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Performance Characteristics of VCR Engine using Tomato Seed Oil As Alternative Fuel

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Abstract *- The study is aimed to synthesizing a novel solution of performance of VCR engine using Tomato Seed oil with various compression ratio. This test also conducts to drop off emissions like unburned hydrocarbons (HC), nitrogen oxide compounds (NOx), and carbon monoxides. The engine which has DI Compression Ignition is fueled with blends of both diesel and biodiesel are used. Furthermore, improvement in parameters presentation likes BTE and SFC was also simultaneously targeted. Tomato seed oil blend with diesel-biodiesel blends (B20 and B40) with compression ratio 15.5. All the exhaust emissions are drastically reduced except nitrogen oxide emission and performance increased and reduced specific fuel consumption.*

Key Words: Tomato seed oil, Transesterification, Methanol, variable compression ratio (VCR), Performance.

I. INTRODUCTION

In the cutting edge of the world, the interest of non-sustainable power sources is expanding step by step because of modernization and motorization. Interest for power and tremendous increment in the quantity of automobiles has brought about more prominent interest for oil based fuels[1]. The expanding interest for the oil based energizes has prompted oil emergencies in the ongoing occasions. Along these lines thought has been revolved around working up the sustainable or interchange powers to swap the crude oil based fuel for vehicles[2].

In diesel and fuel comprise of mixes of different blends of various chemical compounds of various hydrocarbon chains (HC) that are toxic as well as unsafe[3]. The Carbon monoxide (delivered while the ignition is inadequate), nitrogen (created in high temperatures when burning happens), and sulfur oxides (created while basic sulfur is available), and particulates for the most part created during ignition are other explicit emissions of interest[4]. So the moment has come to scan for its substitutes.

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There are a numerous alternate of fuel such vegetable oils, biogas, biomass, essential alcohols are largely inexhaustible character in nature[5]. From the above mentioned oils, vegetable oils seem to be of outstanding significance as they are inexhaustible, biodegradable, non-poisonous and conditionneighborly[6].The alternative fuel has a high level of lubricity, clean fuel consumption and can be used in existi ng unmodified diesel engines[7].Biodiesel fuel characteristic s including flash point and fire point have also been inspecte d and qualities are discovered nearer to the diesel values[8]. The engine and emission characteristics attributes below various biodiesel rates were likewise considered[9]. The outcomes shows that the biodiesel created utilizing tomato seed oil could decrease Carbon dioxide and smoke emissions[10].

Biodiesel indicates a group of items produced using vegetable oil as a choice creature, for example, methanol and mono alkyl esters (from unsaturated fats)[11]. This examination is showing that biodiesel is found on the mass premise own a vitality substance is about 12% not as much as oil based diesel fuel[12]. It diminishes un burned hydro carbons (HC), carbondi oxide (CO2) for lower loads, and pretty much equivalent measure Nitrogen oxides (NOx) rather than diesel-fuel engines[13]. Household, sustainable diesel engine energy (fuel) is got from common oil for example, oil in tomato seed. Contrast with diesel fuel, biodiesel is environ ment friendly fluid liquid in engine test, both fuel consumption as well as power consumption.

II. METHODS AND MATERIALS

Transestrification is a chemical effect to the production of esters and glycerol from oil. An alcohol is to make esters with the triglycerides. In general, it is used to increase the reaction speed and yield catalyst. Because of the reversible response, in the transesterification process, it requires excess alcohol to move the balance to the item side butane, ethanol can be used. Soluble base catalyzed and commercially frequently used transestrification faster than corrosive catalyzed transestrification. R1, R2, R3 and R ' refer to a variety of group of alkyls. Transesterification procedure creates an incredible shift in viscosity for vegetable oils. This technique generated biodiesel is completely misci ble to any degree with mineral diesel.

III. TOMATO SEED OIL PROPERTIES

Property of tomato seed oil is shown in the Table-I.

Table-I: Property values of tomato seed oil

Sl. No	Property	Tomato seed oil
1	Density (at 30 0 C ,gm/m)	0.9122
2	viscosity (at 40 °C, cst)	29.11
3	Specific gravity	0.9172
4	Calorific value (kJ/kg)	36268
5	Flash point (°C)	330
6	Fire point (°C)	340
7	Pour point (°C)	-20
8	Cloud point (°C)	-120
9	Cetane index	15

