A Review on biodiesel performance in a single cylinder IC Engines

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Abstract- **The demand for energy is growing tremendously due to the modernization in every aspect of human life. Among the different alternative sources, biofules are becoming popular due to their low emission rate, when used in engines in comparison to the fossil fuels. The biofuels are extracted from different organic feed stocks, which are plant waste, animal waste and other wastes products. In this present paper pioneers work done on four stroke, single cylinder, air cooled, direct injection diesel engine is carried out to know the characteristics of biodiesel.**

***Index Terms*— Single cylinder, biodiesel, Four stroke Engine, emission characteristics.**

I. INTRODUCTION

Nowadays there is a growing interest in the development and utilization of alternative fuels. In recent years biogas, biodiesel, vegetable oil, ethanol, n-butanol and diethyl ether have attracted much attention as alternative fuels [1]. Because they are renewable and can be produced from the agricultural waste. Following literatures are listed out based on the biodiesel produced from the agricultural waste and which are tested to produce the energy.

Samuel et al. [1] synthesized carbon based solid acid catalysts via an efficient one pot hydrothermal carbonization sulfonation without need of high temperatures. They noticed that activity loss upon reuse of the catalyst was proved to be by de-sulfonation and could be completely reversed. They listed out this catalyst prepared from a cheap, widely available, and easily renewable form of biomass, and it is highly effective.

Pak- Chung Lau et al. [3] to examine the manganese glycerolate and this compound provide a total of eight positive charges to compensate for the eight negative charges generated from the hydroxyl group(-OH) in four glycerol ligands. Therefore the yield could achieve more than 99% in 1.5h under the optimized reaction conditions. This process of catalytic system can be applied in bio-lubricants production using higher alcohols with over 99% yield in 3h.

Dussadee Rattanahra et al. [4] this catalytic performance in esterification of oleic acid for biodiesel production. The La catalysts calcined at 600^0C exhibited the balancing of strong Lewis acid and Lewis basic sites. Which is related to the catalytic activity with FAME content of 63.60% was obtained at calcinations temperature of 500^0C, which was lower than those La and Ce catalysts. Showed that the reverse and unwanted saponification reactions as probably occurred during the reaction, caused in the slowing down of the reaction rate. This could be attributed to the coexistence of strong acid and basic sites in the catalyst.

Rawaz Ahmed et al. [5] the substitution of non-renewable fossil fuels with a sustainable liquid feedstock for biofuel production. The cost of conventional biofuel production is higher than that of petroleum- based fuel production since it is produced mostly from expensive high-quality virgin oil, 70-80% of the overall biofuel production cost is associated with the cost of raw materials. The esterification of high free fatty acid lipid feedstocks from wastewater containing FOGs is an alternative route to biodiesel production as a renewable energy is possible and hence with increasing concern over globel warming, it is foreseeable that biodiesel usage would continue to grow at a fast face. This will trigger the development of more sophisticated methods of bio diesel production and refining to cope with the increasing market demand.

Harsh Dadhania et al. [6] synthesized the catalytic production of bio diesel has attracked the attention of academic and commercial research duo to its highest efficiency and sustainable environmental condition, this impacts on various parameters like the molar ratio of alcohol to acid, reaction temperature, time were evaluated, and amount of catalyst, after the reaction`s completion catalyst can be easily separated from the

reaction mixture through the external magnet and could be re used up to six reaction cycles without losing it`s catalytic efficiency. Various analytical techniques were used to establish its characteristics, thermal stability, morphology, crystalline nature and elemental analysis. Therefore the methodology provides a facile and environmentally begin route for bio diesel production through the esterication of long chain fatty acids.

Encinar J. M et al. [7] basically bio diesel produced from various sources, like using vegetable oils are materials, but now, these vegetable oils are expensive, then replaced by another alternative like animal fats. Originally animal fats have high fatty acids (FFA) leves. Reaction times for esterification and transesterification longer than 120 min were enough to obtain Bio diesel yields above 97%. High methyl ester content biodiesel was obtained by a two step process from high acidity animal fats. The first was an acid esterification and it was followed by basic transesterification.

