Ramchandani et al. 2018. *Int. J. Vehicle Structures & Systems*, 10(3), 212-214
ISSN: 0975-3060 (Print), 0975-3540 (Online)
doi: 10.4273/ijvss.10.3.11

International Journal of
Vehicle Structures & Systems
Available online at www.maftree.org/eja

Performance Characteristics of C.I. Engine with Bio-diesel Blends of Jatropha, Soya Bean Oil and Waste Cooking Oil at Fixed Compression Ratio

Dinesh Ramchandani[a], Yogendra Rathore[b] and R.K. Pandey[c]

[a]*Dept. of Mech. Engg., Sagar Institute of Research & Technology, Bhopal, Madhya Pradesh, India*
Email: dvramchandani@gmail.com
[b]*Dept. of Mech. Engg., Govt. Polytechnic College, RGPV, Raisen, Madhya Pradesh, India*
Corresponding Author, Email: yogendra_ap@yahoo.com
[c]*Dept. of Mech. Engg., Radharaman Engg. College, Bhopal, Madhya Pradesh, India*
Email: rkpmanit@gmail.com

ABSTRACT:

In this paper raw oil (jatropha, soybean and waste cooking fuel) is taken as potential alternative fuel for C.I. engines. The best distinction between these 3 kinds of oils and diesel fuel is viciousness. Every vegetable oil is blended with diesel in variable proportion (20% - 50%). Two sets of experiments are conducted for every fuel blend. First experiment is focussed on a performance check for pure diesel fuel. Second experiment is focussed on a performance check using many blends for each of Jatropha-diesel, soybean-diesel and waste cooking oil-diesel at fixed compression ratio of 18. The results of performance characteristics such as brake specific fuel consumption & brake thermal efficiency for every vegetable oil-diesel blends are compared with that using diesel fuel alone.

KEYWORDS:

Biodiesel; Diesel engine; Engine performance; Jatropha oil, Waste Cooking Oil; Soya Bean Oil

CITATION:

D. Ramchandani, Y. Rathore and R.K. Pandey. 2018. Performance Characteristics of C.I. Engine with Bio-diesel Blends of Jatropha, Waste Cooking Oil and Soya Bean Oil at Fixed Compression Ratio, *Int. J. Vehicle Structures & Systems*, 10(3), 212-214. doi:10.4273/ijvss.10.3.11.

1. Introduction

A century before, Rudolf Diesel first came with the idea of diesel engine, used peanut oil (vegetable oil) for experimental analysis, that point solely indicated that vegetable oils are applicable to cater the requirements of future. In this century, it's believed that crude oil and petroleum products became terribly scarce and overpriced to find and manufacture, though researchers have found variety of the way to increase the fuel economy. However population of countries has raised several folds and additionally energy is the backbone of any nation’s economy. Standard lubricants using the mineral oils and additives are probably toxic to water & soil due to their heavier composition and lesser bio-degradability. There's continually a frightening scenario as far as environment is concerned that pulls our attention towards natural alternative fuel components simply because of rising crude oil costs and inappropriate disposal strategies across the world [1-3].

The properties like high oiliness, viciousness and higher flash points, less evaporative loss and low full accounting price are technical in nature which provides competitive edge. Therefore they're most popular even once some inferior traits like reduced oxidation and thermal stabilities, poor cold flow properties and lower time period. However researchers are working on these limits to be improved by applying some changes in the techniques and systematized research [4-8]. Edible and non-edible vegetable oils are potential for alternative fuels. Edible oils are used by all the population due to their food dependency. Hence, non-edible oils are used as alternative fuels with untapped potential and beneficial to the rural economy [9-12].

2. Experiments

An experimental work is carried out on a variable compression ratio (VCR 17.5:1) water cooled D.I 4-strokes 0.661cc diesel engine built by Kirloskar with single cylinder, power 3.5 kW at 1500rpm (constant speed). The VCR 17.5:1 is modified into VCR 12-18:1. The bore diameter and stroke are 87.5mm and 110mm respectively. The fuel injection is of inline type. The experiments are carried out with fixed compression ratio (CR) of 18 at variable load values of 20%, 40%, 60%, 80% and 100%. The load measuring instruments used for this experimental work are - a dynamometer of eddy current type, a load cell of strain gauge type and a loading unit. The biodiesel is formulated using Jatropha, soya bean, and waste cooking oil (WCO) blends in the proportions of 20%, 30%, 40% and 50% with pure diesel. The fuel properties are listed in Table 1. During experiments, the performance characteristics such as Brake Specific Fuel Consumption (BSFC) and Brake Thermal Efficiency (BTE) are assessed.

