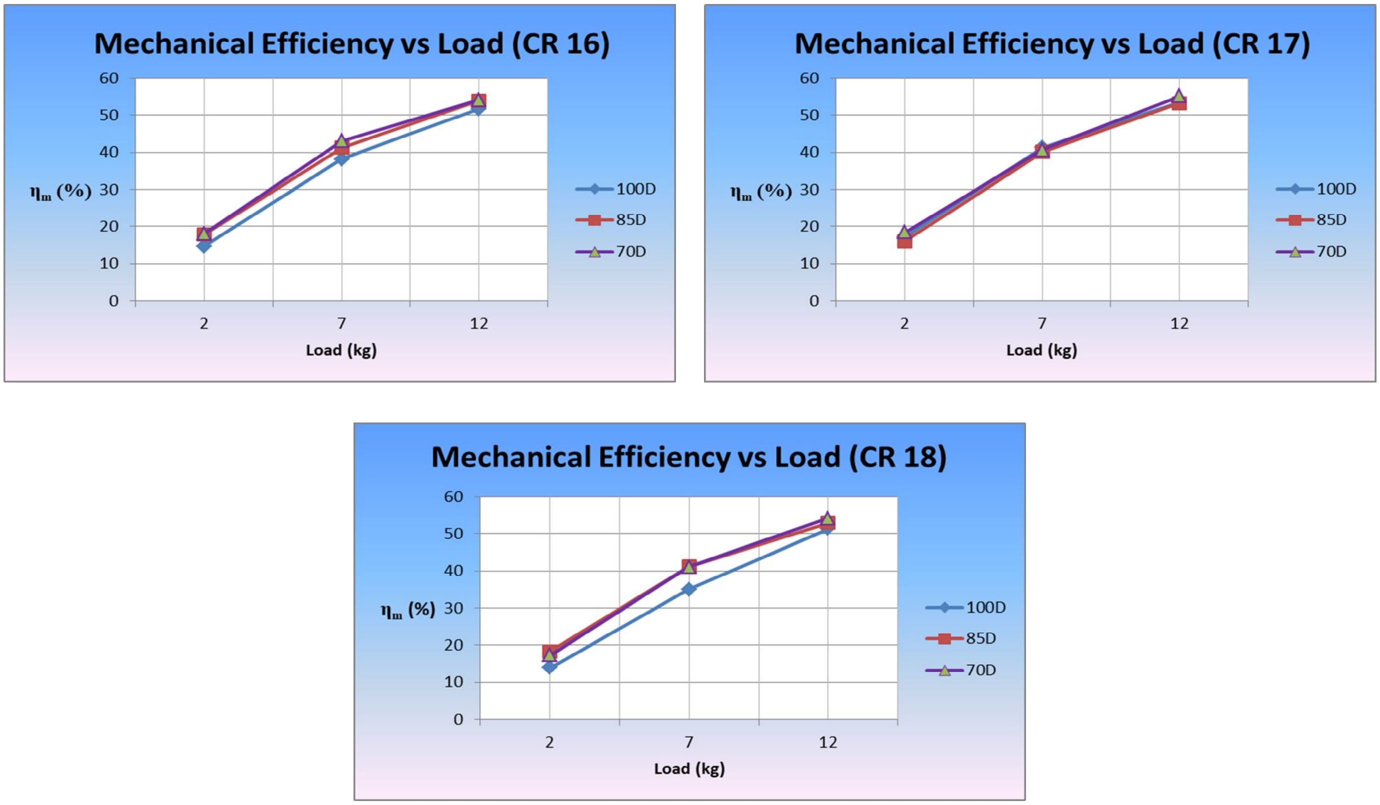
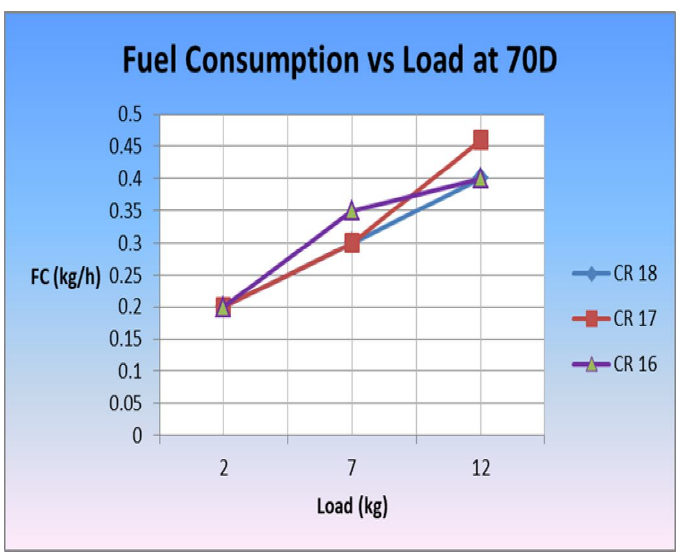
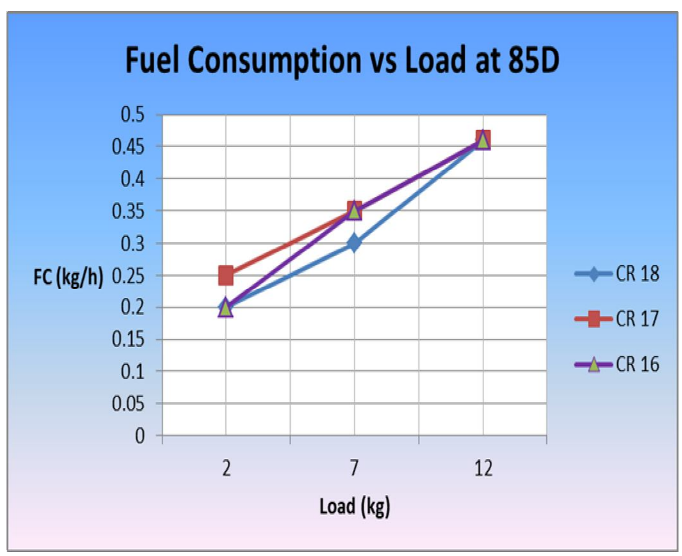


