https://doi.org/10.33472/AFJBS.6.13.2024.3930-3936

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

A STUDY ON BIOLOGICAL ALGAE-BASED BIODIESEL FORENHANCED ENGINE PERFORMANCE AND ENVIRONMENTAL SUSTAINABILITY

Ranjit Nikose[1*], Sohail Bux[2]

[1*]Research Scholar RKDF University, Bhopal, India
[2]Professor RKDF University, Bhopal, India

Email: [2]buxsohail@gmail.com
***Corresponding author: [2*]ranjitnikose75@gmail.com**

Article Info

Volume 6, Issue 13, July 2024

Received: 04 June 2024

Accepted: 05 July 2024

Published: 31 July 2024

doi: 10.33472/AFJBS.6.13.2024.3930-3936

ABSTRACT:

The present article aims at lowering down the pollutants in air due to diesel engine through mixing diesel with algae blooms. After being extracted from the algae bloom, the algae oil products are mixed with diesel in the B5, B15, and B25 ranges. Mixing oil execution is contrasted and the diesel utilizing a VCR motor. Using engine setup, the Biodiesel's mechanical efficiency and overall efficiency were examined. The VCR engine was used to investigate the biodiesel's emission characteristics, including CO and CO2 emissions, under various testing conditions. Based on the findings, it is possible to demonstrate that blended biodiesel has the potential to lessen environmental pollution while also offering superior efficiency to diesel.

Keywords: Biodiesel, Algae, Efficiency, Emission, Engine.

1. Introduction

Because of the need for oil, gasoline costs are quite high in the current situation. Diesel and petroleum by-products (NOx, HC, CO, and CO2) have extremely high emission levels. Products made from biodiesel may be made from a variety of sources, including vegetable oils, animal fat, waste cooking oil, and algal oil. Reducing the need for petroleum products by at least 50% is the primary goal of the biodiesel production process. The incomplete combustion of fuel has resulted in a reduction in waste, particularly in petroleum products. Utilizing a Kirloskar single-cylinder engine with methanol and potassium hydroxide, the transesterification process must create biodiesel from the microalgae Chlorella vulgaris in order to assess the emissions and thermal efficiency of the braking system overall [1-4]. The biodiesel obtained by the transesterification process from microalgae Scenedesmus obliquus. High-quality biodiesel produced from B10 and B20 is compared to reduce emissions and boost thermal efficiency [2-4]. The goal of this article isto replace traditional petroleum and diesel with biodiesel while maintaining good lubricants and clean burn capabilities. Blends B5, B15, and B25 produced by the transesterification process are tested for thermal efficiency and emissions [3-6]. Several blended materials are employed to produce biodiesel, and their efficiency and emission characteristics are analyzed based on the literature papers mentioned above. The majority of mixed materials are quite uncommon and challenging to obtain. Here, in the areas around lakes and ponds, we may quickly and massively gather algae oil. In order to generate biodiesel, algal oil was proposed in this research along with an analysis of its mechanical, thermal, and emission properties.

2. Materials and Methods

The direct injection diesel engine, depicted in Fig. 1, performs the analysis using different ratios ofmixing oil based on algae. The results are compared to the base fuel, such as diesel, using varying quantities of biodiesel—5%, 15%, and 25%—mixed with diesel. The detailed procedure for producing biodiesel is depicted in Fig. 2. The ozone layer was negatively impacted by the elevatedexhaust gas temperature caused by the unburned fuels [5]. When the free fatty acid (FFA) content exceeds 3%, the transesterification process is not helpful. The amount of smoke released has increased dramatically. The setup of the transesterification process and the algal oils are displayedin Figures 2 and 3.