Zekai Miao et al. [8] fine stag (FS) consists of residual carbon (RC) and slag particles (SP). The characteristics of SP and RC separately. SP contain a little of pores and maily consist of spherical particles most of which are solids. RC have a higher pore surface, more continuous and complete pore structure. Therefore the predominant groups of organic carbon within SP matrix are C-C and C-O, C-O groups origanically bound with inorganic elements in SP forming C-O-M (M:inorganic elements). This matter gain a better insight of the characteristics of both slag particles and residual carbon separately. It provides the theoretic support for best utilization. This distinction between different sized particles feature can be applied to obtain the fraction with relatively high carbon contents by sieving. Meanwhile slag partical contains not only inorganic components but also a small amount of organic carbon existing in the slag particle.

Dan Sassonker I et al. [8] the process of levitation was by electromagnetic melting system is carried out and experimentally. This work piece considered is formed by a metallic sphere placed in a conical shaped coil. The proposed model consists of an electrical side subsystem formed by series resonant circuit with time varying resistence and inductance. Finally, the experimental and simulation results are shown to accurately resemble each other, verifying well the proposed modeling approach. The electro magnetic levitation melting work piece, consisting of a conical shaped coil and floating sphere, was explicitly represented by an electro-mechanical model.

Wenjun Zhong et al. [10] bio diesel and gasoline blended, and catalyst is used as hydrogenated to produced as a alternative fuel in compression ignition engine at low temperature combustion. The double injection strategy is proposed to solve the above problems and to find the optimal injection conditions for this tested fuel and at the same time the NOx emission is mainly effect by pilot ratio, PM, THC and CO emissions are controlled by start of injection timing. The double injection mode is applied to obtain advanced combustion phasing and reduced maximum pressure rise rate simultaneously in a GCI engine using gasoline/hydrogenated catalytic biodiesel blends at high load. The NOx emission is more sensitive with the pilot injection ratio and occurred under 40% of the pilot injection ratio with pilot SOI OF -50^0C at TDC.

Erkan Ozturk et al. [11] hazelnut soapstock is waste material of sunflower oil, its form is semi liquid and blended with canola oil bio diesel to improve some properties of the canola oil biodiesel and to reduce the cost of fuel. To investigates performance, emissions, combustion and injection characteristics of a diesel engine, by adding hazenut soapstock to canola oil, the combustion resulting in increased NOx emission and decreased THC, CO, and smoke emissions and sometime. The experimental results showed that the injection and ignition delays and maximum heat release rates decreased with the biodiesel addition. Synthesized that canola oil-hazelnut soapstock mixures with Diesel fuel were tested at four engine loads (25, 50, 75, and 100) and to maintain 2200 rpm engine speed. In conseqentlty the following conclusions are 5% and 10% biodiesel additions did not significantly affect CO_2

Chennapattana S .V. et al. [12] By using Bio diesel as a fuel non edible Calophyllum inophyllum linn o Honne oil Methyl ester/Diesel blends and hence to increase compression ration from 15 to 18 on the DICI-VCR Engine resulted out like specific fuel consumption for biodiesel found to be more than that of diesel but at compression ratio reached 18 , brake thermal efficiency of the engine operated with 100% biodiesel is less than Diesel and same time about emissions resulted out major reduction in CO, and hydrocarbon compared to diesel at compression ratio

18, when were the blends of biodiesel and diesel used B20, B40, B60, B80 and 100% bio diesel.

Navdeep Sharma Dugala et al. [13] blending of dual biofuels like([Mahua and Jatropha) in equal proportions volume (1:1,v/v) with mineral diesel (B10 was a blend of 5% each biodiesel with 90% mineral diesel and same proportions were followed remaining blends like B10, B20, B30, and B40 by running a engine at constant speed of 1500rpm,50% loading conditions(2.6kw) and different compression ratios of 13.5:1, 14.5:1, 15.5:1,and16.5:1 then the resulted out (.15-1.58%) higher brake power and (1.07-12.42%) higher mechanical efficiency as compared with mineral diesel at 16.5:1CR and also peak pressure and exhaust gas temperature were recorded as lowered by 0.15-0.36 bar and 11.1-69.8 0 C respectively and watched emission resulted out Hydrocarbons and carbon monoxide were lower by 33-62% respectevely and the carbon dioxide emission were found to be higher by 42.85% than mineral diesel. Then concluded that B20 had optimum properties.

