Performance Characteristics of Diesel Engine on Sesame Oil- Diesel Blended Fuel

[1]Vivek Pandey, [2]Mukul Kant Paliwal, [3]Vikrant Sharma, [4]Atul Kumar

[1,2,34]Mody University of Science & Technology, Lakshmangarh, Sikar, India

[1]vivekpandey.22@gmail.com, [2]mukulpaliwal.01@gmail.com, [3]vikrantrsharma@yahoo.com,

[4]atulkumargaur25@gmail.com

Abstract- In this world where technology moves faster than anything else, demand of energy resources are increasing for cop up with our requirement. Our earth has vast sources of energy which could provide as much best as possible. But these resources does not gives us guarantee that it could support us in growth of our economy and at the same time provide better environment conditions. We have to choose those options which give us optimum results and help us to reaching our goal of energy security, economic growth and environment safety. In transportation sector, to meet our global requirement, demand of liquid fuel is very high. Although presently we are working on production of third generation biofuel, like algal biofuel, hydrogen fuel, but its implementation would require huge technological challenges to overcome. Until that we can use first and second generation biofuels to fulfil global oil demand and secure oil reserves for future purpose. This study provides utilization of vegetable oil (sesame oil) blend with diesel and its effect on performance parameters of diesel engine.

***Keywords* —blending, brake specific fuel consumption, brake thermal efficiency, diesel, sesame oil**

I. INTRODUCTION

Now a day, due to limited resources of fossil fuels, rising crude oil prices and the increasing concern for environment, there has been renewed focus on vegetable oil as a substitute to petroleum fuel. Fossil fuel is primarily dominating due to its high combustion efficiency, fuel adoptability and handling facility [1]. However the deep concern about fossil fuel is its toxic pollutant generation that links to the global warming, climate change and even some impasse diseases [2]. From the point of view of protecting the global environment and the concern for long term supplies of the conventional diesel fuel, it become necessary to develop alternative fuel comparable with conventional fuels. Diesel fuel drives the transport, farming; commercial, households and industrial sector for the generation of power and replacing a tiny fraction of total consumption by alternative fuels will have a significant impact on the economy and the environment [3]. Petroleum and diesel come in the category of non- renewable fuel and will be exhausted in few decades. These non-renewable also emit pollutants in the form of oxide of nitrogen, oxide of Sulphur, oxide of carbon, lead, hydrocarbon etc. Biodiesel an alternative fuel to commercial diesel which can be evaluated for emission results. However major disadvantage of vegetable oil is its viscosity, which is order of magnitude higher than of mineral diesel [4]. Literature study reveals that vegetable oil can replace for mineral oil if viscosity is reduced by mixing it with diesel or by esterification or by preheating of oil [5]. Biodiesel has low Sulphur contents and hence cause lass environment damage than diesel.

II. MATERIALS AND METHOD

Sesame is originated in Africa, Turkey, India, China, Sudan, Burma, Tunisia, Egypt, Thailand, Mexico, Guatemala, Afghanistan, Pakistan, Bangladesh and etc. The oil content is about 57-63% [9, 10]. Sesame is world's ancient oilseed. This warm- season annual crop is primarily found in well drained soils. India being the largest producer of sesame oil exports around 6,80,000 metric tonne annually. It is unusually high in oil thus decrease in protein content. On one side it is environmentally sustainable to use this fuel on the other hand it will also encourage farmers to plant this crop along with regular food crop. They can also make use of and waste lands for cultivation. Globally, more than 350 oil-bearing crops are identified as potential source of biodiesel which can be classified as edible and non-edible [13] due to diversity of oil bearing crop; it is a challenge to select the potential sources of biodiesel. Hence several of research is ongoing. A number of sources from edible oil are already dominating in several countries. For instance, canola and soybean are used in USA, Palm oil in Malaysia, rapeseed oil in Europe etc. [13, 14]. Sunflower, peanut, coconut and sesame are few other examples of edible oils. The KSRTC began trials of edible oil such as groundnut,

 DOI : 10.18231/2454-9150.2019.0539

sesame, sunflower, castor oil at its engine test bed. A 10 per cent mixing of vegetable oil was used for evaluation of fuel efficiency and smoke emission reduction testing [15]. A comparison of property of Diesel and Sesame oil is given in table 2.1.

