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PERFORMANCE OF CI ENGINE ON PARTICULATE MATTER ETHANOL BLENDING WITH JATROPHA OIL IN VARIABLE PROPORTION- A REVIEW

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ABSTRACT
As a renewable, sustainable and alternative fuel for compression ignition engine, biodiesel instead of diesel has been increasingly became popular. Biodiesel, derived from the transesterification of vegetable oils or animal fats, is composed of saturated and unsaturated long-chain fatty acid alkyl esters. In spite of having some application problems, recently it is being considered as one of the most promising alternative fuels in internal combustion engine. The aim of the present paper is to do a comprehensive review of engine performance and emissions using biodiesel from different feedstock and to compare that with the diesel. From the review it is found that the use of biodiesel leads to the substantial reduction in PM, HC and CO emissions accompanying with the imperceptible power loss, the increase in fuel consumption and the increase in NOx emission on conventional diesel engine with no or fewer modification. However, many further researches about modification on engine, low temperature performance of engine, new instrumentation and methodology for measurements, etc., are recommended while using biodiesel as a substitute of diesel.

Keywords: Ethanol; Renewable; Blend; Bio-fuel; Diesel engines.

I. INTRODUCTION
Biodiesel is a biodegradable and non toxic fuel produced from vegetable oil and animal fats which are renewable. The increasing demand of petroleum based fuel is because of rapid and fast industrialization of automotive sector. There are limited reserves for petroleum based fuels. These are available in limited amount in the world. Therefore the countries those are not having the sufficient stock of petroleum based fuel, are facing the problems of increase cost of fuel which mainly due to the cost involved in the import of the petroleum based fuel. Hence it is required to developed out and investigate the other resources of the alternative fuels, which can be produced easily and locally available sources such as Alcohol, Biodiesel, Vegetable oil, seed oil etc. Methyl or ethyl esters of fatty acids produced from vegetable oil or an animal fat is called biodiesel. Non edible oil or animal fats are the main recourses for production of biodiesel such as Jatropha, Palm, Marine fish oil, Soybean, Cottonseed etc. Biodiesel blends are prepared in a variable proportion with diesel to use in a conventional diesel engine. By using biodiesel in an engine there is also profitable in the reducing harmful pollutants in the environment. This paper reviews the production, properties, performance and emission analysis of different feedstock of blends of biodiesel and experimental work carried out in the various parts of the world. The objective of this study is to produce biodiesel from Jatropha oil, test its properties, and compare its properties with that of diesel.

Due to the petroleum shortage the researchers take interest in finding the alternative fuels for internal combustion engine. There are various types of alternative fuels available for internal combustion engine but biodiesel is most important alternative to diesel engine. Biodiesel is popular due to its renewability, lower exhaust emissions, and biodegradability . Most of the researchers have defined transesterification is one of the

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process for production of biodiesel. Transesterification process is most suitable method used for the production of biodiesel . Biodiesel is a nontoxic, biodegradable and renewable alternative as compared with diesel fuel. The properties of biodiesel are somewhat similar with the diesel fuel. Therefore with few or no any engine modifications are required to use biodiesel in diesel engine. Biodiesel has higher cetane number than petroleum diesel fuel and it does not contain aromatics. The availability of oxygen contains is around 10% to 11% by weight. Due to these characteristics of biodiesel, the emissions reduced in the exhaust gas as compared to base diesel fuel . The cottonseed crop is a fast growing plant and that grows even on drought and poor soils. Biodiesel also sustains at high temperature up to 44°C and at low temperature of up to 4°C. Cotton was the third biggest crops grown worldwide as measured by acreage: soybean which is 47%, occupying 75.4 million hectares; biotech maize (51 million hectares at 32%), biotech cotton (around 24.7 million hectares at 15%) and biotech canola (8.2 million hectares at 5%) . The use of biodiesel in diesel engine increased brake thermal efficiency and reduces emissions . It was also found that additives improved the fuel blend properties like density and viscosity which in turn of improved in the atomization of fuel and showed better combustion characteristics. It results in to higher brake power (BP), lower brake specific fuel consumption (BSFC) and higher brake thermal efficiency (BTE) than diesel . Capered et al. revealed that by using B5, B20 and B100 produced a peak power of 13.6 kW, 13.4 kW and 13.1 kW. Brake-specific fuel consumption increases by using B5, B20 and B100 were 1276, 1155 and 1238 g/kW-h. Carbon monoxide emissions increased by an average 15% and 19% by using B5 and B100. Hydrocarbon emissions decreased by 14% and 26% by using B5 and B100. Oxides of nitrogen (NOx) emission decreased by 4%, 5% and 14 % with B5, B20 and B100 biodiesel blends respectively. However, most of literatures revealed that CO, HC and smoke emissions decreased with biodiesel whereas oxides of nitrogen, carbon dioxide and BSFC increased with biodiesel . Sulphur dioxide emissions decreased by an average of 86% and 94% by using B100 and B50 biodiesel blended with ultralow sulphur diesel. The higher oxygen content of biodiesel improved premixed combustion phase to progress in a better way which leads to better combustion. It is also mentioned that premixed combustion phase is responsible for higher NOx emission . B15 blend shows 2.67%, 3.81%, 4.22% and 5.31% higher peak pressure than diesel at 20%, 40%, 60% and 80% load respectively. Gopal and Karupparaj revealed that combustion starts earlier for base biodiesel and its blends with diesel. The peak heat release rate of biodiesel fuels is lower than conventional diesel fuel because of shorter ignition delay period and lower calorific value (CV) of biodiesel that contributes to lower heat release rate. Combustion for biodiesel starts earlier which results in to shorter ignition delay period and advanced injection timing at all engine loads. The biodiesel gives similar power output as that for diesel. The BSFC for biodiesel increases due to lower heating value of biodiesel. The rate of heat release for diesel fuel is slightly lower than that for biodiesel at lower engine loads. But, as the engine load increases, the heat release rate for diesel is increased and it is higher than that of diesel because of the longer ignition delay period, all through which more fuel is accumulate in the combustion chamber which releases higher heat during the premixed combustion phase. At higher engine loads, the peak cylinder pressures for both fuels are almost same, but the rate of pressure rise and rate of heat release are lower for biodiesel. Mattarelli et al. Reported that BSFC of rapeseed biodiesel increased by 18% than diesel, soot formation reduced by 37.5%. The in-cylinder pressure at low rpm for diesel is higher, revealing a smother combustion start for biodiesel blends. The in-cylinder pressure analysis shows slight differences in the premixed combustion phase, depending on engine speed, at low speed the presence of biodiesel seems to speed up combustion whereas, at high speed, the situation is reversed; after the completion of first combustion phase, the difference among the fuels become smaller.

