International Journal of Advances in Engineering and Management (IJAEM)
Volume 2, Issue 4, pp: 104-109 www.ijaem.net ISSN: 2395-5252

Performance Analysis of Grape Seed Oil as BIOFUEL Blends With Diesel in CRDI Engine

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Date of Submission: 28-07-2020 Date of Acceptance: 12-08-2020

ABSTRACT: over the last two decades there has been a tremendous increase in the number number of automobiles and a corresponding increase in thefuel price. In this regard, alternative fuels like vegetable oils play a major role. Use of pure vegetable oil in diesel engines causessome problems due to their high viscosity compared with diesel fuel. To solve the problems due to high viscosity various techniquesare used. One such technique is fuel blending. In the present work the grape seed biodiesel (B25, B50 and B75); preparedby transesterification process was used as an alternative fuel in a diesel engine. Investigations were carried out for the performance and combustion characteristics ofgrape seed biodiesel. The results were compared with diesel fuel. For this experiment, a singlecylinder, four stroke, water cooled diesel engine at a rated speed of 1500 rpm was used.Tests were carried out over the entire rangeof engine operation at varying load of 0, 1, 2, 3, 4, 5 at rated speed of 1500rpm and results are compared with diesel. The thermalefficiency, bsfc, mechanical efficiency, volumetric efficiency are well comparable with diesel for diesel engine and CRDI engine and better performance and combustion characteristics are observed in case of CRDI engine.

KEYWORDS—Grape seed bio-diesel, CRDI (Common rail direct injection)

I. INTRODUCTION

Fossil fuels are current world scenario in which even the world economy depends on. Depletion of fossil fuels with increase in price rise also with alarming increase in pollution levels are major crisis for the society and our environment. Most of the alternative bio-fuels identified today are proved to be a partial substitute for existing one due to its undesirable fuel characteristics (Devan and mahalakshmi 2010). Adding to this a large number of vehicles is being introduced in the roads every day. Hence there is need for introducing new types of fuels in order to overcome the depletion of fossil fuels and increase in pollution. The biological based alternative fuels called bio-fuels where identified well before the exploration of the other promising alternative fuels. In order to overcomethese demands some forms of bio diesel can be extracted and used which should be comparative on par with diesel with parameters like efficiency and emission. Since we have a large and abundant resources required for abundant production of bio diesel we also should ensure that the new fuel should be efficient and less pollutant when compared with diesel. In order to increase the quality of the bio diesel produced certain filtration and distillation can be made to make the new fuel to be much more efficient. This in case, if done the downward movement of agricultural sector and the eviction of farmers from agriculture can be stopped. This can even re design the agricultural practices that are being formulated and by adding additional revenue for our country. This can also reduce the demand of import of fossil fuels adding revenue for the country by reducing foreign exchange. The main prospective is that this can lead to reduction in import of fossil fuel since we import 80% of fossil fuels regularly.

In order to use bio fuels their properties should be redesigned on par with diesel to use it in Conventional diesel engines .There are certain efficient methods like trans esterification through which the properties of raw vegetable oil can be altered and can be converted into usable form of fuel.

II. LITERATURE SURVEY

1. P.K. Devan and N.V. Mahalakshmi analyzed the complete replacement of diesel fuel with bio-fuels. For this purpose; bio-fuels, namely, methyl ester of paradise oil and eucalyptus oil were chosen and used as fuel in the form of blends. Various proportions of paradise oil and eucalyptus oil are prepared on a volume basis and used as fuels in a single cylinder, four-stroke DI diesel engine, to study the performance and emission characteristics

of these fuels. In the present investigation a methyl esterderived from paradiseoil is considered as an ignition improver. The results show a 49% reduction in smoke, 34.5% reduction in HC emissions and a 37% reduction in CO emissions for the Me50–Eu50 blend with a 2.7% increase in NOx emission at full load. There was a 2.4% increase in brake thermal efficiency for the Me50–Eu50 blend at full load. The combustion characteristics of Me50–Eu50 blend are comparable with those of diesel.

