International Journal of Scientific Research & Engineering Trends
Volume 9, Issue 4, Jul-Aug-2023, ISSN (Online): 2395-566X

Improvement of Efficiency of Mixed Biodiesel Fuel: A Review

M.Tech. Scholar Aafreen Khanam, Prof. & Head Nitin Tenguria
Department of Mechanical Engineering,
Sagar Institute of Research and Technology,
Bhopal, Madhya Pradesh, India

Abstract- Diesel with a biodiesel blend has recently been commercially available all over the world due to the paucity of fossil fuels. The growing cost and demand of conventional fuels are anticipated to be lessened by the use of biodiesel in diesel fuel mixes. Engine emissions are also known to be decreased by biodiesel fuel mixtures. The biodiesel may soon pose a threat to diesel fuel. Biodiesel cannot totally replace diesel fuel due to its high density, low cetane number, and poor calorific value. Consequently, biofuel-combined diesel engines are preferable. The study's objective was to offer a thorough analysis of the articles on the combustion, ejection, and performance characteristics of diesel engines powered by biodiesel-diesel mixes. The potential and role of nanoparticles in the production of bioethanol have been investigated in numerous research studies in the past. This study summarized studies that used different biofuel nanoparticle ratios to analyze the effects on diesel fuel economy. Additionally, this study contained research publications outlining several techniques for enhancing engine performance. It had been reported that nanoparticle addition to biodiesel-diesel blends reduces brake-specific fuel consumption by 18 to 20% compared to blends containing no alcohol or alcohol with or without nanoparticles. Nanoparticles showed helpful function in the development of biofuels from feedstock preparation to chemical reactions. Nano particles were also investigated to be very thermally conductive, which increased combustion and brake performance by 2% to 5%, respectively. Studies have shown that nitric oxide ejections rose by 50% whereas HC, CO, and PM ejections significantly decreased. The results of the studies that were analyzed in this paper suggest that using biodiesel and biodiesel blends as a fuel for CI engines could possibly increase performance while lowering emissions.

Keywords- HC, CO, and PM, CI engines etc.

I. INTRODUCTION

Fossil fuels account for the vast majority of the world's energy demands (Zheng & Hou, 2009). For instance, the transportation sector relies on non-renewable, liquid fossil fuels for 95% of its traditional energy needs (ExxonMobile, 2019). Fossil fuels, on the other hand, are not anticipated to last more than a few decades (Shafiee & Topal, 2009). Furthermore, fossil fuels are responsible for more than 95% of global carbon emissions (Abas, Kalair, Khan, 2015). Furthermore, it is anticipated that the need for liquid fuels will continue to rise in the near future (International Energy Agency, 2021).

The International Energy Agency (IEA) has a program that aims to achieve net engine emissions zero by 2050. In this regard, it is thought to be a significant challenge to reduce reliance on fossil fuels. These factors have led to the investigation of numerous alternative fuels, including syngas (Paykani et al., 2022), biodiesel (Maheshwari et al., 2022; Pandey et al., 2022), natural gas (Stettler et al., 2016; Pandey, Badruddin, &Khan, 2022), hydrous ethanol (Wang et al., 2022), and bio-butanol (Zhen, Wang,&Liu, 2019).+

The most promising alternative fuel for traditional diesel engines is biodiesel. It is made from vegetable or animal oils and alcohol, either with or without the use of a catalyst, to generate mono-alkyl esters of long-chain fatty acids (Khan et al., 2009; Baskar, & Aiswarya, 2016; Chenet al., 2012; Cremonez et al., 2015; Oneret al., 2009). It can be made using the supercritical alcohol method without a catalyst and the trancesterification /esterification procedure with a catalyst present.

Vegetable oil molecules are typically triglycerides with unbranched chains of variable lengths and different levels of saturation, as opposed to the ideal petro-diesel molecules, which are unbranched and saturated hydrocarbon molecules with chain lengths of 12–18 carbon numbers. Triglycerides make up 90–98% of vegetable oils, with extremely minor amounts of mono- and diglycerides. Esters containing three fatty acids and a glycerol molecule make up the majority of triglycerides (Rahman et. al. 2019; Deka & Basumatary, 2011; Karmakar, Dhawane & Halder, 2018).

