ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Performance and Emission Analysis of Safflower Biodiesel on VCR Engine by Varying Injection Pressure

Saladi Pranav Sagar
PG Student,
Department of Mechanical Engineering
Bonam Venkata Chalamayya Engineering College
Odalarevu-533210

Mr. G. Narasa Raju, M.Tech. (Ph.D)
Associate Professor
Department of Mechanical Engineering
Bonam Venkata Chalamayya Engineering College
Odalarevu-533210

Abstract

Due to the diminishing reserves of petroleum fuels and environmental degradation, the search for alternate fuels for diesel engines has been intensified from the last two decades. Diesel engines are the major source of transportation, industrial power generation and agriculture sector. Using straight vegetable oils in diesel engines is not an invention; Rudolf Diesel first used peanut oil as a fuel in his newly developed CI engine. During the World War II vegetable oils were used as fuel in emergency conditions when diesel was scarce. Due to gradual depletion of world petroleum reserves and the impact of environmental pollution of increasing exhaust emissions, there has been focus on vegetable oils and animal fats as an alternative to petroleum fuels. Vegetable oils are renewable and environment friendly. Vegetable oils can be substituted for diesel fuel if viscosity is reduced by blending it with diesel. Due to its calorific valve which is slightly.

The fuel properties of esterified safflower oil and its blend with diesel fuel at different proportions are studied including engine tests. This study gives the comparative measures of brake specific fuel consumption, brake power, brake thermal efficiency, mechanical efficiency, volumetric efficiency, CO, CO2, HC, NOx and smoke opacity. The results indicate that the CO and HC emissions were lower than diesel at SBD20 CR16.5 at 210. At full load 210 SBD20 CR16.5 indicated thermal efficiency is more than diesel. From the investigation it can be concluded that biodiesel can be used as an alternative to diesel in a compression ignition engine without any engine modifications.

KEY WORDS: ***Safflower oil, VCR Engine, Smoke opacity, Alternative Fuel.***

INTRODUCTION

The concept of using bio fuels dates back to 1885 when Dr. Rudolf Diesel built the first diesel engine with the full intention of running it on vegetative source. In 1892 he stated “The diesel engine can be fed with vegetable oils and would help considerable in the development of agriculture of the countries which use it and that the use of vegetable oil for engine fuels may seems insignificant today. But such oils may become in course of time as important as petroleum and the coal tar products of the present times”.

MATERIALS AND METHODS

In this project we tried to investigate the potential use of safflower seed oil Methyl Esters as Bio-diesel. During the course of this project we have actually prepared safflower Seed Oil Methyl Ester (SSOME) (pure bio-diesel or B100).

Various experiments were conducted on SSOME and the results were recorded. We collected the results of safflower Oil Methyl Ester from various journals and research papers. The results of SSOME were compared with conventional diesel. A brief introduction about the material used in this project is given below.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Figure: 1.1 SAFFLOWER SEEDS

Table: 1.1 Characteristic of safflower Oil

PROPERTIES	VALUE
Acid value	Not more than 6.0
Saponification value	186-196
Iodine value	135-148
Unsaponifiable matter,%	Not more than 1.0 per cent
Calorific value KJ/kg	35894
Cetane number	41
Specific gravity	0.9246-0.9280
Density in kg/m3	883
Fire point	234

STEPS INVOLVED IN TRANSESTERIFICATION

Now take 1 liter of sample oil.

That oil is to be heated up to 55 to 600 c temperature but not exceed 700 c.
Now take 200 ml of methanol or ethanol in to that add 4.5 grams of KOH.

Shake that mixture well up to KOH dissolved fully. It will become potassium meth oxide solution.

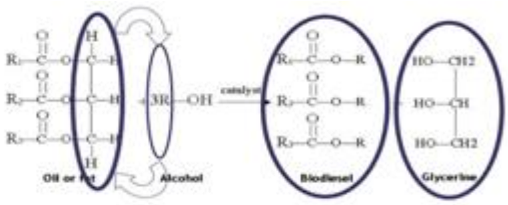
Now add that solution to 1 liter sample oil with constant stirring of raw oil. Stir up to 10 to 15 minutes.

Leave that solution to settle down up 8 to 10 hours.

It will form two distinct layers.

That upper layer is called Bio-diesel and lower dark and thick layer called glycerol which is used to make soap.

Figure3.2: transesterification equipment



Equipment for Constant Heating

In transesterification process we need constant heating to separate the esters, for this we used a steam bath it is shown in plate 3.1

Figure3.3: Constant Heating

Separation of Methyl esters

After transesterification the mixture at the end is settle for at least 10 hours. The lower layer will be of glycerin and the upper layers ethyl ester (bio-fuel). After settling we have to separate the ethyl ester from the glycerin shown in plates 3.2 and 3.3. The mixture is separated by using a separating flask.