Table 1: Properties of diesel, Jatropha oil blend, soya bean oil blend and waste cooking oil blend

Properties		Density (kg/m^3)	Kinematic viscosity (mm^2 /sec)	Calorific value (kJ/kg)
Diesel		849	4.7	43210
Jatropha oil blends	B20	853	4.83	42147
	B30	857	4.95	41626
	B40	859	5.07	41116
	B50	864	5.2	40833
Soya bean oil blends	B20	856	3.34	42037
	B30	860	3.79	41447
	B40	863	4.18	40858
	B50	867	4.85	40268
Waste cooking oil blends	B20	851	3.75	41846
	B30	853	3.9	41190
	B40	855	4.36	40552
	B50	856	4.92	39798

3. Results and discussions

BSFC is the fuel flow rate per unit power output. It is a quantity of the efficiency of the engine in using the fuel supplied to produce work. With various oils with same blends, the variations of BSFC with respect to load are shown in Figs. 1 to 4, for constant speed of 1500 rpm and a constant compression ratio of 18. The BSFC of the diesel with respective blends show a decrease for an increase in the load. Also the BSFC shows an increase along with high proportion of biodiesel in the blend. For example, the BSFC at 80% load of Jatropha B20 is 0.27 kg/kW-hr which is least and for same blend with B50 it is 0.36 kg/kW-hr. The BSFC for all fuels at 80% of load and B20 are diesel fuel 0.25 kg/kW-hr. Jatropha is 0.27 kg/kW-hr, soya bean is 0.29 kg/kW-hr and WCO is 0.30 kg/kW-hr. If we compare higher blend to pure diesel then it shows a fact that because of higher viscosity of biodiesel, its combustion at lower load is partially completed which results in large mass consumption for unit power output. At higher loads, increase in temperature reduces the effect of high viscosity and BSFC of various blends will come up satisfactorily near to that of pure diesel.