The aim of this review was to provide a comprehensive examination of the literature on the combustion, ejection, and performance characteristics of diesel engines driven by biodiesel-diesel mixtures.

II. GLOBAL SCENARIO

Biodiesel is used in countries such as the United States, Brazil, Germany, Italy, France and other European Union countries. Even though, it's possible for generation and application is greater, the report said in the "Biotechnologies" about the global landscape of biodiesel, 62 countries viewing for a compulsive used for biofuels.

The mandates come from EU-27 and it has planned by the Renewable Energy Directive (RED) stated 11% renewable contents by 2021 butitisahind rance to 5–7.5%rangein recent months. In America 13 countries have set their mandate sand yet few under consideration, followed by 12 countries in Asiapac and 10 countries in Africa have their mandates.

However, the major blending is man dates the global demand and countries such as the US, China and Brazil has set their target sanditis already Brazil set their levels by 15-20% blending range by 2020.

III. INDIAN SCENARIO

Present now, compare to world biofuel generation, India accounts for only 1%, and it has been likely to increase by scheme support composed by the government of India, technological know-how's and efficient feedstock generation at a lower cost. In India presently employed with E5 ethanol mandatory, and by 2017, it has been planned to raise the volume of ethanol blend to 20 percent in all biofuels content even though as a hard target.

As per the current survey about the biofuels, due to the delayed sourcing of ethanol from sugar mills, oil marketing companies (OMC) are failing to achieve the E5 mandate as well as future schedule as E10 mandate. Maharashtra one of the leading sugarcane producing state has approved 10% blend in, all biofuel from the 5% from January, and it is slowly implemented in other states too. The national scheme concerning about biofuels, said that it is diverging from modern international attitudes which may lead conflict with food security.

India, the total potential for renewable energy power production as on 31.03.13is estimated at 94125MW. It includes wind power potential of 49130MW (52.2%), and small-hydropower (SHP) potential of 19750 MW (20.98%). Besides, biomass power potential of 17,538MW (18.63%) from biogases-based cogeneration in sugar mills of 5000MW (5.31%) and 2707 MW(2.88%) from waste to energy is produced.

IV. LITERATURE REVIEWS ON ENGINE PERFORMANCE USING BIODIESEL AND DIESEL COMBINE

Humke et al. (1981) reported the possibility of using vegetable oil as fuel for diesel engine. The investigation had been done on the soybean oil and diesel fuel combine and the thermal efficiency, particulate ejections were analyzed. There is an improvement in performance and ejection characteristics. The results showed that vegetable oils are hopeful alternatives as fuel for diesel engine. The alcoholysis of carboxylic esters process is used for producing biodiesel from used cooking oil and informed that the process is affected by the molar ratio of glycerides to alcohol, catalyst, reaction temperature, reaction time, free fatty acids and water content in the oils. Mechanism and kinetics of alcoholysis of carboxylic esters and its improvements have also been studied (FangruiMa&MilfordAHanna1999).

It has made an attempt on single cylinder, four stroke diesel engine on the performance, combustion and ejection characteristics of different methyl esters of biofuels, including thevetia peruviana seed oil, jatropha oil, pungamia oil, mahua oil and neem oil. It is concluded that methyl ester of thevetia peruviana seed oil (METPSO) has comparable engine performance with a lesser amount of ejection compared to other combine. Brake thermal efficiency increases with increasing brake power for all fuels. This is due to decrease in heat loss and raise in power developed with increase in load. It is observed that with the brake thermal efficiency curves of five combine of biodiesel closely follow that of diesel and the maximum deviation is found to be 9.39%for neem oil at the maximum load .It is only 2% for METPSO. This is due to higher energy content and lower density of the METPSO blend compared too there bio-diesel combine (Balusamy&Marappan2009).

Bose et al. (2000) conducted an experiment with diesel-linseed oil combine and ethyl acetate linseed oil and the performance and emission characteristics were analyzed. The impact of injection pressure on then gine performance has been studied. They concluded that BTE and BSFC of both linseed oil combine and neat ethyl acetate linseed oil are comparable with that of diesel. The experimentation on low heat rejection diesel engine was conducted using Pongamia oil and ethyl acetate Jatrophaoil by Prasad & Mohan (2000). To increase the performance of the engine, Esterification and preheating were done. Also reported that there was an increasing BTE and decreasing BSEC.