Fig 6. Effect of varying blend percentage at given compression ratio on mechanical efficiency

V. FUEL CONSUMPTION

Figure 7 & 8 shows effect of varying compression ratio and blend percentage on fuel consumption. Increase in load increases fuel consumption. Fuel consumption is lower at compression ratio 18 for blends 70D and 85D, while for 100% diesel, least is at compression ratio 17. As observed from figure 8, blend of 70D results in minimum fuel consumption at all compression ratios. For compression ratio of 18, blend of 100D results in maximum fuel consumption.





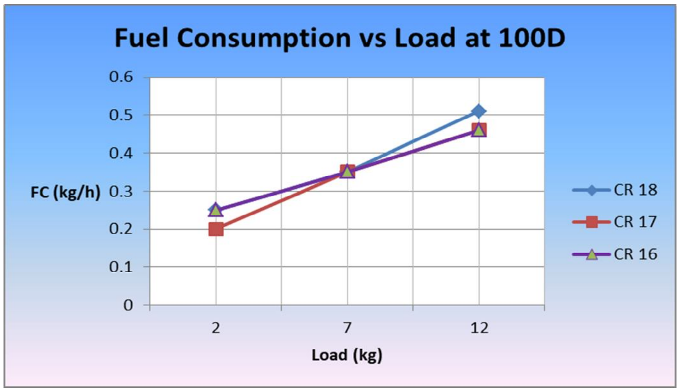


Fig 7. Effect of varying compression ratio at given blend percentage on fuel consumption