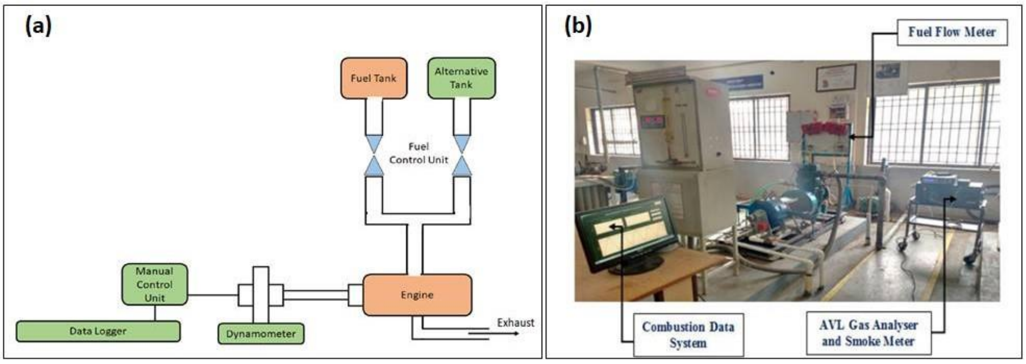

Fig. 1. (a) Schematic of experimental setup (b) engine setup

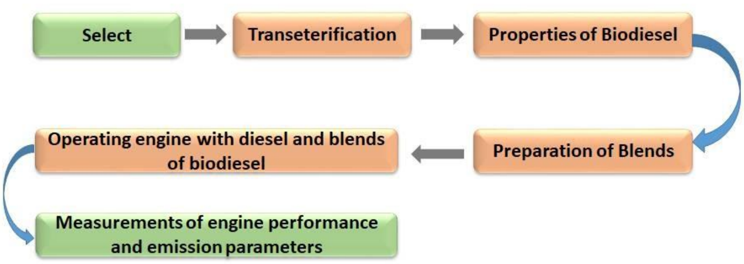

Fig. 2. Production process of biodiesel

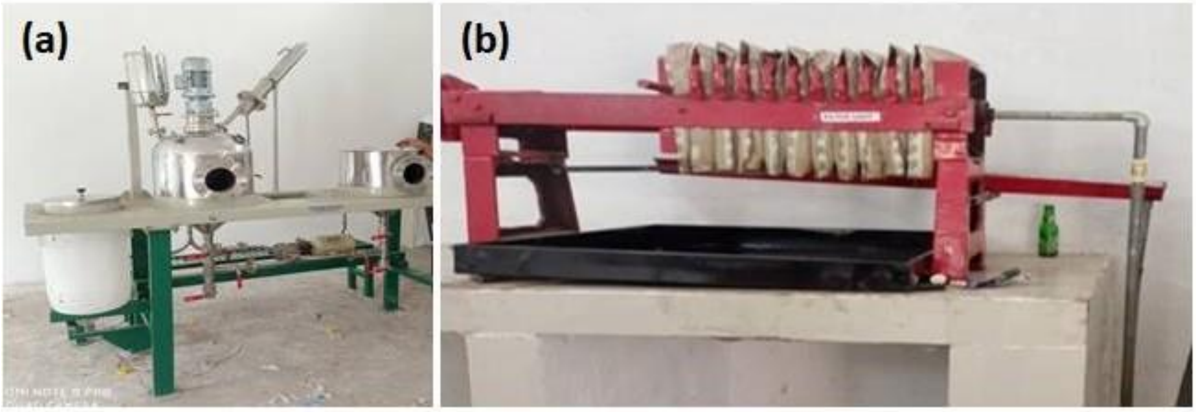

Fig. 3. (a) Transesterification setup (b) Algae based oil

Following the transesterification process, oils are blended in various ratios, including B5, B15, and B25. 1900 milliliters of diesel and 100 milliliters of biodiesel are combined in B5. The mixture in B15 is (1700 ml diesel + 300 ml biodiesel). 1500 milliliters of diesel and 500 milliliters of biodiesel are combined in B25. The characteristics of the blended and diesel oils shown in Tables 1 and 2.

Table 1. Flash and fire point of diesel and blended biodiesel

Fuel	Flash Point	Fire Point
B5	62	69
B15	69	74
B25	78	82
Diesel	58	65

Table 2. Calorific value of diesel and blended biodiesel

Fuel	Calorific Value (KJ/Kg)
B5	43900
B15	43775
B25	43600
Diesel	44200

3. Results and discussion

The primary goals of this effort are to increase mechanical and brake thermal efficiency and decrease CO and CO2 emissions. The outcomes of different blended oil performances are displayedin the following table. The combined fuels' overall efficiency with various loads is displayed in Table 3 and Fig. 4. The results show that B15 and B25 produce more efficiently than diesel.