Reddyetal. (2000) investigated at the suitability of 30% (by vol) vegetable oils (cotton, coconut, sunflower and mustard) with diesel in the existing diesel engine for different injection pressures. They found that 210 bars are the optimum injection pressure for cotton and coconut oil combine, 180 bars for sunflower oil blend and 160 bars for the mustard oil blend. They also reported that increase in brake thermal efficiency results in increase of injection pressure. The investigation made on vegetable oil fuels and their methyl ester(raw sunflower oil, raw cotton seed oil, raw soybean oil and their methyl esters, refined corn oil, distilled opium poppy oil and refined rapeseed oil) on a direct injection, four stroke, single cylinder diesel engine performance and exhaust emissions.

They concluded that both vegetable oils and their methyl esters are promising alternatives for diesel engines (SelimCetin kaya et al. 2001). Senthil Kumar et al. (2001) have reported that duel fuel engines can use a wide range of fuels and it can be operated with low smoke emissions and high thermal efficiency. Jatropha oil is used with methanol additive on this dual fuel engine. It was found that HC and CO emissions were higher in the duel fuel mode. Senthil Kumar et al.(2001) conducted an experiment with jatropha oil and its methyl ester on a CI engine.

From the performance point of view, it was found that both jatropha oil and its methyl esters are better alternatives for diesel in CI engine.

Bhupesh Sahuetal. (2018) conducted an experiment in CI engine using Jatropha oil and evaluated the performance and emission characteristics of a diesel engine using different combine of methyl ester of Jatropha with mineral diesel. From the results, it is concluded that the decrease in brake thermal efficiency and an increase in brake specific fuel consumption was achieved. There was the reduction CO, HC, Nitric oxide, Smoke opacity and increase of CO2 and Nitric oxide emission.

Abed et al. (2019) conducted experiments on a single cylinder diesel engine using Jatropha, palm, algae and waste cooking oils. Emissions are measured and compared with diesel. CO, HC, CO2 and smoke emissions are lower for biodiesel mixtures B10 and B20 (Jatropha, algae and palm) compared to diesel fuel. NOx emissions from all biodiesel mixtures B10 and B20 increases than diesel fuel for all biodiesel blend B10 and B20.

It is reported that 20% blend of bio diesel from Jatropha curses and Pongamia pinnata gives comparable performance and less emission when used as fuel in direct injection diesel engine (Kumar et al. 2004). Suryawanshi & Deshpandey (2004) conducted experiments on various combine using pongamia oil methyl ester with diesel on CI engine. There is significant progress in engine performance with reduction in HC, CO and Smoke emissions. NOx emissions are found to be slightly high. The experiments were conducted to examine the properties, performance and emission characteristics of different combine (B10, B20 and B40) of pongamia, jatropha and neem in comparison to diesel. It was reported that, with less Emission of HC, CO and smoke, the performance of B20 was closer to diesel. It was concluded (Venkateswara Rao et al.2008) that compared to Jatropha and neem methyl esters, Pongamia methyl esters gave improved performance. The performance, emission and combustion characteristics of biodiesel from neem oil and combined with diesel was investigated by the author in the DI diesel engine. It was found that on comparing the performance with the diesel the brake thermal efficiency of all biodiesel combines were higher. The CO and HC emissions were less, but NOx emissions were on the higher side (Atul Dhar et al. 2012).

Bertoli et al. (1997) used various oxygenated fuels for better diesel combustion. Burning of oxygenated compounds resulted in a large drop of soot volume fraction and an increase in flame temperature. From the results; reasonable increase in NOx emission is obtained. Matthew Stoner et al. (1999) investigated the effects of addition of two different oxygenate families to diesel on emissions of an optically-accessible DI diesel engine.

The results showed that the reduction of NOx and smoke emissions, than the glycol ethers used at the same oxygen content in the blended fuel. Brianetal (2001) conducted an experiment on the effects of different oxygenated fuels with DGL on the emissions and combustion of a single cylinder diesel engine.