Bhupendra Singh Chauhan et al. [14] pure biodiesel and blended biodiesel with line diesel fuel after wide range of investigation carried out to solve two problems are depletion of fossil fuel and environmental degradation. Then the concept of study is to compare in types issues like performance, combustion, and emission characteristics, Jatropha biodiesel to mineral diesel when performance results releaved were the brake thermal efficiency lowered, and brake specific fuel consumption was found to be higher and parallel emission results noticed, HC, CO, and CO_2 and smoke were lowered but for NOx emission was higher ,from above said resulted that Jatropa bio fuel energy is main alternative fuel in near future according to decentralized energy production is concerned. Therefore Jatropa biodiesel and its blends could be used in conventional diesel engine without any modification.

GreenPaul V et al. [15] agriculture origin products like, vegetable oil and plants, at same time emissions are able to reduce net carbon dioxide and carbon monoxide, parallelly NOx emissions higher. The main drawback of biodiesel is that properties high viscocity and low volability. Therefore benfits from biofuels are made from renewable sources blended in any proportion with mineral diesel, biodegradeable composition, domestically produced from non petroleum, non toxic nature, zero sulphour and lead. Increased engine life duo to self-lubricating property and hence safer to handle. Then running parameters of engine were absorbed, brake power, Exhaust gas temperature, optimum load and efficiency under lower economical expenditure.

Antony Miraculas G et al. [16] calophyllum and in ophyllum oil methyl ester biofuel used and absorbed at higher CR19 induces high cylinder temp which enhanced vaporization inside engine cylinder and hence better performance only to a certain extent, and at higher CR19 reaches proportionally Oxides of nitrozen emission increases, and duo to high biofuel blends, get better combustion phenomenon at these condtions reduces the emissions of CO and Unborned hydrocarbon, it is suitable for B30 at CR19. Mohit Vasudeva et al. [17] carried and esterification process using two step method for higher free acid crude rice bran oil, and blended 10.20 and 40%Volume.Crude rice bran biodiesel in variable composition ratio from 15 to 18. Then to examine engine performance of exhaust emission parameters. They noticed BSFC is at 18CR increasing, 18.6% and 14.66% increases in BSFC and increase in brake thermal efficiency.

V.Hariram et al. [18] one way for production of biodiesel was vegetable waste cooking oil, whenever this biodiesel was blends with mineral fuel, by running diesel engine at compression ratio of 18, then the output revealed that 11% brake thermal efficiency improved. The blended fuel have B20, and B30 high viscous property and lower calorific value and result out that 9%BSFC decreased, and also emission wise 10.1% of hydrocarbon raises duo to high temperature developed inside the cylinder when compression ratio reached 18CR, Nitrous Oxide (NOx) emission raised18%.

Bhaskor J. Bora et al.[19] regularly used shape of piston inside engine cylinder is hemi sperical for the basic designed piston, they are modified into two types Deep cylindrical piston (DCP), and Shallow Re-Entrant piston (SRP). The main aim of study was to found the analysis various compression ratio, specially compression ratio,17:1, 16:1, and 15:1 of different biofuels blends like Soyabean, ricebran and Pongamia, by using different piston shapes to inside engine cylinder presses for piston geometrics. The experimental investigation carried out to running C I engine operating characters and load capability of pressure with respect to fuel air-mixing rate, crank angle rotation, turning moments. By using pongamia

biodiesel blends with diesel, pistons geometry was analysed, then drawn graph between the developed pressure inside engine cylinder against total deformation and Equivalent values, finally this experimental study to predicts which part piston structure damaged on the top or bottom of engine cylinder skirt lastly finite elements analaysis was used optimize the mechanical thermal stresses developed with less deformation (FEM).

