Resour Environ Econ, 2024, 5(1): 417-419
DOI: 10.25082/REE.2023.01.004

COMMENTARY

Energy audit for biodiesel performance

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Received: May 25, 2024;
Accepted: June 26, 2024;
Published: July 1, 2024.

Citation: Mohite S. Energy audit for biodiesel performance. *Resour Environ Econ*, 2024, **5**(1): 417-419. https://doi.org/10.25082/REE.2023.01.004

Abstract: The performance and emission characteristics of the biodiesel – diesel mix have been assessed using the energy audit method. The goal of this commentary is to get familiar with the examination of the performance characteristics of a diesel engine fuelled with biodiesel blends using energy audit technique. An examination of heat flow, brake-specific energy consumption, friction power, and smoke has been conducted. Efficiency can be enhanced by implementing this strategy, resulting in savings of both time and energy.

Keywords: mix oil, biodiesel blend, energy audit, least square method, foresight approaches

1 Introduction

Fossil fuel reserves are inadequate and its reduction is a main worry, as it is widely used in this world. The fossil fuel's extensive uses in industry, transport and agriculture causes its reduction rapidly. Harmful emissions are emitted in the atmosphere due to fossil fuel use. This difficulty can be solved with the utilisation of alternative fuel.There are plenty of alternative fuels, such as vegetable oils, biodiesel, bio-alcohol and many more. Nevertheless, biodiesel is poised to gain wider acceptance as an alternative fuel in several types of diesel engines [1].

Foresight approaches have been discovered to be beneficial for long-term planning in areas such as strategic energy management, energy policy, and renewable and sustainable energy planning, in order to effectively handle uncertainties. Futures studies can influence the process of anticipating and speculating about future and developing technology [2].

2 Mixtures of low and high free fatty acid content oils for biodiesel

Karanja and the mixtures of Karanja and low free fatty acid content Linseed oils have been chosen to make biodiesel in this research. It has been observed that the mixtures of low and high free fatty acid content oil have been relatively unexplored to produce biodiesel. Karanja and Linseed are plentifully available in India. The different process parameters have been chosen during the production of Karanja biodiesel and mix oil (Karanja and Linseed oils) biodiesel and the same has been optimized to get higher biodiesel production yields. Their physical properties have been tested and it has been found at par with diesel and ASTM D6751 biodiesel standards [3].

The studies were conducted to get a range of performance and emission characteristics with 10%, 20% and 30% biodiesel (Karanja biodiesel and Mix oil biodiesel) blends at brake powers ranging from 0.5 to 3.5 kW at a compression ratio of 18:1 at 1500 rpm. The studies were performed on a diesel engine of 1-cylinder with 4- stroke, water cooling and direct injection arrangement. Measurements have been conducted to assess the mechanical efficiency, volumetric efficiency, braking thermal efficiency, exhaust gas temperature, air fuel ratio, and emissions of CO, NOx, and HC for biodiesel blended fuels. All these parameters have been found satisfactory in comparison to diesel [4–6].

3 Energy audit in biodiesel

There are various types of energy audit to apply for the improvement of efficiency in industries, buildings and fishing vessels. Regarding the energy audit, there has been less research conducted on the utilization of biodiesel blends in diesel engines. Upon conducting a thorough examination of existing literature, a methodology for conducting an energy audit specifically tailored for

biodiesel engines has been developed. The preliminary energy audit technique is used to evaluate performance characteristics. The preliminary energy audit is comprised of the various factors. These factors are composed of heat flow analysis factors such as consumption in brake power, wastages in water cooling, exhaust gas and radiation. These factors are also composed of brake specific energy consumption, loss of friction power and smoke [7]. During this energy audit technique, method of least square has been applied for the finding of relations in biodiesel blends ratio and parameters of energy audit at rated load [5, 6].

During biodiesel's energy audit, there would be increased in BSEC (brake specific energy consumption) respectively with the biodiesel concentration increase in the energy audit for 10%, 20% and 30% Karanja biodiesel blends. The highest hike of 8.5% in BSEC has been noted in B30 and diesel. When B20 is used as fuel then the largest amount of heat has been transformed to work. The heat wasted in cooling water (HJW) has been found to be the maximum in all types of losses,with a range of 35.48% to 37.79%. Heat wasted in exhaust gas is in range of 21.87% to 23.9%. Heat wasted in radiation (HRAD) is in range of 10.7% to 11.9%. Heat is utilised for useful work (HBP) in the range of 27.92% to 29.04% only. The highest lessening in friction power loss is noted for B30 Karanja biodiesel blend with respect to diesel. The friction power loss is found to be approximately similar at divergence of loads. There are 11.49%, 6.89% and 2.29% decrement in losses of friction power than that of diesel at 3.5kW correspondingly. The highest reduction in smoke is noted for B30 Karanja biodiesel blend. During this energy audit, it is observed that B20 (Karanja biodiesel blend) is useful as a fuel in view of efficient conversion of heat energy into useful work (brake thermal efficiency) in comparison to all tested fuels [5].