In this, a matrix of oxygen containing fuel, assessed the impact of weight percent of oxygen content, oxygenate chemical structure and oxygenate volatility on emissions. It was concluded that as the weight percent of oxygen in the fuel increases, the PM decreases and also at fixed oxygen content, the fuel containing DGL resulted in a drastic reduction in PM, compared to other oxygenates.

According to (Daoodetal.2014), fuel additive technology is based on the use of a solid, fuel additives (iron, aluminum, calcium and silicon based oxides), to reduce NOx emission and also to improve the quality of fly ash. The component of the biodiesel contains free fatty acid (FFA) as the main constituent. That means in this case the biodiesel is hardly to ignite itself with a higher flash point. However, when alcohol additives, 5% and 10% by volume diluted into bio diesel blend fuel, B20, the flash points for those B20- alcohol blend fuels are lower when compared to mineral diesel and biodiesel B100. The effect of Tri a cetin (T) as an additive with biodiesel was analyzed by (Venkateswara etal. 2012) on direct injection diesel engine for performance and combustion characteristics. Normally in the use of diesel fuel and neat biodiesel, knocking can be detected to some extent. By adding tri a cetin additive to biodiesel, this problem can be corrected to some extent and also the tail pipe emissions are reduced. A Comparative study was conducted using petro-diesel, biodiesel and additive combine of biodiesel on the engine. Coconut oil methyl ester (COME) was used along with additive at various percentages by volume for all load ranges of diesel in respect of engine efficiency and exhaust emissions. Among the all blend fuel stried, 10% Tri a cetin combination with bio-diesel shows satisfactory results.

Prakash et. al. (2012) conducted an experiment on diesel engine using methyl ester of karanja and jatropha with wood pyrolysis oil and studied the performance and emission characteristics. It is observed that improved performance and reduced smoke capacity.

Neeraj Sahu & Shrihar Pandey etal. (2022) conducted an experiment on Effect of Mixed Biodiesel fuel on the Efficiency of Diesel Engines and studied the performance and emission characteristics. It is observed that improved efficiency of diesel engine performance and reduced smoke capacity.

V. RESEARCH GAP

Many researchers carried out the experiments for different biofuel sand its combine such as Pongamia Pinnata, Azadirachta Indica, Jatropha Curcas, and Thevetia peruviana etc, to measure the performance and emission characteristics of a diesel engine. They reported that performance and emission characteristics of biodiesel and its combine were better compared to diesel fuel.

But resource for getting bulk quantity of individual species is the question mark to run an engine in longer period of time and also make it reality. Immediate larger quantity of cultivation and production of biodiesel from individual species is also the big challenge.

To meet the challenges with usage of biodiesel in a diesel engine, a new methodology of mixed biodiesel is introduced in this research work and there by shortage of biodiesel cloudberry solved.