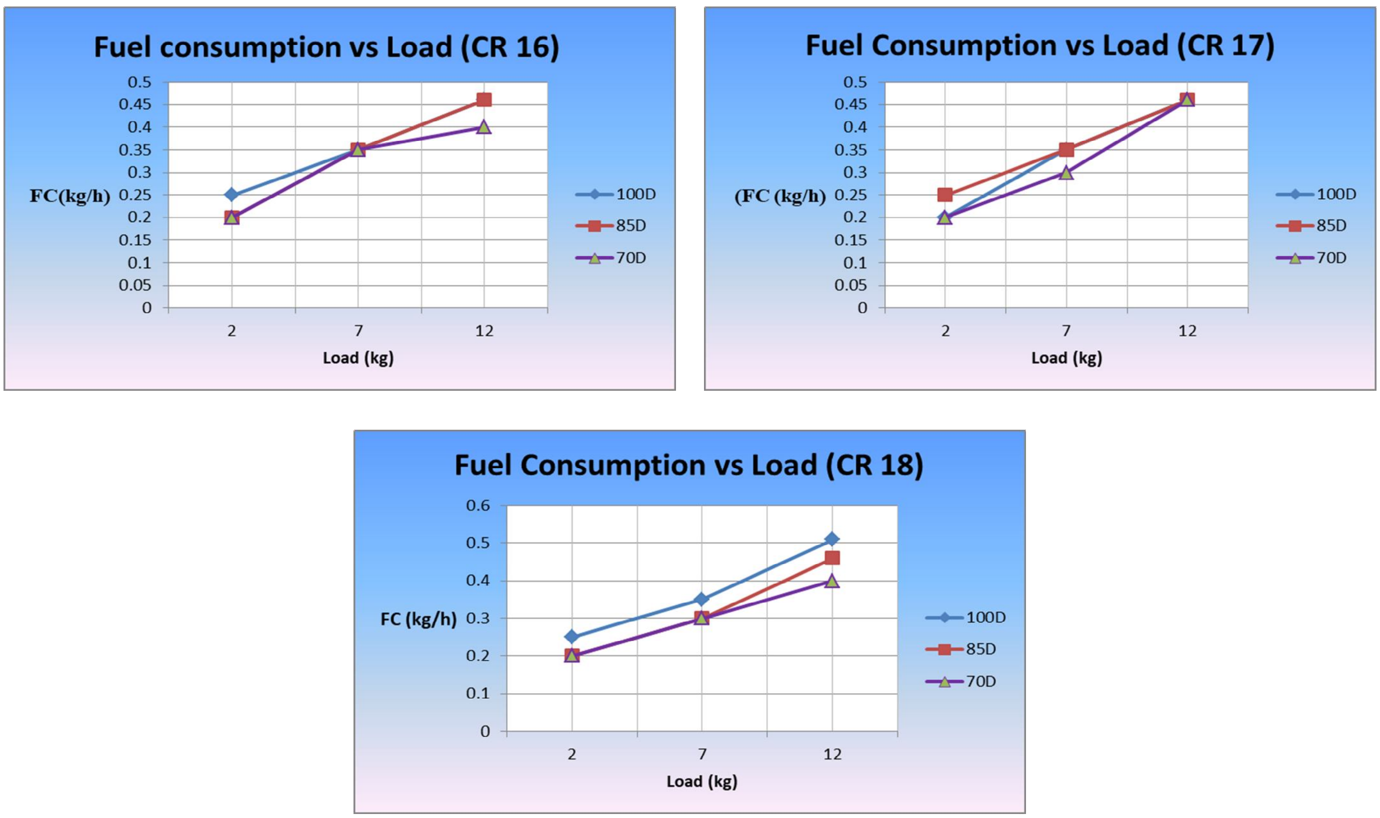


Fig 8. Effect of varying blend percentage at given compression ratio on fuel consumption