Bio Diesel Extraction Process

Pyrolysis

Pyrolysis is the process of conversion of one substance into another by means of heat or with the aid of catalyst. It involves heating in the absence of air or oxygen and cleavage of chemical bonds to yield small molecules. The pyrolyzed material can be vegetable oils, animal fats, natural fatty acids and methyl esters of fatty acids. The pyrolysis of fats has been investigated for more than 100 years, especially in those areas of the world that lack deposits of petroleum. Since World War I, many investigators have studied the pyrolysis of vegetable oil to obtain products suitable for engine fuel application. Tung oil was saponified with lime and then thermally cracked to yield crude oil, which was refined to produce diesel fuel and small amounts of gasoline and kerosene.

Transesterification Process

The conversion of Jatropha oil into its methyl ester can be accomplished by the transesterification process. Transesterification involves reaction of the triglycerides of Jatropha oil with methyl alcohol in the presence of a catalyst Sodium Hydroxide (NaOH) to produce glycerol and fatty acid ester.

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II. LITERATURE REVIEW

A large no. of experiments and studies were carried out for checking the feasibility of biodiesel in Diesel engines. A summary of some of these works is listed below:

A study was performed on " Emission characteristics of biodiesel obtained from jatropha seeds and fish wastes in a diesel engine" in 2017.This study emphasize on the reuse of fish waste and use of waste land for cultivation of jatropha seeds. By this study we come to know that using blends of biodiesel obtained from jatropha seeds, Exhaust gas temperature and NOx are observed to be higher for these fuels compared to diesel[1].

A investigational study was performed on "performance and emission characteristics of a variable compression multi fuel engine fuelled with Karanja biodiesel–diesel blend" in 2017. This investigation was summarised as the performance and emission of a single cylinder four stroke variable compression multi fuel engines when fuelled with 20%, 25% and 30% of Karanja blended with diesel and compared with standard diesel[2].

The comparative study on "A comparative study of stability characteristics of mahua and jatropha biodiesel and their blends" in 2017. This comparative study emphasized on the oxidation and storage stability of mahua and jatropha biodiesel, The presence of more unsaturated fatty acid (76.8%) in jatropha biodiesel than in mahua biodiesel (58.81%) makes the jatropha biodiesel more prone to oxidation and the induction period of jatropha biodiesel is lower (3.75 hrs) as compared to that of mahua biodiesel[3].

A research paper published as "Investigation on performance and emission characteristics of a variable compression multi fuel engine fuelled with Karanja biodiesel–diesel" in 2017. This research results as experimental investigations on a single cylinder, direct injection, diesel engine using diesel-biodiesel blends with cetane improver Ethyl Hexyls Nitrate as an additive under different Exhaust Gas Recirculation conditions, with increase in EGR percentage CO2, CO emissions were found to be increased while HC, NOX emissions were decreased[4].

A study was performed on "An impact of ethyl esters of groundnut acid oil (vegetable oil refinery waste) used as emerging fuel in DI diesel engine" in 2017. In this study researched An impact of ethyl esters of groundnut acid oil (vegetable oil refinery waste) used as emerging fuel in DI diesel engine and they drawn as a result, the specific fuel consumption is minimum (0.264 kg/kWh) for B20EEGAO at maximum load. The calorific value decreasing with increase in EEGAO blends. At full load, B20EEGAO has the higher brake thermal efficiency of 29.90% compared to other biodiesel blends. This could be ascribed to the content of more amount of oxygen in B20EEGAO, which may have brought about its enhanced burning. There is lower in smoke density for B20EEGAO (40.3 HSU) compared to diesel (43 HSU) at maximum load[5].

