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Performance Analysis of VCR Engine Fuelled with Diesel Blended with Jatropha and Animal Fat Bio Diesel

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Abstract: Clean emission profile, nontoxic, ease of use and huge dependence on foreign petroleum products made biodiesel become one of the fastest growing alternative fuels in the world. Biofuels hold promise but require major R&D efforts. The main concern with biodiesel fuel is its high price. One of the futures aims in biodiesel research is on the selection of inexpensive feedstock with high value-added by-products This study investigates about the performance of biodiesel based on jatropha and animal fat in blends with pure diesel in a VCR engine. Load test is conducted on various compression ratios ranging from 16.5 to 19 with pure and blended fuels. It's also intended to investigate the performance of fuel blend of diesel and mixture of biodiesels of different origins. Results showed that blend of biodiesel and biodiesel mixtures with diesel can give comparable performance with slight modification in compression ratio
Keywords: Biodiesel, Jatropha, Animal Fat, VCR

I. INTRODUCTION

The world is constantly in search of a solution to address the depletion of, as well as the environmental degradation caused by fossil fuels. Being a finite source and having increasing demand day by day research inclined towards the alternative fuels [1]. Biodiesel can be produced by the transesterification of lipids.

Animal fat can be two major source of lipids that can be used for the production of biodiesel. In recent years, some researchers have turned their interest toward animal fat-based biodiesel [2–5]. Animal fat-based biodiesel is a sustainable source of raw materials and their properties are very similar to biofuel vegetable origin biodiesel [6]. The utilization of liquid fuels such as biodiesel produced from Jatropha oil by transesterification process represents one of the most promising options for the use of conventional fossil fuels [7] Since many properties of biodiesel are very close to diesel, biodiesel is attracting attention as a potential alternate fuel, either in the form of blends or as a direct replacement for diesel.

Many researchers concluded that being oxygenated fuels, both jatropha based bio diesel and Animal fat-based biodiesel have cleaner combustion and reduced emission when blended with diesel. The brake thermal efficiency increases for the PO/Diesel blends. HC emissions for all those fuels except for the PO/Diesel blends are found lower, while CO emissions rise for all types of fuels. NOx emissions were higher at low load, but lower at full load [8]. It is observed a drastic reduction in CO and PM emissions while using biodiesel with respect to home heating oil.

The PAHs contained in PM, in case of biodiesel were nearly 13 times less toxic than the oil; formaldehyde on the contrary, was nearly double for biodiesel.

The VOCs were very low for both the fuels. The results show that there may be benefits in using biodiesel in home heating or in industrial processes [9]. A single cylinder diesel engine fuelled with methyl ester from waste animal fats was investigated performance and the emissions testing were reported that because of the higher amount of oxygen of biodiesel, while thermal efficiency gets higher, HC and CO emissions in the exhaust get lower compared to diesel fuel [10]. The objective of current research work is to investigate the performance of diesel blended with Jatropha and Animal fat Bio diesel on VCR engine. It is also intended to investigate whether the biodiesel can be mixed and used as a blend with diesel in the engine

II. MATERIALS AND METHODOLOGY

The experimental investigation is carried on a VCR engine with four set of fuels namely D100,A20D80,J20D80 and M20D80 by varying load, keeping speed constant for compression ratio 16.5,17,18 and 19.Where D100,A20D80,J20D80 and M20D80 are 100% pure diesel, blend of animal fat biodiesel and pure diesel in the ratio 80:20, blend of Jatropha biodiesel and pure diesel in the ratio 80:20 and blend of animal fat biodiesel, Jatropha bio diesel and pure diesel in the ratio 80:10:10 respectively .

III.EXPERIMENTAL SECTION

Experiment set up consists of Kirloskar multi-fuel, vertical, water cooled, direct injection, naturally aspirated engine VCR engine coupled to eddy current dynamometer as shown in figure .it can be set into various compression ratios as required and can be operated at its rated speed .