REFERENCES

[1] Abed, KA, Gad, MS, El Morsi, AK, Sayed, MM & Abu Elyazeed, MM 2019, 'Effect of biodiesel fuels on diesel engine emissions', Egyptian Journal of Petroleum vol. 28, pp. 183–188.
[2] Artur Malinowski, Joanna Czarnocka & Krzysztof Biernat 2020, 'An Analysis of Physico-Chemical Properties of the Next Generation Biofuels and Their Correlation with the Requirements of Diesel Engine', Biodiesel- Feedstocks, Production and Applications, Intech Science, Technology, and Medicine, open access Publisher.
[3] Atul Dhar, Roblet Kevin & Avinash Kumar Agarwal 2012, 'Production of biodiesel from high-FFA neem oil and its performance, emission and combustion characterization in a single cylinder DICI engine', Fuel Processing Technology, vol.97, pp.118-129.
[4] Azam, MM, Waris, A & Nahar, NM 2005, 'Prospects and potential of fatty acid methyl esters of some non-traditional seed oils for use as biodiesel in India', Biomass and Bioenergy, vol. 29, pp. 293–302
[5] Bailey, B, Eberhardt, J, Goguen, S & Erwin, J 1997, 'Diethyl ether (DEE) as a renewable diesel fuel', SAE Publication No. 972978.
[6] Balat, M 2006, 'Sustainable transportation fuels from biomass materials', Energy Educ Sci Technol, vol. 17, pp. 83–103.
[7] Balusamy, T & Marappan, R 2009, 'A Comparative Analysis on the Performance and Emission Characteristics of Thevetia Peruviana Seed Oil (TPSO) with other Non-edible Oil in CI Engine', International Energy Journal, vol. 10, pp. 93-100.
[8] Banapurmath, NR, Tewari, PG & Hosmath, RS 2008, 'Experimental investigations of a four-stroke single cylinder direct injection diesel engine operated on dual fuel mode with producer gas as inducted fuel and Honge oil and its methyl ester (HOME) as injected fuels',Renewable Energy, vol. 33, pp. 2007-2018.
[9] Bertoli, C, Del Giacomo, N & Beatrice, C 1997, 'Diesel Combustion Improvements by the Use of Oxygenated Synthetic Fuels', SAE Paper No. 972972.
[10] Bhupesh Sahu, Ajay Singh Paikra, Dilbag S Mondloe & Himanshu Agrawal 2018, 'Performance and emission characteristics of diesel engine working on Jatropha Methyl Ester and its blends', International
[11] Research Journal of Engineering and Technology, vol. 5, pp. 682-688.
[12] Bose, PK, Beg, RA, Ghose, BB & Subodh Kumar Saha 2000, 'Linseed based fuels for dieselengines', National Conference Proceedings of IC Engine and Combustion, pp. 160-165.
[13] Brian E Hallgren & John Heywood, B 2001, 'Effects of Oxygenated Fuels on DI Diesel Combustion and Emissions', SAE Publication No. 010648.
[14] Can Hasimoglu, Murat Ciniviz, Ibrahim Ozsert, Yakup Icingur, Adnan Parlak & Sahir Salman, M 2008, 'Performance characteristics of a low heat rejection diesel engine operating with biodiesel', Renewable Energy, vol. 33, pp. 1709-1715.
[15] Carmen C Barrios, Carlos Martín, Aida Domínguez-Sáez, Paloma Álvarez, Manuel Pujadas & Jesús Casanova 2014, 'Effects of the addition of oxygenated fuels as additives on combustion characteristics and particle number and size distribution emissions of a TDI diesel engine', Fuel vol. 132, pp. 93–100.
[16] Clothier, PQE & Moise A Pritchard 1990, 'Effect of free-radical release on diesel ignition delay under simulated cold-starting conditions', Combustion & Flame, vol. 81, no.3, pp.242- 250.
[17] Dan Li,Wenjun Fang, Yan Xing, Yongsheng Guo & Ruisen Lin 2009, 'Effects of dimethyl or diethyl carbonate as an additive on volatility and flash point

of an aviation fuel', Journal of Hazardous Materials vol. 161, pp. 1193–1201.

[18] Daniel Kocis, KiHoon Song, HyungSik Lee & Thomas Litzinger 2000, 'Effects of dimethoxy methane and dimethyl carbonate on soot production in an optically- accessible DI diesel engine', SAE Int. J.012795.

[19] Hanna, Fangrui Ma & Milford 1999, 'Biodiesel production: a review', Bio resource Technology, vol. 70, pp.1-15.

[20] Hiroshi Kitagawa, Tadashi Murayama, Shigeru Tosaka & Yasuhiro Fujiwara 2001, 'The Effect of Oxygenated Fuel Additive on the Reduction of Diesel Exhaust Particulates', SAE Paper No. 012020.

[21] Huang, ZH, Jiang, DM, Zeng, K, Lir, B & Yang, ZL 2003, 'Combustion characteristics and heat release analysis of a direct injection compression ignition engine fuelled with diesel-dimethyl carbonate blends', Proc.Instn Mech. Engrs, Part D: J.Automobile Engg, vol. 217, pp. 595-605.

[22] Humke, AL & Barsic, NJ 1981, 'Performance and Emissions Characteristics of a Naturally Aspirated Diesel Engine with Vegetable Oil Fuels-(Part 2)', SAE Paper No. 810262.

[23] Kalam, MA & Masjuki, HH 2002, 'Biodiesel from palm oil – an analysis of its properties and potentials', Biomass-and-Bioenergy, vol. 23, pp. 471-477.

[24] Niraj, Shrihar Pandey, HH 2022, 'Biodiesel An Analysis on Effect of Mixed Biodiesel fuel on the Efficiency of Diesel Engines.', Biomass-and-Bio energy, vol. 2, pp. 464-470.