2. K.Anand et al, indicated that the ignition delay for biodiesel-methanol blend is slightly higher as compared to neat biodiesel and the maximum increase is limited to 1 deg work reported as A maximum thermal efficiency increase of 4.2% due to 10% methanol addition in the biodiesel is seen at 80% load and 16.67 SI engine speed. The unburnt hydrocarbon and carbon monoxide emissions are slightly higher for the methanol blend compared to neat biodiesel at low load conditions whereas at higher load conditions unburnt hydrocarbon emissions are comparable for the two fuels and carbon monoxide emissions decrease significantly for the methanol blend. A significant reduction in nitric oxide and smoke emissions are observed with the biodiesel-methanol blend.

3. Jincheng Huang et al, carried out the thermal efficiencies of the engine fuelled by the blends were comparable with that fuelled by diesel the smoke emissions from the engine fuelled by the blends were all lower than that fuelled by diesel; the carbon monoxide (CO) werereduced when the engine ran at and above its half loads, but were increased at low loads and low speed; the hydrocarbon (HC) emissions were all higher except for the top loads at high speed; the nitrogen oxides (NOx) emissions were different for different speeds, loads and blends.

4. Silvia Mironeasa et al discussed for different grape varieties from different growing regions have been studied in terms of the physico-chemical and structural characteristics. Also the content obtained from the seed oil and the qualities of the oil were analyzed. The chemical values obtained from the analyzed species, as a percentage of dry matter varies between 8-68 and 9, 78 - for protein, between 6-26 and 9-01 - for oil, between 2-14 and 8-28 for Ash and the total of carbohydrates is between 64-72 and 73.01%.

5. G.R. Kannan and R. Anand investigated the performance, emission and combustion characteristics of the engine under different load conditions at a constant speed of 1500 rpm. The results indicated that biodiesel and micro emulsion fuels had a higher brake specific fuel consumption (BSFC) than that of diesel. A slight improvement in the brake specific energy consumption (BSEC) was observed for micro emulsion fuels. The brake thermal efficiency of biodiesel and micro emulsion fuels were comparable to that of diesel. The emission characteristics like carbon monoxide (CO), carbon dioxide (CO2), unburnt hydrocarbon (UHC), nitric oxide (NO)and smoke emissions for biodiesel and micro emulsion fuels were lower than diesel fuel at all load conditions.

6. Carmen Maria Fernandez et al, carried out different methods of extraction, refining and transesterification of grape seed oil were assayed. Two techniques of oil extraction were compared: solvent extraction and pressing. Two conventional transesterifications of the refined oil were carried out using methanol and bioethanol, being the methyl and ethyl ester contents higher than 97 wt. %. Finally, several in situ transesterifications were done. In situ transesterification did not reach either the oil yield extraction or the alkyl ester contents but the obtained biodiesel had better oxidation stability in comparison with the conventional process.

7. Jagadeesh Alku et al carried out for the performance and combustion characteristics of pongamia methyl esters. The results were compared with diesel fuel. For this experiment, a single cylinder, four stroke, water cooled diesel engine at a rated speed of 1500 rpm was used. Tests were carried out over the entire range of engine operation at varying load of 0, 1, 2, 3, 4, 5.2 at rated speed of 1500rpm and results are compared with diesel. The thermal efficiency, bsfc, mechanical efficiency, volumetric efficiency are well comparable with diesel for diesel engine and low heat rejection engine and better performance and combustion characteristics are observed in case of LHR engine. From investigation it can be stated that up to 25% blend of pongamia biodiesel can be substituted for diesel engine without any modification and with Modification we can blend up to 25% we can get better performance and combustion characteristics than normal engine.