A investigational study performed on "Ternary blends of diesel fuel oxygenated with ethanol and castor oil for diesel engines" in 2017.This study emphasized the main drawback of its use as fuel is its poor solubility when it is blended with diesel fuel. Although additives are used to improve its miscibility. In this work also summarised the use of castor oil as additive to increase the miscibility of ethanol/diesel fuel blend is proposed, after this comes to know higher the ethanol content the lower the kinematic viscosity and HCV, although the higher the presence of castor oil the higher the CFPP values. It has also been observed that the higher the percentage of ULSD the higher the value of HCV[6].

An investigational study was performed on **"**Optimization of Diesel Fuel and Corn Oil Mixtures Composition" in 2016. In this study investigated that concept of Study of a diesel engine performance with exhaust gas recirculation (EGR) system fuelled with palm biodiesel, mineral diesel and palm biodiesel operated with two different modes (EGR and normal) in a diesel engine at full load at 2500 rpm. Increases in fuel economy are obtained with the use of palm biodiesel and EGR employment at the specific engine speed. This research emphasized The decreases in the exhaust gas temperature when the EGR is employed for both test fuels. NOx emission is reduced significantly when the EGR is applied with increases in CO and UHC emissions are obtained for both test fuels[7].

A research paper published on "Internal Combustion Engine Performance and Emissions Fuelled With Biodiesel-Diesel-Ethanol Blends" in 2015. This paper critically reviews on fuel properties, performance and emission of biodiesel-diesel- ethanol blends. After studied this paper it comes to know the emissions are strongly depended on engine operating conditions and bio fuel concentration in the blend. Combined blends of

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biodiesel-diesel-alcohol reduce NOX and HC significantly. The peaks of smoke emissions were reduced in a large extent with the increase of percentage of ethanol in blended fuels[8].

A comparative study was performed on "Developed Statistical Analysis of Engine System-Level Factors for Palm Biodiesel Fuelled Diesel Engine Responses" in 2015. In this study, an experimentally validated 0D/1D numerical model was developed for a single-cylinder diesel engine fuelled with biodiesel and diesel fuels. Using the model, 2000 cases generated from the combination of 13 system-level and in-cylinder parameters at four levels each were statistically analysed using regression analysis. The independent main effects which are statistically significant were identified for each of the output parameters. NOx is found to be influenced by injector-related parameters, while soot is affected by oxygen availability and in-cylinder residence time. Engine performance outputs such as BSFC and indicated power are influenced by operating conditions, although they depend on the combustion quality[9].

A research paper published "An Overview on Production, Properties, Performance and Emission Analysis of blends of Biodiesel'' in 2015, After reviewing this research it comes to know that Biodiesel received much more attention because of its environmental benefits and economic as well as its availability in the form of natural resources. Biodiesel produced from non edible oil natural resources can distinguish the use of edible oil for the production of biodiesel the biodiesel is more economical and non pollutant alternative fuel for the CI engine[10].

III. PROPOSED METHODOLOGY

The researchers have consistently trying to produce the vegetable oil derivatives which hold approximately similar characteristics as conventional diesel fuels. Methyl alcohol is most frequently used however sometimes ethyl alcohol is also used in the production of biodiesel. In general any primary secondary and tertiary alcohol can be used only the constrained is that higher alcohol leads to higher cost. The fatty-acid ethyl esters (FAME) produced from Methyl alcohol is more volatile than that of fatty-acid ethyl esters (FAEE). FAEE also shows higher viscosity, lower cloud and pour points in comparison to FAME.Methyl alcohol is cheaper and more reactive than ethyl alcohol. However in terms of toxic nature and renewable, ethyl alcohol shows good characteristics. Presently major source of production of Methyl alcohol are non renewable fossils. A catalyst is also required to speed up the production of biodiesel. Sodium hydroxide (NaOH) or potassium hydroxide (KOH) is used as a base catalyst in this reaction. The main issues with the use of triglycerides as substitute for conventional diesel fuel are higher viscosity, lower oxidation stability and lower volatility. These characteristics can be improved though mainly four methods namely direct use and blending, micro-emulsification pyrolysis/cracking

IV. CONCLUSION

After reviewing the above literature survey ,it is observed that the biodiesel received much more attention because of its environmental benefits and economic as well as its availability in the form of natural resources. It has also comes to know the biodiesel is increase the efficiency, exhaust gas temperature of CI engine and decrease the particulate matters from exhaust gases which are released to environment. Biodiesel produced from non edible oil natural resources can distinguish the use of edible oil for the production of biodiesel. This increases its natural demand in the market of transportation sector and scientists and researchers are now studying possible new sources of non edible oil of plant based or animal fats. After reviewed this research we can say that the jatropha oil is economical and efficient for the diesel engine ,it has low carbon emission comparison than pure diesel used in CI engine.

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