Performance Analysis of the Binary Delonix Regia Bio Diesel and Diesel

R.Kamalanathan[1], M.Nataraj[2]

Department of Mechanical Engineering
Sri Venkateshwaraa College of Engineering and Technology

Abstract -*This paper provides an overview of recent biodiesel advances. Bio-diesel is a liquid bio-fuel made from vegetable oils, animal fats, seeds oils, and an alcohol that can be used alone or combined with diesel oil in diesel engines. Bio-diesel is a renewable energy source that can help lower greenhouse gas emissions and agriculture's "carbon footprint." Biodiesel is made by combining vegetable oil with an alcohol (typically methanol or ethanol) and a catalyst (usually sodium hydroxide or potassium hydroxide). The first step is to extract the oil from the seeds, such as "Delonix regia." The glycerin is separated from the oil in this procedure. Bio-diesel is a thinner version of the original oil that works better in diesel engines. Delonix Regia Biodiesel and Diesel blend is tested and performance is analyzed.*

Key Words: Delonix regia,bio-diesel, diesel,binary blend, Performance analysis

1. DELONIX REGIA

Delonix regia is a flowering plant native to Madagascar that belongs to the bean family Fabaceae, subfamily Caesalpinioideae. It's known for its fern-like leaves and bright orange-red petals that bloom with in summer.

Fig: Delonix Regia Seeds

The shade and ornamental value of the tree are the main reasons for its planting. It's a wonderful tree for controlling soil erosion in arid and semi-arid environments because of its hardiness and aggressive root structure.

Delonix Regia has huge flowers with four spreading crimson or orange-red petals up to 8cm long and a fifth upright petal, the standard, that is slightly larger and dotted with yellow and white.

Corymbs of the flower emerge along and at the ends of branches. The complex leaves have a fluffy appearance and is doubly pinnate. They are a typical light, vivid green. When young, the pods are green and flaccid, but as they mature, they become dark-brown and woody. This can measure up to 60cm in length and 5cm in width. The seeds are tiny, weighing an average of 0.4 g.

2. METHODOLOGY

Mechanical crushing extracts oil from Delonix Regia seeds, yielding 240ml raw oil from 1kg of seeds. The transesterification process is used to make biodiesel from extracted oil.

3. BIODIESEL (10)-DIESEL (90) PERFORMANCE

Performance analysis carried out in the kirloskar TV-1 engine.

Following is the specification of engine:

Speed maintained at 1500 rpm,

Mass flow rate of cooling water: 7lit/min

Specific gravity of oil = 0.8182

Blending ratio= BD (10) & D(90)

Calorific value of oil =10,010 KCal/Kg

Table – 1

% of Load	Calculated Load		Time taken for 10cc of fuel consumption			EGT
	N	Kgf	t_1 (sec)	t_2 (sec)	t_{avg} (sec)	°C
20	33.35	3.4	40.07	40.28	40.2	185
40	67.68	6.9	25.5	25.0	25.2	242
80	135.3	13.8	22.97	22.98	22.9	318
100	169.7	17.3	20.3	20.9	20.7	330
100	169.7	17.3	20.3	20.9	20.7	330

3.1 Fuel Consumption

Fuel consumption = $\frac{10}{T_{avg}}$ x Sp.gravity of fuel x density of water x 10^{-6} x 3600 kg/hr

T_{avg} for variable blends given in the table

For 20% load

$$F_UC_{20} = \frac{10}{40.24} \times 0.8182 \times 1000 \times 10^{-6} \times 3600$$

$$F_UC_{20} = 0.730 \text{ kg/hr}$$

For 40% load

$$F_UC_{40} = \frac{10}{25.49} \times 0.8182 \times 1000 \times 10^{-6} \times 3600$$

