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Comprehensive Study of Nahar and Karanja Biofuel with EGR on Diesel Engine

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ABSTRACT: - Biodiesel produced from Pongamia oil has been considered as promising option for diesel engines because of its environmental friendliness. In this work, bio-diesel from Pongamia pinnate and Mesua ferrea oil is prepared, tested on diesel engine for different blend such as B10, B20, B30 & B40. Comparison made with diesel on various Emission parameter such as NOX, unburned hydrocarbon, oxygen, carbon monoxide, exhaust gas temperature, smoke opacity. Performance parameter like break thermal efficiency, mechanical efficiency, break specific fuel consumption are evaluated. Performance increases slightly when engine fuelled with biodiesel. Study reveals the effect on biodiesel on diesel engine when compared to diesel and evolves conclusion with respect to emission and performance.

KEYWORDS: - Nahar, Karanja, Biodiesel, NO_x, Emission, Nano particle, Exhaust gas recirculation.

I. INTRODUCTION

Biodiesel, an alternate fuel has attracted considerable attention during the past decade as a renewable, biodegradable and non-toxic fuel. Increasing uncertainty about global energy production and supply, environmental concerns due to the use of fossil fuels like petroleum products especially of diesel fuel has grown up significantly. A reduced cost than fossil fuel and produce biodiesel from waste fats and oils and another option for cost reduction is to reduce the cost of processing through optimizing the process variables that affect the yield and purity of biodiesel. In India, there are many trees bearing oil like ratanjot (jatropha curcus), mahua (madhuca indica), pilu (salvodara oleoids), nahar (mesua ferralina), kokam (garcinia indica), rubber seed (hevea brasiliensis) and karanja (pongamia pinnata) etc. Among these species, which can yield oil as a source of energy in the form of biodiesel, Pongamia pinnata has been found to be one of the most suitable species due to its various favorable attributes like its hardy nature, high oil recovery etc. Also the use of nahar oil (Mesuaferrea Linn) as a potential source of biodiesel. Nahar oil is a medium-sized to large evergreen tree with short trunk, found in the Himalayas from Nepal east wards, in North-Eastern India, Deccan Peninsula and the Andaman Islands.

II. LITURATURE SURVEY

[1] Harish Venu, Venkataramanan Madhavan .The title of the paper “Effect of AL₂ O₃ nanoparticles In Biodiesel – ethenol Blends at various injection strategies: Performance, emission and combustion characteristics” had studied that AL₂ O₃ nanoparticle addition in biodiesel has improve the engine performance with significant emission including HC,CO,NOX and CO₂. also optimizing a fuel blend to retarded injection time, Nano particle addition help in meeting emission norms. Emission vise AL₂ O₃ addition result in lower HC,CO,CO₂ NOX and smoke emission.AL₂ O₃ additive optimize the engine parameters such as Compression ratio, injection timing and load have significance in improving combustion.[2]Santosh Kumar das, Pradeep Lingfa &Supriya B. Chavhan .Research in title “An experimental

investigation on the application potential of heterogeneous catalyst Nahar biodiesel and its diesel blends as diesel engine fuel” said that the experimental investigation of diesel engine slightly reduce brake thermal efficiency and excellent exhaust emission up to 405 blending of biodiesel with convection diesel fuel with. At full load, compared to diesel fuel, the brake thermal efficiency dropped by 1.64% and 1.83% whereas brake specific fuel consumption increased by 5.07% and 6.765 for B30 and B40 blend respectively. [3]K.shivramakrishnan Said in “Investigation on performance and emission characteristics of a variable compression multifuel engine fuel with karanja biodiesel blend in 2017 said that the karanja biodiesel has brake thermal efficiency of blends increase as compression ratio increases. The maximum break thermal efficiency of B25 at full load at compression ratio 18, which higher than that of diesel. The Karanja oil blends gives higher combustion pressure at high compression ratio due to longer ignition delay and lower heat release rate when compared to diesel and also the specific fuel consumption decreased with increase in compression ratio. The hydrocarbon emission of various blends have been reduced compared to diesel.[4] Bhupendra Singh Chauhan, Naveen Kumar, Haeng Muk Cho, Hee Chanh Lim Title of the paper “A study on performance and emission of a diesel engine fueled with karanja biodiesel and its blends. “Stated that in biodiesel production process of karanja oil has kinematic viscosity and specific gravity has reduced. Higher flash point of karanja methyl Ester and its blends than diesel fuel suggests their safe storage and handling, higher density, lower calorific value, higher kinematic viscosity of Karanja Biodiesel. The result shows that Brake thermal efficiency has about 3-5% lower with karanja biodiesel and its blends with respect to diesel the peak cylinder pressure and heat release rate was lower for karanja bio diesel.

