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Performance Evaluation of the Combination of Bio Fuels Derived From Waste Cooked Oil and Pongamia Pinnata Oil

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ABSTRACT

Almost all countries are dependent on petroleum fuel to fulfill their energy requirements Increase in energy demand due to growth in population has affected the underground fossil fuel resources . In order to counter this problem, researchers are looking for alternative sources of energy. Biodiesel is one of the potential alternatives to petroleum dies el, as its properties are very comparable to dies el. Moreover, biodiesel is mainly derived from renewable feeds tocks like edible, non -edible oils or animal fats. In recent decade, the main focus it to prepare biodiesel from edible oils like cottonseed oil, sunflower oil, coconut oil. Producing biodiesel from edible oils may leave negative effect on agriculture in terms of scarcity of food crops so non-edible oils are preferred for production of biodiesel. The main advantages of using biodiesel are it's portability, being readily available, better combustion efficiency, lower sulphur content, higher cetane number, higher bio degradability, domestic origin, higher flash point and improved lubrication property. Researchers have found that with us e of biodiesel nitrogen oxides (NOX) emission increases whereas hydrocarbon (HC), carbon monoxide (CO), and particulate matter emissions (PM) decrease in comparison to dies el fuel. The present paper, therefore, focuses on the emissions from biodiesel fuelled dies el engine operation.

Key Words: *Bio-Diesel, Nitrogen Oxides, Sulphur, Cetane Number, Hydrocarbon, Carbon Monoxide.*

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1. INTRODUCTION

Biofuels are liquid transportation fuels made from plants and animal residues used for car, trucks, airplanes and trains. The primary sources of bio fuel are ethanol and biodiesel. Ethanol known as ethyl is an alcohol produced from renewable feedstock's such as cassava, maize, sorghum, and potatoes. Biodiesel on the other hand is a light to dark yellow liquid immiscible with water, with high boiling point and low vapor pressure. It also refers to a diesel – equivalent processed fuel derived from biodiesel sources (such as vegetable oils), which can be used in unmodified diesel – engines vehicles. It is also biodegradable, non-toxic and typically produces about 60% less net carbon dioxide (CO2) emissions than petroleum – based diesel. The American Society for Testing and Materials (ASTM) defines biodiesel fuel as monoalkyl esters of long chain fatty acids derived from a renewable lipid feedstock, such as vegetable oil or animal fat. ''Bio'' represents its renewable and biological source in contrast to traditional petroleum-based diesel fuel; ''diesel'' refers to its use in diesel engines. As an alternative fuel, biodiesel can be used in neat form or mixed with petroleum- based diesel. In fact, the concept of biodiesel dates back to 1912 when Rudolf Diesel (the invention of the first diesel engine) stated that "The use of vegetable oil for engine fuels, may seem insignificant today but such oil may become, in the course of time, as important as petroleum and the coal-tar products of the present times.". Specific sources of biodiesel are coconut oils, jatropha, soyabean oils, cotton seed oils, and beniseed oils. The use of biofuel reduces air toxic gas emissions radically and green house gas buildup. Highlights of the specific features of the Jatropha curcas plant and its potential for the production of biofuel, protein concentrates as livestock feed and value-added products that could enhance the economic viability of Jatropha seed oil-based biodiesel production was reviewed by Harinder et al. The review elucidated the roles of the plant in carbon capture, enhancing socio-economic conditions, food production in the tropical regions, and influencing microclimate, vegetation and soil quality .The study was able to how a comparative account of the toxic and non-toxic genotypes of Jatropha curcas from their physical and chemical characteristics as well as their potential for biodiesel and livestock feed production. Compared to automotive gas oil (petroleum-based diesel), biodiesel has a more favourable combustion emission profile, such as low emissions of carbon monoxide, particulate matter and unburned hydrocarbons. Carbon dioxide produced by combustion of biodiesel can be recycled by photosynthesis, thereby minimizing the impact of biodiesel combustion on greenhouse effect.

2 OBJECTIVE

- Production of Bio-diesel using transtrification process.
- To study the Performance characteristics of waste cooking oil.