The experiment is conducted at a constant speed of 1500rpm and varying compression ratio from 16.5 to 19 .The engine was started by hand cranking with diesel fuel supply, and it was allowed to get its steady state. Experiment were conducted at loads 0,5,10,13 and 17 kg with diesel. The engine was next run with A20D80,J20D80,M20D80 and performance test were carried out.

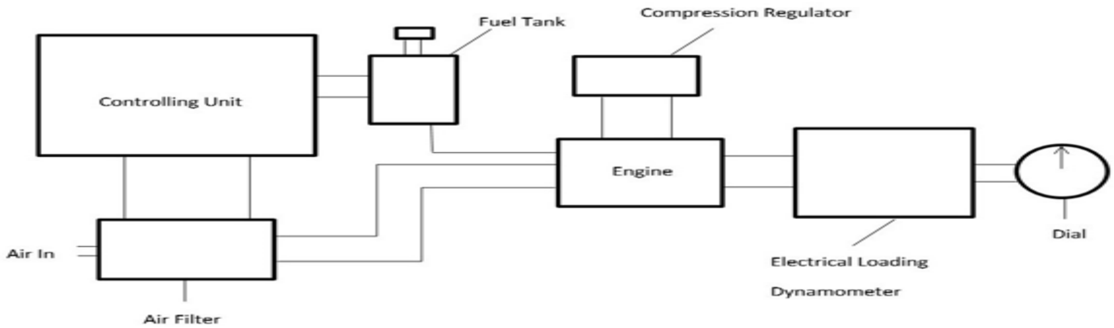

Fig. 1 Experimental Set up

Properties of bio diesel from jatropha and animal fat are having their properties very close to diesel. Here bio diesel and pure diesel are blended in volumetric ratio 20:80 and used as fuel in performance test

Table I. Properties of bio diesel from jatropha and animal fat

PROPERTIES	JATROPHA BIODIESEL	ANIMAL FAT BIODIESEL	PURE DIESEL
DENSITY (g/ml)	0.865	0.879	0.841
VISCOSITY	5.2	4.48	4.5
CALORIFIC VALUE(MJ/KG)	39.2	39.3	42.0
FLASHPOINT (CELSIUS)	175	140	50

Table 2. Engine specifications

Engine	Kirloskar
Speed	1500Rpm
No of cylinder	single
Bore	80mm
Stroke length	110mm
Compression ratio	12:1to 20:1
Bhp	5HP
Cooling system	Water cooled
Method of ignition	Compression ignition
Orifice diameter	20mm
EDDY CURRENT DYANOMETER SPECIFICATION	
POWER	3.7KW
SPEED	1500RPM
MAX TORQUE	2.4Kg-M

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IV. RESULTS AND DISCUSSION

1) *Compression Ratio is 16.5:* For compression ratio equal to 16.5 SFC of J20D80, A20D80 and pure diesel are comparable, were as mixture M20D80 is having higher SFC. In other words M20D80 give lowest efficiency compared to ordinary diesel, J20D80 & A20D80