8. T. Elango and T. Senthilkumar, investigated performance and emission characteristics of a diesel engine which is fuelled with different blends of jatropha oil and diesel (10-50%). A single cylinder four stroke diesel engine was used for the experiments at various loads and speed of 1500 rpm. An AVL 5 gas analyzer and a smoke meter were used for the measurements of exhaust gas emissions. Engine performance (specific fuel consumption SFC, brake thermal efficiency, and exhaust gas temperature) and emissions (HC, CO, CO2, NOx and Smoke Opacity) were measured to evaluate and compute the behavior of the diesel engine running on

biodiesel. The results showed that the brake thermal efficiency of diesel is higher at all loads. Among the blends maximum brake thermal efficiency and minimum specific fuel consumption were found for blends up to 20% Jatropha oil. The specific fuel consumption of the blend having 20% Jatropha oil and 80% diesel (B20) was found to be comparable with the conventional diesel. The optimum blend is found to be B20 as the CO2 emissions were lesser than diesel while decrease in brake thermal efficiency is marginal.

III. BIODIESEL PRODUCTION AND PROBERTIES

The chemical process commonly used make bio-oils lessviscous, turning them into “biodiesel” is called“Transesterification”

A. Transesterification Process

Grape seed oil was used as the raw oil to be transesterified withmethanol in a reacting tank. The temperature values are below in the reactant mixture from evaporating.The potassium hydroxide was stirred with methanol for 10minutes using an electric-magnetic stirrer to form potassiummethoxide, which was then poured into the reacting tank and mixed with the grape seed oil. The total reaction time was 60 minutes. Almost total conversion to grape seed oil bio diesel wasachieved quickly after a few minutes from the start of the reaction, depending on the ambient conditions.

B. Properties of biodiesel comparison with diesel

Properties	Diesel	Grape seed biodiesel
Viscosity at 40°c (centi stokes)	35.2	37.6
Flash point(°c)	48	87
Fire point(°c)	63	87
Pour point(°c)	3	-9
Calorific value (kj/kg)	43989	10413
Density at 15°c (gm/cc)	0.82	0.8507

IV. EXPERIMENTATION

Engine components:

Figure.1 Experimental set up

The figure.1 shows line diagram of set up. The important components of the system are
(i) The engine
(ii) Dynamometer

Table 2 Engine specifications

Maker	Kirloskar Av1
Type	Vertical cylinder, DI diesel engine
Speed	1500 rpm
Compression ratio	17:1
Cooling system	Water
Fuel	Diesel& bio diesel
Bore and stoke	87.5mm × 110mm

Testing procedure

Experiments were conducted with esterified grape seed oil and diesel blends having 25%, 50%, 75%, and 100% (B25-B100) esterified grape seed oil on volume basis at different load levels. Tests of engine performance on pure diesel were also conducted as a basis for comparison. The percentage of blend and load, were varied and engine performance measurements such as brake specific fuel consumption, air flow rate, and exhaust gas temperature and emissions were Measured to evaluate and compute the behavior of the diesel engine. Each time the engine was run at least for few minutes to attain steady state before the measurements were made. The experiments were repeated thrice and the average values were taken for performance and emission measurements.

V. RESULTS AND DISCUSION

A series of engine tests were carried out using diesel and biodiesel to find out the effect of various blends on the performance and emission characteristics of the engine. Investigations are carried out on the engine mainly to study the effect of specific fuel consumption, brake thermal efficiency, exhaust gas temperature and emissions such as NOx, CO, CO2, HC and smoke opacity.

Comparative analysis of performance and emission characteristics of grape seed Biodiesel blends and diesel on normal engine.

Performance characteristics:

A.Variation of specific fuel consumption with brake power

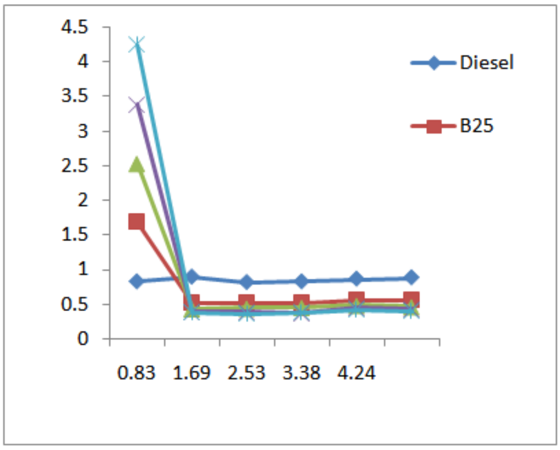

Figure 1. Variation of specific fuel consumption with brake power

Fig. 1 shows Brake specific fuel consumption variation brake power for the grape seed oil and pure diesel. It isobserved that the brake specific fuel consumption is found todecrease with increase in load. Among the blends B25 concentration shows the minimum specific fuel consumption than other blends and pure diesel. The minimum BSFC is observed as 0.36 for B25 blend where as for pure diesel it was 0.37 at initial load of the engine. This may due to better combustion and an increase in the energy content of the blend.
This is also due to lower calorific value of the blended fuel as compared with diesel.