Figure3.4: Process of Separation

Glycerin is the useful by–product produced in process of making bio-diesel, which is used in the making of soap's and many other beauty products.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Washing of bio-fuel

Washing the ester is necessary to improve fuel properties largely by removing the residual, free glycerol and small amount of KOH remaining from the catalyst. The primary purpose of the ester washing step is the removal of any soaps formed during the transesterification reaction. In addition water provides a medium for addition of acid to neutralize the remaining catalyst

PREPERATION OF BLENDS WITH DIESEL

The obtained Bio-Diesel is blended for conducting the performance test, the Lin seed Bio- Diesel is mixed in proper proportions.

Procedure

1. The Bio- Diesel is first filtered form impurities.
2. Required amount of fuel and Bio-Diesel is taken into the measuring jar and mixed thoroughly the amount of proportions shown in table.
3. Obtained SBD fuel properties are find out and these values are tabulated in tables.

Table: 3.1 Blending Percentage of Fuel

Notation	Fuel Quantity	Bio-Diesel Quantity	Diesel Quantity
SBD20	1 LITRE FUEL	200 ml	800ml
SBD40	1 LITRE FUEL	400 ml	600ml
SBD60	1 LITRE FUEL	600 ml	400 ml
SBD80	1 LITRE FUEL	800 ml	200 ml
SBD100	1 LITRE FUEL	1000ml	0ml
SBD00	1 LITRE FUEL	0ml	1000ml

Figure: 3.6 (a) SBD20 (b) D10

SPECIFICGRAVITY- RESULT

Table: 3.2 Results of Specific Gravity for SOME and Diesel

S.No	Oil	Notation	Specific Gravity
1.	Diesel	D100	0.850
2.	Safflower Oil Crude	SOME	0.872
3	Safflower Oil Methyl Ester Blends With Diesel (SBD)	SBD20	0.86

VISCOSITY – RESULTS

Table 3.3: Viscosities for SBD and Diesel at 40 degree centigrade

S.NO	OIL	Notation	KinematicViscosity(Cst)
1	Diesel	D100	3.05
2	SafflowerMethyl Ester	SBD100	24.12
3.	Safflower Methyl Ester (SBD)	SBD20	3.94

CALORIFIC VALUE RESULTS

Table: 3.4 Results of Calorific Value in kJ/kg for SSOME and Diesel

Oil	Diesel	SBD20	SBD40	SBD60	SBD80	Crude Safflower Oil
Calorific Value	42489	41318	39562	39194	38757	36248

After find all properties of SOME then next stage performance and emissions parameters are find with the help of 4-stroke single cylinder compression ignition diesel engine, Gas analyzer and smoke meter.

FLASH AND FIRE POINTS – RESULTS

Table: 3.5 Results of Flash and Fire Points of SOME and Diesel

S. No	Oil	Notation	Flash Point	Fire Point
1.	Diesel	D100	57	61
2.	Raw Safflower Oil	SBD100	225	235
3.	Oil Methyl SafflowerEster(SSOME)	SBD20	259	242

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

CARBON PERCENTAGES – RESULTS

Table: 3.6 Results of Carbon Residue for SOME and Diesel

S. No	Oil	% of Carbon
1.	Diesel	0.1
2.	Safflower Oil	0.39

The variation of brake power with loads for different CR and FI combinations are included in the below charts. The engine is run for constant speed for both diesel and SBD20 at each loading condition. However, with the increase in load, BP increases. SBD20 for CR15 and CR18 shows high BP at full load. For low loads i.e. no load, 20% and 40% loads diesel shows good results, whereas for 60%, 80% and full load SBD20 CR15 shows high BP compared to other combinations. Fuel Injector of 230bar under 80% load and full load produces high BP; SBD20 CR18 shows almost equal values as that of die

Chart 6.1: Variation of Shaft output with engine Load (Fuel Injection-190bar)

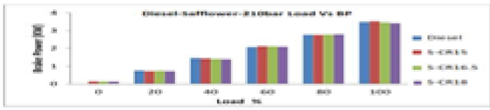


Chart 6.2: Variation of Shaft output with engine Load (FI-210bar)

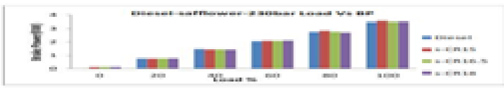


Chart 6.3: Variation of Shaft output with engine Load (FI-230bar)

Volumetric Efficiency

The variation of volumetric efficiency with Loads is shown in Figure. With the increase in load VE reduces for all the CR-IT combinations as shown in Figs. At highest load VE for SBD20 CR18 is almost 7% at 190 and SBD20 CR18 is almost 5% at 230 lower than to that of no load condition. This is because, with the increase in load the fuel supply in the cylinder increases, thereby increase in the residual gases after combustion. This results reduction in the available volume inside the cylinder and creates restriction towards the fresh charge to fill the cylinder. That is why at higher loads VE reduces.