[5]A.M.Ashraf, H.H.Ma sjuji, M.A.Kalam, I.m.Rizwanul Fattah, S Imetenan, S.A.Shahir, h.M.Harak Said in the paper of “Production and comparison of fuel properties, engine performance and emission characteristics of biodiesel from various non-edible vegetable oils.” A review stated that the application of biodiesel has shown positive impact in resolving issues of poisonous environment, reduces fossil resources and increasing demand also biodiesel has economic & environment benefits as well as renewable origin. Good availability of non-edible seed like karanja, polanga, cotton seed, jatropha, Nahar, rubber seed and neem in India the presence of monounsaturated fatty acid in biodiesel blend at low temperature could improve ignition quality, fuel flow, properties and fuel stability.[6]Rupesh L. Patel, C.D.Sankhavar Title as “Biodiesel production from karanja oil and its use in diesel engine: A review” talk about the transesterification, pyrolysis, Micro emulsion and blending are four primary method for production of biodiesel. The yield of 97% of karanja oil methyl ester has obtain from karanja oil by transesterification process at 65° using 1 wt% of KOH, 6:1 molar ratio of methanol to oil in 2 hour. The cost of B20 blend of karanja biodiesel with diesel is very close to diesel price. This cost can further decreases by developing large scale production unit of karanja biodiesel, and it increase the mission of NO_x and CO₂ as compare to diesel but emission reduces by add additives in biodiesel.[7] Prafulla D. Patil, Shugang gang Title as “Optimization of biodiesel production from edible & non edible oils”The non-edible oils Pongamia glabra (karanja) & edible oil such as corn canola were found good viable sources for producing biodiesel. A 2 step & single step transesterification Process used for producing biodiesel from free fatty acid, edible or non-edible vegetable oils. Yields of this process about 90-95% for J.Curcas, 80-85 for p. glabra, 80-95% for canola, 80-85 corn. The fuel properties production of biodiesel from ASTM standard for biodiesel. [8]Malaya Naik, L.C. Meher, S.N.Naik, L.M. Das Title “Production of biodiesel from high free fatty acids karanja (Pongamia Pinnate) oil.Karanja is underutilized plant, which is grow in many part of India oil contaminated with high free fatty acids (FFAS). Depending on moisture content in seeds during collection. This paper discusses the mechanism of dual process adopted for the production of biodiesel from karanja oil containing FFA up to 20%. The yield of biodiesel from high FFA karanja by dual step process observed to be 96.6-97% non-edible oil contains toxic components.

[9]P.K.Srivastava, Madhumila verma Title “Methyl ester of karanja oil from Jharkhand region has been prepared by transesterification method”. Physical & chemical properties of karanja oil & methyl ester determined.Maximum thermal efficiency also determined brake specific fuel consumption of biodiesel of karanja oil is higher.Methyl ester of karanja oil suitable substitute of petroleum diesel fuel. [10]S.S.Hoseni, G.Najafi, B.Ghobadian, Rizalman mamat, Nor Azwati, Che Sidik, W.H. Azmi Title “The effect of combustion management on diesel engine emission fueled with biodiesel-diesel blends.” Reduce the emission of diesel engine. In this review, effective result strategies combustion management, fuel additives & after treatment technology which are reported in various research studies engine pollutants is using biofuels, combination of diesel biodiesel, with turbocharger must be used diesel oxidation catalyst selective catalytic reduction (SCR) & diesel Particulate filter (DPF) must be utilized.[11] Anchuchaya Devi, Vijay K. Das, Velentina and Dhanapati Deka Title “Fuel quality assessment of biodiesel produced through alcoholics from Pongamia glabra, Mesua ferrea and their blend a novel yet cinch approach. Pongamia glabra & Mesua ferrea satisfy the most convincing species due to their various attribute like annual seed yield. The oil contents of Mesua ferrea and Pongamia glabra are 72% & 37% respectively as the acid produced individually from both the seeds and blending both the oil in 1:1 ratio recorded remarkable fuel quality enhancement in the blended biodiesel which can

used as a better fuel than the individual biodiesel prepared from both the oils.[12]Sushma. S. of Mechanical Department said that biodiesel is produced from hybrid oil (dairy waste milk scum and karanja). Some important properties like flash point, fire point, density, calorific value, kinematic viscosity, are determined as per the Indian standards and were found to be within the limits of biodiesel standards. The Brake thermal efficiency of diesel fuel is increased about 1.44% when compared to that of neat biodiesel at 100% load. The Brake thermal efficiency of B10 is very close to that of diesel fuel at full load condition. By increasing the load of the engine, the brake thermal efficiency also increases for all the tested fuel types. The specific fuel consumption of biodiesel and its blends at all loads is higher than diesel fuel. As the load increases, BSFC decreases for all fuel blends. The BSFC of B10 is very close to that of diesel fuel at full load condition. A little increase in fuel consumption is often encountered due to the lower calorific value of the biodiesel. [1]