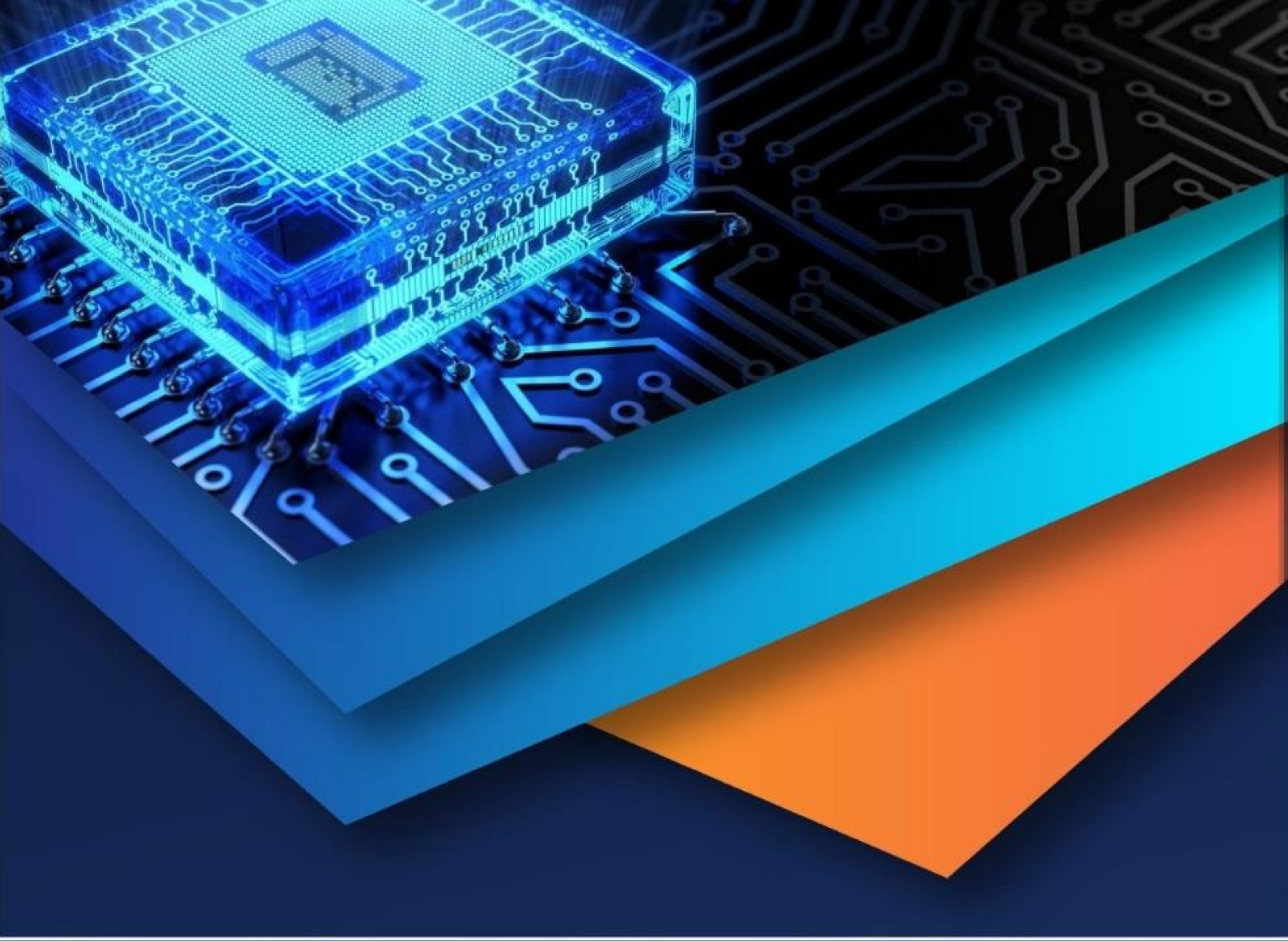
VI. CONCLUSIONS

A. Engine is able to operate without any modification as properties of plastic pyrolysis oil are similar to diesel fuel.
B. Compression ratio of 18 results in highest brake thermal efficiency and lowest fuel consumption at blends of 70D and 85D.
C. Compression ratio of 17 results in maximum mechanical efficiency and least fuel consumption for 100% diesel.
D. Blend of 70D results in maximum brake thermal efficiency and mechanical efficiency at all compression ratios. It also results in minimum fuel consumption.