B.Variation of mechanical effiency with brake power

The variation of mechanical efficiency with brake power, for diesel and grape seed biodiesel blends are as shown in figure..2 for normal engine . The mechanicalefficiency of diesel is slightly higher than the grape seedbiodiesel in case of normal engine. From the graph it is increasein the concentration of grape seed biodiesel in dieseldecreases the mechanical efficiency. Here we can see theeffect of thermal barrier coating which increases themechanical efficiency. At full load D100 and B25 in DI hasmaximum efficiency of 77.23% and 77.23% respectively This is due to fuel burning completely in DI engine due increased temperature in combustion chamber.

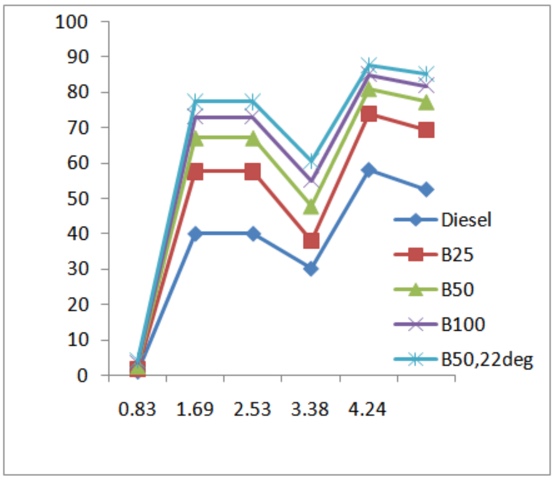

Figure 2. Variation of mechanical efficiency with brake Power

C.Variation of brake thermal efficiency with brake power

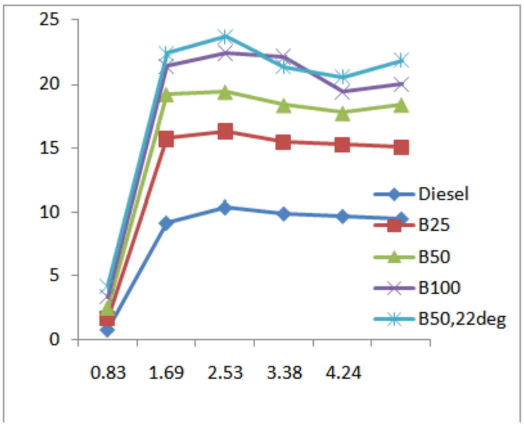

Figure 3 Variation of brake thermal efficiency with brake power

International Journal of Advances in Engineering and Management (IJAEM)
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The brake thermal efficiency variation with brake power for the grape seed oil and diesel are shown in figure3. It can be seen that in the beginning with increasing brake power of the engine the brake thermal efficiency of various concentration of blends and pure diesel were increased. The maximum brake thermal efficiency of the engine was 23.69 for corn oil B25 at brake power 4.24 where it is 22.38 for diesel. This is due to improved atomization fuel vaporization, better spray characteristics and improved combustion through mixture.