Mustafa Atakan Akar et al. [19] the main object of research work performance, combustion and Emissions characteristics of C I engine have two types of biodiesel like butanol and Flax seed biodiesel by learned fluid properties, performance characteristics like brake power, BSFC, brake thermal efficiency, then flax seed biodiesel was used as a fuel in C I engines, brake power and torque value were reduced and performance of engine was Butanol biodiesel blended with diesel even decremented and last one is emissions, HC and CO were reduced by blend butanol with to flax seed oil after that by using FSME caused increase in the Nitric Oxide emission. Find out results when Butanol and flax seed oil blended diesel NOx emissions are reduced when compared diesel fuel.

Deepak Pastor et al. [21] experimental investigation carried out by linseed biofuel oil used was blended with diesel to adjusting the compression ratios 15.5, 17, 18.5, and 20, blended ratio's were 1:5, 1:4, 1:3, and 1:2 by volume, the engine performance characteristics were Specific fuel consumption and brake thermal efficiency at 20 increased 13.6% of BTE and same time at B20 blended ratio BSFC reduced by 16%. To evaluated emission characteristics analysed by VCR multi fuel engine.

Siva Rama Krishnan.K et al. [22] karanja biofuel blend with the mineral diesel by 15%, 20%, and 25% when ever to run four stroke single cylinder water cooled with eddy current dynameter compression C I engine using for their results at various compression ratio were 18:1, 17:1, 16:1, and 15:1.By the surface methodology to find out optimum working range now the conclusion was that 20% biodiesel-diesel blend at compression ratio of 18.

Abdulrahman Shakir Mahmood et al. [23] corn oil is a biofuel used as a alternative fuel by the experiment conducted on single cylinder four stroke multi fuel engine for varying the compression ratio's 15, 16, 17, and 18 then characteristics like performance, emission with mineral diesel biofuel blended with diesel at B20, B15, B10, and B5 by volume, then the resulted out brake thermal efficiency was reduced by an amount of 2.5, 4.5, 6.2, and 8.4% respectively at the same time investigated that specific fuel consumption incremented by an amount 3.5, 6.6, 9.5, and 14%. By the blended conditions emission characteristics were insignificant decrement in hydrocarbon, carbon monoxide, decrease in smokey opacity and increment in NOx and CO_2 then the conclusion is giving optimal characteristics values.

Safak Yildizhan et al. [23] bio fuel is extracted from waste cooking oil, used as an alternative fuel, Experiment conducted on VCR Multi fuel engine for compression ratio's 16 to 14. Therefore the properties of biofuel used are found to near to the standard fuel and hence blended at B20 by volume. Waste cooking oil used as a pure fuel, the experimental results out to be a little increment in specific fuel consumption, and a little decrement in efficiency, therefore emission characteristics of biofuel was to be come down to 22% of CO, due to more percentage of O_2 in the biodiesel, HC were come down because of complete combustion and hence in contrast CO_2 and NOx emission are gone up duo to high temperature in combustion process and hence high percentage of O_2 in biodiesel.

Mahesh R et al. [25] an experimental work was done on VCR Multi fuel internal combustion engine, by utilizing the blended ratio of jack fruit biofuel and diesel 20:80, 40:60, and 60:40 respectively, then resulted out to performance, combustion, and emission characteristics particularly emission parameters CO, HC, and O_2 in biofuel was lower, and same time biofuel emits NO_2 and CO_2 and about performance high specific fuel consumption and thermal efficiency. On a single vertical cylinder, constant maintenance speed (RPM), water cooled VCR(Variable compression ratio) engine with a one hole nozzle at multiple load, raw jack fruit biodiesel conversion into a pure jack fruit biofuel by trasesterification process.