REFERANCES

[1] X. Wang and P. Ni, “Combustion and emission characteristics of diesel engine fueled with diesel-like fuel from waste lubrication oil,” Energy Convers. Manag., vol. 133, pp. 275–283, 2017.
[2] K. Sivaramakrishnan, “Investigation on performance and emission characteristics of a variable compression multi fuel engine fuelled with Karanja biodiesel–diesel blend,” Egypt. J. Pet., pp. 1–10, 2017.

[3] I. Kalargaris, G. Tian, and S. Gu, "Combustion, performance and emission analysis of a DI diesel engine using plastic pyrolysis oil," Fuel Process. Technol., vol. 157, pp. 108–115, 2017.
[4] V. K. Kaimal and P. Vijayabalan, "An investigation on the effects of using DEE additive in a di diesel engine fuelled with waste plastic oil," Fuel, vol. 180, pp. 90–96, 2016.
[5] P. Senthilkumar and G. Sankaranarayanan, "Effect of Jatropha methyl ester on waste plastic oil fueled DI diesel engine," J. Energy Inst., vol. 89, no. 4, pp. 504–512, 2016.
[6] V. Hariram and R. Vagesh Shangar, "Influence of compression ratio on combustion and performance characteristics of direct injection compression ignition engine," Alexandria Eng. J., vol. 54, no. 4, pp. 807–814, 2015.
[7] S. Nagaraja, K. Sooryaprakash, and R. Sudhakaran, "Investigate the Effect of Compression Ratio Over the Performance and Emission Characteristics of Variable Compression Ratio Engine Fueled with Preheated Palm Oil - Diesel Blends," Procedia Earth Planet. Sci., vol. 11, pp. 393–401, 2015.
[8] A. Sharma and S. Murugan, "Potential for using a tyre pyrolysis oil-biodiesel blend in a diesel engine at different compression ratios," Energy Convers. Manag., vol. 93, pp. 289–297, 2015.
[9] D. H. Qi, C. F. Lee, C. C. Jia, P. P. Wang, and S. T. Wu, "Experimental investigations of combustion and emission characteristics of rapeseed oil-diesel blends in a two cylinder agricultural diesel engine," Energy Convers. Manag., vol. 77, pp. 227–232, 2014.
[10] B. De and R. S. Panua, "An experimental study on performance and emission characteristics of vegetable oil blends with diesel in a direct injection variable compression ignition engine," Procedia Eng., vol. 90, pp. 431–438, 2014.
[11] P. Behera and S. Murugan, "Combustion, performance and emission parameters of used transformer oil and its diesel blends in a di diesel engine," Fuel, vol. 104, pp. 147–154, 2013.
[12] M. Mani, G. Nagarajan, and S. Sampath, "An experimental investigation on a di diesel engine using waste plastic oil with exhaust gas recirculation," Fuel, vol. 89, no. 8, pp. 1826–1832, 2010.
[13] S. Murugan, M. C. Ramaswamy, and G. Nagarajan, "Assessment of pyrolysis oil as an energy source for diesel engines," Fuel Process. Technol., vol. 90, no. 1, pp. 67–74, 2009.
[14] Sehmus Altun, H. Bulut, and Cengiz Oner, "The comparison of engine performance and exhaust emission characteristics of sesame oil-diesel fuel mixture with diesel fuel in a direct injection diesel engine," Renew. Energy, vol. 33, no. 8, pp. 1791–1795, 2008.



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