Overall efficiency

Table 3. Overall efficiency of diesel and blended biodiesel

Fuel	Load (%)	Brake Power (KW)	B5	B15	B25	Diesel
Diesel	0	0	0	0	0	0
B5	20	0.89	16.3	17.8	17.9	16.1
B15	40	1.82	26.1	35.6	36.6	22.5
B25	60	2.74	37.5	41.8	43.9	38.2

Table 4. Mechanical efficiency of diesel and blended biodiesel

Fuel	Load (%)	Brake Power (KW)	B5	B15	B25	Diesel
Diesel	0	0	0	0	0	0
B5	20	0.89	39.6	42.5	40.5	41.4
B15	40	1.82	58.5	62.5	61.5	53.5
B25	60	2.74	60.2	68.7	66	64.6

Table 5. CO emissions of diesel and blended biodiesel

Fuel	Load (%)	Brake Power (KW)	B5	B15	B25	Diesel
B5	20	0.89	0.02	0.02	0.02	0.03
B15	40	1.82	0.02	0.02	0.02	0.03
B25	60	2.74	0.02	0.02	0.015	0.035
Diesel	0	0	0.015	0.02	0.03	0.035

Table 6. CO2 emissions of diesel and blended biodiesel

Fuel	Load (%)	Brake Power (KW)	B5	B15	B25	Diesel
B5	20	0.89	1.4	1.6	1.4	1.9
B15	40	1.82	1.5	1.4	1.7	1.9
B25	60	2.74	1.5	1.5	1.6	1.9
Diesel	0	0	1.2	1.2	1.1	1.9