Arul Mozhi Selvan et al. [26] ehanol blends with diesel used as a fuel Experiment conducted on vertical, four stroke direct ignition single cylinder engine on variable compression ratio 19:1, 15:1, and 17:1. Then resulted out in which signifying gas pressure increases, proportionally to increase max rate of pressure, and cumulative heat release rate, whenever ethanol concentration is higher duo to maintain more ignition delay, therefore the engine performance, the exhaust gas temperature is low at lower compression

ratio's and also revealed that emission and performance parameters were optimum level on a VCR engine when compression ratio is equal.

Tamilselvan R et al. [27] pentandra and mahua oils blends with minerals diesel the main concept of this study was impact on compression ratio (CR) on the entire performance, combustion, and emission parameters of a single four stroke vertical VCR engine by eddy current loading for variables compression ratio's of 19, 18, 17, 16, and 15 the main concept of this study was compression ratio proportional to combustion pressure developed inside the engine cylinder, instead use of biodiesel having more percentage of O_2 and hence combustion rate is increased and complete combustion take place inside the engine combustion chamber, and duo to high cetane number ignition lag is short, results in amount of fuel is burnt stable in pre mixed chamber, duo to this situation, to maintain proportionality compression ratio increased maximum pressure moves near to TDC (Top dead centre). Therefore results out are in time combustion, at low compression ratio, HRR (Heat release rate) is low for all blends as less fuel is burnt in delay period.

Bhojraj N. Kale et al. [28] micro algae is the alternative fuel in the different fuel ratio MAB10 to MAB50 with diesel, when combustion take place inside the engine cylinder resulted-out performance parameter was improved, compression ratio increases 15:5, 16:5, and 17:5 with blended ratio, like brake thermal efficiency, simultaneously specific fuel consumption inversely proportional to compression ratio and also emission characteristics out HC and CO reduced by 19.23%, and 14.16% respectively and NO proportionally increased.

Kannan S. et al. [29]corn oil methyl esters used as a alternative fuel, blends with diesel for different for different blends for B20, B40, and B60 various compression ratio's 17:1, 18:1, and 19:1 then the experiment conducted on a single cylinder four stroke VCR diesel engine, consequently, performance parameters out at peak load and constant speed (rpm) with compression ratio's of 17:1, 18:1, and 19:1 at a point with B60 at compression ratio 19:1, Brake specific fuel consumption is minimized, and also brake thermal efficiency improved and about emission parameters CO, and HC were reduced.

Karthickkeyan V et al. [30] B20 Orange Methyl Esters has been found to be excellent for biodiesel production, to convert B20 OME pure by Trasesterification process. The Experiment conducted on a single cylinder C I Engine with Compression ratio of 17:1, and 18:1 for Brake thermal efficiency improved, at B20 OME observed that high heat release rate than diesel fuel at compression ratio reach 18:1, further more Biofuel (B20 OME) have more O_2, and also at all loads B20 OME expressed a greater rate of pressure and Exhaust gas temperature, for remarkable observation is compression ratio 17, diesel fuel showed lower CO, and HC than B20 OME at CR18, both diesel fuel and B20 OME showed comparable increase for HC, and CO emission and for loads NOx emission increased.

Amr Ibrahim et al. [31] environmental advantages are achievable by using a renewable fuels as waste cooking oil as a Biofuel, by the experiment to get the optimum performance, this study main aim was to determine how adjusting the compression must be tuned, effected on the an engine combustion characteristics, performance parameters and emission properties when those running an various blends. An engine performance decreased whenever high blends of biofuel concentration duo to high quantity of O_2. Boosted performance, when increased the engine compression ratio gradually. When compared in the issue of torque generated with Biofuel B50 with diesel fuel improved by 11.1% at compression ratio 18 for both fuels. Additionally for the fuels to reduced the ignition delay period and combustion duration, while Brake thermal efficiency rose to 6% duo to increasing compression ratio.

CONCLUSIONS

The combustion, performance and emission characteristics of a single cylinder, four stroke, direct injection diesel engine having a constant power output. By using biodiesel HC, CO are reduced significantly, and NOx increases up to mark. The brake thermal efficiency improved, and specific fuel consumption reduced at constant engine speed.

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