IV. EXPERIMENTAL SETUP

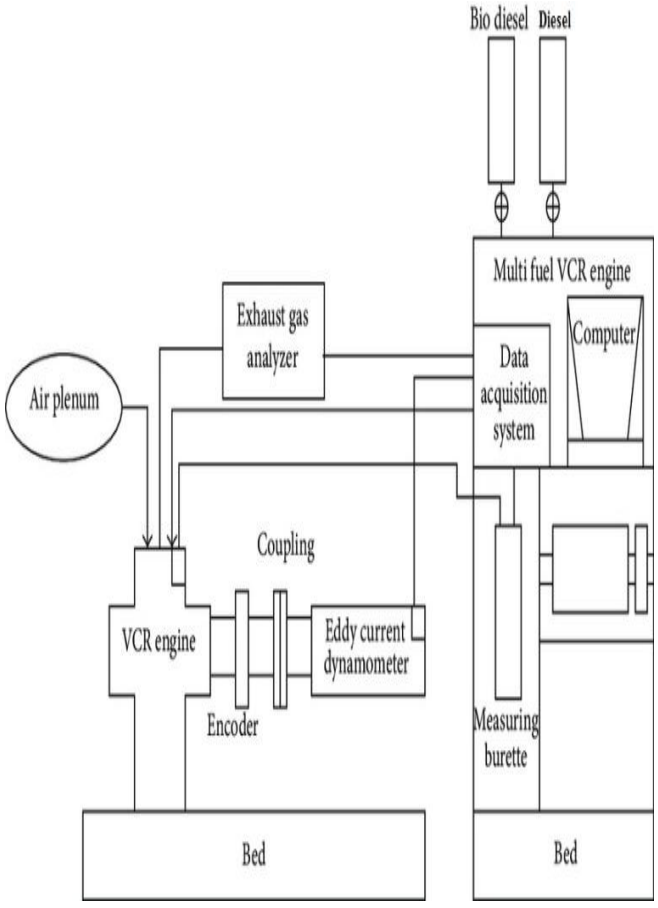

Fig. 1.Experimental setup

The tests were directed at a Kirloskar engine (water cooled) , variable compression ratio of four stroke single cylinder. Fig.1. shows the experimental setup.To test a conventional engine, tomato seed oil mixes (B20 and B40) with diesel were used. Engine is paired with dynamometer of an eddy current to apply different loads. A diesel engine's performance parameters such as BP, SFC brake and BTE have been evaluated. The engine pattern shown in below Table II

Table- II: Pattern of engine

Make	Kirloskar-TV1
Power and Speed	5.2 kW and 1500 rpm
Type of engine	Single cylinder, DI and 4 Stroke
Compression ratio	15.5:1
Bore and Stroke	80 mm and 110 mm
Method of loading	Eddy current dynamometer
Method of starting	Manual cranking or Self Starter
Method of cooling	Water
Type of ignition	Compression ignition
Nozzle opening pressure	210 bar
Lube oil	SAE40

V. RESULT AND DISCUSSION

A. Brake Thermal Efficiency

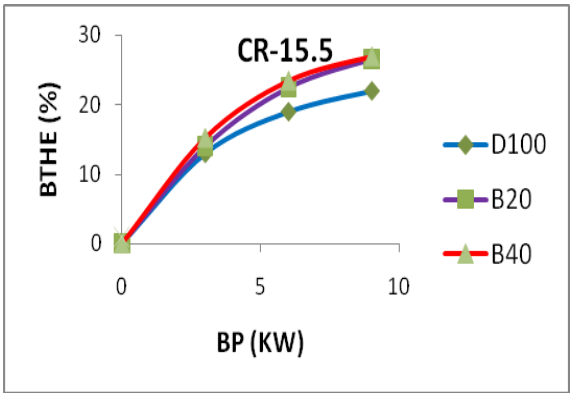

Fig. 2.BP Vs BTE.

The pure diesel and blends B20 and B40 are making the brake thermal efficiency (BTE) which are compared in the fig.2. It shows the BTE is increase with load for both blends. Its almost same for lower loads. For higher loads there is a variation up to 15% for B20.

B. Specific Fuel Consumption

The SFC of blends with diesel is compared in the fig.3. It shows that SFC increases for both blends with VCR than pure diesel because of the high viscosity blend and calorific value when compared to diesel.