[13]Jibitesh Kumar Panda1, Vemparala Gopala Krishnasaid that Mahua biodiesel and diesel additives (2-EHN, Ethanol) seems to have a potential to be used as a substitute fuel in Direct Injection diesel engines without any alteration The brake thermal efficiency was 3% better than D100 and for the blend BL1 shows a better efficiency as compared to the pure diesel. Brake specific fuel consumption is lower for Mahua biodiesel blends and additives than D100 .The blend BL1 have 30% less BSFC then D100 Most of the major exhaust pollutants such as CxHy and exhaust gas temperature are reduced with the use of biodiesel and the additive. By using BL4 we can reduce 16% CxHy and exhaust gas temperature like 4.3% for BL1. From the experimental analysis for both performances and emissions, it is concluded that BL1 could replace the diesel for diesel engine for better performance. [14]M. V. S. Murali Krishna1, N. Durga Prasada Rao said that Peak BTE with engine with ceramic coated LHR combustion chamber with biodiesel operation was higher in comparison with conventional engine at recommended (3%) and compatible at optimized injection timing. BSEC was compatible at recommended injection timing and optimum injection timing. EGT with LHR combustion chamber with biodiesel operation was marginally lower in comparison with conventional engine at recommended (15%)and optimized injection timings (13%). Coolant load with LHR engine with biodiesel operation was lower (9% and 26%) at recommended and optimized injection timings respectively in comparison with conventional engine. Sound levels were lower (20% and 38%) with LHR combustion chamber with biodiesel operation at recommended and optimized injection timings respectively in comparison with conventional engine. Volumetric efficiencies were lower (4% and 7%) with LHR combustion chamber with biodiesel operation at recommended and optimized injection timings respectively in comparison with conventional engine. [15]Aman Mamualiya and Harvinder Lal said that it was found that karanja is non-edible oil which is available in Rajasthan, India. Karanja oil has potential that can be converted into biodiesel. The characteristics of karanja biodiesel are found to be closed as per ASTM and BIS standards. Further the engine performance and emissions shows that karanja biodiesel can be used in CI engine without any modification. The experiment results shows blends B10 and B20 shows the same results. They improved BTH, EGT and reduced BSFC. Further they also reduced emissions like CO₂, CO, HC and smoke density and increases NO_x level as compared to diesel. [16]G. Lakshmi Narayana Rao said that Crude Karanja oil was transesterified using NaOH as catalyst and methanol to form biodiesel. The conversion was 92% at 600c. The fuel properties like viscosity, density, flash point, fire point and calorific value of the transesterified product (biodiesel) compare well with accepted biodiesel standards i.e ASTM and German biodiesel standards. The viscosity of biodiesel oil is nearer to that of diesel and the calorific value is about 12% less than that of diesel. More lubricating than diesel, so it increases the life of engines, Biodegradable, Non-toxic. High flash point and hence safe to transport and store, Oxygenated fuel and hence clean burning. Low viscosity and hence improved injection and atomization, Cetane no. of esters is greater, reduced emissions, 90% reduction in cancer risk, Provides domestic, renewable energy.

[17]Satya Narayan Naik said that Biodiesel has become more attractive to replace petroleum fuel. As per the reported literature, most of the transesterification studies have been done on edible oils like rapeseed, soybean, sunflower and canola by using methanol and NaOH/KOH as catalyst. There are very few studies reported on production of biodiesel by utilizing non-edible oils, among which, karanja is one of the most potential species to produce biodiesel in India, which could offer opportunities for generation of rural employment, increasing income and improving environment. Presently, only 6 per cent of the total potential of theoilseed is being collected properly. The above experimental results reveal the alkaline catalyzed transesterification as the promising area of research for production of biodiesel in decentralized scale from economic point of view. Hence the process can be further improved to get high yield as well as fuel quality biodiesel. [18]N. Shrivastavaa, S.N. Varmaa said that in this study, biodiesel was prepared in our laboratory from Karanja oil. The KOME and its blends were compared with diesel fuel. Based on the experimental study, the main result of performance and emission parameters are summarized as follows. The KOME showed higher fuel consumption and higher energy consumption than diesel fuel. The thermal efficiency of Biodiesel and its blends was lower than the diesel fuel. The emission of KOME and its blends showed reduction in carbon monoxide, Hydrocarbon and smoke emissions whereas NO_x emission was found higher compared to diesel.