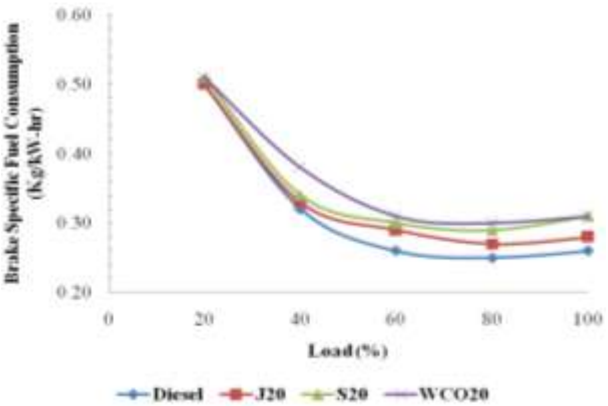

Fig. 1: Variation of BSFC with engine load for B20

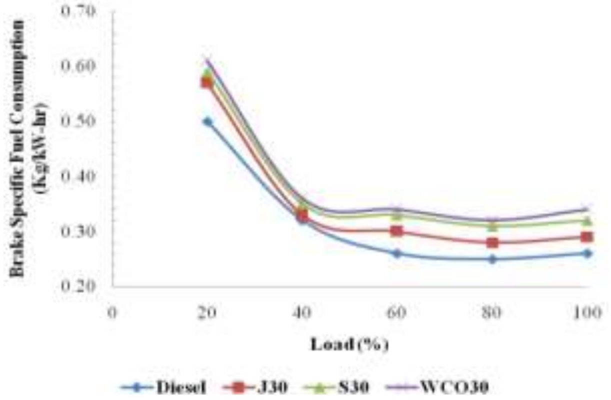

Fig. 2: Variation of BSFC with engine load for B30

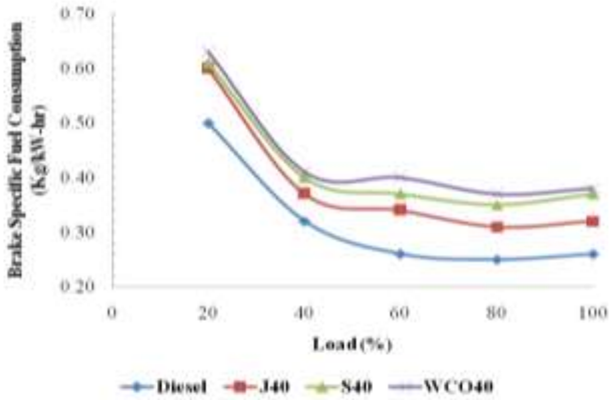

Fig. 3: Variation of BSFC with engine load for B40

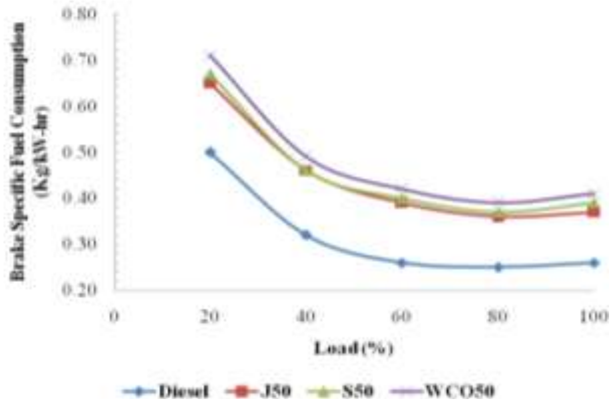

Fig. 4: Variation of BSFC with engine load for B50

BTE is the ratio of power output to the energy input as fuel, which finally will be the product of mass flow rate of injected fuel and the lower heating value. With various oils with same blends, BTE varies in comparison with percentage of load as in Figs. 5 to 8, for constant speed of 1500 rpm and a constant compression ratio of 18. The BTE increases with increase in loads for diesel and all biodiesel blends. It could be because of fall in heat loss and increase in power. At B20 and 80% load, BTE of jatropha is 31.99%, soya bean is 30.44% and WCO is 29.63% compared to diesel being 34.02%. This depicts that BTE decreases with increase in blend ratio because of lower heating value of biodiesel and higher viscosity. At 80% load, maximum BTE is found in Jatropha B20 blend as 31.99% and minimum in WCO B50 blend as 23.73%.