Table 2.1 Properties of diesel & sesame oil

Property	Diesel	Sesame oil
Heating value (kJ/kg)	43060	39300
Viscosity (cSt @ 40^0C)	2.814	34.764
Specific gravity	0.825	0.92
Flesh point(^{0}C)	71	260
Fire point(^{0}C)	103	265
Cloud point (^{0}C)	-5	-2
Pour point(^{0}C)	-11	-8
Cetane number	50	40.2

The experimental setup consist a single cylinder, four-stroke, air cooled, kirloskar made 4.4 kW rated power diesel engine. For applying load the engine was coupled with necessary instruments like an eddy current dynamometer with electronic controller. The engine runs at constant speed at 1500 rpm for different load conditions. Fuel consumption measuring unit was provided with engine specifications of the test engine are given in table 2.2

Table 2.2 Specifications of Engine

Parameter	Specification
Model/Make	TAFI/ Kirloskar
Rated BP (bhp/kW)	6/4.4
Rated Speed (rpm)	1500
Number of Cylinder	1
Bore x Stroke (mm)	87.5 × 110
Displacement volume (cc)	662
Compression Ratio	17.5:1

In this experiment we use diesel engine with eddy current dynamometer. Readings were taken at constant as well as varying load conditions on the engine with using dynamometer.

Engine performances parameters such as bhp, bsfc, brake thermal efficiency etc. were evaluated during the course of experiments. Initially the tests were carried out diesel and then sesame-diesel blends were used for further investigation.

III. Results & Discussion

Fuel consumption

Fig.3.1 shows the variations of fuel consumption with break load at various blend proportions in the diesel. From the above graph it shows that at full load condition fuel consumption is enhanced. This graph shows that maximum fuel consumption take place for S15 and minimum fuel consumption is for S25 at full load condition. Fuel consumption of S5, S20, S30 are very much closer to that of diesel at full load. Heating value of blends decrease with increase in percentage of sesame oil this may increase its fuel consumption, but oxygen present in oil provides batter combustion which somehow reduces fuel combustion with more percentage of sesame oil [16].

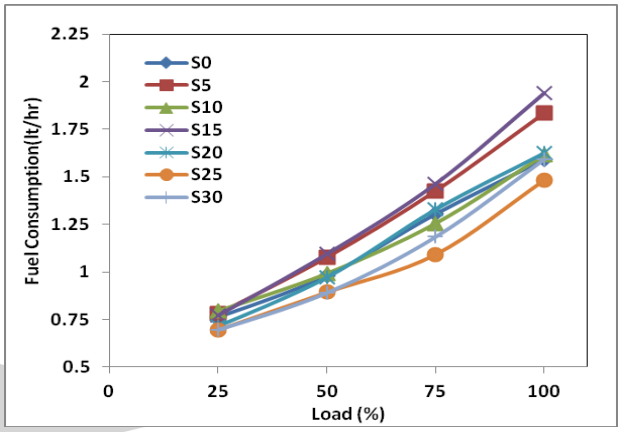

Fig 3.1: Variation of fuel consumption with load

Break specific fuel consumption

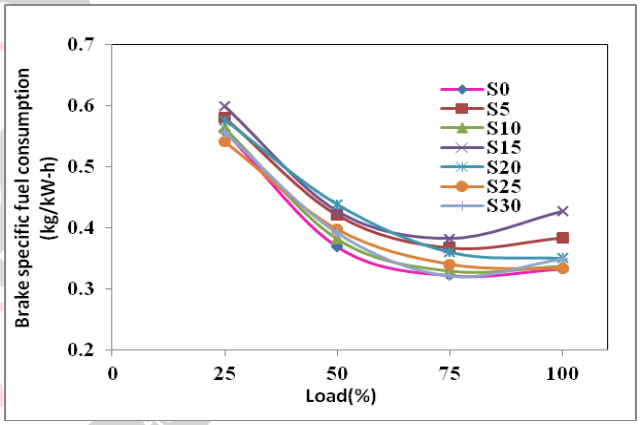

Fig 3.2: Variation of bsfc consumption with load

Fig.3.2 shows the variations of Break specific fuel consumption with break load at various blend proportions in the diesel. The above fig shows that bsfc of diesel is lower as compare to all fuel blends. Maximum bsfc was obtained in case of S15, while S10, S25 and S30 give approximately same results as that of diesel. There is slight increase in brake specific fuel consumption as the cetane number decrease. [17] Although the diesel-sesame oil blend gives almost same power at rated speed but increase in specific fuel consumption can be attributed by low heating value and more density of blends

Break thermal efficiency

The brake thermal efficiency of all tested blends at different load conditions is shown in fig 3.3. Maximum and almost similar brake thermal efficiency has achieved for diesel, S10, S25 and S30 at full load and very much closer to S10, S25 and S30. While lower brake thermal efficiency was observed for blend S5, S15 and S20 at full load. The

 DOI : 10.18231/2454-9150.2019.0539

specific fuel consumption is inversely proportional to brake thermal efficiency. Hence net calorific value and oxygen available in blends plays an important role in increase of brake thermal efficiency [18]. Fig.3.3 shows that break thermal efficiency is lower at initial load condition but as load increase efficiency increase.

