Experimental Investigations on Single Cylinder CI Engine for Variable Compression Ratio & Variable Injection Pressure Using Treble Fuel

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Abstract- For the very existence of internal combustion engine in the wide spread as they are now, it is renewable, sustainable and alternative fuel that the world looks forward i.e. biodiesel instead of diesel. It has been increasingly fuelled to study its effects on engine performances and emissions in the recent two decades. The researches regarding blend of diesel and single biodiesel have been done already. Very few works have been done with the combination of two different biodiesel blends with diesel and left a lot of scope in this area. The present investigation is to bring performance for two biodiesels from different feedstock i.e. waste cooking oil biodiesel and palm staerin biodiesel. The effects of dual biodiesel in diesel at various proportions were examined in a single cylinder, direct injection, air cooled and high speed diesel engine at various engine loads with constant engine speed of 3000 rpm and with variable compression ratio & variable injection pressure.

Keywords – variable compression ratio, variable injection pressure, waste cooking oil biodiesel, palm staerin biodiesel

I. INTRODUCTION

India ranks sixth in the world in the term of energy demand accounting for 3.5 % of world commercial energy demand. It is expected to grow at 4.8%. The growth in energy demand in all forms is expected to continue unabated owing to increasing urbanization ,standard of living and expanding population with stabilization not before mid of the current century.[1]

Bio-diesel consists of mono alkyl esters produced from vegetable oils, animal or old cooking fats. Bio-diesel contains no petroleum diesel, but it can be blended with petroleum diesel**.** Mono-alkyl esters of long chain fatty acids (biodiesel) is a promising substitute of petro diesel fuel that can be produced from natural, renewable resources such as wide variety of vegetable oils and animal fats.[1]

Now-a-days dual fuel technique is most widely adopted with blended fuel and gaseous fuel. In the present experiment, dual biodiesel i.e. waste cooking oil biodiesel plus palm stearin biodiesel and hydrogen are used in compression ignition engine to reduce emission and increase the performance characteristics [2].

II. MATERIALS AND METHODS

A. VCR Engines

The standard available engines (with fixed compression ratio) can be modified by providing additional variable combustion space. There are different arrangements by which this can be achieved. Tilting cylinder block method is one of the arrangements where the compression ratio can be changed without change is combustion geometry. With this method the compression ratio can be changed within designed range without stopping the engineWhere the parameter α is called embedding intensity and their effect of validity of the algorithm directly is apply after this process, after that apply the inverse wavelet transform to the image for find out watermark image.

B. Experimentation

Engine Specifications
The test is carried out in an engineering college using a
kirloskar make,
Type 1cylinder,
4 stroke diesel,
Water cooled,
Model tv1,
Stroke 110 mm,
Bore 87.5 mm.
661 cc,
VCR engine CR range 12 to 18.
Dynamometer Type eddy current,
Water cooled,
Loading unit Eddy current

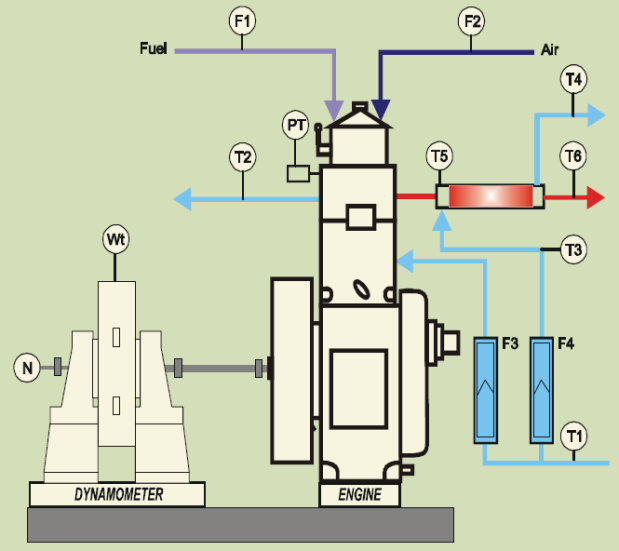

Figure 1. Block diagram for the test set up

C. Experimental setup

Where,

F1	Fuel consumption	
F2	Air consumption	
N	Engine speed	rpm
Wt	Loading in	kg
F1	Fuel consumption	kg/hr
F2	Air consumption	kg/hr
F4	Calorimeter water flow	kg/hr
T1	Engine water inlet temperature	^{0}K
T2	Engine water outlet temperature	^{0}K
T3	Calorimeter water inlet temperature	^{0}K
T4	Calorimeter water outlet temperature	^{0}K
T5	Exhaust gas to calorimeter inlet temp.	^{0}K
T6	Exhaust gas from calorimeter outlet temp.	^{0}K