Emission characteristics:

D.Variation of hydrocarbon with brake power

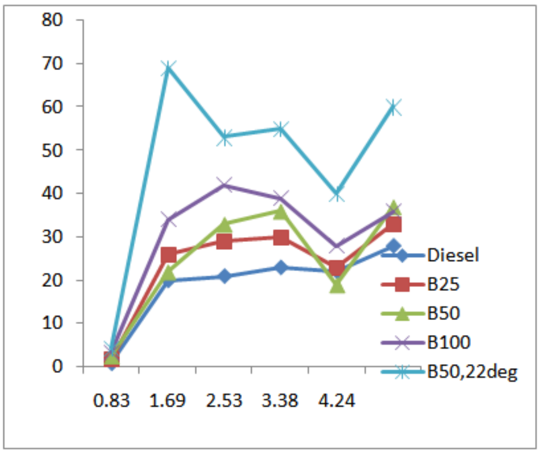

Figure 4. Variation of hydro carbon with brake power

The hydro carbons variation with brake power for the grape seed oil and diesel are shown figure-4.The hydro carbons are lower for all the blends for the grape seed oil compared with diesel. The lowest value of HC was 21 at brake power 0.83 and it was 25 for diesel. This result depends on oxygen quantity and fuel viscosity, in turn atomization.

E.Variation of NO_X with brake power

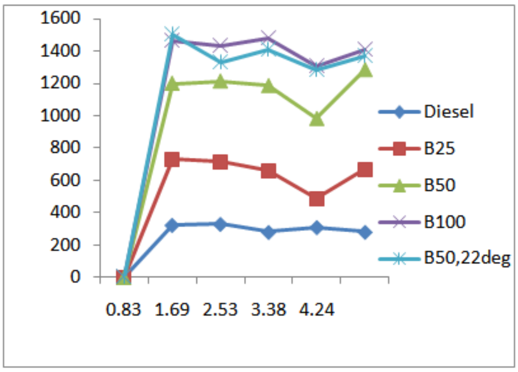

Figure 5. Variation of NO_X with brake power

The NO_X variation with brake power for the grape seed oil and diesel are shown figure-5.The NO_X are lower for all the blends for the grape seed oil compared with diesel. The lowest value of NO_X was 280 at brake power 0.83 and it was 324 for diesel. This result depends on oxygen quantity and fuel viscosity, in turn atomization.

F.Variation of CO_2 with brake power

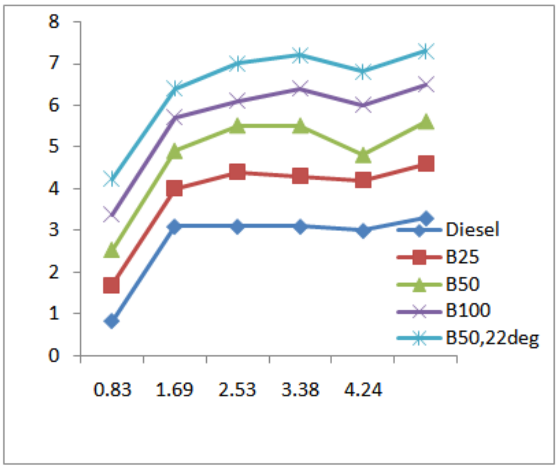

Figure 6. Variation of CO_2 with brake power

The variation of carbon dioxide with brake power of the engine is shown in figure-6. It is observed that carbon dioxide emission increase with increase of brake power. The Minimum carbon dioxide value for the grape seed oil was 3 at B50 and at the initial brake power 0.83 at it was 3.10 for diesel. This is a result of low availability of oxygen during combustion.

VI. CONCLUSIONS

The following conclusions were drawn from these investigations carried out on normal DI Diesel engine and CRDI engine for different loads. The conclusions ofthis investigating at are as follows.

- The maximum brake thermal efficiency 23.69% was observed with the blend B25 as compared to purediesel and the other blend at the brake power 4.24kwof the engine.
- The specific fuel consumption of the 0.36kg/kw-hr was observed with the blend B15 the SFC is lowerfor above blend than that of other blends and purediesel.
- In the combustion analysis, the maximum cylinder pressure observed as 81bar for B7 blends than all the other blends at maximum brake power of the engine.
- The heat release rate are also higher for 75 blend than pure diesel and all the other blends.

- The CO_2 percentage increased with increase of loads. The minimum value occurred at B75&B100.
- The hydro carbons are also lower for all the blends compared with diesel.

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International Journal of Advances in Engineering and Management
ISSN: 2395-5252

IJAEM

Volume: 02 Issue: 01 DOI: 10.35629/5252

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