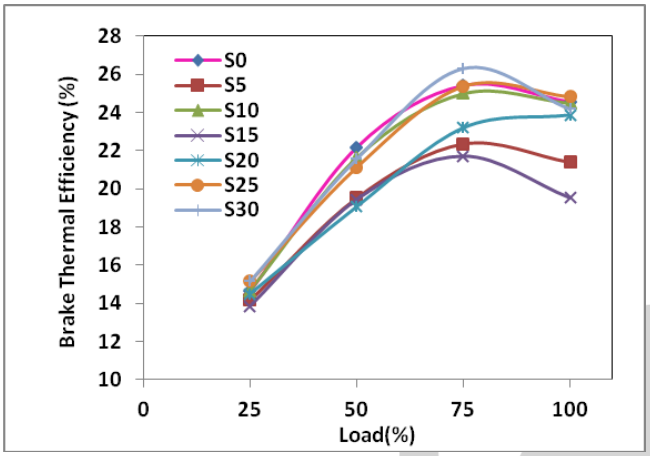

Fig 3.3: Variation of BTE with load

IV. CONCLUSION

In this study the performance characteristics of four-stroke Diesel engine when operating with different Diesel- Sesame Oil Blended Fuel and diesel were experimentally evaluated without any hardware modifications at various engine loads. The following conclusions can be drawn.

- Maximum fuel consumption was found for S15 at full load condition due to lower calorific value of sesame compared to diesel.
- Maximum brake thermal efficiency was found for S30 blend at 75% of load condition due to good availability of oxygen molecule in the blend which lead to noval combustion of the blended fuel inside the cylinder.
- From the experiments it was found that fuel blends can be directly used without any modification in the engine.
- As percentage of sesame oil in diesel increases, obtained results were very close to that of diesel especially for brake thermal efficiency and bsfc of the engine.

Overall, due to very small difference in the performance characteristics of the engine, sesame-diesel blends can be used as a replacement of diesel in the existing fleet of compressed ignition engines without any hardware modification in engine performance.

REFERENCES

[1] Mofijur M., Masjuki H. H., Kalam M. A., Atabani A. E., Fattah I. M. R. and Mobarak H. M., Industrial Crops and Products, 53(2014), 78-84.

[2] Aransiola E. F., Ojumu T. V., Oyekola O. O., Madzimbamuto T. F.and Ikhu-Omoregbe D. I. O., Biomass and Bio-energy.

[3] Barnwal B.K., Sharma M.P., Prospects of biodiesel production from vegetable oils in India, Renewable and sustainable energy reviews, 9(2005)363-378.

[4] Ayhan Demirbas, Progress and recent trends in biodiesels fuels, Energy conversion and management, 50(2009)14-34.

[5] Agarwal A.K., Rajamanoharan K., Experimental investigations of performance and emissions of karanja oil and its blends in a single cylinder agriculture diesel engine, Applied energy, 86(2009)106-112

[6] Ayhan Demirbas, A realistic fuel alternative for diesel (2008), Biofuel, 978-1-84628-9941.

[7] Global biofuel –An overview (2016)

[8] Robert Rapier, The Global Outlook For Biofuels (2014)

[9] A. Saydut, M. Z. Duz, C. Kaya, A. B. Kafadar and C. Hamamci, Bioresource Technology, 99(2008), 6656-6660.

[10] N. E. Mohamed and M. M. Wakwak, Journal of Radiation Research and Applied Sciences.

[11] Sesame profile, Agriculture marketing resource centre (2011)

[12] Sesame: economic importance and production, the financial express. (2007)

[13] Silitonga A. S., Masjuki H. H., Mahlia T. M. I., Ong H. C., Chong W. T. and Boosroh M. H., Renewable and Sustainable Energy Reviews, 22 (2013), 346-360.

[14] Atabani A. E., Silitonga A. S., Ong H. C., Mahlia T. M. I., Masjuki H. H., Badruddin I. A. and Fayaz H., Renewable and Sustainable Energy Reviews, 18(2013) 211-245.

[15] Deccan Herald, (2015)

[16] Nilamkumar S.P., Tirth A.B., Deshmukh H.P. Evaluation of engine performance by using sesame oil, DEE and its blend with diesel on four stroke four cylinder DI diesel engine, Journal of Information, Knowledge and Research in Mechanical Engineering, (2013) ISSN 0975-668X.

[17] Fortnagel.M.,Handenberg.H.O.,Gairing.M.,"Requirement of diesel fuel quality: effects of poor quality fuels" in API Mid- year Meeting (2007)

[18] Agarwal A.K., Dhar A., Biofuels and the Hybrid Fuel Sector, Proc Indian Natn Sci Acad, (2015) PP. 775-785.

 DOI : 10.18231/2454-9150.2019.0539