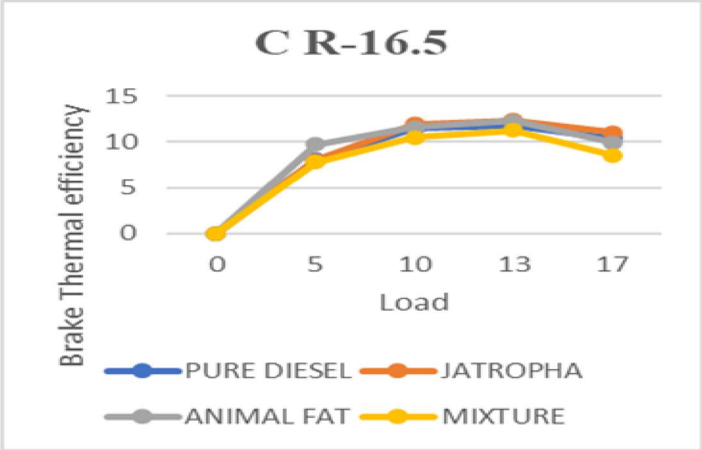

Fig.2 Brake thermal efficiency at 16.5 Compression Ratio

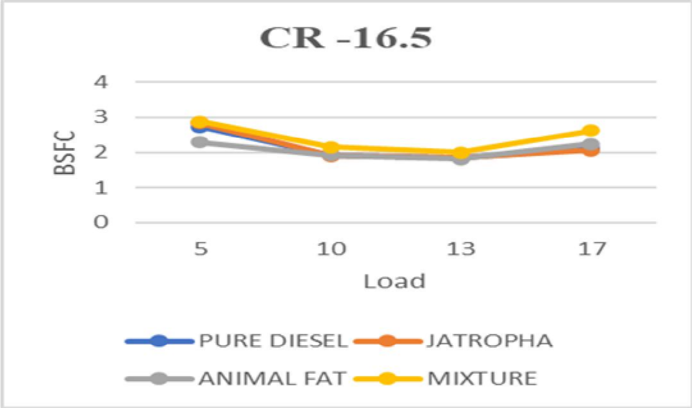

Fig.3 Brake Specific Fuel Consumption at 16.5 Compression Ratio

2) *Compression Ratio is 17:* At compression ratio equal to 17. efficiency of M20D80 lies in between J20D80 and A20D80. At CR= 17 pure diesel has least efficiency. Jatropha a has the most efficient fuel for CR= 17. Pure diesel has highest specific fuel consumption, M20D80 & J20D80 are almost close. And SFC of A20D80 lies in between pure diesel and M20D80. As the compression ratio increases to 17 all blends show considerable growth in efficiency which is highest for J20D80.M20D80 is closer to jatropha biodiesel.

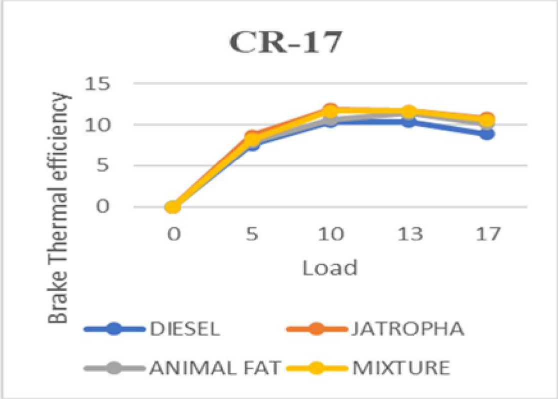

Fig.4 Brake thermal efficiency at 17 Compression Ratio

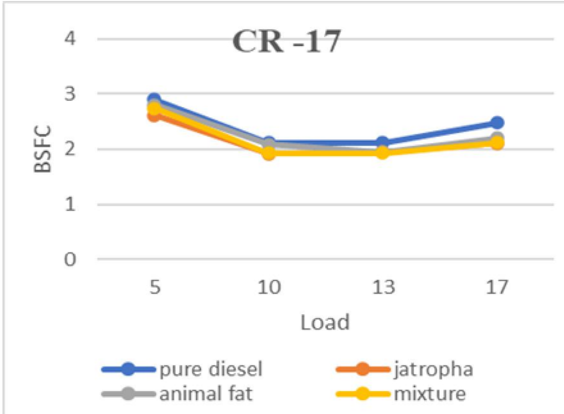

Fig.5 Brake Specific Fuel Consumption at 17 Compression Ratio

3) *Compression Ratio is 18 and 19*: At compression ratio equal to 18, M20D80 and J20D80 shows the maximum efficiency at mid loads 10 and 13. Efficiency of pure diesel is comparable to M20D80 and J20D80. A20D80 has the least efficiency in this compression ratio. At this compression ratio A20D80 has highest SFC compared to other fuels and lowest SFC for J20D80 & M20D80. SFC of pure diesel lies in between A20D80 J20D80.The trend of CR=16, is repeated for CR=18. For compression ratio equal to 19, M20D80 is highly efficient compared to pure diesel, A20D80 and J20D80.Efficiency of A20D80 and pure diesel are almost close and they have the least efficiency in this compression ratio. For CR- 19, A20D80 and pure diesel has almost same SFC.J20D80 has the lowest SFC and M20D80 lies in between.M20D80 shows highest efficiency.