3 METHODOLOGY

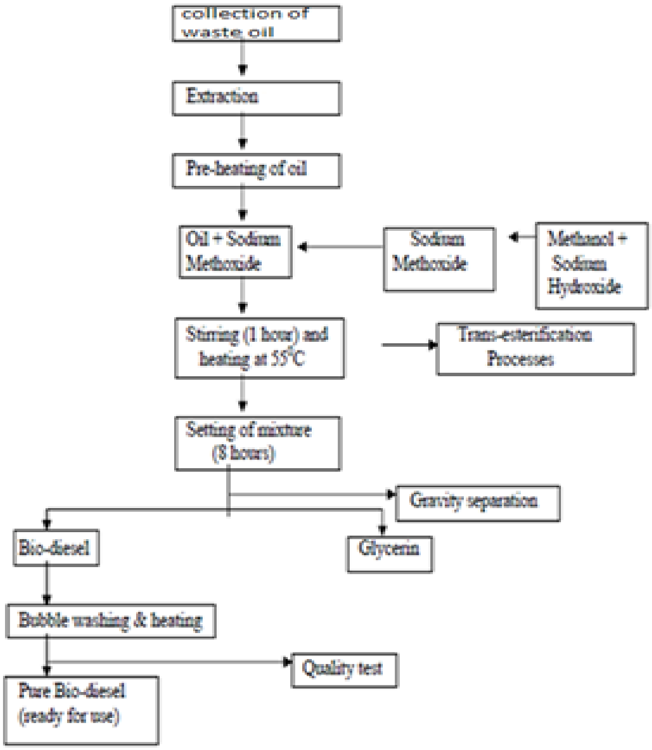

Figure 1.1: Biodiesel production for Waste cooking oil

Figure1. 2. Transesterification unit

Figure1. 3. Honge Seeds

Table1.1.Biodiesel Properties of Honge oil

PROPERTY	DIESEL	Waste Cooking Oil
FLASH POINT	65°C	225°C
FIRE POINT	78°C	230°C
VISCOSITY	2.86 poise	4.02 poise
S.G	0.827	0.924
CV	44030 kJ/kg K	40873 kJ/kg K

3.1 Pre Treatment of Pongamia Pinnata

- **Seed cleaning**

Foreign material is generally removed twice once prior to storage and again as the oleaginous material enters the continuous process for oil expelling to reduce machine wear. The foreign materials to be removed may consist of a combination

Figure1. 4. Decorticator

- **Fine Filtering**

Figure1. 5. Filtering of pongamia oil

4. EXPERIMENTATION

Figure1. 6. Four Stroke Diesel Engine

Brake Horse Power: 6 BHP
Orifice diameter: 0.025m
RPM: 1500rpm
Fuel: Diesel oil
Cylinder: multi
Bore diameter: 85mm
Stroke length: 80mm
Working cylinder: 4 stroke
Compression ratio: 18:1
Starting: Centrifugal Governor
Dynamometer: Mechanical/Rope
Cooling: water cooled

5 NUMERICAL CALCULATIONS OF BLEND 20 (B20)

For torque (T) =5 N-m, speed (N) =1497 rpm, time for 10cc of fuel (t) =62 seconds

BRAKE POWER (BP)

BP= $\frac{2\pi NT}{60*1000}$ KJ/s=KW

N=1500rpm

T-Torque (measured by indicator) Nm

BP= (2*3.14*1500*0.157*9.81)/ (60000)

BP= 0.241 KW

TOTAL FUEL CONSUMPTION (TFC)

TFC = 36-S/t

= 36-0.8275/24

= 0.783 kg/hr

SPECIFIC FUEL CONSUMPTION (SFC)

SFC = TFC/BP kg/Hr

= 0.783/0.241

= 3.271 kg/ hr

INPUT POWER

= TFC*CV/3600

= 0.783*44000/3600

= 9.57 kW

BRAKE THERMAL EFFICIENCY (η_{bth})