Table -1 Properties of diesel, waste vegetable oil [3] & and palm staerin [4]

Properties	Diesel	Waste vegetable oil	Palm Staein oil
Density @ 15°C in gm/cc	0.845	0.8868	0.855@40°C
Viscosity @ 40°C	3.25	6.05 cst	4.5
Flash Point by PMCC method	32	52°C	174°C
Fire Point by PMCC method	78	86°C	--
Calorific Value in Kcal/kg	44938	8919	43938

III. EXPERIMENT AND RESULT

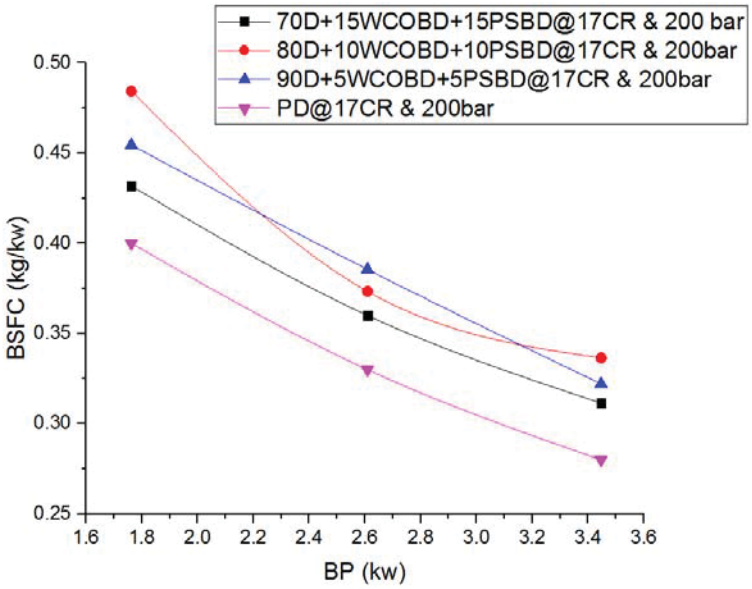

Figure 2. BP V/S BSFC Plot for WCOBD + PSBD + Diesel @ 17 Compression ratio & 200Bar injection pressure

The above graph reveals that as the biodiesel blends increase in its constituent the bsfc approaches near to diesel fuel, hence 30% biodiesel has been successfully fractioned at 15%wcobd and 15% psbd.

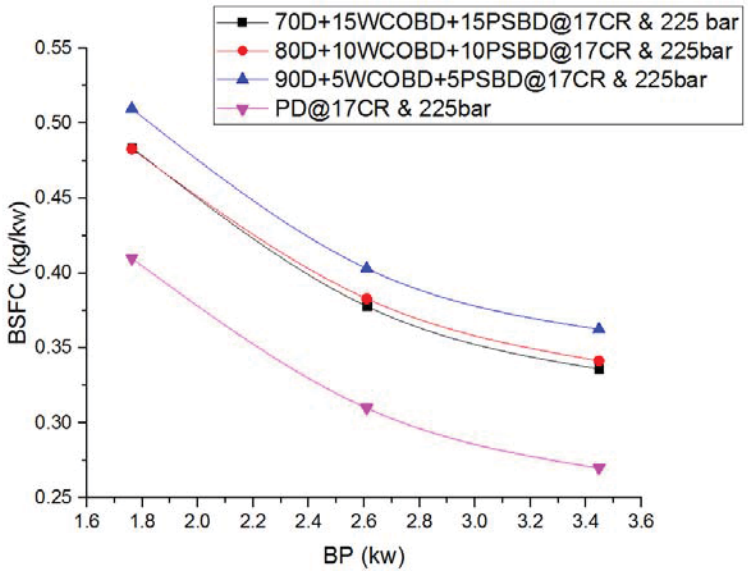

Figure 3. BP V/S BSFC Plot for WCOBD + PSBD + Diesel @ 17 Compression ratio & 225Bar injection pressure

The above graph reveals that as the biodiesel blends increase in its constituent the bsfc approaches near to diesel fuel, hence 30% biodiesel has been successfully fractioned at 15%wcobd and 15% psbd.