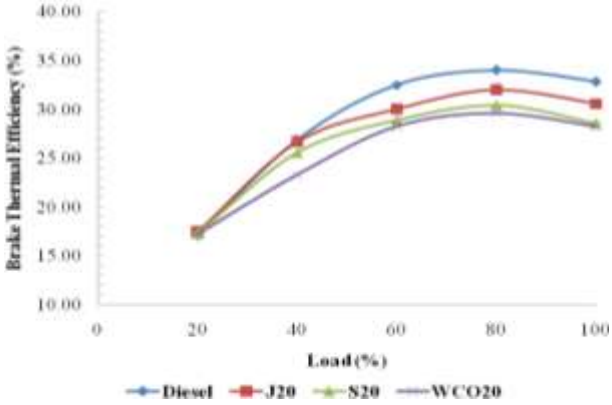

Fig. 5: Variation of BTE with engine load for B20

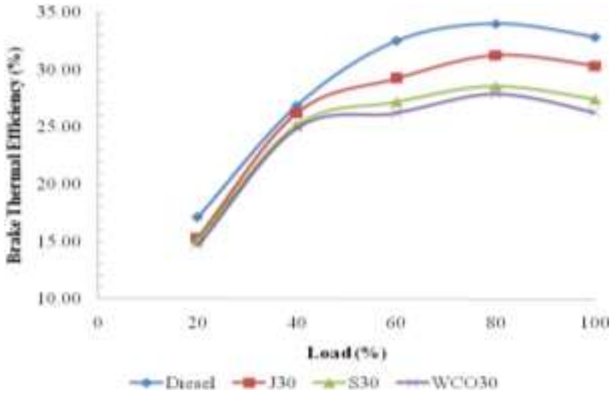

Fig. 6: Variation of BTE with engine load for B30

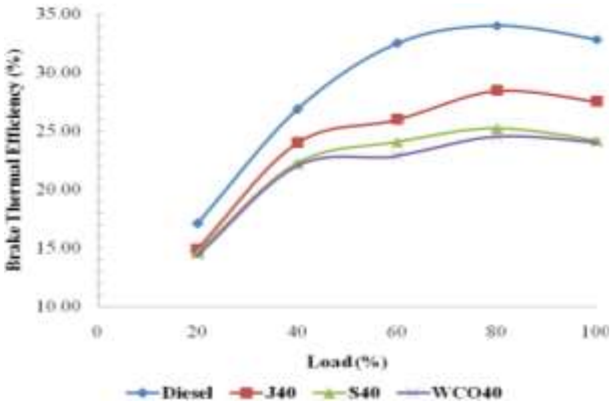

Fig. 7: Variation of BTE with engine load for B40

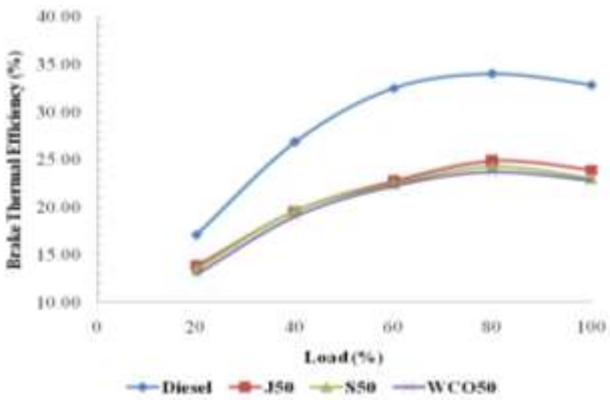

Fig. 8: Variation of BTE with engine load for B50

4. Conclusions

The experimental work towards the performance characteristics- BSFC and BTE of VCR C.I. engine was carried out with a variety of blends of biodiesel. Bio-diesel B20 blend indicates quite closer values of BTE at all the load conditions in comparison with diesel fuel. With constant speed and fixed compression ratio of 18, blends of bio-diesel showed similar kind of BSFC in comparison with pure diesel oil. At all loads BSFC of Jatropha blends was the least amongst all the blends. With the same load conditions, B20 blend of Jatropha bio-diesel shows BSFC quite closer to pure diesel oil followed by soya bean oil and waste cooking oil.

REFERENCES:

[1] I.I. Ştefănescu, C. Calomir and G. Chiriţă. 2002. On the future of bio-degradable vegetable lubricants used for industrial tribosystems, *The Annals of University "Dunărea De Jos" of Galaţi Fascicle VIII,* 94-98.

[2] W.J. Bartz. 2006. Ecotribology: Environmentally acceptable tribological practices, *Tribology Int.*, 39, 728-733. https://doi.org/10.1016/j.triboint.2005.07.002.

[3] A. Adhvaryu, G. Biresaw, B.K. Sharma and S.Z. Erhan. 2006. Friction behaviour of some seed oils: Bio based lubricant applications, *Ind. Engg. Chem. Res.*, 45, 3735-3740. https://doi.org/10.1021/ie051259z.

[4] S.Z. Erhan and S. Asadauskas. 2000. Lubricant base stocks from vegetable oils, *Ind. Crops Prod.*, 11, 277-282. https://doi.org/10.1016/S0926-6690(99)00061-8.

[5] H. Wagner, R. Luther and T. Mang. 2001. Lubricant base fluids based on renewable raw materials their catalytic manufacture and modification, *Appl. Catal.*, 221, 429-442. https://doi.org/10.1016/S0926-860X(01)00891-2.

[6] S.Z. Erhan, B.K. Sharma, J.M. Perez. 2006. Oxidation and low temperature stability of vegetable oil-based lubricants, *Ind. Crops Prod.*, 24, 292-299. https://doi.org/10.1016/j.indcrop.2006.06.008.

[7] S. Asadauskas, J.M. Pérez and J.L. Duda. 1996. Oxidative stability and anti-wear properties of high oleic vegetable oils, *Lubrication Engg.*, 52, 877-882.

[8] O. Emmanuel, K. Allayer, O. Obahiagbon and M. Ori-jesu. 2009. Biodegradation of vegetable oils: A review, *Scientific Research and Essay*, 2009, 4(6), 43-548.

[9] M. Shahabuddin, S.S. Masjuki and M.A. Kalam. 2013. Experimental investigation in to tribological characteristics of bio-lubricant formulated from jatropha, *Oil, Proc. Engg.*, 56, 597-606. https://doi.org/10.1016/j.proeng.2013.03.165.

[10] A.K. Singh. 2011. Castor oil-based lubricant reduces smoke emission in two-stroke engines, *Ind. Crops Prod.*, 33, 287-295. https://doi.org/10.1016/j.indcrop.2010.12.014.

[11] A.K. Jain and A. Suhane. 2012. Research approach & prospects of non-edible vegetable oil as a potential resource for bio-lubricant: A review, *Advanced Engg. & Applied Sci. J.*, 1(1), 23-32.

[12] D.S. Chinchkar, S.T. Satpute and N.R. Kumbhar. 2012. Castor oil as green lubricant: A review, *Int. J. Engg. Research & Tech.*, 1 (5), 1-3.