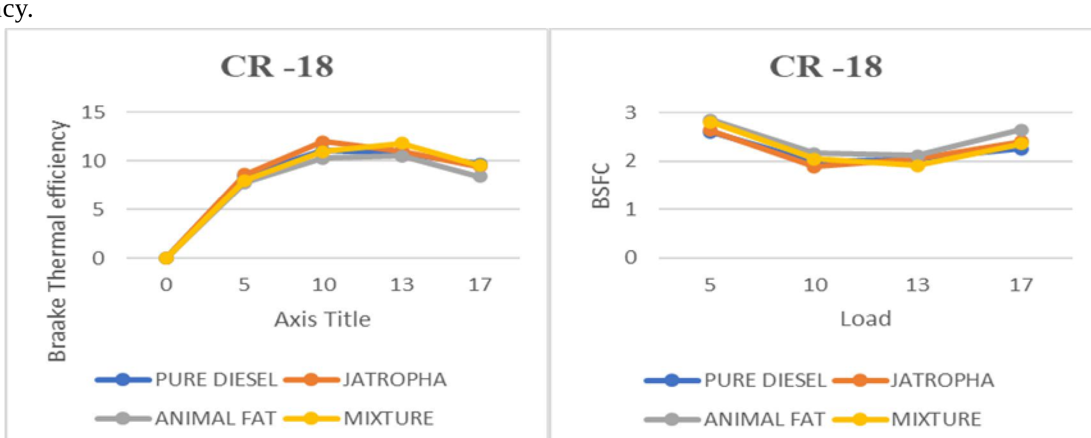

Fig.6 Brake thermal efficiency and Brake Specific Fuel Consumption at 18 Compression Ratio

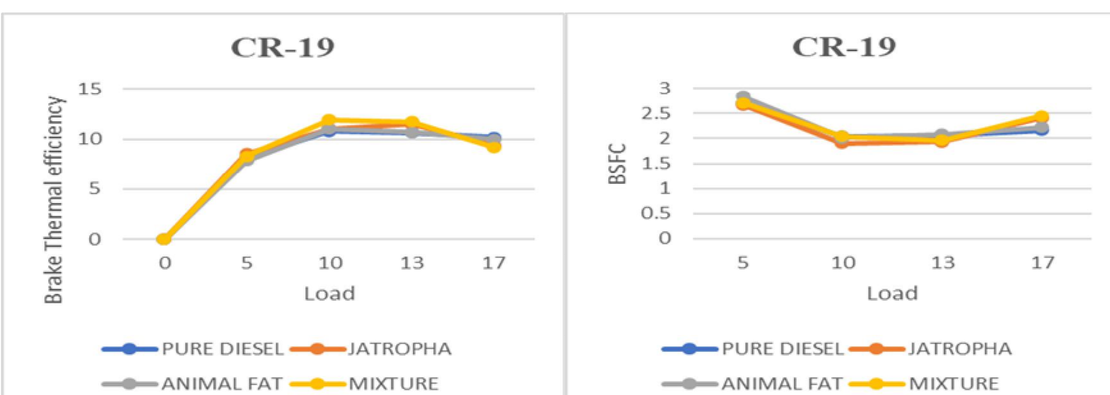

Fig.6 Brake thermal efficiency and Brake Specific Fuel Consumption at 19 Compression Ratio

V. CONCLUSIONS

Experimental analysis suggest that biodiesel can be blended with diesel and gives almost similar performance compared to diesel. The fuel A20D80 shows the maximum efficiency in the CR=16.5 at a load 13. Fuel J20D80 shows the maximum efficiency in the CR=16.5 at a load 13. Fuel M20D80 shows the maximum efficiency in the CR=19 at a load range 10-13. The results show that depending on the availability various biodiesels can be mixed and can be used in blends with pure diesel with slight variation in compression ratio almost same or better performance can be obtained