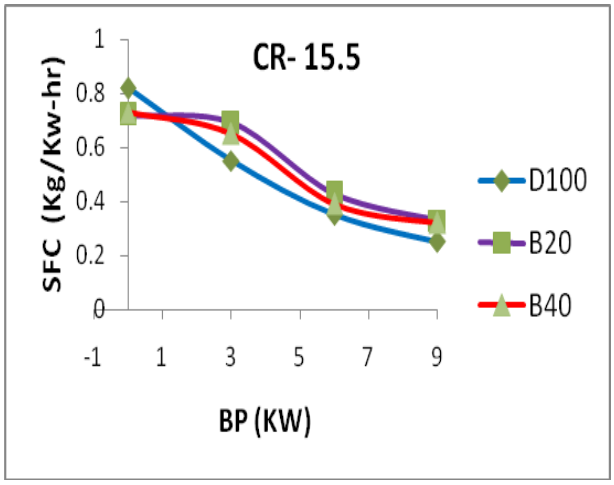

Fig. 3.BP Vs SFC.

C. CO2 Emission

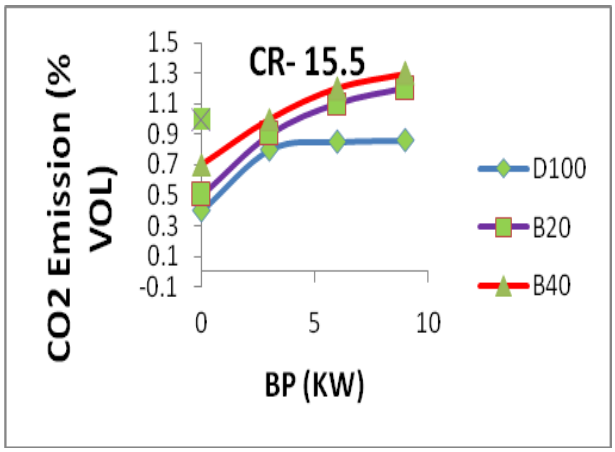

Fig. 4.BP Vs CO2.

The CO_2 emitted is higher forB20 and B40 that of diesel is shown in fig.4 due to fuel incomplete in combustion. For supplying the additional oxygen to the cylinder will rectify the incomplete combustion of the fuel. From observations and graph, CO_2 of biodiesels that are little bit higher that of diesel at 80 % load.

D. HC Emissions

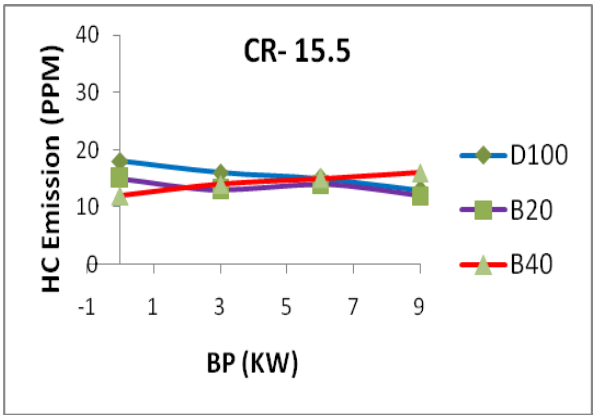

Fig. 5.BP Vs HC Emission.

we seen that for B20 & B40 samples tried, the emission of HC is found to diminish along with increment in load. From the fig.5. Biodiesels emits less hydro carbon discharges than diesel up to half load. Both the mixes show very high HC emission than diesel for above 50% load.

E. NOx Emissions

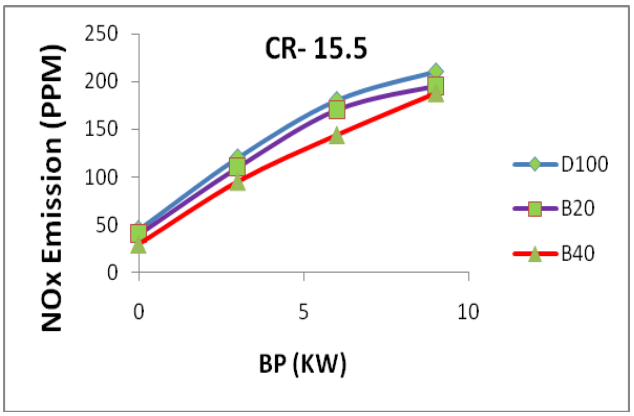

Fig. 6.BP Vs NOx emission.

From the fig. 6. it is seen that both the mixes tried created lower NOx discharge than diesel for all the loads.Additionally, the rate increment in NOx outflow is high at high loads.

VI. CONCLUSION

The emission characteristics and performance of engine for oil from tomato seed is blend on variable compression engine ratio are investigated.

- It shows the brake thermal efficiency is increase with load for both blends
- It shows that SFC increases for both blends with VCR than pure diesel.
- Hydrocarbon emission is less compare to diesel for up to 50% loads and increasing thereafter.
- Carbon dioxide emission is little bit more as diesel for all loads. .only for higher loads its increasing
- NOx emissions less for both blends compare to diesel

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