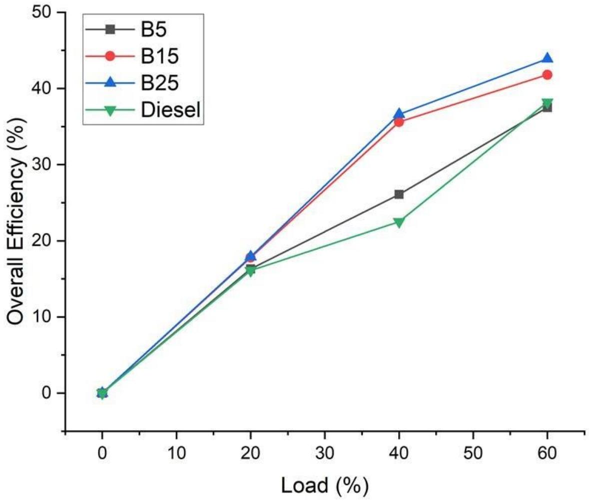

Fig. 4. Overall efficiency of diesel and blended biodiesel

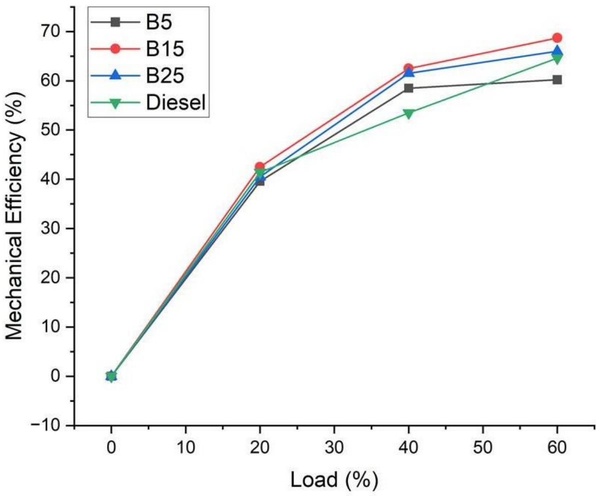

Fig. 5. Mechanical efficiency of diesel and blended biodiesel

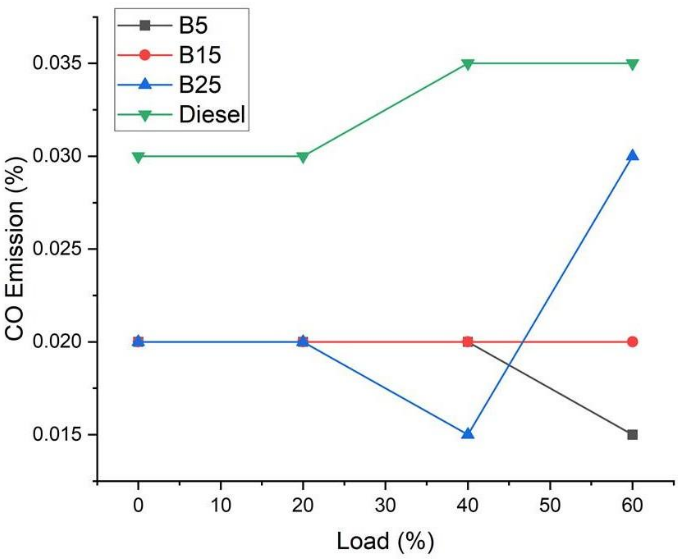

Fig. 6. CO emissions of diesel and blended biodiesel

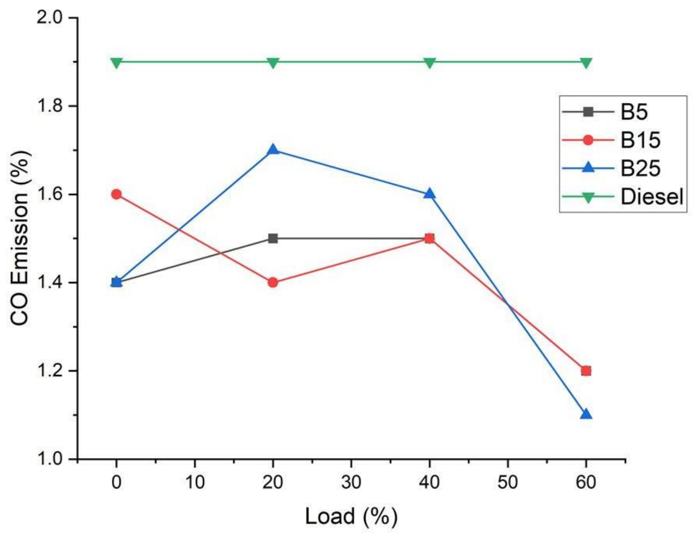

Fig. 7. CO2 emissions of diesel and blended biodiesel

The mechanical efficiency of the blended oils is displayed in Table 4 and Fig. 5. Compared to other blends, B15 Blend has reached the highest efficiency. Fuel B25 is more efficient than diesel fuel. All nations have demonstrated a strong desire to lower air pollution in order to protect the environment in recent years [7-8]. the main problem is CO and CO2 emissions from vehicles polluting the air. When compared to gasoline and diesel, biodiesel can lower the emission percentage [9–10]. The CO and CO2 emission percentages are displayed in Tables 5 and 6 and Figs. 6 and 7. When compared to diesel, the blends B5, B15, and B25 yield extremely low CO2 emissions in the CO2 emission test. 4.

4. Conclusion

Because of population increase and globalization, daily fuel consumption is relatively high in the current situation. Therefore, all industries and other energy users must switch to affordable alternative energy sources. The process involved combining biodiesel at different intensities and testing it in a DI-Diesel engine. Vehicles and other energy-related enterprises can use the new biodiesel blend. Here, the main ingredient used to generate biodiesel at different blending levels— such as B5, B15, and B25—is algal oil. The outcome demonstrates that blend B15 has attained exceptional mechanical and overall efficiency in addition to emitting a low proportion of CO and CO2. Thus, biodiesel is the greatest substitute for diesel and other petroleum-based goods and is also an effective way to lower air pollution.

5. Reference

a. Chi NTL, Duc PA, Mathimani T, Pugazhendhi A (2019) Evaluating the potential of green alga Chlorella sp. for high biomass and lipid production in biodiesel viewpoint. Biocatal Agric Biotechnol 17:184–188.

b. Pullen J, Saeed K (2014) Factors affecting biodiesel engine performance and exhaust emissions—part II: experimental study. Energy 72:17–34.

c. Kouzu M, Hidaka JS (2012) Transesterifcation of vegetable oil into biodiesel catalysed byCaO: a review. Fuel 93:1–12.

d. Viola E, Blasi A, Valerio V, Guidi I, Zimbardi F, Braccio G et al (2012) Biodiesel from fried vegetable oils via transesterifcation by heterogeneous catalysis. Catal Today 179:185–190.

e. Alaswad A, Dassisti M, Prescott T, Olabi AG (2015) Technologies and developments of third-generation biofuel production. Renew Sustain Energy Rev 51:1446–1460.

f. Barnett J, Adger WN (2007) Climate change, human security and violent confict. Polit Geogr 26:639–655.

g. Singh A, Nigam PS, Murphy JD (2011) Renewable fuels from algae: an answer to debatableland based fuels. Bioresour Technol 102:10–16.

h. Mata TM, Martins AA, Caetano NS (2010) Microalgae for biodiesel production and otherapplications: a review. Renew Sustain Energy Rev 14:217–232.

i. Muralidharan K, Vasudevan D (2011) Performance, emission and combustion characteristics of a variable compression ratio engine using methyl esters of waste cookingoil and diesel blends. Appl Energy 88:3959–3968.