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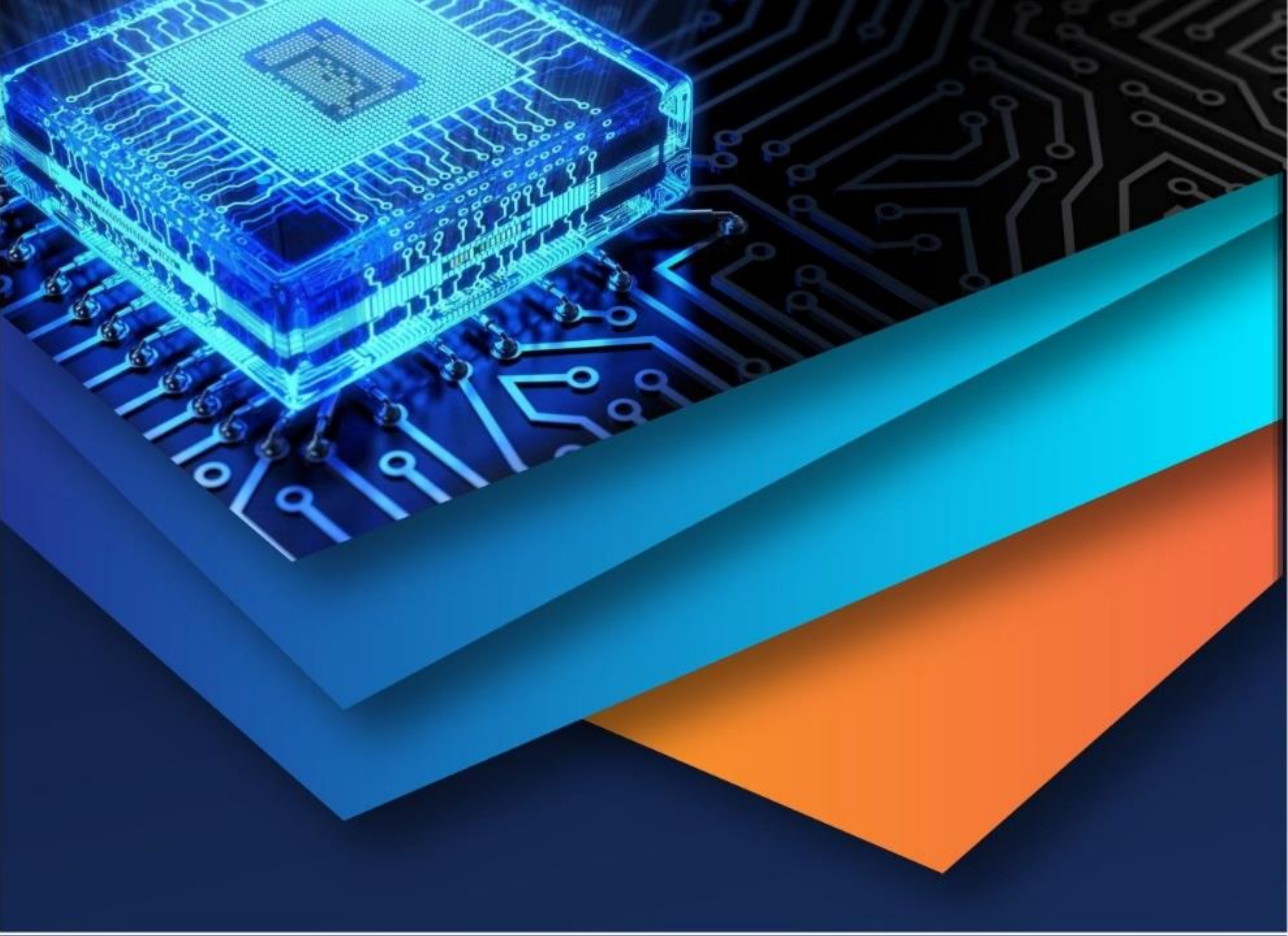

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