The 20 percent blend of KOME showed higher average reduction in CO, HC, and Smoke in comparison to average increase in NO_x so it can be concluded from the above mentioned findings that the Karanja oil methyl ester (KOME) and its blends can be used as an alternative fuel in diesel engine without any significant modification in the engine. [19]Venkata Ramesh Mamilla St.Peter's said that Crude Karanja oil was transesterified using NaOH as catalyst and methanol to form biodiesel. The conversion was 92% at 600. The fuel properties like viscosity, density, flash point, fire point and calorific value of the transesterified product (biodiesel) compare well with accepted biodiesel standards i.e. ASTM and German biodiesel standards. The viscosity of biodiesel oil is nearer to that of diesel and the calorific value is about 12% less than that of diesel. More lubricating than diesel, so it increases the life of engines, Biodegradable, Non-toxic. [20]Mohamed E. S. Mirghani International Islamic University said that The NSO obtained after the extraction processes was dark yellow. The characterization processed done in this project showed that the free fatty acid content of the NSO is high which about 7%, the IV is 77.3 mg Iodine/ g oil, the phosphorus value is 33.5 ppm and the SV is 101.5 mg KOH/ g oil. The average molecular weight of the NSO was determined from the SV of the oil which had given 539.74 g or approximately 540g. On the other hand, the experimental results of NSO bio lubricant viscosity optimization to obtain the optimum condition to produce high viscosity indicated that the reaction temperature, the reaction time and the catalyst dosage were the main factors affecting the optimization processes. In addition, the data analysis using Design Expert software had shown a significant interaction between the NSO bio lubricant viscosity, the temperature, the time and the catalyst dosage. The viscosity achieved was nearer to the benchmark value when the temperature was more than 150°C, 80 minutes reaction time and about 0.8% of the catalyst dosage. [21]N. A. Kabbashi1, I. Y. Qudsieh, Irmanish Ibrahim said that The fuel properties like viscosity, density, flash point, fire point and calorific value of the trans esterified product (biodiesel) compare well with accepted biodiesel standards i.e ASTM and German biodiesel standards. The viscosity of biodiesel oil is nearer to that of diesel and the calorific value is about 12% less than that of diesel. More lubricating than diesel, so it increases the life of engines, Biodegradable, Non-toxic. High flash point and hence safe to transport and store, Oxygenated fuel and hence clean burning. Low viscosity and hence improved injection and atomization, Cetane no. of esters is greater, reduced emissions, 90% reduction in cancer risk, Provides domestic, renewable energy.

III. CRITICLE DISCUSSION ON LITURATURE REVIEW

- Production of biodiesel from edible and non-edible oils was explained and optimization is done by various researchers, also explained about development and advance method for preparing and analyse the result from Nahar and karanja seeds and experiments. Biodiesel can be considering as feasible alternative substitution fuel for diesel engine without any modification. (2,4,5,7,11,16,17,21)
- Many researcher added Nano particle in pure diesel to improve performance and reduce emission of CI engine. Nano particle plays major role in improving the fuel properties and enhancing the performance of engine.(7,13)
- Many researchers use Al₂O₃ as additive for cleaner combustion and reduce exhaust gas temperature. (1,6,13)
- Pro Production methodology of biodiesel from edible and non edible oils was explained and optimization is done by various researchers. They concluded that further research and development on some advanced methods such as super critical methanol process in situ alkaline transesterification and micro wave method is necessary. (1,2,4,)

IV. CONCLUSION

Biodiesel blend B20 could replace the diesel fuel because of greater efficiency. B20 also having less value of BSFC. CO, CO₂, HC, NO_x and O₂ Emissions are also very low in case of B20 than diesel fuel. It can be possible to use Karanja and Nahar biodiesel when more plantations will be done so that economically it will be acceptable.

NOMENCLATURE

B10 – 10% Biodiesel + 90% pure diesel

B20 – 20% Biodiesel + 80% pure diesel

B30 – 30% Biodiesel + 70% pure diesel

B40 – 40% Biodiesel + 60 % pure diesel

Ci – Compression ratio



NO_x – Nitrogen of oxide

BSFC – Break specific fuel consumption

CO – Carbon monoxide

CO₂ – Carbon dioxide

HC – unburned hydrocarbon

O₂ – oxygen

Al₂O₃ – aluminium oxide

NaOH – sodium hydroxide

V. ACKNOWLEDGEMENT

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