$$F_UC_{40} = 1.155 \text{ kg/h}$$

For 100% load

$$F_U C_{100} = \frac{10}{20.7} X\, 0.8182\, X\, 1000\, X\, 10^{-6}\, X\, 3600$$

$$F_U C_{100} = 1.4 \text{ kg/hr}$$

3.2 Fuel Power (F_UP)

$$F_UP = \frac{Fuelconsumption \times calorificvalue}{3600}$$

For 20% load

$$F_U P_{(20)} = \frac{F_U C_{(20)} XC.V}{3600}$$

$$F_U P_{(20)} = \frac{0.730 X 41881.84}{3600}$$

$$F_U P_{(20)} = 8.4927 \text{kW}$$

For 40% load

$$F_U P_{(40)} = \frac{1.155 X 41881.8}{3600}$$

$$F_U P_{(40)} = 13.4370 \text{ kW}$$

For 100% load

$$F_U P_{(100)} = \frac{1.4226 X 41881.84}{3600}$$

$$F_U P_{(100)} = 16.5503 \text{ kw}$$

3.3 Brake Thermal Efficiency (BTE)

$$BTE = \frac{BP_1}{F_U P} X100$$

For 20% load

$$BTE_{(20)} = \frac{BP_1}{F_U P_{(20)}} X100$$

$$BTE_{(20)} = \frac{1.04}{8.4927} X100$$

$$BTE_{(20)} = 12.24\%$$

For 40% load

$$BTE_{(40)} = \frac{BP_{(40)}}{F_U P_{(40)}} X100$$

$$BTE_{(40)} = \frac{2.08}{13.43} X100$$

$$BTE_{(40)} = 15.48\%$$

For 100% load

$$BTE_{(100)} = \frac{BP_{15}}{F_U P_{(100)}} \times 100$$

$$BTE_{(100)} = \frac{5.2}{16.55} \times 100$$

$$BTE_{(100)} = 31.41\%$$

3.4 Specific Fuel Consumption (SFC)

$$\text{SFC} = \frac{F_U C}{BP}$$

For 20%load

$$\text{SFC}_{(20)} = \frac{0.730}{1.04}$$

$$\text{SFC}_{(20)} = 0.7019 \text{ kg/kw.hr}$$

For 40%load

$$\text{SFC}_{(40)} = \frac{1.155}{2.08} \text{SFC}_{(40)}$$

$$\text{SFC}_{(40)} = 0.5552 \text{ kg/kw.hr}$$

For 100%load

$$\text{SFC}_{(100)} = \frac{1.4226}{5.2}$$

$$\text{SFC}_{(100)} = 0.2735 \text{ kg/kw.hr}$$

CONCLUSION

Table - 2

%load	BP	BTE	FP	FC	SFC
20	1.04	12.2	8.49	0.73	0.701
40	2.08	15.4	13.4	1.15	0.555
60	3.12	21.4	14.5	1.25	0.401
80	4.16	29.9	14.9	1.28	0.30
100	5.2	31.4	16.5	01.4	0.273

For varied loading conditions, the table provides brake power, brake thermal efficiency, fuel power, fuel consumption, and specific fuel consumption values for a blend of diesel and biodiesel combination.

REFERENCES

[1] Rajesh Gupta, Dinesh Kumar Soni1* 2- Comparison of diesel and diesel-water blend performance and emission characteristics under various injection timings Vol. 7, No. 4, 2015, International Journal of Engineering Technology and Science

[2] Naveen Kumar P1, Vinayaka Talugere2, Rajesh. S3, Pavan Kumar4 - pyrolysis procedure to produce fuel component from waste plastic May-2018www.irjet.net

[3] Alemayehu Gashaw, Tewodros Getachew, and Abile Teshita Mohammed - Biodiesel production as an alternative fuel: a review http://www.researchgate.net/publication/302961082 (January 2015)

[4] DamingHuangabHainingZhouaLinLina - Biodiesel as a Fuel AlternativeEnergy Procedia Volume 16, Part C, Volume 16, Part C, Volume 16, Part C, Volume 16, Part C, Volume

[5] Angelo C. Pinto, No. 7 Guarieiro, Lilian L. N. Rezende, Michelle J. C. Ribeiro, Nbia M. Torres, Ednildo A. Lopes, Wilson A. Pereira, Pedro A. de P. Biodiesel: an overview by Jailson B. de Andradehttps://doi.org/10.1590/S0103-50532005000800003 16 (6b) • Nov 2005

[6] Prof. A.G.Buibhar, Prof. P.P.Pande, Prof. J.P.Kaware4 8. Ganesh p. Hade, Prof. A.G.Buibhar, Prof. P.P.Pande, Prof. J.P.Kaware4 (2017). The literature review "Bio diesel as an alternative fuel for compression ignition engines –A review" International Engineering and Technology Research Journal (IRJET)

[7] Sampriti Sarma (2017) "bio diesel: the future fuel": a survey of the literature International Engineering and Technology Research Journal (IRJET).

[8] "Production methods of bio diesel": A literature study by A. Rajalingam1*, S. P. Jani1, A. Senthil Kumar2, and M. Adam Khan3. Chemical and Pharmaceutical Research is a journal that publishes research on chemicals and pharmaceuticals (www.jocpr.com)/

[9] G. Pranesh, R. Silambarasan, and Senthil An experimental comparison of combustion in a diesel engine running on bio diesel versus diesel fuel. http://www.tandfonline.com/loi/tbfu

[10] Senthil Kumar, Jani S PA, Biodiesel ProductionMethods: https://www.researchgate.net/publication/306140139