η_{bth} = (BP/IP) * 100

= 3.271/9.57

η_{bth} = 2.539 %

INDICATED POWER

IP = BP+FP

= 0.241+1.8

= 2.041 kw

INDICATED THERMAL EFFICIENCY η_{Ith}

η_{Ith} = Indicated power/input power * 100

η_{Ith} = 2.041/9.57

η_{Ith} =21.32%

MECHANICAL EFFICIENCY η_{mech}

η_{mech} = BP/IP

= 0.241/2.043

η_{mech} = 11.85 %

6 RESULTS AND DISCUSSIONS

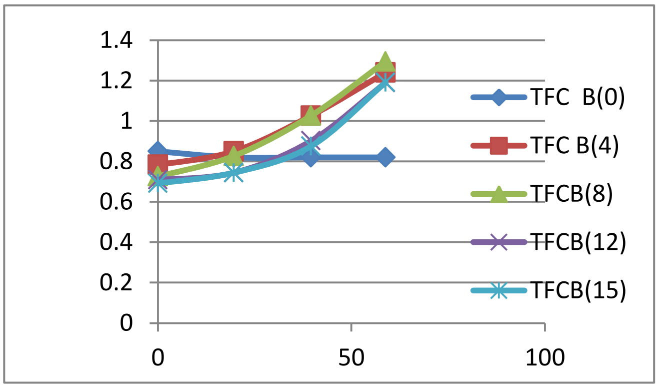

Figure 1. 7. TFC Vs Load

In the above figure 1.7 shows that Total fuel consumption v/s Load applied in the different blend decrease with load when total fuel consumption is more when compare to other blends. From the figure, it is clear that variation of total fuel consumption is directly proportional to load of the engine at corresponding pressures and even though exhaust gas temperature increases gradually as increases the applied load on the engine. 250 bar injection pressure curved line shows the higher gas temperature which exhaust through the engine as the load applied on the engine.

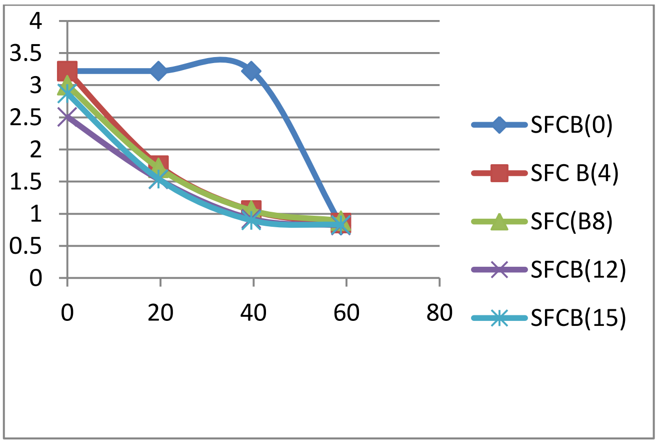

Figure 1.8. SFC Vs Load

Fig 1.8.shows SFC Vs Load in this graph it is observed that blend 0 means 100% diesel having more deviation than other blends. From the figure, it is clear that specific fuel consumption is decreases for all the blend except blend 0 variation of specific fuel consumption is directly proportional to load of the engine at corresponding pressures and even though exhaust gas temperature decreases gradually as increases the applied load on the engine. 250 bar injection pressure curved line shows the higher gas temperature which exhaust through the engine as the load applied on the engine.

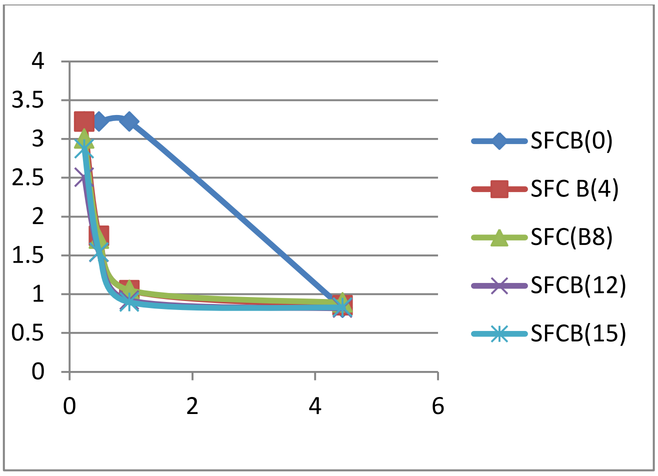

Figure1. 9. SFC vs BP

Fig 1.9.shows SFC Vs BP when load increases brake power decreases continuously in case of blend 0 and all other blends follows same paths. From the figure, it is clear that specific fuel consumption is decreases for all the blend except blend 0 variation of specific fuel consumption is directly proportional to Brake power of the engine at corresponding pressures and even though exhaust gas temperature decreases gradually as increases the applied load on the engine. 250 bar injection pressure curved line shows the higher gas temperature which exhaust through the engine as the load applied on the engine.