When energy audit of mix oil biodiesel blends are performed for 10%, 20% and 30% biodiesel blend, it is found that BESC of biodiesel blends are more than that of diesel. The optimal conversion of heat into useful work is achieved when B10 is utilized as fuel. The heat loss to cooling water (HJW) is the largest among all losses, ranging from 36.48% to 38.04%. The heat loss to exhaust gas (HEgas) ranges from 21.07% to 23.7%. The heat loss due to radiation is determined to be between 11.2% and 11.9%. The utilization of heat for productive work output ranges from 27.92% to 29.72%. The blend ratio has been found to have a significant impact on reducing HBP (Heat to brake power), as determined by the least square approach. Furthermore, a strong negative linear association ($R_2 = 0.947$) has been seen between the blend ratio and HBP. Friction power loss is significantly reduced in B30 compared to diesel across all loads for biodiesel blends. The friction power loss for a fuel is consistently similar with only a tiny variation across all loads.The Friction power loss for B30, B20, and B10 is determined to be 19.89%, 16.32%, and 4.08% lower than that of diesel at 3.5kW, respectively. The blend ratio has been found to have a significant impact on reducing friction power, as determined by the least square approach. Additionally, a strong negative linear relationship ($R_2 = 0.947$) exists between the blend ratio and friction power. B30 emits smallest amount of smoke. Smoke opacity have been reduced for all blends. There is reduction of 10.23% in smoke for diesel and B10 biodiesel blend, when compared at 3.5kW. B10 could be used as fuel in diesel engine when efficient conversion of heat into useful work is considered with least amount of brake specific energy consumption [6].

4 Conclusion

The goal of this commentary is to get familiar with the examination of the performance characteristics of a diesel engine fuelled with biodiesel blends using energy audit technique. Preliminary energy audit is a appropriate method to evaluate performance characteristics of biodiesel engine.In this energy audit, consumption of fuel's heat energy alongwith brake specific energy consumption, friction power and smoke have also been considered. This method of energy audit reveals the fuel's heat energy distribution in the diesel engine. The implication of biodiesel blends with BSEC, friction power and smoke emission is also considered. This is one of the most significant advantages of this energy audit, which saves time with proper evaluation. The regression equation is employed to determine the relationship between the blends ratio and energy audit parameters at rated capacity using the least square method. The regression analysis would be able to assist us in predicting the selection of the appropriate blend ratio for the energy audit parameters that are necessary.

Abbreviations

B10: 10% Biodiesel blend (volumetric basis)
B20: 20% Biodiesel blend (volumetric basis)

B30: 30% Biodiesel blend (volumetric basis)

Conflicts of interest

The author declares that there is no conflict of interest.

References

[1] Mohite S, Kumar S, Maji S. Experimental Studies on use of Karanja Biodiesel as Blend in a Compression Ignition Engine. International Journal of Renewable Energy Research. 2016, 6(2): 355-360.
https://doi.org/10.20508/ijrer.v6i2.3191.g6795

[2] Alizadeh R, Lund PD, Soltanisehat L. Outlook on biofuels in future studies: A systematic literature review. Renewable and Sustainable Energy Reviews. 2020, 134: 110326.
https://doi.org/10.1016/j.rser.2020.110326

[3] Mohite S, Kumar S, Maji S, et al. Production of Biodiesel from a mixture of Karanja and Linseed oils: Optimization of process parameters. Iranica Journal of Energy and Environment. 2016, 7(1): 12-17.
https://doi.org/10.5829/idosi.ijee.2016.07.01.03

[4] Mohite S, Kumar S, Maji S. Investigations on Performance and Emission Characteristics of Mix Oil Biodiesel Blends. Iranica Journal of Energy and Environment. 2016, 7(3): 255-261.
https://doi.org/10.5829/idosi.ijee.2016.07.03.07

[5] Mohite S, Maji S, Pal A. Performance Characteristics of Karanja Biodiesel Blends Using Energy Audit Technique. Recent Advances in Mechanical Engineering. ICRAME 2020. Lecture Notes in Mechanical Engineering. Lecture Notes in Mechanical Engineering. Springer, Singapore. 2021: 167-177.
https://doi.org/10.1007/978-981-15-9678-0_14

[6] Mohite S. Mix Oil Biodiesel Blend's Performance Characteristics with Energy Audit. Recent Advances in Mechanical Engineering. FLAME 2022. Lecture Notes in Mechanical Engineering. Springer, Singapore. 2023: 263-277.
https://doi.org/10.1007/978-981-99-1894-2_22

[7] Mohite S, Maji S. Importance of Energy Audit in Diesel Engine Fuelled with Biodiesel Blends: Review and Analysis. European Journal of Sustainable Development Research. 2020, 4(2): e0118.
https://doi.org/10.29333/ejosdr/7596