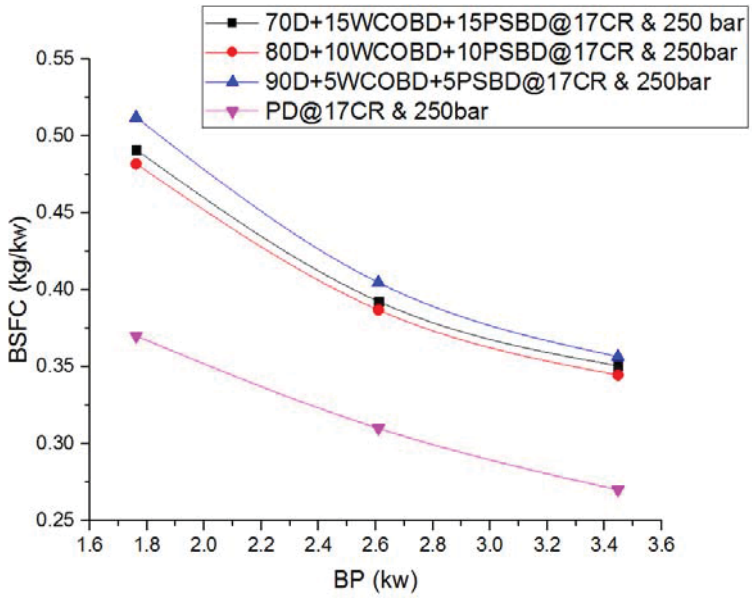

Figure 4. BP V/S BSFC Plot for WCOBD + PSBD + Diesel @ 17 Compression ratio & 250Bar injection pressure

The above graph reveals that as the biodiesel blends increase in its constituent the bsfc approaches near to diesel fuel, hence 30% biodiesel has been successfully fractioned at 15%wcobd and 15% psbd. The optimum being 20% biodiesel.

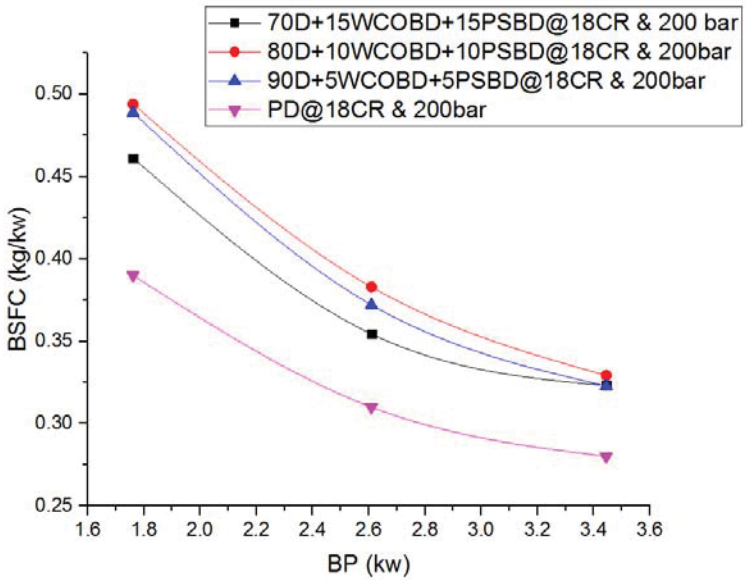

Figure 5. BP V/S BSFC Plot for WCOBD + PSBD + Diesel @ 18 Compression ratio & 200Bar injection pressure

The above graph reveals that as the biodiesel blends increase in its constituent the bsfc approaches near to diesel fuel, hence 30% biodiesel has been successfully fractioned at 15%wcobd and 15% psbd.