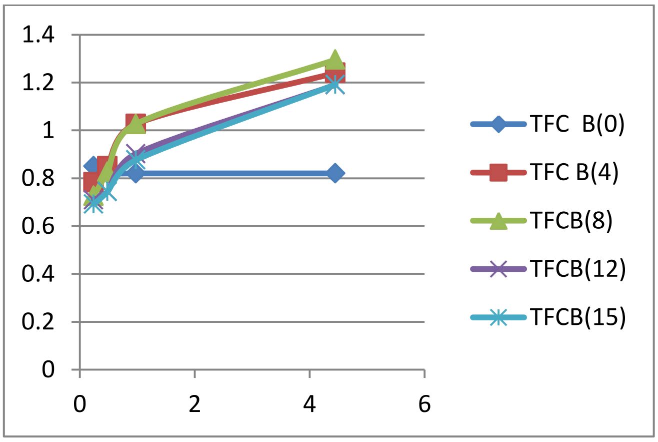

Figure1.10.shows TFC Vs BP in this case total fuel consumption at blend 0%

Fig 1.10 .shows TFC Vs BP when load increases brake power constant in case of blend 0 and all other blends follows same paths. From the figure, it is evident that even increase of total fuel consumption will result increase of Brake power because due to fuel consumption is more for other blends

7 CONCLUSION

- Biodiesel is an alternative and renewable fuel for diesel engines and has become more attractive in recent times.
- Biodiesel usage is attributed to lesser exhaust emissions in terms of carbon monoxide, hydrocarbons and particulate matter.
- In the various blends it is observed that B8 gives the best performance compare to other blends.
- The bi-products during process such as glycerol is used in soap formation.
- Cake which is bi-products can be used as an organic manure. Biodiesel can be considered as future fuel and it is a green fuel.

REFERENCES

1. A.K. Pandey & M.R. Nandgaonkar, Experimental Investigation of the Effect of Esterified Karanja Oil Biodiesel on Performance, Emission and Engine Wear of a Military 160hp Turbocharged CIDI Engine, Proceedings of the World Congress on Engineering, Vol. 3, London, UK, 2011.

2. Ashish J., Kalyan M., M. Jagadish, M. Merawade & M.C.Navindgi,Performanc and Emission Characteristics of Mahua and Linseed Biodiesel Operated at Varying Injection Pressures on CI Engine, International Journal of Modern Engineering Research, Vol. 2, Issue 3 (2012) pp. 1142-1149.

3. M.N.Channappagoudra,S. Thaned, N.R. Banapurmath, K. Ramesh & G.Manavendra, Effect of swirl on DI diesel engine operated with Honge Biodiesel, Int. Journal of Engineering Research and Applications, Vol. 3, Issue 6 (2013) pp. 595-601.

4. Mr. Kanji D.D. & Prof. G.P. Rathod, Review on Performance and Emission characteristics of diesel engine fuel blended with linseed oil and diesel, International Journal of Advanced Engineering Research and Studies, Vol. 02, Issue 02 (2013) pp.0507.

5. S.Prabhakar,KAnnamalar & I.J.R Lavani, Experimental study of using hybrid veritable oil blends in diesel in diesel engine, Journal of science & Industrial research, Vol. 71 (2012) pp. 612-615.

6. A. Chandrashekar, N.S. Mahesh, B. Gowda & W. Hall, Life cycle assessment of biodiesel production from Pongamia oil in rural Karnataka, CIGR Journal, Vol.14, No.3 (2012) pp. 67-77.

7. V.S. Yaliwal, S.R. Daboji, N.R. Banapurmath & P.G.Tewari, Production and Utilization of Renewable Liquid Fuel in a Single Cylinder Four Stroke Direct Injection Compression Ignition Engine, International Journal of Engineering Science and Technology, Vol.2(10) (2010) pp. 5938-5948.

8. R.S. Kumar, R. Manimaran & V. Gopalakrishnan, Performance and Emission Analysis Using Pongamia Oil Biodiesel Fuel with an Artificial Neural Network, Advanced Engineering and Applied Sciences: An International Journal, 3(1) (2013) pp. 17-20.

9 B.B. Ghosha, S.K. Haldar & Ahindra N., Synthesis of biodiesel from oils of jatropha, karanja and putranjiva to utilize in Ricardo engine and its Performance & Emission measurement, Proceedings of the 4th BSME- ASME International Conference on Thermal Engineering 27-29 December, Dhaka, Bangladesh, (2008) pp. 731-738.