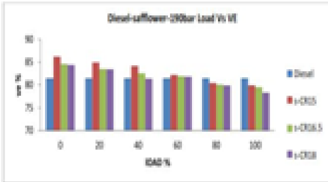


Chart 6.13: Variation of Volumetric Efficiency with engine Load (FI-190bar)

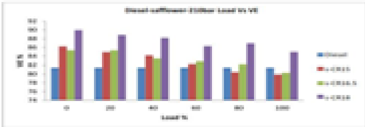


Chart 6.14: Variation of Volumetric Efficiency with engine Load (FI-210bar)

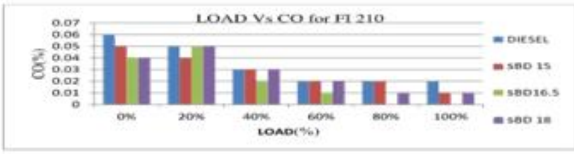


Chart 6.15: Variation of Volumetric Efficiency with engine Load (FI-230bar)

Indicated Thermal efficiency

The variation of Indicated Thermal efficiency for all the combinations of CR and FI combinations is included in the charts. From the trends of the diagrams it can be understood that the SBD20 run provides almost a similar efficiency to that of diesel. It has been seen that for FI 210bar at 100% load SBD20 provides a maximum BThE than diesel.

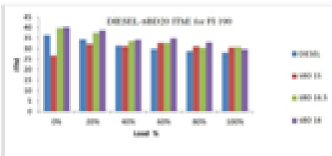


Chart 6.16: Variation of Indicated Thermal Efficiency with engine Load (FI-190bar)

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

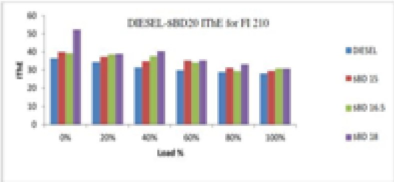


Chart 6.17: Variation of Indicated Thermal Efficiency with engine Load (FI-210bar)

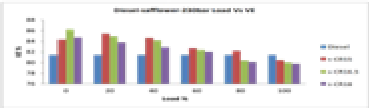


Chart 6.18: Variation of Indicated Thermal Efficiency with engine Load (FI-230bar)

CONCLUSION:

In this project experiments were conducted on computerized variable compression ratio four stroke single cylinder water cooled direct injection diesel engine at constant speed using various safflower biodiesel blends. The conclusions were as listed here after comparing all the test results with baseline test results based on performance and emission parameters.

REFERENCES

1. Swarna Kumari, CH. Penchalayya, A.V. Sita Rama Raju, Performance Evaluation of Diesel Engine with Safflower oil, Journal of Engineering Studies and Research -Volume 19 (2013) No. 2

2. Narayan Reddy, J., Ramesh, A., Parametric studies for improving the performance of a Jatropha oil-fuelled compression ignition engine, Renewable Energy, vol.31, no. 12, 2006, p. 1994–2016.

3. Agarwal, A.K., Bijwe, J., Das, L.M., Effect of biodiesel utilization on wear of vital parts in compression ignition engine, J. Eng. Gas Turbines Power, vol. 125, 2003, p. 604-615.

4. Gandhi, V.M., Cherian, K.M., Red cell hemolytic test as an in vitro approach for the assessment of toxicity of Karanja oil, Toxicol. in Vitro, vol. 14, 2000, p. 513-519.

5. Srivastava, A., Prasad, R., Triglycerides-based diesel fuels, Renew. Sust. Energy Rev.,no. 4, 2000, p. 111 - 144.

6. Abdul, M., Gerpen, J.H., The effect of biodiesel oxidation on engine performance and emissions, Biomass and Bio Energy, vol. 20, no. 4, 2001, p. 317-342.

7. Swarna Kumari, A., Penchalayya, Ch. A., Sitarama, Raju, V., Ravi, Kumar, Puli, Investigations of diesel engine using neemoil, Journal of Engineering Studies and Research, vol.17, no. 4, 2011, p. 44-47.

8. Kalam, M.A., Maskuki, H.H., Biodiesel from palm oil - an analysis of its properties and properties and potential, Biomass and Bio Energy, vol. 23, 2002, p. 471-480.

9. Lin, C.Y., Li, R.J., Engine performance and emission characteristics of marine fish oil biodiesel produced from the discarded parts of marine fish, Fuel Process Technol., vol. 90, 2009, p. 883-891.

10. Pukrakek, W.W., Engineering fundamentals of the journal of the internal combustion engine, USA, Simon and Schuster Company, 1997.

11. Yi; Alex C. “Pollution control system for an internal combustion engine”, Patent no.5517978, 1996.

12. Anand, K., Sharma, R.P. and Mehta. P.S. (2011) Experimental investigations on combustion, performance and emissions characteristics of neat karanji biodiesel and its methanol blend in a diesel engine. Biomass and Bioenergy, 35, 533-541.