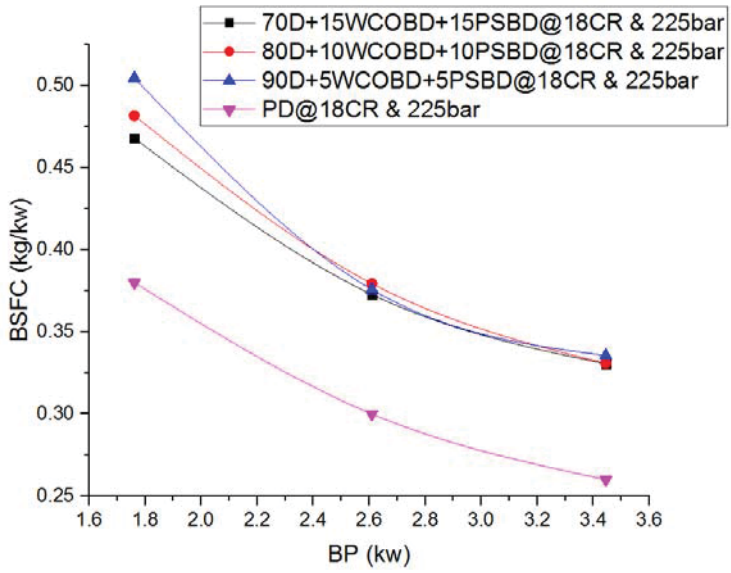

Figure 6. BP V/S BSFC Plot for WCOBD + PSBD + Diesel @ 18 Compression ratio & 225Bar injection pressure

The above graph reveals that as the biodiesel blends increase in its constituent the BSFC approaches near to diesel fuel, hence 30% biodiesel has been successfully fractioned at 15%wcobd and 15% PSBD. Further at heigher loads i.e. BP the bsfc converge even for low blended mixtures.

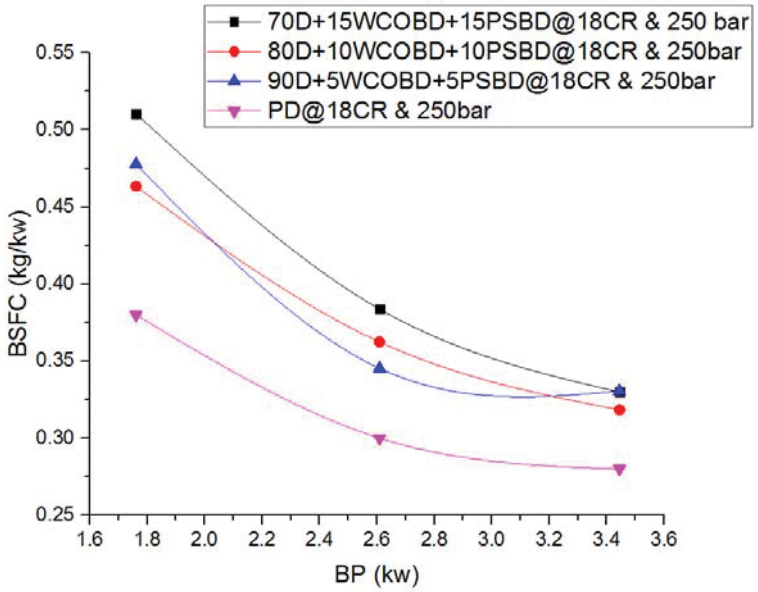

Figure 7. BP V/S BSFC Plot for WCOBD + PSBD + Diesel @18 Compression ratio & 250Bar injection pressure

The above graph reveals that as the biodiesel blends increase in its constituent the BSFC approaches away from diesel fuel, interpreting to this is that higher cpmoression ratio and injection pressure the treand reverses hence 90% biodiesel has been successfully fractioned at 10%wcobd and 10% psbd, which seems to be optimum . At heigher injection pressure the trend reverse and as more blended mixture BSFC increases

IV.CONCLUSION

Compression ratio and injection pressure play a vital role in the performance of internal combustion engine working on biodiesel. At higher compression ratios and high injection pressure BSFC increase for the blended mixtures when

the proportion is elevated. Hence it is experienced that the optimum operating pressure is 18 @ 225bar injection pressure.

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