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Effect of Mixed Biodiesel fuel on the Efficiency of Diesel Engines: A Review

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I. INTRODUCTION

The enormous increase in the number of automobiles and the increasing demand electricity has resulted in greater demand for petroleum products. The increasing demand for petroleum products has led to the oil crisis in the recent times. Therefore, there is an urge for finding out a replacement and attention has been focused on developing the renewable or alternative fuels to replace the petroleum based fuels for vehicle usage.

Fossil fuels produced by underground heat and pressure are consumed more rapidly than being created. Insufficient quantities or unreasonable price of petroleum fuels deeply concerns us, whereas the renewable energy is a promising alternative solution because it is clean and environmentally safe. Due to petroleum fuel, pollution and accelerating energy consumption have already affected equilibrium of the earth's landmasses and biodiversity. Carbon monoxide (produced when combustion is inefficient or incomplete), carbon-di-oxide (a product of the combustion of materials with carbon in them), hydrocarbons (produced as a result of poor fuel ignition), nitrogen oxides (produced when combustion occurs at very high temperatures), sulfur oxides (produced when elemental sulfur is present in the fuel), and particulates that are generally produced during combustion are other specific emissions of concern. So it is time to search for its alternative fuels.

II. GLOBAL SCENARIO

Biodiesel has been in use in various countries such as the United States of America, Brazil, Germany, Italy, France and other European unions. Even though, its potential for production and application is much more. The report stated in the "Biofuel Digest" about the global scenario of biodiesel, 62 countries looking for a mandatory implementation of biofuels. The mandates come from EU-27 and it has planned by the Renewable Energy Directive (RED) stated 10% renewable contents by 2020 but it is a hindrance to 5 – 7.5% range in recent months. In America 13 countries have set their mandates and yet few under consideration, followed by 12 countries in Asiapac and 10 countries in Africa have their mandates. However, the major blending is mandate the global demand and countries such as the US, China and Brazil have set their targets and it is already Brazil set their levels by 15-20% blending range by 2020.

III. INDIAN SCENARIO

At present, compare to world biofuel production, India accounts for only one percent, and it has been likely to increase by policy support framed by the government of India, technological know-how's and efficient feedstock production at a lower cost. In India currently 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 present 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 policy concerning about biofuels, said that it is diverging from modern international attitudes which may lead conflict with food security.

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

IV. EVIEWS ON ENGINE PERFORMANCE USING BIODIESEL AND DIESEL BLENDS

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 blends and the thermal efficiency, particulate emissions were analyzed. There is an improvement in performance and emission characteristics. The results showed that vegetable oils are hopeful alternatives as fuel for diesel engine. The transesterification 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 transesterification and its improvements have also been studied (Fangrui Ma & Milford A Hanna 1999). It has made an attempt on single cylinder, four stroke diesel engine on the performance, combustion and emission 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 emission compared to other blends. 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 blends 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 to other bio-diesel blends(Balusamy & Marappan 2009) .

Bose et al. (2000) conducted an experiment with diesel-linseed oil blends and esterified linseed oil and the performance and emission characteristics were analyzed. The impact of injection pressure on the engine performance has been studied. They concluded that BTE and BSFC of both linseed oil blends and neat esterified linseed oil are comparable with that of diesel. The experimentation on low heat rejection diesel engine was conducted using Pongamia oil and esterified Jatropha oil 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. Reddy et al. (2000) investigated that 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 bar is the optimum injection pressure for cotton and coconut oil blends, 180 bar for sunflower oil blend and 160 bar 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 (Selim Cetinkaya et al. 2001). Senthil Kumar et al. (2001) has 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 Sahu et al. (2018) conducted an experiment in CI engine using Jatropha oil and evaluated the performance and emission characteristics of a diesel engine using different blends 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, NOx, Smoke opacity and increase of CO_2 and NOx 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, CO_2 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 B20increases than diesel fuel for all biodiesel blend B10 and B20.

It is reported that 20% blend of biodiesel from Jatropha curcas and Pongamia pinnata gives comparable performance and less emission when used as fuel in direct injection diesel engine (Kumar et al. 2004). Suryawanshi & Deshpande (2004) conducted experiments on various blends 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 blends (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 blends 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. Brian et al. (2001) conducted an experiment on the effects of different oxygenated fuels with DGL on the emissions and combustion of a single cylinder DI 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 (Daood et al. 2014), fuel additive technology is based on the use of a solid, fuel additives (iron, aluminium, 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 biodiesel 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 Triacetin (T) as an additive with biodiesel was analyzed by (Venkateswara et al. 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 triacetin 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 blends 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 fuels tried,10% Triacetin 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 opacity.

V. RESEARCH GAP

Several researchers carried out the experiments for different biofuels and its blends 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 blends 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 thereby shortage of biodiesel could be resolved.

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